Real Exchange Rates and Income Distribution

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Abstract

This thesis is composed of three distinct but related analysis around the topic of real exchange rate theories. First, based on Lakatos (1971) Methodology of Scientific Research Programmes (MSRP) framework, I provide a reappraisal of the origin and evolution of Purchasing Power Parity (PPP) theory in Cassel’s economic thought. A critical review of Cassel’s writings on PPP reveals that the formulation of the theory and how Cassel himself interpreted the theory went through significant changes from his initial presentations, starting from 1916, to the early 1930’s. From this starting point, the intended contributions are two-fold. First, it traces the shifts in the formulation of the theory introduced by Cassel to the critiques emerging from contemporary authors within the academic debates. I argue that, while the introduction of these adjustments made his formulation of the theory ‘internally’ more consistent, it also insulated the core theoretical proposition from falsification by empirical counter-examples. Thus, a second intended contribution of the research is to propose an assessment of these changes based on Lakatos framework of MSRP. The use of this framework enables one to better understand how these changes can be related to the rise and eventual decline of PPP theory in the academic and policy debates of the 1920’s.

Following this historical excursus into the origins of PPP theory, the research moves to a theoretical analysis of the income distribution implications of the so-called Harrod-Balassa-Samuelson effect. I provide a formalization of this effect in a two-sector prices of production model, where both the tradable and the non-tradable commodities are used as intermediate inputs, to study the co-evolution of the real exchange rate and wage share within countries. Under constant profit rates, when both commodities are used as intermediate inputs, I demonstrate that the relationship between real exchange rate and the wage share depends on the ratio with which tradable and non-tradable commodities physical output are used as intermediate input in the production of both sectors.

Lastly, the research develops a panel-data econometric analysis of the relationship between the real exchange rate and wage share across a sample of 118 countries, for the period of 1970-2014, using data from the Penn-World Table (version 9.1). The empirical results point to a different relationship between the real exchange rate and the wage share according to the countries level of economic development. At low levels of economic development, at which previous literature has found a positive effect of real exchange rate undervaluation on economic growth, a devaluation of the real exchange rate appears to be associated with an increase (decrease) in the wage share (profit share), contrary to what would be expected by previous literature. These results call for a re-assessment of the mechanisms through which real exchange rate undervaluation is allegedly stimulating economic growth in developing economies.
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1. Introduction

This chapter introduces the research. Section one explains the aim and the background that motivates the research. Section two presents the research questions which will be addressed throughout the thesis, while the third section is aimed at introducing the research methods which are used and the intended contributions of the research. Section four outlines the structure of the thesis.

1.1 Background Motivation of the Research

Strategies to boost economic growth in less developed countries have been for long a question occupying the mind of researchers in economic development, as well as of policymakers. In light of this, one particular aspect that has been a long-standing issue in the debate is the impact of real exchange rates levels on economic growth. The real exchange rate between two currencies is defined as the product of the nominal exchange rate (the US dollar cost of one Euro, for example) and the ratio of prices between the two countries. Since the times when Swedish economist Gustav Cassel (1916, 1918) proposed his Purchasing Power Parity (PPP) theory, economists have been tempted to derive equilibrium, optimal or expected levels of exchange rates, from which actual real exchange rates have been assessed as under or overvalued.

According to traditional mainstream analysis, under a free-floating exchange rate system, currencies are ought to converge back towards their ‘natural’ equilibrium levels. As such, no country would be able to maintain its currency at levels assessed as under or overvalued (Eichengreen, 2007). However, as will be discussed in the literature review chapter, empirical evidence shows that countries real exchange rates tend to show large and persistent deviations from levels associated with equilibrium, despite of the framework of analysis used to determine this equilibrium. This ‘puzzle’ has prompted the development of research analysing the relationship between real exchange rate misalignments (under or overvaluation) with economic growth.

A traditional view, within mainstream approach to development economics, has associated these misalignments with macroeconomic instability with harmful consequences to economic growth. On the one hand, real exchange rate overvaluation has been connected with slower economic growth due to its connection with balance of payment crisis. This would be characterized by countries with overvalued real exchange rates accumulating large current

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1 See for example Goldfajn and Valdes (1995) and Kaminsky and Reinhart (1999), for the mainstream perspective.
account deficits, which would then trigger a crisis in moments of sudden stops of capital inflows due to changes in international liquidity. On the other, real exchange rate undervaluation was seen as to promote an inefficient allocation of resources as it would enable less efficient firms to remain in activity, which would lead to lower long-run economic growth. Williamson (1990) epitomises this view, which has been referred to as the “Washington Consensus”. This terminology represents a set of policies which shaped much of the economic reforms pushed by multilateral financial institutions during the 1990’s to developing countries which had suffered with balance of payments crisis.

While the detrimental effects of real exchange rate overvaluation have been somewhat more peacefully accepted, the view that real exchange rate undervaluation is also detrimental to economic growth has been challenged since the heydays of the “Washington Consensus”. Stimulated by the economic development of East Asian Economies and, more recently, by China, several studies have investigated and reported a positive association between real exchange rate undervaluation and higher economic growth, a finding which has been shown to be more robust for the case of developing countries (Dollar, 1992; Razin and Collins, 1997; Aguirre and Calderón 2005; Prasad, Rajan, and Subramanian, 2007; Eichengreen, 2008; Rodrik; 2008).

However, the determination of whether the real exchange rate of a country is in equilibrium, under or overvalued is a contentious issue, as multiple competing theories of real exchange rate equilibrium co-exist. Over the past decade the literature has submitted this relationship to extensive testing using different measures of real exchange rate equilibrium (and associated misalignments), econometric techniques, sample of countries and periods, with fairly favourable results.

Among these frameworks, one of the most commonly used in this literature has been the PPP adjusted for the Harrod-Balassa-Samuelson effect (Rodrik, 2008; Gala, 2008; Rapetti et. al., 2012; Missio et. al., 2015; among others). This approach supposes that under free trade conditions and with negligible transportation costs, the price of tradable commodities should be equalized when expressed in common currency (i.e. when the price of the foreign commodity is adjusted for the nominal exchange rate). However, the price of non-traded commodities could diverge between countries, leading to changes in the real exchange rate between any two given countries.

However, it is important to acknowledge that some authors, like Couharde and Sallenave (2013) present findings which indicates important non-linearities, with only modest undervaluation’s being positive for growth. Nouira and Sekkat (2012), for instance, find that currency undervaluation doesn’t have a statistically significant effect on growth once overvaluation episodes are excluded. Implying that countries with undervalued currencies grow more than countries with overvalued currencies, but not necessarily grow faster than countries whose real exchange rate are at equilibrium levels. Rapetti (2020) provides a thorough review of the literature, as well as new evidence evaluating the findings of the literature over the past decade.
countries overtime. In particular, the hypothesis of the Harrod-Balassa-Samuelson effect is that non-tradable commodities would become more expensive as GDP per capita increases, due to equalization of real wages between sectors while labour productivity in the in the tradable sectors would be increasingly higher than in the non-tradable sector. This hypothesis would explain the stylized fact that more developed countries tend to have more appreciated real exchange rates (Balassa, 1964; Samuelson, 1964).

The literature has tested the relationship between real exchange rate undervaluation and economic growth using other frameworks to derive real exchange rate equilibrium levels. Bereau et. al. (2012) and Couharde and Sallenave (2013), for example, both uses 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 (in line with the so-called Harrod-Balassa-Samuelson effect), the terms of trade, and the outstanding stock of net foreign assets. On its turn, papers like Berg and Miao (2010) and MacDonald and Vieira (2012) use a framework usually referred to as the Fundamental Equilibrium Exchange Rate (FEER), where the equilibrium level of the real exchange rate is the level compatible with a sustainable current account balance (meaning equilibrium or small stable deficit)³.

The literature has also devoted considerable attention debating the potential mechanisms through which undervaluation would raise economic growth. The main mechanisms can be categorized into three groups: (i) increasing the competitiveness of tradable sectors; (ii) alleviation of the balance of payment constrain to growth; and (iii) redistribution of income from workers (consumers) to capitalists (savers)⁴.

In the literature, Rodrik (2008), Eichengreen (2008), and Guzman et. al. (2018) have argued that real exchange rate Undervaluation may help to foster growth through mechanism (i). Increased competitiveness of the tradable sector would foster economic growth due to intrinsic characteristics of the sector, such as: (a) having higher productivity levels; (b) being locus of technological spillovers, and where (c) learning by doing, and (d) increasing returns to scale would be more prominent. The fact that the relationship is stronger and more robust for the case of developing economies is attributed to the view that the tradable sector suffers disproportionately from government or market failures, which would prevent low-income

³ The particularity of each theoretical approach, as well as the empirical evidence regarding its ability to explain actual real exchange rate movements, will be discussed in detail in the literature review (Chapter 2).

⁴ The emphasizes on the redistribution of income from consumers to savers or from workers to capitalists differ depending on the theoretical background of specific authors. Nevertheless, the underlying mechanism is the same, that is the redistribution of income leading to higher investment levels.
economies from converging towards higher income levels. Razmi et. al. (2012) argues that, unlike developed economies, low-income countries typically have large amounts of (hidden) unemployment. As such, promoting and sustaining real exchange rate undervaluation could lead to the mobilization of these unemployed resources, which is key to the development process. Connected to the first (i) mechanism some authors, like Barbosa (2006), Araujo and Lima (2007) and Porcilé and Lima (2013), emphasize that lower exchange rates levels would be key to avoiding Balance of Payment crisis; and to relax the external constraint, which would be a major binding constraint to economic growth for developing countries (Thirlwall, 1979). A third group of authors, such as Gala (2008) and Razmi et. al. (2012), Gluzmann et. al. (2012), argue that real exchange rate undervaluation would be associated with redistribution of income towards profits (savings), which could stimulate capital accumulation and, consequently, economic growth.

Overall, significant attention has been given to testing the robustness of the cross-country correlation between real exchange rate undervaluation level and economic growth under alternative frameworks of deriving real exchange rate equilibrium. Moreover, the literature also has focused on identifying causal mechanism through which the undervaluation would stimulate economic growth, and to the inclusion of additional control variables. Less attention, however, has been devoted to understanding how persistent ‘undervaluation’ is achieved and sustained, in the one hand, and what are the broader economic outcomes associated with this strategy, in the other.

This last point is of crucial importance as the real exchange rate is not per se a direct policy variable. Real exchange rates are, in its turn, an outcome of the relation between nominal exchange rates with relative price levels between two countries. The transmission from nominal appreciation (devaluation) in the nominal exchange rate to a real exchange rate appreciation (devaluation) will depend on the behaviour of domestic and foreign price levels. Thus, what is required is a change in the relative prices between the domestic country and the rest of the world, when these are expressed in a common currency. As Eichengreen (2008) remarks, except in planned economies, real exchange rates are not directly controlled by policy makers, but are the outcome of other policies and economic forces. In market economies, even as some policies, such as monetary or fiscal policy, may affect nominal exchange rates, its long-term effect in the real exchange rate will depend on what happens to relative prices. Hence, it is vital to comprehend the inter-relation between changes in the nominal exchange rate, in relative prices between non-tradables and tradables and between foreign and domestically produced tradables (i.e. the international terms of trade).

From a classical political economy perspective, market relative prices gravitate around their natural prices, their prices of production (Sraffa, 1960). In this approach, relative prices
between two commodities tend to gravitate around its long-period position. While market prices would be influenced by many unsystematic and temporary forces, natural prices would be independent of these forces and from movements in market prices, being affected solely by more systematic and persistent forces, such as real wages, profits rates and technical conditions of production. As such, following this approach, persistent changes in relative prices would only be sustained if followed by changes in the relative costs of production.

However, an increasingly important aspect in contemporary capitalism is the fact that most economies operate not only under relatively free trade conditions, but also under conditions of relative free international mobility of capital. Thus, in theory, due to a competitive process among capitals, a turbulent equalization process of the (risk adjusted) profit rates within and between sectors is expected to occur, and not only equalization of prices between equivalent tradable commodities (Shaikh, 1999, 2016). As such, a sustained real exchange rate depreciation would be dependent on a reduction of real wages or, in the best-case scenario, of an increase in it below the increase in labour productivity (Shaikh and Antonopoulos, 2013). In the absence of changes in the sectoral composition of the economy, this would lead to a decrease in the wage share, as it has been demonstrated for instance by Jesus and Kumar (2014).

Moreover, while promoting economic growth in developing economies is an important policy goal, developing economies also tend to be marked by very high levels of income inequality, which has been linked with several socio-economic and political problems. Income inequality is associated with worst health (Pickett and Wilkinson, 2015) and education (Thorson and Geahart, 2018) outcomes, higher crime rates (Choe, 2008) and lower social mobility (Andrews and Leigh, 2009), eroding social cohesion and increasing the possibility of political instability. As such, development strategies that exacerbate income inequality may be socially unsustainable. Indeed, we live in period of increased political unrest, with the rise of authoritarian regimes in several countries of the developing world, which can be associated to the high and increasing income inequality documented in the past decades. For instance, the wage (labour) share, that is the share of total income going to wages (workers), has fallen consistently since the 1980’s with detrimental social and economic outcomes. The OECD (2012), for example, notes that the wage share has declined in 26 out of 30 advanced economies between 1990 and 2009. In emerging and developing economies ILO (2011) also reports declines in the wage share, but with different intensities across regions. In the one hand, declines in Asia and North Africa have been more prominent; while, on the other, the wage share in Latin American countries have had a more diverse pattern among countries of the region.

Therefore, beyond analysing the relationship between real exchange rate undervaluation and economic growth, it is of crucial importance to understand what is implied
by undervaluation, and which policies would promote it according to the different frameworks of real exchange rate equilibrium. This analysis hopefully will shed light on the broader socio-economic implications of pursuing such development strategy. To this end, the research aim of this thesis is to analyse the link between real exchange rate and functional income distribution.

1.2 Research Aim and Objectives

This study examines the relationship between real exchange rates and income distribution. More specifically the main research question that guides the research is the following:

*How are real exchange rates related to changes in the functional income distribution?*

As discussed in the previous section, this is motivated by the claim made in recent literature that economic growth is positively affected by the maintenance of real exchange rates at undervalued levels. While the literature has mainly focused on the mechanisms through which real exchange rate ‘undervaluation’ affects growth, less attention has been devoted to how this ‘undervaluation’ can actually be achieved and sustained, as well as a consideration of the broader socio-economic implications of this. And, to this end, this thesis has the following overall aim: to understand what are the political economy implications of pursuing a development strategy based on real exchange rate ‘undervaluation’.

Before moving ahead, it is important to clarify what meaning does the concept of political economy is understood in this thesis. Throughout this thesis the notion of political economy is concerned with the interaction of political and economic processes within a society. More specifically how the distribution of power affects the distribution of income and wealth between different groups and individuals, and the processes that create, sustain and transform these relationships over time.

The aforementioned primary research aim entails several ancillary research questions, which are explored throughout the thesis. Firstly, what is the benchmark against which an exchange rate valuation can be compared? To be able to speak about ‘under’ or ‘over’ valuation one needs to be able to define this benchmark as an exchange rate equilibrium. As such, a first task for the thesis is to review the literature on real exchange rate equilibrium theories. Among the main theories of real exchange rate equilibrium, Purchasing Power Parity (PPP) theory, originally developed by Gustav Cassel, has served as a central point from which other

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5 In particular, this issue will be explored in more detail in chapter 4 where alternative distributional ‘closures’ are explored. In regard to this, chapter 4 analyse analytically the effect of a technical change in a sector affects the real exchange rate and the share of aggregate income appropriated by each class (workers and capitalists) is dependent on which class has the power to set their income rate (real wage and profit rate) independently and which income rate is, consequently, determined residually.
approaches have built upon or centred its criticism. However, there is a significant controversy around the interpretation of what PPP theory exactly entails and how Cassel, himself, interpreted it. As such, the first objective is as follows:

- **Objective 1**: Review Cassel’s own writings on Purchasing Power Parity theory and provide a novel narrative of the evolution of his economic thought
  - What were the theoretical core that led to the formulation of PPP theory by Cassel?
  - What adjustments have Cassel made to his own presentation of the PPP theory?
  - What led to these changes and how can we interpret these changes?

Building on a specific interpretation of the PPP theory as an arbitrage condition for tradable commodities, one of the most widely accepted theories of real exchange rate equilibrium rests on the so-called Harrod-Balassa-Samuelson effect. As briefly explained earlier, this effect states that, because labour productivity increases in the tradable sector, real wages in the economy tend to increase in both tradable and non-tradable sectors. Consequently, this would lead to an increase in the relative price of non-tradable commodities, which, *ceteris paribus*, would lead to an appreciation of the real exchange rate. Although, this has been a widely researched theory, little attention has been given to the functional income distribution implications associated with it. Hence:

- **Objective 2**: Analyse the functional income distribution implications associated with the Harrod-Balassa-Samuelson Effect within a Sraffian linear prices of production framework.
  - What happens to the wage share following an increase of labour productivity in the tradable sector?
  - Does the choice of distributive ‘closure’, that is which distributive variable (profit rate or real wages) is taken as exogenously determined, affect the results?
  - How does the consideration of non-tradable goods as a basic good affect the result?

Theoretical analytical models provide insights and hypothesis about the relationship between the variables of interest. However, it is of key importance that these are empirically grounded in reality. Hence, it is important to assess the consistency of the relationship predicted by each analytical model, developed to address objective 2, with the empirical evidence. Therefore, in line with the overall aim and research question of the thesis:

- **Objective 3**: Analyse the relationship between functional income distribution and real exchange rate from an empirical perspective.
  - How are changes in the real exchange rate associated with changes in each country’s wage share relative to the rest of the world?
- Is this relationship univocal across countries at all levels of development?
- Does the relationship depend on the level of international capital mobility?

1.3 Contributions of the Research

In order to address the above-mentioned research objectives, this thesis conducts three distinct, but related analysis, around the common topic of real exchange rate theories and its relationship with functional income distribution. The thesis contributes to our understanding of the income distribution implications embedded in different real exchange rates equilibrium theories, such as the Cassel’s Purchasing Power Parity theory and its adjusted version for the Harrod-Balassa-Samuelson effect from an historical, theoretical, and empirical perspective.

First, following from the analysis developed to meet objective 1, this thesis contributes to the field of History of Economic Ideas, providing a new interpretation of the development and evolution of PPP theory in Cassel’s, based on the Lakotosian Methodology of Scientific Research Programmes (MSRP) framework. Second, the analysis developed following objectives 2 and 3 contributes to the literature on the relationship between real exchange rates and functional income distribution. Under objective 2 I develop a theoretical analysis of the income distribution implications of the Harrod-Balassa Samuelson effect within a Sraffian linear prices of production framework, where both non-tradable and tradables commodities are used as intermediate inputs. And, in line with objective 3, I develop a panel-data econometric analysis analysing the relationship between real exchange rate and the wage share across a sample of 118 countries, for the period of 1970-2014, using data from the Penn-World Table (version 9.1).

The development of Purchasing Power Parity theory into an operational theory used determine empirically the equilibrium exchange rate by Cassel during the 1st World War, marks the beginning of a long list of theoretical frameworks developed trying to determine empirically the equilibrium level of exchange rates. However, the attempts to determine equilibrium levels of real exchange rate have been riddled with lack of subsequent empirical corroboration, which have led researchers to a continuous process of specification and re-specification of theoretical propositions and empirical hypotheses, as is exemplified in the review conducted in Chapter 2. The theoretical tensions and lack of empirical corroboration observed by modern approaches, which attempt to determine exchange rate equilibrium and forecast its behaviour, is by no means a something new.

Indeed, the analysis of Cassel’s writings on PPP theory from 1916, when he first provided an empirical analysis using the building blocks of the theory, until the early 1930’s reveals a similar process of specification and re-specification of the theoretical propositions of what he understood PPP theory to mean, in light of criticisms received and empirical evidence. Hence,
instead of having one definition of what PPP theory consisted for Cassel, what one actually finds in Cassel’s writings is a series of subsequent versions of the theory, which may explain why one finds in the modern literature different interpretations of what PPP theory is and meant in Cassel’s own view. To analyse the change and adjustments in the subsequent formulations of PPP theory in Cassel’s writings, I use Lakatos (1971) Methodology of Scientific Research Programmes (MSRP) framework and the typology offered by Lakatos (1976) to classify the strategies adopted by Cassel to defend and adjust his formulations of PPP theory. This approach will hopefully provide a new, and improved, history and understanding of the evolution of PPP theory in Cassel’s own economic thought.

Following this historical excursus into the origins of PPP theory, the thesis proceeds in the analysis of real exchange rate equilibrium theories by providing a theoretical contribution, in which the functional income distribution associated with the Harrod-Balassa-Samuelson effect is analysed, in line with objective 2. In recent years several authors have analysed the relationship between real exchange rates and functional income distribution from a theoretical perspective. However, the main focus has been on the changes of the real exchange rate and in income distribution associated with a nominal exchange rate devaluation when countries use imported commodities as intermediate inputs (e.g. Lima and Porcile, 2013; Ribeiro et. al., 2017; Dvoskin and Feldman, 2018; Dvoskin et. al., 2020). However, changes in the nominal exchange rate are not the only source of change in real exchange rates. Indeed, as emphasized by the Harrod-Balassa-Samuelson effect another factor driving real exchange rate are changes in the relative price between tradable and non-tradable commodities. Hence, using a linear prices of production framework, I analyse the co-evolution of real exchange rates and the wage share following an increase in labour productivity in the tradable sector (as assumed by the Harrod-Balassa-Samuelson effect).

The classical surplus approach (Sraffa, 1960), in which income distribution is affected by non-market forces, requires the analysis to take one of the two distributive variables (the profit rate or the real wage) as given in the analysis to be able to render the price system as determined, i.e. as having the same of number of equations and unknown variables. In the literature, these alternative choices about which distributive variable is chosen as given in the analysis is referred as alternative distributive ‘closures’ (Blecker and Setterfiled, 2019). The analysis developed will analyse two different closures that have been used in the recent literature to analyse the relationship between real exchange rate and functional income distribution. On the one hand, following Ribeiro et. al. (2017), I analyse the ‘closure’ where the real wage is taken as the exogenous distributive variable and assumed to be increasing in line
with the labour productivity of the tradable sector. On the other hand, following Dvoskin and co-authors\(^6\), I analyse the exogenous profit rate ‘closure’.

Furthermore, previous literature analysing the relationship between real exchange rate and income distribution has modelled the domestic economy as being composed of only one tradable sector (e.g. Gala, 2008; Lima and Porcile; 2013, Ribeiro et. al., 2017) or when including a non-tradable sector, assumed that it is demanded solely for final consumption and uses only labour in production (Dvoskin and Feldman, 2018; Dvoskin et. al., 2020, as well as Razmi et.al 2012). Hence, another contribution of the research developed in chapter 4, is to analyse what happens to the relationship between the two variables of interest when the non-tradable commodity is used as an intermediate input by both sectors.

The incorporation of intermediate inputs, together with the recognition that capitalist earn a profit rate on the advanced capital needed to purchase these, and not only on top of labour costs, as traditionally assumed by Neo-Kaleckian models, brings out some important results worth emphasizing. As one introduces intermediate inputs, the wage and profit share are affected, not only by changes in real wages and profit rates but also, by changes in relative prices. Hence, an increase in the labour productivity of the tradable sector will affect income distribution. However, in the exogenous real wages ‘closure’ (in which real wages in the economy increase in line with labour productivity of the tradable sector) the expected relationship between the wage share and the real exchange rate remains the same as the one which has normally been emphasized by the literature- i.e. an increase (decrease) in the wage share, associated with an appreciation (depreciation) of the real exchange rate. In the meanwhile, in the exogenous profit rate ‘closure’ the relationship depends on the relative ratio of the physical output of each commodity which is used as an intermediate input. In particular, when the ratio of the tradable commodity’s final output, used as intermediate inputs, is lower than the ratio of the non-tradable commodity, than the aggregate wage share falls as the real exchange rate appreciates. These novel analytical results point to different hypothesis of the long-run relationship between real exchange rates and a country’s aggregate wage share, which are then analysed in light of the empirical evidence conducted in Chapter 5, under objective 3.

With respect to objective 3, this research contributes to the literature regarding the mechanisms through which real exchange rate undervaluation may simulate or not economic growth\(^7\). As discussed in section 1.1, one of the main mechanisms would be through a redistribution of income towards profits associated with the real exchange rate undervaluation,

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\(^6\) Dvoskin and Feldman (2018); Dvoskin et. al. (2020)

\(^7\) See Rapetti (2020) for an exhaustive survey of the empirical literature since the seminal contribution of Rodrik (2008).
which would stimulate investment, and, consequently, economic growth. Hence, the econometric analysis developed under objective 3 will enable the research to gauge what extent a real exchange rate devaluation is associated with a shift in income distribution away from workers’ wage share towards capitalists’ profit share. Following the cue from the literature on real exchange rate undervaluation and economic growth, which only finds a robust significant positive effect for the case of developing countries, I specifically investigate whether the relationship between the wage share and the real exchange rate is different across developing and developed countries, using static and dynamic panel-data models.

The empirical results point to a different relationship between the real exchange rate and the wage share according to the countries level of economic development. At low levels of economic development, at which previous literature has found a positive effect of undervaluation on economic growth, a devaluation of the real exchange rate is in fact associated with an increase (decrease) in the wage share (profit share). It is only at higher levels of income per capita that a devaluation of the real exchange rate is in fact associated with a decrease (increase) in the wage share (profit share), as would be typically expected the literature. These results indicate that, instead of real exchange rate undervaluation being positive for economic growth in developing countries because they produce a shift of income towards profits, undervaluation would stimulate economic growth in developing countries precisely because they are not associated with a reduction of the wage share. Hence, the negative effect on domestic demand, associated with a lower wage share, which would induce lower capacity utilization and, hence, lower investment and economic growth, would not be present in countries at lower levels of development. In contrast, at higher level of income per capita, as real exchange rate undervaluation becomes associated with lower wage share, undervaluation will produce a negative effect on domestic demand, with negative consequences on investment, counteraction other positive effects which real exchange rate undervaluation may produce. Lastly, this distinct relationship between the real exchange rate and the wage share according to development levels is rationalized in terms of the differences in the productive structure and specialization pattern between countries at different stages of economic development, and related to different results steaming from the analytical models derived in chapter 4.

1.4 Structure of the Thesis

The thesis is divided into seven chapters which are briefly outlined here. In the following I provide a brief description of the contents of each chapter offering a guide of the thesis to the reader. Following this introductory chapter, which has provided the background and rationale motivating this research, Chapter 2 provides a literature review on the main theories of real
exchange rate equilibrium from both a mainstream perspective and classical surplus approach, based on the work of Anwar Shaikh.

Chapter 3 discusses the origin and evolution of Purchasing Power Parity (PPP) theory of exchange rate determination as advanced by Gustav Cassel from a history of economic ideas perspective. As will be pointed in the review in chapter 2, in modern literature PPP theory has been associated with the hypothesis that the real exchange rate of countries should be constant in the long-run. A view that is often portrayed as steaming from Cassel’s work. However, through a review of Cassel’s own writings on PPP theory, I argue that Cassel’s own view and use of PPP went through marked changes in his writings between the 1910’s and the 1930’s. From a positive theory of exchange rate determination where real exchange rate would remain constant over-time in its early formulation, from the mid-1920’s Cassel own exposition of PPP would evolve towards a normative equilibrium concept, which can be understood as the exchange rate level consistent with the ‘natural’ rate of interest.

In Chapter 4 I seek to analyse the functional income distribution implications associated with the PPP-adjusted by Harrod-Balassa-Samuelson effect model of real exchange rate determination, in line with research objective 2. I provide a formalization of the Harrod-Balassa-Samuelson effect in a prices of production framework with two-sectors, under two alternative distributive ‘closures’. And argue that, in light of the Harrod-Balassa-Samuelson effect, the relationship between the wage share and the real exchange rate depends fundamentally on the distributive ‘closure’ and whether the non-tradable sector enters the system as a basic commodity, in the sense of Sraffa (1960). These results highlight that the relationship between income distribution and real exchange rate has an institutional dimension, related with the relative forces in the class struggle over income, and a technical dimension, associated with the productive specialization of the economy and which types of inputs are required in the production process. In particular, results indicate that when if the profit rate is assumed to be constant and determined exogenously, due to, for example, free international mobility of capital giving power to capitalist to protect their margins, and the non-tradable commodity is used as an intermediate input in the production of both goods (i.e. is a basic commodity), the relationship between the wage share and the real exchange rate becomes undetermined following the Harrod-Balassa-Samuelson effect.

To address the research objective 3, in Chapter 5 I present an econometric panel-data analysis between real exchange rate and the wage share using data from the Penn-World Table (version 9.1). The empirical results reveal a marked contrast in the relationship between real exchange rate and the wage share according to the countries’ development level. While for economies with higher income per capita levels a decrease in the wage share is associated with
a depreciation of the real exchange rate, for economies with lower-income levels an increase in the wage share is associated with an appreciation of the real exchange rate. In light of the framework developed in chapter 4, I argue that this result emerges from the differences in the activities that compose the tradable and non-tradable sectors at different stages of development.

Lastly, Chapter 6 provides a conclusion for this thesis where the main research findings are summarized, the contributions to knowledge are emphasized, the limitations of the research are highlighted, as well as indicating directions of future research.
2. Theories of Real Exchange Rate Equilibrium

2.1 Introduction

The purpose of this chapter is to review existent theories of real exchange rate equilibrium. As discussed in Chapter 1, in the past decade the importance of real exchange rate levels has gained renewed attention. Beyond their potential role in explaining trade imbalances and balance of payment crisis, an emerging literature has claimed that the real exchange rate undervaluation would promote economic growth. However, to be able to determine whether a real exchange rate is under or overvalued, one need first to be able to determine an equilibrium real exchange rate. However, there is no universally accepted theory of real exchange rate equilibrium, from which real exchange rates can be subsequently assessed as under or overvalued, in the literature.

The literature on real exchange rate equilibrium is vast and many different theoretical approaches have been advanced in the literature. The existing approaches differ among themselves not only in regard to the underlying theoretical frameworks, but also with regard to the notion of equilibrium employed (positive or normative) and to the timeframe considered for such an equilibrium8 to be achieved, i.e. short-run, medium-run or long-run. In theories which adopt a positive definition of equilibrium, real exchange rates are believed to converge endogenously (under assumed conditions) to a level consistent with the theoretical equilibrium and, hence, equilibrium assumes an analytical role. In other theories, equilibrium is used in a normative sense, as a point of reference, but with no endogenous mechanism which will drive the real exchange rate towards the equilibrium level. Thus, in these cases equilibrium is said to assume an evaluative role, which may be (or not) associated with ‘optimality’.

However, considering the vast number of existent theories of real exchange rate equilibrium, a review of all the different approaches existent in the literature goes beyond the scope of this chapter. Instead, given the background motivation of the thesis, the review will focus, in section 2.2, on the approaches used to estimate real exchange rate ‘misalignments’ by the literature; especially those which have linked real exchange rate undervaluation to economic growth, as introduced in Chapter 1. In particular, the review will focus on assessing the different notions of equilibrium and the time-frames implied by the definition of equilibrium used, as well as empirical corroboration for approaches in which equilibrium assumes a positive connotation. Subsequently, in section 2.3, in line with the overall aim of this research to study the relationship between real exchange rates and income distribution, I will review the approach developed by Shaikh (1999, 2016), based on the Surplus approach developed by Classical-Marxian Political

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8 For those approaches who employ a positive definition of equilibrium
Economy tradition. In this alternative framework, the long-term movements of real exchange rate are explained primarily by relative unit labour costs, i.e. the evolution of relative labour productivity and real wages. This chapter closes with a concluding summary in section 2.4.

2.2 Mainstream Theories of Real Exchange Rate Equilibrium

Although the approaches reviewed in this section may differ significantly between each other, and sometimes may even be used by heterodox authors, the approaches reviewed in this section may be grouped together under the heading of ‘mainstream’ as these tend to emphasize monetary and demand-side factors as the main drivers of relative prices, in general, and of real exchange rates, in particular\(^9\). In this section I will focus on the four approaches which have been used in the literature (introduced in Chapter 1) to assess the effect of real exchange rate undervaluation on economic growth, namely: (i) Purchasing Power Parity (PPP) (section 2.2.1); (ii) PPP adjusted for Harrod-Balassa Samuelson hypothesis (section 2.2.2); (iii) Behavioural Equilibrium Exchange Rate (BEER) (section 2.2.3); (iv) Fundamental Equilibrium Exchange Rate (FEER) (2.2.4). The review will emphasize the notion of real exchange rate equilibrium embedded in each, i.e. positive or normative\(^10\); and, for those approaches in which equilibrium in principle assumes a positive role, the review will assess the empirical evidence in favour (or not) of the theory.

2.2.1 Purchasing Power Parity

Although its roots can be traced back to the Salamanca School in the 16th Century (Officer, 1982), the specific terminology of the Purchasing Power Parity (PPP) was introduced by Gustav Cassel (1918) during the 1st World War. The formulation of PPP by Cassel offered an explanation for the wide movements observed in foreign exchange rates during the 1st World War, following the abandonment of the fixed gold parities of the gold standard, in which countries experienced, concomitantly, high levels of inflation.

According to modern presentations of PPP theory (e.g. Sarno and Taylor, 2002), the foreign exchange rate between currencies of two countries would reflect the differences in the national price levels, in what is normally referred to as, the ‘absolute PPP’ version of the theory. In this version, the PPP level of exchange rate is defined as the exchange rate level which equalizes the price levels prevailing in two countries when expressed in the same currency. In other words, ‘absolute PPP’ would be the exchange rate level which makes the purchasing

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\(^9\) With the exception of the Harrod-Balassa-Samuelson effect which involve a relative cost as the determinant, but which has, nevertheless, been widely adopted by mainstream literature.

\(^{10}\) Or using Machlup (1958) categorization analytical (positive) or evaluative (normative) notions of equilibrium.
power of one currency be the same in both countries (MacDonald, 2007). This implies that nominal foreign exchange rate levels \( e = \frac{\text{Price of foreign currency}}{\text{Per unit of currency of domestic currency}} \) and relative price levels would display an exact inverse relationship between them. As a consequence, the real exchange rate between two countries should be equal to one, when ‘absolute PPP’ is said to hold. Algebraically, this can be expressed as:

\[
RER_t = e \frac{P}{P^*} = 1
\]

(2.2.1)

However, considering that prices are normally expressed in terms of indexes and not in monetary levels, the literature also refers to the formulation in terms of inflation levels (Officer, 1976), which has become known as “relative PPP”. In this version, when two countries experience inflation, the new equilibrium exchange rate is equal to the old rate multiplied by the quotient of the degrees of inflation experienced by each country. In mathematical terms, this implies that the real exchange rate between any two countries should be constant over time, with movements in the nominal exchange rate counter-balancing the different inflation levels observed by the two countries. Algebraically, this may be expressed as:

\[
\Delta RER_t = \Delta e \frac{\Delta P}{\Delta P^*} = 0
\]

(2.2.2)

Since the breakdown of the Bretton Woods monetary system in the early 1970s the topic has been intensively scrutinized and tested. The early empirical literature\(^{11}\) on PPP of the 1970’s and early 1980’s attempted to directly estimate this relationship econometrically in the log-linear format\(^{12}\):

\[
rer_t = \alpha + \beta p_t + \beta^* p_t^* + \epsilon_t
\]

(2.2.3)

Where the hypothesis tested would be whether coefficient is \( \beta = 1 \) and \( \beta^* = 1 \) in level equation, which would validate Absolute PPP hypothesis, and both equal to zero in a first difference equation, validating Relative PPP. However, apart from hyperinflationary economies, PPP tended to be rejected based on such estimates, with few exceptions\(^{13}\) (Froot and Rogoff, 1995). However, even if the hypothesis in such test were corroborated the result could be considered as spurious due to non-stationarity of the residuals (MacDonald, 2007).

As such, the second stage in the development of the empirical literature during the 1980’s was to employ tests for unit-roots to check for the stationarity of the real exchange rate, as this would imply that the real exchange rate would oscillate around a stable mean and

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\(^{11}\) See, for example, Krugman (1978) and Frenkel (1981).

\(^{12}\) In the equation lower case letter represent variables in logarithms format.

\(^{13}\) See, for an example, Frenkel (1976).
corroborate the hypothesis of relative PPP. However, most studies\textsuperscript{14} were unable to reject the
no unit-root hypothesis of real exchange rate of the currencies of the main industrialised
countries against one another, suggesting that deviations from PPP could be permanent (Sarno
and Taylor, 2002).

The third stage tests studied whether the nominal exchange rate and relative prices
levels displayed a cointegrations relationship\textsuperscript{15}. This would imply that the real exchange rate
time-series would display mean-reverting characteristics, and as such one could infer that the
deviations from PPP would tend to fade away as time passes. However, with the exception of
high-inflation economies, the early literature\textsuperscript{16} was unable to establish significant mean-
reversion of the of the exchange rate towards PPP levels for the post Bretton-Woods period
(Froot and Rogoff, 1995).

A possible alternative explanation for the relative disappointing results obtained by the
literature of the late 1980’s, however, was that the tests employed to examine the long-run
stability of the real exchange rate suffered from very low power when applied to the post
Bretton-Woods system due to small sample size\textsuperscript{17}. As Froot and Rogoff (1995) and Lothian and
Taylor (1995) argue, if the speed with which the real exchange rate converges back towards its
long run mean is fairly slow, then the probability of rejecting the presence of unit-roots in the
real exchange rate series, when in fact the real exchange rate is mean-reverting, would be as
low as 5 per cent. And, as Lothian and Taylor (1995) claim, even with a timespan of a century of
data the chance of correctly rejecting the presence of unit-root, thus confirming the PPP
hypothesis, would be less than 50 per cent.

To try to overcome the low power problem, researchers in the 1990’s attempted to
increase sample sizes to test the PPP hypothesis by using long-horizon data sets and Panel Data
studies. In the former approach sample sizes increased by including data from the period before
the break-down of Breton Woods system. In the latter approach, by pooling together many
different countries, there is an increase in the number of observations. Following these
approaches, several studies from the mid-1990’s provided evidence supporting the validity of
PPP theory in the long-run, including for the post-Bretton Woods periods.

\textsuperscript{14} See, for example, Enders (1988); Meese and Rogoff (1988), Mark (1990).
\textsuperscript{15} A cointegration relationship is established when there exists a linear combination of the two non-
stationary series which is itself stationary.
\textsuperscript{17} An issue which would not be resolved by using higher frequency data, as one is interested in testing a
long-run relationship. Hence, using higher frequency is likely to introduce more noise to the time-series
than anything.
However, in his influential review of the literature, Rogoff (1996) reports that among the studies which do find evidence of real exchange rate series reverting towards their long-run mean, it does so at a very low pace. On average, estimates on the convergence of the real exchange rate towards its long-run mean would occur at a pace around 15% a year. This implies that, after an initial shock, it would take between three to five years to eliminate 50% of the deviation\textsuperscript{18}. However, when using data from very long periods, it encompasses various exchange rate regimes and international monetary standards. As a consequence, there is a high chance of finding structural breaks on the data.

For panel-data studies, in turn, by pooling together many different countries, there is an increase in the number of observations. Several studies from the mid-1990’s provided evidence supporting the validity of PPP theory in the long-run for the period post-Bretton Woods\textsuperscript{19}. However, as Taylor and Sarno (1998) argue, these results could be misleading because the null hypothesis in panel unit-root tests used in these studies is that all of the series are generated by unit-root processes, as such the null hypothesis is rejected even if only one of the series included in the panel is stationary.

Nevertheless, even if we disregard the inherent limitations of long-span or panel-data studies and consider their results as producing firm evidence in support of PPP hypothesis, the slow speed of convergence towards the mean still configured a sort of empirical puzzle in light of neoclassical theory (Rogoff, 1996). While the non-observance of the validity of PPP in the short-run could be rationalized as being caused, in part, by price stickiness, it would still be expected a substantial convergence of real exchange rate back towards PPP levels over one to two years, as wages and prices adjust to a shock\textsuperscript{20}. However, as reviewed, the evidence suggests that it takes between three to five years to eliminate only 50% of the deviation. These slow speed of adjustments of real exchange rate towards their long-run mean, when combined with a high volatility of nominal exchange rates in the short term, constituted what Rogoff (1996) dubbed as ‘the purchasing power parity puzzle’.

Since Rogoff (1996) first advanced the ‘PPP puzzle’, further work trying to unpack these results has been conducted over the last two decades. One of the developments has been the possibility of a non-linear adjustments process. The idea, advanced by several authors in the second-half of the 1990’s\textsuperscript{21}, is that the speed and strength with which the real exchange rate

\textsuperscript{18}The period necessary to eliminate 50% of the deviation is what the specialized literature refers to as half-life of deviations.
\textsuperscript{20} A period of adjustment of 1 to 2 years would be the story consistent with Dornbusch’s (1976) overshooting model.
\textsuperscript{21} A thorough review of the papers which advance the notion of a non-linear adjustment process and test this hypothesis can be found in Sarno and Taylor (2002) and MacDonald (2007).
would revert back towards its long-run mean would depend on the size of the deviation. The rationale behind this line of reasoning is that international trade of different commodities is affected by different levels of transaction costs and trade barriers. As the deviation of a country's real exchange rate from the level consistent with the PPP increases, gains from arbitrage would emerge for an increasing range of commodities, and, consequently, it would eventually trigger the movement in the changes in the nominal exchange rate or in domestic prices to bring the real exchange rates back closer to levels consistent with PPP. The idea is that there would exist a neutral band, in which deviations within these limits would be last for long periods, while deviations occurring outside the neutral band would be rapidly reverted (MacDonald, ch. 3, 2007).

Several studies in the past 20 years have tried to assess this hypothesis through the use of smooth transition autoregressive (STAR) models. These studies have, generally, reported much faster mean-reversion speeds, and confirmed differences in the speed of adjustments depending on the magnitude of the deviations. However, MacDonald (2007, ch.3) sounds a cautionary note regarding these non-linear estimators, considering them as a black box. Furthermore, it is important to note that what these models are actually testing is a convergence towards an equilibrium that shifts to different levels over time. This differs from the hypothesis under enquiry using traditional unit root tests (previously discussed), which test whether a deviation of real exchange rate reverts towards a constant equilibrium. Therefore, a comparison between the speed of reversion towards the mean obtained in STAR models with previous research must be regarded with caution. It is unclear to what extent it is the actual real exchange rate level which reverts to equilibrium or whether deviations from 'equilibrium' lead to changes in its level.

Moreover, Sjolander (2007) also warns that since these types of models can accommodate an infinite numbers of regime shifts (which are determined based on the data), there is a risk of this models to overfit the series by mistaking randomness with a smooth transition between regimes. Thus, if enough shifts are included, each regime could be mistakenly regarded as stationary. As such, it should be no wonder as to why these types of non-linear models perform so poorly (even in relation to other linear specifications) when applied to out-of-sample exchange rate forecast (Rossi, 2013).

In the chapter concerning exchange rates and international prices in the latest edition of the Handbook of International economics, Burstein and Gopinath (2014) summarizes the

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22 For example, Michael, et. al. (1997), Taylor et al. (2001), Pettonen and Sager (2009).
23 In the sense, that real exchange rate equilibrium level would display a hysteretic behaviour (Libman, 2017).
main recent developments in the literature concerning exchange rates and international prices, and its main empirical findings. In their review, the authors reaffirm the finding that real exchange rates, based on consumer price indexes, moves closely to Nominal Exchange Rate, displaying high persistence with long-lasting deviations from their long-run means.

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

“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)

Despite its intuitive appeal, the empirical support regarding the PPP has been rather weak, however many economists still tend to ‘most instinctively believe in some variant of purchasing power parity as an anchor for long-run real exchange rates’ (Rogoff, p.647, 1996). Hence, in one form or another, the assumption that PPP hold is still present as in many theoretical models in international macroeconomics, including in the heterodox literature. The apparent disconnection between real exchange rate and relative national price levels has since been regarded as an empirical puzzle. However, given the evidence one must ask if PPP hypothesis of constant real exchange rates should really hold in the long run? This questioning has been present in the literature for long and it is at the heart of criticism directed to PPP theory, and to Cassel, from authors such as Balassa (1964) and Samuelson (1964), for example, whose contributions, and empirical analysis associated with it, will be analysed in the next section.

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24 As is the case of the derivation of Thirwall’s Law (Thirwall, 1979) and, consequently, in many derivations of Balance of Payment Constrained Growth Models, for example, see Araujo and Lima (2007).


2.2.2 Harrod-Balassa-Samuelson hypothesis

The most traditional explanation put forward to explain long-run deviations of real exchange rate from PPP levels highlight the role played by the evolution of prices of non-tradable goods and services based on the contributions of Harrod (1933), Balassa (1964) and Samuelson (1964). The underlying argument is based on the idea that PPP holds for the case of tradable commodities, which refers to an interpretation of PPP theory as an arbitrage condition. PPP would be the aggregate counter part of the Law of One Price - which states that in the context of free trade and in the absence of significant costs of transportation the price of a homogenous good should be equalized across nations. However, for the case of services and commodities which are not internationally tradable (either due to high transportation costs of some commodities or due to the nature of the service), there would be no endogenous market mechanism which would induce the equalization of prices of these commodities between the different countries. Since these latter enter in the calculation of price indexes used in the calculation the purchasing-power parities, but which do not affect exchange rates directly as they don’t enter international trade, there would be tendency from real exchange rates to diverge from levels compatible with PPP due to the different behaviour of non-tradable prices in each country.

Although aimed at discussing relative prices and structural change, Baumol’s (1967) model of unbalanced macroeconomic growth is illustrative of the mechanism at work here. Baumol’s claim is that a rise of productivity in the dynamic sector (e.g. tradables) allows for an increase in wages within this sector, without implying a raise in costs and prices of their output. However, if labour is mobile across sectors, this increase in wages would exert a spill over effect on wages of less dynamic sectors (e.g. non-tradables), which otherwise would face a labour shortage. The resultant increase in costs in the less dynamic activities would raise their output prices. As a consequence, prices of non-tradable goods and services are expected to be higher in countries with higher levels of productivity in the tradable sector. Therefore, what is implied by the Harrod-Balassa-Samuelson (H-B-S) hypothesis is that the relative price of non-tradable goods and service is driven by productivity differentials across sectors; and, consequently, the real exchange rate is driven by the differentials in the relative price of non-tradables across countries. Departing from the real exchange rate equation in log-linear format, we have:

\[ \text{rer} = e + p - p^* \]  \hspace{1cm} (2.2.4)

If we assume, following MacDonald (2007), that the price index of a country is composed of two types of commodities, a tradable and a non-tradable, one can express the price index of each country by the following expressions:
\[ p = (1 - \alpha_{NT})p_T + \alpha_{NT}p_{NT} \]  
\[ p^* = (1 - \alpha_{NT}^*)p_T^* + \alpha_{NT}^*p_{NT}^* \]  
\[ \text{(2.2.5)} \]
\[ \text{(2.2.6)} \]

Where the subscripts \( nt \) and \( t \) refer to non-tradable and tradable commodities, respectively, while \( \alpha_{NT} \) and \( \alpha_{NT}^* \) represent the share of non-tradables in the price index of the domestic economy and foreign country. Then, substituting the terms in equation (2.2.5) by (2.2.6) and (2.2.7):

\[ \text{rer} = e + ((1 - \alpha_{NT})p_T + \alpha_{NT}p_{NT}) - ((1 - \alpha_{NT}^*)p_T^* + \alpha_{NT}^*p_{NT}^*) \]  
\[ \text{(2.2.7)} \]

Rearranging the terms and separating the weights of non-tradables from tradables commodities one arrives at the following expression:

\[ \text{rer} = \alpha_{NT}(p_{NT} - p_T) - \alpha_{NT}^*(p_{NT}^* - p_T^*) + e + p_T - p_T^* \]  
\[ \text{Harrod–Balassa–Samuelson effect} \]
\[ \text{relative price of domestic to foreign tradables} \]  
\[ \text{(2.2.8)} \]

As such, the real exchange rate is the result of differences in the relative price between non-tradables and tradables within each country, i.e. the Harrod-Balassa-Samuelson effect, and the relative prices of domestic to foreign tradables, which would tend to be equal to zero due to arbitrage implicit in PPP.

Tests of the Harrod-Balassa-Samuelson have proceeded mainly following two routes. The first one is to assess which of the two relative price effects pointed in equation (2.2.8) explain the overall behaviour of the real exchange rate. In other words, the literature has tried to assess whether changes in the real exchange rate are better explained by changes in the prices of domestic relative to foreign tradable goods (implying a violation of the Law of One Price); or due to changes in the domestic relative prices between non-tradables and tradable goods. The second route followed is to build measures of relative productivity of traded and non-traded goods and regressing the real exchange rate\(^\text{25}\) on them.

As discussed by MacDonald (2007) the econometric tests following the first route find that movements in the real exchange rate of a country across time are in a large measure explained by movements in the relative price of traded goods between the domestic and foreign economy. Hence, deviation of real exchange rates from PPP levels would be explained mainly by movements in terms of trade. However, these indirect test does not preclude the possibility of a direct relationship between relative productivity levels and real exchange rate levels.

Cross-sectional and panel-data studies, in similar vein of the original empirical analysis conducted by Balassa (1964), tend to find a strong correlation between real GDP per capita

\(^{25}\)Real exchange rate computed using consumer price indexes.
levels, taken as a proxy of the relative productivities between countries, and the real exchange rate. A relationship that was initially tested with 12 countries by Balassa (1964) (see figure 2.1 below), has since been corroborated in samples with more than 100 countries within the scope of the Penn-World-Tables\(^ {26}\), compiled every few years as part of the International Comparison Project (ICP) initiated by Summers and Heston (1988).

**Figure 2.1: Relationship between real exchange rate and per capita GDP level from Balassa (1964) original paper.**

Source: Balassa (1964)

However, Asea and Mendoza (1994) argue, from a Neoclassical perspective, the relationship between real exchange rates and per capita Income can only be conditionally accepted as evidence in favour of Harrod-Balassa-Samuelson hypothesis, as it requires further assumptions of perfect competition and homothetic preferences. More definitive evidence should be provided on the basis of direct tests, either testing the relationship between relative prices and relative productivity differences between non-traded and tradable commodities within countries; or testing the relation between relative prices of non-tradable sector between two countries and the real exchange rate (Sarno and Taylor, 2002).

On the one hand, taking advantage of the data collected on prices of similar tradable and non-tradable commodities across different countries for the International Comparison Program (ICP)\(^ {27}\), Heston, Nuxoll and Summers (1994) examine the price differentials across countries and find that the difference between tradable and non-tradable price are positively related with income levels\(^ {28}\). This result is consistent with the hypothesis of the Harrod-Balassa-Samuelson effect.

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26 A point to which I shall return in the empirical analysis conducted in Chapter 5, which will use data from the Penn-World-Tables.
27 From which the Penn-World Tables are derived.
28 In a recent study Chen et al. (2015), using the prices provided in the ICP, find that the relative price of nontraded goods account for two-thirds of the cross-sectional variation in real exchange rates.
On the other hand, the empirical studies which explores time-series dimension find only weak evidence in favour of a long-run cointegration relationship between productivity growth and real exchange rates\(^{29}\). At shorter time horizons, movements in the relative price between tradables commodities (i.e. the terms of trade) tend to explain most of the variability and systematic movement observed in real exchange rates\(^{30}\). The movements in the relative price between tradables and non-tradables (Harrod-Balassa-Samuelson effect), although have the expected sign, would be less influential in explaining the behaviour of real exchange rates in the short to medium run.

In sum, while cross-sectional differences in real exchange rate appear to be related to productivity differentials across countries, the evidence reviewed indicate that changes in terms of trade would be the main factor explaining the changes of a country’s real exchange rate, with the exception of the long-run. Together with the evidence reviewed in section 2.2.1 regarding the close co-movement between real exchange rate and nominal exchange rates (Rogoff, 1996; Burstein and Gopinath, 2014), these findings have contributed to the development of other approaches and factors which could better explain the behaviour of real exchange rates over shorter time horizons. One of these approaches, which have gain traction since the 1990’s, is the so-called Behavioural Equilibrium Exchange Rates approach, to which I turn attention to in the next section.

### 2.2.3 Behavioural Equilibrium Exchange Rates

The Behavioural Equilibrium Exchange Rates (BEER) approach is a more empirical driven framework that seeks to determine the level around which currencies will gravitate to over an intermediate horizon. Hence, it tries to combine variables that account for long run determinants (such as the one discussed in the previous sections) with other possible determinants, which have persistent effects over the business cycle. These include factors which affect the nominal exchange rate, such as interest rate differentials, and others, like the changes in the terms of trade and the net foreign asset position, for example. However, it is important to emphasize that the exact set of variables included are driven by stylized facts and data availability for the countries under analysis, and, hence, tend to vary in the literature.

According to MacDonald (2007), the departing point of the BEER approach is the concept of uncovered interest rate parity (UIP), where the expected change in the value of the

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\(^{29}\) See for example, Canzoneri et al. (1996); Lee and Tang (2007) and Chong. et al (2012).

nominal exchange rate in period $t$ to period $t+1$ is given by the difference between the local and foreign interest rates$^{31}$:

$$E_t(e_{t+1}^e) - e_t = i_t - i_t^*$$

(2.2.9)

where $E_t(e_{t+1}^e)$ denotes the expected value of the nominal exchange rate in period $t$ for period $t+1$; $e_t$ is the nominal exchange rate in period $t$, defined in terms of domestic currency per unit of foreign currency; while $i_t$ and $i_t^*$ are the local and foreign nominal interest rates, respectively. In an economy with an open capital account, nominal exchange rates are affected by changes in interest rates set by monetary policy, among other factors. As long as nominal prices adjust more slowly (if it adjusts at all) than the nominal exchange rate, than monetary policy would also influence the real exchange rate. By subtracting expected inflation differential from the above expression, one arrives at the uncovered interest parity condition in real terms:

$$E_t(re_{t+1}^r) - re_t = r_t - r_t^*$$

(2.2.10)

Where $re_r$ represents the real exchange rate and $r$ represent the Real Interest Rates. Solving the above expression for $re_{t}^r$, one can see that in this framework the prevailing real exchange rate is a function of the expected value of the real exchange rate ($E_t(re_{t+1}^r)$) and of the current interest rate differential ($r_t - r_t^*$):

$$re_{t}^r = E_t(re_{t+1}^r) - (r_t - r_t^*)$$

(2.2.11)

The important assumption introduced by this approach is the modelling approach to the unobserved expectation of the real exchange rate ($E_t(re_{t+1}^r)$), which are assumed to be solely determined by long run economic fundamentals.

In Clark and MacDonald (1998), one of the benchmark references in this literature, three variables are assumed as long run determinants: the Harrod-Balassa-Samuelson effect ($hbs$), terms of trade ($tot$), and net foreign asset position ($nfa$), all measured relative to their foreign counterpart. The rationale for the inclusion of the net foreign asset position is the idea that the accumulation of foreign asset liabilities would, eventually, require a devaluation of the countries real exchange rate, in order to produce higher trade surpluses necessary to service these external liabilities. Furthermore, they include the ratio between domestic and foreign government debt, each measured as percentage of GDP, ($\frac{gdebt_t}{gdebt_t^*}$) as a proxy of the risk premium:

$$re_{t}^{BEER} = f \left( (r - r^*), hbs, tot, nfa, \left( \frac{gdebt_t}{gdebt_t^*} \right) \right)$$

(2.2.12)

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$^{31}$For sake of simplicity the premium risk component is assumed absent in this exposition, as the primary objective here is to provide a simple construction of the determination of equilibrium of real exchange rates in the BEER framework.
The inclusion of the net foreign asset position (nfa) is derived from the balance of payments approach of the real exchange rate determinants. Hence, it’s fair to say that embedded notion of equilibrium of the real exchange rate which is consistent with current account balance (MacDonald and Ricci, 2007). However, what differentiate it from other approaches is that the real exchange rate equilibrium is defined relative to the current levels of the variables considered to be fundamentals.

To be able to derive reliable estimates of the long-run relationship, a first step, as the real exchange rate tend not to be stationary, is to test if the variables cointegrate, i.e. if all the variables have the same order of integration, and a linear combination of this collection of variables is integrated of order zero. Hence, for example, departing from the following initial econometric model, we have:

\[
rer_t = \beta_0 + \beta_1(r_t - r_t^*) + \beta_2 hbs_t + \beta_3 tot_t + \beta_4 nfa_t + \beta_5 \left(\frac{gdeb_t}{gdebt_t}\right) + \varepsilon_t \quad (2.2.13)
\]

Then, from the variables which the test results indicate that possess a cointegration relationship, the long-run BEER is estimated. Results in the literature tend to find two different cointegration vectors: one reflecting the real interest rate differentials (adjusted for the risk-premium) and other relating the remaining variables of the right-hand side in equation (2.2.13) (see, for example, Clark and MacDonald, 1998; or Benassy-Quere et. al., 2009). Thus, the long-run BEER is calculated based on estimated coefficients in the equation (2.2.13), denoted with a hat in equation (2.2.14) below, of the variables that display a cointegration relationship with the real exchange rate, such as the terms of trade (tot), the Harrod-Balassa-Samuelson effect (hbs), net foreign asset position (nfa):

\[
rer_t^{\text{BEER}} = \beta_0^\hat{} + \beta_2^\hat{} hbs_t + \beta_3^\hat{} tot_t + \beta_4^\hat{} nfa_t + \beta_5^\hat{} \left(\frac{gdeb_t}{gdebt_t}\right) + \varepsilon_t \quad (2.2.14)
\]

And, hence, the real exchange rate misalignment is the difference prevailing between the levels of real exchange rate (rer_t) and the BEER (rer_t^{\text{BEER}}).

Over the past two decades several works in the literature have estimated BEER’s. The BEER methodology has also been introduced as one of the methodologies used by the IMF in their External Balance Assessment (EBA) since the early 2000’s (Abiad. et.al., 2009). Given its empirical driven nature, the number variables included in the estimations has increased and

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32 Like the Fundamental Equilibrium Exchange Rate (FEER) and current External Balance Assessment (EBA) methodology of the IMF, which are discussed in section 2.2.4.
33 Order of integration refers to the minimum number of differences required to obtain a covariance stationary time-series.
34 Referred to as Equilibrium real exchange rate Approach (ERER) in IMF documents.
35 Which succeeded the IMF Consultative Group on Exchange Rate issues (CGER)—an internal working group which had been working on assessing Exchange Rate Misalignments from countries since 1997.
varied depending on data availability, the sample of countries under inquiry, and choices made by researchers. Together with the multiple possible estimation techniques, this gives rise to a potential degree of uncertainty regarding the estimations.

As highlighted by Adler and Grisse (2017), the estimated coefficients and, consequently, the implied Real Exchange Equilibrium is sensitive to the combination of variables included in the model, and econometric identification strategies adopted. Hence, for example, in the EQCHANGE database, compiled by Couharde et. al. (2017)36, it is possible to obtain 18 different measures of BEER37; and their most sophisticated estimate includes variables like GDP per capita, net foreign assets, and terms of trade to estimate their equilibrium exchange rate. Studies which focus exclusively on advanced economies tend to include a much wider variety of variables. In their review of the literature since the early 2000’s, Adler and Grisse (2017) identify 13 commonly used variables that would capture structural determinants of the demand for traded relative to nontraded goods, which would drive the relative prices; and, hence, be associated with the real exchange rate behaviour. Beyond the factors already discussed, these include:

- **Demography**: Increases of old-age population would be associated with lower savings, higher demand for non-tradables and, hence, an appreciated real exchange rate.

- **Fiscal deficit**: A larger fiscal deficit implies lower saving, higher demand non-tradables and, consequently, real exchange rate appreciation.

- **Government consumption**: Government consumption is mostly made up of services, which are mostly classified as non-tradables. Hence, should therefore be associated with a real appreciation.

- **Trade Openness**: Countries more open to trade would have lower prices for domestic tradable goods, which would be associated with a more depreciated real exchange rate.

- **Output gap**: A positive Output Gap, i.e. GDP level above its potential, would be associated with higher domestic price level and, hence, with an appreciated real exchange rate.

- **Private credit**: An expansion of domestic credit above its long-term average could reflect strong domestic demand and, hence, is associated with higher domestic price level and with an appreciated real exchange rate.

- **Trade balance**: Trade surpluses are associated with a weaker real exchange rate.

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36 Whose measures of misalignments is among the ones with highest country coverage possible in the BEER literature and are made available under the name of EQCHANGE database.

37 From the combination of 2 different Real Effective Exchange Rate indexes (due to weighting system), 3 different BEER estimates and 3 possible samples of countries.
- **Central bank reserves:** Foreign exchange reserve accumulation by central banks is expected to prevent the appreciation of the real exchange rate and, hence, is associated with more depreciated real exchange rate level. It is included as a second measure for the effects of monetary policy on exchange rates.

Looking at a sample of 22 advanced economies, from all the possible combinations of variables tried, Adler and Grisse (2017) concluded that the variables which tend to be more robustly linked with the real exchange rate were: Central bank reserves, government consumption, private credit, real interest rates, the terms of trade, GDP per capita, net foreign assets and openness.

In sum, the BEER framework is an empirical driven methodology of deriving real exchange rate equilibrium. The approach is based on finding cointegration relationships between the real exchange rate and other economic variables, which are expected to influence the long-run behaviour of relative prices, and the nominal exchange rates, following economic theory. Departing from real Uncovered Interest Parity with a risk premium component, it determines the expected future movements in real exchange rates from long-run fundamentals. However, among the fundamentals considered, it expands on PPP and on the Harrod-Balassa-Samuelson effect by introducing several other potential variables, which may influence demand. Hence, within a neoclassical framework, these variables would influence the relative price between non-tradables and tradable commodities.

Lastly, another important feature is that in the BEER framework the exchange rate equilibrium is estimated relative to the current prevailing levels of the fundamentals, and do not use the equilibrium values expected to prevail in the long-run steady state. This is a key difference between the BEER approach and Macroeconomic Balance approaches, such as Fundamental Equilibrium Exchange Rate (FEER) (Williamson, 1985), which seek to estimate a real exchange rate equilibrium consistent with a macroeconomic internal and external balance. This latter framework will be the focus of the review in the following section.

**2.2.4 The Macroeconomic Balance approach and the Fundamental Equilibrium Exchange Rate**

The Macroeconomic Balance (MB) framework focuses on the requirements for achieving internal and external balance simultaneously. The internal balance is associated with a zero-output gap for the economy and the external balance is related with the current account equilibrium with a sustainable net external (asset or liability) position. Its origins can be traced back to Nurkse (1945) and Meade (1951). It was developed into an empirical tool through the works of several scholar during the 1980’s and 1990’s, such as Williamson (1985, 1994), who coined the term Fundamental Equilibrium Exchange Rate (FEER) to describe the equilibrium
exchange rate estimate derived from this approach. This methodology has since been incorporated and further developed by IMF research staff\textsuperscript{38}, who have introduced it as one of the tools used in the institutions exchange rate surveillance exercises\textsuperscript{39}, a topic that has always been at the core of the IMF’s mandate. Since 2014 the IMF publishes yearly assessments of Real (Effective) Exchange Rates misalignments for individual countries based on this approach.

As described by Lee et. al. (2008), the macroeconomic balance approach to exchange rate assessments conducted by the IMF consists of three steps. The first step is to estimate, using panel econometric techniques, an equation for the Current Account balance that include different group of explanatory variables, such as macroeconomic and structural fundamentals, cyclical factors, and policy related regressors\textsuperscript{40}:

\[
\frac{CA}{GDP} = \beta_0 + \beta_1 X_{mf} + \beta_2 X_{sf} + \beta_3 X_{cyc} + \beta_4 X_p + \epsilon \tag{2.2.15}
\]

Where:

- \(X_{mf}\): Is the vector which summarizes all variables that reflect macroeconomic fundamentals such as Net Foreign Asset; GDP per worker; expected 5-year real GDP growth rate\textsuperscript{41}; reserve currency status\textsuperscript{42};
- \(X_{sf}\): Is the vector which summarizes all variables that reflect structural fundamentals like demographics, institutional quality\textsuperscript{43}; and Exhaustible oil and natural gas resources\textsuperscript{44}.
- \(X_{cyc}\): Is the vector which summarizes all variables that reflect cyclical factors such as the Output Gap; and the Commodity Terms-Of-Trade gap interacted with the trade openness.
- \(X_P\): Is the vector which summarizes all variables that are directly related to economic policy such as the Fiscal balance\textsuperscript{45}; share of Public Health spending to GDP; Credit to GDP.
ratio relative to long-run trend\textsuperscript{46}; and an index of Capital Controls interacted with (i) Foreign Exchange Intervention\textsuperscript{47} to GDP ratio, (ii) GDP per worker; and (iii) global risk aversion\textsuperscript{48}.

Using coefficient estimates (denoted with a hat) of policy, cyclical, macroeconomic and structural fundamental variables, the predicted values for the current account balance in percent of GDP are given by:

\[
\frac{\text{CA}}{\text{GDP}} = \beta_0 + \beta_1 X_{mf} + \beta_2 X_{sf} + \beta_3 X_{cyc} + \beta_4 X_p
\] (2.2.16)

It is important to highlight that, contrary to the other approaches reviewed thus far, the Macroeconomic Balance framework to real exchange rate equilibrium is a normative one. Hence, the second step is to compute the deviation of the Current Account balance from what it would be the expected balance when the economy is equilibrium, that is, when the policy variables are at their “desired”, sustainable, levels\textsuperscript{49}. If we denote values of policy variables that are deemed sustainable as \(X_p^*\), add and subtract this from previous equation, we can decompose the Current Account balance into three elements:

\[
\frac{\text{CA}}{\text{GDP}} = \beta_0 + \beta_1 X_{mf} + \beta_2 X_{sf} + \beta_3 X_{cyc} + \beta_4 X_p^* + \beta_4 (X_p - X_p^*)
\] (2.2.17)

The CA “norm” captures the implied current account balance when all underlying macroeconomic fundamentals are at their actual values, but assuming that all policy variables are set at their medium-term sustainable levels \(X_p^*\) and excluding cyclical effects. Meanwhile, the cyclical component measures the contribution of the output gap and of the terms of trade to the predicted current account. Finally, the policy gap measures by how much deviations in policy variables from their sustainable levels contribute to the overall deviation of the predicted current account balance from its norm.

According to the latest version of IMF macroeconomic balance methodology (Cubeddu et. al., 2018), the relevant Current Account imbalance which needs to be corrected by changes

\footnotesize{\textsuperscript{46} To capture the countries position in the credit cycle. Credit booms are associated with higher spending and, hence, current account deficits.  
\textsuperscript{47} Proxied by the transaction-based change in reserves, as recorded in balance of payments (BOP) statistics. 
\textsuperscript{48} The VXO is an index of implied U.S. stock market volatility created by the Chicago Board Options Exchange (CBOE) 
\textsuperscript{49} For a description on how the benchmarks for the relevant policy variables are set within the current EBA framework of the IMF, please, see Cubeddu et. al. (p.24-25, 2018).}
in the real exchange rate is the gap between the Current Account “norm” and the actual Current Account balance adjusted by the cyclical component \((\beta_3 X_{cyc})\) estimated by equation (2.2.16):

\[
\frac{CA^{\text{gap}}}{GDP} = \frac{CA^{\text{cyc adj}}}{GDP} - CA^{\text{norm}} \tag{2.2.18}
\]

Where \(CA^{\text{cyc adj}}_{GDP} = \frac{CA}{GDP} - \beta_3 X_{cyc}\) and \(CA^{\text{norm}} = \beta_0 + \beta_1 X_{mf} + \beta_2 X_{sf} + \beta_4 X^*_p\).

The third and last step involves estimating country-specific current account-real exchange rate elasticities, which allows the Current Account gap \(\frac{CA^{\text{gap}}}{GDP}\) to be translated into a consistent real exchange rate gap. The real exchange rate gap captures the deviation of the current real exchange rate from the level expected to bring the Current Account into equilibrium. This level of the real exchange rate is what the literature in the past has referred to as the Fundamental Equilibrium Exchange Rate (FEER) level.

The 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 creates some controversy regarding the reliability of FEER estimates. To be able to derive the FEER estimate, it is necessary in the third step to estimate trade price-elasticities, from which one can compute the change in exports and imports that is expected to follow, and then work backwards 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. Also in several circumstances estimated elasticities may not be statistically significantly different than zero. Furthermore, the presence of other adjustment channels (such as financial linkages which might impact income transfers and the capital account) are usually not considered\(^{50}\), and have important implications for the estimation of the price elasticities. Therefore, there is a considerable degree of uncertainty around the estimation of the equilibrium level.

Moreover, the need to define the desired levels of the policy variables seen as sustainable in the middle-run also introduces a certain degree of arbitrariness to this type of exercises. And the estimation of the FEER can be rather sensitive to changes in key parameters. For example, Driver and Wren-Lewis (1999), while conducting a sensitivity analysis of FEER calculations for the US dollar, the Japanese yen and the German mark, highlight that changes in the values of the sustainable capital account position of 1 pp (as proportion of GDP) could produce changes of around 5% in the FEER estimates. Hence, also due to measurement errors,

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\(^{50}\) As well as quantity adjustments of GDP, which is normally would be adjusting mechanism emphasized in an original Keynesian framework.
it is important to regard FEER estimates within a confidence interval rather than as a point estimate. Consequently, small deviations from FEER should not be understood as misalignment of real exchange rate beyond reasonable doubt.

Although FEER like calculations are not meant to be optimal forecasts but estimates of where a currency is relative to its “fundamental” equilibrium level, Abiad et. al. (2009) provide an assessment regarding how previous versions of the IMF methodology to estimate FEER’s performed in predicting future movements of Real Effective Exchange Rates in 3- and 5-years windows. Although, real exchange rates assessed as undervalued in the IMF assessments tended to appreciate and vice-versa, the magnitude by which real exchange rates tended to correct the estimated misalignment would be relatively small. Reinforcing the result also obtained by other methodologies of real exchange rate equilibrium - misalignments are highly persistent. However, considering that the embedded notion of equilibrium in the FEER approach is one of macroeconomic balance, the persistent misalignments measured in this approach are a by-product of the persistency of trade imbalances normally observed in the world economy, a point to which I shall return in section 2.3 while presenting Anwar Shaikh’s (1999, 2016) framework.

2.2.5 Summary

The mainstream literature on determination of real exchange rate equilibrium is vast, with multiple theories and approaches being developed over the course of a century. In this review I’ve focused in four approaches of real exchange rate equilibrium, which have been used by the literature that links real exchange rate undervaluation and to higher economic growth. Namely, the Purchasing Power Parity (PPP) theory, Harrod-Balassa-Samuelson approach, Behavioural Equilibrium Exchange Rate (BEER) and Fundamental Equilibrium Exchange Rate (FEER) were reviewed in this section.

In the modern literature, PPP theory has been associated with the hypothesis that real exchange rate should display a stationary behaviour, as relative price levels between countries should compensate movements in nominal exchange rates. After the break down of the Bretton Woods fixed exchange rate system and with the rise of rational expectations, PPP theory gained increased popularity with the development of the Monetary and Portfolio models of the 1970’s (Frankel, 1992), which embedded the assumption of PPP as an arbitrage condition. Since then, PPP hypothesis of real exchange rate behaviour became the subject of exhaustive empirical analysis. After almost 50 years of research, however, it has been impossible to resolutely confirm the hypothesis that real exchange rates are stationary, with the notable exception of economies in hyper-inflationary context (Shaikh, 2016). In most countries the real exchange rates are found to be non-stationary, and tend to revert towards their long-run mean, but at a rather slow-pace.
These results, together with insights coming from theoretical investigations, have fuelled several criticisms of the PPP theory. As the modern originator of the theory, and one of its fiercest advocates, Gustav Cassel has been at the forefront of much of these criticisms directed towards PPP over time.

However, as it will be explored in more detail in Chapter 3, some commentators, like Moosa (1999), sustain that the contemporary testing practices of PPP theory are based on a misrepresentation of the theory. Moreover, criticisms directed at Cassel would fail to consider that he himself had recognized several factors which could lead to a diversion of real exchange rate from levels consistent with PPP hypothesis of constant real exchange rate. Other commentators, like Kadochnicov (2013), claim that PPP in Cassel’s economic thought would be a normative theory of real exchange rate equilibrium. PPP would be associated with the exchange rate level consistent with a sustainable international trade balance position, much more aligned with the Macroeconomic Balance approach, based on Fundamental Equilibrium Exchange (FEER’s) framework (reviewed in section 2.2.4), than with what modern empirical literature has associated PPP to be.

Overall, the analysis conducted in this section surrounding the empirical testing of the PPP hypothesis reveal a pattern of brief periods of excitement with new empirical results, following the application of new econometric techniques, being succeeded by perceived drawbacks in their methodology. These drawbacks then led to changes in the interpretation of equilibrium and on the scope of theory, leading to the emergence of a new set of hypotheses to test the theory. This patterns of change and adjustment of the theory and in its auxiliary hypothesis is by no means something new and specific to the literature which have tried to empirically test the PPP hypothesis in the past decades. In fact, as it will be demonstrated in Chapter 3 these tensions regarding how to define PPP and what is the implied equilibrium of exchange rates according to the theory were present in Cassel’s own writings, as well as in the literature regarding PPP theory and associated calculations from the 1920’s.

Among the explanations prevalent in the literature for the non-stationarity of real exchange rates, one of the most established is the hypothesis known as the Harrod-Balassa-Samuelson effect, reviewed in section 2.2.2, which attributes changes in real exchange rates to the divergence in prices of non-tradable commodities across countries. The increase in the productivity of tradables would lead to increases in wages in both tradable and non-tradables sectors. As the productivity in the non-tradable sector would be stagnant, this would lead to

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51 These results have also contributed to the development of alternative explanations for the non-stationarity of real exchange rate in the literature, some of which were covered in previous sections.
increases in cost and prices of the non-tradable sector. Considering that typically the productivity in the tradable sector would be higher in countries with higher GDP per capita, this would explain why real exchange rates tend to be more appreciated in richer countries. Empirical studies, typically, have found strong support for the Harrod-Balassa-Samuelson hypothesis in cross-sectional studies, while in the time-series dimension evidence has been less conclusive.

The mainstream literature has moved forward towards the exploration of further potential determinants of real exchange rates. Reflecting assumptions arising from neoclassical theory, most of the variables included in the BEER and FEER frameworks (reviewed in section 2.2.3 and 2.2.4) are related to their potential role in explaining shifts in demand between tradables and non-tradables. As such, haven’t delved much into further aspects related to cost of production differences and income distribution.

In the Harrod-Balassa-Samuelson hypothesis, it is implicitly assumed that real wages increase in line with the productivity of the tradable sector, keeping the wage-share of in value added intact. However, several studies have documented a decoupling between the increase in productivity and real wages in several advanced economies, a trend that has occurred at a different pace across countries. As consequence of this, variations in the relative unit labour costs between domestic and foreign tradables occurs, which tend to affect their relative prices and, hence, real exchange rates. In a recent paper, Berka et. al. (2018) provides supportive evidence for the Harrod-Balassa-Samuelson hypothesis once controlled for changes in relative unit labour costs in the context of eurozone countries.

Berka et. al. (2018) derives a theoretical model that attribute the empirical findings to the existence of a “labour wedge”, which is defined in mainstream literature as the measured difference between the marginal product of labour and the marginal rate of substitution between leisure and consumption of households. However, the authors do concede that “one interpretation for this phenomenon [holding productivity constant, higher unit labour costs lead to real exchange rate appreciation] is that there are separate institutional forces driving factor prices, independent of factor productivities” (Berka et. al., p.1544, 2018). This idea that distributional variables, such as real wages, are not determined by supply and demand forces, but driven by institutional forces is exactly the starting point of the classical surplus approach to the determination of relative prices (see, for example, Sraffa, 1960; Garegnani, 1983, 1984). And the application of this framework to the explanation of real exchange rate equilibrium has been

52 See for example OECD (2018)
53 And it would be this marginal rate of substitution which would determine the slope of the labour supply curve at each level of employment.
developed by Anwar Shaikh (1999, 2016), whose contributions I bring into focus in the next section.

2.3 The Surplus Approach to Real Exchange Rate Equilibrium

An alternative approach to the mainstream theories reviewed on the previous section has been developed by Anwar Shaikh (1999, 2016) and other researchers, such as Napoles (2004) and Antonopoulos (1999), from a 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 are ultimately determined to relative unit labour costs. In this section, before presenting Shaikh’s model, it is useful to present the analytical structure of the surplus approach as it has been formulated following the works of Sraffa (1960), which re-instate the classical political economy framework as developed by David Ricardo and Karl Marx.

2.3.1 The analytical core of surplus theories and the prices of production method to the determination of relative prices

As described by Sraffa (1960) in the surplus approach the system of production and consumption are characterized as a circular process, in a sharp contrast with neoclassical economics, which conceptualise economies as a ‘one-way avenue that leads from factors of production to consumption goods’ (Sraffa, p.93, 1960). Hence, the central focus of economic theory is on the necessary conditions to ensure the reproducibility of the system and to determine, what classical authors referred to as, the social surplus\textsuperscript{54}. The social surplus is defined as the amount of goods and services available for consumption by the society, after deducting the amount of goods and services needed as inputs, so the economic system is able to reproduce the social product at the same scale over successive periods (Garegnani, 1987).

To be able to determine the social surplus, classical authors took as given the level of the net social product and the necessary consumption to ensure the subsistence of workers. To be able to take these magnitudes as data, it is necessary to take as given (i) the technical conditions of production; (ii) the composition of the social product in physical terms; and (iii) one of the distributive variables (the real wage or the profit rate). From (i) and (ii) one is able to derive the number of workers. When these are taken together as givens, by choosing one of the distributive variables in (iii), one is able to derive the social surplus\textsuperscript{55}. The possibility of choosing

\textsuperscript{54} What in contemporary economic statistics may be associated with net product. Although, in the classics it’s also net of subsistence wages.

\textsuperscript{55} The social surplus would be the part of production which is not necessary for the reproduction of the existing social system. Thus, it could be either re-invested, in order to expand and transform the existing economic system, or spent in luxury (non-subsistence) consumption (Martins, 2017).
which of the distributive variables is taken as given, gives rise to the possibility of alternative ‘closures’ to the price system, a notion which will be explored in chapter 4.

According to Garegnani (1987), the determination of one of the distributive variables outside of the economic system is an essential feature that distinguish the classical surplus approach from neoclassical marginalism, in which both the wage rate and profit rate are determined simultaneously by means of supply and demand curves. Furthermore, in the neoclassical marginalist approach, given the determination of the wage rate by means of supply and demand, one cannot take the social product as given. Hence, the social product must also appear among the magnitudes to be determined. To achieve this, neoclassical theory introduces two new sets of data in its analytical core, consumers tastes and production factors availability (labour and capital). These, when coupled with behavioural assumptions of diminishing marginal utility and productivity, yield well behaved downward (upward) sloped demand (supply) curve for factors of production (labour and capital), which are necessary to determine a stable equilibrium for the wage and profit rates.

At first, the Neoclassical simultaneous determination of the distributive variables, and the lack of need to take the social product as given, may seem as a more sophisticated and appealing way of modelling the economic system. However, as the results of the Cambridge capital controversies of the 1960’s and 70’s have illustrated, as soon as one has to consider the existence of heterogenous capital goods, capital needs to be expressed in terms of value. Consequently, the determination of the quantity of capital as a factor of production cannot be determined prior to the determination of relative prices and of income distribution. As such, the initial endowment of capital goods (which are themselves produced means of production) can only be taken as given in kind. The implication of this, however, is that (i) wages and profits could not be determined by marginal productivities in the presence of multiple capital and consumer goods; and (ii) a stable long-run equilibrium, with uniform rate of profits across sectors, cannot be established within the neoclassical framework, and only short-period equilibria can be determined (Mandler, 1987).

Within the classical surplus approach, the issue of capital heterogeneity also provided important complications. The rate of profit was defined as the ratio between social surplus and social capital, that is, two aggregates of heterogeneous commodities. This forced the classical authors to face the problem of value - to be able to calculate the value of profits and of capital

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56 Moreover, given the determination of the wage rate by means of supply and demand, one cannot take the social product as given, which would need to be also simultaneously determined.
57 For a review of the main issues and findings regarding the Capital Controversies, see Hartcourt (1972) and Lazzarini (2015) for some of the unsettled issues regarding, what is considered to be, the 2nd phase of the debate.
advanced, and, hence, obtain the rate of profits, one needs to first determine relative prices of commodities, which are part of the capital advanced, and social surplus (Roncaglia, 2005). Ricardo’s (2001[1821]) ingenious device to solve this problem consisted in associating the relative prices between commodities with the relative quantities of labour directly and indirectly required in their production, extending the application of the Labour Theory of Value to the capitalist mode of production setting. The Labour Theory of Value enabled Ricardo to measure all the different elements necessary to calculate the rate of profits in homogeneous terms, expressing total output, capital advanced, and subsistence wages in terms of the necessary labour embodied in their production.

However, as Ricardo was well aware58, aside from special cases, the exact direct relationship between relative prices and relative embodied labour between two commodities is inconsistent with the assumption of a uniform rate of profits across all sectors of the economy. Furthermore, the uniform rate of profit assumption is considered to be instrumental to express in analytical fashion the Smithian idea of the ‘competition of capitals’, which would be a central feature of capitalistic mode of production (Roncaglia, 2005). In general, the determination of relative prices by the ratio of labour directly and indirectly embodied in the production of each commodity would be incompatible with the condition of uniform rate of profits due to three factors: (i) different proportions of fixed and circulating capital required for production of each commodity; (ii) different durability of fixed capital employed in each sector; and (iii) differences in the time length needed to complete the production process (Steedman, 1977). Consequently, the relative prices between commodities, whose production processes display one of these three characteristics, would fluctuate when confronted with changes in the distribution of income between wages and profits, despite the relative labour hours needed for production of both commodities remaining unchanged.

As such, as Sraffa (1960) contribution would later make clear, the problem of the determination of the exchange ratios (i.e. relative prices) that get established among the various sectors is to be tackled, in a capitalistic economy, simultaneously with the problem of income distribution between social classes. This is due to the fact that, when commodities are at one and at the same time output and means of production, the price of one commodity cannot be determined independently of others, nor the set of relative prices is independent of changes in income distribution between profits and wages. Hence, in this framework the prices of production can be represented by a system of simultaneous equations of the following nature:

58 Ricardo, in the preface of subsequent editions of the ‘Principles of Political Economy and Taxations’ (1819 and 1821), would recognize the specific conditions under which his formulation of the labour theory of value would be accurate.
\[ p_1 = (p_1 a_{11} + \cdots + p_n a_{n1} + w l_1)(1 + r) \]
\[ p_2 = (p_1 a_{12} + \cdots + p_2 a_{n2} + w l_2)(1 + r) \]
\[ \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \]
\[ p_n = (p_1 a_{1n} + \cdots + p_2 a_{nn} + w l_n)(1 + r) \]

In which the system is, initially, underdetermined, as it possesses more unknowns than equations. Hence, for the determination of relative prices it would be necessary to take as a given the same magnitudes needed to determine the social surplus (as discussed above), these are (i) the technical conditions of production; (ii) the composition of the social product in physical terms; and (iii) one of the two distributive variables. Following this procedure, the other distributive variable (real wage or profit rate) would be determined as a residual, simultaneously with the relative prices. The prior determination of one of the distributive variables, instead of an analytical subterfuge, can be seen as a strength, as it opens up the possibility of explaining relative prices and income distribution among classes by institutional forces. As such, it allows space for the incorporation of the effect of broader social and political forces into the economic analysis, which have had different powers to influence the distribution of the social product produced collectively by society across the different historical periods and modes of production.

Authors in the surplus tradition, such as David Ricardo and Karl Marx would take the real wage as given. In their works, real wages were assumed to fluctuate around their “natural” levels, which would be determined by subsistence levels. However, it’s important to note that the notion of subsistence would depend not only on biological factors, but also influenced by historical and cultural norms (Garegnani, 1983). In Ricardo (2001[1821]), gravitation of real wages around subsistence levels relied on the Malthusian law on population, by which the persistency of the real wage above (below) its “natural” subsistence level would induce an increase (decrease) in the population, and, consequently, would eventually lead to an increase (decrease) in the size of the labour force. This increase, in its turn, would pressure real wages downwards (upwards), back to the “natural” subsistence levels. Although Marx was critical of Ricardo’s explanation, he also sustained that the real wages would tend to converge to a historically determined subsistence level, which would be socially determined (Dobb, 1973). One of the key factors explaining this pattern would be the existence of a significant “labour reserve army”, which would place capitalists in a favourable position in the wage bargaining process. In Marx’s view, a fall in unemployment improved the bargaining positions of workers, leading to a rise in real wages. This, in its turn, would lead to a reaction from capitalists which would seek to introduce new machinery to replace workers. As a consequence, this would lead to an increase in unemployment rates overtime, re-establishing the “labour reserve army”, and compressing real wages back to subsistence level.
Although classical authors and Marx shared the view of real wages being determined by the notion of subsistence, Garegnani (1983) argues that the distinctive feature of the surplus approach was, more generally, the importance attributed to institutional and political elements in the determination of income distribution. Hence, the determination of the real wage would be “best studied before and independently of the determination of relative prices and of the other shares in total product” (Garegnani, p.311, 1983). In its turn, the separate determination of the real wage would allow one to determine the price system and the rate of profit simultaneously and independently of any demand function for products.

As Sraffa (1960)\textsuperscript{59} writes, the choice of the real wage as the variable determined outside the system of production would be suitable to describe productive relations in the preliminary stages of capitalism, where wages could be specified as a bundle of necessary commodities determined by the physiological and social conditions of subsistence. However, with the progress of capitalism and the possibility of changes in the distribution of the surplus (of income), the question of determination of which of the two distributive variables (real wages and the rate of profits) should be taken as determined by social-institutional conditions resurfaces in the current stage of capitalism. That is, the question of which alternative distributive ‘closure’ should be chosen by the theorist regained importance.

Within different strands of the surplus approach to the determination of distribution and relative prices, authors such as Pivetti (1992), Panico (1988) and Shaikh (1980, 1984, 2016), in the development of their theories, have taken the rate of profits as the given distributive variable, providing different explanations for this option along the way. On the one hand, following the cue of Sraffa (1960, chapter V), Pivetti (1992) and Panico (1988) make the case in favour of determining the rate of profits by the level of monetary rate of interest, which is set institutionally by central banks. Hence, these authors provide what has become known as a monetary theory of distribution. The argument put forward relies on the view that interest rates are determined exogenously by monetary authorities, and are seen as directly related to price changes within a costs-of-production approach to relative prices. Therefore, persistent changes in the interest rates constitute either changes in normal costs (when capital employed in production is borrowed) or in opportunity costs (as it represents the rate of return on capital employed into alternative ends). As such, a persistent fall in interest rates would induce a fall in prices relative to money wages, reducing the rate of profit and, thereby, generating changes in income distribution.

\textsuperscript{59} See Sraffa (Chapter V,1960)
Thus, following this approach, the solution of the price system for the relative prices, in the two commodities case with wages being paid post-factum, may be expressed in the following manner:

\[ p_1 = (p_1a_{11} + p_2a_{21})(1 + r) + p_2w\bar{l}_1 \]  
\[ p_2 = (p_1a_{12} + p_2a_{22})(1 + r) + p_2w\bar{l}_2 \]

(2.3.1)  
(2.3.2)

Where both commodities are basic goods\(^{60}\), and for sake of simplicity, I assume that commodity 2 is also the wage good and, hence, \( w \) represents the real wage; \( a_{ij} \) and \( \bar{l}_2 \) represent, respectively, the technical and labour coefficients. As discussed, taking the technical conditions of production as given (\( \bar{a}_{ij} \) and \( \bar{l}_2 \)), leaves the system with four unknowns \((p_1, p_2, w, r)\) with only two equations, rendering the system undetermined. The solution is, then, to analyse the system in terms of relative prices, taking one commodity as numéraire, and assuming one of the distributive variables as given. Following the discussion above, the profit rate \((\bar{r})\) is assumed here as the given distributive variable. Hence, the system can be re-written in the following format:

\[ 1 = (\bar{a}_{11} + \frac{p_2}{p_1}\bar{a}_{21})(1 + \bar{r}) + w\bar{l}_1 \]

(2.3.3)

\[ \frac{p_2}{p_1} = (\bar{a}_{12} + \frac{p_2}{p_1}\bar{a}_{22})(1 + \bar{r}) + w\bar{l}_2 \]

(2.3.4)

Solving the above system for the relative price:

\[ \frac{p_2}{p_1} = \frac{\bar{l}_2 - \bar{l}_2\bar{a}_{11}(1 + \bar{r}) + \bar{l}_1\bar{a}_{12}(1 + \bar{r})}{\bar{l}_1 - \bar{l}_1\bar{a}_{22}(1 + \bar{r}) + \bar{l}_2\bar{a}_{21}(1 + \bar{r})} \]

(2.3.5)

As such, the equation above makes clear that, in general, relative prices will depend on technical and labour coefficients, and on the particular level of the rate of profit, while wages would be determined simultaneously, given by:

\[ w = 1 - a_{11}(1 + r) - \frac{p_2}{p_1}a_{21}(1 + r) \]

(2.3.6)

Hence, taken together, equations (2.3.4) and (2.3.6) bring to the forefront the relationship between income distribution and relative prices highlighted at the beginning of this section.

Now that the analytical core of surplus theories of value and distribution, and its approach to the determination of relative prices using the prices of production method has been introduced, in the next section it is possible to discuss the relationship between real exchange

\(^{60}\) Meaning that both commodities enter directly or indirectly as means of production in every and each process of production.
rate and income distribution using the surplus approach along the lines proposed by Shaikh (1999, 2016) contributions.

2.3.2 Shaikh’s model of real exchange rate determination

The point of departure for Shaikh (1999, 2016) is the consideration of the real exchange rates as the international relative prices expressed in a common currency. Hence, the author uses the prices of production framework developed in the previous section to the study of real exchange rate. Using the previously presented framework to the analysis of the determination of relative prices between two countries, i.e. the real exchange rate, the system of equations described in the previous section can be re-written as:

\[ p_1^0 = (p_1^0 a_{11} + p_2^0 a_{21}) (1 + r) + p_2^0 w l_1 \]  
\[ p_2^0 = (p_1^0 a_{12} + p_2^0 a_{22}) (1 + r) + p_2^0 w l_2 \]  
\[ p_1^* = (p_1^* a_{11} + p_2^* a_{21}) (1 + r^*) + p_2^* w^* l_1^* \]  
\[ p_2^* = (p_1^* a_{12} + p_2^* a_{22}) (1 + r^*) + p_2^* w^* l_2^* \]

Where E is the exchange rate defined as number of units of foreign currency (*) per unit of domestic currency \( E = \frac{\text{units of foreign currency}}{\text{unit of domestic currency}} \). Assuming that: (i) after the opening up of international trade there is a complete specialization between countries; and (ii) that due to having lower reproducible costs in each sector, the domestic country ends up exporting commodity 2 and the foreign country exports commodity 1, then each country determines the international price of the commodities it exports. In this scenario, the above price system (represented by equation (2.3.7) to (2.3.10)) collapses to those equations which arise from international competition between capitals, i.e. equations (2.3.8) and (2.3.9) in the above system. Furthermore, if we assume that under free international trade conditions and negligible transportation costs that tradable goods are subject to the Law of One Price (i.e. \( p_1^0 = p_1^* \) and \( p_2^0 = p_2^* \)), the system above can be rewritten in terms of relative prices by dividing both equations by \( p_1^0 \) as:

\[ 1 = \left( \frac{p_2^0}{p_1^0} a_{11}^* + \frac{p_2^0}{p_1^0} a_{21}^* \right) (1 + r^*) + w^* l_1^* \]  
\[ \frac{p_2^0}{p_1^0} = \left( a_{12} + \frac{p_2^0}{p_1^0} a_{22} \right) (1 + r) + w l_2 \]

This price system is also structurally identical to the national case with different profit rates across sectors presented in the previous section, equations (2.3.1) and (2.3.2). Again, given the technical coefficients and real wages, we have a system of two equations with three
independent variables: in this case, the international terms of trade $\left( \frac{p_2^E}{p_1^E} \right)$ and two national profit rates. As such, this configures an undetermined system and, hence, it allows for alternative ‘closures’, that is different choices to which variable is assumed to be determined outside the system.

As Shaikh (1999) argues, the ‘closure’ adopted by neoclassical theory is to assume that the international terms of trade are the independent variable, determined by some other set of relations outside the price system, which in turn determine the two national rates of profit. And, in accordance with the principle of comparative advantage, the terms of trade are assumed to move to restore the equilibrium in the international trade balance.

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 which 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, according to Quantity Theory of Money (QTM), would lead to a decrease in prices. The 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, changes in the real exchange rate would only come to rest when it has 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.

Alternatively, 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 would highlight that the inflow (outflow) of funds generated by an initial trade surplus (deficit) would raise (lower) liquidity in short term financial markets, reducing (increasing) interest rates. 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 equalized.

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61 In this simplified economy of only 2 commodities, full specialization, and no capital flows, is analogous to the real exchange rate.

62 In Harrod’s (1939) reasoning trade balance would be affected through a positive response of investment to the lower interest rate, as investment would increase output and imports.
balanced. In this sense Shaikh asserts: “Trade imbalances are self-covering, not self-correcting” (Shaikh, p.55, 2014, italics in the original).

The assumption drawn from comparative advantage theory type of closure, i.e. that changes in relative prices (such as real exchange rate) are able to re-equilibrate trade imbalances, disregard the tendency of countries to display low export and import price elasticities (a non-satisfaction of the Marshall-Lerner condition\textsuperscript{63}), especially in the context of growing importance of Global value Chains (GVC)\textsuperscript{64} (Ahmed et. al., 2015). Shaikh (1999), however, addresses a more fundamental critique- the effect of the change in the real exchange rate on the rate of profit in each country. In the scheme above, a change in the real exchange rate would lead to an imbalance (disequalization) between the domestic and the foreign profit rates. This fact can be highlighted by solving the price system given by equations (2.3.11) and (2.3.12) for \((1+r)\) and \((1+r^*)\):

\[
(1 + r) = \frac{p_2E}{p_1^*} - w^*l_2 \quad (2.3.13)
\]

\[
(1 + r^*) = \frac{1 - w^*l_1^*}{a_{11}^* + \frac{p_2E}{p_1^*}a_{21}^*} \quad (2.3.14)
\]

And taking the derivatives for each with respect to the real exchange rate:

\[
\frac{d(1 + r)}{d\left(\frac{p_2E}{p_1^*}\right)} = \frac{a_{12} + a_{22}wl_2}{\left(a_{12} + \frac{p_2E}{p_1^*}a_{22}\right)^2} > 0 \quad (2.3.15)
\]

\[
\frac{d(1 + r^*)}{d\left(\frac{p_2E}{p_1^*}\right)} = \frac{a_{21}^*(w^*l_1^* - 1)}{\left(a_{11}^* + \frac{p_2E}{p_1^*}a_{21}^*\right)^2} \leq 0 \quad (2.3.16)
\]

While, on the one hand, an increase in real exchange rate\textsuperscript{65} \(\left(\frac{p_2E}{p_1^*}\right)\) will increase the domestic profit rate \((r)\) is clear, as highlighted by both the numerator and denominator being always positive in equation (2.3.15) (considering that all variables are strictly positive number for any economically meaningful system). The sign of effect on the foreign profit rate, given by equation (2.3.16), will depend on whether \(w^*l_1^* \leq 1\). However, note that if \(w^*l_1^* > 1\textsuperscript{66}, the rate of profit

\textsuperscript{63} Marshall-Lerner condition is considered to be satisfied when the absolute sum of a country's export and import price-elasticities of demand is greater than one.

\textsuperscript{64} With the emergence of GVC's an increasing amount of trade flows are composed of intermediate inputs. Hence, in these circumstances, an exchange rate devaluation would have a small effect in promoting exports, as at the same time it would make intermediate inputs used in production more expensive.

\textsuperscript{65} Depreciation of the domestic currency.

\textsuperscript{66} Which would imply a wage share higher than 100%.
would be negative. And, hence, typically such production technique would be economically unviable. Thus, leading to a conclusion that for feasible values of \( w^* l_1 \) the foreign rate of profits \((r^*)\) falls with an increase in real exchange rate \( \left( \frac{p_2^E}{p_1} \right) \).

Therefore, 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 in 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 international mobility of capital between countries, trade imbalances are bound to be a normal outcome of international trade among nations with different competitive positions.

It is important to highlight, though, that Shaikh disagrees with the assumption of uniformity of (average) profit rates within industries\(^{68}\) and with the determination of profit rates by interest rates adopted by Sraffians authors (as discussed in the previous section). Furthermore, he disagrees with the notion adopted by Sraffians of the monetary interest rate as a cost-component. In his view, although interest rate can serve as a lower benchmark for the profit rate, the division of the net operating surplus into interest and profit is determined by the “division between debt and equity” (Shaikh, p.260, 2016).

In Shaikh view, prices in capitalism are driven by what he refers to as real competition\(^ {69} \) which would be the central regulating mechanism of capitalism. The forces of real competition would cause two different effects in regard to the level of profit rates. On the one hand, competition within an industry is characterized by individual producers’ price-cutting behaviour in an attempt to gain market share and real competition leads to a roughly equalization between the prices set by each seller. As, at any point in time in a given industry, there will exist a different set of producers whose capital investments (on plant and equipment) were done at different periods, there will be a difference in cost structure between these (even if wages and working conditions are the same for all). And, hence, it is the same force of real competition, which tends to equalize selling prices, that lead to the co-existence of unequal profit margins and profit rates within sectors.

\(^{67}\) Appreciation of the foreign currency.

\(^{68}\) The uniformity of (average) profit rates within industries would derive from the assumption of only one method of production existing in any given industry (Shaikh, p. 298, 2016). However, this proposition can be related, in fact, with the Sraffian method of inquiry being concerned with discussing long-run ‘normal’ (steady-state) positions, where alternative ‘less-profitable’ methods of production would have been abandoned already.

\(^{69}\) In opposition with the definition used in neoclassical economics of perfect competition.
On the other hand, capital mobility across sectors, the other major principle of real competition, would produce a tendency of equalization of profit rates between the different sectors of the economy. However, Shaikh emphasizes that the equalization of profit rates would occur between, what he defines as, ‘regulating capitals’ and not between sectoral average profit rates. Considering that firms competitive pricing behaviour is characterized by under-cutting competitors, ‘regulating capitals’ would be the set of capitals (firms) representing the best generally reproducible conditions of production, the one with lower unit cost (at normal output level). As such, these would be the capitals which would remain profitable at the lowest possible price levels. Hence, price levels in each sector would be determined by the set of capitals (firms) representing the best generally reproducible conditions of production, the one with lower unit cost (at normal output level), with the rest of producers (capitals) being considered as price-followers. Consequently, competition between capitals between sectors would tend to equalize profit rates of ‘regulating’ capitals because these would be the ones that would be the focus of new investment. Hence, Shaikh (p. 268, 2016) defends the view that “the equalization process is turbulent, and ceaseless: it is gravitational process, not a state of equilibrium”. Despite the difference in explanations, emphasis and interpretations given by Shaikh in relation to the Sraffian variant of the surplus approach, both strands argue for the tendency towards equalization of profit (interest) rate as a central consequence of capitalist competition.

In the case of international trade and the real exchange rates, it follows that, due to the mobility of capital between countries, profit rates should tend towards equalization ($r = r^*$) between countries. And Shaikh (2016) argues that, due to international competition, the profit rate should be the distributive variable taken as given at the prevailing international level ($\bar{r} = \bar{r}^*$) for any given country:

\[
1 = \left( a_{11}^* + \frac{p_{2E}}{p_1^*} a_{21}^* \right) (1 + \bar{r}^*) + w^* l_1^* \tag{2.3.17}
\]

\[
\frac{p_{2E}}{p_1^*} = \left( a_{12} + \frac{p_{2E}}{p_1^*} a_{22} \right) (1 + \bar{r}^*) + w l_2 \tag{2.3.18}
\]

Following the Pasinetti (1973) vertically integrated sectors approach, Shaikh (1999, 2016) 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), for example, $p_2 w l_1$; direct unit profits (DUP), $1 + r$; and unit input costs (UIC), $p_1 a_{12} + p_2 a_{22}$. 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

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70 Which would depend also on the vintage composition of the capitals operating in the sector.
71 Or, more precisely, risk-adjusted profit rates should tend towards equalization.
into its different constituent elements. As this process continue, 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 \((v_{iULC})\) and its vertically integrated profit-wage ratio \((1 + \pi)\):  
\[
p_i = v_i \times (1 + \pi)
\]  
(2.3.19)

In this setting, the relative prices are expressed by:
\[
\frac{p_2 * E}{p_1^*} = \frac{(v_2 * E / v_1^*)}{Z} \left\{ \frac{(1 + \pi_2)}{(1 + \pi_1)} \right\}
\]  
(2.3.20)

Shaikh's (1999, 2016) argues that the profit-wage ratio \((Z)\) 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 what is being discussed is vertically integrated profit-wage ratios \((\pi_1, \pi_2)\), 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), Shaikh argues that their dispersion will tend to be much smaller.

The model derived so far involved only two tradable commodities, with each country specializing in the production of only one of them after opening up to international trade. Nevertheless, once we move to a multi commodity setting, in which non-tradable commodities are accounted for, Shaikh (2016) argues that it is necessary to distinguish the terms of trade from the real exchange rate \((RER)\), that is it is necessary to incorporate the Harrod-Balassa-Samuelson effect. Abstracting from differences in composition of the consumer price index in each country the real exchange rate following Shaikh (2016, p.519) the real exchange rate is, thus, defined as:
\[
RER = \frac{p_A * E}{p_B} = \left( \frac{v_2 / v_1^*}{V_{iULC}} \right) \left( \frac{P_{tA} * E / P_{tB}}{P_{tA} / P_{tB}} \right) \text{ Price ratio of non–tradable to tradable goods}
\]  
(2.3.21)

The form with which Shaikh introduces the role of the non-tradable into the price system which determines the real exchange rate, however, can be considered rather ad-hoc, as

\[72\] For a demonstration of this ‘Smithian’ decomposition used, please, see Shaikh (2016, p.385 to 387).

\[73\] As discussed in the previous section, however, the exact proportionality between relative unit labour costs and relative prices posed in the above expression would only hold if profit rate is equal to zero or, when profits are positive, if capital-labour ratios are uniform across sectors.
it is introduced in an *ex-post* manner to the derivation of the terms of trade. This approach implicitly embeds a view of the non-tradable commodity as a non-basic good, i.e. whose prices do not enter the price equations of other commodities because it is neither used as intermediate inputs, nor is a wage-good. As such, although Shaikh’s contribution brings to the forefront of the analysis the relationship between income distribution and real exchange rate, it is circumscribed to what happens within the tradable sector as analysed by the sectors unit labour costs. To fully grasp the relationship between changes in the real exchange rate and aggregate income distribution it is important to incorporate the non-tradable sector, exploring different patterns of input-output relationship that it might have with the domestic and foreign tradable sectors.

The empirical evidence presented by the literature\(^{74}\) that has applied Shaikh’s model shows that real unit labour costs and real exchange rate present similar long-run trends, where the unit labour costs appears to play a role of centre of gravitation around which the real (effective) exchange rate would fluctuate around. Below I present some empirical evidence of previous applications of this framework. Figure 2.2 and 2.3 shows the real effective exchange rate\(^{75}\) and adjusted real effective unit labour costs\(^{76}\) for US and Japan calculated in Shaikh and Antonopoulos (2013). Figure 2.4 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 it was 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 2.5 is from Antonopoulos (1999) and shows results for Greece when compared to twelve selected OECD economies.

In terms of econometric methodology, the empirical literature has applied rather similar methods to the BEER framework (reviewed in section 2.3). It uses cointegration tests to assess the existence of a long-run relationship between real exchange rate and explanatory variables, and econometric estimators such as vector error correction model (VECM) and autoregressive distributed lag (ARDL). However, rather than using directly the terms of trade (as is done in the BEER framework) it uses relative unit labour costs, which in this framework is understood to be the long-run determinant of relative prices and, therefore, of the terms of trade. Furthermore, in the econometric estimates, Antonopoulos (1999), Martinez-Hernandez, (2010, 2017), Ersoy (2010) and Shaikh and Antonopoulos (2013) include other variables in the model in order to

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\(^{74}\) A non-exhausting list of empirical applications of this framework covering both developed and developing countries, such as Japan, USA, Spain, Greece, Turkey and Mexico are Shaikh and Antonopoulos (2013), Napoles (2010), Antonopoulos (1999), Martinez-Hernandez (2010, 2017) and Ersoy (2010).

\(^{75}\) The term effective in ‘real effective exchange rate’ refers to the exchange rate of the dollar against a basket of currencies which represent US’s main trading partners.

\(^{76}\) 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.
track short-run influences such as interest rate differentials, in line with the results obtained by the literature of Behavioural Equilibrium Exchange Rate.

Figure 2.2: Real Effective Exchange Rate and Adjusted Real Effective Unit Labour Costs for the USA

Source: Shaikh and Antonopoulos (2013)

Figure 2.3: Real Effective Exchange Rate and Adjusted Real Effective Unit Labour Costs for Japan

Source: Shaikh and Antonopoulos (2013)
Figure 2.4: Real Exchange Rate and Real Unit Labour Costs in Mexico


Figure 2.5: Real Exchange Rate and Real Unit Labour Costs in Greece

Source: Antonopoulos (1999)

Overall 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.
Even though domestic (and foreign) demand and movements in the nominal 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 real 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 real exchange rate and economic growth.

Regarding the long-run behaviour of real exchange rate, the approach developed in this section provides further insights onto why real exchange rate 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. Moreover, it also provides a theoretical explanation to why PPP seems to hold in contexts 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 differentials the bulk of the adjustment in real exchange rate would be covered by a depreciation of the nominal exchange rate (Shaikh, 1999). As such, relative PPP would seem to hold.

Finally, this approach indicates two basic routes through which a country can increase its relative competitive position. A high road in which a country gains 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).

2.4 Summary

The concept of equilibrium lies at the heart of economic analysis since its inception, being a central organising concept of economic theorising in both Classical and Neoclassical schools of thought. The literature on International Economics, in general, and on Exchange

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77 There are only some branches of heterodox schools arguing against the usefulness of the use of “equilibrium” as central organising concept in economics, in particular strands of the post-Keynesian tradition (following the views exposed by Kaldor, 1972; and Robinson, 1956) and Austrian economics (for example see Hayek, 1968).
Rates, in particular, probably is one which makes more extensive use of equilibrium concepts than any other field of economics.

In this chapter I’ve analysed several different theories of real exchange rate equilibrium. In section 2.2, the review has focused on the approaches to estimate real exchange rate equilibrium used the literature on real exchange rate undervaluation and economic growth. Moreover, as one of the overall aims of this thesis is to analyse the relationship between income distribution and real exchange rate, the approaches reviewed in section 2.2 are contrasted with the approach developed by Anwar Shaikh, based on the Classical-Marxian Surplus approach, presented in section 2.3.

Overall, beyond the differences in theoretical backgrounds stemming from different schools of thought, the co-existence of a myriad of theories of exchange rate equilibrium maybe attributed to the myriad of ways that the concept of equilibrium has been used and abused in the economics. As has been highlighted by Austrian economist Fritz Machlup, through time “economists have used the notion of equilibrium in a variety of contexts and for a variety of purposes and on several occasions in proceeding from one topic to another some have failed to note transformations in the use made of it and in the meanings read into the terms” (Machlup, p.1, 1958). And, hence, he warned about the dangers to economic analysis that arises from the failure to differentiate between what he defined as descriptive, analytical, and evaluative conceptions of equilibrium78.

Probably, the most prominent use of the concept of equilibrium in economics has been its role as a methodological device in the development of abstract theory. It is one of the few concepts and methodological devices that transcended the move from Classical Political Economy to Neoclassical Economics79, in what can be referred to as the method of long-period positions. In this methodological framework, the concept of equilibrium is employed in connection with theoretical models containing a specified set of variables designed to analyse the connection between a chain of events triggered by a change in some variable. In this sense, following Machlup (1958) definition, equilibrium represents a state of affairs where the levels of the selected interrelated variables are so adjusted to one another that no inherent (endogenous) tendencies for the level of the variables of the model to change persists, i.e. the model reaches a new steady-state. As such, from an initial position of equilibrium a model, following a “disequilibrating” change, the model developed should tract analytically the

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78 The last two notions of equilibria are sometimes also referred in the literature as positive and normative conceptions of equilibrium.

79 At least until the move in some branches of Neoclassical analysis to the method of inter-temporal equilibrium, which have replaced the method of long-period positions by the notion of short-run consecutive equilibria.
reactions triggered, the adjusting changes, which would bring the variables to a “new” equilibrium level. In this sense, the equilibrium is seen as an attractor towards which the model (and the economic system, in the empirical counterpart) is expected to converge to or around which the system “gravitates” around. Hence, equilibrium has an analytical, positivist, connotation, which in principle is not supposed to have in-built value judgements.

At the theoretical level, this notion of equilibrium provides a great freedom of choice to the theorist in the construction of a model and the selection of the relevant variables. At this level, the main restrain is only its “internal” logical consistency, that is, whether conclusions derived are consistent with the stated assumptions; and with the interrelation of the chosen variables are plausible in light of observed reality in broad terms. As can be exemplified by multitude of existent theories of exchange rate equilibrium reviewed in this chapter, the criteria of what is to be considered the equilibrium is left wide open.

A different use of the term equilibrium in economics has been the use of the concept in a normative sense, where the connotation of equilibrium moves from an analytical device to an evaluative one. In this line, often the equilibrium assumes a condition of optimality or desirability, where the most evident case in the history of economic thought might be the case of Welfare Economics. In the case of the theories of real exchange rate reviewed in this chapter, this is explicitly the conception of equilibrium adopted in the Macroeconomic Balance Approach and Fundamental Equilibrium Exchange Rate (FEER) reviewed in section 2.2.4. In these approaches the embedded notion of equilibrium relies on the notion of internal and external balance, defined respectively as a situation there is a zero-output gap and current account equilibrium, with a sustainable net external (asset or liability) position.

The other theories reviewed in this chapter, in principle, follow an analytical, positivist, concept of equilibrium, where equilibrium is taken as an attractor. However, the definition of equilibrium in each of the approaches differ from one another. On the one hand, as portrayed by recent literature, the departing point from PPP (2.2.1) and its adjusted version to the role of non-tradables, the Harrod-Balassa-Samuelson effect (section 2.2.2), is of an arbitrage condition between the prices of commodities across countries should be equalized when expressed in common currencies. On the other hand, the Behavioural Equilibrium Exchange Rate (BEER) (section 2.2.3) and Shaikh theory (section 2.3.2) departs from an arbitrage condition for the real interest rate and profit rates, respectively, exemplifying what has been the great freedom of choice theorists have in defining the equilibrium conditions. Moreover, even though the BEER framework and Shaikh theory may come from different theoretical backgrounds, they share

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80 GDP level in line with the estimated Potential Output.
81 Or ‘sustainable’ deficit.
some similar features beyond the similar econometric techniques used in the empirical research of both theories. In particular, the role of terms of trade in explaining the behaviour of real exchange rates. However, while the BEER framework directly uses the prevailing level of the terms of trade, in Shaikh’s approach the unit labour costs of tradable commodities are used instead, as these are seen as the long-run determinants of the terms of trade. Hence, the time dimension of the notion of equilibrium implied by the BEER framework is much more directed to short-to-medium run, while in Shaikh’s the notion of equilibrium used refers more to the long-run.

In principle, differences between models and theoretical approach would be expected to be settled through empirical research. However, as it has been recognized since Meese and Rogoff (1983, 1988), exchange rates are one of the most difficult macroeconomic variables to predict using economic models. In many situations the models based on established economic theories have been unable to provide better insight than agnostic models based purely on a random walk, where analysts have been able to develop models which have a good fit to the data based on theoretical models discussed in this chapter, but are unable to produce good out-of-sample forecasts (Rossi, 2013). A situation which the advancement in computing power and research produced in the subsequent decades have been unable to provide much progress. As such, forecast of real exchange rates continues to be an empirical puzzle, especially at short time horizons (Rogoff and Stavrakeva, 2008). Consequently, the co-existence of multiple theories of real exchange rate equilibria is likely to persist over time.

One possible explanation for the adherence of the real exchange rate behaviour to its theoretical ‘fundamentals’ may be associated with the possibility that Central Banks, in open economies operating under relative free capital mobility of capital, still retain a certain degree of autonomy in setting short-term interest rates to levels different from those ruling in the rest of the world, as it has been emphasized by post-Keynesian literature (Smithin, 1994; Lavoie, 2000; Smithin, 2002). This view stands in contrast to what is implied by mainstream and Shaikh’s (1999, 2016) approaches discussed in this chapter. Moreover, with the empirical failure of PPP and UIP, changes in Central Bank’s interest rate would lead to changes in the real exchange rate. In this post-Keynesian perspective there would be no ‘natural’ equilibrium level to which the real exchange rate would gravitate towards. Contrarily, the real exchange rate would be determined politically by the Central Bank, as long as it has power to set real interest rates and sustain real interest rate differentials with other countries.

In light of the difficulty of forecasting real exchange rate behaviour based on established theories of real exchange rate equilibrium, estimates of real exchange rate equilibrium based on reviewed theories of real exchange rate have been used to a large extent as a qualitative tool to
assess and classify countries real exchange rates as ‘over’ or ‘under’ valued and relate it to broader economic outcomes, as it has been the case of the literature on real exchange rate undervaluation and economic growth discussed in Chapter 1. However, in doing so economic analysts fall into the trap long warned by Fritz Machlup, highlighted above, of proceeding from an analytical (positive) notion of equilibrium to an evaluative (normative) one without noticing the changes in meaning implied while making it. Hence, in Chapter 3, I go back to the beginning, to the writings of Gustav Cassel on PPP, in the late 1910’s and 1920’s, to demonstrate how the tension between different notions of equilibrium has been an issue since the outset in the history of exchange rate equilibrium theories.

Moreover, the literature on the effects of real exchange rate real exchange rate undervaluation on economic growth has used mainly estimates of equilibrium based on PPP adjusted for Harrod-Balassa-Samuelson effect to assess real exchange rate misalignments, with some papers also estimating misalignments using the BEER and FEER frameworks. However, if real exchange rates don’t exhibit tendencies to move towards equilibrium level estimated in these approaches, what might be happening is the failure of these approaches in capturing other variables that may explain the behaviour of real exchange rate and which may also be related to economic growth. In particular, the case of functional income distribution which has been related to real exchange rate level (as reviewed in section 2.3.2), but also have been for long associated with economic growth. Indeed, the relationship between functional income distribution and economic growth has been a central tenet in the history of economic thought, starting from the works of David Ricardo and Karl Marx, passing through the works of Michael Kalecki (1954, 1971) and being present in contemporary neo-Kaleckian literature, following the contributions of Bhaduri and Marglin (1990) and Blecker (1989). The approach developed by Anwar Shaikh (1999, 2016) and co-authors, reviewed in section 2.3.2, provides an interesting starting point for the analysis of the relationship between real exchange rate and functional income distribution. However, the price system used in Shaikh’s analysis consider economies composed only of tradable sectors, with the effect of relative prices between domestic tradable and non-tradable commodities being only subsequently added in an ad-hoc fashion. Hence, the conclusion regarding real exchange rate and income distribution derived from this framework relates only to what happens within the tradable sector. As such, in Chapter 4 I will focus on modelling explicitly the non-tradable sector and study the overall change in functional income distribution following a technical change in line with the Harrod-Balassa-Samuelson effect.
3. At the crossroads between economic theory and policy: Gustav’s Cassel evolving formulation of Purchasing Power Parity theory in the context political debate of the 1920’s

3.1 Introduction

As the review in chapter 2 emphasized, the notion of equilibrium assumes multiple meanings in economic literature of real exchange rate theories. And often, in their analysis, economists have jumped between different notions of equilibrium while using theories of exchange rate equilibrium, without noticing the implications to the meaning read into them (Machlup, 1958). In this chapter I will argue that this underlying tension in the use of the concept equilibrium in exchange rate theory has been present since its inception. From a history of economic thought perspective, this chapter illustrates this issue by reconstructing the development of Purchasing Power Parity (PPP) theory of exchange rate equilibrium by Swedish economist Gustav Cassel in the late 1910’s and until the early 1930’s. I will argue that at the heart of this tension in Cassel’s writing lies in the jump in use of the concept of equilibrium from a methodological device in the development of abstract theory, models, to a characterisation of concrete historical situations as one of equilibrium, which is key to transform the theoretical concept into an operational concept for economic policy.

The PPP theory was put forward by Cassel initially in 1916 to explain the ‘abnormal’ fluctuations of exchange rate across European countries and the United States during the 1st World War in the aftermath of the breakdown of the gold standard, where exchange rates between currencies had remained pegged to gold in the preceding half century. At a time of high levels of inflation and of volatility in exchange rates, Cassel (1916a) compiled estimates of theoretical exchange rates based on the ‘gold parity’ exchange rate prevalent before the War updated by the ratio of inflation between countries which would provide new reference values to understand the movements of exchange rates during this new era. Later, Cassel (1918) would coin the PPP terminology that would define these theoretical exchange rates ever since. With the formulation of PPP theory, Gustav Cassel’s name was elevated to world fame.

After the War, Cassel would participate in expert panels and contribute with written memoranda in important conferences organized by the League of Nations in Brussels in 1920 and in Genoa in 1922 that tried to resolve the major economic and political issues facing Europe such as the resumption of the gold standard. In these debates, Cassel (1921) would argue vigorously against the proposals of a return to pre-war nominal gold parities as the return to

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82 Explicitly endorsed by Keynes, as editor of The Economic Journal, in a comment at the end of the paper. Not a usual feature at the time.
them would require a delicate policy of deflation, which would lead to a recession due to the burden placed on debts accumulated during the period of inflated prices prevalent during and after the War.

Cassel's central argument was that the fluctuations of exchange rates were caused by the different levels of inflation observed in countries during the War. In its turn, inflation had been caused by the increase in the money supply due to the increasing public requirements to finance the war effort, in line with the Quantity Theory of Money (QTM). Hence, there would be one equilibrium level nominal exchange rate between two countries consistent with each level of relative supply of money and real output. From an initial position of equilibrium, where nominal exchange rates were fully adjusted, a change in the supply of means of payments (not justified by an increase in the supply of commodities) would trigger adjustments, changes, in the price level and in the exchange rates towards the new equilibrium position. The new equilibrium of the nominal exchange rate level would be given by the initial rate multiplied by the quotient of inflation observed in each country and would be the appropriate base to set new gold parities as countries attempted to return to a gold standard after the war.

As the modern originator and one of the fiercest advocates of the theory of the PPP theory as the most relevant factor in explaining the behaviour of exchange rates, Gustav Cassel has been at the forefront of much of the criticisms directed towards PPP over time. As reviewed in Chapter 2, critics have for long claimed that PPP theory fails to consider several factors beyond commodity arbitrage that would influence exchange rates such as non-tradable commodities, capital flows, terms of trade, among other temporary factors. Authors like Bresciani-Turroni (1934), Viner (1937), Balassa (1964) and Samuelson (1964), among others, were all critical of Cassel. However, authors such as Holmes (1967), Humphrey (1979) and Moosa (1999) claim that the version of PPP theory used to criticize Cassel misrepresents his own understanding of PPP theory, which was based on the QTM and Comparative Advantage theory, and that he had acknowledged many of the criticisms raised in subsequent literature.

Although both critics and supporters of Cassel draw evidence for their interpretations of what Cassel really meant by the PPP theory from Cassel's own writings, they tend to take Cassel's view in isolation from the literature at the time, and as immutable across the time span of almost two decades. In doing so, previous contributions dismiss the possibility that Cassel's own understanding and main use of PPP may have actually evolved in light of criticisms received at the time and of the empirical evidence. The analysis conducted in this chapter of Cassel's writings on PPP over the course of two decades will reveal the evolving nature of the concept of equilibrium adopted by him in his formulations and the different meanings read into the PPP theory of exchange rate equilibrium.
While initial empirical evidence, reported by Cassel (1916), would appear to support Cassel’s view, from the latter part of the 1st World War onwards the behaviour of some exchange rates seemed to diverge consistently from PPP levels. Either due to these results or to emerging criticisms to PPP theory, fact is that after 1918 Cassel would progressively introduce an increasing number of auxiliary assumptions to his formulation of PPP theory. Beyond the inclusion of qualifying statements pointing to causes of temporary deviations of exchange rates from PPP, Cassel would amend the formulation of PPP theory with the inclusion of four key assumptions: (i) unilateral hindrances to trade; (ii) PPP indexes should be calculated starting from a base period in which there had been a certain equilibrium in international trade; (iii) constancy of relative prices; (iv) no international capital flows\(^83\). Moreover, instead of mere clarifications of previously held views, I argue that these assumptions later introduced in his presentation of PPP theory were in fact a reaction to several points raised in the academic debate of his time; especially considering that some of these were raised in journals to which he was a regular contributor at the time, such as ‘The Economic Journal’\(^84\), and from other key economists at the time such as Hawtrey (1919) and Keynes (1923).

Even though throughout the 1920’s Cassel would, at times, concede that exchange rates would only converge to levels consistent with PPP under restrictive conditions and, hence, it didn’t necessarily represent the equilibrium of exchange rate in a positive sense; he would continue to argue that PPP constituted, in what can be characterized as, a normative equilibrium of exchange rates. The insistence on a determinate empirical equilibrium value for the rate of exchange by Cassel can be categorized as, what Machlup (1958) defined as a fallacy of ‘misplaced concreteness’, while his advocacy for the use of PPP in the determination of new gold parity levels, despite his own acknowledgements of other relevant factors affecting exchange rates, can be characterized as ‘disguised politics’ (Machlup, 1958). Ultimately, this behaviour would draw much of the criticisms received by Cassel at the time, by the likes of Taussig (1927), Hawtrey, (1928[1919]) and Viner (1937).

Considering these issues, a central question that motivates this chapter is: how can one, from a history of economic ideas perspective, rationalize the changes in Cassel’s own interpretation and use of the Purchasing Power Parity theory? Were the changes introduced by Cassel no more than an attempt to evade falsification of the main hypothesis of his theory? Or

\(^{83}\) All of which are issues that are at the centre of later criticisms directed at him and PPP reviewed in chapter 2 such as the ones raised by Samuelson (1964) and Balassa (1964) and Shaikh (1980), respectively.

\(^{84}\) However, it is necessary to note that these connections are, to a certain extent, inevitably speculative, as unfortunately Gustav Cassel was not known to cite other authors, neither tended to acknowledge contributions or to directly respond to criticisms received from specific commentators, in most cases, as commented previously by multiple authors, see Brems (1989), for an example.
can one rationalize Cassel’s efforts as an attempt to provide his formulation of PPP doctrine with ‘internal’ theoretical consistency as an attempt to retain the unrefuted content of the theory, as he tried to advocate the use of PPP indexes as a sound basis for the establishment new gold parities in the 1920’s?

To approach these questions this chapters applies Imran Lakatos (1970) Methodology of Scientific Research Programmes (MSRP) framework to rationally reconstruct the history of the Purchasing Power Parity theory in Gustav Cassel’s work. In the MSRP framework the process by which a falsified auxiliary assumption is replaced by a new one becomes the key criterion of appraisal of whether a research programme is degenerating or not. Hence, it is a useful framework to rationalize the evolution of PPP theory in Cassel’s work, its rise to prominence in the public and academic debate in the aftermath of the First World War, as well as its subsequent downfall.

Thus, the remaining sections of this chapter are structured as follows: In section 3.2, I briefly present Lakatos’ Methodology of Scientific Research Programmes (MSRP) and how one could adapt it to the context of analysing specific doctrine and theories. In section 3.3, I review the writings of Cassel, highlighting the most important changes introduced in his presentation of PPP theory, relating these to contributions made in the literature at the time. Section 3.4 seeks to situate the formulation of PPP theory within Cassel’s overall research programme in economics and to provide an overall assessment of the evolution of the PPP theory in Cassel’s work under the MSRP framework. Section 3.5 places Cassel’s formulation and use of PPP theory into historical context. The chapter closes with section 3.6 which provides some concluding remarks.

3.2 Methodology of Scientific Research Programmes and Rational Reconstructions

As noted in the introduction, it is the aim of this chapter to use a modified Methodology of Scientific Research Programmes (MSRP) framework, as applied in works such as Leijohnhufvud (1976) and Fulton (1984), to formulate a rational reconstruction of the evolution and change experienced by Cassel in his formulation of PPP theory. This approach will hopefully produce a new improved history and understanding of the evolution of PPP theory in Cassel’s economic thought.

Contrary to previous accounts of Cassel’s view and understanding of PPP, a careful review of his writings and of his contemporaries reveals that Cassel’s presentation of PPP doctrine evolved significantly from its early formulations during the 1st World War throughout the 1920’s. After enjoying wide acceptance at first, the PPP doctrine would be at the centre of
the debate and would receive increased scrutiny on both empirical and on theoretical grounds. These events led Cassel to provide several reformulations of the theory and clarifications of what he understood PPP theory to be. Thus, from a methodological stance what is required is a framework comprising of a set of concepts and tools which will enable us to rationalize this process. A modified MSRP framework is particularly useful to the appraisal of economic theories in this context, as it provides a vocabulary and a set of concepts which enables us to better understand the development, maturation and decline of ideas in science. To this end, this section seeks to present the key elements of this framework and address the key question, when trying to apply Lakatos framework to economics, of defining at which level a research programme is perceived to exist.

In Lakatos framework, research programmes would be subdivided in its ‘hard-core’ and ‘positive heuristics’ components. The former contains the fundamental characteristics which shape the research programme- the set of principles to which all those working in that programme subscribe. The latter can be understood as a normative hard-core, which provide some basic guidance on how to modify the ‘refutable’ variants of the research programme; it would establish some ‘rules of the game’ on how to modify and sophisticate the ‘refutable’ protective-belt. Though, it is important to note, that the ‘positive heuristic’ component is as essential as the ‘hard-core’ for a research programme, “it cannot be given up without giving up the program itself” (Latsis, 1976, p.16). Lastly, a research programme would be complemented by a ‘protective belt’ of propositions, auxiliary hypothesis and assumptions which would constitute the flexible part of the research programme, containing the non-essential elements which could be abandoned or replaced without giving up the specific approach as explanation or prediction of the phenomena at hand.

As Vint (1994) argues, in applying Lakatos MSRP framework to economics, there has been broadly two different approaches to how a research programme can be characterized, that is, at which level it is perceived to exist? A first approach, as understood in the works of Latsis (1976) and Blaug (1976), is to build the hard-core of the research programme around general propositions emphasizing the role of rational self-interested economic behaviour of agents as the central unifying element of the programme. The protective-belt, in its turn, would then be comprised of theories or hypothesis developed from these hard-core assumptions. The second approach, which will be followed in this chapter, is to focus on particular branches of theory, and attempts to characterize the research programme and its associated ‘hard-core’ more specifically in terms of particular laws or principles.

According to Fulton (1984), Lakatos conception of the hard-core would differ from the ‘hard-core’ formulations in the style of Latsis (1976) and Blaug (1976). The formulations by these
latter authors would comprise of ‘presuppositions’, judgements about the behaviour of agents, while in Lakatos (1970) the examples of the ‘hard-core’ of Newtonian physics or Bohr’s research programme of light emission (in early quantum physics) would comprise of formal theoretical statements such as specific laws or axioms. Hence, every research programme would have a more specific formal ‘hard-core’ built against a background of some general presuppositions concerning the nature of scientific activity itself. Thus, it is based on, what Vint (1994) describes as, the Fulton-Leijonhufund interpretation of Lakatos MSRP framework that the analysis of Cassel’s Research Programme will be conducted throughout the remaining of this chapter. In this approach the elements of the hard-core are a series of lemmas (postulates, assumptions) which can be combined together to produce various theorems or predictions.

An important aspect of Lakatos’ concept of the ‘hard-core’ is the notion of irrefutability. But as Vint (1994) argues, these are irrefutable not because of their nature (consisting of value judgements or allegedly untestable behavioural assumptions), but because they are not to be tested as a result of a methodological decision of the members of the research programme. This approach leads to the decision that the anomalies must lead to changes only in the protective-belt of the theory, on its auxiliary ‘observational’ hypothesis and initial conditions which must be observed for the theoretical propositions to be valid. In contradistinction, in a ‘dogmatic’ falsificationist perspective the emergence of such anomalies (counter-examples) would require abandonment of the theory and (or) research programme. However, Lakatos would recognize value in strategies adopted by theorists, in certain circumstances, where core propositions of a theory are insulated from falsification by the introduction of suitable auxiliary assumptions (hypothesis) that act as ‘protective belt’. Thus, to appraise a research programme, what would be required would be the development of some methodological rules, in advance of the test, to guide the acceptance (or not) of what adjustment strategies would be acceptable in the defence of scientific theories; and what are the conditions for the rejection of the related hypothesis or theorem.

Hence, Lakatos’ proposition, building on Popper’s methodological falsificationism, would be to provide a new rationale for falsification and the criteria of appraisal for a theory to be regarded as scientific. In this sense, the falsification criteria could no longer be the mere existence of counter-examples and anomalies. A theory would be considered as falsified only when a new theory is developed, which is able to explain the success of the previous theory while also being able to explain what configured as anomalies, puzzles to the previous theory. That is, only when new theory displays an increased explanatory content relative to the previous
one, it will be able to supersede the previous one. In this framework, thus, falsification becomes an exercise of comparison of (subsequent versions of) theories, rather than one of mere comparison of theory with facts. Hence, the problem which one is faced with is - how to appraise the changes introduced in the formulation of theoretical propositions, that is, how one “sort out the genuine (or justified) defence manoeuvres from ad hoc ones?” (Latsis, 1976, p.10).

In ‘Proofs and Refutations’, Lakatos (1976) provided a typology which becomes a useful guide on how to analyse these strategies. In this work, Lakatos classifies the types of responses to counter-examples developed by theorists based on whether the amendments to the theory are ‘content-decreasing’ or ‘content-increasing’, i.e. if the new formulation of the theory became more restrictive or more general. Within the content-decreasing reactions, Lakatos describes five typical strategies: (i) method of surrender; (ii) monster-barring; (iii) monster-adjustment; (iv) exception-barring; (v) lemma-incorporation.

The ‘method of surrender’ involves the rejection of a theory as false in face of the anomaly. This method would be akin to the approach advocated by a ‘dogmatic’ falsificationist. The second alternative is to respond to the counter-example by the method of ‘monster-barring’. This strategy involves the rejection of the counter-example by engaging in a re-specification of definitions in such a manner that the “monster” is barred. Consequently, the counter-example is rendered invalid as it doesn’t meet the specification of the model. The third strategy is labelled as ‘monster-adjustment’, where one argues that the contradiction between the counter-example and the theoretical proposition is only apparent. The apparent contradiction is attributed to the empirical operationalization of the theory or at the auxiliary theories of the observation.

‘Exception-barring’ method, would be the inclusion of a list of exceptions with the theorem. The result is a more restricted theoretical proposition, but one is able to retain its true content, while insulating it from counter-examples occurring in specific scenarios. Yet, this strategy would be only justifiable if one is able to isolate the cases in which counter-examples arises while being unable to provide a theoretical demonstration that could explain the phenomena. The last strategy would be the method of lemma-incorporation. It improves on the ‘exception-barring’ by employing a ‘demonstration analysis’, where the theorist is able to determine a lemma which is able to explain why the theoretical propositions is not able to explain the counter-example. The inclusion of the lemma to the theorem yields a consistent

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85 That is, when a new theory T’ is able to explain the previous success of theory T (i.e. retaining the unrefuted content of T) while also being able to explain the previous ‘counter-example’ with its reformulation.
definition, unaffected by the counter-example, but still at cost of a (minimum) restriction in its range.

Lakatos would contrast the above ‘content-decreasing’ reactions to anomalies with those which would be able to increase the empirical content of the theorem (‘content-increasing’). That is, new theoretical formulations which would be able to retain the former’s unrefuted content, while at the same time being able to turn the previous anomaly, counter-example, into a corroboration of the new theoretical formulation.

As Blaug (1976, p. 423) remarks, in a Lakatosian framework “we test theories, but we appraise research programmes”. In the face of anomalies, a research programme progresses developing subsequent versions of a theory, in which each subsequent formulation is the result of adding auxiliary clauses to the previous theory in order to accommodate some anomaly. In this context, the criterium of appraisal of the research programme is whether the introduction of new auxiliary hypothesis, which gives rise to a new version of the theory, can be interpreted as theoretically and empirically progressive. Thus, an evaluation of the strategies employed by Cassel in reaction to the anomalies faced by PPP, in light of Lakatos typology, is an essential element for the appraisal of the evolution of his research programme.

In the Lakatosian framework, the series of subsequent theories can be viewed as theoretically progressive if each new version has some excess empirical content over its predecessors, that is, if it is able to predict novel facts while retaining the unrefuted content of the previous theory. And, it would be deemed as empirically progressive if some of the new empirical content is corroborated by facts. Finally, a progressive research programme would, thus, be characterised if it is both theoretically and empirically progressive and degenerating if is not. If this series of theories can only be deemed as theoretically progressive but not empirically progressive, the problem shift represented by the reformulations is seen as ‘scientific’. And, as ‘pseudo-scientific’ if it cannot be deemed progressive in neither sphere.

With the elements of Lakatos MSRP framework presented in this section in mind, I move on to present Cassel’s work on PPP theory from 1916 to 1932, relating the changes introduced by him on the formulation of the theory to the academic debate present at the time surrounding his theory. The assessment of the changes introduced in PPP theory by Cassel in light of Lakatos MSRP framework will be discussed in section 3.4. This organization hopefully enables the reader to use the framework in its own way to assess the strategies adopted by Cassel in reaction to the anomalies faced by PPP theory, against which the reader is invited to compare the tentative interpretation provided in section 3.4.
3.3 The origin and evolution of PPP theory in Gustav Cassel’s economic thought

One of the aims of this chapter is to highlight that Cassel’s own view and presentation of PPP theory evolved significantly in light of the academic debate of the time and assumed different connotation in Cassel’s own writing. Starting from Cassel’s original formulation of PPP, this section documents the changes introduced in his presentations of PPP theory, relating these to criticisms and remarks made previously by the contemporary literature. In sub-section 3.3.1 I focus on Cassel’s original presentation of PPP theory. Sub-section 3.3.2 deals with the early qualifications introduced by Cassel, in particular the role of temporary factors and the role of unilateral hindrances to trade. Lastly, in sub-section 3.3.3 I discuss, what can, be classified as more fundamental changes in the assumptions introduced by Cassel, as these can be seen as having significantly restricted the scope of theory.

3.3.1 Cassel’s original formulation of PPP theory

References in the contemporary literature regarding the Purchasing Power Parity are, commonly, made to Cassel’s 1918 paper- ‘Abnormal Deviations of International Exchanges’, which is where Cassel first coins the term. Nevertheless, it is in a paper published at The Economic Journal in 1916 – ‘The Present Situation of the Foreign Exchanges’- where he first provides a concise formulation of the theory:

“(…) The theory of the foreign exchanges which I have given for some years in my lectures starts from the view that the rate of exchange is primarily an expression for the value in the money of one country put upon the money of another country. If we consider two countries, A and B, with independent paper currencies, the money of A can have value in B only on the ground that it represents buying power, or more generally paying power, in A. The price in B of the money of A will, therefore, be broadly proportional to the buying power of the money of A and will consequently stay in inverse proportion to the general level of prices in A. Further, the price in B will, of course, tend to be proportional to the general prices in B. Thus, the rate of exchange between the two countries will be determined by the quotient between the general levels of prices in the two countries.” (Cassel, 1916a, p.62)

It was two years into the first world war and with many countries de facto already out of the gold standard which gave an initial opportunity to Cassel to test his theory and the results presented by him regarding the exchange rate between the Swedish Krona and the British Pound.

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86 At least in the English language.
87 It is important to highlight that it is with a reference to the last phrase of this quotation that Balassa (1964) sustains that Cassel indeed formulate and proposed initially what has become known as the ‘absolute’ version of PPP hypothesis.
at that time left him hopeful of the validity of his theory. Furthermore, the view put forward by Cassel received an endorsement in a footnote at the end of the paper from Keynes, then editor of the journal. The introduction of the Purchasing Power Parity denomination to define his foreign exchange rate theory, though, would come only two years after\(^88\). In a very brief article published in 1918 in *The Economic Journal*, he writes:

“According to the theory of international exchanges which I have tried to develop during the course of the war, the rate of exchange between two countries is primarily determined by the quotient between the internal purchasing power against goods of the money of each country. (...) At every moment the real parity between two countries is represented by this quotient between the purchasing power of the money in the one country and the other. I propose to call this parity ‘the purchasing power parity’.” (Cassel, 1918, p.413, italics on the original)

### 3.3.2 Early modifications to PPP theory

In two papers published in 1916 (Cassel 1916a; 1916b) Cassel had compiled statistics on price levels and notes in circulation (money supply) for Sweden, England, France, Germany and Russia; and compared these with bilateral exchange rates of the Swedish Krona relative to the respective currencies of these countries which provided promising results that seemed to confirm his theory. However, by 1918 results for the case of Sweden and other economies were not so encouraging anymore. The evidence presented by Cassel (1918) remarks that even though England had faced a lower inflation rate since 1914 than Sweden. Nevertheless, rather than devaluating, as it would be predicted by PPP theory, the Swedish Krona had appreciated relative to pound. This situation required further explanation from Cassel in defence in his theory. Therefore, Cassel would start to introduce further qualifications to his exposition of PPP theory.

To this end, Cassel (1918) poses free trade as a sufficient condition for the exchange rates to converge to the value given by the parity, which evidently wasn’t the prevailing situation during the war. However, Cassel highlights that even in the case when mutual (equivalent) restrictions to trade are imposed by both countries the exchange rates wouldn’t be able to deviate from the purchasing power parity. It would be only in the case of restrictions to trade being imposed by one side that would cause exchange rates to deviate from the PPP:

“If the trade between the two countries is hampered more severely in one direction than in the other the rate of exchange will deviate from its purchasing power parity. If the imports of a country is more severely restricted than its exports the consequence will be that foreign money will sink in value, as claims in such money will be comparatively easy to procure, but difficult to make use of.” (Cassel, 1918, p.413)

The introduction of unilateral restrictions to trade would be exactly the case of neutral economies vis-à-vis the belligerent countries during the war. As the war progressed the belligerent nations had increasingly imposed restriction on exports of commodities. This movement sought to increase the supply of goods to the domestic market and limit scarcity of commodities, and it would explain, for example, the deviations from the PPP in the exchange rate between the Swedish Krona and the British Pound\(^89\) observed in the 2\(^{nd}\) half of the War, in Cassel’s view.

In 1919, with another article on *The Economic Journal*, Cassel returned to the topic of abnormal deviations of exchange rates to grant further concessions to situations where exchange rates would deviate from the PPP equilibrium due to the developing sharp depreciation of the German Mark. In this paper, Cassel emphasizes that exchange rates would deviate from PPP norm (i) in cases where governments must procure foreign exchanges, regardless of costs, in order to be able to face international debt payments\(^90\), for example; (ii) due to speculation in the foreign exchange market; and (iii) expectations regarding the currency’s internal future purchasing power, in which traders in the foreign exchange market would anticipate the movements in the inflation rate.

However, all of these situations would lead to temporary (short-run) deviations of exchange rates from values given by PPP. As such, as long as there were no unilateral restrictions to trade the deviation of the exchange rate levels from the ones consistent with PPP would stimulate exports (imports) in the country whose currency would be undervalued (overvalued), increasing the demand for its currency, raising its value and, hence, restoring foreign exchange rate equilibrium. It would be during the course of the 1920’s that Cassel would recognize and

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\(^{89}\) To better understand the importance of this for Cassel one should bear in mind Cassel’s view regarding the value of money. For Cassel demand for currency (either domestic or foreign) derives from their purchasing power of desired commodities. If country A, for example, imposes a restriction for buyers from country B to purchase goods produced in A the demand for that currency in the FX markets would, consequently, fall. If in the other hand demand from buyers from Country A for commodities produced in B remained high and unaffected by trade restrictions a mismatch between supply and demand for currency of country A would be inevitable and, therefore, its value as measured in terms of currency of country B would fall.

\(^{90}\) As would apparently be the case of Germany at the time.
try to deal with more fundamental critiques to the PPP theory and misconceptions which were emerging in debate, as PPP theory became more popular after the War.

### 3.3.3 From minor modifications to the introduction of fundamental changes in the formulation of PPP theory

The early 1920’s marks Cassel’s rise to prominence as an international authority on monetary issues. In the years after the War, Cassel’s work and PPP theory would become widely used and subject of intense scrutiny in the policy and academic debate. In the United States, Cassel’s work would be subject of a symposium published in *The Annals of the American Academy of Political and Social Science* where a paper by him (Cassel, 1920b) would receive reviews by several economists, ranging from central and private bankers to academics like Irwin Fisher (1920). In September 1920 Cassel would play an influential role as a member of the expert committee in the Brussels International Financial Conference organized by the League of Nations, to which Cassel contributed with the most widely read and discussed memorandum on ‘The World’s Monetary Problem’91 92. In this piece Cassel would defend the use of PPP theory to calculate new exchange rates equilibria as a basis for countries to set new gold parities of their currencies. This memorandum, together with a second drafted by Cassel for the 1921 League of Nations meeting would be reprinted in book format in the following year (Cassel, 1921) and would be the base material of the views exposed in his famous ‘Money and Foreign Exchange after 1914’, published in 1922.

Beyond Irwin Fisher’s (1920) review, several of the most influential economists of the time93 would weigh in and discuss the merits and the shortcomings of Cassel’s formulation of PPP; and (or) provided their own interpretations of the theory. Consequently, Cassel (1922) provides important responses and clarifications to criticisms received by PPP theory. In particular, for the purposes of this section, three aspects deserve closer attention due to the broader implications that they constituted to the theory and its empirical evidence: (a) a clear differentiation between what is nowadays referred to a ‘Absolute’ and ‘Relative’ formulations of PPP theory; (b) the role of non-tradable commodities and, consequently, which price index would be more suitable to calculate PPP indexes; and (c) the role of capital flows.

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91 Originally published in Vol. V. of the Proceedings of the Conference, this memorandum, together with a second drafted by Cassel for the 1921 League of Nations meeting would be reprint in book format in the following year, see Cassel (1921).

92 The success of Cassel’s memorandum is also exemplified by Siepmann’s (1920) account that the version, in English, of the memorandum was already out of print, with no more copies available, when the time came for it to be used by the conference in Brussels. For a brief, but thorough, overview of the issues discussed, and positions defended by delegates at Brussel’s conference also see Siepmann (1920).

93 Like Hawtrey (1919), Pigou (1920, 1922), Bickerdike (1922), Agnell (1922), Keynes (1922, 1923) and, of course, Wicksell (1919).
(a) ‘Absolute’ and ‘Relative’ PPP

By the early 1920’s, with a widespread discussion of the theory, multiple calculations, by supporters and critics, of PPP theory, using different sources and price-indexes, from multiple countries were becoming usual. On the one hand, while supporters would consider deviations of exchange rates from PPP as special cases, as a temporary phenomenon or attributing them to the inadequacy of the coverage of existing price-indexes. On the other hand, critics used these deviations as evidence of the fallacy of PPP as a positive theory of exchange rate determination (Anderson, 1920). This wide-ranging debate may have led Cassel to respond to some of the criticisms that his theory had received and comments about misconceptions that he had identified in some of the works at the time that have calculated PPP, although as usual he does not make direct reference to any of them. In particular, one issue taken by Cassel (1922) was with the way to calculate what would the PPP equilibrium exchange rate:

“People want to determine by direct means the quotient of the purchasing power parity of money in the respective countries, and to regard this quotient as the normal level of the exchange rates. But the problem is not so simple. It is only if we know the exchange rate which represents a certain equilibrium that we calculate the rate which represents the same equilibrium at an altered value of the monetary units of the two countries. Now the exchange rates prevalent during the gold standard régime before the War manifestly correspond on the whole to a certain general equilibrium of international trade. If we suppose this equilibrium to have been unaltered- or at any rate not so altered as to disturb the exchange rate- then, on the basis of the exchange rates ruling before the War, and with our knowledge of the degree of inflation of the different currencies, we can calculate the purchasing power parities which are to be taken as the normal exchanges between the paper currencies of today.” (Cassel, 1922, p.142)

This formulation differs from the one given, at earlier stages, in Cassel (1916) and Cassel (1918) by explicitly condemning the direct use of the quotient of the prevailing price levels in two countries at any given point in time to establish the equilibrium exchange rate, as would be implied by an ‘Absolute’ version interpretation of PPP theory. Cassel amended definition of PPP theory would be based on inflation differentials, like in modern ‘Relative’ PPP formulations. However, one would need to depart from base period which can be taken as one where a certain equilibrium of international trade had existed.

Cassel’s analysis here clearly follows the conception of equilibrium typical of economic theory, as argued by Machlup (1958), where starting from an initial position of equilibrium a

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94 A point raised by Pigou (1920) which would receive subsequent attention in the literature in the early 1920’s.
disequilibrating change (different levels of inflation) leads to adjusting changes (in the exchange rate) until the variables in the model (prices in each country and exchange rate) are fully adjusted to a ‘new’ equilibrium. However, as he tries to characterize the concrete situation of the exchange rates prevailing before the War as one of equilibrium of international trade, he incurs, in what Machlup (1958) defines, in a fallacy of ‘misplaced concreteness’. As much as the concept of ‘equilibrium’ would be useful and central to development of abstract economic theory, for Machlup (1958) it would be ill suited to the characterization of historical situation and, hence, the association of “a concrete situation ‘observed’ in reality as one of ‘equilibrium’ is to commit the fallacy of misplaced concreteness” (Machlup, p.12. 1958). In Cassel’s case, with the formulation of PPP theory, this occurs not only due to the particular difficulty in characterizing a historical situation as one of equilibrium, but also to the fact that no other changes which could influence exchange rates had taken place between the initial and final period of analysis. This last point would lead Cassel to make further necessary qualifications in regard to the role of changes in relative prices, to which I now draw attention to.

(b) Incorporating the assumption of no changes in relative prices

As mentioned, since the proposition of the theory by Cassel (1916), PPP theory gained wide popularity, while, concomitantly, began to be scrutinized by contemporary economists. And one issue in particular that was of concern in the debate was the role of changes in relative prices between exported commodities vis-a-vis the general level of prices and, consequently, which price index would be more suitable to calculate the new exchange rate equilibrium under inflation of currencies95.

In a reply in *The Economic Journal* to criticisms made by Van Dorp (1919), Cassel (1920a)96 acknowledged that if prices of exports had risen more than the general price level, exchange rates of equilibrium could lie below the ratio given by PPP calculations. However, the full implications of this effect to his theory would only be more thoroughly acknowledged in 1922:

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95 See, for example, the discussion and arguments made by Hawtrey (1919), Van Dorp (1919), Pigou (1920), Agnell (1922).
96 The reader is here referred to a note written by Cassel which is appended at the end of his main article.
"If in each country prices are unaltered in their relation to one another, but have only undergone a common rise, then there is nothing to prevent our supposing the balance of trade between the countries to be unaltered. The equilibrium of the exchanges must, then, have been dislocated in the manner shown by the ratio of the deterioration of money in the two countries. If, on the other hand, the different prices have moved in their relation to one another, this circumstance may possibly in itself have affected the equilibrium of international trade and have caused some dislocation in the equilibrium of the exchanges." (Cassel, 1922, p.141 and 142)

Therefore, if relative prices within one country change and if these changes in relative prices between countries were to differ, then equilibrium exchange rates would be different from the rate calculated based on the old parity adjusted for relative inflation as professed by his PPP calculations. Important to note here, as shall be more extensively discussed in section 3.4, is the view that the equilibrium exchange rate is the one consistent with equilibrium in international trade. Hence, as relative prices between tradable and non-tradable commodities changed international trade equilibrium would be distorted altering with it the equilibrium exchange rate level. As such, in the presentation of PPP theory, Cassel (1922) explicitly introduces the assumption of no changes in relative prices:

“Our calculation of the purchasing power parity rests strictly on the proviso that the rise in prices in the countries concerned has affected all commodities in a like degree. If that proviso is not fulfilled, then the actual exchange rate may deviate from the calculated purchasing power parity.” (Cassel, 1922, p.154)

However, it is important to note that, contrary to other factors previously highlighted by Cassel, this would be a factor which would cause exchange rates to deviate persistently from the rate given by the PPP. Although, Cassel doesn’t make specific reference to the role of non-tradable, he must have been well aware of the argument which would become the cornerstone of the contributions of Harrod, (1933), Balassa (1964) and Samuelson (1964). After all, the distinction between tradable and non-tradable price movements was at the core of Van Dorp (1919) criticisms97, as well as in Pigou’s (1920, 1922) discussion of PPP theory98. The proposition that PPP ratios should be calculated solely on the basis of tradable commodities would, however, never be endorsed by Cassel:

97 As stated by Van Dorp: “we have to divide the price-level in each country in two sections: one section represents the prices of those commodities which are still an object of international trade, the other the prices of those goods which cannot be exported or imported. These latter prices move quite independently in every country. If we want to measure the fall of exchange by the index number, we can only use the prices of the former commodities. This may answer for the anomaly which Prof. Cassel observed.” (Van Dorp, 1919, p.501)

98 All three published in *The Economic Journal*, to which Cassel was a consistent contributor at the time. Similar reasoning can be found in Hawtrey’s 1st edition of *Currency and Credit*, published in 1919.
“Some people believe that Purchasing Power Parity should be calculated exclusively on price indices for such commodities as form the subject of trade between two countries. This is a misapprehension of the theory. There is never any definite group of commodities that can be exported. Even a small alteration in the rate of exchange restrict the group of exportable goods. (...) The whole theory of Purchasing Power Parity essentially refers to the currencies concerned and variations in this value can be measured only by general index figures representing as far as possible the whole mass of commodities marketed in the country” (Cassel, 1928, p.33)

The reliance on using general price indexes, reveals once more that the theoretical basis for Cassel was his adherence to the QTM, i.e. change in price levels accrues primarily from changes in the quantity of means of payment. This would contrast to the interpretation given to PPP by Van Dorp (1919), Pigou (1920, 1922), Agnell (1922), and later by Keynes (1922, 1923), which would present PPP as an arbitrage condition, a generalization of the Law of One Price. Nevertheless, this position sustained by Cassel was at odds with his own explanation of why foreign currencies are demanded in the first place:

“(…)What is the principal reason for a foreign currency being in demand, and what effect has an alteration in the intrinsic value of that currency upon the demand for the same? Our willingness to pay a certain price for foreign money must ultimately and essentially be due to the fact that this money possesses a purchasing power as against commodities and services in that foreign country. On the other hand, when we offer so and so much of our own money, we are actually offering a purchasing power as against commodities and services in our own country.” (Cassel, 1922, p.138)

If the demand for foreign currency arises from demand for commodities which can be imported, wouldn’t be the price of these tradable commodities the ones which would affect the demand for foreign currency? And consequently, be the ones used to calculate the PPP?

(c) **Incorporating the assumption of No Capital Flows**

A last important thing to note while looking at Cassel’s view of demand for foreign currency while discussing PPP\(^99\) theory, is that he reduces the demand for a foreign currency to a demand accruing from the need to pay for imports of commodities. In doing so, Cassel completely disregards demand for foreign currency by investors and speculators, which would demand a foreign currency based on the purchasing power that this would grant them against a stock of assets and securities in this foreign country. For investors and speculators, their demand for foreign currency would take into consideration profits possibilities, taxes paid, and

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\(^{99}\) Although, in other parts of his work he would refer to possibilities of financing of trade balances through deferral of payment, discounting liabilities and proper loans (Cassel, 1923 [1918], p. 488-489)
risks associated with the investments made in the foreign country, not what purchasing power it possesses against a flow of commodities and services (Keilhau, 1925).

Although, this point may seem trivial at first it is quite important for Cassel’s explanation of the market mechanisms which ensures that exchange rates converge back to equilibrium if it is initially above the PPP ratio. Such an overvalued exchange rate, as it stimulates imports and reduce exports, would increase demand for foreign currency while reducing its supply (due to lower receipts from exports), in its turn this would lead to a devaluation of the exchange rate, re-establishing the exchange rate at the level consistent with PPP\(^{100}\). Implicit in Cassel’s argument was the assumption that imports, and exports could not be financed through foreign credits and, thus, wouldn’t generate counteracting capital flows, which would prevent the movement of the exchange rate back towards the PPP level. This is a point raised by Van Dorp (1919), which sets up a simple example where excess imports were funded by a foreign loan. Wicksell (1919), Keilhau (1925), Terborgh (1926)\(^{101}\) also emphasize the lack of treatment of capital flows in Cassel’s analysis of exchange rates, leading Keilhau (1925, p.225) to suggest provocatively that PPP theory should be rebaptise as “the doctrine of commodity parity”\(^{102}\). Indeed, as Wicksell (1969\[1919\], p.245) argues:

> “an excess of exports ought not, by itself, to lower our rates of exchange\(^{103}\) with other countries if, in one way or another, we are offered sufficiently high rates of interest over there to induce us to carry over our claims for the time being. (…) Once that point has been reached everything will remain in equilibrium, including the balance of payments, in spite of the continued excess exports.”

A view which reinforces Shaikh’s criticism reviewed in Chapter 2 that trade imbalances are not self-correcting, but instead self-covering. It would be, only, in 1928, in a lecture delivered at the University of Chicago as part of series of lectures by invited speakers on Foreign Investments\(^{104}\), that Cassel would explicitly acknowledge the requirement of an extra assumption of no capital flows for his Purchasing Power Parity theory to be valid. The

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\(^{100}\) References to this classic mechanism of equalization can be found in almost all of Cassel’s texts regarding PPP. For an example, “It is likewise obvious that every deviation of the true exchange rates from the purchasing power parities must cause considerable disturbances in international trade. The export from A to B must be largely checked if B’s currency is valuated lower in A than what would correspond to the general price level in B compared with the price level in A. At the same time the import from B to A would be artificially stimilated by such a valuation. Indeed, both these influences would tend to raise the value of B’s currency in A, and to restore it to the purchasing power parity, which shows that this parity is the true equilibrium of the exchanges.” (Cassel, 1922, p. 157 to 158).

\(^{101}\) Terborgh (1926) gives credits to Jacob Viner for raising this point in discussions with him.

\(^{102}\) Italics in the original

\(^{103}\) Exchange rate, in the passage, refers to the price paid in domestic currency to acquire one unit of foreign currency.

\(^{104}\) The series of lectures organized by the Harris Foundation would be published in the same year by the University of Chicago Press.
formulation presented, then, by Cassel (1928b) can be seen as his final take on what PPP theory meant, with a rather similar exposition of the main aspects of the theory being incorporated in 2nd English edition\textsuperscript{105} of ‘The Theory of Social Economy’, published in 1932\textsuperscript{106}. In this formulation, PPP would be assigned the role of a fundamental factor determining exchange rates with all other factors seen as reasons, that can lead to exchange rates to deviate from PPP levels, considered to be of secondary importance, as “disturbances”, which Cassel grouped under three groups:

“The first comprises the monetary disturbances caused by processes of inflation or deflation. The second is formed by all sorts of artificial hindrances to international trade. The third group contains those disturbances that may be caused by international movements of capital. When the currencies concerned are kept at an invariable purchasing power on their internal markets, when the trade between the countries is not hampered by artificial hindrances, and when no capital movement the rate of exchange must stand at the equilibrium level represented by the Purchasing Power Parity and cannot show more than small and quite temporary deviations from this level.” (Cassel, 1928b, p.17)

As such, when ruling out these sources of disturbances, the PPP as a theory of exchange rate determination would hold true for Cassel. However, it is important to note that the three assumptions introduced by Cassel discussed in this section have different implications for PPP theory if not met. On the one hand, with the assumption of no change in relative prices would cause a structural shift in the exchange rate consistent with equilibrium in international trade from the level calculated by PPP indexes (as previously discussed). On the other hand, the existence of capital flows would be factors that prevented actual exchange rates from converging back towards levels consistent with the PPP indexes. While the definition of PPP in ‘relative’ terms would render PPP empirically applicable only to the extent that an equilibrium in international trade occurred in a specific point in time.

\textsuperscript{105} “We assume that all commodities are immediately paid for; in other words, that the one country extends no credit to the other, at least not for a period longer than is technically necessary for adjusting the mutual payments. This position [Purchasing Power Parity], then, represents the equilibrium position for the rate of exchange, for in any other position a constant scarcity of foreign currency would be felt in one of the countries, and the price of this foreign currency would of necessity rise. Only a rate of exchange at which the balance of trade is in equilibrium can possess a permanent stability. This rate of exchange is termed the purchasing power parity.” (Cassel, 1932, italic added for emphasis).

\textsuperscript{106} Translated from the 5th German Edition, the 1932 edition brings a complete independent section on International Trade (Book V), which was not present in the 1st English edition published in 1923. In it, Cassel expands his view on PPP theory to great extent on the chapter on International Payments and Adjustment of the Balance of Payments under free independent monetary standards.
3.4 A Methodological Appraisal of the evolution of PPP theory within Cassel’s Research Programme

As the review in the last section emphasizes, Cassel’s presentation of PPP theory evolved significantly from its early formulations during the 1st World War throughout the 1920’s. After enjoying wide acceptance at first, the PPP theory would be at the centre of the debate and would receive increased scrutiny on both empirical and on theoretical grounds. These events led Cassel to provide several reformulations of the theory and clarifications of what he understood PPP theory to be. As such, this section aims to analyse the formulation and the evolution of PPP theory in Cassel’s work, presented in the previous section, by means of Lakatos MSRP framework, discussed in Section 3.2.

First, in sub-section 3.4.1, I analyse how the formulation of PPP theory relates to Cassel’s broader research programme and emerges from its ‘hard-core’ elements. Following the Fulton-Leijonhufund interpretation of Lakatos’ MSRP framework, the elements of the ‘hard-core’ are a series of lemmas (postulates) which can be combined together to produce various theorems or predictions, such as the PPP theory of exchange rate determination. Moreover, in the Lakatosian framework, the research programme’s ‘hard-core’ is irrefutable by the methodological decision of the those working on the research programme. Consequently, this leads to an approach where ‘anomalies’, counter-examples are dealt with by changes in the so called ‘protective-belt’ of the theory. Alterations are circumscribed to changes on its auxiliary ‘observational’ hypothesis and initial conditions which must be observed for the theoretical propositions to be valid. As such, the strategies adopted by Cassel in modifying the ‘protective-belt’ of assumptions of his formulation of PPP theory, highlighted in the review conducted in section 3.3, are analysed in section 3.4.2, by the aid of the typology introduced by Lakatos (1976), discussed in section 3.2.

3.4.1- The relation between PPP theory and the central analytical core of Cassel’s Research Programme

Cassel’s interpretation of PPP theory cannot be seen in isolation from his views regarding functioning of the economy as a whole, his views on international trade and on the role that economic theory plays. The analysis of Cassel’s theoretical writings reveals much of what, in Lakatos (1970) terminology, can be considered the ‘hard-core’ elements of his research programme, the fundamental characteristics which, when combined together, shape the various testable theorems and predictions of Cassel’s research programme. For Cassel (1928d, p.589): “[T]he essential function of economic theory is to explain how prices are fixed. In this problem two separate questions are involved, namely, the question how prices are determined relatively to one another; and (...) how the absolute price height of prices is determined”. It
would be the combination of Cassel’s explanation for these two elements, which can be viewed as the hard-core of his research programme in economics, that would give rise to his formulation of PPP theory.

Beyond gaining recognition for his formulation of the PPP theory, Cassel is well known for his development of his general equilibrium system. The main formulation of this system appeared in ‘The Theory of Social Economy’ first published in German in 1918, and which would be translated into English in 1923\(^{107}\). This work can be seen as a direct descendant of that of Walras\(^{108}\) and constitutes the basis of Cassel’s explanation for relative prices. Simplifying Walras’s general equilibrium approach, Cassel (1923 [1918]) provided three models for a closed economy which have consequently become known as the Walras–Cassel models (Walker, 2003). The first describing a pure exchange economy, with a fixed number of commodities. In the second, Cassel considers, what can be interpreted as, a model of stationary state (as the quantities of commodities are constant). In this model Cassel assumes as given the quantities of money to be spent by consumers, quantity of factors of production and technical coefficients. And a third model where he considers the case of steady-state growth, i.e. uniform growth where there is no structural change observed in the economy.

A major difference with Walras’ approach was that in Cassel’s models the economy is assumed to be always in equilibrium; hence, there is no \textit{tatonnement} process. As such, Cassel didn’t need to examine questions related to convergence, stability, and the possibility of multiple equilibria. Moreover, another major difference with Walras’ system was that Cassel disregarded the use of the concept of marginal utility as basis for the explanation of prices as he wanted economic theory to be free from the use of non-observable magnitudes (such as utility). Cassel would favour a more direct approach to the theory of relative prices based on what he called Principle of Scarcity\(^{109}\). Hence, in his system aggregate demand for each commodity would be a function of all commodity prices; while in the supply side, production was modelled by linear production functions with fixed technical coefficients and firms producing at zero profits. With \(n\) equations and \(n\) unknowns Cassel’s system of simultaneous equations would be able to

\(^{107}\) The translation of Cassel’s theoretical work into English in this period is yet another example of his increasing international recognition, building on his participation at the Brussels International Financial Conference, organized by the League of Nations in September 1920, and following publication of his ‘\textit{Money and Foreign Exchange After 1914}’ in 1922. ‘\textit{The Theory of the Social Economy}’ was also translated into French, Japanese and, of course, Swedish.

\(^{108}\) Important to note that it was Cassel’s General Equilibrium System formulation which would later influence a generation of economists like Von Neuman, who were mainly acquainted, only, with Cassel’s formulation (Brems, 1989).

\(^{109}\) However, this take would be criticized by Wicksell (1934 [1918]), who comments that something is scarce only in relation to their wants. Consequently, the degree of scarcity would be measured in the same way as marginal utility, by their opportunity cost. Thus, Wicksell would argue that both concepts would be equivalent.
determine relative prices, based on the scarcity of the factors of production, which were always assumed to be fully employed, for a given technology. However, when considering two economies open to trade there is one extra price to be determined, the exchange rate, rendering the price system undetermined. Hence, one would need to introduce one extra equation into the system, as would be later explained by Cassel (1928, p.13-14):

“As long as a country forms a closed unit for itself these factors determine relative prices according to the system of equations which I have given in my “Theory of Social Economy”. When two countries are brought into connection with one another all prices are affected and a new system of prices is established. These prices are determined by a new system of equations, comprising all the elements of the two systems that determined prices when the countries were isolated. But in this new system of equations a new unknown quantity enters, and that is the rate of exchange between the countries. On the other hand, a new equation is added to the system, expressing the equilibrium of the balance of trade that A buys as much from B as it sells to B. Thus, the system is complete, all prices are determined, and among them particularly the rate of exchange.”

As such within Cassel’s own system an exchange rate would only be stable to the extent that it was consistent with a balance in international trade. As he would add in the 2nd English edition of his ‘Theory of the Social Economy’: “Only a rate of exchange at which the balance of trade is in equilibrium can possess a permanent stability. This rate of exchange is termed the purchasing power parity” (Cassel, 1932, p.658). This highlights an important link between PPP and comparative advantage theory, which for Cassel determines specialization in international trade. While in the gold standard, a trade imbalance would lead to higher inflation in the surplus country (which would eventually adjust the trade balance); in a system based on flexible exchange rates (between two countries possessing an inconvertible paper monetary standard) the exchange rate would play the role of the adjustment variable, ensuring a specialization pattern in international trade compatible with comparative advantage and the balance in trade:

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110 Emphasis on the original.
“A country, in its trade with another country, can never have an all-round superiority, and can never be so inferior in competition that it can sell no products at all to the other country. There is no such thing as an absolute superiority in the sense that one country produces more cheaply than the other. Such a comparison can only be made at a definite rate of exchange. Let the one country be inferior to the other in technique and organisation, let it be worse equipped with capital, land, and skilled labour; nevertheless, there exists a rate of exchange at which it can sell as many commodities to the richer country as it buys from it, and thus equilibrium will come about in its trade with that country theory. (...) The rate of exchange must so be fixed that advantages and disadvantages in respect to costs of production are so compensated that the balance of trade is brought into equilibrium.” (Cassel, 1932, p.658)

As such, Cassel’s general equilibrium system forms the basis for the determination of relative prices in a closed economy. And, when coupled with comparative advantage theory, his general equilibrium system forms the basis to the determination, also, of the exchange rate in an open economy setting.

The second part of the task of economic theory for Cassel would be to determine the absolute price levels, which in Cassel’s analysis would be dependent on the value of money. This, in its turn, would be underpinned by its relative scarcity as in any other commodity, in accordance with the principle of scarcity that shapes Cassel’s analysis, as highlighted by Brems (1989). Money would not be attributed any special role in Cassel’s system and changes in money supply would affect only monetary variables, and not real variables. As such, Cassel adopted the real-monetary dichotomy, where money is seen only as veil, one of the core elements of the broader neoclassical research programme.

The combination of the view of relative prices as scarcity indexes, which always adjusts to ensure full employment of the factors of production, and of monetary neutrality would lead to the formulation of the testable theorems and predictions of Cassel’s research programme, such as the QTM and the PPP, which were tightly linked. If the economy is at full employment, then, the only effect of increased supply of money will be an increase in the domestic price level and, according to PPP, lead to a depreciation of the exchange rate. That is, causality would run from increase in the money supply to prices (i.e. QTM) and from prices to exchange rate (i.e. PPP). Indeed, while writing in 1916, Cassel makes explicit this connection:

“Now according to the quantitative theory of money the general level of prices varies, other things being equal, in direct proportion to the quantity of the circulating medium in a country. If this be true, the rate of exchange between the two countries must vary as the quotient between the quantities of their circulating media.” (Cassel, 1916, p.62)
Cassel (1916) would even use the changes in the ‘circulating medium’ to test the validity of his theory on the behaviour of the exchange rate between Sweden and countries like Russia, France, and Germany. However, during the 1920’s Cassel would become much less certain about the symmetry between increase in circulating media\textsuperscript{111} and rise in prices; and of the causality going from increase in note circulation to rise in prices. For instance, Cassel (1922) concedes that banks “cannot force upon the public more currency than trade requires” (Cassel, 1922, p.26) and rise in prices bring about an increase in demand for notes\textsuperscript{112}, a point which was raised by Anderson (1920) and Scott (1920) in their reviews of Cassel (1920b), published together in the special edition of the Annals of the American Academy of Political and Social Science. Nevertheless, while conceding that the QTM as normally formulated was untenable, Cassel (1922) would still cling on to the monetary neutrality proposition. Hence, he would propose, what he considered to be, a reformulation of the QTM. In doing so, Cassel would still sustain that the chief reason of the rise in prices since the beginning of the War was due to monetary factors, in his terminology, in the ‘creation of artificial purchasing power’. This concept, which had briefly appeared in his early works, would gain centre stage in his analysis of inflation throughout the 1920’s:

“rise in prices must occur when extra purchasing power is put on the hands of government, or in fact, of whomsoever it may be who directly takes advantage of this purchasing power. The heightened competition for the non-increased supply of commodities which the newly created purchasing power evokes cannot help having this effect. To what height the rise in prices will go cannot be determined theoretically (...). This rise in prices in its turn manifestly brings about an increased need for currency. Obviously, one must expect that the quantity of currency required by trade grows in proportion to the rise in prices.” (Cassel, 1922, p.27)

In this new format, the rise in prices would be explained by an increase in credit extended either to the government or to the private sector to a degree higher than available funds accruing from the flows of actual savings. In Cassel’s view this would be caused by an inappropriate discount policy, where interest rates were kept below equilibrium levels. Although, Cassel saw the benefits of banks creating ‘money’ by extending credits as part of their daily operations, these would still have to be kept in check by total amount of available savings over time:

\textsuperscript{111} In “Post-War Monetary Stabilization”, a book which compiles a series of three lectures given by Cassel at Columbia University in 1928, Cassel concedes that causality between increase in the supply of money and price increase cannot be precisely determined. He also, denies the symmetry between increase in money supply and prices, claiming that changes in the velocity of circulation would play major roles in the context of high inflation rates: “We cannot tell how much prices will rise. The endeavours which the old quantity theory of money made in this direction were doomed with failure.” (Cassel, 1928, p.6)

\textsuperscript{112} Also, his explanation of the inflation observed during the War as a consequence of the expansion of the money supply by governments was also a point of contention with Wicksell (1925).
“A complete daily adjustment between demands for capital and fresh savings is scarcely possible. It is therefore of advantage if the issue of bank currency is given certain elasticity, so that demands for capital may be met without unnecessary disturbance. This elasticity, however, must not be taken advantage of to meet, during prolonged periods, demands for capital on a higher scale than amount of savings effected within the same period permits.

If banks allow more credit than they are on these grounds economically justified in giving, then the active purchasing power in the country is raised without a corresponding increase of purchasable commodities. The inevitable result, therefore, is a rise in prices.” (Cassel, 1922, p.103)

And, consequently, the general means to keep creation of purchasing power in check and keeping the value of a currency stable would be through an appropriate discount rate policy. Indeed, Cassel forcefully advocated throughout the 1920’s¹¹³ that interest policy should be used to ensure the equality between savings and investment:

“The only rational and at the same time practically useful rule to go by, therefore, is that demand for capital must, by means of the rates of interest of the banks, be limited to the amount of funds supplied by current saving, so that no artificial purchasing power, with its accompanying rise in prices, will be created.” (Cassel, 1922, p. 104, italics on the original)

The resemblance of Cassel’s proposals for monetary policy and inflation targeting policy adopted by modern monetary policy is startling. However, more important to our purposes here is how Cassel’s re-statement of QTM in an economy dealing with credit instruments and his approach to price stabilization reveals the acceptance of the money supply as endogenously determined and shows a great connection with the theory advanced by Wicksell’s (1898). Despite the critical remarks made by Wicksell to Cassel’s explanation of PPP theory¹¹⁴ and of inflation after the outbreak of the War¹¹⁵, Vernengo (2001) suggests that, in an open economy, PPP can be interpreted as the ‘natural’ exchange rate, compatible to the ‘natural’ rate of interest rate. Hence, provided one adjusts for real shocks, PPP would be the nominal exchange rate level at which there would be no upward or downward pressure on prices, and, consequently, bring stability to the real exchange rate.

Wicksell’s theory of interest and fluctuations of prices lies in the distinction made between the interest rate prevailing in the market and what he defines as the ‘natural’ rate of interest, which would be given by the intersection between demand for credit for investment and available supply of savings. An increase in the natural rate, such as the shock caused by the

¹¹³ As did other Swedish economists such as Wicksell, Davidson and Heckscher (Magnusson, 1991).
¹¹⁵ See Wicksell (1925).
extra demand for capital brought about by the First World War effort, for example, would produce initially a difference in regard to the market rate. This would imply that the borrowing rate would be below the rate of return on new investment. In this case, investment would exceed savings. Assuming that the economy is at full-employment, price increases would follow, causing the cumulative causation process. Hence, it can be traced, a parallel between the Cassel’s concept of “creation of artificial purchasing power” and the negative difference between the natural and the prevailing market interest rate.

Nevertheless, as Wicksell (1919) claimed, through manipulation of the market interest rate, central banks could drive (and maintain) the exchange rate to (at) any level that they found suitable for an indeterminate period, provided it maintains a real interest rate differential. As such, a surplus in the trade balance would be sustainable as long as the domestic interest rate was kept below the foreign one, leading exporters to invest their profits in securities abroad rather than repatriate them. However, as Vernengo (2001) argues, if for instance this prevalent market interest rate is below the ‘natural’ rate for an indeterminate period of time, a process of inflation would kick in. Hence, a nominal exchange rate which would initially be perceived as undervalued in the PPP approach would, with the process of inflation, become the new equilibrium in accordance with PPP and, eventually, with rise in costs, the export surplus is eroded as well as the real interest rate differential. As such, the long-run equilibrium between nominal exchange rates and PPP can be retained. However, in contradiction to Cassel’s stated views, it would be possible that not only changes in price levels cause shifts in the exchange rate but also that changes in the rate of exchange can cause changes in the price level, as argued by Wicksell (1919, p.233)116.

Overall, to sum up, Cassel’s general approach to economics was one based in a general equilibrium system, for which a definitive set of relative prices which cleared markets ensuring full utilization of the factors of production exists. Naturally, foreign exchange rate as a relative price would also have an equilibrium price, which for Cassel would be determined by the trade balance, in line with the comparative advantage theory of international trade. Moreover, also in line with the Neoclassical approach, the adherence to the real-monetary dichotomy was retained throughout Cassel’s writings despite changes in interpretation of the QTM. These core elements of Cassel’s research programme were combined to form the specific hypothesis of PPP theory of exchange rates. Now that we have linked Cassel formulation of the PPP to the elements of the ‘hard-core’ of his research programme, in the next sub-section I analyse the

116 For the detailed account of the differences in interpretation of the role process of interest rate differentials and price fluctuations in Wicksell’s and Cassel’s views, see Humphrey (2002).
adjustments and qualifications introduced by Cassel in what can be classified as the ‘protective-belt’ of his formulation of PPP theory identified in section 3.3.

3.4.2- A Lakatosian analysis of Cassel’s modifications to PPP theory

Considering that a theoretical proposition can always be insulated from falsification by the modification and (or) introduction of a new suitable auxiliary hypothesis; in the Lakatosian framework falsification criteria is no longer the mere existence of counter-examples and anomalies. The criteria of appraisal become the analysis of the nature of the strategies adopted to modify the theory in light of counter-examples, anomalies. In this sense, the remainder of this section will appraise whether the introduction of the new auxiliary hypothesis can be interpreted as theoretically and(or) empirically progressive, by the aid of the typology developed by Lakatos (1976) discussed in section 3.2.

As the discussion in the last section highlights, the formulation of PPP theory is tightly linked to the overall research programme of Cassel. The combination of Cassel’s view of the determination of relative prices based on his principle of scarcity, which would always clear markets ensuring full employment of the factors of production; and from his adoption of monetary neutrality led to the simple and categorical formulation of PPP theory present in his earlier statements in Cassel (1916) and Cassel (1918). In this, any trade deficit of a given country ‘A’ in relation to another Country ‘B’ would have as a counterpart the emergence of a relative scarcity in foreign exchange markets of the currency of country ‘B’ (which experiences a trade surplus). As a consequence, this would set in motion forces that are expected to adjust the exchange rate between the two currencies back towards levels consistent with balanced trade\(^{117}\). And, thus, embedded in the theory was the notion than an exchange rate level would be stable only if it was compatible with the balance in trade\(^{118}\).

Starting from this simple, categorical formulation, the review conducted in section 3, highlighted the fact that Cassel amended his presentation of PPP theory in four key aspects\(^{119}\): (i) unilateral hindrances to trade; (ii) PPP indexes should be calculated starting from a base

\(^{117}\)It is important to note, that Cassel’s approach to economics was consistently one of general equilibrium analysis based on system of equations. And without the equation of balanced trade Cassel system of equations for an open economy would become undetermined, as in the open economy an extra price has to be determined, the exchange rate, see Cassel (1928c).

\(^{118}\)And yet, the idea that there would be a unique exchange rate level compatible with balance in international trade carries with it the embedded a notion that the economy would naturally converge to full-employment. As with different unemployment levels, and, thus, demand levels, there is multiple exchange rates consistent with balance in international trade.

\(^{119}\)Beyond short-term temporary deviations such as (i) in cases where governments must procure foreign exchanges, regardless of costs, in order to be able to face international debt payments, for example; (ii) the role of speculation; and, (iii) expectations regarding the currency’s internal future purchasing power, in which traders in the foreign exchange market would anticipate the movements in the inflation rate.
period in which there had been a certain equilibrium in international trade; (iii) changes in relative prices; (iv) international capital flows. In light of the discussion in section 3.2, how can we interpret the changes and amendments introduced by Cassel? Can these be seen as theoretically and/or empirically progressive? Or do they indicate a degeneration of Cassel’s research programme?

While initial empirical corroboration was heralded as general validity of the main proposition of his approach (Cassel, 1916), later lack of empirical corroboration was not taken as valid tests to falsify the theory. Faced with lack of empirical corroboration between his PPP calculations and the behaviour of the exchange rate between the Swedish Krona to the British Pound, Cassel (1918) could have used an ‘exception-barring’ strategy, in which PPP theory would not be applicable to situations where free trade was not operative. However, this would render his previous demonstration of the empirical corroboration of PPP invalid as well, as it could hardly be sustained that the free trade was the norm even in the beginning of the War. Thus, when Cassel (1918) appeals to the (i) unilateral hindrances to trade, due to the export restrictions imposed by the belligerent countries, as the factor explaining the divergence; he is engaging in what can be framed as a ‘lemma-incorporation’ strategy. As discussed in section 3.2, this strategy keeps the loss-content to a minimum, as its introduction is able to explain the counter-example, while still being able to keep the previous demonstration. After all, it was easier to defend that the unilateral hindrances to international trade imposed by belligerent countries had increased disproportionally vis-à-vis neutral economies as the War entered in a more acute phase from 1916 onwards.

The second key change can be found in Cassel (1922), can also be interpreted as an attempt to insulate the PPP theory from empirical anomalies. His initial formulation in the 1916 and 1918 articles had left margin for divergent interpretations of the theory. Indeed, the definition provided in Cassel (1916) can be associated with, what has become known as, the ‘absolute’ version of PPP theory, where exchange rate should be equal to the ratio of price levels between two countries given at any point in time, as Balassa (1964) has highlighted in his criticisms of Cassel’s formulation of PPP. However, Cassel (1922) would clearly distance himself from this interpretation of the theory. He would defend his theory from empirical counterexamples based on ‘absolute PPP’ interpretations with a strategy of re-specifying the definition of PPP in such a way that the counter-example is barred. In the sense, empirical counter-examples would be dismissed as the case at hand would not meet the specification of the model, in what Lakatos (1976) terminology qualifies as a ‘monster-barring’ strategy. Hence, Cassel (1922) would formulate PPP theory in, what has become known as, its ‘relative’ version.
In its ‘relative’ version PPP theory states that, when two countries experience inflation, the new equilibrium exchange rate is equal to the exchange rate from the base period multiplied by the quotient of the degrees of inflation experienced by each country. However, as Cassel would remark the new inflation-adjusted exchange rate, that is the exchange rate consistent with the PPP indexes, would only consist of a true equilibrium if the ‘old’ exchange rate is taken from a base period where equilibrium in international trade had prevailed. Important to note here is that, with the introduction of this qualification, any empirical counter-example can be dealt with - by arguing that a deviation of actual exchange rate from the level consistent with PPP occurs because in fact the ‘old’ exchange rate is taken from a base period where international trade was not in a ‘true’ equilibrium. Hence, insulating the theory from any empirical falsification.

It would be the criticism by Van Dorp (1919) and Wicksell (1919), and subsequent authors, regarding change in relative prices and the role of capital flows that would pose a higher threat to Cassel’s formulation of PPP theory. Given the prominence of capital flows and the impossibility to claim that, as a rule, prices of different commodities would rise proportionally, Cassel could hardly argue that the ‘anomaly’ didn’t fit the specification of the model. Faced with these anomalies his problems were two folded. On the one hand, unable to provide a new lemma which would be able to account for the ‘anomaly’ while retaining the validity of previous empirical corroboration, Cassel’s reaction would be to reformulate the PPP theory adding the auxiliary assumptions of no changes in relative price and of no capital flows. Thus, engaging in what can be interpreted as an ‘exception-barring’ strategy.

As such, from the empirical perspective, the changes introduced by Cassel in the theory insulated the core proposition from empirical falsification. Among the qualifications introduced by Cassel one finds short-run, transitory, factors which would cause exchange rate to deviate from PPP. Other qualifications implied that PPP norm would converge to the market exchange rate level, as exchange rates adjusted faster than prices in the expectation of continuous process of inflation. While in the long-run, changes in relative prices would cause exchange rates to diverge persistently from levels given by PPP indexes. However, alternatively, it could be the case that a permanent deviation could represent the fact that the base period was not one where international trade was in true equilibrium or due to the inadequacy of existing price indexes in reflecting true relative inflation degrees in each country. Without methods to adequately capture the influence of such effects Cassel resorted to strategies discussed in this section which, in Lakatosian terms, can be considered as ‘content-decreasing’

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120 At least with the statistical methods of the time, where regression analysis and econometrics were still in its infancy.
strategies and, hence, the changes introduced by Cassel can hardly be categorized as an empirically progressive problem-shift. With the introduced changes, the theory had lost much of its initial intuitive appeal, something that did not go without notice by some commentators at the time (e.g. Agnell, 1925; Terborgh, 1926).

In Lakatos framework a research programme can be categorized as theoretically progressive when each new version of theoretical propositions leads to the prediction of novel facts while retaining the unrefuted content of the previous theory. And, at one level, it can be argued that the introduction of these auxiliary assumptions may have rendered some internal consistency to Cassel’s formulation of PPP theory, in the sense that with their introduction the main proposition follows from the stated initial conditions. Moreover, the introduction of such assumptions implicitly recognizes the existence of a myriad of other factors which would also affect the exchange rates, expanding the theoretical content of the theory while retaining the initial proposition that exchange rates respond to changes in the inflation rate. As such, it can be argued that the changes introduced to the formulation of PPP were theoretically progressive.

In the MSRP framework when problem-shifts can be categorized as theoretically progressive but not empirically progressive the research programme is considered to be degenerating, although the changes are still regarded as scientific. However, as Vint (1994) argues the lack of empirical corroboration during a period may not necessarily lead to the refutation of the theory and abandonment of the research programme. In the Lakatosian framework, a theory would be considered as falsified only when it is superseded by a new theory, which displays an increased explanatory content relative to the previous one. The criticisms and consequent amendments to PPP theory may have rendered the empirical determination of the true ‘equilibrium’ exchange rate intractable. However, the existence of a unique ‘equilibrium’ real exchange rate consistent with equilibrium in international trade, around which the exchange rates prevalent in the market at any point in time would gravitate, could not be given up without giving up the entire neoclassical research programme. That is, for given structure of demand, technology, and availability of factors of production, there would exist a unique set of relative prices (including the exchange rate) which clear all markets ensuring the full employment of all factors of productions, which is determined exclusively by ‘real’ variables, not being affected by changes in ‘monetary’ variables.

As such, despite neoclassical authors like Taussig claiming that: “There is no normal or settled rate of exchange based on purchasing power” (Taussig, 1927, p.357), it would be only

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121 In opposition to pseudo-scientific problem-shifts, which are categorized by the lack of empirical and theoretical progressiveness.
with the emergence of the Keynesian paradigm that the notion of the existence of a unique equilibrium exchange rate consistent with equilibrium in international trade would be completely disregarded. In this sense, Joan Robinson would later remark:

"It is now obvious that there is no one rate of exchange which is the equilibrium rate corresponding to a given state of world demands and techniques. In any given situation there is an equilibrium rate corresponding to each rate of interest and level of effective demand, and any rate of exchange, within very wide limits, can be turned into the equilibrium rate by altering the rate of interest appropriately. Moreover, any rate of exchange can be made compatible with any rate of interest provided that money wages can be sufficiently altered. The notion of the equilibrium exchange rate is a chimera. The rate of exchange, the rate of interest, the level of effective demand and the level of money wages react upon each other like the balls in Marshall's bowl, and no one is determined unless all the rest are given" (Robinson, 1949 [1947], p.103)

Consequently, the notion of PPP as an equilibrium exchange rate, at least from a positive perspective, would stay dormant for decades, only to be resurrected with the re-emergence real-monetary dichotomy in the macroeconomic theory of the 1970's, after the collapse of the Bretton-Woods system. Since then, as highlighted by Moosa (1999), empirical testing of PPP hypothesis of exchange rate has become a thriving industry, as is further exemplified by the review in Chapter 2.

3.5 Cassel’s use of PPP in the context of the political debate of the 1920’s

Originally, Cassel (1916) proposed PPP theory to explain the abnormal fluctuations observed in foreign exchange rates since the outbreak of the First World War. Overtime, as reviewed in section 3.3, Cassel introduced an increasing number of modifications to the theory. At the same time that the changes introduced insulated his PPP theory from falsification arising from counter-examples, it was accompanied by a change in its core message as emphasized by Cassel. Indeed, as discussed by Kardochnicov (2013), Cassel would use PPP theory as an element of justification for his proposal of policy coordination for stabilization of international monetary conditions, within the debates regarding the restoration of the Gold Standard. As such, it represents a shift in interpretation from a positive conception of the theory to a normative one.

Cassel’s exposition of PPP theory brought him international recognition and most likely played an important role in his invitation to prepare one of the experts memoranda to be used to inform the debate concerning the resolutions adopted by Brussel’s International Financial
Conference organised by the League of Nations in September 1920\textsuperscript{122}. Cassel’s memoranda would attract significant attention and together with a second drafted by Cassel for the 1921 League of Nations meeting would be reprinted in book format in the following year (Cassel, 1921). The recognition achieved in these fora would pave the way for the publication of his well-known ‘Money and Foreign Exchange after 1914’ (Cassel, 1922), the translation of his ‘Theory of the Social Economy’ (Cassel, 1923a [1918]) into English. As well as leading to invitations to lecture abroad, in places such as the London School of Economics (Cassel, 1923b)\textsuperscript{123}. Cassel would also be part of the expert panel in the 1922 International Economic Conference, organized by the League of Nations held in Genoa.

At the centre of the economic policy debate at these fora would be the resumption of normal conditions in international trade and credit, disrupted by tariffs and gold export & import restrictions imposed during the war. It was a consensus at the time that the conditions of high inflation rates and volatility in exchange rates prevalent since the outbreak of War was a cause of much distress to international trade. As such the return to the Gold Standard was seen as of paramount importance for the normalization of international business conditions. The Gold Standard, with its fixed exchange system defined by gold parities and currency issuance limited by pre-determined gold (reserves) cover ratios, had been associated with monetary stability for decades preceding the war in most of Western Europe and in the United States.

Given the policy discussion, the focus of his contributions shifts from providing an explanation of the movements of exchange rates since the break-up of the gold standard to a broader discussion regarding the means to achieve monetary stability in the post-war period. As such, any analysis of Cassel’s texts during the 1920’s should consider this political and institutional context. As the resolutions proposed by the Commission on Currency and Exchange\textsuperscript{124} makes clear, it was “highly desirable that countries which have lapsed from an effective gold standard should- return thereto” (League of Nations, 1922, p.11). The controversy relied on whether national currencies should be restored to their pre-war parity or if a new gold parity should be settled at a somewhat lower level, or, in other words, as Keynes would put it, controversy lied in “the choice between Deflation and Devaluation” (Keynes, 1923, p. 141).

\textsuperscript{122} Memoranda’s for the conference were prepared for the delegates by five eminent economists. Beyond Cassel’s economists invited were Arthur Pigou from England; Charles Gide from France; Gijsbert Bruins from the Netherlands; Charles Gide from France; and Maffeo Panetaleoni from Italy.

\textsuperscript{123} As well as in the United States in 1928, where he would give a series of lectures (later reprinted in book format) at the University of Columbia and at the University of Chicago.

\textsuperscript{124} Adopted unanimously by the conference, and similar to those which would be adopted in 1922 in the Genoa Conference.
However, to Cassel discontent, in the final report of the conference the answer to the question regarding the exchange rate level at which countries should establish their gold parities was left to countries to decide for themselves. Recommendations were restricted to an advice of caution regarding the speed of enactment of deflationist policies: “Deflation if and when undertaken, must be carried out gradually and with great caution; otherwise, disturbances to trade and credit might prove disastrous” (League of Nations, 1922, p.12). The idea that deflation could be gradually conducted would be an object of harsh criticism by Cassel (1920a, 1922), who would consider the economic consequences of deflation to be even more disastrous than the ones caused by the process of inflation. For Cassel, the policies necessary to enact it (such as raising taxation and, or, increasing interest rates) would provoke a recession and the prospect of a long decline in prices would hamper enterprise, which would ultimately bring about a violent fall in prices. Hence, the idea of a gradual, managed, process of deflation with minimal economic impacts was in fact an untenable proposition.

If deflation of currencies and the return to pre-war parities was undesirable, at which devaluated level should countries decide to fix their currencies gold, this is, their new gold-parity levels? And here the formulation of PPP as empirical tool would come into play in Cassel’s analysis, proposing the use of PPP indexes as a benchmark to establish new gold parities without having to go through the perils of deflation. In Cassel’s argument, the fluctuations of exchange rates and high or low nominal quotations of currencies relative gold in comparison to their pre-war parities were not per se a cause of hindrance to international trade, disturbances in international trade would only emerge in the case where exchange rates deviated from their purchasing power parities:

“low prices on foreign currencies do not mean an encouragement of imports from them or a handicap for the home producer, provided these exchanges are a true expression for the purchasing power of the foreign money; on the same condition, high prices of foreign currencies do not in any way hamper the import from them. In fact, the terms "high" or "low" exchanges have no sense in themselves; if they are to be used they must obviously refer to the normal rates of exchange, i.e., to the purchasing power parities. But when used, as is generally the case, in reference to old parities which have lost all real significance they are in the highest degree misleading. Equally clear it is that every deviation of the actual rates of exchange from the purchasing power parities must cause considerable disturbances in international trade.” (Cassel, 1921, p.44-45)

And, albeit deviations would be seen by him mostly as a temporary phenomenon which would set in motion the market forces which would eventually eliminate it (thus, in theory, eliminating the need to fix exchange rates); Cassel argued that “in reality, this restoration to equilibrium may take a long time, especially if the forces depressing the exchange are strong and work
continually. And this period may prove very disturbing for trade and industry in both countries” (Cassel, 1921, p.45). In this context, PPP would assume a much more a normative connotation, defended on grounds of promoting equilibrium in international trade and minimizing disturbances which would hamper the growth of trade and economic activity.

As such, although originally devised as a positive theory of exchange rate, PPP theory would later assume a normative role. PPP became a useful theoretical construct that would support Cassel’s position against deflation and the return to pre-war parities in the debates of the early 1920’s concerning the restoration of the Gold Standard. Cassel insistence on the argument that the equilibrium exchange rate after the war was given by PPP, understood as the inflation-adjusted pre-war exchange rate, needs to be analysed in this context. And in this sense, Cassel’s use of PPP theory to determine a new equilibrium may be seen as an example of what Machlup (1958) calls ‘disguised politics’ fallacy, which occurs when one infuses “a value judgment, (...) into the concept of equilibrium designed for economic analysis” (Machlup p.14, 1958). Even though, after a careful look at Cassel’s work of the time and political context, one may claim that his political intensions were not so disguised, after all his choice of taking 1914 as the base year implied a value judgement that the pre-war status-quo represented an equilibrium state of affairs in international trade.

Although, following the criticisms highlighted in section 3.3, Cassel would adjust his presentation of PPP at the theoretical level, in the empirical discussions Cassel would minimize, and at times ignore, the presence of other factors determining exchange rates. Cassel would defend his position from criticisms by arguing the effects of other variables discussed were likely to be statistically very small given the magnitude of currency inflation observed in domestic prices. This behaviour held by Cassel during debates in the 1920’s may explain why, in the literature, his view of exchange rate determination and PPP theory has so often been portrayed as a grossly simplified theory of exchange rate determination. To this end, it is interesting to take a look at the words of Gunnar Myrdal, who was Cassel’s PhD student (despite having very distinct views regarding economics), regarding Cassel’s, at times, oversimplified exposition of his theories:
“Cassel's theories were sometimes conspicuously stamped by their time and were even designed to come to grips with specific practical problems. Hundreds of theoretical pedants in many countries have had the opportunity of flaunting their knowledge of elementary international trade theory by demonstrating that Cassel’s theory of purchasing power parity has no universal validity. Nothing could be easier—it is now done by first-year students. But in a deeper, pragmatic sense Cassel was nevertheless right for, when monetary stability was to be restored after the First World War, nothing could have been more important than to impress upon politicians and bankers precisely this approximate but nonetheless fundamental relationship between price levels and exchange rate. Cassel himself, however, did not clearly realize this limitation of his theory, which may perhaps excuse the excessive pedantry of many of his critics.” (Myrdal, 1963 [1945], p.2)

Cassel’s views on methodology of economics as an empirical science may offer some insight on the reasons why his presentations of PPP theory, in certain circumstances, lacked explicit recognition of other factors affecting the behaviour of exchange rates and lack of rigour in clearly stating the conditions and assumptions required for the validity of his formulation of PPP theory.

“As soon as an economic movement is a result of several causes, it becomes the task of economic theory to explain the particular influence of each of these causes. In order to do so, it is generally necessary first to take out the most important factor and study its separate effect, which will then be represented by a particular movement. From this theoretical movement the actual movement will show deviations, which we then have to ascribe to other factors. This method of procedure doubtless involves some arbitrariness, as the first factor may be chosen in different ways. The art of economic theory to a great extent consists in the ability to judge which of a number of different factors cooperating in a certain movement ought to be regarded as the most important or essential one. Obviously in such cases we must choose a factor of permanent character, a factor which must always be at work. Other factors which are only of a temporary character and may be expected to disappear, or at any rate can theoretically be assumed to be absent, must for that reason alone be put in a subordinate position.” (Cassel, 1928a, p.28-29)

And in the case of exchange rate this dominant factor, for Cassel, was to be sought in PPP theory and, consequently, in the role of relative domestic inflation rates, at least during that historical period. This methodological expedient of emphasizing the most essential factor would be met with reservations by several authors, such as Viner (1937), for example, commenting on Cassel’s argument:
“No objection can be made to this, if it is to be understood to mean merely that minor factors should be treated as minor factors. But if it is presented as justification for the omission of mention of minor factors, and even for express denial that they are operative, on the ground that their recognition weakens the persuasive power of one’s argument, then this amounts merely to saying that bad theory may make good propaganda.” (Viner, 1937, p.387)

A concern also emphasized by Hawtrey (1928)\textsuperscript{125}, who while working at the UK Treasury during the 1920’s played a key role in the debate about the return of the UK to the Gold Standard:

“But to recommend a dogma on account not of its inherent validity but of its good practical consequences is dangerous. When people discover its theoretical weakness, they may not only reject the dogma, but neglect the practical consequences.” (Hawtrey, 1928, p.442)

As discussed in the beginning of this chapter, Machlup (1958) highlighted that over the curse of history economists have used the concept of equilibrium in a variety of contexts and for different purposes, without clearly noting the transformations of the meaning read into the term. The analysis of Cassel work on the PPP reveals the same pattern. In Cassel’s defence, Karodchnicov (2013) argues that the clear differentiation between normative and positive analysis would only emerge in economics decades later with the work of Friedman (1953). Nevertheless, Cassel’s work and use of the concept of PPP as empirical tool to determine equilibrium in exchange rates after the war seems to be a clear example of what Machlup (1958) would define as “misplaced concreteness” and “disguised politics”. A concern which was expressed by contemporary authors of Cassel, as shown by the quotations of Viner and Hawtrey.

\textbf{3.6 Conclusion}

This chapter reviewed Cassel’s work on the formulation of Purchasing Power Parity (PPP) theory. In particular, this chapter has explored two issues. First, the different conceptions of equilibrium present in Cassel’s definitions of PPP, and, secondly, how the theory evolved in his writings, with the addition of several assumptions throughout the years, in light of Lakatos framework of Methodology of Scientific Research Programmes (MSRP). In the modern literature, PPP theory has been associated with the hypothesis that real exchange rates should be constant in the long-run: a hypothesis that has been subject to extensive testing, however, with fairly weak empirical corroboration, leading to controversy over the actual interpretation of theory and to criticisms of it in the literature. Given that historically he was a major proponent of the doctrine, Cassel’s name has been at the forefront of much of the criticisms directed to

\textsuperscript{125} It’s interesting to follow the changing view regarding Cassel and PPP from Hawtrey’s first edition in of ‘Currency and Credit’ in 1919 to this later one (third edition).
PPP. However, Cassel’s own interpretation of the theory has been subject to significant controversy. In this chapter, I argue that the contrasting interpretations of PPP stems from the inevitable tensions that emerge when trying to apply the concept of equilibrium, a well-defined concept for the development of abstract economic theory, to concrete historical situations. A tension that has plagued all approaches of real exchange rate equilibrium theories reviewed in Chapter 2.

Although both critics and supporters of Cassel’s formulation of PPP theory draw evidence from Cassel’s own writings in favour of their interpretations of what was his understanding of PPP, I argue that previous contributions take Cassel’s view in isolation of the shifting historical context and as immutable across the time span of almost two decades in which he regularly published on the topic. In fact, the analysis of Cassel’s writings reveals that starting from a crude formulation of PPP in, what has become known as, its ‘absolute’ version (in 1916), Cassel would progressively polish the presentation of PPP making clear his support for the ‘relative’ version of PPP. Furthermore, Cassel did indeed explicitly introduce several auxiliary assumptions and recognized other factor which would influence the trajectory of real exchange rates, as argued by Holmes (1967), Humphrey (1979) and Moosa (1999). However, it is not clear to what extent Cassel was aware of the limitations of PPP theory from the outset. Indeed, in Cassel’s early works one notes that the several auxiliary assumptions and acknowledgment of other effects on the determination of exchange rates were not discussed in his presentations. Instead, the introduction of the new auxiliary assumptions and qualifications to the theory, which substantially altered its interpretation and implications, would only be progressively introduced over the years, something that did not escape the eyes of commentators at the time.

To understand these changes in the formulations of PPP theory in Cassel’s work, it is important to consider the repercussion that Cassel’s work achieved in his time, taking into account the historical and political context. Coining the theory’s name, and applying it to the analysis of the fluctuation in exchange rate during the First World War, gave Cassel and PPP theory international recognition. It became widely used and discussed in academic and policy circles, as well as in specialized press. From the end of the War until the late 1920s, controversies abounded in the literature regarding which price indexes should be used for comparisons; about the necessary conditions needed for the theory to be valid; and its embedded assumptions, such as its reliance on the Quantity Theory of Money (QTM). As the review in section 3.3 highlights, the auxiliary assumptions, later introduced by Cassel in his formulations of PPP, can be traced to criticisms and qualifications raised by other authors in well-known journals and other public outlets to which Cassel was a regular contributor. However, the importance of these criticisms has to a large extent been obfuscated in the literature, possibly due to Cassel’s typical attitude.
of not referencing the work of others or acknowledging the contribution of others to the development of his own ideas, and by noy responding directly to criticism raised to his own work.

From the several auxiliary assumptions introduced by Cassel in his presentations of PPP theory I’ve emphasized four assumptions which have, in my view, the most relevant implications. Namely these assumptions are: (i) no unilateral hindrances to trade; (ii) the need to calculate PPP indexes departing from a base year in which there had been a certain equilibrium in international trade; (iii) constancy of relative prices; (iv) no capital flows. These assumptions were delineated using the Lakatos MSRP framework. I’ve argued that the introduction of these auxiliary assumptions provided consistency to the ‘internal’ logic to Cassel’s formulation of PPP theory, i.e. its main propositions are valid under the stated initial assumptions. However, this ‘internal’ consistency came at a cost of empirical falsifiability, as any empirical counter-example could be explained away by arguing that the case under analysis didn’t meet one or more of the auxiliary assumptions needed to be verified for the theory to be valid.

In section 3.4.2, the assumptions introduced by Cassel were analysed in light of Lakatos (1976) proposed typology of classifying strategies used to adjust theoretical propositions in face of anomalies. This typology provides a criterion of appraisal to analyse changes and amendments to theoretical propositions, which may be regarded as scientific or as being introduced in ‘ad-hoc’ manner in order to evade falsification, based on whether they provide increasing or decreasing empirical or theoretical content. In the particular case of Cassel’s amendments to PPP theory, the introduction of restrictive assumptions of (iii) constancy of relative prices and of (iv) no capital flows can hardly be seen as empirically progressive, as it greatly reduced the set of possible falsifiers of the theory. With the introduction of these assumptions, rather than a general theory of exchange rate determination under free trade, PPP as a theory would assume different meaning, valid in a much narrower set of cases. Under restrictive assumptions (i) and (ii) it could still be regarded as a positive theory of exchange rate movements determination (but valid only under specific conditions). However, it would be empirically applicable only to situations in accordance with assumption (ii), i.e. to a case where an initial equilibrium in international trade could be found; and, lastly, in as much as one agrees that situation prevalent in the pre-war period as one of a stable equilibrium in international trade, a theory whose validity was circumscribed to the specific historical period of Cassel writings.

The final judgement whether the introduction of the auxiliary assumptions discussed is to be appraised as done in ‘ad-hoc’ basis, and, as such, if PPP theory by the late 1920’s had
become a degenerative research programme, or if it assumed a new meaning (from positive to normative conception of equilibrium), remains a matter of individual judgement. Nevertheless, the MSRP framework is particularly fruitful to make sense of these developments as it provides a clear framework within which to consider the development, change and decline of theories and research programmes as a whole.

In sum, at the same time that the changes introduced by Cassel insulated his PPP theory from falsification arising from counter-examples, it also provoked a change in its core message as emphasized by Cassel. Rather than understanding PPP theory as positive theory of exchange rate, Cassel would argue that PPP constituted the equilibrium exchange rate in a more normative stance. Under the political debate of return to the gold standard in the 1920’s his main advocacy was for the use of PPP as a benchmark to establish new gold parities without having to go through the perils of deflation. Thus, in contrast with how it is normally portrayed in the modern literature discussed in Chapter 2, PPP would assume more a normative meaning than being a positive long-run theory of exchange rate determination, i.e. able to explain actual long term-movement of exchange rates, as has been emphasized by Kadochnicov (2013).

The analysis of the relationship between PPP theory and the analytical ‘hard-core’ of Cassel’s overall research programme in economics, conducted in section 3.4.1, provide additional arguments to this point. This relationship between the PPP theory and Cassel’s overall research programme has been underemphasized in the literature reviewing Cassel’s work on PPP. Overall, at the core of Cassel’s research programme was his general equilibrium system, which draws on the work of Walras’ and the view of monetary neutrality. While in a closed economy Cassel’s initial system of simultaneous equations would be able to determine relative prices, when he considered an open economy there would be one extra price to be determined, the exchange rate. Hence, the system would become underdetermined. Therefore, it would be necessary to introduce an extra equation to close the system. This extra equation would be the balance of trade, in line with comparative advantage theory. This idea would inform the later definition of PPP provided by Cassel (1928, 1932). In these latter works, Cassel would argue that the only exchange rate which would possess any permanent stability (which could, hence, be associated with equilibrium) would be the exchange rate consistent with equilibrium of the international trade. As such, it would be this exchange rate level which he would term as the purchasing power parity, in the 2nd English edition of ‘The Theory of Social Economy’ (Cassel, 1932).

However, in a world with free mobility of capital internationally and where Central Banks determined interest rates exogenously, which were eventually recognized and incorporated by Cassel in his presentation of theory, the notion of equilibrium associated with
PPP would assume a different connotation. In this format, instead of assuming the role of a positive theory of exchange rate determination, as initially proposed, PPP would assume a much more normative connotation, where the PPP level of exchange rate would be the one consistent with equilibrium in the international trade balance. As such, it can be argued that Cassel’s formulation of PPP theory, ultimately, was much more associated with the current Macroeconomic Balance (MB) approach, as notably adopted by the IMF, and the conception of the associated Fundamental Equilibrium Exchange Rate (FEER), than with the hypothesis of a constant real exchange rate which has been so associated with PPP and Cassel’s name in the modern literature, as has been argued by Kadochnicov (2013).

In the end, it is important to stress that the contrasting interpretation of what PPP means stems from Cassel’s own work and his occasional ambiguous presentations. After all, Cassel did formulate and use, in a positive sense, the hypothesis of constant real exchange rate in his analysis of exchange rate movements during (and in the aftermath of) the First World War, a period marked by great volatility in exchange rates which had been unseen among most European countries for almost half a century. Subsequently, in the context of the debates within the League of Nations about the return of European countries to the gold standard in the first half of the 1920’s, Cassel did defend that new gold parities should be settled by countries exogenously at levels determined by PPP theory, arguing in a normative sense. However, in doing so, I argue that Cassel would fall into the trap of “misplaced concreteness” and “disguised politics”, long highlighted by Machlup (1958), when trying to translate the concept of equilibrium from abstract theory to concrete historical situations. This eventually led him to a continuous process of change and adjustment in his exposition of PPP theory, introducing an increasing number of auxiliary assumptions and necessary conditions, which needed to be fulfilled to sustain his defence of PPP as a theory of real exchange rate equilibrium. Hence, overall, I argue that the tension and contrasting definitions of PPP theory present in Cassel’s economic thought stems from the crossroads between developing economic theory and trying to influence policy-making that he found himself in the years after the First World War. A tension that was inherited in later formulations of the concept in the literature.

Before finalizing this chapter, it is important to highlight the theory of knowledge embedded in Cassel’s views on methodology of economics. Although, PPP can be interpreted as empirically driven theory, it was emphasized in section 3.4.1 that the need for equilibrium exchange rate was a logical necessity of his general equilibrium system, which I identified as one of the ‘hard-core’ elements of his research programme to economic. The general equilibrium models developed in Cassel (1923) consists of the ‘pure’ theoretical foundations of his system.
of analysis, which is firmly grounded within the realm of a deductivism\textsuperscript{126} epistemology. Although, at certain stages the analysis in the subsequent chapter also rely in a deductive reasoning, it has an important difference in regard to the theory of knowledge embedded in Cassel’s methodological framework. In Cassel’s framework of analysis there is the existence of one single true ‘equilibrium’ level for the real exchange rate, dependent solely on monetary and technological factors. This convergence entails that functional income distribution is an adjusting variable, with also a unique equilibrium value, determined in line with neoclassical theory by marginal productivities of labour and capital. In the analysis developed in the next chapter, however, following the classical political economy approach adopted thorough this thesis, functional income distribution is also dependent on power relations and institutional factors operating in society, which may differ between historical periods and between countries. This view follows from the ontological open system approach emphasized by Chick and Dow’s (2005), and will be instrumentalized by the exploration of the relationship between the real exchange rate and functional income distribution under alternative distributional ‘closures’ in the next chapter.

\textsuperscript{126}Here understood as the process of asserting validity of a conclusion from a set of premises which have been allotted a truth value.
4. Harrod-Balassa Samuelson effect: Real Exchange Rate and Functional Income Distribution under alternative ‘closures’

4.1 Introduction

As reviewed in Chapter 2, among one of the most prominent explanations for the observed long-run deviations of real exchange rates from levels consistent with PPP is the so-called Harrod-Balassa-Samuelson effect. In this framework, the observed pattern of more developed countries displaying appreciated real exchange rates would be explained by the role of the evolution of relative prices between non-tradable and tradable commodities. While the price of tradable commodities between countries would be equalized through international competition, there would be no endogenous market mechanism to induce the equalization of the price of non-tradable commodities between countries. The hypothesis, formulated independently by Harrod (1933), Balassa (1964) and Samuelson (1964), was that as labour productivity rises in the production of tradable commodities (typically associated with manufacturing), it would lead to a proportionate increase in real wages in the tradable sector. However, with free mobility of labour between sectors, real wages are equalized between sectors. Consequently, real wages would also increase in the non-tradable sector, while its labour productivity would be stagnant, leading to an increase in its relative costs and prices. Hence, the price of non-tradable commodities would be relatively more expensive in more developed countries, which due to having relatively higher labour productivity in the production of tradables would have higher real wages, leading to higher prices of non-tradable. This would, consequently, lead to more appreciated real exchange rates.

In line with one of the overall aims of the thesis – to analyse the relationship between real exchange rates and income distribution – this chapter seeks to analytically study the relationship between real exchange rate equilibrium in a PPP framework adjusted by the Harrod-Balassa-Samuelson effect and functional income distribution. The background motivation for this analysis, discussed in Chapter 1, is due to the use of this framework in the estimation of real exchange rate undervaluation (overvaluation), which has been associated with higher (lower) economic growth, in particular to the case of developing countries (Dollar, 1992; Razin and Collins, 1997; Eichengreen, 2008; Gala, 2008; Rodrik, 2008; Rapetti et.al, 2012; Missio et. al. 2015). Among the mechanisms through which real exchange rate undervaluation might stimulate economic growth, neo-Kaleckian authors, such as Gala (2008) and Razmi et. al. (2012), argue that the channel is through changes in income distribution towards profits. In neo-Kaleckian open economy growth models (e.g. Blecker 1989) an increase in the profit share has a positive effect on investments and net exports, while it reduces private consumption. Hence, undervaluation would stimulate growth whenever it produces a positive net effect on aggregate
demand, in what has been called a profit-led regime. As such, it is important to analyse the relationship between real exchange rates and income distribution.

In the original formulations the embedded hypothesis in the Harrod-Balassa-Samuelson effect was not fully developed in analytical terms. While in Harrod (1933) and Samuelson (1964) the workings of the model weren’t formally developed, Balassa (1964) provides a simple derivation considering only a case which can be classified as a pure labour economy. As such, these formulations are unsuitable for discussing the underlying functional income distribution consequences of the Harrod-Balassa-Samuelson hypothesis of real exchange rate behaviour. Hence, in this chapter I will develop the Harrod-Balassa-Samuelson effect within a prices of production framework, including positive profits and intermediate inputs, under alternative distributive ‘closures’.

The work developed by Anwar Shaikh and co-authors, reviewed in Chapter 2, provide ample evidence in favour of the relationship between real exchange rates depreciation and falling real unit labour costs, but it is explicitly concerned with unit labour costs of the tradable sector (proxied by the manufacturing sector). The non-tradable sector is not explicitly modelled in the analytical derivation of the real exchange rate, and the Harrod-Balassa-Samuelson effect is only controlled for through the introduction of a proxy variable in the empirical work. In line with the neo-Kaleckian modelling tradition, contributions by Gala (2008), Lima and Porcile (2013), and Ribeiro et. al. (2016) have tackled the relationship between real exchange rate undervaluation, income distribution and economic growth analytically, but have modelled the domestic economy as being composed of only one (tradable) sector. In its turn, Razmi et. al. (2012) do develop a two-sector model which does take into consideration a non-tradable sector. Nevertheless, the non-tradable sector is assumed to use only labour as input and, hence, does not require intermediate commodities either domestically produced or imported from other countries.

Within the Sraffian tradition, the works of Dvoskin and Feldman (2018) and Dvoskin et. al. (2020) also analyses the relationship between real exchange rate and income distribution. However, their analysis differs in focus to what will be pursued in this chapter. Their contribution focuses on the analysis of distributive impacts of nominal devaluation in situations in countries

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127 Rogoff (1992) is the first to formalize the effect within a neoclassical production function framework. However, it does so by altering one of the key assumptions regarding equalization of real wages between sectors. Instead, real wages in each sector are determined by the marginal labour productivity prevalent in each sector. Hence, the sectoral biased technical change assumed in Harrod-Balassa-Samuelson effect do not generate income distribution repercussions.

128 As is demonstrated by Jesus and Kumar (2014) real unit labour costs as is demonstrated by Jesus and Kumar (2014) is equivalent to the wage share when output and wages are deflated by the same price index.
where there is technical dependency (i.e. countries not possessing the technology to produce the capital goods used in production of the tradable commodity). Hence, like in Razmi et. al. (2012), the tradable sector is modelled as using only imported intermediate inputs, while the non-tradable sector is assumed to require only labour as input in production. In this chapter, I will analyse the effect of a technical change in the tradable sector, rather than the effect of a nominal devaluation.

Thus, this chapter seeks to contribute to the literature by analysing the relationship between the real exchange rate and functional income distribution by modelling the non-tradable sector explicitly and with different degrees of complexity in the production process. Specific focus will be devoted to what happens to the relationship between real exchange rate and the wage share when non-tradables commodities are also considered as basic commodities, in the sense of Sraffa (1960). Basic commodities are those commodities which enter in the production process of all other commodities either as intermediate inputs or as consumption goods which are part of the workers’ wage basket (wage-goods); and, hence, their conditions of production affect cost and prices of other commodities. As such, this chapter will show how the real exchange rate and sectoral and aggregate wage shares are affected by a ‘Harrod-neutral’\(^\text{129}\) technical change, which raises the labour productivity in the tradable sector, within a prices of production approach\(^\text{130}\) under alternative distributional ‘closures’. These alternative ‘closures’ will point out towards a different relationship between real exchange rates, functional income distribution and sectoral technical change as countries develop. Subsequently, the econometric analysis developed in chapter 5 will shed light on which analytical ‘closure’ derived in this chapter is more consistent with the empirics of the relationship between real exchange rate and the wage share.

As discussed in section 2.3.1 in Chapter 2, when heterogenous capital goods are considered, to be able to determine relative prices (such as the real exchange rate), together with the value of the social product and income distribution in the surplus approach, one needs to take as given (i) the technical conditions of production; (ii) the composition of the social product in physical terms; and (iii) one of the distributive variables (the real wage or the profit rate). This latter condition opens up the possibility of alternative distributive ‘closures’ for the

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\(^{129}\) In the literature, there are several alternative assumptions on how technical progress affect the productivity of labour and of ‘capital’ (use of intermediate inputs). The assumption of ‘Harrod-neutral’ technical change is that technical change is purely labour-saving, reducing the labour coefficients and maintains constant the technical coefficients. Other assumptions regarding technical change include ‘Hicks-neutral’, ‘Solow-neutral’ and ‘Marx-biased’. For a discussion of these different types of technical change, see Blecker and Setterfield (2019, chapter 2).

\(^{130}\) Inspired by the contributions of Sraffa (1960), in which profits are earned on advanced capital used to pay for workers’ wages (wage fund) and (or) due to intermediate inputs utilized in the production process.
system, namely taking either the real wage or the profit rates as exogenous. As such, within the prices of production framework, I analyse the functional income distribution implications of the so-called Harrod-Balassa-Samuelson effect under two alternative distributives ‘closures’.

In Section 4.3, I explore the consequences of a ‘Harrod-neutral’ technical change in the tradable sector on relative prices between non-tradable and tradable commodities, and on the wage share, when the real wages are considered the exogenous distributive variable (i.e. determined outside the system of equation); and assumed to be rising in both sectors in line with the growth of labour productivity of the tradable sector, in strict accordance to the original hypothesis of the Harrod-Balassa-Samuelson effect. In section 4.4, I analyse the problem when the profit rate is taken as the exogenous distributive variable, due to the international mobility of capital, in line Shaikh’s (1980, 1999, 2016) argument discussed in Chapter 2. However, before analysing the two alternative ‘closures’, to help situate the reader, section 4.2 provides a decomposition of the real exchange rate for a three-commodities case to explicitly account for the difference between the domestically produced and imported tradable commodities.

4.2 Real Exchange Rate Decomposition

In this section, I present a decomposition of the real exchange rate which extends the one presented in section 2.2.4, in the sense that, beyond differentiating between tradables and non-tradables, it differentiates between domestically and internationally produced tradables. This should enable the reader to understand more clearly the connection between the prices of production analysis developed by Shaikh (1999, 2016), reviewed in section 2.3.2, the Harrod-Balassa-Samuelson effect, and the analysis of the effects on the aggregate income distribution, which will be developed throughout the rest of the chapter.

As previously discussed in Chapter 1, the real exchange rate is not a policy variable per se that can be determined by monetary policy alone, nor simply in the financial market. It is rather the nominal exchange rate \( E \)\(^{131} \) multiplied by the ratio of price index between the domestic country \( P_A \) and a foreign country \( P_B \):

\[
\text{RER} = \frac{P_A \times E}{P_B}
\]  \hspace{1cm} (4.2.1)

Taking natural logarithms of the above expression:

\[
\text{rer} = p_A + e - p_B
\]  \hspace{1cm} (4.2.2)

If we assume that the price index of country A is composed of three types of commodities – domestically produced tradable (commodity 1), non-tradable (commodity 2) and

\[\text{currency of country B} \]

\[\text{currency of country A} \]

131 \( E = \frac{\text{currency of country B}}{\text{currency of country A}} \)
imported tradable (commodity 3) — one can express, following Alberola et al. (1999), the price index of each country by the following expressions:

\[ p_A = (1 - \alpha_2^A - \alpha_3^A)p_1^A + \alpha_2^A p_2^A + \alpha_3^A (p_3^B - e) \]  \hspace{1cm} (4.2.3)

\[ p_B = (1 - \alpha_2^B - \alpha_1^B)p_2^B + \alpha_2^B p_2^B + \alpha_1^B (e + p_1^A) \]  \hspace{1cm} (4.2.4)

where \( \alpha_2^A \) and \( \alpha_2^B \) represent the share of non-tradables in the price index of countries A and B, \( \alpha_3^A \) and \( \alpha_1^B \) the share of imported tradables coming from the other country, with the share of domestic tradable being derived as a residual \( (1 - \alpha_2^A - \alpha_3^A) \). Substituting the terms in equation (4.2.2) from (4.2.3) and (4.2.4), simplifying and re-arranging the terms to separate the weights of non-tradables from tradables commodities, the following expression is derived:

\[ \text{rer} = \frac{\alpha_2^A (p_2^A - p_1^A) - \alpha_2^B (p_2^B - p_3^B)}{\alpha_3^A (p_1^A + e - p_3^B)} \]  \hspace{1cm} (4.2.5)

To establish a result in which the real exchange rate is determined only by the price ratio of tradables and non-tradables, more simplistic presentations of this decomposition (such as the one presented in Chapter’s 2 equation 2.2.8), do not differentiate tradables produced domestically from tradables produced abroad. In addition, it is assumed that, under conditions of free trade with negligible transportation costs, the price of the tradable commodity (when expressed in common currency) is equalized between countries (i.e. the Law of One Price holds). Hence, under these simplifying assumptions, the last term in (4.2.5) (i.e. the relative price of domestic to foreign tradables) collapses to zero, as \( p_1^A \) and \( p_3^B \) represent the same commodity.

In the more general setting presented above (in equation (4.2.5) - where each country produces different tradable commodities), to achieve the same result one needs much stronger propositions. Rather than assuming that free trade leads to the equalization of the same commodity in two countries, one needs to assume that either: (i) the nominal exchange rate adjusts to equalize aggregate price indexes of the tradable sector (which is equivalent to assume that the Purchasing Power Parity holds for tradables); or (ii) that the weights under which the tradable commodity produced in each country enters the price index of each country are the same; which would only hold for the case when \( \alpha_2^A = \alpha_2^B \). This implies that tradables goods

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132 While in the case of country B the domestically produced tradable is commodity 3 and the imported one is commodity 1.
133 i.e. capturing what has been dubbed in the literature as the Harrod-Balassa-Samuelson effect.
134 So \( \alpha_2^A \) and \( \alpha_2^B \) don’t appear in the decomposition.
135 That is, if \( (1 - \alpha_2^A - \alpha_3^A) = \alpha_2^B \) and \( (1 - \alpha_2^A - \alpha_3^A) = \alpha_3^A \).
produced in the foreign country (B) are consumed domestically (A) in the same proportion in each country. However, this scenario is more exception than rule; it would happen only by fluke.

Considering that in reality countries at different levels of development have different consumption baskets, the relative weights are different in each country, implying that the change in the relative prices of the tradables each country produces will have an effect on the real exchange rate (rer) between them. This point was explored by Shaikh’s (2016) approach, reviewed in section 2.3.2, which explains the behaviour of relative price of domestic to foreign tradables as a consequence of changes in the relative real unit labour costs between the domestically produced tradable (commodity 1) and the foreign produced (by country B) tradables (commodity 3 here). However, Shaikh’s (1999, 2016) price model does not explicitly account for the role of non-tradables; instead, the effect of the change in relative prices between tradable and non-tradable sector (i.e. the Harrod-Balassa-Samuelson effect) is introduced explicitly only in the empirical analysis using proxy variables such as relative real GDP per capita.

As such, Shaikh’s approach provides support to the view that real exchange rate depreciation is associated, ceteris paribus, with lower real unit labour cost and, consequently, with a lower wage share in the tradable sector. However, it does not allow, by itself, a derivation of the relationship between real exchange rate depreciation and changes in the aggregate income distribution. In the next sections, I therefore analyse the relationship between relative prices between non-tradable and tradable commodities within one country (i.e. the 1st term in equation (4.2.5)), looking specifically at sectoral biased technical change, embedded in the Harrod-Balassa-Samuelson hypothesis of real exchange rate behaviour.

4.3 Functional Income Distribution under Harrod-Balassa-Samuelson model of Real Exchange Rate behaviour in a prices of production framework with exogenous Real Wages

In this section we analyse the changes in functional income distribution that accompany the changes in the real exchange rate driven by the Harrod-Balassa-Samuelson effect of a ‘Harrod-neutral’ (pure labour-saving) technical change in the tradable sector when the real wage is assumed to be exogenous. Furthermore, labour productivity in the non-tradable sector is assumed to be stagnant. As discussed in the introduction of this chapter, from the original authors who first proposed the biased technical change hypothesis in order to explain real exchange rate behaviour, only Balassa (1964) provides a formal analysis of the effect. However, he did so considering an economy which used only labour to produce both goods and with zero profits, in what within the classical surplus approach would be classified as a pure labour economy. Its main limitation, therefore, is that it does not bring out the income distributional
implications of a change on the real exchange rate caused by the Harrod-Balassa-Samuelson effect.

To analyse the income distribution dimension, the simplest format to introduce capital and profits in a prices of production framework is to model capital as a wage fund, where profits are earned on advanced capital used to fund workers’ wages which are paid before the production process (that is, wages are paid ex-ante). Hence, in section 4.3.1 I present a two-sector wage fund model where the technical conditions of production, real wages and the physical composition of the social product are taken as exogenous, and the system is solved for profit rate, relative prices, the income distribution in each sector, as well as for the aggregate economy. This is the case which most closely resemble the canonical neo-Kaleckian model, where the mark-up\(^{136}\) accrues solely on top of labour costs. Subsequently, introducing more complexity to this system, in section 4.3.2 I analyse the case where the tradable commodity is used as an intermediate input and the non-tradable commodity is a wage-good in both sectors. In section 4.3.3 I also analyse the case where the non-tradable commodity enters the system as an intermediate input, while the tradable commodity is a wage-good, in both sectors.

### 4.3.1 A Wage fund model

Consider an economy composed of two sectors, a tradable and a non-tradable sector. To simplify the notation, as in Section 4.2, the tradable sector will be denoted as sector 1 and the non-tradable sector will be denoted as sector 2\(^{137}\). Due to free mobility of labour and capital between sectors, the real wage rate (\(w\)) and the profit rate (\(r\)) are assumed to be uniform across the two sectors. The labour coefficient (\(l_j\)) are given by the number of workers (\(N_j\)) divided by the gross output (\(X_j\)) and, thus, reflect the inverse of the labour productivity. In this setting, the price system is given by:

\[
\begin{align*}
    p_1 &= p_1 w l_1 (1 + r) \\
    p_2 &= p_2 w l_2 (1 + r)
\end{align*}
\]

In this setting, there is a total of 6 unknowns (the two prices, the two distributive variables and two labour coefficients) with only 2 equations, rendering the system as undetermined. Taking one of the prices as the numeraire addresses one of the degrees of freedom of the system; hence, dividing both equations by for \(p_1\) the system can be re-written as:

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\(^{136}\) This mark-up is equal to the profit rate when capacity utilization is at its normal level.

\(^{137}\) Through this chapter the wage-good will be always defined as the commodity whose price (\(p_j\)) multiplies the real wage (\(w\)) in the price system.
\[ 1 = w_l(1 + r) \]  
\[ \frac{p_2}{p_1} = w_l(1 + r) \]

To be able to solve the system it is necessary to take the two labour coefficients and one of the distributive variables as given. In this section, I will analyse the system taking real wages as given and will solve the system for the profit rate \((r)\) and relative prices \((\frac{p_2}{p_1})\). Solving equation (4.3.3) and (4.3.4) for the profit rate (with the wage rate as given):

\[ r = \frac{1 - w_l}{w_l} = \frac{\frac{p_2}{p_1} - w_l}{w_l} \]  

Solving the two expressions for the profit rate in (4.3.5) for relative prices, one is able to determine the relative prices independently of income distribution:

\[ \frac{p_2}{p_1} = w_l \left( 1 + \frac{1 - w_l}{w_l} \right) = w_l \left( \frac{w_l + 1 - w_l}{w_l} \right) = \frac{w_l}{w_l} \]  

\[ \frac{p_2}{p_1} = \frac{l_2}{l_1} \]  

As such, an increase in the labour productivity in the tradables sector \((l_1)\) vis-à-vis the non-tradable sector labour productivity \((l_2)\) leads to a change in relative prices in the same proportion, making the non-tradable commodity relatively more expensive. In its turn, \textit{ceteris paribus}, this leads to an appreciation of the country’s real exchange rate, in line with the hypothesis of the Harrod-Balassa-Samuelson effect.

In order to understand the income distribution implications of this change in relative prices, it is necessary to determine the wage share in each sector, given by the ratio between total wages paid in a sector \((W_j)\) and value added \((Y_j)\). Total wages paid in a sector will depend on the total number of workers employed in this sector \((N_j)\), together with the already defined real wage rate \((w)\) and the price of the tradeable \((p_1)\), which is the sole wage good in the system considered. Under the pure labour case here, where production is carried out only using labour as inputs, Value added \((Y_j)\) in each sector will be equal to the (money) value of its gross output \((X_j)\). Under this set of definitions, one can write the wage share of sector 1, as the following:

\[ \text{Wage Share}_1 = \frac{W_1}{Y_1} = \frac{p_1 w N_1}{p_1 X_1} \]  

\[^{138}\text{In the next section (4.4) I will do the opposite, take the profit rate as determined outside the system and analyse what happen to the real wages and relative prices.}\]
Cancelling out the price terms, and since from above $X_1 = \frac{N_1}{l_1}$, the wage share of sector 1 (tradable sector) can re-expressed as:

$$Wg\ Share_1 = w l_1 \quad (4.3.9)$$

Equation (4.3.9) shows that the wage share in sector 1 will be determined ultimately by the real wages paid to each worker and its labour coefficient (the inverse of labour productivity). Hence, if one follows the assumption embedded in the original formulations of Harrod (1933), Balassa (1964) and Samuelson (1964), that real wages increase in line with labour productivity which (which implies that $\Delta w = -\Delta l_1$), then the wage share in sector 1 (tradable) will remain constant as the country’s equilibrium real exchange rate appreciates.

Now to understand what will happen to the aggregate wage share, it is necessary to analyse what happens with the wage share in sector 2 (the non-tradable sector). The wage share in sector 2 will be defined similarly to equation (4.3.8). The main difference, however, will be that while the relevant price to define nominal wages ($p_1w$) will be the price of the wage-good ($p_1$), for the determination of the sector’s 2 gross output in value terms ($Y_2$) will be $p_2$:

$$Wg\ Share_2 = \frac{W_2}{Y_2} = \frac{p_1 w N_2}{p_2 X_2} \quad (4.3.10)$$

where $X_2$ is the gross output of the non-tradable commodity in physical terms. As it was the case in sector 1, total wages in sector two is given by $W_2$, which consists of the price of the wage good ($p_1$) multiplied by the real wage ($w$) and the number of workers employed in the sector ($N_2$). By substituting gross output in the above expression by $X_2 = \frac{N_2}{l_2}$, dividing numerator and denominator by the numeraire ($p_1$) and simplifying, one arrives at:

$$Wg\ Share_2 = \frac{w N_2}{p_2 \cdot \frac{N_2}{l_2}} \quad (4.3.11)$$

Substituting $\frac{p_2}{p_1}$ from equation (4.3.7) and simplifying, one arrives at the final expression for the wage share in sector 2:

$$Wg\ Share_2 = w l_1 \quad (4.3.12)$$

Thus, in a wage fund model where labour is the only input used in production, the wage share of sector 2 (non-tradable) sector is also determined by the real wages and labour productivity of sector 1 (tradable sector). Thus, if we again follow the embedded assumption in the original formulations of Harrod (1933), Balassa (1964) and Samuelson (1964) that real wages in sector 2 increases in line with labour productivity of sector 1, then the wage share in sector 2 will also be constant as the real exchange rate appreciates. Hence, in an economy where labour is the only input necessary for production, the tradable commodity (commodity 1) is the only wage-good.
and profits are earned on advanced capital used to pay wages, then a biased technical change in the tradable sector, *ceteris paribus*, leads to an appreciation of the country’s real exchange rate, but will not affect the aggregate functional income distribution. This is a consequence of the fact that in the system considered here in this sub-section only the tradable good is a basic good, i.e. enters in the price equation of both goods.

Consequently, if one considers a case with intermediate inputs, but where tradable commodity is at the same time used as an intermediate input and as a wage-good, while the non-tradable good is a non-basic commodity (a final good consumed solely by capitalists), results will not differ. This occurs because, since it produces a non-basic commodity, what happens in the non-tradable sector has no consequence for the reminder of the price-system. Therefore, the case where the same commodity is used as a wage and intermediate good will not be discussed explicitly in this chapter, as its result will be equivalent to the result obtained in this section. Alternatively, in the next sections I will analyse cases where both commodities are basic goods, entering in all equations of the price system either as an intermediate input or as the wage-good (i.e. enters the price equations multiplying the real wage, *w*, and, hence, appears in all equations).

**4.3.2 Tradable commodity used as an intermediate good, non-tradable commodity used as the wage-good**

Developing the analysis further, in this section I will analyse the case where the tradable commodity is used as an intermediate good and the non-tradable commodity now enters into the price system as the wage-good (i.e. the commodity whose price multiplies the real wages, *w*). Once one has to consider a production system where there is more than one basic commodity\(^{139}\), relative prices will no longer be determined in physical terms. And, consequently, relative prices will no longer be determined independently from the distribution of income. As a consequence, the change in real exchange rate will also depend on changes in income distribution and no longer solely on technical change. To highlight this let’s analyse a case where the tradable commodity (produced by sector 1) is used both as an intermediate input and as a final good, while the non-tradable commodity (produced by sector 2) enters the system as the wage-good, which in national account terms is also considered as a final good. Moreover, to simplify the algebra let’s consider the case where wages are paid *post-factum* (i.e. after the

\(^{139}\) Irrespective of whether the commodity enters in the production systems as an intermediate input or as a wage-good.
period of production) and, hence, profits are earned on advanced capital used to purchase intermediate inputs necessary for production:

\[ p_1 = (p_1 a_{11})(1 + r) + p_2 w l_1 \]  
\[ p_2 = (p_1 a_{12})(1 + r) + p_2 w l_2 \]  

Dividing (4.3.13) and (4.3.14) by the numeraire \( p_1 \):

\[ 1 = (a_{11})(1 + r) + \frac{p_2}{p_1} w l_1 \]  
\[ \frac{p_2}{p_1} = (a_{12})(1 + r) + \frac{p_2}{p_1} w l_2 \]

In this system the profit rate will no longer be determined independently from relative prices. Isolating the profit rate in equations (4.3.15) and (4.3.16) yields:

\[ r = \frac{1 - a_{11} - \frac{p_2}{p_1} w l_1}{a_{11}} = \frac{\frac{p_2}{p_1} - a_{12} - \frac{p_2}{p_1} w l_2}{a_{12}} \]

Analogously to the profit rate, the relative price will also no longer be determined independently from income distribution. In particular it will now depend on the real wages \( w \) together with the technical conditions of production \( (a_{11}, a_{12}, l_1, l_2) \). Solving (4.3.17) for the relative price ratio:

\[ \frac{p_2}{p_1} = \frac{a_{12}}{a_{11}(1 - w l_2) + a_{12} w l_1} \]  

If real wages increase in line with the fall in \( l_1 \), then the denominator in (4.3.18) falls as the unit labour cost in sector 1 \( (w l_1) \) remains constant. However, when the unit labour cost in sector 2 \( (w l_2) \) increases this means that the non-tradable commodity (commodity 2) will become relatively more expensive. In its turn, *ceteris paribus*, this leads to an appreciation of the country’s real exchange rate equilibrium, in line with the Harrod-Balassa-Samuelson hypothesis.

With regard to the impact of these changes in the aggregate functional income distribution, the wage share in both sectors would increase. The increase in the wage share in sector 2 follows primarily from the increase in the sector’s unit labour cost \( (w l_2) \) due to, on the one hand, real wages increasing proportionally to the fall in \( l_1 \); on the other, the labour coefficient in sector 2 (which produces the non-tradable commodity) has remained unchanged. However, there is a further factor driving sector’s 2 wage share, which will also drive the wage share of sector 1 (which produces the tradable commodity) upwards, related to the change in relative prices between intermediate inputs and nominal wages. To see this, it is useful to derive

\[^{140}\text{However, it’s important to emphasize that main conclusions are not altered if one we consider the case where wages are paid ex-ante.} \]
the wage share in both sectors again. In the current price system setting, the wage share in sector 1 is defined by:

$$Wg\ Share_1 = \frac{W_1}{Y_1} = \frac{p_2wN_1}{p_1X_1 - p_1A_{11}}$$ \hspace{1cm} (4.3.19)

Where $X_1$ is the gross output in sector 1 (tradable commodity) and $A_{11}$ total intermediate consumption of the tradable commodity demanded by sector 1. By dividing numerator and denominator by the numeraire ($p_1$), substituting $A_{11} = a_{11}X_1$ and $X_1 = \frac{N_1}{l_1}$ in the above expression and simplifying, one arrives at the following expression for the wage share:

$$Wg\ Share_1 = \frac{p_2wl_1}{p_1(1 - a_{11})}$$ \hspace{1cm} (4.3.20)

Considering that the unit labour cost of sector 1 ($wl_1$) is kept constant by assumption, the wage share in sector 1 increases as $\frac{p_2}{p_1}$ increases, following the increase in the real unit labour cost of sector ($wl_2$)\(^{141}\), as can be seen in equation (4.3.18). Moreover, as the next section will make clear, this result is the same irrespective of which commodity is taken as the wage-good and which assumes the role of intermediate input. For instance, if the tradable commodity was the wage-good and the non-tradable commodity the intermediate input, it would be value added which would fall (due to an increase in the cost of intermediate inputs), while total nominal wages ($p_2w$) would remain constant (as it will become clearer in the next section). In the case presented here, total nominal wages increase while value added remain constant (as can be more easily observed in equation (4.3.19)). It will be only in the case where the same commodity is used both as an intermediate and as a wage good that the wage share in sector 1 will remain constant.

In turn, the wage share in Sector 2, in the current setting, can be defined by:

$$Wg\ Share_2 = \frac{W_2}{Y_2} = \frac{p_2wN_2}{p_2X_2 - p_1A_{12}}$$ \hspace{1cm} (4.3.21)

where $X_2$ is the gross output of sector 2 (non-tradable commodity) and $A_{12}$ intermediate consumption of the tradable commodity by sector 2. Dividing numerator and denominator by

\(^{141}\) The real unit labour cost of sector 2 ($wl_2$) will increase because, following the original assumptions embedded in the Harrod-Balassa-Samuelson effect, real wages increase in line with the increase in labour productivity of sector 1 ($l_1$, the tradable sector) while labour productivity in sector 2 ($\bar{l}_2$, the non-tradable) remains constant.
the numeraire \((p_1)\) and substituting \(A_{12} = a_{12}X_2\) and \(X_2 = \frac{N_2}{l_2}\) in the above expression, we have:

\[
Wg\ Share_2 = \frac{\frac{p_2}{p_1}wl_2}{\frac{p_2}{p_1} - a_{12}}
\]

(4.3.22)

Since now the relative price appears both in the numerator and the denominator of (4.3.22) it is useful to substitute the relative price \(\left(\frac{p_2}{p_1}\right)\) in the above expression from equation (4.3.18) and simplify, arriving at an expression which relates the wage share in sector 2 to its ultimate determinants:

\[
Wg\ Share_2 = \frac{wl_2}{1 - a_{11}(1 - wl_2) - a_{12}wl_1}
\]

(4.3.23)

The unit labour cost (ULC) in sector 2 \((wl_2)\) appears both in the numerator and the denominator. However, considering that \(a_{11} < 1\) and \(wl_1\) is constant, the wage share in sector 2, which produces the non-tradable commodity, will univocally increase when labour productivity in sector 1 (labour coefficient, \(l_1\)) increase (decrease). Moreover, the increase will be higher the smaller the technical coefficient \(a_{11}\) is. To appreciate this result more readily, it might be useful to take the derivative of (4.3.23) with respect to the real wage:

\[
\frac{\partial Wg\ Share_2}{\partial w} = \frac{l_2(1 - a_{11})}{(1 - a_{11}(1 - wl_2) + a_{12}wl_1)^2} > 0
\]

(4.3.24)

The following can, thus, be established, when only the tradeable commodity is used as an intermediate input. When the equilibrium real exchange rate appreciates following a biased technical change in the tradable sector (sector 1), and real wages increase in both sectors in line with the labour productivity of the tradable sector, the aggregate wage share will univocally increase. While the wage share in sector 1 will remain constant if the wage-good is the same as the intermediate good, it will increase whenever these are different. Moreover, the wage share in sector 2 will increase following the increase in its unit labour cost, in addition to the relative price change.

4.3.3 Non-tradable commodity used as an intermediate input and tradable as wage good

Even though sectors such as agriculture and manufacturing, which are traditionally considered as a tradable activity, are the ones most typically associated with intermediate inputs, non-tradable activities such as Services, Electricity and other public utility services are
also prevalently used as intermediate. Therefore, in this section, I will analyze if the introduction of non-tradables commodities (with stagnant labour productivity) as an intermediate input affects the results observed in the previous section. In this setting the price system is given by:

\[ p_1 = (p_2 a_{21})(1 + r) + p_1 w_1 \]  
\[ p_2 = (p_2 a_{22})(1 + r) + p_1 w_2 \]  

(4.3.25)  
(4.3.26)

Dividing (4.3.25) and (4.3.26) for the numeraire \( p_1 \):

\[ 1 = \left( \frac{p_2}{p_1} a_{21} \right) (1 + r) + w_1 \]  
\[ \frac{p_2}{p_1} = \left( \frac{p_2}{p_1} a_{22} \right) (1 + r) + w_2 \]  

(4.3.27)  
(4.3.28)

If, as before, real wages are taken as the exogenous variables and one isolates the profit rate in equations (4.3.27) and (4.3.28):

\[ r = \frac{1 - \frac{p_2}{p_1} a_{21} - w_1}{\frac{p_2}{p_1} a_{21}} = \frac{\frac{p_2}{p_1} (1 - a_{22}) - w_2}{\frac{p_2}{p_1} a_{22}} \]  

(4.3.29)

Analogously to the case of the previous section, the relative price will also no longer be determined independently from income distribution. Solving (4.3.29) for relative prices yields:

\[ \frac{p_2}{p_1} = \frac{a_{22} - a_{22} w_1 + a_{21} w_2}{a_{21}} \]  

(4.3.30)

The change in roles played by each commodity does not affect the effect of an increase in sector’s 1 labour productivity on relative prices, with commodity 2 becoming relatively more expensive under the assumption that real wages increase with sector’s 1 labour productivity.

Consequently, the effect on functional income distribution will be the same as in the case of the previous section, where the tradable commodity was considered as an intermediate good. As such, the wage share in both sectors will increase. In the current price system setting, the wage share in sector 1 is defined by:

\[ W_1 \text{Share}_1 = \frac{W_1}{Y_1} = \frac{p_1 N_1 w}{p_1 X_1 - p_2 A_{21}} \]  

(4.3.31)

Where \( X_1 \) is the gross output of sector 1 (tradable commodity) and \( A_{21} \) intermediate consumption of the non-tradable commodity (produced by sector 2) demanded by sector 1. By dividing numerator and denominator by the numeraire \( (p_1) \), substituting \( A_{21} = a_{21} X_1 \) and \( X_1 = \frac{N_1}{l_1} \) in the above expression and simplifying, one arrives at the following expression for the wage share:
\[ Wg \ Share_1 = \frac{wl_1}{1 - \frac{p_2}{p_1}a_{21}} \] (4.3.32)

As such as the non-tradable commodity becomes relatively more expensive \(\frac{p_2}{p_1}\) the denominator of expression (4.3.32) falls, explaining the increase in the wage share of sector 1, while it’s unit labour cost \((wl_1)\) remains constant. In its turn, the wage share in sector 2 is given by:

\[ Wg \ Share_2 = \frac{W_2}{Y_2} = \frac{p_1wN_2}{p_2X_2 - p_2A_{22}} \] (4.3.33)

Where \(X_2\) is the gross output of sector 2 and \(A_{22}\) intermediate consumption of the non-tradable commodity by sector 2. Dividing numerator and denominator by the numeraire \((p_1)\) and substituting \(A_{22} = a_{22}X_2\) and \(X_2 = \frac{N_2}{l_2}\) in the above expression, one has that:

\[ Wg \ Share_2 = \frac{wl_2}{\frac{p_2}{p_1}(1 - a_{22})} \] (4.3.34)

In the case of sector 2 both the numerator (due to the rise in the sector’s unit labour cost) and the denominator (due to the rise in the relative price of the non-tradable commodity) change. Hence, to be able to determine the overall effect on the sector’s wage share it’s necessary to substitute \(\frac{p_2}{p_1}\) in (4.3.34) for (4.3.30), which yields:

\[ Wg \ Share_2 = \frac{a_{21}wl_2}{(a_{22}(1 - wl_1) + a_{21}wl_2)(1 - a_{22})} \] (4.3.35)

Considering that the unit labour cost of sector 1 \((wl_1)\) is kept constant by assumption, it’s useful to substitute \(wl_1\) for a constant \((\delta)\) and take the partial derivative of (4.3.35) in relation to wages to analyse what happens to the wage share of sector 2 following the increase in real wages triggered by the rise in labour productivity in sector 1\(^{142}\), which yields:

\[ \frac{\partial Wg \ Share_2}{\partial w} = \frac{a_{21}a_{22}l_2(1 - \delta)}{(1 - a_{22})(a_{22}(1 - \delta) + a_{21}wl_2)^2} \leq 0 \] (4.3.36)

In mathematical terms, the derivative in (4.3.36) can be either positive or negative. However, to be positive the unit labour cost in sector 1 \((wl_1 = \delta)\) needs to be higher than 1 \((\delta - 1 > 0)\). Therefore, its production would be economically unviable. Hence, economically the derivative in (4.3.36) will be always positive. As such the wage share in sector 2 increases in line with the

\(^{142}\) Alternatively, one can compute the total derivative of the wage share of sector 2, which would include the partial derivatives of \(l_1\) and \(w\).
rise of its unit labour costs. This occurs despite the rise in relative price of the non-tradable commodity, which leads to an increase in the amount of capital (in value) needed to fund production, as now the non-tradable commodity is used as an intermediate input.

In summary, the results of this section confirm the results obtained in section 4.3.2: the increase in labour productivity in the sector 1 (tradable commodity) leads to a change in relative prices, which makes the non-tradable commodity relatively more expensive. If real wages in both sectors increase in line with the labour productivity of sector 1, absolute price of the tradable commodity will remain constant, while prices of the non-tradable commodity will increase. Consequently, ceteris paribus, this leads to an appreciation of the real exchange rate of the domestic currency vis a vis foreign currency, in line with the Balassa-Samuelson effect. At the same time these changes in labour productivity in sector 1, real wages, and in relative prices, produce changes in income distribution in both sectors, with the wage share in both sectors increasing, and in the aggregate, as a result. Analysing a case where both goods are using intermediate inputs will not affect the direction of the results, but will make, however, the algebra much more complicated\textsuperscript{143}. Hence, the formal presentation of this case is omitted in this chapter.

\textbf{4.3.4 Analysis of the profit rate in cases with intermediate inputs and implications for the behaviour of the Real Exchange Rate}

Before concluding the analysis of the distributive ‘closure’ adopted throughout section 4.3, there is one issue of concern which has remained untouched so far, that is - the impact of the ‘Harrod-neutral’ (labour-saving) technical change in sector 1, when accompanied by a proportionate increase in real wages in both sectors, on the general rate of profit of the economy when both commodities are basic goods. This is of particular importance because, in a world where free international mobility of capital increasingly becomes the norm, changes in profitability of investments affect capital flows. And, in its turn, these will affect nominal exchange rates and, potentially, real exchange rates.

To analyse the effect of changes on the profit rate, when both commodities are treated as basic goods (as discussed in subsection 4.3.2 and 4.3.3), it is useful to return to equation (4.3.29), substituting the relative price by equation (4.3.30) to yield:

\[
\frac{1}{1 - \frac{p_2}{p_1}a_{21} - \frac{w_2}{a_{21}}} = \frac{1 + w_1(a_{22} - 1) - a_{22} - a_{21}w_2}{a_{22} - a_{22}w_1 + a_{21}w_2} \tag{4.3.37}
\]

\textsuperscript{143} In particular, relative prices become a second-degree function.
Treating the unit labour cost of sector 1 \((wl_1)\) as a constant, following the assumption taken in this section, and replacing it with \(\delta\), one can re-express (4.3.37) as:

\[
r = \frac{1 + \delta(a_{zz} - 1) - a_{zz} - a_{z1}wl_2}{a_{zz} - a_{zz} \delta + a_{z1}wl_2}
\]  

(4.3.38)

Finally, taking the derivative of the profit rate with respect to changes in real wages in (4.3.38), one observes the effect on the profit rate associated with Harrod-Balassa-Samuelson hypothesis regarding the evolution of sectoral technical change and real wages:

\[
\frac{\partial r}{\partial w} = \frac{a_{z1}w_2(\delta - 1)}{(a_{zz}(1 - \delta) + a_{z1}wl_2)^2} \leq 0
\]  

(4.3.39)

In mathematical terms, the derivative can be either positive or negative. However, to be positive the unit labour cost in sector 1 \((wl_1 = \delta)\) needs to be higher than 1 \((\delta - 1 > 0)\). This would imply that the price of commodity 1 would not be sufficient to cover even its labour costs, resulting in negative profit rates. Therefore, its production would be economically unviable. Hence, for positive levels of real wages, the profit rate will fall when real wages in both sectors rises in line with the labour productivity in sector 1 (the tradable sector)\(^{144}\):

\[
\frac{\partial r}{\partial w} < 0 \quad \text{for} \quad w > 0
\]  

(4.3.40)

As a consequence, in an economy with free mobility of capital where production is undertaken with non-zero profits, and with more than one basic good the assumption regarding the evolution of real wages embedded in the Harrod-Balassa-Samuelson effect becomes problematic. This is because a change in relative prices where the non-tradable commodity becomes relatively more expensive leads to an appreciation of the real exchange rate will imply a fall in the profit rate in the domestic economy vis-à-vis the foreign economy. And, as such, this movement would, eventually, provoke a counter-acting force of depreciation of the nominal exchange rate as capital flows would move from the domestic to the foreign economy, a condition that would be unsustainable in the long-run for most economies\(^{145}\).

Moreover, it is important to highlight the international monetary system operated under very different conditions when Samuelson (1964) and Balassa (1964) developed their

\(^{144}\) Moreover, it is important to note that this is a result that emerges only once one considers the, more general, setting in which both commodities are basic goods. In the wage fund setting, for example, considered in section 4.3.2 the profit rate (defined by (4.3.5)) is determined solely by the unit labour cost of sector 1, and as this remains constant, the profit rate would remain constant.

\(^{145}\) With the notable exception of countries responsible for the emission of the ‘reserve’ currency, like the United States.
argument. In the 1950’s and 1960’s countries operated under the regulations of the so called ‘Bretton-Woods’ system, which placed several restrictions on capital mobility and on flexibility of nominal exchange rates. Hence, while the issue of a falling profit rate under this system would not have immediate repercussions on the exchange rates, this is no longer the case under the circumstances that contemporary capitalism operates. As such, the traditional distributive ‘closure’ of real wages increasing in line with labour productivity of tradable sector, which is still largely used in the neo-Kaleckian literature, is unsuitable to represent the dynamics of today’s world. Owing to this perceived issue, in the next section I explore the relationship between functional income distribution, a ‘Harrod-neutral’ technical change in the tradable sector and the real exchange rate following an alternative ‘closure’. Instead of taking the real wages as the exogenous distributive variable, the profit rate is assumed to be exogenously determined and equalized between countries due to international mobility of capital.

4.4 Functional Income Distribution under Harrod-Balassa-Samuelson model of Real Exchange Rate behaviour in a prices of production framework with exogenous Profit Rates

In this section I analyse the changes in functional income distribution that accompany the changes in the real exchange rate, which are driven by the Harrod-Balassa-Samuelson effect of a biased technical change in the tradable sector. However, now the analysis is conducted taking the profit rate as the exogenous distributive variable, using the Sraffian prices of production framework. As it was done in the previous section, technological change is assumed to be ‘Harrod-neutral’, i.e. it reduces solely the labour coefficients. Moreover, also following the same structure of the previous section, analysis will be conducted in each sub-section with increasing degrees of complexity. However, to avoid unnecessary repetition of previously obtained results some cases are omitted, in particular the case of a Wage Fund model. This is due to the fact that, in this particular setting, the change in the choice of the exogenous distributive variable doesn’t affect any of the derived results in sub-section 4.3.1. In the Wage Fund setting, where production uses only labour as input, relative prices will depend solely on the relative labour coefficients. Thus, the wage and capital shares in both sectors are affected solely by changes in the exogenous distributive variables (the real wage in the last section and the profit rate in the current section), and not by technical change.

Therefore, I start in section 4.4.1 considering the case where production is carried out in both sectors using the tradable commodity as an intermediate input and the non-tradable commodity as the sole wage good. Section 4.4.2 deals with the reverse situation, that is when the non-tradable commodity is used as an intermediate input and the tradable commodity is the sole wage good. Contrary to what was observed in section 4.3, the results in regard to
functional income distribution in these two cases will differ. In the one hand, in the case section 4.4.1 the wage share of the tradable sector remains stable and of the non-tradable sector increases. In the other hand, in the case analysed in section 4.4.2 the wage share of the tradable sector falls and of the non-tradable sector remains constant. These opposing results on the wage share depending on which commodity is used as an intermediate input (the productivity stagnant non-tradable or the productivity progressive tradable), leads to the analysis in section 4.4.3 to consider a case where both commodities are used as intermediate inputs. Results regarding income distribution point to a scenario where the wage share in the tradable sector falls, while the wage share in the non-tradable sector increases. As such, this situation doesn’t allow one to univocally claim that the aggregate wage share will either increase or decrease. However, further analysis reveals that the overall effect on the aggregate wage share depends on the relative proportions with which each commodity is used as an intermediate good relative to their total output. Hence, if a higher ratio of the tradable commodity output is used as an intermediate input than the aggregate wage share increases, while if a higher ratio of the non-tradable commodity output is used as an intermediate input than the aggregate wage share falls. This theoretical result is highlighted with the aid of three numerical examples in the end of the section 4.4.3.

4.4.1 Tradable as intermediate and non-tradable as a wage good

As it was done in section 4.3.2, this section considers a case where the tradable commodity enters the production system as an intermediate commodity and the non-tradable commodity is the sole wage-good considered in the system. However, now the profit rate is taken as the exogenous distributive variable. Moreover, to simplify the algebra let’s consider the case where the wages are paid post-factum (i.e. after the period of production) and, hence, profits are earned on advanced capital used to purchase intermediate inputs necessary for production:

\[ p_1 = p_2 a_{21}(1 + r) + p_1 w l_1 \]  
\[ p_2 = p_2 a_{22}(1 + r) + p_1 w l_2 \]  

Dividing (4.4.1) and (4.4.2) for \( p_1 \):

\[ 1 = a_{11}(1 + r) + \frac{p_2}{p_1} w l_1 \]  

\[ 146 \] However, it’s important to emphasize that main conclusions are not altered one we consider the case where wages are paid ex-ante.
\[
\frac{p_2}{p_1} = a_{12}(1 + r) + \frac{p_2}{p_1} w_l_2
\]  
(4.4.4)

Solving (4.4.3) and (4.4.4) for real wages:

\[
w = \frac{1 - a_{11}(1 + r)}{\frac{p_2}{p_1} l_1} = \frac{p_2}{p_1} \frac{1 - a_{12}(1 + r)}{l_2}
\]  
(4.4.5)

The relative price will also no longer be determined independently from income distribution. In particular it will now depend on the profit rate \(r\) beyond the technical conditions of productions \(a_{11}, a_{12}, l_1, l_2\):

\[
\frac{p_2}{p_1} = \frac{l_2 + (l_1a_{12} - l_2a_{11})(1 + r)}{l_1}
\]  
(4.4.6)

As such, what will happen to the relative prices following an increase in labour productivity in sector 1 (fall in the labour coefficient \(l_1\)) will depend on the derivative of equation (4.4.6) with respect to a change in \(l_1\):

\[
\frac{\partial p}{\partial l_1} = \frac{-l_2 + l_2a_{11}(1 + r)}{l_1^2} \leq 0
\]  
(4.4.7)

The result of the derivative of relative prices \(\frac{p_2}{p_1} = p\) can, in principle, be either positive or negative. However, for it to be negative it requires that \(a_{11}(1 + r) > 1\). However, from (4.4.5) one may note that this would imply negative real wages. Hence, the tradable commodity (produced by sector 1) will become univocally cheaper relative to the non-tradable commodity (produced by sector 2) for all levels of positive real wages. As it happened in section 4.3.2.

However, in regard to the impact of these changes in the sectoral functional income distribution, the results differ from those observed in section 4.3.2. As the profit rate is now constant, real wages will increase by less than labour productivity in sector 1. Consequently, as will become clear below, the wage share in sector 1 (tradable commodity) will remain constant, while it will increase in sector 2 (non-tradable commodity). To see this it’s useful to recall equation (4.3.20) which defines the wage share in sector 1 for the case where tradable commodity is used as an intermediate and non-tradable commodity is the wage good:

\[
Wg Share_1 = \frac{\frac{p_2}{p_1} w_l_1}{(1 - a_{11})}
\]  
(4.3.20)

However, instead of substituting the relative prices in the above expression, we know substitute real wages by (4.4.5):
The relative prices and labour coefficient cancel out and the above expression simplifies to:

\[ Wg\ Share_1 = \frac{p_2 l_1}{p_1 l_1} \left(\frac{1 - a_{11}(1 + r)}{1 - a_{11}}\right) \tag{4.4.8} \]

Therefore, the wage share in sector 1 (whose price is taken as the numeraire) will depend solely on the technical coefficient and the rate of profits, and, hence, will not be affected by the change in the labour productivity. Intuitively, what we have here is that nominal wages (instead of real wages) increase in line with the labour productivity of sector 1, that is, the rise of real wages plus the increase in the prices of the non-tradable commodity (the wage-good) relative to the tradable commodity is equal to the increase in labour productivity of sector 1. However, in sector 2, as nominal wages \(\frac{p_2}{p_1}w\) increase in line with sector’s 1, while its labour productivity remains unchanged, the wage share increases. Hence, the increase in the wage share in sector 2 reflects the increase in real wages and in the relative price of the wage-good (here assumed to be the non-tradable commodity)\(^{147}\). To see this let’s recall equation (4.3.22) which defines the wage share in sector 2:

\[ Wg\ Share_2 = \frac{p_2 w l_2}{p_2 - a_{12}} \tag{4.3.22} \]

If we substitute real wages by (4.4.5) and simplify:

\[ Wg\ Share_2 = \frac{l_2 - l_2 a_{11}(1 + r)}{p_2 l_1 - l_2 a_{12}} \tag{4.4.10} \]

Considering that the relative price \(\frac{p_2}{p_1}\) increases while the labour coefficient of sector 1 \(l_1\) decreases, it’s useful to substitute the relative prices term by equation (4.4.6), and simplify, to understand what will happen to the wage share in sector 2.

\[ Wg\ Share_2 = \frac{l_2 - l_2 a_{11}(1 + r)}{l_1 a_{12} r + l_2 - l_2 a_{11}(1 + r)} \tag{4.4.11} \]

Hence, in sector 2 (which produces the non-tradable commodity) the wage share depends on the labour and technical coefficients of sector 1 and sector 2, beyond the rate of profits. Moreover, as the labour coefficient in sector 1 only appears in the denominator as a

\(^{147}\) Again, if we change the wage good to the tradable commodity results in quantitative terms may differ, but the direction of change will remain unaltered.
positive number, one can safely conclude that the wage share in sector 2 increases as labour coefficient of sector 1 (productivity) falls (increases):

$$\frac{\partial Wg \text{ Share}_2}{\partial l_1} < 0 \quad (4.4.12)$$

As such, as the non-tradable commodity (produced by sector 2) becomes relatively more expensive, which *ceteris paribus* appreciates the real exchange rate of the country (as can be seen in equation (4.2.5)), the aggregate wage share of the economy will tend to increase considering that it remains constant in sector 1 and it increases in sector 2, when the tradable commodity is the only intermediate input used in the production of both commodities and the non-tradable commodity is the wage-good.

### 4.4.2 Non-tradable as an intermediate commodity and tradable as wage good

In this section I consider what happens to relative prices and to the wage share when one considers the non-tradable commodity (produced by sector 2, where the labour productivity is assumed to be stagnant) as an intermediate input and the tradable commodity (produced by sector 1, where labour productivity increases) is the final wage-good. What the results of this section will highlight is that changes in the aggregate functional income distribution will be opposite to the those observed in the previous section. Following the increase in labour productivity in the production of the tradable commodity (produced by sector 1), the change in relative prices, which makes the non-tradable commodity (produced by sector 2) more expensive, will lead to a fall in the wage share in sector 1, while the wage share in Sector 2 will remain unaltered. Therefore, this indicates that the relationship between sectoral biased technical change, real exchange rate and income distribution will be different, depending on the role played by each commodity in the production system. In the setting under consideration in this sub-section the price system is defined as followed:

$$p_1 = p_2 a_{21}(1 + r) + p_1 w l_1 \quad (4.4.13)$$

$$p_2 = p_2 a_{22}(1 + r) + p_1 w l_1 \quad (4.4.14)$$

Dividing (4.4.13) and (4.4.14) for $p_1$:

$$1 = \frac{p_2}{p_1} a_{21}(1 + r) + w l_1 \quad (4.4.15)$$

$$\frac{p_2}{p_1} = \frac{p_2}{p_1} a_{22}(1 + r) + w l_2 \quad (4.4.16)$$
Solving (4.4.15) and (4.4.16) for real wages:

\[
w = \frac{1 - \frac{p_2}{p_1} a_{21} (1 + r)}{l_1} = \frac{\frac{p_2}{p_1} (1 - a_{22}(1 + r))}{l_2}
\]  (4.4.17)

Solving (4.4.17) for the relative price:

\[
\frac{p_2}{p_1} = \frac{l_2}{l_1 - (l_1 a_{22} - l_2 a_{21}) (1 + r)}
\]  (4.4.18)

Again, as we had in section 4.4.1, the result of the derivative of relative prices \( \frac{p_2}{p_1} = p \) in relation to a change in the labour coefficient \( l_1 \) can, in principle, be either positive or negative. However, it would be negative only if \( a_{22} (1 + r) > 1 \) and from equation (3.5) is possible to note that this would imply negative real wages.

\[
\frac{\partial p}{\partial l_1} = \frac{-l_1 + l_1 a_{22}(1 + r)}{(l_1 - (l_1 a_{22} - l_2 a_{21}) (1 + r))^2} > 0; \quad \text{if } w > 0 \]  (4.4.19)

Hence, once again, the tradable commodity (produced by sector 1) will become univocally cheaper relative to the non-tradable commodity (produced by sector 2) for all levels of positive real wages.

In regard to the impact of these changes in the aggregate functional income distribution results we be opposite to the one observed in the previous section. The wage share of sector 1 (tradable commodity) will fall, while it is the wage share in sector 2 (non-tradable commodity) which remains unaltered. To see this analytically, it is useful to derive once again the wage share for both sectors. wage share in sector one was given by equation (4.3.32):

\[
W_g Share_1 = \frac{w l_1}{1 - \frac{p_2}{p_1} a_{21}}
\]  (4.3.32)

By substituting real wages \( w \) for (4.4.17) and simplifying, one gets the following expression for sector’s 1 wage share:

\[
W_g Share_1 = \frac{1 - \frac{p_2}{p_1} a_{21} (1 + r)}{1 - \frac{p_2}{p_1} a_{21}} \]  (4.4.20)

Substituting the relative price in the equation above by equation (4.4.18) and simplifying, one arrives at:

\[
W_g Share_1 = \frac{l_1 - l_1 a_{22} (1 + r)}{l_1 - l_1 a_{22}(1 + r) + l_2 a_{21} r}
\]  (4.4.21)
Now considering that the labour coefficient of sector 1 \((l_1)\) appears both at the top and at the bottom of (4.4.21) to determine what happens to the wage share in sector 1 it’s useful to take the partial derivative in relation to \(l_1\), which yields:

\[
\frac{\partial Wg \ Share_1}{\partial l_1} = \frac{l_2 a_{21} r - l_2 a_{21} a_{22} r (1 + r)}{(l_1 (1 - a_{22} (1 + r))) + l_2 a_{21} r} \leq 0
\]  
\((4.4.22)\)

Again, as we had for the relative price, the change in the wage share following a change in the labour coefficient of sector 1 can, in principle, be either positive or negative depending on the value of the numerator in (4.4.22) will be either positive or negative, that is whether:

\[
l_2 a_{21} r \leq l_2 a_{21} a_{22} r (1 + r)\]
\((4.4.22)\)

Which can be simplified to:

\[
1 \leq a_{22} (1 + r)
\]  
\((4.4.24)\)

However, once again, if one recalls equation (4.4.17), which defines the real wages in this price system, \(a_{22} (1 + r) > 1\) would imply negative real wages. Hence, for any positive level of real wages the wage share of sector 1 falls following a fall in the labour coefficient (increase in the labour productivity) of sector 1:

\[
\frac{\partial Wg \ Share_1}{\partial l_1} > 0; \ for \ all \ w > 0
\]  
\((4.4.25)\)

Intuitively, this is the consequence of the fact that profits are gained on top of advanced capital advanced in intermediate goods. As the relative price of intermediate inputs increase and the technical coefficients remains constant, the capital advanced is higher and, hence, for a given profit rate, the profit share will be higher and the wage share will smaller.

In sector 2, however, the wage share will now remain constant depending solely on technical coefficients and on the profit rate as it happened with sector 1, in the previous section, when it’s commodity (tradable) was solely used as an intermediate. Recalling equation (4.3.34) which defined the wage share in sector 2 for the case where non-tradable is used as an intermediate input and the tradable commodity is the wage good:

\[
Wg \ Share_2 = \frac{wl_2}{p_2 (1 - a_{22})}
\]  
\((4.4.26)\)

Substituting real wages \((w)\) for (4.4.17) and simplifying, one gets the following expression for sector’s 2 wage share:

\[
Wg \ Share_2 = \frac{1 - a_{22} (1 + r)}{1 - a_{22}}
\]  
\((4.4.27)\)
Hence, once we switch the roles played by the tradable and the non-tradable commodities the results flip. Now it is in sector 1 (final tradable good) that the wage share depends on the labour and technical coefficients of sector 1 and sector 2, beyond the rate of profits. In sector 2 (intermediate non-tradable good) the wage share will depend solely on the technical coefficient and the rate of profits and, hence, will not be affected by the change in the labour productivity in sector 1 and in real wages.

As it happened in the previous sub-section (4.4.1), the share of value added going to wages in the sector producing the intermediate input (sector 2 in this section) will not be affected by an increase in labour productivity in sector 1, that is a fall in its labour coefficient. In this section, this is the role played by sector 2 (which produces the non-tradable commodity) instead of sector 1 (which produces the tradable commodity), as in the preceding section. The effect of a change in the labour coefficient of sector 1 is not as straight forward as it was in sector 2 in the preceding section, but it will be positively associated (for positive real wage rates), meaning that a fall in the labour coefficient (increase in labour productivity) leads to a fall in the wage share of sector 1 (tradable final good).

The results obtained in this sub-section are markedly different from the results observed in sub-section 4.3.3, when real wages were taken as the exogenous distributive variable and assumed to be increasing at the same rate as labour productivity. In that case when non-tradable commodity was used as an intermediate input the wage share in both sectors increased. Now, under the alternative closure of exogenous profit rate, the change in labour productivity in sector 1 (which produces the tradable commodity) leads to a fall in the wage share in the sector, while it will remain constant in sector 2. This is due to the change in the commodity which is used as an intermediate input. Now, as the intermediate input (the non-tradable commodity) used by sector 1 becomes relatively more expensive than the sector’s output, nominal value added in sector 1 falls. In sector 2, as the intermediate input and the output commodity used is the same, Value-Added stay constant.

Throughout section 4.3 the assumption regarding which commodity is used as an intermediate good didn’t affect the direction of the results. In both sections 4.3.2 and 4.3.3, the wage share in both sectors would increase following the increase in labour productivity in sector 1 and the associated increase in real wages. In the current section (4.4) the direction of change in the wage share of each sector is markedly different depending on which commodity is used as an intermediate input. As such, this leads to a need to consider a more general case where both commodities are used as intermediate inputs in the production of both goods, a case which will be investigated in the next sub-section.
4.4.3 Both commodities as intermediate inputs and tradable commodity as a wage-good:

The analysis in the previous sections considered cases with one intermediate input, analysing in turn what happened when, first, the tradable was an intermediate input and, secondly, the tradable was an intermediate input. Considering the different results obtained regarding the effect on the wage share, in this section I will analyse the case where both commodities are used as intermediate inputs, increasing the degree of complexity. Therefore, in this section I analyse the effect of a biased sectoral technical change on relative prices and on each sector and aggregate wage share when both tradable and non-tradable commodities are used as intermediates in the production of both goods. The analysis in this section reveals that the wage share in sector 1, which produces the tradable commodity, will fall (as it had in sub-section 4.4.2) and will increase in sector 2, which produces the non-tradable commodity (as it had occurred in sub-section 4.4.1). The fact that the wage share in each sector goes in different direction, however, leaves the overall effect to the aggregate wage share indetermined. However, I show by means of a numerical example that the overall effect depends on which sector has a higher ratio of its own output devoted to final consumption relative to its use as intermediate inputs. As such, the aggregate wage share can increase even when the wage share falls in sector which has a larger weight in the economy’s value added while it is increasing in a sector with a small weight in the economy’s value added.

In a two-sector, two-commodities case where both commodities are used as intermediate goods and the tradable commodity is the wage-good, the price system can be represented as:

\[ p_1 = (p_1 a_{11} + p_2 a_{21})(1 + r) + p_1 w l_1 \]  \hspace{1cm} (4.4.28)

\[ p_2 = (p_1 a_{12} + p_2 a_{22})(1 + r) + p_1 w l_2 \]  \hspace{1cm} (4.4.29)

Dividing (4.4.28) and (4.4.29) for the numeraire \( p_1 \):

\[ 1 = (a_{11} + \frac{p_2}{p_1} a_{21})(1 + r) + w l_1 \]  \hspace{1cm} (4.4.30)

\[ \frac{p_2}{p_1} = (a_{12} + \frac{p_2}{p_1} a_{22})(1 + r) + w l_2 \]  \hspace{1cm} (4.4.31)

Solving (4.4.30) and (4.4.31) for the real wages \( w \):

\[ w = \frac{1 - a_{11}(1 + r) - \frac{p_2}{p_1} a_{21}(1 + r)}{l_1} = \frac{\frac{p_2}{p_1} - a_{12}(1 + r) - \frac{p_2}{p_1} a_{22}(1 + r)}{l_2} \]  \hspace{1cm} (4.4.32)
Solving for the relative price:

\[
\frac{p_2}{p_1} = \frac{l_2(1 - a_{11}(1 + r)) + l_1 a_{12}(1 + r)}{l_1(1 - a_{22}(1 + r)) + l_2 a_{21}(1 + r)}
\]  \hspace{1cm} (4.4.33)

Taking the derivative of relative prices \((\frac{p_2}{p_1} = p)\) in relation to a change in the labour coefficient \((l_1)\) yields:

\[
\frac{\partial p}{\partial l_1} = \frac{l_2(a_{11}(1 + r) + a_{22}(1 + r) + a_{12} a_{21}(1 + r)(2 + r)) - 1 - a_{11} a_{22}(1 + r)(2 + r))}{(l_1(1 - a_{22}(1 + r)) + l_2 a_{21}(1 + r))^2} \leq 0
\]  \hspace{1cm} (4.4.34)

Which again, as it happened in the previous sub-sections, can be either positive or negative in mathematical terms. However, for it to be positive, the numerator needs to be positive, which would imply that real wages are negative, as it also happened in the one intermediate input case. Hence, a fall in the \(l_1\) leads to an increase in the relative price:

\[
\frac{\partial p}{\partial l_1} < 0 \quad for \quad all \quad w > 0
\]  \hspace{1cm} (4.4.35)

In regard to the impact of these changes in the sectoral functional income distribution, what one finds is that there is a combination of the results of sections 4.4.1 and 4.4.2. While the wage share of sector 1 (tradable commodity) will fall, the wage share in sector 2 (non-tradable commodity) will increase. To see this analytically it is useful to derive once again the wage share for both sectors. In the current setting of the model, the wage share in sector 1 is defined by:

\[
Wg\ Share_1 = \frac{Wg}{Y_1} = \frac{p_1 w N_1}{p_1 X_1 - p_1 A_{11} - p_2 A_{21}}
\]  \hspace{1cm} (4.4.36)

Where \(X_1\) is the gross output and \(A_{11}\) and \(A_{21}\) intermediate consumption of sector 1 for the tradable and non-tradable commodities, respectively. Dividing numerator and denominator by \(p_1\) (numeraire):

\[
Wg\ Share_1 = \frac{\frac{p_1}{p_1} w N_1}{\frac{p_1}{p_1} X_1 - \frac{p_1}{p_1} A_{11} - \frac{p_2}{p_1} A_{21}}
\]  \hspace{1cm} (4.4.37)

Substituting \(A_{11} = a_{11} X_1\), \(A_{21} = a_{21} X_1\) and \(X_1 = \frac{N_1}{l_1}\) in the above expression and simplifying, one has that:

\[
1 + a_{11} a_{22}(1 + r(2 + r)) - a_{11}(1 + r) - a_{22}(1 + r) - a_{12} a_{21}(1 + r)(2 + r)
\]

\[
l_1(1 - a_{22}(1 + r)) + l_2 a_{21}(1 + r)
\]

\[\text{This becomes clearer if one substitute (4.4.33) into (4.4.32) and simplify, which yields:}
\]

\[
w = \frac{1 + a_{11} a_{22}(1 + r(2 + r)) - a_{11}(1 + r) - a_{22}(1 + r) - a_{12} a_{21}(1 + r)(2 + r)}{l_1(1 - a_{22}(1 + r)) + l_2 a_{21}(1 + r)}
\]

148 This becomes clearer if one substitute (4.4.33) into (4.4.32) and simplify, which yields:
\[
W_g Share_1 = \frac{wN_l}{\frac{N_l}{l_1} \left(1 - a_{11} - \frac{p_2}{p_1} a_{21}\right)} = \frac{wl_1}{1 - a_{11} - \frac{p_2}{p_1} a_{21}} \tag{4.4.38}
\]

Substituting the wages in the above expression by \((4.4.32)\) and re-arranging the terms, one arrives at:

\[
W_g Share_1 = \frac{1 - a_{11} (1 + r) - \frac{p_2}{p_1} a_{21} (1 + r)}{1 - a_{11} - \frac{p_2}{p_1} a_{21}} \tag{4.4.39}
\]

Considering that the labour coefficient of sector 1 \((l_1)\) doesn’t appear explicitly in \((4.4.39)\), and only implicitly through its effect on relative prices, it’s useful to analyse the change in the wage share in sector 1 directly in relation to the change relative price \((\frac{p_2}{p_1} = p)\) \(^{149}\):

\[
\frac{\partial W_g Share_1}{\partial p} = - \frac{a_{21} r}{\left(1 - a_{21} + \frac{p_2}{p_1} a_{21}\right)^2 (1 + r)} < 0 \tag{4.4.40}
\]

As such, as the non-tradable commodity becomes relatively more expensive the wage share in sector 1 will fall (for given profit rates and real wages equalized between the two sectors), following the ‘Harrod-neutral’ technical change in sector 1 implied in the Harrod-Balassa-Samuelson effect.

In its turn in the current setting the wage share in sector 2 will be given by:

\[
W_g Share_2 = \frac{W_2}{Y_2} = \frac{p_1 wN_2}{p_2 X_2 - p_1 A_{12} - p_2 A_{22}} \tag{4.4.41}
\]

Where \(X_2\) is the gross output in sector 2 and \(A_{12}\) and \(A_{22}\) are the intermediate consumption of sector 2 for the tradable and non-tradable commodities, respectively. Dividing numerator and denominator by \(p_1\) (numeraire):

\[
W_g Share_2 = \frac{\frac{p_1}{p_1} wN_2}{\frac{p_2}{p_1} X_2 - \frac{p_1}{p_1} A_{12} - \frac{p_2}{p_1} A_{22}} \tag{4.4.42}
\]

Substituting \(A_{12} = a_{12} X_2\) and \(X_2 = \frac{N_2}{l_2}\) in the above expression, yields:

\[
W_g Share_2 = \frac{\frac{N_2}{l_2} \left(\frac{p_2}{p_1} - a_{12} - \frac{p_2}{p_1} a_{22}\right)}{\frac{p_2}{p_1} - a_{12} - \frac{p_2}{p_1} a_{22}} = \frac{wl_2}{\frac{p_2}{p_1} - a_{12} - \frac{p_2}{p_1} a_{22}} \tag{4.4.43}
\]

\(^{149}\) Instead of substituting the relative prices and differentiating the wage share in relation to sector’s 1 labour coefficient.
Substituting $w$ by $(4.4.32)$, one gets:

$$\frac{W g \text{ Share}_2}{W g \text{ Share}_1} = \frac{\frac{p_2}{p_1} - a_{12}(1 + r) - \frac{p_2}{p_1}a_{22}(1 + r)}{\frac{p_2}{p_1} - a_{12} - \frac{p_2}{p_1}a_{22}}$$

Again, considering that the labour coefficient of sector 1 ($l_1$) doesn’t appear explicitly in $(4.4.44)$, and only implicitly through its effect on relative prices, the effect of a change in relative prices on the wage share of sector 2 of a Harrod-biased technical change in sector 1 can be analysed directly in relation to the change relative price ($\frac{p_2}{p_1} = p$):

$$\frac{\partial W g \text{ Share}_2}{\partial p} = \frac{a_{12}r}{\left(1 - a_{12} + \frac{p_2}{p_1}a_{12}\right)^2 (1 + r)} > 0$$

As such, consequently, wage share in sector 2 will increase following the increase in the relative prices ($\frac{p_2}{p_1}$), caused by a reduction in $l_1$ for given profit rates.

Now with both goods used as intermediaries, the wage share of both sectors will depend on what happens to relative prices, which in its turn depends, beyond the profit rates, also on the labour and technical coefficients and, hence, will not remain constant following the increase in labour productivity (fall in the labour coefficient, $l_1$, in the sector 1). However, considering that the wage share in sector 1 will fall and in sector 2 will increase, the impact on the aggregate wage share will not be easily determined (as occurred on the previous sections). Instead the overall impact will depend on the magnitude of the changes of the wage share in different directions in each sector (the shift effect) and in the share of each sector in the economy (share effect). However, as relative prices changes will affect both the sectoral wage shares, in line with what has been presented so far, and Value Added by each sector, it will also cause changes in the shares of each sector in the economy. Hence, the intra-sectorial shift effects and the share effects in this case are inter connected.

In particular, the overall effect in the aggregate wage share will depend on which sector has the higher ratio of its physical output used as intermediate input. When both sectors have the same ratio of its output devoted to intermediate consumption the aggregate wage share will remain constant, following an increase (fall) in labour productivity (labour coefficient) in sector 1, which produces the tradable commodity. When the ratio of the tradable commodity’s output used as intermediate inputs is higher than the ratio of the non-tradable commodity than the aggregate wage share increases. And, consequently, when the ratio of the tradable commodity’s output used as intermediate inputs is smaller than the ratio of the non-tradable commodity than the aggregate wage share falls.
Proposition:

\[ \frac{A_{11} + A_{12}}{X_1} = \frac{A_{21} + A_{22}}{X_2} \quad \text{then} \quad \frac{\partial Wg \ Share}{\partial l_1} = 0 \]

\[ \frac{A_{11} + A_{12}}{X_1} > \frac{A_{21} + A_{22}}{X_2} \quad \text{then} \quad \frac{\partial Wg \ Share}{\partial l_1} < 0 \]

\[ \frac{A_{11} + A_{12}}{X_1} < \frac{A_{21} + A_{22}}{X_2} \quad \text{then} \quad \frac{\partial Wg \ Share}{\partial l_1} > 0 \]

It’s important to emphasize that what I’m advancing here is not which sector has the higher weight in total valued added (final demand), but comparing the proportions of output of each sector which is devoted to final and intermediate consumption of each sector. To clarify this intuition let’s look at 3 different numerical examples: (a) when the same proportion of the physical output of each commodity is used as an intermediate input; (b) when the tradable commodity (produced by sector 1) is more intensively used as an intermediate input than the non-tradable commodity (produced by sector 2); (c) when the non-tradable commodity (produced by sector 2) is more used as an intermediate input than the tradable commodity (produced by sector 1).

**Numerical examples:**

(a) **Same proportions**

Suppose that an economy produces 2 commodities, one tradable commodity (produced by sector 1) and another non-tradable commodity (produced by sector 2). Moreover, free mobility of capital and labour across sectors ensures that profit and wage rates between both sectors are equalized (\(r_1 = r_2\) and \(w_1 = w_2\)). At initial period (t=0) the technical conditions of production (technical and labour coefficients) as well as the profit rate are given in the table 4.1 bellow:

**Table 4.1: Exogenous Variables (Technical and Labour coefficients and the Profit rate) in period t = 0**

<table>
<thead>
<tr>
<th>Country A</th>
<th>Technical coefficient ((a_{1j}))</th>
<th>Technical coefficient ((a_{2j}))</th>
<th>Labour coefficient ((l))</th>
<th>Profit Rate ((r))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sector 1 (tradable)</td>
<td>0.3</td>
<td>0.1</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Sector 2 (non-tradable)</td>
<td>0.1</td>
<td>0.2</td>
<td>2</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Under these initial conditions, the relative price is equal to 1:

\[
\frac{p_2}{p_1} = \frac{l_2 - (l_2a_{11} - l_1a_{12})(1 + r)}{l_1 - (l_1a_{22} - l_2a_{21})(1 + r)} = 0.823
\]

While the real wage is equal to:

\[
w = \frac{1 - (a_{11} + \frac{p_2}{p_1}a_{21})(1 + r)}{l_1} = 0.213
\]

The wage shares in sector 1 and 2 will be equal to:

\[
Wg Share_1 = \frac{1 - (a_{11} + \frac{p_2}{p_1}a_{21})(1 + r)}{1 - a_{11} - \frac{p_2}{p_1}a_{21}} = 0.690 = 69.0\%
\]

\[
Wg Share_2 = \frac{\frac{p_2}{p_1} - \left(a_{12} + \frac{p_2}{p_1}a_{22}\right)(1 + r)}{\frac{p_2}{p_1} - a_{12} - \frac{p_2}{p_1}a_{22}} = 0.763 = 76.3\%
\]

To analyse the aggregate wage share it will also be necessary information on the quantity system (see Table 4.2), to be able to derive the weights of each sector. At the initial period, physical output of the tradable commodity (produced by sector 1) is of 810 units, while of the non-tradable commodity (produced by sector 2) is of 500 units. Given the technical coefficients provided in table 4.1 this means that sector 1 demands 243 units of its own output, the tradable commodity, as intermediate inputs and 81 units of the non-tradable commodity. In its turn sector 2 requires a total of 50 units of the tradable commodity and 100 units of the non-tradable commodity as intermediate inputs. Given the labour coefficients total employment in sector 1 is 1620 and sector 2 is 1000. Considering the net physical output and relative prices determined in the price system discussed above the value added (at current prices) in sector 1 is equal to $500.3 and of $279.4 in sector 2.

### Table 4.2: Quantity System

<table>
<thead>
<tr>
<th>Country A</th>
<th>Physical Output</th>
<th>Total Intermediate Consumption</th>
<th>Labour Coefficient</th>
<th>Labour Added (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sector 1</strong> (tradable)</td>
<td>810</td>
<td>243</td>
<td>81</td>
<td>1620</td>
</tr>
<tr>
<td><strong>Sector 2</strong> (non-tradable)</td>
<td>500</td>
<td>50</td>
<td>100</td>
<td>1000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>293</td>
<td>181</td>
<td>2620</td>
<td>779.7</td>
</tr>
</tbody>
</table>

*Where applicable*
Hence, the aggregate wage share is given by the wage share in each sector multiplied by the sector’s weight in total value added:

\[ Wg\ Share_{Ag} = \frac{Wg\ Share_1 \cdot VA_1 + Wg\ Share_2 \cdot VA_2}{VA_1 + VA_2} \]

\[ Wg\ Share_{Ag} = \frac{0.690 \cdot 500.3 + 0.763 \cdot 279.4}{779.7} = \frac{558.7}{779.7} = 71.7\% \]

Now let’s analyse what happens to the relative prices and to the aggregate wage share following an increase in the labour productivity in tradable sector (commodity 1) of 25%, that is, the labour coefficient falls to 1.5:

Table 4.3: Exogenous Variables (Technical and Labour coefficients and the Profit rate) in period \( t = 1 \)

<table>
<thead>
<tr>
<th>Country A</th>
<th>Technical coefficient ((a_{1j}))</th>
<th>Technical coefficient ((a_{2j}))</th>
<th>Labour coefficient ((l))</th>
<th>Profit Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sector 1  (tradable)</td>
<td>0.3</td>
<td>0.2</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Sector 2 (non-tradable)</td>
<td>0.1</td>
<td>0.3</td>
<td>2</td>
<td>0.5</td>
</tr>
</tbody>
</table>

The relative prices \(\frac{p_2}{p_1}\) will now equal to:

\[ \frac{p_2}{p_1} = \frac{l_2 - (l_2 a_{11} - l_1 a_{12})(1 + r)}{l_1 - (l_1 a_{22} - l_2 a_{21})(1 + r)} = 0.981 \]

While real wages will increase to:

\[ w = \frac{1 - (a_{11} + \frac{p_2}{p_1} a_{21})(1 + r)}{l_1} = 0.269 \]

As a consequence, the wage share in both sectors will no longer be the same. Both wage shares will change, but in opposite directions. The wage share in sector 1 (tradable) will fall from 69.0% to 66.9% and the wage share in sector 2 (non-tradable) will increase from 76.3% to 78.4%:

\[ Wg\ Share_1 = \frac{1 - (a_{11} + \frac{p_2}{p_1} a_{21})(1 + r)}{1 - (a_{11} - \frac{p_2}{p_1} a_{21})(1 + r)} = 0.669 = 66.9\% \]

\[ Wg\ Share_2 = \frac{\frac{p_2}{p_1} - (a_{12} + \frac{p_2}{p_1} a_{22})(1 + r)}{\frac{p_2}{p_1} - (a_{12} - \frac{p_2}{p_1} a_{22})(1 + r)} = 0.784 = 78.4\% \]
The change in relative prices will cause changes in the value added in both sectors, as can be seen in Table 4.4 below:

Table 4.4: Value Added per sector in each period

<table>
<thead>
<tr>
<th>Country A</th>
<th>Value Added ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t=0</td>
</tr>
<tr>
<td>Sector 1 (tradable)</td>
<td>500.3</td>
</tr>
<tr>
<td>Sector 2 (non-tradable)</td>
<td>279.4</td>
</tr>
<tr>
<td>Total</td>
<td>779.7</td>
</tr>
</tbody>
</table>

Consequently, the aggregate wage share in period t=1 will be equal to:

\[
Wg Share_{Ag} = \frac{0.669 \times 487.5 + 0.784 \times 342.6}{830.1} = \frac{594.8}{830.1} = 71.7\%
\]

The aggregate wage share has remained unchanged between the two periods despite the change in the wage share in both sectors. This is related to the fact the changes in the relative weights of each sector have exactly counterbalanced the higher fall in sector’s 1 wage share relative to the increase observed in sector’s 2. In period t=0, the share in total value added of sector 1 was of 64.16% while sector’s 2 corresponded to 35.84%. In period t=1, however, the share in total value added of sector 1 fell to 58.73% while sector’s 2 increased to 41.27%.

The fact that the share effect exactly counterbalanced the intra-sectoral shift effects has to do with one specific issue, which is the main finding which I would like to emphasize here. The ratio of usage of each commodity between intermediate input and final demand was equal. And whenever this is the case the aggregate wage share will remain unchanged as the intra-sectoral changes in the wage share caused by a sectoral biased technical change (which then led to changes in relative prices). In the above example we have that this ratio is exactly the same for both sectors; that is, which implies that 36.2% of the physical output in each sector is used as intermediate inputs:

\[
\frac{A_{11} + A_{12}}{X_1} = \frac{243 + 50}{810} = 0.362 = \frac{81 + 100}{500} = \frac{A_{21} + A_{22}}{X_2}
\]

(b) Tradable commodity is more intensively used as an intermediate input than the non-tradable commodity

Now let’s consider an example when the ratio of the tradable commodity’s output used as intermediate inputs is higher than the ratio of the non-tradable commodity and analyse what happens to the aggregate wage share, following an increase (fall) in labour productivity (labour coefficient) in sector 1. For simplicity, without loss of generality, let’s consider a case where the
profit rate and all the technical and labour coefficients are the same as in example (a) (see table 4.1), which implies that relative prices and the wage share in each sector will be the same.

Consider that at the initial period t=0 (Table 4.5), physical output of the tradable commodity (produced by sector 1) is still of 500 units, while of the non-tradable commodity (produced by sector 2) is also of 500 units. Given the technical coefficients provided in table 4.5 this means that sector 1 demands 150 units of the tradable commodity as intermediate inputs and 50 units of the non-tradable commodity. In its turn, sector 2 will now require a total of 50 units of the tradable commodity and 100 units of the non-tradable commodity as intermediate inputs. Given the labour coefficients, total employment in sector 1 is 1000 and sector 2 is also 1000. Considering the net physical output and relative prices determined in the price system discussed above, the value added (at current prices) in sector 1 is equal to $308.8 and of $279.4 in sector 2.

**Table 4.5: Quantity System**

<table>
<thead>
<tr>
<th>Country A</th>
<th>Physical Output</th>
<th>Total Intermediate Consumption</th>
<th>Labour Coefficient $(l_i)$</th>
<th>Labour $(N_i)$</th>
<th>Value Added (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sector 1</td>
<td>500</td>
<td>150</td>
<td>2</td>
<td>1000</td>
<td>308.8</td>
</tr>
<tr>
<td>(tradable)</td>
<td></td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sector 2</td>
<td>500</td>
<td>50</td>
<td>2</td>
<td>1000</td>
<td>279.4</td>
</tr>
<tr>
<td>(non-tradable)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total*</td>
<td>200</td>
<td>150</td>
<td></td>
<td>3020</td>
<td>588.2</td>
</tr>
</tbody>
</table>

*Where applicable

As such in this case, the ratio of intermediate consumption to physical output of each commodity is of:

\[
\frac{A_{11} + A_{12}}{X_1} = \frac{150 + 50}{500} = 0.4
\]

\[
\frac{A_{21} + A_{22}}{X_2} = \frac{50 + 100}{500} = 0.3
\]

Hence, in this case, 40% of the output of sector 1 is devoted to intermediate consumption, while only 30% of the output of sector 2 is devoted to intermediate consumption. As a consequence, following the reduction in the labour coefficient $(l_i)$ in sector 1 the aggregate wage share is expected to increase. In period t=0, the aggregate wage share in total value added will be:
Following an increase in the labour productivity in tradable sector of 25%, the labour coefficient falls from 2 to 1.5. The change in relative prices will be the same as in example (a) and the total value added will change, as can be seen in Table 4.6 below:

### Table 4.6: Value Added per sector in each period

<table>
<thead>
<tr>
<th>Country A</th>
<th>Value Added</th>
<th>Value Added</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>($) t=0</td>
<td>($) t=1</td>
</tr>
<tr>
<td>Sector 1 (tradable)</td>
<td>308.8</td>
<td>300.9</td>
</tr>
<tr>
<td>Sector 2 (non-tradable)</td>
<td>279.4</td>
<td>342.6</td>
</tr>
<tr>
<td>Total</td>
<td>588.2</td>
<td>643.5</td>
</tr>
</tbody>
</table>

Consequently, the Aggregate wage share in period $t=1$ will be equal to:

$$Wg\ Share_{Ag} = \frac{0.690 \times 308.8 + 0.763 \times 279.4}{588.2} = \frac{426.5}{588.2} = 72.5\%$$

The aggregate wage share has, thus, increased by 0.5 pp between the two periods. This is related to the fact that the sector 2 has now a larger weight in value added in relation to the example (a). In period $t=0$, the share in total value added of sector 1 was of 52.5% while sector’s 2 corresponded to 47.5%. In period $t=1$, however, the share in total value added of sector 1 fell to 46.8% while sector’s 2 increased to 52.2%.

**c) Non-tradable commodity is more intensively used as an intermediate input than the tradable commodity**

If, on the other hand, we have an economy where a larger ratio of the output of sector 2 (which produces the non-tradable commodity) is devoted to intermediate consumption relative to the ratio of sector’s 1 output (tradable commodity), which is consumed as intermediate inputs, the aggregate wage share will fall following a biased sectoral technical change which increases the labour productivity in sector 1 (i.e. a reduction in $l_1$).

Let’s consider a case where the profit rate and all the technical and labour coefficients are the same as in the previous examples. As such the price system and the wage share in each sector will be the same as in example (a) and (b). However, now, at the initial period $t=0$ (Table 4.7), physical output of each commodity is equal to 600. Given the technical coefficients provided in table 4.1 this means that sector 1 demands 300 units of the tradable commodity as intermediate inputs and 100 units of the non-tradable commodity. In its turn, sector 2 will now
require only 50 units of the tradable commodity and 100 units of the non-tradable commodity as intermediate inputs. Given the labour coefficients, total employment in each sector 1 is of 2000 and 1000 in sector 2. Considering the net physical output and relative prices determined in the price system discussed above, the value added (at current prices) in sector 1 is equal to $617.6 and of $279.4 in sector 2.

**Table 4.7: Quantity System**

<table>
<thead>
<tr>
<th>Country A</th>
<th>Physical Output</th>
<th>Total Intermediate Consumption</th>
<th>Labour Coefficient (l_i)</th>
<th>Labour (N_i)</th>
<th>Value Added (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A_{1j}</td>
<td>A_{2j}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sector 1</td>
<td>(tradable)</td>
<td>1000</td>
<td>300</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>Sector 2</td>
<td>(non-tradable)</td>
<td>500</td>
<td>50</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>Total*</td>
<td></td>
<td>300</td>
<td>200</td>
<td>3000</td>
<td></td>
</tr>
</tbody>
</table>

*Where applicable

As such in this case, the ratio of intermediate consumption to physical output of each commodity is of:

\[
\frac{A_{11} + A_{12}}{X_1} = \frac{300 + 50}{1000} = 0.35
\]

\[
\frac{A_{21} + A_{22}}{X_2} = \frac{100 + 100}{500} = 0.40
\]

Hence, in this case, 35% of the output of sector 1 is devoted to intermediate consumption, while 40% of the output of sector 2 is devoted to intermediate consumption. As a consequence, following the reduction in the labour coefficient (l_i) in sector 1 the aggregate wage share is expected to increase considering that sector 2 weight in the total value added is lower than the in the case analysed in example (a) and (b).

In period t=0, the aggregate wage share in total value added will be:

\[
Wg\ Share_{Ag} = \frac{0.690 \times 617.6 + 0.763 \times 279.4}{897.0} = \frac{639.7}{897.0} = 71.3\%
\]

Following an increase in the labour productivity in tradable sector of 25%, the labour coefficient falls from 2 to 1.5. The change in relative prices will be the same as discussed in example (a) and the total value added will change as can be seen in Table 4.8 below:
Table 4.8: Value Added per sector in each period

<table>
<thead>
<tr>
<th>Country A</th>
<th>Value Added ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t= 0</td>
</tr>
<tr>
<td>Sector 1 (tradable)</td>
<td>617.6</td>
</tr>
<tr>
<td>Sector 2 (non-tradable)</td>
<td>279.4</td>
</tr>
<tr>
<td>Total</td>
<td>897.1</td>
</tr>
</tbody>
</table>

Consequently, the aggregate wage share in period t=1 will be equal to:

\[ W_g \text{Share}_{Ag} = \frac{0.669 \times 601.8 + 0.784 \times 342.6}{944.4} = \frac{671.3}{944} = 71.1\% \]

The aggregate wage share has, thus, fallen by 0.2 pp between the two periods. This is related to the fact that the sector 2 (which saw its wage share increase) has now a smaller weight in Value Added in relation to the examples discussed (a) and (b). In period t=0, the share in total Value Added of sector 1 was of 68.9% while sector’s 2 corresponded to 31.1%. In period t=1, however, the share in total value added of sector 1 fell to 63.7% while sector’s 2 increased to 36.3%.

4.5 Conclusion

This chapter has discussed the functional income distribution implications of a Harrod-biased technical change which raises labour productivity in the tradable sector vis-à-vis the non-tradable sector, under alternative distributive ‘closures’ in a Sraffian prices of production framework. This is motivated by the so-called Harrod-Balassa-Samuelson effect, which attributes the tendency for the real exchange rate to appreciate as countries develop to an increase in the relative price of the non-tradable sector relative to tradable commodity. And, in particular, this chapter was concerned in analysing how the consideration of non-tradable commodities as a basic good, entering the production process of both commodities either as an intermediate input or as a wage-good, affects the relationship between ‘Harrod-neutral’ technical change in the tradable sector, real exchange rate and functional income distribution.

In section 4.3, real wages were taken as the exogenous distributive variable and assumed to increase in both sectors in line with the labour productivity of the tradable sector, in strict accordance with the original formulations by Harrod (1933), Balassa (1964) and Samuelson (1964). The results derived under this distributive ‘closure’ are summarized in table 4.9. In this scenario, when only the tradable commodity is needed in production, either as an intermediate input or as a wage-good, the increase in relative price of the non-tradable commodity, and the associated appreciation of the real exchange rate, is not accompanied by
changes in the wage share of either sector. Consequently, technical change does not cause changes in the aggregate wage share, as it was exemplified in sub-section 4.3.1.

Once non-tradable commodities become either part of the workers consumption basket (like in sub-section 4.3.2) or is used as an intermediate input in the production of both commodities (like in sub-section 4.3.3), the increase in labour productivity in the tradable sector continues to lead to an increase in the relative price of the non-tradable commodity. However, in these situations the change in relative price is accompanied by an increase the wage share of both sectors and, consequently, in the aggregate wage share. This change in the wage share, nevertheless, is due to a fall in the profit rate. However, in an economy with free international mobility of capital, if the profit rate in the domestic economy falls vis-à-vis the foreign economies, it would be expected to eventually trigger an outflow of capital which, ceteris paribus, would lead to a depreciation of the nominal exchange rate. Consequently, the idea embedded in the Harrod-Balassa-Samuelson effect, that is an increase in labour productivity leads to an appreciation of the real exchange rate, becomes problematic in a world with free international mobility of capital when non-tradable commodities is a basic commodity.

**Table 4.9: Changes in the wage share as the real exchange rate appreciates, with real wages increasing in line with sector 1’s labour productivity ‘closure’**

<table>
<thead>
<tr>
<th></th>
<th>4.3.1- Wage Fund</th>
<th>4.3.2- Tradable as Intermediate Input and non-tradable as wage-good</th>
<th>4.3.3- Non-tradable as Intermediate Input and tradable as wage-good</th>
</tr>
</thead>
<tbody>
<tr>
<td>$W_g Share_{TR}$</td>
<td>Stable</td>
<td>Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>$W_g Share_{NT}$</td>
<td>Stable</td>
<td>Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>$W_g Share_{Ag}$</td>
<td>Stable</td>
<td>Increase</td>
<td>Increase</td>
</tr>
</tbody>
</table>

Thus, in section 4.4 the alternative ‘closure’ of exogenous profit rates was explored and its results are summarized in Table 4.10 below. At one level, the results observed in this section confirmed results of section 4.3; that is, it is only when the non-tradable commodity is considered as a basic good (either as wage-good or as an intermediate input) that the change in relative prices associated with the Harrod-Balassa-Samuelson effect leads also to changes in the wage share. However, at another level, for fixed profit rates, the one intermediate input cases considered in sections 4.4.1 and 4.4.2 lead to a different pattern of results, in contrast with what was observed in section 4.3. In section 4.4.1, when the tradable commodity is an intermediate input and the non-tradable commodity is the wage-good, the wage share of the tradable sector remains constant, while it increases in the non-tradable sector. Consequently, the aggregate wage share will univocally increase following the ‘Harrod-Neutral’ technical change in the tradable sector. In section 4.4.2 I’ve analysed what happens to the wage share following an
increase in the labour productivity of the tradable sector, when the tradable commodity enters into the system as the wage-good and the non-tradable commodity as the sole intermediate input. In this setting, the wage share of the tradable sector falls, while it remains constant in the non-tradable sector, which leads to a univocally decrease in the aggregate wage share.

**Table 4.10: Changes in the wage share as the real exchange rate appreciates under the exogenous profit rate ‘closure’**

<table>
<thead>
<tr>
<th></th>
<th>4.4.1- Tradable as Intermediate Input</th>
<th>4.4.2- Non-tradable as Intermediate Input</th>
<th>4.4.3- Both as Intermediates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(a) Used with the same intensity</td>
<td>(b) Tradable used more intensively</td>
<td>(b) Non-tradable used more intensively</td>
</tr>
<tr>
<td>$W_{g Share}^{Tr}$</td>
<td>Stable</td>
<td>Fall</td>
<td>Fall</td>
</tr>
<tr>
<td>$W_{g Share}^{NT}$</td>
<td>Increase</td>
<td>Stable</td>
<td>Increase</td>
</tr>
<tr>
<td>$W_{g Share}^{Ag}$</td>
<td>Increase</td>
<td>Fall</td>
<td>Stable</td>
</tr>
</tbody>
</table>

The contrasting pattern of results observed in section 4.4.1 and 4.4.2 highlighted the need to consider a more general case where both commodities are used as intermediate inputs. Results of section 4.4.3 point to a scenario where the wage share of the tradable sector falls, while it increases in the non-tradable sector. Hence, the aggregate wage share could either increase or decrease following the ‘Harrod-neutral’ (i.e. labour saving) technical change in the tradable sector. However, through numerical examples it was shown that what happens on the wage share at the aggregate levels depends fundamentally on the relative ratio of the physical output of each commodity which is used as an intermediate input. When both commodities have the same ratio of its output devoted to intermediate consumption, the aggregate wage share will remain constant following an increase (fall) in labour productivity (labour coefficient) in the tradable sector. When the ratio of the tradable commodity’s output used as intermediate inputs is higher than the ratio of the non-tradable commodity than the aggregate wage share increases. And, consequently, when the ratio of the tradable commodity’s output used as intermediate inputs is smaller than the ratio of the non-tradable commodity than the aggregate wage share falls. This result is of particular interest because it explains why one may expect to observe a contrasting relationship between the real exchange rates and the wage share in different countries depending on the stage of development and the specificities of the tradable commodities in which each country specializes in, as it will be explored in the next chapter through an empirical analysis.
5. Functional Income Distribution and Real Exchange Rates- Panel Data Analysis

5.1 Introduction

In this chapter I seek to provide further insights into the relation between real exchange rates and functional income distribution from an empirical perspective. The results derived analytically in Chapter 4 point to different possible relationships between the real exchange rate and the wage share, in light of ‘Harrod-Neutral’ technical change in the tradable sector. On the one hand, when real wages are considered exogenous (and increasing in line with labour productivity of the tradable sector), the real exchange rate and the wage share are expected to display a positive relationship in all cases. On the other hand, when profit rates are considered to be the exogenous distributive variable (and assumed to be constant), the relationship between the real exchange rate and the wage share depends on the role played by the tradable and non-tradable commodities. In this sense, when both commodities are basic goods, the aggregate wage share may fall or increase depending on which commodity has a higher proportion of its output used as an intermediate input. The empirical analysis in this chapter is designed to shed light on which analytical ‘closure’ derived in chapter 4 is more consistent with the empirics of the relationship between real exchange rate and the wage share. Hence, this chapter proposes an econometric analysis of the relationship between real exchange rates and aggregate wage share for a panel of 118 countries for the period of 1970-2014, using data from the Penn-World Table.

As discussed in Chapter 1, the background motivation for this analysis is related to literature linking the real exchange rate undervaluation (overvaluation) with higher (lower) economic growth, in particular to the case of developing countries (Dollar, 1992; Razin and Collins, 1997; Aguirre and Calderón 2005; Eichengreen, 2007; Gala, 2008; Rodrik; 2008). Over the past decade, the empirical literature has submitted this relationship to extensive testing using different measures of exchange rate equilibrium (and associated misalignments), econometric techniques, sample of countries and periods, with fairly favourable results. In regard to the different theories of real exchange rate equilibrium reviewed in Chapter 2, Rodrik (2008), Gala (2008), Rapetti et. al. (2012), and Missio et. al. (2015), among others, have used a panel data approach to estimate real exchange rate Equilibrium based on a PPP approach adjusted for the Harrod Balassa-Samuelson effect.  

150 As discussed in the Chapter 1 these findings have found support in empirical analysis using alternative notions of real exchange rate equilibrium, such as the Fundamental Equilibrium Exchange Rate (FEER) and the Behavioural Equilibrium Exchange Rate (BEER), however, with some reservations. Only modest
Significant attention has also been devoted to understanding the mechanisms through which real exchange rate undervaluation would stimulate economic growth. Rodrik (2008), Eichengreen (2008) and Guzman et. al. (2018) have argued real exchange rate undervaluation may help to foster growth by increasing the competitiveness of tradable sectors. The fact that the relationship is stronger and more robust for the case of developing economies is attributed, by Rodrik (2008), to the view that the tradable sector suffers disproportionately from government or market failures, which would prevent low-income economies from converging towards higher income levels. Razmi et. al. (2012) argues that, unlike developed economies, low-income countries typically have large amounts of (hidden) unemployment. As such, promoting and sustaining real exchange rate undervaluation could lead to the mobilization of these unemployed resources, which is key to the development process. Moreover, as argued by Barbosa-Filho (2004), Araujo and Lima (2007) and Porcile and Lima (2013), Ferrari et. al. (2013) among others, the real exchange rate devaluation and sustaining undervaluation would be key to avoiding balance of payment crisis; and to relax the external constraint, which would be a major binding constraint on economic growth for developing countries (Thirlwall, 1979). Lastly, and more relevant to the analysis in this chapter, Frenkel and Ros (2006), Gala (2008), and Razmi et. al. (2012) argue, along neo-Kaleckian lines, that real exchange rate undervaluation would be associated with redistribution of income towards profits, which could stimulate capital accumulation and, consequently, economic growth.

Some studies try to disentangle the relationship between real exchange rate levels and economic growth by adding additional control variables (Goncalves and Rodrigues, 2017; Ribeiro et. al., 2020) or by exploring its effects on different components of GDP (Gluzmann et. al.;2012). Goncalves and Rodrigues (2017), using a newer version of the Penn World Tables (PWT 9.0) that covers the period from 1950 to 2014, claim that real exchange rate misalignments become non-significant once controlled for the saving rate; while Ribeiro et. al. (2020) finds that the that real exchange rate misalignments become non-significant once controlled for the changes in the wage share. Lastly, Gluzmann et. al. (2012) explores the effect of undervalued currency on different components of GDP, as well as in employment, and finds that undervaluation is positively associated with economic growth due to its effect in stimulating greater domestic savings and investment, as well as employment.

Underlying this last group of studies, however, is the notion that the real exchange rate is an exogenous policy variable, when it is in fact a relative price, which in the way Rodrik (2008) undervaluation would be positive for growth (Couharde and Sallenave, 2013) and that that currency undervaluation doesn’t have a statistically significant effect on growth once overvaluation episodes are excluded (Nouira and Sekkat, 2012).
defines it mainly captures the differences in the relative price of nontraded goods. As such, rather than being directly a policy variable *per se*, the real exchange rate is the outcome of other policies and processes occurring in the economy. As Rodrik (p.406, 2008) remarks:

“maintaining real undervaluation requires either higher saving relative to investment or lower expenditure relative to income. This can be achieved through fiscal policy (a large structural surplus), incomes policy (redistribution of income to high savers through real wage compression), saving policy (compulsory saving schemes and pension reform), capital account management (taxation of capital account inflows, liberalization of capital outflows), or currency intervention (building up foreign exchange reserves).”

And, in fact, when Rodrik (2008) investigates the determinants of real exchange rate undervaluation he finds it to have statistically significant associations with lower levels of terms of trade, capital account openness and Foreign Direct Investment (FDI) inflows, on the one hand; and, on the other, with higher levels of government consumption over GDP and savings ratio. Despite mentioning real wage compression as a mechanism to achieve a real exchange rate undervaluation Rodrik (2008) do not test it, perhaps owed to the fact that at the time the available version of the Penn-World Tables (PWT 6.2) didn’t include information on income distribution. However, since PWT version 8.0 information regarding the wage share has been included.

Few other studies have attempted to analyse what drives and sustains real exchange rate undervaluation. Kubota (2011) studies the influence of different policy instruments in promoting and sustaining undervaluation using Probit and Tobit estimators. Although results are mixed, the author find that foreign exchange rate intervention and fiscal discipline are effective in promoting modest undervaluation (below 20%), while under flexible exchange rate regimes real exchange rate undervaluation have a positive impact on growth irrespective of the undervaluation level targeted. Using propensity score matching models, rather than standard regressions, Libman (2017) find that exchange rate pegs are associated with overvaluation. Barbosa et. al. (2018) analyses the issue using Probit and Logit models for a broad sample of developing countries. For the broad sample\(^{151}\), the authors find that weaker the capital controls increase the probability of attaining an undervalued real exchange rate and that interventions in the foreign exchange rate market can help to sustain it at competitive levels. Surprisingly, the

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\(^{151}\) It is important to note that regression results for the sub-sample of East Asian and Latin American countries differ among them, with the possibility of sustaining real exchange rate undervaluation being more challenging in Latin America countries.
unemployment rate does not contribute to promoting undervaluation, which leads the authors to propose that real wage compression may not be an important factor in promoting undervaluation. However, real wages, unit labour costs or, alternatively, the wage share are not directly tested.

Hence, the empirical analysis developed in this chapter contributes to the literature by analysing directly functional income distribution implications of pursuing real exchange rate devaluations in developing and developed economies. Furthermore, it helps to shed some light whether income distribution aspects are one of the channels through which real exchange rate undervaluation may foster economic growth. In particular, the empirical results reveal a marked contrast in the relationship between real exchange rate and the wage share according to the country’s development level and to some extent depending on the level of capital account openness. However, contrary to what might be expected, for countries with lower income per capita level, devaluation of the real exchange rate is not associated with a lower wage share. In fact, empirical evidence which will be presented indicate that this relationship only occurs in countries at higher levels of income, a group for which positive results of real exchange rate undervaluation on economic growth reported in the literature has been less robust. These empirical results will be interpreted in light of the analytical results derived in Chapter 4 and I will argue that the empirical evidence provided is consistent with the results derived for the exogenous profit rate ‘closure’.

Having situated my research within the broader related literature in this introductory section, the remaining sections of this chapter are structured as follow: In section 5.2, I discuss the methodology of the research, the econometric design and data sources for the main variables used in the econometric analysis. Section 5.3 presents the descriptive statistics and discuss some of the stylized facts regarding the main variable of interest. The main results for both the full-sample, and robustness tests implemented to validate the analysis, are presented in section 5.4. In section 5.5, I discuss the results for the different income levels classifications. The chapter wraps up with section 5.6 where I provide a brief summary of the main results, together with some concluding comments.

5.2 Methodology and Data Sources

The main aim of this chapter is to analyse the relationship between the real exchange rate and income distribution from an empirical perspective. To address this task the underlying research strategy that informs the research in this chapter is deductive reasoning. According to Blaikie (2009) a deductive research strategy is characterized by its aim to test theories, eliminating false ones, and corroborate the surviving ones. Hence, the strategy of the research
is to assess alternative hypotheses with the use of a quantitative framework, analysing which hypothesis may be considered as consistent with the empirical evidence. To this end, the discussion developed in Chapter 4 led to the formulation of alternative hypothesis regarding the relationship between the real exchange rate and the wage share, depending on the different distributive ‘closures’. In particular, two alternative hypotheses can be formulated:

**Hypothesis 1:** Real exchange rate and the aggregate wage share are positively associated in all cases (in line with the analytical results obtained in section 4.3, in which the Real Wage is considered as the ‘exogenous’ distributive variable and assumed to increase in line with labour productivity).

**Hypothesis 2:** Relationship between real exchange rate and the aggregate wage share is ambiguous, since it will depend on the role played by the non-tradable and tradable commodities produced by each sector, which is hypothesized to be associated with the level of development (in line with the analytical results obtained in section 4.4, in which the profit rate is considered as the ‘exogenous’ variable and assumed to be equalized across countries due to international competition).

To assess these hypotheses this chapter proposes a panel-data econometric framework as the method of analysis. This will allow the reader to assess the empirical strength of the relationship implied in each hypothesis for a broad sample of countries, including both developing and developed economies. The choice of this particular method arises from the profile of the research question tackled in this chapter and the open-ended possibilities left by the theoretical analysis. Hence, econometric analysis will be used here with the aim to provide further insights on the relationship between the variables of concern, which may help one to navigate through the different theoretical possibilities raised by the analysis in Chapter 4.

However, it is important to emphasize that applied econometrics do not represent a definitive test of economic theories. An econometric model, just like theoretical model, is a representation of the actual phenomenon which faces the same difficult choices between reality and manageability, and, consequently, rely on simplifying assumptions regarding the true data generating process, which are themselves untestable. As such, the empirical regularities and correlations between variables uncovered by regression analysis are not interpreted as a test of universal laws. Instead, the use of econometrics as a research strategy is considered as an instrument to corroborate theoretical claims based on empirical regularities, which are context specific and bounded by historical circumstances; for which the resulting estimates should be triangulated with insights arising from descriptive and historical analysis, in line with the suggestions of Downward (2017).
5.2.1 Econometric design

The objective is to examine the relationship between the real exchange rate and the wage share to assess the different hypothesis that emerge for the relationship between these variables, depending on the different ‘closures’ presented in Chapter 4. In order to design the econometric model, one of the first requirements is to define which variable are considered to be the dependent and independent variables. As discussed in section 2.3.1, in Chapter 2, in the classical surplus approach to the theory of value and distribution, relative prices (such as the real exchange rate) cannot be determined prior to income distribution, which is influenced by non-market forces (Garegnani, 1987). Hence, in line with the general approach taken in this thesis, the real exchange rate cannot be determined independently, and prior to, the determination to the wage share. As such, in the empirical analysis developed in this chapter, the real exchange rate will be considered as the dependent variable, and the wage share will appear as the independent variable\(^{152}\), in all specifications.

The econometric specification departs from the standard methodology used to estimate real exchange rate equilibrium based on the PPP framework adjusted for the Harrod-Balassa-Samuelson effect (hereafter referred to as “adjusted-PPP” framework, discussed in section 2.2.2). This framework has been the dominant approach used in the recent empirical literature of real exchange rate undervaluation and economic growth since the work of Rodrik (2008), who estimate the following regression for the real exchange rate:

\[
\ln (RER)_{it} = \beta_1 \ln RGDP_{pcit} + \alpha_t + \epsilon_{it}, \tag{5.2.1}
\]

Where the dependent variable \(\ln (RER)_{it}\) represent the natural logarithm of the real exchange rate in country \(i\) in period \(t\); \(\ln RGDP_{pcit}\) is the natural logarithm of the real GDP per capita in country \(i\) in period \(t\), which is usually seen as a proxy for the Harrod-Balassa-Samuelson effect. Considering that the real exchange rate is a ratio involving the currencies and prices in each country, the relevant change in the explanatory variables is the change occurred in the domestic economy relative to the change occurred in the foreign economy in the same period. Hence, explanatory variables should be either explicitly introduced as a ratio or, alternatively, in a panel-data setting may be dealt with by introducing time-fixed effects (\(\alpha_t\)) using the within-transformation. In the case of including time-fixed effects, instead of estimating the model on the original data, the estimation will use the deviations of regressors from the sample average

\(^{152}\) This differs from the view supported in Ribeiro, Lima and McCombie (2020), who implicitly treat the real exchange rate as the independent variable and the wage share as the dependent variable in their model. My choice also takes into consideration the fact that analysis will be developed using 5-year non-overlapping periods, considering it a sufficient time of adjustment for the variables in real terms not to be driven entirely by the nominal exchange rate, as may be argued from a Keynesian perspective.
in each period \(t\). In other words, the time-fixed effect term is introduced here to consider the fact that, on average, real GDP \(\text{per capita}\) tend to grow over time for all countries. As such, the estimate of the \(\beta_1\) coefficient should capture only the variation of GDP \(\text{per capita}\) of country \(i\) relative to the average of the sample. Lastly, \(\varepsilon_{i,t}\) is the residual component, which seeks to capture all of the variance that is not captured by the other regressors.

From this basic setting, to study the relationship between real exchange rate and income distribution, I will introduce the wage share variable \((\text{adjlabsh}_{i,t})\) in equation (5.2.1), among other set of controls \((X_{i,t})\) taken from the literature, such as variables suggested by the BEER framework (reviewed in section 2.2.3):

\[
\ln (RER)_{i,t} = \beta_1 \ln (RGDP_{pc})_{i,t} + \beta_2 \text{adjlabsh}_{i,t} + \beta_3 X_{i,t} + \alpha_t + \varepsilon_{i,t} \tag{5.2.2}
\]

Where \(\beta_2\) captures the effect of changes in the wage share variable \((\text{adjlabsh}_{i,t})\) and \(\beta_3\) is a vector representing the estimated coefficients for the vector of control variables \((X_{i,t})\).

Moreover, considering that theoretical framework developed in section 4.4 indicates that the relationship between functional income distribution and real exchange rates is dependent on conditions of free international mobility of capital, I introduce the capital account openness index \((ka\_open)\) and the interaction term between wage share and capital account openness as independent variables:

\[
\ln (RER)_{i,t} = \beta_1 \ln (RGDP_{pc})_{i,t} + \beta_2 \text{adjlabsh}_{i,t} + \beta_3 ka\_open_{i,t} + \beta_4 \text{adjlabsh}_{i,t} \times ka\_open_{i,t} + \beta_5 X_{i,t} + \alpha_t + \mu_{i,t} \tag{5.2.3}
\]

The introduction of the capital account openness variable in the regression also serves the purpose to control for unobserved effects. For instance the BEER framework reviewed in section 2.2.3, Chapter 2, emphasizes that the degree of capital account openness as one of the potential determinants of real exchange rate movements. While previous research has shown that episodes of Capital Account liberalization (proxyed by changes in the index of capital account openness) have led to a reduction in the wage share (Jayadev, 2007; Furceri and Loungini, 2018).

Overall, the underlying hypothesis tested by the introduction of this interaction effect is that a devaluation of the real exchange rate is only associated with a reduction in the wage share in countries with a high degree of capital account openness. Due to a high degree international capital mobility, the profit rate would become more rigid and, hence, changes in relative prices (such as the real exchange rate) would be a consequence of changes in real wages relative to

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153 It’s important to highlight though that the introduction of time and/or individual effects, in general, serves the purpose of controlling unobserved heterogeneity that may be correlated with the regressors, which would lead (if ignored) to biased estimates of \(\beta_1\) (Cameron and Trivedi, 2005, p. 726).
productivity, which would affect the wage share. Overall, the analysis is performed using panel-level data, taking non-overlapping period averages of 5 years. Beyond increasing the comparability of my results, the reasons for this are two folded. On the one hand, real exchange rate deviations from its theoretical equilibrium value are an expected outcome in the short term, but would, according to traditional theory, revert back to equilibrium levels over medium to long run periods. Also, it would be expected that only persistent undervaluation would have an impact on growth. Moreover, taking yearly figures would make results much more sensible to measurement errors, and five-year averaging attenuates these errors (see Johnson et. al., 2009). This option may also be seen as consistent with the Classical Surplus approach concern in the relationship between relative prices and income distribution is related with the explanation of “normal” prices, that is those which are expected to be “centre of gravity” for market prices. Hence, it is more consistent with the concern of analysing long-term trends than short-term fluctuations.

5.2.2 Variable definitions and data sources

This subsection describes the data sources of the dependent variable \((RER_{i,t})\), the main variables of interests \((\text{labsh}_{i,t})\) and the control variables \((X_{i,t})\) employed in the econometric analysis. Both the dependent variable and the main variables of interest are taken from the Penn-World-Table version 9.1 (Feenstra et.al (2015)). The Penn-World-Table includes data from 1950 up to 2014 and it covers 184 countries in total. However, coverage is not homogeneous across time, thus resulting in an unbalanced panel. Moreover, the number of observations for the real exchange rate, real GDP per capita and of wage share levels observations differ considerably.

Since the release of version 8.0 the Penn World Table has information of the wage share in current (national) prices and is computed as the sum of total labour compensation in a country’s GDP, based on national accounts information. The wage share measure \((\text{labsh})\) available in the database is adjusted for income of self-employed, which mitigates the issue of the varying degrees of informality within and between countries. However, for many countries this income is not observed, and figures are imputed using specific criteria\(^{154}\). More complicated is the fact that in some countries the wage share values in the database are constant for several years in a row, indicating extrapolation by replication of observations observed in one year to other years by the providers of the database. This required some treatment in the database to clean the dataset from repeated observations.

\(^{154}\) For further details, see Feenstra et.al (2015)
The real exchange rate (RER) is calculated by dividing the Purchasing Power Parity index \((PPP_{it})\) by the nominal exchange rate \((x_{it})\). The PPP index reflects the price level of the country relative to price level of the USA for a similar consumption basket. Values below 1 indicate a price level lower than the one observed in the USA in the reference year (2011). The nominal exchange rate \((x_{it})\) is given by the national currency divided by the US dollar.

\[
\ln RER_{it} = \ln \left( \frac{PPP_{it}}{x_{it}} \right)
\]

The models of real exchange rate reviewed in section 2.3, and that served as the benchmark for the analysis developed in section 4.4, hinge on assumptions of free international mobility of capital, which is relevant to account for the role that openness of the capital accounts. In the literature several attempts have been made to develop indexes that try to capture the level of openness of the current and capital account. The openness indexes available in the literature can be categorized into three different categories: (i) de jure indicators; (ii) de facto indicators; and (iii) hybrid indicators, with this last one being a combination of de jure and de facto measures.

De jure indicators describe practices that are legally recognised, which may impose restrictions on the free movement of financial flows and on imports and exports of goods. However, De jure measures may not necessarily reflect a country’s actual degree of financial integration, either because of lack of enforcement of the changes in legal restrictions or because change in controls for an area may cause a response in other trade and asset flows. Also, these indices are at times unable to capture, for example, the fact that even countries with relatively closed capital accounts became substantially more financially integrated over the past decades (Quinn et. al., 2011).

De facto indicators have been developed to try to track more closely the observable phenomena of increased capital mobility by the evolution quantity-based or price-based variables and actual trade and financial openness. However, de facto measures suffer from their own limitations and biases. In particular, typical measures of trade openness, such as the ratio of exports plus imports to GDP tend to overstate (understate) the trade openness of countries with small (large) populations and lower (higher) GDP per capita, due to the relative size of the non-tradable sector. Moreover, as Furceri and Loungini (2018) highlight, de facto indicators are more sensitive to reverse causation issues in panel regressions. Lastly, hybrid indicators have been developed trying to combine the information arising from both legal practices and actual

\[155]\text{Note that the definition of the real exchange rate adopted here is the inverse of the one adopted by Rodrik (2008) and, hence, signals will be reversed.}\]
observed patterns in trade and capital flows. However, hybrid measures will carry and combine biases and limitations from both approaches.

Considering that the measures will be used in a panel-data econometrics analysis, I adopt *de jure* measures of trade and financial openness, following the advice Furceri and Loungini (2018). For financial openness I will use the index compiled originally by Chinn and Ito (2006), which provides a *de jure* measure based on IMF’s Annual Report AREAER Categorical Table of Restrictions, covering 181 countries for the period ranging from 1970 to 2016, on its latest update. Chinn and Ito (2006) method converts the IMF’s Table of Restrictions information into binary (0/1) codes accounting for several categories of restrictions, and uses principal component analysis to create an extensive aggregate measure of capital account openness capital account openness \( (KAOPEN) \)\(^{156}\). However, due to the binary nature of the information contained in the Table of Restrictions, indexes based on it tend to group together countries that are partly open, those that are substantially but not fully open, and those that are completely closed.

As reviewed in Chapter 2, the literature has also tended to emphasize other important variables which may determine the behaviour of the real exchange rates which may need to be controlled for. In particular, considering the data availability for both developed and developing economies and the econometric framework, I introduce controls for the terms of trade, savings ratio to GDP, government consumption ratio to GDP, as well as the net foreign asset (NFA) position. An improvement in the terms of trade is expected to be positively associated with an appreciation of the real exchange rate and a move towards overvaluation of the real exchange rate. The savings ratio to GDP has been one variable introduced within the BEER framework (reviewed in section 2.2.3) to control for demographic factors. The idea is that increases of old-age population would be associated with lower savings, higher demand for non-tradables and, hence, a more appreciated real exchange rate. In turn, an increase in the government consumption ratio to GDP is also associated with higher real exchange rate as it is an expenditure category which mostly consists of services and, hence, of non-tradables. The data source for these three variables is the World Bank’s World Development Indicators (WDI) database, maintained by the World Bank. The NFA data is provided Lane and Milesi-Ferretti (2007). A negative NFA position implies that the country has accumulated foreign asset liabilities, this capital inflow tends to appreciate the real exchange rate, but eventually would require a devaluation of the countries real exchange rate, in order to produce higher trade surpluses.

\(^{156}\) Variables used are current account restrictions, export proceeds surrender requirements, and presence of multiple exchange rates, capital account restrictions (with this last one being used on five year rolling average to account for capital account openness transitions).
necessary to service these external liabilities. In table 5.1 I provide the overall list of variables (with their definitions, sources, and period coverage) used in the analysis carried out in this chapter, together with the expected sign in the regression analysis to be carried out.
<table>
<thead>
<tr>
<th>Name</th>
<th>Code</th>
<th>Definition</th>
<th>Source</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real exchange rate</td>
<td>RER</td>
<td>( pl_{gdpo}^{-1} \times PPP / xr )</td>
<td>Author's own calculation</td>
<td>1950-2014</td>
</tr>
<tr>
<td>Real GDP per capita</td>
<td>rgdpe</td>
<td>Expenditure-side real GDP at chained PPPs (in mil. 2011US$)</td>
<td>PWT 9.1</td>
<td>1950-2014</td>
</tr>
<tr>
<td>Purchasing Power Parity indexes</td>
<td>PPP</td>
<td>Price level of CGDPo relative to price level of USA CGDPo GDPo in 2011=1</td>
<td>PWT 9.1</td>
<td>1950-2014</td>
</tr>
<tr>
<td>Nominal Exchange Rate</td>
<td>xr</td>
<td>Exchange rate, national currency/USD (market+estimated)</td>
<td>PWT 9.1</td>
<td>1950-2014</td>
</tr>
<tr>
<td>Wage share</td>
<td>labsh</td>
<td>Share of labour compensation in GDP at current national prices</td>
<td>PWT 9.1</td>
<td>1950-2014</td>
</tr>
<tr>
<td>Government Consumption to GDP</td>
<td>GOVGDP</td>
<td>Includes all government current expenditures for purchases of goods and services. Data are as share of GDP and divided by 100.</td>
<td>WDI</td>
<td>1960-2014</td>
</tr>
<tr>
<td>Savings ratio to GDP</td>
<td>GDSGDP</td>
<td>Gross domestic savings is calculated as GDP less final consumption expenditure (total consumption). Data are as share of GDP and divided by 100.</td>
<td>WDI</td>
<td>1960-2014</td>
</tr>
<tr>
<td>Terms of Trade</td>
<td>TT</td>
<td>The terms of trade effect equal capacity to import less exports of goods and services in constant prices. Data are in constant local currency</td>
<td>WDI</td>
<td>1960-2014</td>
</tr>
</tbody>
</table>
5.1 Descriptive analysis and stylised facts

Following the discussion of the research methodology and data sources that will be used in this research, this section presents a descriptive analysis and some stylised facts between the main variables of interest of this research. In particular, I will focus on the historical evolution and the relationship between the real exchange rate, the real GDP per capita, the wage share and capital account openness. Moreover, this section will highlight the differences in the data availability of each variable and the summary statistics of the control variables utilized in the econometric analysis conducted in the next section.

As discussed in the previous section, the source of the main variables of interest is the Penn-World-Table (PWT) version 9.1, which includes data from 1950 up to 2014, covering more than 184 countries in total in its more recent versions. Coverage, however, is not homogeneous across time. Therefore, the analysis developed in this chapter deals with an unbalanced panel. Moreover, it is important to highlight that the number observations for the real exchange rate and real GDP per capita, on the one hand, and for wage share levels, on the other, differ considerably. Once the non-overlapping 5-year period averages are taken, there are 1,899 observations for the real exchange rate and real GDP per capita, while there are only 744 observations for the wage share variable. Figure 5.1 shows the relationship between the real exchange rate (ln. RER) and the real GDP per capita (ln.rgdpePC) highlighting which observations also have data on the wage share (in red) and those which do not (in grey). Figure 5.1 highlights, at a 5-year non-overlapping period frequency, perhaps the main stylized facts about real exchange rates long-run behaviour - their correlation with the level of income per capita across countries, for which the so-called Harrod-Balassa-Samuelson effect has been one of the main explanations put forward by the mainstream literature.

As has been extensively documented and discussed in the literature, the wage share has fallen consistently since the 1980’s. The OECD (2012), for example, notes that the wage share has declined in 26 out of 30 advanced economies between 1990 and 2009. In emerging and developing economies, ILO (2011) also reports declines in the wage share, but with different intensities across regions. On the one hand, declines in Asia and North Africa have been more prominent; while, on the other, the wage share in Latin American countries have had a more diverse pattern among countries of the region. This overall declining pattern is reflected in the wage share data used. In the sample there is a declining trend in the average wage share in the period analysed, which is not due to the mere inclusion of more countries in the database. Indeed, when one looks at the average wage share of a restricted group of 17 countries for which there are observations for all periods between 1966-1970 to 2002-2006, the wage share declines in line with the trend observed for the entire sample (see Figure 5.2 below). Hence, it is important to note that what would be expected to affect real exchange rates are not changes in the countries wage share per se, but changes

---

157 For which there is also observations for the other variables, RER and real GDP per capita.
158 Defined here as the ratio between foreign to domestic currency.
relative to foreign economies. And, thus, econometric estimations include time-fixed effects, which demean the dependent and independent variables relative to the period average.

**Figure 5.1: Real GDP per capita and real exchange rate (discriminating for observations for which there is also data on the wage share)**

![Graph showing real GDP per capita and real exchange rate](image)

Source: Author’s elaboration based on Penn-World-Table Version 9.1

**Figure 5.2: Average wage share in each period (full Sample of countries X restricted sample)**

![Graph showing average wage share](image)

Source: Author’s elaboration based on Penn-World-Table Version 9.1

The lack of data availability regarding the wage share in countries prior to 1970’s led to the choice of restricting the sample in the study to the 1970-2014 period. Moreover, the PWT is one of the widest cross-country databases available in the literature, while it is one of its strengths, it also ends up providing a wide range of observations coming from countries with very small populations. Hence, regression results might be driven by this subset of countries, which many times have very particular productive structure and specialization patterns, with many operating as *de jure* or *de facto* tax-havens\(^{159}\). Hence, to avoid the influence of such outlier observations on the estimated results, countries with a population below 1 million

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\(^{159}\) Thus, within this group of countries the real exchange rate behaviour is expected to follow a dynamic of its own.
people in 2000 were excluded from the dataset\textsuperscript{160}. Thus, for the baseline regressions the dataset is composed of 1,227 observations from 148 countries for the real exchange rate and real GDP variables, for which there are 664 observations from 118 countries for the wage share. Further variables introduced as controls will reduce further the number of observations, but only marginally. Indeed, when all regressors used in the analysis are included in the regression equation the number of observations is equal to 539.

One important variable introduced in the empirical analysis will be the degree of capital account openness (\textit{ka\_open}). Capital account openness plays a distinctive role in the analysis not only because it is a variable that the empirical literature has highlighted as one potential determinant of real exchange rates, but also because the theoretical framework developed in section 4.4, which this chapter seeks to test, relies on free international mobility capital assumption to justify its distributive closure. Hence, in this chapter the capital account openness (\textit{ka\_open}), taken from Chinn and Ito (2008) database, will be used as a proxy of the free mobility of capital. The \textit{ka\_open} index has been coded as a continuous variable ranging from 0 to 1, with 1 implying that the country has free mobility of capital. For contextualization, a score of 1 has been the value attributed to the United Kingdom since the 1985-1989 period, while Brazil until the 1989-1994 period has had a score of 0.

Figure 5.3 presents an overview of the probability distribution of each of the main variables of interest used in the research, as well as the Pearson correlation coefficients and scatter plots between each pair of variables. As expected, the correlation coefficient between the natural logarithm of the real exchange rate (\textit{ln.RER}) and natural logarithm of the Real GDP per capita (\textit{ln.rgdpePC}) is high (0.665) and statistically significant. However, the correlation coefficient between these two variables with the adjusted wage share (\textit{adjlabsh}) are, at first sight, close to zero in the sample. Regarding their sampling distributions all three variables have a modest left skewed distribution\textsuperscript{161}, while presenting a kurtosis close to the value observed in the normal distribution\textsuperscript{162}. The index of capital account openness (\textit{ka\_open}), however, presents a double-humped distribution with many observations clustered around very low levels of openness and then another cluster of observations close to 1, which indicates full capital account openness. Moreover, the index show a significant positive correlation with both the natural logarithm of the real exchange rate (\textit{ln.RER}) and natural logarithm of the real GDP per capita (\textit{ln.rgdpePC}), which indicates that the countries with more appreciated real exchange rates and higher income levels tend also to have also higher degrees of capital account openness.

\textsuperscript{160} However, it’s important to note that the main regression results are not dependent on this procedure.
\textsuperscript{161} \textit{ln.RER} has a skewness of -0.12, \textit{ln.rgdppc} of -0.34 and, \textit{adjlabsh} -0.51.
\textsuperscript{162} A Normal distribution present a Kurtosis of 3, while for \textit{ln.RER} it is 2.80, \textit{ln.rgdppc} of 2.24 and, \textit{adjlabsh} 3.23.
Further summary statistics for the independent and dependent variables, as well as for control variables included on the econometric model are presented in Table 5.2. The median of the log of real GDP per capita is of 8.58 which correspond to a real GDP per capita of $5,250 (chained PPPs in 2011 US$) which corresponds to Lebanon’s GDP per capita in the 1985-1989 period. The median for ln.RER is -1.11, which corresponds to Bolivia’s real exchange rate also in the 1985-1989 period. The adjlabsh median is of 55.56% lies in between the wage share levels observed in China in 2009-2014 period and in Jamaica in 1979-1984. Important to note that the median value of the adjlabsh is more than 1 pp higher than the mean of the sample (54.31%) despite the distribution being left skewed (-0.51). The median value for ka_open in the database is 0.37, which is close to the value observed for the UK during the 1975-1979 period (0.35). The sample mean is equal to 0.47 which is close to the value observed for Colombia in the 2004-2009 period.

Lastly, it is important to highlight that the wage share variable has the lowest coverage among all variables used in the analysis with only 664 observations\textsuperscript{163}. This represents slightly more than half of the total observations available for the real exchange rate and real GDP per capita. The missing data of the wage share occurs mainly for the observations at the beginning of the sample period and for low-income economies. Hence, including the wage share variable in the regressions will affect the relationship estimated between the other variables. For instance, in the restricted sample of 664 observations for which there is

\textsuperscript{163} After exclusion of observations of countries with very small populations.
data, for both the wage share and real GDP per capita the median value of real GDP per capita rises from $5,250 to $10,000.

Table 5.2: Descriptive Statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>mean</th>
<th>median</th>
<th>sd</th>
<th>min</th>
<th>max</th>
<th>count</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln.RER</td>
<td>-1.10</td>
<td>-1.11</td>
<td>0.61</td>
<td>-3.71</td>
<td>0.37</td>
<td>1227</td>
</tr>
<tr>
<td>ln.rgdpePC</td>
<td>8.58</td>
<td>8.55</td>
<td>1.23</td>
<td>5.46</td>
<td>12.35</td>
<td>1227</td>
</tr>
<tr>
<td>adjlabsh</td>
<td>54.31</td>
<td>55.56</td>
<td>12.06</td>
<td>15.08</td>
<td>85.20</td>
<td>664</td>
</tr>
<tr>
<td>ka_open</td>
<td>0.47</td>
<td>0.37</td>
<td>0.35</td>
<td>0.00</td>
<td>1.00</td>
<td>1035</td>
</tr>
<tr>
<td>Gov Consumption</td>
<td>0.153</td>
<td>0.148</td>
<td>0.058</td>
<td>0.011</td>
<td>0.544</td>
<td>1018</td>
</tr>
<tr>
<td>Savings Ratio</td>
<td>0.194</td>
<td>0.201</td>
<td>0.138</td>
<td>-0.334</td>
<td>0.642</td>
<td>1023</td>
</tr>
<tr>
<td>ln.TTrade</td>
<td>4.56</td>
<td>4.58</td>
<td>0.05</td>
<td>4.08</td>
<td>4.61</td>
<td>1128</td>
</tr>
<tr>
<td>NFA to GDP (in US$ dollars)</td>
<td>-0.004</td>
<td>-0.003</td>
<td>0.014</td>
<td>-0.202</td>
<td>0.130</td>
<td>1084</td>
</tr>
</tbody>
</table>

Source: Author’s elaboration based on Penn-World-Table Version 9.1, World Bank/WDI, Chinn and Ito (2006) and Lane and Milles-Ferretti (2007)

5.2 Regressions results - Full Sample of Countries

This section presents the econometric results of the regression models discussed in section 5.2.1 for the full sample of countries as described in the previous section. Section 5.4.1 presents the baseline regression results, in which I depart from a basic specification regressing the real exchange rate on real GDP per capita to evaluate the effect of changes in the wage share on the real exchange rate. In section 5.4.2, I conduct several robustness checks that seek to test the validity of the main results obtained in the baseline regressions.

5.4.1- Baseline Regression Results

In this section I present some preliminary evidence regarding the relationship between the real exchange rate and the wage share. The analysis departs from the basic specification regressing the real exchange rate on real GDP per capita (specified in equation 5.2.1), which seeks to capture the Harrod-Balassa-Samuelson effect, and then proceeds in a step-wise manner adding the variables of interest to evaluate the effect of changes in the wage share on the real exchange rate. In line with the discussion of the nature of the model, and following the literature, a fixed-effects rather than random-effects estimation is used in the estimation process.

With respect to the econometric evidence, Table 5.3 illustrates the results for the full sample of countries over the period 1970-2014, including the three main independent variables of interest, as well as several control variables: the natural logarithm of the real GDP per capita (ln.rgdpePC), the adjusted wage share (adjlabsh) and capital account openness index (ka_open), which are entered sequentially to understand the specific role played by each new regressor and, hence, evaluate if the different combination
of regressors alter significantly the explanatory power of the other variables of interest. In column 1, I present the results of regressing the real GDP per capita (ln.rgdpePC) on the real exchange rate (ln.RER), from which the literature on undervaluation and economic growth has derived the measure of misalignment to assess the effect of real exchange rate undervaluation on economic growth.

Before adding the wage share variable as a regressor in the estimated model, in column 2 I present the results of regressing the natural log of the real GDP per capita (ln.rgdpePC) on the real exchange rate (ln.RER) in the restricted sample of observations for which there also exists information on the countries’ wage share. By proceeding in this way, it will be possible to get a more clear understanding on what drives changes in the ln.rgdpePC estimated coefficient, disentangling the effect of adding the wage share to the regression (as is done in Column 3) from the effect of restricting the sample. This is an important step considering that, as discussed in the previous section, the coverage of the PWT 9.1 for the wage share variable is much smaller than the coverage of the real GDP per capita variable, which is used to estimate the (adjusted-PPP) real exchange rate equilibrium used by the literature. This has important implications to the estimated relationship between real GDP per capita and real exchange rates, as can be seen from the comparison between the results in column (1) and (2), in Table 5.3. On the one hand, when regressing the natural logarithm of the real exchange rate (ln.RER) on the natural logarithm of real GDP per capita (ln.rgdpePC) on the entire sample, the estimated coefficient is equal to 0.186 (column 1). On the other hand, when restricting the sample only to the observations for which there is also data for the country’s wage share, the estimated coefficient for the ln.rgdpePC increases significantly in magnitude to 0.327 (column 2).

When the wage share (adjlabsh) is introduced into the regression model (column 3), the estimated coefficient for the ln.rgdpePC remains rather similar (0.292). This implies that a 1% increase in real GDP per capita relative to other countries is associated, on average, to an appreciation of 0.292% in its real exchange rate. The coefficient for the wage share is of 0.29. This means that a 1 pp increase in the wage share relative to other countries leads to an appreciation of 0.291% in the real exchange rate. However, the coefficient estimated is not statistically significant when using robust standard errors.

The capital account openness index (ka_open) is introduced into the next regression equation (reported in column 4); its coefficient is positive and statistically significant and an increase in 1 pp in the capital account openness relative to other countries is associated with an increase of approximately 0.30% in the real exchange rate. Results for the estimated coefficients remain qualitatively unaffected. The magnitude of the estimated wage share (adjlabsh) coefficient remains similar (0.28) and statistically

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164 The full sample includes 1227 observations.
165 Recall that the wage share data is entered in decimals and not as a percentage; hence, the semi-elasticity is given directly by the coefficient.
166 Results of the Breusch-Pagan test for homoskedasticity and Pesaran’s cross-sectional dependence tests indicate the presence of heteroskedasticity and cross-sectional dependence in the errors, and hence, standard error reported have been corrected for their presence.
insignificant, while the estimated coefficient for the \( \ln.rgdpePC \) is only slightly lower (0.26), but remains highly significant.

Following the adopted theoretical framework, in column (5) I include an interaction term between the wage share and capital account openness index. The inclusion of this interaction term seeks to understand whether the relationship between the wage share and the real exchange rate is contingent on the level of capital account openness. The hypothesis here is that a high level of capital account openness imposes a constraint on reducing or increasing profit rates and, consequently, the adjustments in relative prices would be absorbed by the wage share in income. Thus, countries with high levels of capital account openness are expected to display lower wage shares associated with devaluation in the real exchange rate. The results reported in Column 5 provide some support for this hypothesis\(^{167}\).

In column (5), with the introduction of the interaction term, the coefficient of the main term for the wage share (\( \text{adjlabsh} \)) represents the effect of a change in the wage share on the real exchange rate when the country’s capital account is closed (\( \text{ka}\_\text{open} = 0 \)). As such, when the country’s capital account is closed, a 1 pp increase in the wage share is associated, on average, with a 1.06% devaluation of the real exchange rate. However, for countries where the Capital Account is not fully closed the effect of change in the wage share on the real exchange rate is given by the sum of the coefficient of the main term for the wage share (\( \text{adjlabsh} \)) plus the coefficient of the interaction term multiplied by the level of the capital account openness prevailing in the country in that period (\( \beta_2 + \beta_4 \text{ka}\_\text{open} \)). For instance, for a country with a \( \text{ka}\_\text{open} \) index of 0.47 (i.e. equal to the mean value of the sample) the effect of an increase of 1 pp in the wage share on the real exchange rate is approximately equal to 0.28%\(^{168}\). For a country which has fully open capital account (\( \text{ka}\_\text{open} = 1 \)) the effect of an increase of 1 pp in the wage share on the real exchange rate will be of approximately 1.86%.

\(^{167}\) It is important to highlight that the main effects for \( \text{adjlabsh} \) and \( \text{ka}\_\text{open} \) haven’t been demeaned. Hence, the main effect coefficients must be interpreted as the effect of change in the independent variable when the other assumes a value of zero. This choice was made to enable a more ready interpretation of the effect of the wage share on the real exchange rate. However, the interpretation of the coefficient effect for capital account openness in itself is irrelevant as the no country in the sample has a wage share of zero.

\(^{168}\) \( \beta_2 + \beta_4 \text{ka}\_\text{open} = -1.06 + (2.86 \times 0.47) \approx 0.28 \)
Table 5.3: Regressing the real exchange rate on the functional income distribution under different degrees of capital account openness

<table>
<thead>
<tr>
<th>Dependent variable: ln RER</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln.rgdpePC</td>
<td>0.198***</td>
<td>0.295***</td>
<td>0.292***</td>
<td>0.239***</td>
<td>0.223*</td>
<td>0.190***</td>
<td>0.160***</td>
<td>-0.045***</td>
<td>0.310**</td>
</tr>
<tr>
<td></td>
<td>(0.030)</td>
<td>(0.029)</td>
<td>(0.028)</td>
<td>(0.030)</td>
<td>(0.124)</td>
<td>(0.052)</td>
<td>(0.048)</td>
<td>(0.111)</td>
<td>(0.124)</td>
</tr>
<tr>
<td>adjlabsh</td>
<td>0.291</td>
<td>0.278</td>
<td>-1.063***</td>
<td>0.230</td>
<td>-1.152**</td>
<td>-0.401</td>
<td>-1.906***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.276)</td>
<td>(0.287)</td>
<td>(0.359)</td>
<td>(0.305)</td>
<td>(0.449)</td>
<td>(0.574)</td>
<td>(0.359)</td>
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</tr>
<tr>
<td>ka.open</td>
<td>0.301***</td>
<td>-1.227***</td>
<td>0.349***</td>
<td>-1.256***</td>
<td>-0.533*</td>
<td>-1.029***</td>
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<tr>
<td></td>
<td>(0.068)</td>
<td>(0.282)</td>
<td>(0.083)</td>
<td>(0.346)</td>
<td>(0.309)</td>
<td>(0.282)</td>
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<td>Gov Cons. to GDP</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.436***</td>
<td>1.365***</td>
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<td>(0.470)</td>
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<td>Savings to GDP</td>
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<td>0.405</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.410)</td>
<td>(0.338)</td>
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<td></td>
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<td>0.455</td>
<td>0.188</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>(0.692)</td>
<td>(0.695)</td>
</tr>
<tr>
<td>NFA to GDP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-2.657*</td>
<td>-0.150</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1.422)</td>
<td>(1.372)</td>
</tr>
<tr>
<td>adjlabsh x ka.open</td>
<td>2.863***</td>
<td>3.018***</td>
<td>1.423**</td>
<td>2.244***</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(0.562)</td>
<td>(0.689)</td>
<td>(0.568)</td>
<td>(0.652)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Observations</td>
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<td>664</td>
<td>664</td>
<td>588</td>
<td>588</td>
<td>539</td>
<td>539</td>
<td>539</td>
<td>433</td>
</tr>
<tr>
<td>Fixed-Effect</td>
<td>Time</td>
<td>Time</td>
<td>Time</td>
<td>Time</td>
<td>Time</td>
<td>Time</td>
<td>Time</td>
<td>Two-Ways</td>
<td>n.a</td>
</tr>
<tr>
<td>R²</td>
<td>0.240</td>
<td>0.464</td>
<td>0.468</td>
<td>0.574</td>
<td>0.631</td>
<td>0.603</td>
<td>0.661</td>
<td>0.088</td>
<td>0.044</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.235</td>
<td>0.456</td>
<td>0.460</td>
<td>0.566</td>
<td>0.623</td>
<td>0.592</td>
<td>0.650</td>
<td>-0.177</td>
<td>0.028</td>
</tr>
<tr>
<td>F Statistic</td>
<td>385.032*** (df = 565.206*** (df = 287.694*** (df = 258.775*** (df = 245.859*** (df = 113.570*** (df = 126.970*** (df = 5.028*** (df = 18.397*** (df = 1; 1217)</td>
<td>1; 654)</td>
<td>2; 653)</td>
<td>3; 576)</td>
<td>4; 575)</td>
<td>7; 523)</td>
<td>8; 522)</td>
<td>8; 417)</td>
<td>8: 425)</td>
</tr>
</tbody>
</table>

Note: *p<0.1; **p<0.05; ***p<0.01. Robust corrected standard errors in parentheses
The introduction of control variables (columns 6 and 7), typically emphasized in the literature as determinant of real exchange rates reviewed in Chapter 2, does not alter the pattern of results obtained for the wage share coefficients. That is, in countries where the capital account is closed ($ka_{open}=0$) an increase in the wage share is associated with a devaluation of the real exchange rate. In the meanwhile, in countries where the capital account is open an increase in the wage share is associated with an appreciation of the real exchange rate. Among the control variables, the coefficient of the ratio of government consumption to GDP has turned out to be statistically significant in both specifications, for which estimates indicate that a 1 pp increase in government consumption to GDP leads to an appreciation of the real exchange rate of approximately 1.4%. The rationale for this would be that government consumption tends to be mainly composed of services, a non-tradable sector, whose price would increase and lead to an appreciation of the real exchange rate.

Following the results of specification tests which also indicate the presence of significant individual fixed-effects\(^{169}\), I also estimate in column (8) the model including two-ways fixed effects. The inclusion of individual fixed-effect in the estimated regression, however, affects mainly the coefficient of the natural logarithm of real GDP per capita ($\text{In.rgdpePC}$), which becomes negative (although close to zero and statistically insignificant). The signs of the coefficients regarding the wage share remain the same, although magnitudes are lower. The estimated coefficient for the main term is -0.401 and is no longer statistically significant, while the coefficient for the interaction term is equal to 1.423 and remains statistically significant. Hence the main message remains the same. For countries with closed capital accounts ($ka_{open}=0$) an increase in the wage share is associated with a devaluation of the real exchange rate. For countries with an open capital account an increase in the wage share is associated with an appreciation of the real exchange rate. However, it is important to note that with the inclusion of individual fixed-effects the adjusted R-Squared of the regression becomes negative. This may be related to the fact that most of the variability between the observations for the wage share variable in the sample comes from comparison between countries, while changes in the wage share within countries changes tend to be rather low. Hence, once the individual fixed-effect is added it eliminates most of the variation, which can lead to a low efficiency of the estimator (Wooldridge, 2007).

Alternatively, considering that the results of Wooldridge’s tests for serial correlation favours the use of the first-difference estimator over the fixed-effect model, in column (9) I also

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\(^{169}\) Both the results of F-tests and LM tests (Breusch and Pagan, 1980) favour the inclusion of both time and individual effects.
present the results for the regression using the first-differences estimator. Estimated coefficients, in general, confirm the insights obtained from the previous specifications, although the relative strength of the effects differs slightly. The coefficient for the \( \text{ln.rgdpePC} \) is 0.309, implying that a 1% increase in GDP is associated with an appreciation of 0.31% of the real exchange rate. The signs of the coefficients regarding the wage share remain the same. However, the magnitudes of the coefficients for the main term and for the interaction term differ. The estimated coefficient for the main term is increase, in absolute term, to -1.906 and is statistically significant at the 0.01% level. For the interaction term, the estimated coefficient remains positive (2.244) and statistically significant. However, considering that the coefficient for the main term becomes much more negative, the overall association between the wage share and the real exchange rate only turns positive at a much higher level of capital account openness, when the \( \text{ka_open} > 0.85 \).  

5.4.2 Robustness tests

In order to evaluate the validity of the results presented in the previous subsections, different robustness tests were performed. Firstly, alternative measures for key variables of interest have been used to analyse the key relationships of interest. An alternative measure of capital account openness, developed by Quinn and Toyoda (2008), was employed which has a wider coverage available than the data-sets provided by official institutions such as the IMF and the World Bank. Quinn and Toyoda (2008) measure of capital account openness (CAPITAL), like Chinn and Ito’s (2007), is an \textit{de jure} measure based primarily on coding text embedded on the IMF’s Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). However, these two indexes differ in the form they are constructed. On the one hand, Quinn and Toyoda’s (2008) CAPITAL measure tries to also measure the intensity of restrictions in place. On the other, Chinn and Ito’s (2007) \( \text{ka_open} \) index uses a binary classification of the restrictions existent in place\textsuperscript{171}. Hence, Quinn et. al. (2011) argue that CAPITAL index can be considered as an early indicator of capital account openness, while Chinn and Ito’s (2007) \( \text{ka_open} \) index is a much more restrictive measure.

Another important issue that needs to be considered is the fact that the real exchange rate is a variable that displays a high degree of persistence (inertia). As highlighted by Min et.al (2015) and discussed in Chapter 2, the real exchange rate displays very low reversion to the mean properties. Therefore, it is appropriate to check the robustness of the results obtained in

\textsuperscript{170} For contextualization, Australia’s \( \text{ka_open} \) index in the 1994-1999 was of 0.879

\textsuperscript{171} There are other differences in the methods used to compute and aggregate data between the two indexes. For further information on the differences between the two measures, please, see Quinn et. al. (2011).
a dynamic panel-data setting by including a lag of dependent variable in the right-hand side of our estimated equation. However, as is well-known since the work of Nickell (1981), coefficients of the lagged dependent variable estimated by fixed effect models in dynamic setting are biased downwards, especially in the context of large N with relatively small T, such as the panel under inquiry here. This bias arises due to the demeaning process, which creates a correlation between the regressor and the error term. The inclusion of other control variables doesn’t tackle this bias. Actually, if the included regressors are correlated with the lagged dependent variable to some degree, their coefficients may also become biased. In the case under consideration here, this issue would be problematic if the real exchange rate of country \(i\) in period \(t-1\) is correlated with wage share levels of country \(i\) in period \(t\). To tackle the potential bias caused by this possibility, following the literature, I will also use the General Method of Moments (GMM) estimators, developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998).

In this framework, one sets up a generalized method of moments (GMM) problem in which the model is specified as a system of equations, where in the Difference-GMM estimator one uses lagged levels of the endogenous variables as instruments for the first-differences instruments. However, lagged levels of the endogenous variables can often be very weakly correlated with lagged first-differences, leading to the weak-instrument problem. Hence, first-differences can be quite poor instruments, especially if variables are close to a random walk (Wooldridge, 2007). Thus, Arellano and Bover (1995) and Blundell and Bond (1998) developed an extension, known in the literature as system-GMM, which explores further moment conditions. In this estimator, lagged differences of the endogenous variables are also included as instruments, beyond the suitable lags of the levels of the endogenous variables (which enter the equation in differenced form).

In Table 5.4, I present the result for dynamic panel-data models estimated using panel-fixed effects, and first-differences estimator, as well as the two-step System-GMM estimator\(^{172}\)\(^{173}\). The coefficient of the lagged dependent variable is statistically significant in all specifications. However, as expected, its magnitude differs considerably depending on which estimator is used, with time fixed-effects providing the highest estimated coefficient (0.709) and

\(^{172}\) Results of the GMM estimator are highly susceptible to the instrument proliferation problem highlighted by Roodman (2009). In the GMM estimators, the number of instruments grows quadratically with the T dimension. As in our case \(T=9\) and \(n=118\), thus, the instrument proliferation problem can become an issue as the number of instruments can end-up overfitting the number of endogenous variables and distorting the results of the Sargan Test. As such, following the recommendations of Roodman (2009), the System-GMM uses the collapsed instruments option in the pLm R-package developed by Milos and Croissant (2014).

\(^{173}\) Following the results of the Wald-test for time and individual effects, the system-GMM is estimated taking into consideration two-ways fixed effects.
turning negative when the model is estimated using first-differences (-0.071), with the coefficient estimated using the System-GMM estimator (0.426) being slightly higher than the one estimated using the two-ways fixed effect (0.367). Most importantly, what seems to be most affected by the inclusion of the lagged dependent variable is the estimated coefficient for the \( \ln \text{rgdpePC} \), which drops in magnitude to close to zero whenever the estimated coefficient for lagged independent variable is high (as can be observed in columns 1, 3 and 4).

**Table 5.4: Dynamic Panel-Data Models**

<table>
<thead>
<tr>
<th></th>
<th>Dependent variable: ln RER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time Fixed Effect</td>
</tr>
<tr>
<td>lag (ln.RER)</td>
<td>0.709***</td>
</tr>
<tr>
<td></td>
<td>(0.027)</td>
</tr>
<tr>
<td>ln.rgdpePC</td>
<td>0.055***</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
</tr>
<tr>
<td>adjlabsh</td>
<td>-0.296</td>
</tr>
<tr>
<td></td>
<td>(0.160)</td>
</tr>
<tr>
<td>ka.open</td>
<td>-0.492***</td>
</tr>
<tr>
<td></td>
<td>(0.122)</td>
</tr>
<tr>
<td>Gov Cons. to GDP</td>
<td>0.259</td>
</tr>
<tr>
<td></td>
<td>(0.184)</td>
</tr>
<tr>
<td>Savings to GDP</td>
<td>0.136</td>
</tr>
<tr>
<td></td>
<td>(0.109)</td>
</tr>
<tr>
<td>In TTrade</td>
<td>-0.088</td>
</tr>
<tr>
<td></td>
<td>(0.184)</td>
</tr>
<tr>
<td>NFA to GDP</td>
<td>0.401</td>
</tr>
<tr>
<td></td>
<td>(0.524)</td>
</tr>
<tr>
<td>adjlabsh x ka.open</td>
<td>1.117***</td>
</tr>
<tr>
<td></td>
<td>(0.229)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Observations</th>
<th>N(^{\ast}) of Instruments</th>
<th>Adjusted R(^{2})</th>
<th>AR (3) test (p-value)</th>
<th>Sargan test (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>539</td>
<td>539</td>
<td>433</td>
<td>148</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>0.881</td>
<td>0.067</td>
<td>0.046</td>
<td>0.7628</td>
<td>0.11212</td>
</tr>
</tbody>
</table>

**Note:** *p<0.1; **p<0.05; ***p<0.01. Robust corrected standard errors in parentheses*

In its turn, the main message extracted from the previous regressions without the autoregressive term, regarding the relationship between the real exchange rate and the wage
share, remains unaffected. The coefficient for the main term of the wage share \( (adjlabsh) \) is still negative in all specifications. However, its magnitude differs considerably depending on the estimator used. In column (1), which includes only time-fixed effects in the regression, the estimated coefficient is -0.296 and is statistically significant. In column (2), which include also individual fixed effects, the estimated coefficient drops slightly (-0.184) and is no longer statistically significant. In the model estimated in first-differences (column 3) and with the system-GMM estimator (column 4) the estimated coefficient is much higher in absolute terms (-1.972 and -1.618, respectively), but it is statistically significant only for the first-differences model. These results confirm the insight that, in countries with closed capital accounts \( (ka\_open = 0) \) an increase in the wage share is associated with a devaluation of the real exchange rate. In the meanwhile, the estimated coefficient for the interaction term between the wage share and capital account openness index \( (adjlabsh \times ka\_open) \) remains positive, as well as substantially higher than the coefficient estimated for wage share’s main term. Therefore, in countries with fully open capital accounts \( (ka\_open = 1) \) an increase in the wage share is associated with an appreciation of the real exchange rate. In particular, for the System-GMM estimator the coefficient for the interaction term is 4.245, which implies that for a country with a fully open capital account an increase in 1 pp in the wage share is associated with an 2.67% appreciation of the real exchange rate.

One last important robustness checks necessary to analyse concerns the interaction effect. In particular, Balli and Sorensen (2013) advise on two tests to hedge against misspecification when estimating regressions with interaction terms. First, they suggest that researchers should estimate a regression also including the squared terms of both variables in the interaction to ensure that the interaction is not spuriously capturing the effect of a non-linear effect of one of the independent variables. Secondly, specifically regarding panel data, there is the danger that the regression with interaction effect spuriously capturing country or time-varying slopes, for which the authors suggest running a regression where the country or time-specific means are subtracted from each variable in the interaction. And, thirdly, in regressions where other independent variables introduced are correlated with one of the variables included in the interaction, the estimated interaction term may actually spuriously capture interactions between different independent variables. Hence, to control for this possibility, Balli and Sorensen (2013) suggest that variables of interest in the interaction should be orthogonalized by means of the Frisch–Waugh-Lovell theorem. In the present case, the interest is on understanding how the partial derivative of the real exchange rate with respect to the wage share is affected by the degree of capital account openness. However, as discussed, the capital account openness index \( (ka\_open) \) displays a considerable correlation with GDP per
Hence, to analyse the robustness of the results of the interaction term, it is important to orthogonalize the capital account openness index ($ka_{open}$) with respect to the real GDP per capita, as well as other potential covariates included in the main regression.

Table 5.5 reports the results for the regression models including the different robustness checks proposed by Balli and Sorensen (2013). In Columns (1) and (2) I introduce the squared terms of the wage share and of the capital account openness index to the baseline equations presented in the previous sections. In column 2, control variables used in the previous section are also introduced into the regression equation. And, while in column (1) the squared term of the capital account openness index ($ka_{open}^2$) is statistically significant at the 10% level, the estimated coefficient for the interaction term remains similar in magnitude to what was observed previously (around 3, see columns (5) and (7) in table 5.2), as well as statistically significant. Also, it is important to clarify that in columns (1) and (2) the interacted variables were not mean-centred. As such, coefficients for the main terms represent the effect of a change in the dependent variables when the other variable is equal to zero, which explains the negative coefficients. From column (3) onwards the interacted variables have been time demeaned and, hence, the coefficients of the main terms represent the effect of a change in the variable of interest evaluated at the time-average level of the other interacted variable and, hence, coefficients change signal to positive. In Columns (3) and (4) I report results for the regression including squared terms for the variables of interest and interaction term, with both variables being time-demeaned. Estimated coefficient of the interaction term, however, remains relatively similar in magnitude and statistically significant, indicating that the interaction effect is not spuriously capturing a non-linear effect of one of the independent variables included in the interaction on the real exchange rate or time-varying slopes.

In columns (5) to (8), instead of subtracting the period-average, I orthogonalize the capital account openness index with respect to log of real GDP per capita, due to the substantial correlation between the two variables. In Column (5) the magnitude of the coefficient drops, relatively to the previous estimates, to 2.224, but remains statistically significant at a 1% level. In column (7) the squared terms of the time-demeaned wage share and of the orthogonalized capital account openness index are included. And, despite the latter being statistically significant different than zero, its inclusion on the equation doesn’t seem to affect the estimated coefficient

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174 As such, the first-stage the capital account openness is regressed on the natural logarithm of the real GDP per capita ($\ln(rgdpePC)$).

175 In table 5.5 all even numbered columns include the control variables previously introduced in the analysis, while odd numbered columns include, beyond the interacted variables, only the natural logarithm of the real GDP per capita.
for the interaction term, which remains around 2.2, nor increases the explanatory power of the regression model.

Columns (6) and (8) include several other control variables, which have been discussed throughout the chapter. Namely, the ratio of government consumption to GDP, the ratio of savings to GDP, the natural logarithm of the terms of trade and the ratio of net foreign assets (NFA) to GDP. And, consequently, the orthogonalization of the capital account openness index is done with respect to all control variables beyond the log of real GDP per capita. And, with this procedure the estimated coefficient for the interaction term between the wage share is no longer statistically significant and its magnitude drops considerably, to 1.511 in column (5), and to 1.027 in column (7), when the regression also includes squared terms for both interacted variables.

Lastly, concerning the results presented in this section, it is important to highlight though that the capital account openness index (ka_open) is positively correlated with the level of real GDP per capita. As such, it is necessary to investigate whether the different effect of the wage share on the real exchange rate is due to different levels of the capital account openness or if this is driven by other differences (such as productive structure as discussed in section 4.4) which are also related real GDP per capita levels. Hence, in the next section I will analyse whether the relationship between real exchange rate and income distribution differs depending on the country’s income level in different sub-samples.

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176 The coefficients of these control variables are omitted in table 5.5. to enhance visibility of the main variables of interest in the table.
Table 5.5: Robustness tests for the interaction term between the wage share and capital account openness Index

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln.rgdpePC</td>
<td>0.225***</td>
<td>0.164**</td>
<td>0.222***</td>
<td>0.163***</td>
<td>0.282***</td>
<td>0.260***</td>
<td>0.285***</td>
<td>0.272***</td>
</tr>
<tr>
<td></td>
<td>(0.029)</td>
<td>(0.046)</td>
<td>(0.029)</td>
<td>(0.046)</td>
<td>(0.026)</td>
<td>(0.041)</td>
<td>(0.023)</td>
<td>(0.039)</td>
</tr>
<tr>
<td>adjlabsh</td>
<td>-1.181</td>
<td>-1.549</td>
<td>0.356</td>
<td>0.364</td>
<td>0.341</td>
<td>0.220</td>
<td>0.266</td>
<td>0.163</td>
</tr>
<tr>
<td></td>
<td>(1.544)</td>
<td>(1.466)</td>
<td>(0.248)</td>
<td>(0.276)</td>
<td>(0.268)</td>
<td>(0.296)</td>
<td>(0.268)</td>
<td>(0.303)</td>
</tr>
<tr>
<td>ka_open</td>
<td>-1.597***</td>
<td>-1.611***</td>
<td>0.290***</td>
<td>0.342***</td>
<td>0.327***</td>
<td>0.370***</td>
<td>0.311***</td>
<td>0.333***</td>
</tr>
<tr>
<td></td>
<td>(0.440)</td>
<td>(0.446)</td>
<td>(0.070)</td>
<td>(0.078)</td>
<td>(0.068)</td>
<td>(0.077)</td>
<td>(0.057)</td>
<td>(0.072)</td>
</tr>
<tr>
<td>adjlabsh^2</td>
<td>0.113</td>
<td>0.374</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(1.375)</td>
<td>(1.325)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ka_open^2</td>
<td>0.351*</td>
<td>0.338</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(0.206)</td>
<td>(0.212)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>(adjlabsh_t - adjlabsh_l)</td>
<td>0.269</td>
<td>0.692</td>
<td>-0.654</td>
<td>0.186</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(1.491)</td>
<td>(1.449)</td>
<td>(1.722)</td>
<td>(1.887)</td>
<td></td>
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</tr>
<tr>
<td>(ka_open_t - ka_open_l)</td>
<td>0.222</td>
<td>0.206</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.192)</td>
<td>(0.202)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>(ka_open)^2</td>
<td></td>
<td>-0.884***</td>
<td>-0.744***</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>(0.190)</td>
<td>(0.225)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>adjlabsh x ka_open</td>
<td>2.810***</td>
<td>2.963***</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.614)</td>
<td>(0.677)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(adjlabsh_t - adjlabsh_l) x (ka_open_t - ka_open_l)</td>
<td>3.048***</td>
<td>3.147***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.659)</td>
<td>(0.720)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(adjlabsh_t - adjlabsh_l) x ka_open</td>
<td>2.224***</td>
<td>1.511</td>
<td>2.239***</td>
<td>1.027</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.675)</td>
<td>(0.977)</td>
<td>(0.613)</td>
<td>(0.969)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Observations: 588 539 588 539 588 539 588 539
Controls Included: No Yes No Yes No Yes No Yes
Fixed-Effect: Time Time Time Time Time Time Time Time
R^2: 0.635 0.664 0.633 0.661 0.590 0.609 0.612 0.622
Adjusted R^2: 0.626 0.652 0.624 0.649 0.581 0.597 0.603 0.609
F Statistic: 165.818*** 102.744*** 164.498*** 101.414*** 206.766*** 101.757*** 150.920*** 85.681***

Note: *p<0.1; **p<0.05; ***p<0.01. Robust corrected standard errors in parentheses. Control variables included in even numbered columns but not reported: Gov. Consumption, Savings and NFA as ratios to GDP and natural log of the terms of trade. Gov. Consumption ratio to GDP significant in all cases. NFA ratio to GDP significant in columns (6) and (8).
5.3 Analysis by level of development

In this sub-section, I investigate whether there are asymmetries in the relationship between wage share levels and the real exchange rate according to the level of economic development. To this end, I split the sample into different groups using different criteria. First, I use different GDP per capita thresholds (results presented in table 5.6) to categorize countries into two sub-samples. Secondly, I employ the World Bank income-level classification of Low, Lower-Middle, Middle-High- and High-Income countries to break up the sample (table 5.7), and run separate regressions for each group.

Table 5.6 reports the results for the regression with and without the interaction term between the wage share and the capital account openness using different GDP per capita thresholds, in order to break the sample into different groups. In Column 1 and 2, I present results for the sample of observations with real GDP per capita below US$ 7500 (in year 2011 PPP prices), which is fairly close to US$ 6000 in year 2000 PPP prices used by Rodrik (2008) and Rapetti et. al. (2012). It is for this sub-sample for which these author’s find more robust evidence that real exchange rate undervaluation177 positively impacts economic growth. In Columns 3 and 4 I present results for the sample of observations with real GDP per capita above US$ 7500. Alternatively, I split the sample into two using the median value of real GDP per capita (approximately US$ 10000) of the restricted sample, i.e. composed of observations for which there is information of the wage share available. Columns 5 and 6 present the results for the sample of countries with real GDP per capita below US$10000 and Columns 7 and 8 for the sample of countries with countries with real GDP per capita above US$1000.

In general terms, the results for both thresholds reveal a very distinct pattern for the low-income and high-income groups. As can be readily observed in columns 1 and 5, for countries with lower GDP per capita the relationship between real GDP per capita and the real exchange rate is close to zero and not statistically significant. These results are consistent with the evidence documented by Hassan (2016), who argues that the relationship between real GDP per capita and the real exchange rate would be non-linear and would actually follow a U-shape pattern. In other words, for countries at very low levels of income the relationship would be negative, close to zero for middle-income economies, and would turn out to be positive only for countries at higher levels of income.

177 Estimated using the residuals of a regression equation (equivalent to the results reported in column 1, table 5.2) as the real exchange rate misalignment index.
### Table 5.6: Regressing the real exchange rate on the functional income distribution for different sub-samples

**Dependent variable:** ln RER

<table>
<thead>
<tr>
<th></th>
<th>Real GDP per capita (2011 constant US$ PPP prices)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; US$ 7500</td>
<td>&gt; US$ 7500</td>
<td>&lt; US$ 1000</td>
<td>&gt; US$ 1000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ln.rgdpePC</td>
<td>(1) -0.031</td>
<td>(2) -0.022</td>
<td>(3) 0.412***</td>
<td>(4) 0.395***</td>
<td>(5) 0.018</td>
<td>(6) 0.021</td>
<td>(7) 0.406***</td>
</tr>
<tr>
<td></td>
<td>(0.069)</td>
<td>(0.066)</td>
<td>(0.058)</td>
<td>(0.057)</td>
<td>(0.061)</td>
<td>(0.057)</td>
<td>(0.064)</td>
</tr>
<tr>
<td>adjlabsh</td>
<td>(1) -0.697**</td>
<td>(2) -1.118***</td>
<td>(3) 0.685**</td>
<td>(4) -0.461</td>
<td>(5) -0.603**</td>
<td>(6) -1.134***</td>
<td>(7) 0.805**</td>
</tr>
<tr>
<td></td>
<td>(0.314)</td>
<td>(0.410)</td>
<td>(0.297)</td>
<td>(0.582)</td>
<td>(0.303)</td>
<td>(0.406)</td>
<td>(0.325)</td>
</tr>
<tr>
<td>ka_open</td>
<td>(1) 0.184*</td>
<td>(2) -0.584</td>
<td>(3) 0.262***</td>
<td>(4) -0.661*</td>
<td>(5) 0.165*</td>
<td>(6) -0.728</td>
<td>(7) 0.210***</td>
</tr>
<tr>
<td></td>
<td>(0.103)</td>
<td>(0.505)</td>
<td>(0.070)</td>
<td>(0.392)</td>
<td>(0.091)</td>
<td>(0.477)</td>
<td>(0.069)</td>
</tr>
<tr>
<td>Gov Cons. to GDP</td>
<td>(1) 0.823</td>
<td>(2) 0.856</td>
<td>(3) 0.651</td>
<td>(4) 0.734</td>
<td>(5) 0.999</td>
<td>(6) 1.026</td>
<td>(7) 0.715</td>
</tr>
<tr>
<td></td>
<td>(0.673)</td>
<td>(0.670)</td>
<td>(0.611)</td>
<td>(0.579)</td>
<td>(0.669)</td>
<td>(0.664)</td>
<td>(0.556)</td>
</tr>
<tr>
<td>Savings to GDP</td>
<td>(1) 0.539</td>
<td>(2) 0.498</td>
<td>(3) 0.236</td>
<td>(4) 0.169</td>
<td>(5) 0.390</td>
<td>(6) 0.384</td>
<td>(7) 0.094</td>
</tr>
<tr>
<td></td>
<td>(0.409)</td>
<td>(0.398)</td>
<td>(0.374)</td>
<td>(0.306)</td>
<td>(0.389)</td>
<td>(0.374)</td>
<td>(0.403)</td>
</tr>
<tr>
<td>ln TTrade</td>
<td>(1) -0.176</td>
<td>(2) 0.034</td>
<td>(3) 0.112</td>
<td>(4) -0.068</td>
<td>(5) 0.550</td>
<td>(6) 0.679</td>
<td>(7) -0.289</td>
</tr>
<tr>
<td></td>
<td>(1.199)</td>
<td>(1.170)</td>
<td>(0.536)</td>
<td>(0.501)</td>
<td>(1.193)</td>
<td>(1.176)</td>
<td>(0.361)</td>
</tr>
<tr>
<td>NFA to GDP</td>
<td>(1) -0.064</td>
<td>(2) -0.056</td>
<td>(3) -0.034**</td>
<td>(4) -0.025*</td>
<td>(5) -0.046</td>
<td>(6) -0.038</td>
<td>(7) -0.032**</td>
</tr>
<tr>
<td></td>
<td>(0.040)</td>
<td>(0.035)</td>
<td>(0.017)</td>
<td>(0.013)</td>
<td>(0.040)</td>
<td>(0.036)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>adjlabsh x ka_open</td>
<td>(1) 1.511</td>
<td>(2) 1.730**</td>
<td>(3) 1.778*</td>
<td>(4) 1.909**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.989)</td>
<td>(0.748)</td>
<td>(0.937)</td>
<td>(0.792)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>221</td>
<td>221</td>
<td>318</td>
<td>318</td>
<td>269</td>
<td>269</td>
<td>270</td>
</tr>
<tr>
<td>R²</td>
<td>0.164</td>
<td>0.184</td>
<td>0.689</td>
<td>0.708</td>
<td>0.142</td>
<td>0.170</td>
<td>0.643</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.103</td>
<td>0.120</td>
<td>0.674</td>
<td>0.692</td>
<td>0.091</td>
<td>0.118</td>
<td>0.622</td>
</tr>
<tr>
<td>F Statistic</td>
<td>5.733*** (df = 7; 205)</td>
<td>5.742*** (df = 8; 204)</td>
<td>95.704*** (df = 7; 302)</td>
<td>91.135*** (df = 8; 301)</td>
<td>5.965*** (df = 7; 253)</td>
<td>6.466*** (df = 8; 252)</td>
<td>65.371*** (df = 7; 254)</td>
</tr>
</tbody>
</table>

**Note:** *p<0.1; **p<0.05; ***p<0.01. Robust corrected standard errors in parentheses.
Regarding the relationship between the wage share and the real exchange rate, in columns 1 and 5 the estimated coefficient for the wage share turns out to be negative and statistically significant at a 5% level, which would indicate that a higher wage share tends to be associated with a devaluation of the real exchange rate. When looking at the results of the regression models with the interaction term (columns 2 and 6) the sign of both the main and interaction term coefficients for the wage share are in line with the ones reported for the full sample (Table 5.3, column 5 and 7). In the sub-sample of countries with real GDP per capita level below US$7500 (column 2), the estimated coefficient of the main effect of the wage share (that is, when $ka_{open}=0$) is again negative, very similar in magnitude as observed in the regression for the full sample, and statistically significant at a 5% level. The estimated coefficient of the interaction effect, although still positive, drops by half in magnitude and is no longer statistically significant. In the sub-sample of countries with real GDP per capita level below the median (< US$ 10000), the signs of both main and interaction effect coefficients remain the same. However, their magnitude drops considerably, but are still statistically significant at a 1% and 10% significance level, respectively.

The results of the regressions for the subsample of countries with real GDP per capita above US$7500 (columns 3 and 4) and above the median real GDP per capita of US$ 10000 (Column 7 and 8) point towards a completely different relationship between the wage share, the real GDP per capita and real exchange rate. Regarding the relationship between the real GDP per capita and the real exchange rate, the estimated coefficients are positive (around 0.4) and statistically significant, as would be expected by the hypothesis embedded in the Harrod-Balassa-Samuelson effect.

Regarding the relationship between the wage share and the real exchange rate, results point to an overall positive association, meaning that an increase in the wage share is associated with an appreciation of real exchange rates. In both regressions without the interaction term, with capital account openness Index (columns 3 and 7), the coefficient for the wage share is positive, in line with what was observed for the full-sample in the previous section. However, now the estimated coefficients are statistically significant. In the models with the interaction term between the wage share and the capital account openness index (columns 4 and 8) the sign of the coefficient of the main effect is again negative. However, the magnitude of the estimated coefficients drops considerably and are no longer statistically significant. The coefficient of the interaction effect is again positive and statistically significant. Although the magnitude of the coefficient is lower, this is to be expected considering that the magnitude of the coefficient for the main effect has also dropped, rendering an overall effect for countries
with the fully open capital accounts \((ka_{open} = 1)\) similar to what was observed in the full-sample regression presented in the previous section.

Another way to analyse the potential asymmetry in the relationship between the real exchange rate and the wage share depending on the income level of the country is to use the World Bank classification of Low, Middle-Low, Middle-High and High-income countries\(^{178}\), for which results for each specific sub-sample are reported in table 5.7 below. Contrary to the analysis by GDP per capita thresholds just discussed, in the following analysis a country is in the same group in all periods, that is countries don’t move between categories as their income per capita increases through time.

Due to low number of Low-income countries observations for which there is data for the wage share variable, in columns 1 and 2 I report the results for the regressions with and without the interaction effect, respectively, for the sub-sample of Low- and Middle-Low-income countries combined. Results tend to confirm insights from the preceding analysis. The estimated coefficient between the real GDP per capita and real exchange rate level is negative and statistically significant, which would go against the hypothesis for the Harrod-Balassa-Samuelson effect, but in line with the results reported by Hassan (2016) as mentioned.

With regards to the relationship between the wage share and the real exchange rate, in column 1 the coefficient for the wage share is negative and statistically significant. This implies that an increase in the wage share is associated with a devaluation in the real exchange rate. In column 2 the coefficient of the main term is negative and for interaction term with capital account openness the coefficient is positive, both being statistically significant at 5% and 10% levels respectively. The overall effect for a country with a fully open Capital Account is positive, which implies that an increase in the wage share is associated with an appreciation of the real exchange rate, while it is associated with a devaluation in cases where the Capital Account is relatively closed \((ka_{open} < 0.6\) approximately).

The results for the Middle-High-Income countries sub-sample are reported in columns 3 and 4. The estimated coefficient between the real GDP per capita and real exchange rate level becomes positive and statistically significant, in line with what would be expected by the Harrod-Balassa-Samuelson effect. In column 3 the estimated coefficient for the wage share is still negative, very similar in magnitude to the coefficient reported in column 1 but now it is significant at a 1% level. In the regression with the interaction effect (column 4), the main term

\(^{178}\) This classification is based on 2020 GNI per capita data. Low Income countries are defined as countries with a GNI per capita below US$ 1 026, Middle Income countries have a GNI ranging between US$ 1 026 to US$ 12 375 (add mid-low to mid-high threshold) and High-Income countries have a GNI level above this level.
is negative (-1.249), meaning that for a country with a closed capital account \((ka_{open}=0)\) an increase of 1 pp in the wage share is associated to a devaluation of 1.25%. The interaction term, however, is again positive and significant at 10% level. The overall estimated effect implies that, for a country with a fully open capital account \((ka_{open}=1)\), an increase of 1 pp in the wage share is associated with a very modest appreciation in the real exchange rate of 0.17%.

Table 5.7: Regression results for the real exchange rate on the wage share for different levels of income groups (World Bank Classification)

<table>
<thead>
<tr>
<th>Dependent variable: ln RER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low &amp; Mid-Low Income</strong></td>
</tr>
<tr>
<td>(ln.rgdpePC)</td>
</tr>
<tr>
<td>(-0.199)***</td>
</tr>
<tr>
<td>(0.055)</td>
</tr>
<tr>
<td>(adjlabsh)</td>
</tr>
<tr>
<td>(-1.016)</td>
</tr>
<tr>
<td>(ka_{open})</td>
</tr>
<tr>
<td>(0.070)</td>
</tr>
<tr>
<td>(Gov\ Cons. to GDP)</td>
</tr>
<tr>
<td>(0.314)***</td>
</tr>
<tr>
<td>(0.070)</td>
</tr>
<tr>
<td>(Savings to GDP)</td>
</tr>
<tr>
<td>(0.106)***</td>
</tr>
<tr>
<td>(0.269)</td>
</tr>
<tr>
<td>(ln TTrade)</td>
</tr>
<tr>
<td>(1.016)</td>
</tr>
<tr>
<td>(0.234)</td>
</tr>
<tr>
<td>(Observations)</td>
</tr>
<tr>
<td>150</td>
</tr>
<tr>
<td>150</td>
</tr>
<tr>
<td>163</td>
</tr>
<tr>
<td>163</td>
</tr>
<tr>
<td>226</td>
</tr>
<tr>
<td>226</td>
</tr>
</tbody>
</table>

Note: *p<0.1; **p<0.05; ***p<0.01. Robust corrected standard errors in parentheses

For the high-income countries sub-sample, the results (column 5 and 6) reinforce the ones observed in columns 7 and 8 in table 5.4 (subsample of Countries with an GDP per capita above the median of the sample of US$ 10000 in 2011 adjusted-PPP prices). In column 7 the estimated coefficient for the wage share is positive and has a higher magnitude (1.317) than previous estimates, while being statistically significant at a 1% level. Moreover, the introduction
of the interaction term with the $ka_{open}$ index doesn’t seem to be relevant. The interaction term is close to zero and not statistically significant, while the estimated coefficient of the main term of the wage share remains similar, but standards errors increase considerable. Moreover, it doesn’t appear to improve the goodness of the fit of the model, with adjusted R-squared being almost equal.

Overall, the sensitivity analysis conducted in this section helps to clarify some of the factors driving the results observed for the full-sample. As mentioned in the previous section, the capital account openness index used in the analysis is positively correlated with the level of real GDP per capita. Hence, what the regression with interaction effect between the wage share and the capital account openness (Column 5 in table 5.2) seems to be capturing is a non-linear relationship between the wage share and the real exchange rate at different stages of development. Most countries at low-levels of income tend to have closed capital accounts. Hence, what the negative sign of the main effect in the regression for the full sample, presented in the previous sub-section, seems to be capturing is the fact that for countries with low levels of real GDP per capita an increase in wage share tends to be associated with a devaluation of the real exchange rate. In its turn, what the coefficient estimated for the interaction term, for the full-sample, seems to be reflecting the tendency that at higher levels of income the relationship between the wage share and the real exchange rate becomes positive, that is - an increase in the wage share is associated with an appreciation of the currency. However, this leads to the following question - what explains this non-linear relationship between the wage share and real exchange rate at different levels of economic development?

The analytical results derived in Section 4.4, Chapter 4, may shed some light on this puzzle here. There, an increase in the labour productivity in the tradable sector, led to a reduction in its relative price and in the wage share in the tradable sector. The fall in the relative price of the tradable commodity, however, can have a spillover effect which raises the wage share in the non-tradable sector if the tradable commodity is used as an intermediate input in the production of tradables. This occurs, because with cheaper intermediate inputs, less advanced capital is required to fund production and, consequently, the profit share is lower for any given profit rate.

However, at low level of developments countries tend to specialize in the production of primary commodities, which only occasionally are used as intermediates in the non-tradable sector179; while its non-tradable sector may be characterized mainly as an informal service sector

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179 For example, Guzmán et al. (2018, p. 53) argue that “[m]any developing economies, especially in Africa and South America, are highly dependent on agricultural and/or non-renewable natural resource exports (fuels and minerals)”. 
which uses only labour as an input for production. Hence, the spillover effect of a lower relative price of the tradable commodity, which would raise (reduce) the wage (profit) share in the non-tradable sector doesn’t take place. In turn, as economies develop, their tradable sector also begins to be composed of manufacturing activities, while the composition of their non-tradable sector also begins to change towards more complex services which require manufacturing products as intermediate inputs. Hence, at higher stages of development the spillover effect of a lower relative price of the tradable commodity does lead to an increase (reduction) in the wage (profit) share in the non-tradable sector, which would begin to dominate the effect of the fall in the wage share in the tradable sector.

5.4 Summary

This chapter presents the results for the econometric tests on the link between functional income distribution and the real exchange rate for a panel of 118 countries covering the 1970-2014 period. The different tests performed pointed towards a non-linear relationship between the two variables. At low levels of income, an increase in the wage share of the country (relative to the sample period-average) is associated with a devaluation of the real exchange rate. In its turn, as economies develop and income per capita grows the relationship changes and an increase in the wage share of the country (relative to the sample period-average) becomes associated with an appreciation of the real exchange rate. This pattern of results is observed using alternative criteria to categorize countries according to their income level. Overall, these results contribute to the literature on real exchange rate undervaluation and economic growth. In particular, the analysis developed in this chapter helps to understand the underlying mechanisms through which real exchange rate undervaluation may stimulate growth; as well as some of the different results obtained in the literature regarding developing and developed countries. Overall the positive effects of real exchange rate undervaluation on economic growth have been robust mainly for the case of low income and developing economies.

For example, in Rodrik (2008) the effect is robust only for the subsample of countries with GDP per capita below US$ 6000 (measured in 2000 constant PPP prices); and the more robust results for the case of developing countries have been confirmed by most of the literature over the past decade. The empirical evidence presented in this chapter regarding the relationship between real exchange rate and the wage share may shed some light on why this is the case. On the one hand, for the subsample of low- and middle-income economies, for which real exchange rate undervaluation seems to promote economic growth, results indicate that real exchange rate devaluation is, actually, associated with a higher wage share. On the other
hand, for high-income economies, for which real exchange rate undervaluation has no
significant effect on economic growth, results point out to that real exchange rate devaluation
is associated with a lower wage share. Hence, this pattern of results is consistent with a view
that aggregate demand is wage-Led, i.e. an increase in the wage share leads to an increase in
aggregate demand and economic growth (Lavoie and Stockhammer, 2013). As such, real
exchange rate undervaluation could positively affect economic growth in developing countries,
as to achieve it in these countries it is not necessary to produce, concomitantly, a compression
of the wage share. In developed countries, however, a devaluation of the real exchange rate
comes at a cost of a compression of the wage share, and, consequently, produces a compression
of domestic demand, which would reduce economic growth.

In this chapter I do not provide direct evidence that the non-linear relationship between
the real exchange rate and the wage share, for different levels of income, is driven by differences
in the productive structure. Nevertheless, the empirical evidence can be rationalized in terms of
the characteristics of the tradable and non-tradable sectors discussed in chapter 4. In terms of
associated hypothesis formulated in section 5.2, the empirical evidence is consistent with hypothesis 2, derived for the exogenous profit rate ‘closure’ developed in section 4.4. In this
‘closure’, for given levels of profit rate, an increase in the labour productivity in the tradable
sector leads to an increase in the real wages in both sectors. However, if the tradable sector uses
intermediates inputs in production, the increase in the real wage is lower than the increase of
the labour productivity in the tradable sector, reducing the sector’s unit labour cost. In the
meanwhile, the unit labour cost in the non-tradable sector increases, for which labour
productivity was assumed to be stagnant. As the non-tradable commodity becomes relatively
more expensive, it leads to an appreciation of the real exchange rate according to the Harrod-
Balassa-Samuelson effect. The overall impact of the changes in relative prices on the aggregate
wage share will depend on which commodity is used more intensively as an intermediate input
relative its total output, as discussed in section 4.4.3. When the tradable commodity (which
becomes relatively cheaper) is more intensively used as an intermediate input the aggregate
wage share will increase. When the non-tradable commodity (which becomes relatively more
expensive) is more intensively used as an intermediate input, the aggregate wage share would fall.

At low levels of income the tradable sector consists mainly of export-oriented minerals
and (or) staple commodities. These tradable commodities tend to be mainly demanded for final
consumption or directly exported. As such, they are barely used as intermediate inputs in their
own production or in the non-tradable sector, which at low levels of economic development
consists mainly of informal services and subsistence agriculture. Therefore, although the
increase in the real wages spills over to the non-tradable sector, the lower relative price of the tradable commodity will not contribute to reduce the cost of advanced capital needed to fund production, which would reduce (increase) the sector’s profit (wage) Share, for a given profit rate.

However, as countries develop their productive structure goes through marked changes with the emergence of manufacturing and a modern service sector, which re-shape the composition of the tradable and non-tradable sectors. Considering that manufacturing commodities are more intensively demanded as intermediate inputs, the fall in their relative price leads to a reduction in the cost of circulating capital needed to be advanced for production. Hence, it will contribute to reduce (increase) the profit (wage) share on the non-tradable sector. As this occurs, the increase in the non-tradable sector’s wage share starts to overpower the fall in the tradable sector’s wage share, and, consequently, the aggregate wage share increases as the real exchange rate appreciates.

One alternative explanation explored for the non-linear relationship between the real exchange rate and the wage share was the degree of mobility of capital, proxied by the level of capital account openness. The idea behind this was that free mobility of capital across countries lead to the equalization of profit rates between countries. Hence, it would provoke a downward rigidity in the profit rate in face of changes in relative prices, which would have to be absorbed by changes in the real wage relative to labour productivity. This, in its turn, would lead to a reduction (increase) in the wage share as the real exchange rate depreciates (appreciates).

However, with a closed capital account, in light of a change in relative prices, the adjustment between real wages and profit rate would depend on internal institutional characteristics of the economy in question, and could well lead to a negative relationship between the wage share and the real exchange rate.

Although, by introducing an interaction effect between the wage share and de jure indexes of capital account openness, initial analysis found evidence in favour of this hypothesis, the results do not seem to be robust. The regressions using different sub-sample categorizations by development level did provide some support for this hypothesis, but statistical evidence was weaker than for the regression for the full sample. However, the main issue is that there is, in particular, substantial correlation between the degree of capital account openness and level of GDP per capita, as countries with rather closed (open) capital account tend to have lower (higher) GDP per capita. Hence, when the capital account openness Index (\(ka_{open}\)) were instrumented with the residuals of the first stage regression of capital account openness index on GDP per capita and other covariates the interaction term with the wage share was no longer statistically significant.
As such, my preferred explanation for the contrasting relation between the wage share and real exchange rate, according to development level, rests on the differences in the productive structure, as theorized in section 4.4. However, the analysis conducted in this chapter do not provide direct evidence for this mechanism as this would require input-output data for a wide range of low and high-income countries spanning for a long-period of time. Existing international input-output databases (e.g. WIOD\textsuperscript{180}) tend to cover mainly developed economies, selectively including some emerging economies which are relevant in international trade, and don’t go backwards beyond the 1990’s. Hence, the combination of such data with the database used in this study (PWT) would come at a cost of losing most observations on low- and middle-low-income economies, as well as older observations.

\textsuperscript{180} The World Input-Output Database provided by Timmer et. al. (2015).
6. Conclusions

6.1 Introduction

In this concluding chapter the main findings of the research are summarized. The contributions to knowledge, the relation between the research findings and the research objectives delineated in the introductory chapter, and the interconnection between the analysis conducted in the different chapters will be highlighted. Prior to addressing the research questions, it is useful to briefly reiterate the background motivation which justified my research. In particular, the background motivation that informed this research is the claim in the literature of the existence of a positive effect of real exchange rate undervaluation on economic growth, especially in regard to the case of developing economies. While a significant body of research over the past decade has been dedicated to the inquiry of the robustness of this hypothesis, and to the mechanisms which would explain this association, less attention has been devoted on the to the political economy and broader socio-economic implications of pursuing real exchange rate undervaluation. In line with the definition of political economy adopted in this thesis, the overall aim of the thesis is thus to focus on the functional income distributions implications of pursuing real exchange rate undervaluation. To this end the research proceeds into different, but related, enquires around the overall theme concerning real exchange rates. Although using different methodologies, analysis developed in chapters three to five are connected by the overall search to understand the political economy implication embedded into the different theories of real exchange rate equilibrium which were reviewed in Chapter 2.

First, in order to be able to speak about ‘under’ or ‘over’ valuation one needs to define what is the real exchange rate equilibrium from which real exchange rate levels can be evaluated. Therefore, in Chapter 2 I’ve reviewed different theories of real exchange rate equilibrium. This review focused mainly on the approaches which have been used by the literature on real exchange rate undervaluation and economic growth; analysing, in particular, the different conceptions of equilibrium that inform each approach, and the empirical literature testing them. Furthermore, to highlight the relation between functional income distribution and real exchange rates, an alternative framework based on Anwar Shaikh’s (1999, 2016) work is introduced, developed along the lines of the Classical Political Economy tradition which uses the surplus approach.

\[181\] In which political economy is concerned specifically with how the distribution of power affects the distribution of income and wealth between different groups and individuals, and the processes that create, sustain and transform these relationships over time.
The literature review conducted in Chapter 2 highlights that the notion of real exchange rate equilibrium had assumed multiple meanings in the economic literature. And often, economists in their analysis have switched between different notions of equilibrium (positive, normative, or descriptive) while using theories of exchange rate equilibrium, without noticing the implications to the meaning read into them. Therefore, in Chapter 3, I’ve argued that this underlying tension in the use of the concept equilibrium in real exchange rate theory has been present since its inception. I’ve illustrated this point by reconstructing the development of Purchasing Power Parity (PPP) theory of real exchange rate equilibrium as formulated by Gustav Cassel in the late 1910’s and until the early 1930’s. The analysis of Cassel’s published works on this topic, for close to two decades, shows that Cassel’s own use and understanding of the meaning of PPP theory shifted considerably, over the period.

Initially, Cassel (1916, 1918) regarded PPP as the equilibrium level of real exchange rate in a positivistic sense, which embedded a view that real exchange rate equilibrium would be constant, in line with what has been considered as the PPP hypothesis of real exchange rate behaviour by most of the empirical literature since the 1970’s (as reviewed in section 2.2.1). Nevertheless, throughout the 1920’s Cassel progressively introduced several auxiliary assumptions to the theory, which would explain mainly temporary, but also permanent, deviations of real exchange rate levels from those consistent with PPP indexes. Concomitantly, throughout the 1920’s debates concerning the international monetary system return to the fixed exchange rates of the Gold Standard, Cassel would advocate for the use of PPP indexes to set new levels for each currency gold parity and, hence, in this context PPP theory assumed a much more normative connotation. Ultimately, however, in accordance with his theoretical approach, based on general equilibrium, the equilibrium real exchange rate (which he would still refer to as the PPP) would be only the one consistent with equilibrium in international trade. Thus, I argued that Cassel’s own presentation of the PPP theory shifted in latter stage towards an interpretation much more in line with the Fundamental Equilibrium Exchange Rate (FEER) and the Macroeconomic Balance approach (as reviewed in section 2.2.4).

Following this historical analysis into foundations of PPP theory and associated tensions surrounding the notion of equilibrium exchange rates, in Chapter 4 the research shifts towards the analysis of the Harrod-Balassa-Samuelson effect on real exchange rates. In particular, the focus of the chapter was to formalize the Harrod-Balassa-Samuelson effect within a prices of production framework to study the co-evolution of the real exchange rates and functional income distribution. The analysis developed considered what happens to the wage share in the aggregate and in each sector (tradable and non-tradable) following an increase in labour productivity in the tradable sector, as is originally assumed in Balassa’s (1964) and Samuelson’s
(1964) formulations, under two alternative distributive ‘closures’. First, I’ve analysed the price system considering real wages in both sectors as exogenous, and evolving in line with the labour productivity of the tradable sector as the distributive ‘closure’. Subsequently, I’ve analysed what happens to the wage share under an alternative distributive ‘closure’. Following the closure proposed by Shaikh (1999, 2016), I’ve taken the profit rate as the exogenous distributive variable, and assumed it to be constant and equalized between sectors and countries, due to international competition among capital enabled by the free mobility of capital.

The analytical results of the two closures studied in Chapter 4 lead to different hypothesis regarding the relationship between the real exchange rate and the wage share. In the first closure, when real wages are determined exogenously and assumed to increase in line with labour productivity of the tradable sector, the wage share always increases (decreases) as the real exchange rate appreciate (depreciates) following the Harrod-Balassa-Samuelson effect. In the exogenous profit rate ‘closure’, the effect in the wage share caused by the Harrod-Balassa-Samuelson effect, which also leads to, ceteris paribus, an appreciation of the real exchange rate, is ambiguous. In specific, in this ‘closure’ the effect of the technical change on the wage share will depend on the productive structure of the economy, that is the ratio with which each commodity’s (tradable or non-tradable) total output is used as an intermediate input in the overall production of both goods.

The results obtained in Chapter 4, led to the formulation of alternative hypothesis regarding the relationship between the wage share and the real exchange rate, which were explored in the empirical analysis conducted in Chapter 5. In this chapter I’ve analysed the relationship between real exchange rate and the wage share using panel-data econometric models. The sample used in the study consists of an unbalanced panel of 118 countries for the 1970-2014 period, using data from the Penn-World-Table (version 9.1) for the key variables of interest; and using supplementary sources for other control variables introduced in the regressions. In the chapter I have focused on analysing whether the relationship between the real exchange rate and wage share is mediated by either the degree of capital mobility, proxied by de jure measures of capital account openness, and (or) the level of economic development. Initial evidence indicated that the relationship between real exchange rate and the wage share was contingent on the level of capital account openness experienced by the country, as captured by the introduction of an interaction term in the regression between the wage share and capital account openness variables. Only in countries with open capital accounts, higher (lower) wage share level (in the country relative to the rest of the world) would be associated with an appreciation (devaluation) of its real exchange rate.
Subsequent robustness checks, however, indicated that this result might be driven by the observed correlation between real GDP per capita level and levels of capital account openness. Hence, I’ve conducted an analysis using different subsamples based on income level groups. Results pointed out that, in fact, the relationship between the wage share and real exchange rate is contingent on the country’s income per capita level. On the one hand, in countries at lower income levels, higher (lower) wage share levels (in the country relative to the rest of the world) tend to be associated with a devaluation (appreciation) of the real exchange rate. In the other hand, in countries with higher income levels the relationship tends to be the opposite; higher (lower) wage share levels (in the country relative to the rest of the world) tend to be associated with an appreciation (devaluation) of the real exchange rate. Furthermore, within the different income groups sub-sample evidence in favour of significant effect for the interaction between the wage share and the of capital account openness was weaker, although still present for low- and middle-income economies.

After providing this brief summary of the overall research conducted in the thesis and its main findings, in the next section (6.2) I will discuss the overall contributions of this thesis to the literature, and highlight how the research findings emerging from each chapter helps to address the research objectives presented in Chapter 1. In section 6.3 I discuss some of the limitations of the research, as well as pointing some directions for future research on the topic. Lastly, in section 6.4 I provide some concluding remarks.

6.2 Contribution to knowledge

Having summarized the structure of the thesis and its main findings in the previous section, in this section I seek to link these insights to the gaps identified in the literature and to the overall research objectives outlined in Chapter 1. The overall aim of this thesis was to study the relationship between real exchange rate and functional income distribution. Associated with this overall aim, three research objectives were set out in the introduction in Chapter 1. In this section, I will review them and discuss how the research developed throughout the thesis has addressed these objectives, and how the associated research findings contribute to the relevant literature.

- **Objective 1:** Review Cassel’s own writings on Purchasing Power Parity theory and provide a novel narrative of the evolution of his economic thought.

The review of Cassel’s own work on PPP developed in Chapter 3 was designed to address specifically objective 1 from a History of Economic Ideas perspective. In particular, my contribution seeks to clarify what was Cassel’s own understanding of PPP theory and analyse how it evolved through time using Lakatos Methodology of Scientific Research Programme.
The development of the PPP theory elevated Gustav Cassel's name to world fame. A period where Cassel's work was highly influential in both academic and policy circles, with his work appearing in academic journals, newspapers, seating in expert panels and writing policy memoranda for the Swedish and international institutions, such as the League of Nations. Nevertheless, by the turn of the decade the enthusiasm around Cassel work and PPP theory had mostly faded away. The MSRP framework is particularly fruitful to make sense of these developments as it provides a clear framework within which to consider the development and decline of theories and research programmes as a whole.

In modern literature, PPP theory has been associated with the hypothesis that real exchange rates should be constant in the long-run. A hypothesis that has been subject to extensive testing, however, with fairly weak empirical corroboration. This has led to significant controversy over the actual interpretation of theory, with some researchers, on the one hand, engaging in continuous process of re-specification of theoretical propositions and empirical hypothesis, while, in the other hand, other researchers have criticized PPP as a naive theory of exchange rate determination. Considering the association of Cassel's name with the theory, he has been at the forefront of much of the criticisms, given that historically he was a major proponent of the doctrine. However, Cassel's own interpretation of the theory has been subject to significant controversy in the literature.

I have argued that the contrasting interpretations surrounding Cassel's work on PPP existent in the literature stems from the fact that Cassel himself amended his own presentations of PPP theory in different occasions and in different circumstances have used the PPP terminology with distinct meanings. I argue that this Although both critics and supporters of Cassel's formulation of PPP theory draw evidence from Cassel's own writings in favour of their interpretations of what was his understanding of PPP, I argue that previous contributions take Cassel's view in isolation, as constant over the period of almost two decades, in which he regularly published on the topic.

As it has been argued by the likes of Holmes (1967), Humphrey (1979) and Moosa (1999), Cassel did include in his presentations of the determinants of exchange rates several non-monetary factors, beyond relative inflation levels. Among which I've highlighted four key assumptions: (i) no unilateral hindrances to trade; (ii) the need to calculate PPP indexes departing from a base year in which there had been a certain equilibrium in international trade;

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183 Beyond other temporary factors which would cause exchange rates to deviate from levels given by PPP.
(iii) constancy of relative prices; (iv) no capital flows. However, it is not clear to what extent Cassel was aware of the influence of such factors from the outset. The review in Chapter 3 highlights, the auxiliary assumptions, would only be introduced by Cassel in later formulations of PPP, and can be traced to criticisms and qualifications raised by other authors at the time in well-known journals and other public outlets, to which Cassel was a regular contributor. I argue that at the same time that the qualifications and auxiliary assumptions introduced by Cassel in his presentations of PPP theory provided it with greater ‘internal’ logical consistency. However, this ‘internal’ consistency came at a cost of empirical falsifiability, as any empirical evidence, in contradiction with the predicted behaviour based on PPP, could be attributed to one of the increasing auxiliary assumptions which act as an ‘protective-belt’ to the theory. This may help explain why after enjoying so much enthusiasm in the aftermath of the First World War, Cassel’s and PPP theory would lose much of its influence on the public debate by the end of the 1920’s.

- **Objective 2:** Analyse the functional income distribution implications associated with the Harrod-Balassa-Samuelson effect within a linear prices of production framework.

In Chapter 4 I have provided a formalization of the Harrod-Balassa-Samuelson effect, within a prices of production framework, to study the co-evolution of the real exchange rate and functional income distribution implied by the technical change in the tradable sector assumed by the effect. As discussed, Balassa’s (1964) original formulation of this effect assumes zero profits and that only labour is used as an input in production, while Harrod (1933) and Samuelson (1964) presented the idea only descriptively with no formalization. Hence, it does not provide a framework in which functional income distribution comes into play. Shaikh (1999, 2016) introduces the Harrod-Balassa-Samuelson effect in his analysis of real exchange rate determination. However, he does so *a posteriori* of having solved his relative price system between domestic and foreign tradables. Therefore, in his analysis the relationship between real exchange rate and functional income distribution is related solely to what happens to income distribution in the tradable sector. Meanwhile, by incorporating the non-tradable sector explicitly in the price system and solve for its relative price in regard to the tradable sector, my analysis relates changes in the real exchange rate (caused by the Harrod-Balassa-Samuelson effect) to changes in the aggregate wage share.

Furthermore, my analysis contributes to the Neo-Kaleckian literature which has tackled the relationship between real exchange rate undervaluation, income distribution and economic growth. Most studies in this literature have modelled the domestic economy as being composed of only one (tradable) sector (e.g. Gala, 2008; Lima and Porcile, 2013; Ribeiro et. al., 2017). A notable exception of Razmi et. al. (2012), who develop a two-sector model, introducing a non-tradable sector. However, the non-tradable sector is assumed to use only labour as input and,
hence, does not require intermediate inputs produced either domestically or imported from other countries. Within a Sraffa’s modelling tradition, Dvoskin and Feldman (2018) and Dvoskin et. al. (2020) have also analysed the relationship between real exchange rate and income distribution. However, two differences stand out. First, the non-tradable sector is modelled once again as demanding only labour as an input. Secondly, considering that their focus is on technical dependency and the distributive impacts of nominal devaluation, the tradable sector is modelled as using only imported intermediate inputs. Moreover, the focus of most of this literature has been on the effect of a nominal exchange rate devaluation on functional income distribution and on the real exchange rate. However, a nominal exchange rate devaluation is not the only potential source of change in the real exchange rate. Real exchange rates may also be affected by changes in the relative price between tradable and non-tradables.

Hence, my research in Chapter 4 contributes to the literature by analysing the effects of change in relative prices between non-tradable and tradable commodities (generated by a labour-saving technical change in the tradable sector) on the real exchange rate and on the wage share. Furthermore, considering the focus of the analysis on the relative prices between the tradable and non-tradable sector, I’ve extended the analysis to the case where both the non-tradable and the tradable commodity are a basic goods, that is both are used as intermediate inputs in the production process of all commodities. Lastly, the analysis was undertaken two alternative distributive ‘closures’. First, I’ve analysed the price system considering real wages in both sectors as exogenous and evolving in line with the labour productivity of the tradable sector. And second, I’ve analysed the price system considering the profit rate as given.

In the analysis of the ‘closure’ of an exogenous real wage increasing in line with labour productivity in the tradable sector, conducted in section 4.3, I’ve shown that, irrespective of the roles played in production by the non-tradable and tradable commodities, the wage share increases as consequence of the Harrod-Balassa-Samuelson effect, which would also cause an appreciation of the real exchange rate. However, once one considers the cases where the non-tradable commodity enters into the production process either as part of the workers consumption basket or is used as an intermediate input in the production of both commodities, the increase in the wage share comes at a cost of a falling profit rate. Therefore, I argue that under conditions of free mobility, typically prevalent in most advanced economies, this process would lead to an increasing capital outflow, which would generate a devaluation pressure on the nominal exchange rate and, consequently, on the real exchange rate. This effect, hence, can

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184 This distributive ‘closure’ has been used in the literature by Lima and Porcile (2013) and Lima et.al. (2017), for example.
185 A closure which has been adopted by Dvoskin and Feldman (2018) and Dvoskin et. al. (2020), for example.
potentially counteract the Harrod-Balassa-Samuelson effect, which exerts an appreciation pressure the real exchange rate. As such, this result can be viewed as a note of caution to researchers adopting this type of closure in their analysis. This is of particular relevance when analysing technical change and exchange rates in open economies: In more general settings, with more than one basic good, the assumption of constant unit labour costs is equivalent to assuming a falling profit rate under a labour-saving technical change.

Consequently, in section 4.4, I've also analysed what happens to the wage share under an alternative distributive ‘closure’. Following the closure proposed by Shaikh (1999, 2016), I've taken the profit rate as the exogenous distributive variable, and assumed it to be constant and equalized between sectors and countries, due to free international mobility of capital. Under this closure, I've shown that the change in the wage share caused by the Harrod-Balassa-Samuelson effect, which would lead to an appreciation to the real exchange rate, depends on which commodity (tradable or non-tradable) enters the production system as an intermediate input. In the more general case, where both commodities are used as an intermediate input, I've shown by means of numerical examples that the direction of change of the wage share will depend on the ratio of each commodity’s output which is used as an intermediate input. If the ratio of the tradable commodity’s output used as intermediate inputs is higher than the ratio of the non-tradable commodity, then the aggregate wage share increases. If the ratio of the tradable commodity’s output used as intermediate inputs is smaller than the ratio of the non-tradable commodity than the aggregate wage share falls. I argue that this result is of particular interest because it sheds light to the contrasting results observed empirically in the analysis conducted in Chapter 5, where at lower income levels increases (decreases) in the wage share are associated with depreciation (appreciation) of the real exchange rate, while at higher income levels increases (decreases) in the wage share are associated with appreciation (depreciation) of the real exchange rate.

- **Objective 3: Analyse the relationship between functional income distribution and real exchange rate from an empirical perspective.**

Following the theoretical discussion in Chapter 4, I’ve designed an econometric empirical analysis in Chapter 5 to test the different hypotheses regarding the relationship between real exchange rate and income distribution and addresses research objective 3, reproduced here from Chapter 1. In particular, in Chapter 5 I’ve presented cross-country econometric evidence on the link between functional income distribution and the real exchange rate for a panel of 118 countries for the 1970-2014 period.
The main finding coming out of this analysis is the contrasting pattern in the relationship between the real exchange rate and the wage share for groups of countries at different income levels. For countries at higher income levels an increase (decrease) in the wage share (relative to other countries) is associated with an appreciation (depreciation) of the real exchange rate. While this result is consistent with what would be expected by previous studies, for countries at lower income levels the relationship displays a opposite result. For this latter group of countries, an increase (decrease) in the wage share (relative to other countries) is associated a depreciation (appreciation) of the real exchange rate. This result is linked to the theoretical analysis conducted in Chapter 4; in particular, to the outcomes associated with the exogenous profit rate ‘closure’. In this closure, when the ratio of non-tradable commodity final output used as an intermediate input is higher than the ratio for the tradable commodity, an increase in the wage share is associated with a devaluation of the real exchange rate.

The analysis conducted in chapter 5 also contributes to the literature on real exchange rate undervaluation and economic growth and, in particular it sheds light underlying mechanisms which may explain why positive results of real exchange rate undervaluation on economic growth occur mainly for countries at lower income levels. Within the neo-Kaleckian strand, previous contributions, such as Gala (2008), Razmi et.al (2012) or Missio et. al. (2015), interpreted the positive effects of real exchange rate undervaluation as evidence that the accumulation regime in these economies would be profit-led. Nevertheless, the evidence provided in Chapter 5 point towards a different direction for the group of countries which undervaluation promotes growth, with a depreciation in the real exchange rate being actually linked with higher wage shares. In this sense, it may be argued that the real exchange rate undervaluation promotes economic growth only in countries at lower per capita income level precisely because it does not produce negative income distribution repercussions. In this line of reasoning following a Wage-led interpretation of the accumulation process, a compression of the wage share (as occurs in economies with higher income per capita levels), which would lead to lower economic growth, due a to lower domestic demand, reducing capacity utilization and, hence, the propensity to invest of capitalists.

Considering the differences in results observed in the different distributive ‘closures’ presented in Chapter 4, in Chapter 5 I’ve also analysed whether countries with differences degrees of capital mobility exhibited different relationship between real exchange rate and the wage share, as captured by the introduction of an interaction term into the regression equation. On the one hand, certain strands of literature have emphasized that the degree of capital account openness to be an important determinant of real exchange rate (as emphasized by the BEER framework reviewed in chapter 2). On the other hand, previous research has shown that
Initial evidence indicated that, for countries with low level of capital account openness, an increase (decrease) in the wage share (relative to other countries) is associated with a depreciation (appreciation) of the real exchange rate. It would only be in countries with relatively high levels of capital account openness that the increase (decrease) in the wage share (relative to other countries) is associated with an appreciation (depreciation) of the real exchange rate. Nevertheless, subsequent robustness checks reveal that this finding may be attributed to the positive correlation between the capital account openness and countries’ income level.

6.3 Limitations of the research and directions for future research

Before concluding this thesis, discussing the limitations of the research findings and directions for future research is of paramount importance. Hence, in the following paragraphs I highlight some of the identified limitations in the research presented throughout this thesis and some preliminary suggestions for future research on the topics covered.

The analysis of Cassel’s work on PPP theory in Chapter 3 has been restricted to original sources published in English. No extensive archival research was conducted, nor materials published by him in Swedish were consulted. This is a limitation of the research conducted and the incorporation of these alternative sources in future research has the potential to significantly enhance the analysis, specially uncovering the motivations, and readings, that influenced him to introduce the adjustments in the PPP theory highlighted throughout Chapter 3. However, considering the extent of Cassel’s list of publications in English, which covers a period close to two decades in which he regularly published in English, I believe that the thesis has provided more than enough evidence to support the claims advanced and to show the shape of his thought. Of course, though, these could be strengthened by the use of archival sources and other published material in Swedish. Another extension, beyond the confines of this thesis, is to see more extensively how PPP theory was discussed and used in international organisations in the period after WWII. This is a natural extension to my work here, and archival research in important organisations like the OECD, IMF, World Bank, can show the various transformations PPP got as it moved from theory to policy and back into theoretical discussion. The framework that I used to analyse Cassel’s evolution of thought shows that this extension can develop novel insights on the evolution of the concept between theory and policy in the period from WWII until today.

In the thesis I worked extensively on the theoretical work following PPP after WWII. In Chapter 4 I provided a formalization of the Harrod-Balassa-Samuelson effect in a prices of
production framework with different distributional ‘closures’ to study its income distribution implications. Although, significant effort was undertaken to add features that bring the analysis closer to input-output relations observed in the real-world, such as the consideration of the non-tradable commodity as an intermediate input, the analysis still contains several limitations. In particular, one important aspect is the consideration of imported intermediate inputs, which adds an extra layer of complexity for the analysis of the determination of the price system, as it brings in the influence of the nominal exchange rate. The role played by trade in intermediate inputs and how it affects the impacts of changes in exchange rates have received significant attention in recent literature with the rise of Global Value Chains (GVC). In particular, within a prices of production framework Dvoskin and Feldman (2018) and Dvoskin et.al. (2020) have focused on how the presence of intermediate inputs affects the relationship between exchange rate devaluation and income distribution. However, in their work the focus is on the impact of changes in the nominal exchange rate, while in Chapter 4 I’ve looked at the impact of technical change, and haven’t considered cases where non-tradable commodities are used as intermediate inputs. Therefore, an avenue for future research is to merge insights arising from their analysis with the one developed in Chapter 4. On the one hand, future research can consider the income distribution implications of sectoral technical change in a price system where imported intermediate inputs are explicitly accounted for. And, on the other hand, analyse the impact of nominal devaluation is systems where the non-tradable commodity is also incorporated as basic commodity, as it was done in Chapter 4.

The central empirical finding of this research was highlighted in Chapter 5, in which empirical evidence pointed towards a contrasting relationship between functional income distribution and the real exchange rate, depending on the stage of development of the countries in question. However, results provided may rely on specific data sources, methods of computing the wage share and the real exchange rate, and on the econometric methodologies used. Regarding the data used, it is important to highlight that the availability of data for the wage share poses a significant restriction on the sample of countries and periods used in the analysis. As long as motives that lead one country to have information on the wage share data or not is unrelated to factors which were not controlled for in the regression analysis, the results uncovered in the analysis, in respect to the relationship between the wage share and the real exchange rate, may have some generalizability. Nevertheless, as discussed in the methodology section in chapter 5, the empirical regularities, correlations between variables, uncovered by regression analysis are not to be interpreted as a test of universal laws. The insights drawn should be triangulated with descriptive and historical analysis which looks at specific countries as case studies.
Furthermore, considering that real exchange rates and wage share levels for some countries displays non-stationary behaviour, future analysis should investigate potential cointegration relationships between both variables. In case of cointegrating relationship, estimated coefficients, and associated standard errors based on panel-data models estimated with time-fixed effects or first-differences may be biased. However, with a limited number of periods (T = 9), due to the use of 5-year non-overlapping periods, it is difficult to assess formally non-stationarity properties and cointegration relationships between the variables of interest, due to a low power problem of available statistical tests for panels with a short time dimension. Hence, further analysis could be carried out using shorter time frequencies (e.g. yearly) with panel cointegration methods. Another direction which may be followed is to follow the approach of Kubota (2011) and Barbosa et. al. (2018) of using limited dependent variables models, such as Tobit and Probit estimators, to measure the likelihood of real exchange rate undervaluation being associated with lower wage shares.

Further analysis could also explore the robustness of the empirical findings reported in Chapter 5 to the use of alternative measures for the key variables of interest and econometric methods. With regard to the measurement of the key variables used in the research, it is important to elaborate on limitation caused by methods used to compute the real exchange rate and of wage shares measures used. The real exchange rate measure used in the analysis is calculated based on the nominal exchange rate of the country relative to the US dollar, and their price level relative to the one observed in the US. This doesn’t take into consideration the different trade partners with which each country effectively trades. Ideally, the analysis should be conducted with real effective exchange rates. However, these would lead to a much smaller sample, losing in the process many observations of low- and mid-low-income economies. And considering that the results of these countries are particularly relevant to discussion regarding the effect of real exchange rate on economic growth, their exclusion would leave out important pieces of the puzzle which serves as the background motivation for the analysis.

With respect to the wage share, the observations were entered into the regression in absolute terms, while the theory poses the idea that what is relevant are the changes in relative terms. To incorporate this (as well as dealing with non-stationarity issues) the regression used the within-transformation with time fixed effects which effectively demeans the variables included in the regression, that it subtracts the sample period-average from each observation. Hence, estimated coefficients for the variable of interest uses the variation in the wage share relative to the average variation of the sample. However, this is not ideal, considering that the mechanism at work would be competition. Effects of changes in the wage share of different foreign economies in the domestic economy are not all equally relevant. Their impact ultimately
is expected to depend on the intensity which these economies trade with each other and compete in foreign markets with the domestic economy. Hence, ideally the wage share data should be entered into regression directly as a ratio between the domestic economy and a trade-weighted average of foreign economies wage share.
7. References


Fisher, I., (1920) A Discussion of Professor Cassel’s Article, Annals of the American Academy of Political and Social Science, 89, pp. 276–277


Appendix

Chapter 5: Robustness Checks

Table A.1: Regressing the real exchange rate on the functional income distribution under different degrees of capital account openness (Quinn and Toyoda (2008) CAPITAL index)

<table>
<thead>
<tr>
<th></th>
<th>Dependent variable: ln RER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>ln. rgdpePC</td>
<td>0.258***</td>
</tr>
<tr>
<td></td>
<td>(0.043)</td>
</tr>
<tr>
<td>adjlabsh</td>
<td>0.253</td>
</tr>
<tr>
<td></td>
<td>(0.318)</td>
</tr>
<tr>
<td>CAP</td>
<td>0.404***</td>
</tr>
<tr>
<td></td>
<td>(0.138)</td>
</tr>
<tr>
<td>Gov Consumption to GDP</td>
<td>1.417**</td>
</tr>
<tr>
<td></td>
<td>(0.619)</td>
</tr>
<tr>
<td>Savings to GDP</td>
<td>0.334</td>
</tr>
<tr>
<td></td>
<td>(0.499)</td>
</tr>
<tr>
<td>ln TTrade</td>
<td>0.878</td>
</tr>
<tr>
<td></td>
<td>(0.839)</td>
</tr>
<tr>
<td>NFA to GDP</td>
<td>-0.023</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
</tr>
<tr>
<td>adjlabsh x CAP</td>
<td>2.781***</td>
</tr>
<tr>
<td></td>
<td>(1.057)</td>
</tr>
<tr>
<td>Observations</td>
<td>559</td>
</tr>
<tr>
<td>R²</td>
<td>0.497</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.486</td>
</tr>
<tr>
<td>F Statistic</td>
<td>179.837***</td>
</tr>
<tr>
<td></td>
<td>(df = 3; 547)</td>
</tr>
</tbody>
</table>

Note: *p<0.1; **p<0.05; ***p<0.01. Robust corrected standard errors in parentheses
Table A.2: Regressing the real exchange rate on the functional income distribution for different income level thresholds sub-samples - Quinn and Toyoda (2008) CAPITAL index:

<table>
<thead>
<tr>
<th>Dependent variable: ln RER</th>
<th>Real GDP per capita (2011 constant US$ PPP prices)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; US$ 7500</td>
</tr>
<tr>
<td>ln.rgdpePC</td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>ln.rgdpePC</td>
<td>-0.039</td>
</tr>
<tr>
<td></td>
<td>(0.095)</td>
</tr>
<tr>
<td>adjlabsh</td>
<td>-1.100***</td>
</tr>
<tr>
<td></td>
<td>(0.366)</td>
</tr>
<tr>
<td>CAP</td>
<td>0.205</td>
</tr>
<tr>
<td></td>
<td>(0.159)</td>
</tr>
<tr>
<td>Gov Cons. to GDP</td>
<td>1.224*</td>
</tr>
<tr>
<td></td>
<td>(0.741)</td>
</tr>
<tr>
<td>Savings to GDP</td>
<td>0.319</td>
</tr>
<tr>
<td></td>
<td>(0.461)</td>
</tr>
<tr>
<td>ln TTrade</td>
<td>0.819</td>
</tr>
<tr>
<td></td>
<td>(1.350)</td>
</tr>
<tr>
<td>NFA to GDP</td>
<td>-0.076**</td>
</tr>
<tr>
<td></td>
<td>(0.037)</td>
</tr>
<tr>
<td>adjlabsh x CAP</td>
<td>1.916*</td>
</tr>
<tr>
<td></td>
<td>(1.085)</td>
</tr>
<tr>
<td>Observations</td>
<td>181</td>
</tr>
<tr>
<td>R^2</td>
<td>0.228</td>
</tr>
<tr>
<td>Adjusted R^2</td>
<td>0.158</td>
</tr>
<tr>
<td>F Statistic</td>
<td>6.978*** (df = 7; 165)</td>
</tr>
<tr>
<td></td>
<td>7.690*** (df = 7; 211)</td>
</tr>
</tbody>
</table>

Note: *p<0.1; **p<0.05; ***p<0.01. Robust corrected standard errors in parentheses
Table A.3: Regression results for the real exchange rate on the wage share for different levels of income groups (World Bank Classification) (Quinn and Toyoda (2008) CAPITAL index)

<table>
<thead>
<tr>
<th>Dependent variable: $\ln \text{RER}$</th>
<th>Low &amp; Low-Mid Income</th>
<th>Mid-High Income</th>
<th>High-Income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>$\ln \text{rgdpePC}$</td>
<td>-0.218***</td>
<td>-0.170***</td>
<td>0.345***</td>
</tr>
<tr>
<td></td>
<td>(0.052)</td>
<td>(0.051)</td>
<td>(0.067)</td>
</tr>
<tr>
<td>$\text{adjlabsh}$</td>
<td>-1.056***</td>
<td>-2.250***</td>
<td>-0.659**</td>
</tr>
<tr>
<td></td>
<td>(0.232)</td>
<td>(0.539)</td>
<td>(0.258)</td>
</tr>
<tr>
<td>$\text{CAP}$</td>
<td>0.179</td>
<td>-1.141**</td>
<td>0.133</td>
</tr>
<tr>
<td></td>
<td>(0.137)</td>
<td>(0.580)</td>
<td>(0.100)</td>
</tr>
<tr>
<td>$\text{Gov Cons. to GDP}$</td>
<td>1.837**</td>
<td>1.584**</td>
<td>0.719</td>
</tr>
<tr>
<td></td>
<td>(0.790)</td>
<td>(0.687)</td>
<td>(0.706)</td>
</tr>
<tr>
<td>$\text{Savings to GDP}$</td>
<td>1.053***</td>
<td>0.863***</td>
<td>-0.545**</td>
</tr>
<tr>
<td></td>
<td>(0.307)</td>
<td>(0.310)</td>
<td>(0.274)</td>
</tr>
<tr>
<td>$\ln \text{TTrade}$</td>
<td>3.174***</td>
<td>3.762***</td>
<td>1.084</td>
</tr>
<tr>
<td></td>
<td>(0.930)</td>
<td>(1.011)</td>
<td>(1.293)</td>
</tr>
<tr>
<td>$\text{NFA to GDP}$</td>
<td>-0.063*</td>
<td>-0.043</td>
<td>-0.141*</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td>(0.027)</td>
<td>(0.083)</td>
</tr>
<tr>
<td>$\text{adjlabsh x CAP}$</td>
<td>2.277**</td>
<td>1.806*</td>
<td>1.806*</td>
</tr>
<tr>
<td></td>
<td>(0.953)</td>
<td>(0.978)</td>
<td>(1.415)</td>
</tr>
</tbody>
</table>

Observations: 109 109 160 160 229 229

R²: 0.591 0.622 0.276 0.301 0.668 0.681
Adjusted R²: 0.525 0.556 0.201 0.223 0.645 0.657

F Statistic: 19.198*** (d = 7; 93) 18.918*** (d = 8; 92) 7.852*** (d = 7; 144) 7.713*** (d = 7; 143) 61.258*** (d = 7; 213) 56.479*** (d = 8; 212)

Note: *p<0.1; **p<0.05; ***p<0.01. Robust corrected standard errors in parentheses.