



# **The Theory of International Prices: A Classical Production-Based Approach**

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## **Abstract**

This thesis is an investigation into the theory of international prices, following a classical production-based approach. The thesis provides a systematic investigation of different closures to the system of international prices, focusing on the types of assumptions employed by the literature. Three main closures are considered: balanced trade, equal growth rates, and free international mobility of capital. Each of these closures is associated with one or more contributions in the history of thought. Through careful evaluation, the thesis identifies theoretical and empirical shortcomings with each closure.

The thesis then proposes a novel closure to the system of international prices based on given wage disparities. This is done in three successive stages through a step-by-step layering process where each layer adds more realistic and complex scenarios. The first layer builds from a pure labour model; it provides the first formalization of Pasinetti's contributions to international trade theory. The second layer introduces trade in intermediate goods. The third layer introduces positive rates of profit. For each layer, the thesis analyses the conditions required for countries to specialize according to comparative or absolute advantage. It shows that comparative advantage cannot determine specialization by itself; it needs additional assumptions. Furthermore, the thesis argues that given wage disparities are sufficient to determine absolute cost advantages. International prices and specialization are determined based on absolute cost advantages, compatible with the classical process of price competition.

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## **Chapter 1: Introduction**

### **1.1 Motivation of study**

Trade in intermediate goods (or inputs) has always been a characteristic of the capitalistic world economy. Economic history shows that imperialism and colonial ventures established an international division of labour where peripheral countries exported goods in a raw state or with little processing; core countries imported those goods to transform them into consumer goods or more sophisticated inputs for the domestic and international markets.

In the last half-century or so, this characteristic has become much more significant. Today, world production is an integrated production process dispersed amongst different countries. This represents a substantive shift in the international division of labour, with peripheral countries also producing manufactured goods. The literature has given different labels to this evolution of productive integration: global commodity/value chains (Gereffi, 1994; Hopkins and Wallerstein, 1986; Kaplinsky, 2013); offshore outsourcing or “offshoring” (Winkler and Milberg, 2013); and international vertical disintegration (Baldone, Sdogati, and Tajoli, 2007).

Even though the 2008-crisis and the 2020 COVID-19 pandemic caused some disruptions, Global Value Chains (GVCs) show remarkable resilience (Bacchetta et al., 2021). Recently, the World Bank, for example, released a report placing key importance on the role of GVCs in development (World Bank, 2020). It follows, it might be argued, that an analytical tool that is able to shed light on the drivers and characteristics of this type of international division of labour is very important for interpreting the modern world and that it will also be important in the near future.

In empirical work, there is a wealth of literature using input-output techniques to measure and describe GVCs (see the survey by Johnson, 2018). Despite this volume of empirical work, however, there is some consensus in the literature that the theoretical tools available do not offer appropriate explanations (Inomata, 2017). As Grossman and Rossi-

Hansberg (2006) argue, theoretical trade models may not be suited to explaining GVCs because they focus on trade in final goods only. Inomata (2017) suggests that we need a ‘New-New-New Trade Theory’.

Contrary to this position, I suggest that, instead of coming up with a completely new theory, we should go back to classical political economists and Marx. More specifically, Sraffa’s reconstruction of classical political economy (Sraffa, 1951, 1960) is a possible starting point for modelling global production networks. This framework of analysis puts a lot of emphasis on the role of intermediate goods in production, contrary to the traditional Heckscher-Ohlin model that concentrates on the endowments of non-producible factors of production. As noticed by Escaith and Miroudot (2016), there is a lot of overlap between the formal aspects of the empirical input-output analyses and Sraffian analysis (which they refer to as neo-Ricardian).

This thesis aims at drawing on classical political economy to develop a theoretical framework capable of dealing with some of the salient features of GVCs. Any analytical construct must start by isolating the crucial aspects of a complex phenomenon that it wants to explore. On this basis, the core feature of GVCs under investigation is that there is a widespread use of imported inputs.

This core feature implies that there is a circularity in world production. In other words, production in different countries is interconnected. As Gereffi and Korzeniewicz (1994, p. 1) put it: “Capitalism today thus entails the detailed disaggregation of stages of production and consumption across national boundaries”. This justifies the use of modern classical political economy, as developed by Sraffa (1960), which emphasizes that commodities are produced by means of commodities.

One of Sraffa’s contributions to the revitalization of classical political economy was to provide a production-based price system that considers the interconnectedness of industries. This framework explains the prices of production based on technology (the



matrices of technical coefficients) and distribution between capitalists and workers. Besides explaining prices, the framework also shows how the method of production is chosen from those available; where the method of production is understood as a particular combination of inputs required to produce a good.

In the case of international trade, the focus also moves to the consideration of prices of goods traded between countries. The question of choice of method can thus be extended to include which commodities each country will produce. Therefore, a production model that attempts to explain international trade must address at least two related questions: first, how are international prices formed?; and second, what drives specialization between countries? The answer to these questions depends on the structure of the model and its assumptions. To develop this approach, there have been significant advances in classical political economy models that deal with trade in intermediate goods. These contributions can be put into two main groups that share a similar structure but are separated by the type of closure selected in order to answer these questions.

The first group closes the model with an assumption regarding quantities. It includes both Ricardo's approach (Ricardo, 1817, chap. 7) and the more recent developments by Steedman (1979a) and others (organized in Steedman, 1979b). A recent literature on Ricardo has shown how it relies on given quantities produced and on a condition of balanced trade (see Ruffin, 2002; Gehrke, 2017; and Bhering and Serrano, 2019). The assumption of balanced trade with given quantities establishes a unique international relative price that must be observed between countries. Therefore, international relative prices are determined *outside* of production and production conditions must adapt to it.

Steedman (1979a) offers another closure that extends Ricardo's balanced trade condition to a dynamic setting: not only must trade be balanced, but countries must grow at the same rate to keep trade balanced. Using this condition, a formal relationship is established between the rate of growth and the profit rate in any country. Formally, this

closure implies that countries' profit rates are *indirectly* connected via the common rate of growth.

The second group closes the model via an assumption regarding the international mobility of capital, and not via quantities. For example, Shaikh (1999, 2016) and Parrinello (2010) argue that modern capitalism is characterized by free international mobility of capital, which leads to a tendency for an international equalization of profit rates. This is an external critique of Ricardo's well-known assumption that capital is immobile across countries and, from which it follows that profit rates tend to be persistently different between countries. Formally, this new assumption means that rates of profit are *directly* linked via international capital competition; and this allows the literature to reassert the role of absolute advantages in the determination of international trade.

This reassertion of absolute advantage represents a break with the tradition in economics to focus exclusively on comparative advantage. However, the literature often relies on different definitions; and as a result communication can suffer. In this thesis, I propose to redefine both absolute and comparative advantage in a classical production-based approach, thus providing a benchmark for scholars to discuss their ideas.

This thesis identifies some issues with each of these closures to the production-based system of international prices; some closures have inherent theoretical issues, while others struggle to fit with stylized facts. Furthermore, my critiques draws on arguments from both classical political economy and Keynesian economics: thus fitting into the classical-Keynesian paradigm as defined by Bortis (1997, pp. 78-81): "the synthesis of the Ricardian theory of value and distribution and the Keynesian theory of employment determination through effective demand". It substitutes the theory of employment in Ricardo based on Say's Law for the Keynesian (or Kaleckian) theory of effective demand. This paradigm has been developed and extended by authors such as Garegnani (1978, 1979, and 1983b), Pasinetti (1981), and Eatwell (1983).

A distinctive part of my approach is to propose a novel closure of the international price system. This novel closure does not depend on balanced trade, or an equal rate of growth, or free international mobility of capital. Instead, I propose a closure based on persistent differences in nominal wages between countries. It has been recognized that capitalism generates persistent wage disparities (Botwinick, 1993), which may also be true between countries. This assumption offers a determination of the international price system based on absolute costs of production that is consistent with the classical process of price competition.

## 1.2 Research questions and goals

This thesis studies the implications of international trade in intermediate goods for a Sraffa-inspired production model. The focus is on the determination of international prices and the patterns of specialization of production. The main objectives of the thesis are:

- *Objective 1:* To understand how the classical political economy literature examines international trade.

There are two research questions related to this objective:

- a) What additional trade-related assumptions and closures does the literature employ?
- b) What are the theoretical and empirical limitations of each closure?

- *Objective 2:* To evaluate the role of absolute and comparative advantage from a classical political economy perspective.

This raises two research questions:

- a) What is the connection between absolute and comparative costs in the determination of international trade?

- b) What are the implications for the definitions of absolute and comparative advantage when there is trade in intermediate inputs?

- *Objective 3:* Explore the role of nominal wages in the determination of absolute advantage.

This prompts a research question:

- a) What are the implications of taking nominal wages as given in a production model with international trade?

### 1.3 Contributions of the thesis

This thesis offers key contributions to the literature. First, the thesis contributes with a review of the classical political economy literature on international trade organized around a single theme: the closure to the international price system. This critical evaluation is especially important for more modern contributions that have received less attention from the secondary literature. I offer a benchmark to analyse works spanning around two centuries in terms of what they want to explain. This exploration identifies the connections between these different strands of literature, allowing for a better comparison between competing closures and providing a common ground for future discussions.

Based on this critical evaluation of this literature on international trade, this thesis proposes a novel closure to a production model of international trade. This proposed closure relies on an assumption of given nominal wages; it does not require a balanced trade, free international mobility of capital, or equal growth rates. To argue this, I start with very simple configurations to understand the fundamental properties of the model and then I add further complexities to show the generality of the results.

The first layer of complexity is a pure labour model without intermediate goods or profits. It contributes with a formalization of Pasinetti's insights into international trade

(Pasinetti, 1993, chapter 9). As a further contribution, I show that, with given nominal wages, absolute advantages dominate the process of price formation and specialization even in this simple framework. I also show that even if comparative advantage works (as in Ricardo), it requires the additional proviso that absolute cost advantages exist. This simple framework also has a pedagogical value as the intuition behind the new closure is very easy to grasp: students and scholars unfamiliar with the production-based approach may access it here with simple models that are easy to grasp.

In the second layer of complexity, I introduce the assumption that production uses material inputs and that these might be imported. In a seminal paper, Baldone et al. (2007) argue that the inclusion of trade in intermediate goods leads to a determination of prices based on absolute advantage. I criticize this position, instead arguing that it is wage disparities that lead to absolute advantage. It contributes by clearly showing the overlooked role played by given nominal wages in the definition of absolute advantages.

In the last layer of complexity, I extend the argument to a Sraffa-inspired production model with positive rates of profit. Its contribution is to show that the novel closure, based on given wages, can be made operational in a capitalistic setting. In the process of building the model, I also contribute with a definition of absolute advantage that incorporates trade in intermediate goods and positive rates of profit. Absolute advantage is thus shown to be consistent with the classical process of price competition.

This step-by-step approach allows for the establishment of the key role of absolute advantage in different levels of abstraction. Absolute advantage has a more fundamental role than that advocated by the previous literature, as it does not depend on the existence of trade in intermediate goods or on the degree of international mobility of capital. In all layers, I show that an assumption of wage disparities is sufficient to define absolute cost advantage and to determine international prices and specialization based on the classical process of price competition.

## 1.4 Structure of the thesis

This thesis is divided into six chapters. I have attempted to maintain chapters as self-sufficient as possible, so readers may understand them independently. The obvious cost is the repetition of some arguments. Following this introduction, Chapter 2 provides a literature review to critically evaluate the main contributions to international trade theory in the classical political economy approach. The literature review is organized in chronological order. In the literature review, I will identify possible shortcomings of each previous approach, setting out the gap in this literature that our analysis attempts to fill.

I follow a systematic approach by building layers of complexity. This approach is based on an understanding of Pasinetti (1981 and 1993) where the analytical framework is condensed into its most simple form, from which increasingly more complex structures can be introduced. As a starting point to the systematic approach taken in the thesis, Chapter 3 presents a pure labour model as a formalization of Pasinetti's international trade model (Pasinetti, 1993, chapter 9). This is the simplest production framework available under which production happens by means of unassisted labour and there are no profits. Using this framework, I argue that comparative and absolute advantages are not opposites and that given wage disparities are sufficient to determine international prices and the pattern of trade, based on absolute cost advantages.

Chapter 4 adds a new layer of complexity by introducing intermediate goods to the model, before the introduction of positive rates of profit. The key role of absolute advantage is developed in a fully integrated trade system with trade in intermediate inputs. The chapter starts from the seminal contribution by Baldone et al. (2007) and it shows the key role played by given nominal wages. It argues that absolute advantage is still relevant in this more complex framework.

Chapter 5 builds on the insights provided by the simplified analysis in two previous chapters to consider a true capitalistic production system. The chapter introduces the assumption that profit rates are positive. I show that, in this case, the solution to the international production system requires another assumption of a given distributive variable (the rate of profit), consistent with Sraffa's analysis (Sraffa, 1960). I further develop the role of absolute advantage, as the main determinant of international trade, in a full-blown capitalistic economy. Some generalizations are also achieved.

The thesis ends with a conclusion, summarizing the contribution of the thesis. I discuss the limitations of the thesis and possible paths that future research might lead: both in terms of connections with other areas of economics and how the contributions of the thesis could be used for empirical research.

## Chapter 2: Literature review

### 2.1 Introduction

This chapter offers a critical evaluation of the relevant literature for this research thesis. Authors and contributions have been mostly organized chronologically; when dealing with contemporaneous contributions, I have organized them according to the similarity of their assumptions.

The thesis deals with theoretical frameworks that try to explain international trade. This is a broad topic and it also has a very long history in economic theory. Therefore, it is necessary to show the exact scope of the thesis and where it intersects with the literature. Regarding international trade, the objective is to study theories of international prices, with a specific focus on the classical political economy literature.<sup>1</sup>

The theory of value is concerned with the determinants of the rates that goods exchange one for another. The kind of questions that it aims to answer are such as: how many bananas is an apple worth? Alternatively, how many bananas can one buy with the money equivalent to buy one apple? In other words, it attempts to explain *relative prices*. Classical political economy inherits from the physiocrats the notion that costs govern prices (Aspromourgos, 1996; see also Fratini, 2018). Hence, it adopts a cost-based determination of prices. In particular, classical political economy takes as data the size and composition of output, the available technologies of production, and a real distributive variable (either the real wage or the rate of profit) to determine relative prices/costs and the other distributive variable (Garegnani, 1984; Eatwell, 1983).

It is important to notice that the classical theory of value attempts only to explain *natural prices* and not market prices. The distinction between natural and market prices was emphasized by Adam Smith (2007[1776], chap. VII). Adam Smith based the distinction on

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<sup>1</sup> The thesis also deals with productive specialization. However, I shall argue that the determination of international prices and specialization are intrinsically related.



how *persistent* are the forces that act on each: natural prices are determined by persistent forces that can be isolated and investigated, while market prices are influenced by transitory events that cannot be treated analytically. Natural prices are defined as the price necessary to just cover the costs of production: “The commodity is then sold precisely for what it is worth, or for what it really costs the person who brings it to market” (Smith, 2007[1776], p. 47). The study of natural prices is important inasmuch as they ground the evolution of market prices (Garegnani, 1976); Smith used the analogy of natural prices acting as centres of gravitation for market prices. This thesis is only concerned with natural prices and there are no allusions to market prices.

The core of the theory of value is usually presented for a single economy, meaning that it explains relative costs for goods produced inside a sole country. When it moves to considerations of international trade, the theory of value must be able to explain not only the relative prices ruling inside one country but also the relative prices between countries. The latter term we shall call the international relative prices (or terms of trade). For example, the theory must be ready to explain how many bananas produced in India are equivalent to an apple produced in China.

This chapter evaluates previous attempts by the classical political literature to make this transition from domestic relative prices to international relative prices. Addressing Objective 1a from Chapter 1, section 1.2, I will explore the additional assumptions that are necessary to close the model and their possible shortcomings. Addressing Objective 1b, I will use both theoretical arguments and stylized facts to point out possible deficiencies in each closure.

However, before analysing each contribution, it is worth exploring the problem in simple terms; the next two sections show the method of classical political economy and argue that, in general, a theory of domestic relative prices is insufficient to determine international relative prices (or terms of trade).

### 2.1.1 The method of classical political economy

Classical political economy adopts a cost-based theory of prices built around the idea that the relative prices of commodities reflect their comparative costs.<sup>2</sup> In Adam Smith's imaginary scenario of a 'rude state of society' without accumulation of capital, he explains the ratio of exchange between beavers and deer as the relative cost of hunting these animals:

If among a nation of hunters, for example, it usually costs twice the labour to kill a beaver which it does to kill a deer, one beaver should naturally exchange for or be worth two deer. (Smith, 2007[1776], p. 41)

So, the amount of labour spent on hunting these animals provides a good measure of their costs. The ratio between the costs is what determines the rate at which you can exchange beavers for deer, or their relative prices. It thus allows a comparison of their inherent value.

When Smith introduces the accumulation of capital, hence profits, this simple rule no longer applies. In this case, the true cost to bring any commodity to the market divides itself into wages, profits, and rent of land. The crucial step of the argument is when Smith establishes that there is a natural rate for each one of these income categories:

There is in every society or neighbourhood an ordinary or average rate both of wages and profit in every different employment of labour and stock. (...) There is likewise in every society or neighbourhood an ordinary or average rate of rent (Smith, 2007[1776], p. 47)

And the natural price of commodities is defined as the price necessary to cover the wage, profit, and rent when measured at their natural rates:

When the price of any commodity is neither more nor less than what is sufficient to pay the rent of the land, the wages of the labour, and the profits of the stock employed in raising, preparing, and bringing it to market, according to their natural rates, the

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<sup>2</sup> At this stage we are not concerned on how to measure costs. The discussion in this session does not depend on whether one works with a labour theory of value, or with Sraffa's price equations, or even with a marginalist opportunity cost approach. The only concern is the common assumptions necessary to determine persistent relative costs, what Garegnani (1976) calls the method of long-period positions.

commodity is then sold for what may be called its natural price. The commodity is then sold precisely for what it is worth, or for what it really costs the person who brings it to market (Smith, 2007[1776], p. 47)

Smith refers to this as the true cost of production because it is the minimum price that producers would be content with for prolonged periods of time.<sup>3</sup> If prices are below costs for long periods of time, then producers forego production and move to other sectors. But, if prices are above costs, this will attract capital to the sector, eventually reducing prices down to costs.

A comparison between the natural prices (or costs) of two commodities establishes their relative price or the ratio at which they can be exchanged. For this, it is paramount that one is able to create a connection between wages as well as profits<sup>4</sup> in the different branches of production; in other words, to give these a persistent average or natural value.

In classical political economy, the natural wage is determined by a ‘subsistence wage’. This grounds wages as the minimum that allow workers to buy their necessary basket of consumption, a measure of real wages. This is another inheritance from the physiocrats (Stirati, 1994, p. 15-17)<sup>5</sup>, with wages established at a level just sufficient to maintain the worker and its dependants: “A man must always live by his work, and his wages must at least be sufficient to maintain him. They must even upon most occasions be somewhat more; otherwise, it would be impossible for him to bring up a family” (Smith, 2007[1776], p. 57-8).

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<sup>3</sup> There is some ambiguity in Smith’s writing where he defines the natural price as the sum of the natural wage, the natural profit, and the natural rent; each category being independently determined. Both Ricardo and Marx criticized this ‘adding up’ theory of prices (see Sraffa, 1951, pp. 21-22). With respect to Smith’s theory, Marx says that “now the natural price of commodities is supposed to be calculated and discovered by adding together the natural prices of wages, profit and rent. It is one of Ricardo’s chief merits that he put an end to this confusion” (Marx, 1969, p. 97). However, it might be argued that the idea that the natural price resolves itself into wages, profit, and rent does not depend on these being independent variables. Smith’s concept of the natural price of commodities is still valid, even if his calculations are problematic.

<sup>4</sup> This is also true for the rent of land. However, this thesis will not discuss the rent of land anywhere. It suffices to note that, in his theory of value, Ricardo gets rid of the rent of land very early by assuming that it only emerges from differences in productivity in land and that the most productive land is not enough to meet the agricultural demand. So, a theory of differential rent.

<sup>5</sup> See also Aspromourgos (1996, pp. 130-5) for an evaluation of subsistence wages in James Steuart’s writings.

The definition of natural wage as a subsistence wage also includes elements of culture and norms, not only purely biological factors. For example, Smith uses customs and habits to define items of necessary consumption:

By necessities I understand not only the commodities which are indispensably necessary for the support of life, but whatever the custom of the country renders it indecent for creditable people, even of the lowest order, to be without. A linen shirt, for example, is, strictly speaking, not a necessary of life. (...) But in the present times, through the greater part of Europe, a creditable day-labourer would be ashamed to appear in public without a linen shirt, the want of which would be supposed to denote that disgraceful degree of poverty which, it is presumed, nobody can well fall into without extreme bad conduct. (Smith, 2007[1776], p. 676)

Ricardo, while not expanding the discussion very much, seems to agree with Smith in this point when he argues that the natural wage “essentially depends on the habits and customs of the people” (Ricardo, Works, vol. 1, p. 92).<sup>6</sup>

We shall now move to the notion of a natural rate of profit. Adam Smith claimed in certain parts of his work that the natural rate could also be independently defined (see footnote 3 in this chapter). However, Ricardo showed that this was false because, with known methods of production, the profit of the capitalists must be whatever is left after paying the workers their natural wages. Profits are thus measured as a residual variable, or as the surplus; it cannot be independent of wages:

It has been my endeavour to shew throughout this work, that the rate of profits can never be increased but by a fall in wages, and that there can be no permanent fall of wages but in consequence of a fall of the necessities on which wages are expended. (Ricardo, Works, vol. 1, p. 112)

So, profits and wages are intrinsically related by the conditions of production. Profit is the excess of net production above workers’ subsistence.

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<sup>6</sup> All references and quotations from Ricardo are from Sraffa’s edition of his collected works. Specifically, the online edition available at <http://oll.libertyfund.org/titles/159>. I will indicate the respective volume and page number when appropriate.

This theoretical determination of a natural rate of profit requires an important step: competition among capitalists “has a strong tendency to equalize the rate of profits of all” (Ricardo, Works, vol. 1, p. 87). The same value of advanced capital tends to generate an equivalent amount of profits regardless of where it is invested. Capitalists move capital away from sectors that are generating below normal profit rates. It is worth noticing, that the rate of profit does not need to be exactly the same in all branches as they may bear a proportion “in consideration of the security, cleanliness, ease, or any other real or fancied advantage which one employment may possess over another” (Ricardo, Works, vol. 1, p. 88). So, it allows for natural profits to be persistently different as long as this difference is given and reflects a perceived risk of the sectors.<sup>7</sup>

This rule of distribution is crucial because it gives a common basis for comparison. For example, if there is no link between the profit rate of the baker and the farmer, profit rates could move in any direction with respect to each other. It would be impossible to assess how much of the cost of bread comes from using corn as input, as this would change with different combinations of profit rates.

Marx agrees with Ricardo that it is not possible to determine wages, rents, and profits independently as in Adam Smith. He also quotes approvingly that it is this establishment of the natural (or average) rate of profit that explains that natural prices (or values) govern actual prices:

Smith’s [conception] is based on his false assumption, that the three elements independently determine the value of the commodity, while Ricardo’s is based on the correct assumption that it is the *average rate of profit* (at a given level of wages), which alone determines the cost-prices. (Marx, 1968, p. 222, emphases in the original)

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<sup>7</sup> Pivetti (1991, p. 25) refers to these differences in profit rates as the ‘normal profit of enterprise’ which is determined by “the remuneration for the ‘risk and trouble’ of productively employing capital in that particular production sphere”. The only requirement to incorporate these normal profits of enterprise into a classical political economy framework is that this perceived ‘risk and trouble’ is sufficiently stable and independent of the distribution between workers and capitalists (Pivetti, 1991, p. 24).

This is an interesting quotation as it shows that it is the combination of a given real wage and the uniform rate of profits that determine natural prices.

In conclusion, in a classical political economy framework, natural prices are the prices that just cover natural wages and natural profits. In the next section, I discuss the problems that emerge when one attempts to use this general method of determining natural prices for international prices.

### **2.1.2 Indeterminacy of international prices**

It is well-known that a cost-based theory of prices faces problems when trying to determine international prices. The issue is that the same set of assumptions used to determine domestic relative prices is not sufficient to determine international relative prices. Vasudevan (2012, p. 193) refers to this issue as an “indeterminacy of the international terms of trade”. In this section, I will briefly address the issue in simple terms.

As argued in section 2.1.1, classical political economy relies on two assumptions: a) a real wage determined by the necessities of consumption; b) the tendency to equalization of sectoral profit rates. These two assumptions, coupled with given methods of production, are sufficient to determine domestic relative prices as reflecting costs of production.

The problem arises when Ricardo argues that capital is relatively immobile between countries. This means that there is no connection between profit rates in different countries:

In one and the same country, profits are, generally speaking, always on the same level; or differ only as the employment of capital may be more or less secure and agreeable. It is not so between different countries. If the profits of capital employed in Yorkshire, should exceed those of capital employed in London, capital would speedily move from London to Yorkshire, and an equality of profits would be effected; but if in consequence of the diminished rate of production in the lands of England, from the increase of capital and population, wages should rise, and profits fall, it would not follow that capital and population would necessarily move from England to Holland, or Spain, or Russia, where profits might be higher. (Ricardo, Works, vol. 1, p. 113)

The profit rates in different countries do not tend to be the same. It is particularly important that he discusses a *change* in England's profit rates because in this example the ratio between English and Dutch profit rates is changing; this means that they are not in any defined proportion either. So, the differences in profit rates cannot be explained by stable measures of a perceived risk of investing in the different countries (see footnote 7 in this chapter).

The absence of a formal connection between the countries' profit rates implies that it is not possible to calculate the ratio between the costs of production of two goods. Hence, it is not possible to measure their natural prices. The core of the theory of value does not determine international relative prices when profit rates do not tend to follow a given ratio; international relative prices are indeterminate.

There are two general ways to overcome such indeterminacy. The first is to maintain Ricardo's assumption of unequal profit rates and offer additional assumptions to close the model. The second approach is to discard Ricardo's assumptions and impose a tendency of international equalization of profit rates; the theory of international prices is then indistinguishable from a theory of domestic prices. For each option, there are variations across different contributions in the literature. The subsequent literature review is divided into two groups representing the two general solutions; inside each group, the contributions are organized in chronological order.

## **2.2 International trade with unequal profit rates**

This literature review starts with the contributions that maintain Ricardo's assumption of unequal profit rates between countries. This implies a treatment of international relative prices different from domestic relative prices. This section evaluates the main contributions in this line of thought and shows what are their additional assumptions and shortcomings.

### 2.2.1 David Ricardo

It is fitting to start with David Ricardo, one of the first authors to propose an analysis of international prices separate from domestic prices. As argued previously Ricardo separates domestic from international trade based on the mobility of capital. In the domestic setting, capital is assumed to be freely mobile which leads to a tendency to the equalization of profit rates inside the country. In the international setting, capital is assumed to be relatively immobile, hence there is no tendency for the equalization of profit rates between countries. This section shows how Ricardo determines domestic relative prices, the problems raised by international trade, and his choice of closure.

It is well-known that Ricardo adopts a labour theory of value to explain relative prices in a domestic economy: “The value of a commodity, or the quantity of any other commodity for which it will exchange, depends on the relative quantity of labour which is necessary for its production” (Ricardo, Works, vol. 1, p. 45). This is a result of his analysis, instead of an assumption. It is important to show how Ricardo achieves this result based on a given real wage and the free mobility of capital inside a country (see section 2.1.1 in this chapter). I will show this by means of an example.

Borrowing from Ricardo’s chapter on international trade (Ricardo, Works, vol. 1, chap. 7), I construct an example with two countries (England and Portugal) competing in the production of two commodities (cloth and wine). Both countries can produce either commodity, meaning that they have a method of production for cloth and wine. The methods of production are assumed to include only direct labour or unassisted labour.<sup>8</sup> Capitalists advance the workers’ wage and receive a net profit rate from this advancement.

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<sup>8</sup> The assumption of only direct labour is contrary to Ricardo’s chapter on value where he explicitly says that the labour employed to produce a commodity should also include the labour employed to produce its means of production: “Not only the labour applied immediately to commodities affect their value, but the labour also which is bestowed on the implements, tools, and buildings, with which such labour is assisted” (Ricardo, Works, vol. 1, p. 51).

Ricardo does consider pure labour production as a very hypothetical construct where the labour theory of value is perfectly correct. For example, in his unpublished notes on *Absolute Value and Exchangeable Value*, Ricardo says:



As a starting point, it is important to investigate the determination of relative prices/costs in the domestic setting. From the point of view of England, a cost-based theory of prices implies the rate of exchange between cloth and wine produced in England is equivalent to their relative costs. Their relative costs are equal to the ratios of labour bestowed to produce both commodities. From the point of view of Portugal, the same result is true.

Costs must be measured by the wage advanced to workers according to the natural wage rate and by the natural profit rate which must be the same in all sectors (see section 2.1.1 in this chapter). The expressions for the costs to produce cloth and wine in England are:

$$c_c^E = w^E l_c^E (1 + r^E) \quad (2.1)$$

$$c_w^E = w^E l_w^E (1 + r^E) \quad (2.2)$$

where  $c_c^E$  and  $c_w^E$  represent the cost to produce cloth and wine in England;  $w^E$  is the natural wage in England, or the wage that allows workers to buy the known basket of necessities;  $l_c^E$  and  $l_w^E$  are the quantities of labour employed to produce cloth and wine in England; and  $r^E$  is the natural rate of profit in England which tends to be the same in both sectors because of capitalist competition and capital mobility. It is evident that equations (2.1) and (2.2) are

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It appears then that we should have no difficulty in fixing on a measure of value, or at least in determining on what constituted a good measure of value, if all commodities were produced exactly under the same circumstances — that is to say if all required labour only without advances, to produce them, or all requiring labour and advances could be produced and brought to market in precisely the same time.

The difficulty then under which we labour in finding a measure of value applicable to all commodities proceeds from the variety of circumstances under which commodities are *actually* produced. (Ricardo, Works, vol. 4, p. 223-4, my emphasis)

It is clear that he does not consider pure labour as a good representation of actual production. He only considers it to argue that it is the existence of machines and capitals of different durations that make relative prices diverge from embodied labour ratios. Ricardo argued that the labour theory of value was valuable because it offered a good approximation of relative prices (on this, see Stigler, 1958; and the critical comment by Kurz, 2018).

The issue is that introducing reproducible means of production presents analytical problems for a labour theory of value, problems larger than Ricardo had predicted. However, these problems are not directly related to international trade. By assuming only direct labour, the analysis remains coherent, and the main results are unaffected by the analytical problems.

what Adam Smith called natural prices, as they are the minimum prices that would resolve themselves into workers and capitalists receiving their natural rates of remuneration.

To calculate the relative cost between English cloth and wine, divide equation (2.1) by (2.2):

$$\frac{c_c^E}{c_w^E} = \frac{l_c^E}{l_w^E} \quad (2.3)$$

Equation (2.3) shows that the relative costs to produce cloth and wine is equal to the ratio between their labour contents. This is the only rate of exchange that allows English production of cloth *and* wine to pay workers and capitalists their natural remuneration. It is only possible to arrive at this formulation because workers and capitalists are paid their natural remuneration; if there was no connection between the remunerations in each sector, the relative cost would not be determined.

From the point of view of Portugal, the cost equations look very similar:

$$c_c^P = w^P l_c^P (1 + r^P) \quad (2.4)$$

$$c_w^P = w^P l_w^P (1 + r^P) \quad (2.5)$$

where all variables have the same meaning, but now refer to Portugal (hence, the  $P$  superscript). The relative cost of cloth and wine produced in Portugal is also equal to the ratio of their labour content:

$$\frac{c_c^P}{c_w^P} = \frac{l_c^P}{l_w^P} \quad (2.6)$$

This shows how Ricardo can arrive at the conclusion that the relative cost (or values, as he calls it) of commodities in a domestic setting are equivalent to their relative labour contents. He is only able to do so by stipulating that workers and capitalists in any sector receive their natural remuneration, at least as a long period condition.

We may now consider international trade.<sup>9</sup> As mentioned previously, Ricardo assumes that capital is relatively immobile between countries, which implies that there is no tendency for an equalization of international profit rates. The long-period position has  $r^E \neq r^P$ . This poses some problems for a cost-based theory of prices to determine cross-country relative costs. Relative costs are not equal to the ratio of labour coefficients, in Ricardo's words:

The same rule which regulates the relative value of commodities in one country, does not regulate the relative value of the commodities exchanged between two or more countries. (...) The quantity of wine which she [Portugal] shall give in exchange for the cloth of England, is not determined by the respective quantities of labour devoted to the production of each, as it would be, if both commodities were manufactured in England, or both in Portugal. (Ricardo, Works, vol. 1, p. 113)

The rule that Ricardo refers to is the labour theory of value that works in a domestic setting (see equations (2.3) and (2.6)) but not internationally (Bhering, 2017, p. 114). For example, the relative cost of English cloth and Portuguese wine is just the ratio between equations (2.1) and (2.5):

$$\frac{c_c^E}{c_w^P} = \frac{w^E l_c^E (1 + r^E)}{w^P l_w^P (1 + r^P)} \quad (2.7)$$

Equation (2.7) is the natural price of cloth produced in England and wine produced in Portugal because it is the only rate of exchange that would allow workers and capitalists to receive their natural remuneration in both countries.

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<sup>9</sup> The exposition of Ricardo's theory of international trade here is heavily influenced by the so-called 'Sraffa-Ruffin interpretation' of Ricardo. This stems from Sraffa's (1930) reply to Einaudi (1929), and more specifically from Ruffin's (2002) rediscovery of this debate. There was a famous error in James Mill's first edition of his *Elements* (Mill, 1821: see section 2.2.2 in this chapter) which was later retroactively attributed to Ricardo (Chipman, 1965, p. 482; Gehrke, 2017). Sraffa's (1930) goals were very modest and did not involve a coherent reworking of Ricardo's trade theory, he mainly wanted to question the validity of attributing the error to Ricardo. After Ruffin's (2002) contribution, a large literature has been built on this interpretation, exploring Sraffa's claim and its repercussions (see for example: Maneschi, 2004; Bhering, 2017; Bhering and Serrano, 2019; and the book edited by Senga, Fujimoto, and Tabuchi, 2017).

This equation shows very clearly that if wages and/or profits are not the same in both countries, then relative costs cannot be equal to relative labour contents. The difference in wages does not hinder the calculation of relative costs, because they are a given distributive variable set at the natural wages in both countries. At most, the difference in wages represents a slight modification of the labour coefficients. However, profit rates cannot be given parameters of the theory (see section 2.1.1 in this chapter); they must be calculated from the conditions of production and the real wage. So far, cross-country relative costs are undetermined.

Ricardo then investigates which commodities each country produces, or the pattern of specialization. This has implications for the determination of international prices. If England produces cloth and Portugal produces wine, then the international price of cloth must cover the English cost to produce cloth and the international price of wine must cover the Portuguese cost to produce wine. When that is the case, the international relative price must respect equation (2.7). If the inverse situation is true (England produces wine and Portugal produces cloth), then international prices must cover the English cost to produce wine and the Portuguese cost to produce cloth.<sup>10</sup> This shows an important result: there is a *one-to-one correspondence* between international relative prices and the pattern of specialization.

To investigate the pattern of specialization, Ricardo introduces the idea of comparative advantage. The theory of comparative advantage uses relative costs in both countries to establish the boundaries of international trade. With different methods of production, relative costs (equations (2.3) and (2.6)) will not be the same in England and Portugal. Ricardo assumes that the relative cost of producing cloth in terms of wine is lower in England than in Portugal:

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<sup>10</sup> The relative costs for this situation is:  $\frac{c_C^P}{c_W^E} = \frac{w^P l_C^P (1+r^P)}{w^E l_W^E (1+r^E)}$ .

England may be so circumstanced, that to produce the cloth may require the labour of 100 men for one year; and if she attempted to make the wine, it might require the labour of 120 men for the same time. (...) To produce the wine in Portugal, might require only the labour of 80 men for one year, and to produce the cloth in the same country, might require the labour of 90 men for the same time. (Ricardo, Works, vol. 1, pp. 113-4)

So, the domestic relative cost in England is  $c_c^E/c_w^E = 100/120$ , while in Portugal it is  $c_c^P/c_w^P = 90/80$ . Clearly, England has lower relative costs to produce cloth ( $100/120 < 90/80$ ) and Portugal has lower relative costs to produce wine ( $80/90 < 120/100$ ). These numbers became so famous that Samuelson (1969) dubbed them the ‘four magic numbers’.

Analytically, this comparison for cloth is captured by:

$$\frac{c_c^E}{c_w^E} < \frac{c_c^P}{c_w^P} \quad (2.8)$$

This creates space for countries to trade. More specifically, it would be beneficial for England to export cloth and import wine from Portugal. In doing so, England would buy relatively cheaper wine from Portugal, while Portugal would buy relatively cheaper cloth from England. It is cheaper in the sense that the cost to import is lower than the cost to produce the goods themselves. This is the definition of comparative advantage.

This evaluation is true if and only if the international relative prices sit in between the interval represented by condition (2.8). Comparative advantage only solves part of the problem: it only determines that specialization must be with England producing cloth and Portugal producing wine. Since international relative prices must still respect their respective cost of production (equation (2.7)), without a connection between profit rates, relative costs are still undetermined.

Comparative advantage can only define the boundaries in which international trade is mutually beneficial, but it cannot determine international relative prices. Chipman, for example, states: “Even if comparative advantage explains why trade takes place, it does not

explain on what terms” (Chipman, 1965, p. 482). The problem is that, even with given wages, equation (2.7) has two unknowns: relative costs  $\left(\frac{c_C^E}{c_W^E}\right)$  and relative profit rates  $\left(\frac{1+r^E}{1+r^P}\right)$ . If profit rates do not tend to equalise, this equation is therefore undefined. It is in this way that the indeterminacy of international prices appears in Ricardo and the labour theory of value. Comparative advantage by itself is not capable of solving the problem.

Ricardo offers a solution by means of an additional assumption. The first piece of the puzzle is that Ricardo assumes that trade must be balanced in value terms. In other words, the value of imports is equal to the value of exports. If England exports cloth and imports wine, then this condition means that:

$$p_c D_c^P = p_w D_w^E \quad (2.9)$$

where  $p_c$  and  $p_w$  are the international prices of cloth and wine;  $D_c^P$  is the demand of Portugal for cloth; and  $D_w^E$  is the demand of England for wine. From the point of view of England, the left side of equation (2.9) is the value of its exports, and the right side is the value of its imports. Equivalent equations appear in Bhering (2017, p. 116) and Gehrke’s (2017, p. 147) discussion on Whewell’s formalization of Ricardo.

The last piece of the puzzle comes directly from Sraffa’s (1930) defence of Ricardo. In this paper, Sraffa argues that Ricardo’s four magic numbers represent the “Number of men whose labour is required for one year in order to produce a *given* quantity of Cloth [and] Wine” (Sraffa, 1930, p. 541, emphasis added). This has been interpreted as meaning that Ricardo assumes as given the quantities traded (see Ruffin, 2002; Gehrke, 2015; and Bhering and Serrano, 2019; Faccarello, 2021). Therefore, the two demand variables in equation (2.9)

are known.<sup>11</sup> The international relative price is then totally determined by the given demands:

$$\frac{p_c}{p_w} = \frac{D_w^E}{D_c^P} \quad (2.10)$$

As Gehrke (2017, p. 145) notes: “Ricardo starts out from a situation of balanced trade with given terms of trade”. However, nothing guarantees that the international relative price defined in equation (2.10) lies inside the interval of comparative advantage (condition (2.8)) because the demands are exogenous. If it does, then England will be compelled to produce and export cloth, and Portugal will be compelled to produce and export wine.

As I have argued, the international price of the good must cover the costs of the producer. So, the price of cloth must cover the costs of English producers, while the price of wine must cover the costs of Portuguese producers:

$$p_c = c_c^E \quad (2.11)$$

$$p_w = c_w^P \quad (2.12)$$

Relative costs must be equal to relative prices:

$$\frac{c_c^E}{c_w^P} = \frac{p_c}{p_w} \quad (2.13)$$

Since relative prices are determined by demand conditions, relative costs must conform to those. Ricardo’s closure is to determine international relative prices from outside the system of production via a balanced trade and given quantities traded.

Substituting condition (2.13) into the undetermined equation (2.7):

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<sup>11</sup> The connection between the assumptions of balanced trade and given quantities traded with the rest of Ricardo’s theoretical construct is certainly an interesting question. However, it is outside of the scope of this work. For a more in-depth analysis, see Bhering (2017); Bhering and Serrano (2019); and Gehrke (2015, 2017).

$$\frac{p_c}{p_w} = \frac{w^E l_c^E (1 + r^E)}{w^P l_w^P (1 + r^P)} \quad (2.14)$$

which is one equation in one unknown: the relative profit rates  $\left(\frac{1+r^E}{1+r^P}\right)$ , since relative prices are given by equation (2.10). This makes the system completely determined.

Ricardo's framework is, thus, capable of also determining international values. While it is true that his pure theory of value is not capable of determining international relative prices, he introduced additional assumptions to close the international model.

Ricardo justifies this determination of international values based on a quantity theory adjustment. He considers the case when Portugal outsells England in both commodities, meaning that both international prices are set at Portugal's cost levels. This causes an imbalance in the trade account, as England must buy everything from Portugal and sends only money in return. This creates a net outflow of money from the deficit country (England) and a net inflow of money into the surplus country (Portugal). Ricardo argues that these net transfers of money affect the nominal costs in both countries:

But the diminution of money in one country, and its increase in another, do not operate on the price of one commodity only, but on the prices of all, and therefore the price of wine and cloth will be both raised in England, and both lowered in Portugal. (Ricardo, Works, vol. 1, p. 116)

Therefore, costs rise in Portugal and fall in England. These movements in costs and prices only stop when the net transfers of money stop, when trade is balanced.

However, this quantity theory adjustment only happens because Ricardo assumes that productive capacities are given in both countries via Say's Law (see Meacci, 2015). With this assumption, the flows of money imply in changes in the ratio between money and commodities produced. The quantity theory of money says that this will cause variations in price levels.



A classical-Keynesian critique of this process can be put forward. Countries may have spare capacity and can also increase their productive capacities. In this case, the surplus country (Portugal) could use its increased demand to fuel an increase in production and capacity; while the deficit country (England) would shrink its productive capacities due to low demand. If that is the case, the net transfers of money do not lead to changes in the ratio of money to commodities produced and the quantity theory of money does not work. Trade imbalances could remain persistent, the adjustment happening through variations in quantities produced instead of prices.

Apart from these theoretical concerns, Ricardo's assumption of balanced trade also faces problems with empirical validation. The crucial point is that countries nowadays run persistent trade surpluses and deficits. A large empirical literature on 'global imbalances' has been erected to study the persistency of unbalanced trade (see Borio and Disyatat, 2011). Figure 2.1 below shows the net position of selected countries in the trade of goods and services from 2000 to 2020. It is evident that regions like the Euro area, China, and Singapore have been running persistent trade surpluses, while countries like the United States have been running persistent trade deficits.

**Figure 2.1**

Source: Based on World Bank data (<https://data.worldbank.org/>).

Due to its theoretical and empirical difficulties, a theory of international trade based on balanced trade is put into question. This provides a motivation for replacing Ricardo's closure with alternative formulations. The next subsections provide a critical account of the different closures that other authors have proposed to, essentially, the same problem.

### 2.2.2 James Mill

James Mill was one of the main expositors of Ricardo's ideas; his book *Elements of Political Economy* is one of the first examples of a textbook in economics. He attempted to explain Ricardo's ideas in a very clear and concise manner. In this section, I investigate an error by James Mill when he discussed Ricardo's trade theory. While the error itself is not that relevant to the task at hand, its importance comes from the fact that it was instrumental in pulling the theory of international trade further away from Ricardo's original exposition (Faccarello, 2021).

The first two editions of James Mill's *Elements* (1821; 1824) contained a mistake in the treatment of international trade. The error was finally identified and revised in the third edition (1844[1826]). However, a fundamental question was still left open: his framework could not determine international relative prices. The second edition introduced an example with England and Germany exchanging cloth and linen, which I shall use as an illustration of the problem.

Before analysing the error, it is important to realize that James Mill followed Ricardo closely in the determination of domestic relative prices. In the passage where James Mill introduces the England and Germany example, he starts:

If 10 yards of broad cloth in England can purchase 15 yards of linen, which means that they have cost an equal quantity of labour; while in Germany 10 yards of broad cloth can purchase 20 yards of linen (Mill, 1824, p. 118)

which clearly identifies that the ratio of labour contents determines the domestic relative costs. Quantities of commodities produced with the same amount of labour have the same value. The relative cost of cloth in terms of linen in England can be represented as:<sup>12</sup>

$$\frac{c_c^E}{c_l^E} = \frac{l_c^E}{l_l^E} = \frac{15}{10} \quad (2.15)$$

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<sup>12</sup> In the example James Mill states that, in England, 10 yards of cloth exchange for 15 yards of linen. He is not starting with labour coefficients, but rather with quantities of commodities that are produced with the same amount of labour. His example means that the cost to produce 10 yards of English cloth is equal to the cost to produce 15 yards of English linen:

$$(10 \text{ yards of cloth}) \times c_c^E = (15 \text{ yards of linen}) \times c_l^E$$

where  $c_c^E$  and  $c_l^E$  are the unit costs to produce cloth and linen, respectively. Therefore, the relative cost of cloth and linen in England is:

$$\frac{c_c^E}{c_l^E} = \frac{(15 \text{ yards of linen})}{(10 \text{ yards of cloth})}$$

Since the same labour-time can produce either 15 yards of linen or 10 yards of cloth, the labour coefficient to produce one yard of cloth is 50% higher than to produce one yard of linen:

$$l_c^E = 1.5l_l^E \Rightarrow \frac{l_c^E}{l_l^E} = \frac{15}{10}$$

which justifies equation (2.15).

where  $c_c^E$  and  $c_l^E$  are the costs of producing cloth and linen in England;  $l_c^E$  and  $l_l^E$  are the unit labour coefficients of cloth and linen in England. Similarly, the relative cost in Germany is:

$$\frac{c_c^G}{c_l^G} = \frac{l_c^G}{l_l^G} = \frac{20}{10} \quad (2.16)$$

Equations (2.15) and (2.16) show that it is relatively cheaper to produce cloth in England and linen in Germany:  $\frac{c_c^E}{c_l^E} < \frac{c_c^G}{c_l^G}$ . From the definition of comparative advantage, this means that England has a comparative advantage in cloth and Germany in linen (see condition (2.8) in section 2.2.1). There is space for mutually beneficial trade if both specialize according to their comparative advantage.

James Mill then proceeds to investigate why it would be advantageous for England to exchange her cloth for German linen:

it is very evidently the interest of England to send broad cloth to purchase linen in Germany, because with 10 yards of broad cloth, that is, as much cost of production as would produce 15 yards of linen, she can obtain 20 yards. (Mill, 1824, p. 118)

What this means is that England can access Germany's market at the latter's relative prices. From the point of view of England, its producers export their cloth and exchange it for linen in accordance with *Germany's domestic conditions*. At this point there is no error, the implication is that the international relative price of cloth and linen is equal to Germany's relative costs:

$$\frac{p_c}{p_l} = \frac{c_c^G}{c_l^G} = \frac{20}{10} \quad (2.17)$$

where  $p_c$  and  $p_l$  are the international prices of cloth and linen, respectively. The corollary is that Germany does not benefit from trade as the international relative price is equal to its

domestic relative costs, hence Germany cannot buy anything relatively cheaper. As Sraffa notes:

To take, as James Mill does, the extreme case in which the ratio of interchange is such that the whole gain is reaped by one of the two trading countries to the exclusion of the other, and use it to illustrate the general theory of foreign trade, is highly misleading; but in itself it does not involve a contradiction (Sraffa, 1930, p. 539-40)

The problem emerges in the next sentence, where James Mill examines the incentives of trade from the point of view of Germany:

It is equally the interest of Germany to send linen to purchase broad cloth in England, because with 15 yards of linen she can purchase 10 yards of broad cloth in England, which, if made at home, would cost her as much as 20 yards of linen. (Mill, 1824, p. 118-9)

Now, from the point of view of Germany, its producers send linen to England and exchange it for cloth at the latter's domestic conditions. The international relative price is now determined by England's relative costs:

$$\frac{p_c}{p_l} = \frac{c_c^E}{c_l^E} = \frac{15}{10} \quad (2.18)$$

The international relative price is thus defined at two different levels (equations (2.17) and (2.18)). This is clearly a mistake, as the relative price cannot depend on the point of view. The rate at which England exchange its cloth for German linen must be the same as the rate at which Germany exchanges its linen for English cloth, as these are the same operation.

In between the second and third editions of his book, James Mill fixed the error.<sup>13</sup>

James Mill correctly put that

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<sup>13</sup> There is a long discussion on who was responsible for committing and fixing the error. John Stuart Mill claimed that himself and his study group were responsible for spotting and fixing James Mill's error. Thweatt (1987) claims that it was actually John Stuart Mill that wrote the chapter on trade in his father's book, so it was

It is the inevitable effect of such an interchange to bring the relative value of the two commodities to a level in the two countries; that is, to make the purchasing power of linen in respect to cloth, and of cloth in respect to linen, the same in both (Mill, 1844[1826], p. 55)

the international relative price must be the same regardless of the point of view.

However, James Mill is still unable to determine the terms of trade. The level of international relative prices is nowhere to be found in his work. He only goes so far as to say that “the result of competition would be to divide the advantage *equally* between them” (Mill, 1844[1826], p. 54, emphasis added), meaning that international relative prices will be halfway between the countries’ relative costs ( $\frac{p_c}{p_l} = \frac{17.5}{10}$  in the above example). There is no justification for this, only that in this position each country will benefit equally from trade.

The indeterminacy of international prices takes full effect in James Mill and there is no closure provided. In the next section, I will evaluate how John Stuart Mill picked from where his father left off and the closure he proposed.

### 2.2.3 John Stuart Mill

As mentioned in the previous section, John Stuart Mill worked very closely with his father’s book, also with Ricardo’s *Principles*. When discussing the history of the theory of international trade, he argued that Ricardo was the source of error and James Mill was just following Ricardo:

Mr. Ricardo (...) unguardedly expressed himself as if each of the two countries making the exchange separately gained the whole of the difference between the comparative costs of the two commodities in one country and in the other. (Mill, 1844, p. 5-6)

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John Stuart Mill that first committed the mistake. As amusing as these claims might be, they are very hard to verify hence not very relevant for us.

Therefore, according to John Stuart Mill, James Mill had a correct interpretation of Ricardo, the original source of the error. As Sraffa (1930) showed, this is a false perception of Ricardo's contribution (see section 2.2.1 in this chapter).

Stuart Mill takes from his father's indeterminate system and his main positive contribution was to provide a closure to it. Thus, Stuart Mill provided an alternative closure to the system of international prices, hence specialization. As I shall show, his closure is similar to Ricardo in certain aspects but deviates from it in some key ways. This causes a double issue because Stuart Mill's construct has the same empirical problems as Ricardo (see section 2.2.1) but it also introduces additional theoretical concerns.

Stuart Mill starts his chapter *Of International Trade* (Mill, 1968[1871], book 3, chap. 17) by arguing that "cost of production is not the regulator of international values" (p. 587).<sup>14</sup> Stuart Mill uses his father's England-Germany example to illustrate the point. England has a comparative advantage in producing cloth and Germany in linen. The terms of trade will not be equal to either one's cost ratio, though. This is a necessary condition for both countries to benefit from trade (see section 2.2.2 in this chapter).

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<sup>14</sup> This is a clear reference to Ricardo's remark that there is a different rule that regulates international prices (see section 2.2.1 in this chapter). However, it is incorrect to say that international values do not conform to the cost of productions in Ricardo. As I have argued international prices are still equal to the cost of the producing country. Ricardo makes this very clear when he says that "it is the natural price of commodities in the exporting country, which ultimately regulates the prices at which they shall be sold, if they are not the objects of monopoly, in the importing country" (Ricardo, Works, vol. 1, p. 238). Ricardo's allusion to a different rule that regulates relative value seems to imply only that commodities do not exchange in the international market according to their embodied labour ratio.

This confusion by Stuart Mill is more striking when one notices that he knew that prices are not equal to labour ratios when profit rates (and/or wages) differ. In book three, chapters three and four of his *Principles*, Stuart Mill discusses the relationship between cost of production and value. As usual, for reproducible commodities, the general case is that value conforms to the relative amount of labour. However, in paragraphs three and four of chapter four, he admits that when profit and wages are permanently different in the production of two commodities, their relative price is not equal to the ratio of embodied labour. He summarizes this by saying that "Profits, therefore, as well as wages, enter into the cost of production which determines the value of the produce" (Mill, 1968[1871], p. 482). This is exactly what he assumes to happen with international trade (as Ricardo): "between different countries (...) there may exist great inequalities in the return to labour and capital, without causing them to move from one place to the other" (idem, p. 588).

Therefore, contrary to Stuart Mill, "permanent value is proportioned to cost of production" *even* "between commodities produced in distant places" (Mill, 1968[1871], p. 587); it is not proportional to labour embodied though.

Stuart Mill then proceeds to investigate the determination of international prices, or in his words: “what are the causes which determine the proportion in which the cloth of England and the linen of Germany will exchange for each other” (Mill, 1968 [1871], p. 597)? To answer this question, he introduces two assumptions: 1) balanced trade is the only stable situation; 2) each countries’ demand for imports is inversely proportional to the relative price of its imports. The first assumption is the same as Ricardo (section 2.2.1 in this chapter); the second one is an innovation for classical political economy.

The first assumption is justified by recurring to “all trade is in reality barter (...) an actual trucking of one commodity against another” (Mill, 1968 [1871], p. 595). If trade is barter, then the exports and imports in value terms must match every time. After all, for every commodity imported there is a corresponding commodity exported, no matter what. Stuart Mill does relax this hypothesis further on by introducing money. He does not, however, change his conclusions. So, we can proceed as if in a barter system and avoid the complications introduced by money.<sup>15</sup>

Let  $D_l^E$  and  $D_c^G$  be England’s demand for linen and Germany’s demand for cloth, respectively;  $p_c$  and  $p_l$  are the international prices of cloth and linen, through importation. Balanced trade requires that exports and imports are equal in value terms. It can be presented as  $p_l D_l^E = p_c D_c^G$ , where, from England’s point of view, the left-hand side is the value of its imports and the right-hand side the value of its exports. This condition can be manipulated to show explicitly the relationship that must hold between terms of trade and reciprocal demands (see condition (2.10) in this chapter):

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<sup>15</sup> The introduction of money does not change the characterization of balanced trade as the resting position: “whether money is employed or not, things are only in their permanent state when the exports and imports exactly pay for each other” (Mill, 1968 [1871], p. 630). What change is the mechanism through which equilibrium is restored. With barter there can only be equilibrium, as imports are directly exchanged for exports. With money, however, disequilibrium can occur. The difference of exports and imports will be offset by flows of ‘gold’ from the deficit country to the surplus country. Through the quantity theory of money, prices rise in the surplus country and fall in deficit country. This will enforce the correct price level in each country and trade happens *as if* in barter.



$$\frac{p_c}{p_l} = \frac{D_l^E}{D_c^G} \quad (2.19)$$

This has the same empirical problem as in Ricardo's analysis; nowadays countries do not exhibit balanced trade, and it is debatable if they ever did (see section 2.2.1 in this chapter).

Contrary to Ricardo, Stuart Mill does not assume these quantities to be given by the state of accumulation. Instead, he introduces a second assumption that the quantity demanded of a good is negatively related to its relative price: "The demand for a commodity, that is, the quantity of it which can find a purchaser, varies as we have before remarked, according to the price" (Mill, 1968 [1871], p. 597). This assumption is something new in classical political economy and represents a tentative shift to a supply and demand based determination of natural prices.

In fact, he starts his analysis of value with the law of supply and demand (Mill, 1968 [1871], book 3, chapter 2). He separates commodities into three classes with different laws of value. The first class are commodities that have a fixed supply, like paintings from great masters. Their values are ruled by the law of supply and demand. The second class are commodities that could be reproduced virtually indefinitely. These have their value determined by the cost of production. The last, intermediate, class of commodities are those that can be increased in quantity only with a higher cost.

Commodities brought from different countries fall into the second class. They could in principle be "increased or diminished to a great, and even an unlimited extent" (Mill, 1968 [1871], p. 469). Nevertheless, their "value never depends upon anything but demand and supply" (*ibid.*).<sup>16</sup> From there, Stuart Mill establishes that each country's demand for imports is a function of the terms of trade:

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<sup>16</sup> Stuart Mill also uses a supply and demand scheme to determine natural wages. He is thus bringing supply and demand into the theory of distribution; and into the determination of every commodity's value, since they all use labour in their production. This has further implications for the transition between classical and marginal economics (see Bharadwaj, 1989).

$$D_l^E = f\left(\frac{p_l}{p_c}\right) \quad (2.20)$$

$$D_c^G = g\left(\frac{p_c}{p_l}\right) \quad (2.21)$$

where  $f$  and  $g$  are unspecified functions; the specific format of the curves is not given. Instead, he says that they “cannot be reduced to any rule” (Mill, 1968 [1871], p. 599); the shape becomes a matter of statistical determination, at best. The only general rule is that the quantities imported are negatively related to the commodities’ relative prices (i.e.  $f' < 0$  and  $g' < 0$ ).<sup>17</sup>

With equations (2.19), (2.20), and (2.21) it is very easy to find the equilibrium international relative price. It will simply be the one that is equal to the ratio between the two demand functions. This one will be just enough to allow for balanced trade, determining price and quantity:

$$\frac{p_c}{p_l} = \frac{f\left(\frac{p_l}{p_c}\right)}{g\left(\frac{p_c}{p_l}\right)} \quad (2.22)$$

Equation (2.22) has only one variable in it ( $p_c/p_l$ ), thus it is determinate. The solution for this equation is the equilibrium term of trade  $\left(\frac{p_c}{p_l}\right)^*$ . Stuart Mil summarizes it well in the following passage:

when two countries trade together in two commodities, the exchange value of these commodities relatively to each other will adjust itself to the inclinations and circumstances of the consumers on both sides, in such manner that the quantities required by each country, of the articles which it imports from its neighbour, shall be exactly sufficient to pay for one another (Mill, 1968 [1871], p. 598-9)

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<sup>17</sup> A caveat is in place. This does not imply that those demand functions are based on marginalist concepts. They seem to lack a solid theoretical foundation and resort to common sense. However, it opens the possibility for later authors to explain it in terms of “marginal utility” theory of demand.

Stuart Mill determines international relative prices together with quantities. This points towards an incipient general equilibrium model with functional relationships between quantities and prices; which does not mean that Stuart Mill is a marginalist author, but rather as an author with an eclectic framework. See Sotiropoulos (2009) as a defence of Stuart Mill as a classical political economy author, and not marginalist.

Summing up, through the introduction of functions of reciprocal demands, Stuart Mill can determine the terms of trade. This allows him to close the theoretical gap his father had left open. However, to do so he gives a twist to classical political economy by introducing concepts foreign to the theory of value as developed by Ricardo: that of a law of supply and demand to determine natural prices.

In the next section, I will discuss the contribution of Frank Graham, a self-proclaimed rejector of the classical political economy trade model.<sup>18</sup> However, his contribution is interesting and important from a history of thought point of view; it is also not that far away from the classical political economy school.<sup>19</sup>

#### 2.2.4 Graham

Graham wrote one of the most influential books on international trade in the post-war period: *The Theory of International Values*. His contributions are mostly praised by going beyond the simple case of two countries and two commodities; it is the start of a formal general equilibrium theory of trade (McKenzie, 1954).

Graham criticized Stuart Mill's exposition of international trade and the role of reciprocal demands: "the theory of international values has been subject to mortmain. This mortmain derives mainly from John Stuart Mill" (Graham, 1948, p. 27). He argues that when many countries compete in the production of more than two commodities, the impact of

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<sup>18</sup> "The theory of international values here presented is, in form, an elaboration but, in fact, a complete refutation of classical doctrines." (Graham, 1948, p. 3).

<sup>19</sup> Steedman (1979a, p. 14) puts Graham in the "Classical tradition in trade theory".

changes in reciprocal demands in the terms of trade can be negligible (Crespo, 2012, p. 95). According to him, reciprocal demands are not adequate explanations of international prices for reproducible commodities.

Graham returns to a cost of production determination of international prices, but he explicitly rejects the labour theory of value and adopts an opportunity cost theory to explain relative costs:

Labor cost is not a very clear or easily measurable concept and the concept is not necessary to Mill's argument. All that is necessary is that either of the two assumed commodities be capable of increased production, within the respective countries, at constant cost per unit in terms of forgone production of the other commodity (Graham, 1948, p. 27, fn. 1)

Later, he explicitly says that he is dealing with natural prices and argues that “under stable cost conditions, average market values of reproducible non-monopolized goods will more or less closely approximate normal (cost of production) values” (Graham, 1948, p. 313). Therefore, domestic relative prices are determined by stable relative costs of production, even if these are not equal to the ratio of labour coefficients.

As mentioned, Graham focuses on cases when many countries are competing in the production of many commodities. This adds a new layer of complexity to the theory of international trade. His main goal is to explain international relative prices based on normal values.

In chapter IV of his book, Graham (1948, pp. 63-75) deals with a situation with two countries competing in the production of four commodities. The closure he offers is to say that, in these cases, it is very likely that more than one country will share the production of some commodities:

When we are dealing with the trade between two countries in four commodities it is clear that the stablest, and the most probable, situation is for one of the countries to be producing three of the commodities and the other two, with one commodity, inevitably therefore, common to both. (Graham, 1948, p. 63)

Hence, it is a situation of incomplete specialization. If two countries share the production of some commodity, this creates a link between their production system: the cost of production for the shared commodity must be the same in both countries. It provides a way to compare the costs of production in the two countries, hence a way to establish the international prices as based on domestic costs of production.

While Graham gives his example in a multi-country multi-commodity framework, it can easily be expounded in the conventional two-countries two-commodities model. For example, we may use James Mill's illustration of England and Germany trading cloth and linen (see section 2.2.2 in this chapter). Assume that both England and Germany produce cloth, but only Germany produces linen. Domestic relative costs ( $c_c^E/c_l^E$  and  $c_c^G/c_l^G$ ) are given based on the stability of costs of production. If that is the case, then the English cost of production for cloth must be equal to the German cost of production for cloth:

$$c_c^E = c_c^G \quad (2.23)$$

This provides a way to compare the costs in the two countries.

Besides that, Germany produces both cloth and linen which implies that international prices must cover Germany's costs in both commodities. So, the international relative prices cannot be other than Germany's domestic relative costs:

$$\frac{p_c}{p_l} = \frac{c_c^G}{c_l^G} \quad (2.24)$$

which is assumed as given.

The argument is logically sound. It also makes sense empirically; the number of commodities traded internationally is orders of magnitude higher than the number of

countries. It is indeed likely that countries share the production of some commodities. This can also be observed in trade data.

However, the argument is no more than a tautology. As I have emphasized, a theory of international prices cannot be separated from a theory of specialization. The theory that attempts to explain international prices and specialization cannot assume which commodities are shared between countries. This is the same thing as assuming what the theory is supposed to explain.

The question that remains is: do England and Germany share the production of cloth *or* linen? Each option carries a completely different determination of international relative prices (in the first case it is equal to Germany's cost ratio; while in the second it is equal to England's cost ratio). The problem becomes larger with more countries and/or commodities: with two countries and four commodities, by simple combinatorics, there are 24 possible patterns of specialization such that both countries share the production of a single commodity. Graham offers no solution to this question. Despite his interesting approach, Graham's closure also leaves the theory indeterminate; he shows the existence of an equilibrium, but not the uniqueness.

### **2.2.5 Steedman**

Steedman was one of the first authors to attempt to rework the classical trade theory after Sraffa's revitalization of classical political economy. His contributions are organized in two books: *Trade Amongst Growing Economies* (1979a), and *Fundamental Issues in Trade Theory* (1979b). Besides that, he also contributed with other papers developing the arguments further (for example, Metcalfe and Steedman, 1981; Steedman, 2001).

This chapter is mostly concerned with the alternative closures to the international price system. I will, thus, focus on the more positive aspects of Steedman's work. The first book (Steedman, 1979a) is where he develops the most his positive contribution, in the sense

that it tries to build a new trade theory based on Sraffa's reconstruction of classical economics. The second book (Steedman, 1979b), albeit very interesting, aims at extending the critiques of marginalist economics to trade theory (in particular the Heckscher-Ohlin model). It thus looks at how the basic theorems of trade hold up in light of the Cambridge capital controversy debates.

The focus here is on the first book, where Steedman proposes a novel closure based on the Cambridge growth equation. Most of the book deals with a small open economy; small in the sense that international prices are given exogenously. It looks at one country separately from the others, in a kind of 'partial equilibrium'. There are many interesting results, but the second part of the book (chapters 9 and 10) provides the main focus of this section. The second part develops what Steedman calls 'international equilibrium'. There he explicitly takes into consideration countries competing in the production of goods and asks the question of how international prices are determined.

Steedman's model has two countries (Xeres and Zend) competing in the production of three commodities: one pure consumption good and two capital goods (Steedman, 1979a, p. 109). To determine international relative prices and specialization, this setting is quite complex.<sup>20</sup> I will, therefore, reduce the model to two countries ( $X$  and  $Z$ ) and two commodities: commodity 1, a capital good; and commodity 2, a pure consumption good. Each country has one method of production for both commodities; the capital good enters into all methods of production as circulating capital. Wages are paid post-factum, hence are not part of advanced capital.

As is well known, Steedman abandons the labour theory of value in his explanation of domestic relative costs/prices. This is a common thread in the Sraffian literature since

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<sup>20</sup> Steedman's framework is interesting because it emphasizes that all goods must be produced somewhere. So, with more commodities than countries, some countries will necessarily specialize in more than one commodity. Second, it shows quite easily that the results are generalizable to a multi-commodity world. However, the way to determine international prices is not affected by whether there are two or three tradable commodities. I have simplified the model to show its fundamental properties and to make the comparison with the rest of the thesis easier.

Sraffa interpreted the labour theory of value as an instrumental piece to solve prices but not without problems (Steedman, 1977). Instead, Steedman resorts to a price equation system based on Sraffa (1960). It is important to discuss how domestic relative costs are determined.

From the point of view of country  $X$ , its costs of production are:

$$c_1^X = p_1^X a_{11}^X (1 + r^X) + w^X l_1^X \quad (2.25)$$

$$c_2^X = p_1^X a_{12}^X (1 + r^X) + w^X l_2^X \quad (2.26)$$

where  $c_1^X$  and  $c_2^X$  are the costs of production for commodities 1 and 2 in country  $X$ ; the price of the capital good in  $X$  is  $p_1^X$ ; the capital requirements are  $a_{11}^X$  and  $a_{12}^X$ , or how many units of commodity 1 are used to produce either commodity 1 or 2; the rate of profit in  $X$  is  $r^X$ ; the nominal wage is  $w^X$ ; and  $l_1^X$  and  $l_2^X$  are the labour coefficients.

Relative costs measure the rate of exchange that should happen for country  $X$  to produce both commodities 1 and 2, paying capitalists and workers according to their natural remunerations (see section 2.1.1 in this chapter). So, relative costs must be measured when domestic prices are sufficient to cover the costs of production:

$$p_1^X = c_1^X \quad (2.27)$$

$$p_2^X = c_2^X \quad (2.28)$$

Besides that, the real wage is defined outside of the system of production. In other words, workers are paid enough to buy a given amount ( $b_2^X$ ) of commodity 2:<sup>21</sup>

$$w^X = p_2^X b_2^X \quad (2.29)$$

Substituting equations (2.27), (2.28), and (2.29) into equations (2.25) and (2.26):

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<sup>21</sup> Steedman explores different alternative distributive assumptions, not only a given real wage. He emphasizes, however, that this is inconsequential to the main argument and any one of them will generate similar results (Steedman, 1979a, pp. 153-4). I have chosen to present this system with a given real wage because it makes the connection with the classical political economy literature very clear.



$$c_1^X = c_1^X a_{11}^X (1 + r^X) + c_2^X b_2^X l_1^X \quad (2.30)$$

$$c_2^X = c_1^X a_{12}^X (1 + r^X) + c_2^X b_2^X l_2^X \quad (2.31)$$

which is a system with two equations and three variables ( $c_1^X$ ,  $c_2^X$ , and  $r^X$ ).

Since we are interested in relative costs, we may divide both equations by  $c_2^X$  to get:

$$\frac{c_1^X}{c_2^X} = \frac{c_1^X}{c_2^X} a_{11}^X (1 + r^X) + b_2^X l_1^X \quad (2.32)$$

$$1 = \frac{c_1^X}{c_2^X} a_{12}^X (1 + r^X) + b_2^X l_2^X \quad (2.33)$$

This renders the system determinate: there are two equations and two variables ( $c_1^X/c_2^X$ , and  $r^X$ ).<sup>22</sup> The determination of domestic relative costs (or natural prices) requires the same set of assumptions as in Ricardo: a given real wage, known methods of production, and equalization of profit rates (see section 2.2.1 in this chapter). The same set of relationships is valid for country  $Z$  (the second country) with the appropriate changes in superscripts.

As in Ricardo, it is possible to define the range of comparative advantage in this framework (see equation (2.8) in this chapter). Comparative advantage must be defined in terms of the cost ratios. These tend to be different for countries  $X$  and  $Z$ , due to disparities of technology and/or between real wages. So, without lack of generality, we may assume that:

$$\frac{c_1^X}{c_2^X} < \frac{c_1^Z}{c_2^Z} \quad (2.34)$$

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<sup>22</sup> In this case, the domestic relative cost for country  $X$  is:

$$\frac{c_1^X}{c_2^X} = \frac{a_{11}^X + b_2^X (l_1^X a_{12}^X - l_2^X a_{11}^X)}{a_{12}^X}$$

While the general rate of profit if  $X$  produces both goods is:

$$(1 + r^X) = \frac{1 - b_2^X l_2^X}{a_{11}^X + b_2^X (l_1^X a_{12}^X - l_2^X a_{11}^X)}$$

which means that the relative cost to produce commodity 1 is lower in country  $X$ , while the relative cost to produce commodity 2 is lower in  $Z$ . Therefore, country  $X$  has a comparative advantage in commodity 1 and country  $Z$  has a comparative advantage in commodity 2.

However, the same problem of indeterminacy emerges here for international relative prices (see section 2.1.2 in this chapter). If countries specialize according to comparative advantages, then the international price of commodity 1 ( $p_1$ ) must cover its cost in country  $X$  and the international price of commodity 2 ( $p_2$ ) must cover its cost in country  $Z$ :

$$p_1 = c_1^X \quad (2.35)$$

$$p_2 = c_2^Z \quad (2.36)$$

The relevant cost equations are the cost to produce commodity 1 in country  $X$  and commodity 2 in country  $Z$ . Substituting conditions (2.35) and (2.36) into the relevant cost equations:

$$p_1 = p_1 a_{11}^X (1 + r^X) + p_2 b_2^X l_1^X \quad (2.37)$$

$$p_2 = p_1 a_{12}^Z (1 + r^Z) + p_2 b_2^Z l_2^Z \quad (2.38)$$

The international price of commodity 1 is determined by its cost conditions in country  $X$ , while the international price of commodity 2 is determined by its cost conditions in country  $Z$ . There is a mutual interaction between cost conditions in both countries since commodity 1 is used as input everywhere and workers consume a given basket of commodity 2 in both countries. The international system is interconnected.

To find international relative prices, divide both equations (2.37) and (2.38) by  $p_2$ :

$$\frac{p_1}{p_2} = \frac{p_1}{p_2} a_{11}^X (1 + r^X) + b_2^X l_1^X \quad (2.39)$$

$$1 = \frac{p_1}{p_2} a_{12}^Z (1 + r^Z) + b_2^Z l_2^Z \quad (2.40)$$

which is a system with two equations and three variables ( $p_1/p_2$ ,  $r^X$ , and  $r^Z$ ). Thus far the system is indeterminate; it is not sufficient to determine international relative prices: not very different from the case with a labour theory of value, where Ricardo solved the problem with a balanced trade condition and given import/export quantities (see section 2.2.1 in this chapter).

It is at this point that Steedman presents his closure to the system of international prices. He offers a link between the countries' profit rates different from an equalization through competition. Rather, the connection happens through the countries' growth rates.

The first step is to establish a formal relationship between the growth rate and the profit rate in an economy; Steedman adopts the 'Cambridge growth equation'. This sets a one-to-one relationship between the rate of growth of output in a country and its respective rate of profits. It was originally conceived by Kaldor in an influential paper (Kaldor, 1956) and later developed by Pasinetti (1962). More specifically, the rate of growth is equal to the rate of profits times the *given* marginal propensity to save out of profits, when workers do not save. Alternatively, the rate of profits is the ratio between the rate of growth and the marginal propensity to save. For countries  $X$  and  $Z$ , there are the following relationships:

$$g^X = s^X r^X \quad (2.41)$$

$$g^Z = s^Z r^Z \quad (2.42)$$

where  $g^X$  and  $g^Z$  are the rates of growth of output;  $s^X$  and  $s^Z$  are the marginal propensities to save out of profits. The literature on economic growth has pointed many problems at this kind of distributive determination (see Serrano and Freitas, 2017). However, those are not instrumental for the theory of international price determination; I present a short summary of these considerations in an appendix (see Appendix 2.1 to this chapter).

In the second step of the argument, Steedman establishes that for two countries to keep trading with each other, they must grow at the same rate ( $g^X = g^Z$ ). Otherwise, if for example  $g^X > g^Z$ :

with Xeres [country  $X$ ] becoming ever larger relative to Zend [country  $Z$ ], there is no possibility of capitalists in Xeres permanently maintaining a specialization or even a semi-specialization, for the capitalists in Zend would eventually find it physically impossible to meet the import requirements of those in Xeres (Steedman, 1979a, p. 124).

This is none other than Ricardo's condition of balanced trade in a dynamic setting (see section 2.2.1 in this chapter). Countries will only maintain a balanced trade account if they grow at the same rate.

Given the marginal propensities to save out of profits, the countries' rates of profit hold a specific relationship to each other. This allows for the elimination of one degree of freedom. Formally, with equal growth rates, the relationship between the domestic profit rates is:

$$r^X = r^Z \left( \frac{s^Z}{s^X} \right) \quad (2.43)$$

So, the profit rate in country  $X$  bears a constant relationship to the profit rate in country  $Z$ , assuming given marginal propensities to save. This is different from Ricardo's position on permanent differences in profit rates across countries: it is true that profits rates are permanently different, but the ratio between the two is constant, unlike Ricardo (see section 2.2.1 in this chapter).

These assumptions are Steedman's alternative closure to the system of international prices. Substitute condition (2.43) into equations (2.39) and (2.40):

$$\frac{p_1}{p_2} = \frac{p_1}{p_2} a_{11}^X \left( 1 + r^Z \left( \frac{s^Z}{s^X} \right) \right) + b_2^X l_1^X \quad (2.44)$$

$$1 = \frac{p_1}{p_2} a_{12}^Z (1 + r^Z) + b_2^Z l_2^Z \quad (2.45)$$

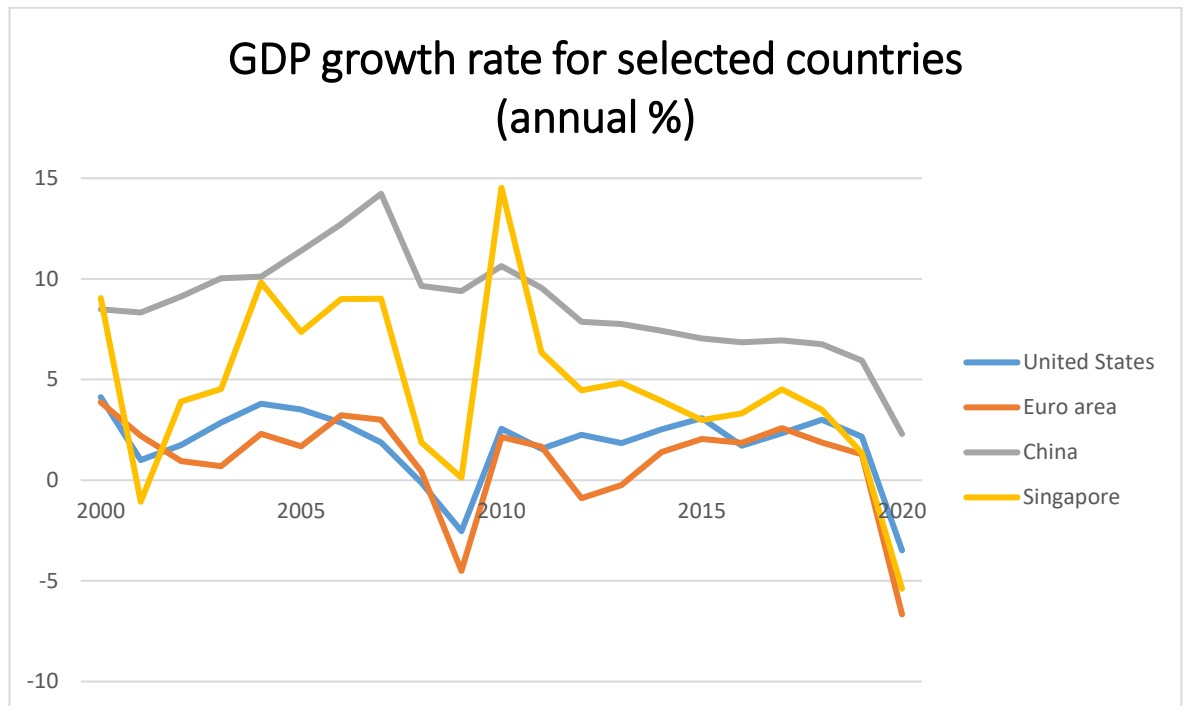
which is a system with two equations and two unknowns ( $p_1/p_2$  and  $r^Z$ ). It is easy to see that this is not very different from the ‘closed’ economy framework where the rates of profit are equal. The only difference is that there is a permanent but constant divergence in the profit rates. This divergence of profit rates is caused by different marginal propensities to save in both countries.

In this way, Steedman is able to solve for international relative prices and the rate of profit. As he summarizes it: “the principal proximate determinants of an international equilibrium are the alternative methods of production, the capitalists’ savings ratios and the exogenous data referring to real wages and/or the growth rate” (Steedman, 1979a, p. 154). The assumptions of given methods of production and a given real wage are the same as in the classical political economy framework.<sup>23</sup> With respect to the assumptions for a domestic economy, it substitutes the equalization of profit rates with given capitalists’ saving ratios. The latter, combined with a Cambridge growth equation, provides a connection between the countries’ rates of profit.

This type of closure suffers from both theoretical and empirical shortcomings. The theoretical aspects relate more to a theory of growth and distribution than to a theory of international trade (see Appendix 2.1 to this chapter). Regarding the empirical aspects, there are two main problems. First, it also relies on a balanced trade approach. This means that it has the same problems of validity as Ricardo’s approach (see section 2.2.1 in this chapter). Second, countries do not seem to grow at a similar rate, even as a long-run tendency (see Figure 2.2 below).

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<sup>23</sup> Sraffa (1960) showed that a classical political economy framework is compatible with either a given real wage or a given profit rate. For Steedman, a given growth rate acts in the same way as a given profit rate, since both concepts are linked via the Cambridge equation with given capitalists’ marginal propensity to save (see equations (2.41) and (2.42)).

**Figure 2.2**

Source: Based on World Bank data (<https://data.worldbank.org/>).

It is evident that countries do not grow at the same rate. There seems to be some correlation between *changes* in the growth rates, but their *levels* do not seem to equalize. The growth rates do not seem to follow any specific ratio either. Regions with similar patterns of growth, like the USA and the Euro area, also have persistent differences in the rates of growth for prolonged periods. As Mazurek (2013) shows, even inside the European Union, there is a wide distribution of growth rates. Therefore, an assumption of equal growth rates is brought into question.

### 2.3 International trade with equal profit rates

Recently, a number of authors have criticized the model of comparative advantage and its assumption of international immobility of capital. They argue that the modern world is characterized by international mobility of capital that is free enough to guarantee an international equalization of profit rates. With this change of perspective, these authors can

reassert the role of absolute advantage as the main determinant of specialization and international prices.

Shaikh (1999, 2016) provides the most comprehensive treatment of the subject, in the sense that it draws many implications from this novel assumption. However, drawing from Brewer (1985), other authors have also proposed the assumption of international equalization of profit rates (see, Parrinello, 2010; Crespo et al., 2020; Bellino and Fratini, 2021). In chronological order, I shall start with Brewer's (1985) statement of absolute advantage. I then investigate Shaikh's contributions as the benchmark for the literature.

### 2.3.1 Brewer

In an influential paper, Brewer (1985) discusses the possibility of using absolute advantage to determine international prices and specialization. To achieve this, Brewer imposes a new set of assumptions: "the assumptions of fixed wages and mobile capital ensure that the location of production is determined by absolute and not by comparative advantage" (Brewer, 1985, p. 177). So, the assumptions behind his model are known methods of production, given real wages, and free international mobility of capital.<sup>24</sup> With respect to Ricardo (see section 2.2.1 in this chapter), the only difference is Brewer assumes that capital is free to move between countries.

Brewer defines absolute advantage as occurring when a country has the lowest cost of production for a commodity compared to another country. We may use Steedman's example of country *X* and *Z* trading commodities 1 and 2, where commodity 1 is a pure capital good and commodity 2 is a pure consumption good. Country *X* has an absolute advantage in the production of commodity 1 if and only if it has a lower cost of production than country *Z*:

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<sup>24</sup> In this paper, Brewer quickly discusses three other cases: 1. given real wage with immobile capital; 2. flexible real wages with free mobility of capital; and 3. flexible real wages with immobile capital. However, he does not expand on those. See Bellino and Fratini (2021) for an evaluation of each of Brewer's cases.

$$c_1^X < c_1^Z \quad (2.46)$$

The assumption of free mobility of capital implies that capitalists will move the production of a good to wherever it is less costly to produce it. The justification is that with lower costs capitalists can acquire higher profits. Therefore, if country  $X$  has lower costs of production in both commodities, it will outcompete country  $Z$  in everything.<sup>25</sup> As Brewer puts it:

Each good will be produced where it is most profitable to produce it, i.e. where costs are lowest. (...) There is nothing to prevent any particular country from having higher costs than others in all lines of production; it then has zero output and employment. (Brewer, 1985, p. 183)

Hence, with free mobility of capital, a country may not be able to compete in the production of any good. This represents an abandonment of the assumption of balanced trade, as countries may run deficits or surpluses in the trade account that are not self-corrected.

This assumption implies a tendency for profit rates to equalize between countries:  $r^X = r^Z$ , which eliminates one degree of freedom of the system. Formally, it plays the same role as the assumption of equal growth rates in Steedman (see section 2.2.5 in this chapter). However, the link between countries' profit rates is just capitalist competition for the highest rate of profit. The system of international prices is indistinguishable from a system of domestic costs; it is capable of determining international prices and the international rate of profit ( $r$ ). The set of assumptions are the same as in the domestic setting: given methods of production, given real wages, and a uniform rate of profit (see section 2.1.1 in this chapter).

Thus, by changing Ricardo's assumption regarding the international mobility of capital, Brewer is able to reinsert absolute advantage into international trade theory. This

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<sup>25</sup> I am glossing over some details on how to calculate prices and the profit rate based on lowest costs of production. Costs of production are not independent variables that can be readily compared, but it is possible to do so with equal profit rates. Brewer does not give a full account on how to do that, but I offer a possible interpretation in Appendix 2.2 to this chapter.



result has been influential in the subsequent literature. Parrinello (2010) builds on Brewer's model to also argue that absolute advantage, what he calls 'national competitiveness', is important for international trade.

Neither Brewer nor Parrinello explain how the equalization of profit rates happens or its consequences. Parrinello makes a vague remark that the mobility of financial capital plays a role (Parrinello, 2010, p. 65). It is the merit of Shaikh to explain how free mobility of financial capital can imply an equalization of the rates of profit on real production. In the next section, I shall explore Shaikh's mechanisms and their consequences.

### 2.3.2 Shaikh

Shaikh (1999, 2016) also provides a framework to determine international prices and specialization based on the assumption of free mobility of capital. From the formal point of view, the way Shaikh closes the model is the same as in Brewer (1985) and Parrinello (2010) (see section 2.3.1 and Appendix 2.2 in this chapter). However, Shaikh provides a much more detailed account of what exactly he means by free mobility of capital and the implications of this assumption.

The assumption of free international mobility of capital means that capitalists may transfer their capital between countries in search of the highest rates of profit. This generates a tendency for equalization of domestic profit rates between countries. There are two complementary ways in which this can be achieved. The first is the more direct route: capitalists transfer plants, machines, and technology to another country to increase their profitability. This requires the free mobility of *real* productive capital. While this would achieve the result of equalization of profit rates, it is not the solution preferred by the literature.

The second route is to assume that *financial* capital is free to move between countries. This does not entail the transfer of plants or machines but free flows of money to buy

domestic bonds and other kinds of securities. As Shaikh (1999, p. 15) puts it: “while competitive flows of direct investment are sufficient, they are not strictly necessary. Short term international capital flows can equally well provide a sufficient force”.<sup>26</sup> This means that foreigners can freely buy domestic assets from other countries as part of their portfolio investment. The direct consequence is that there is a tendency for equalization of interest rates on domestic bonds of similar maturities<sup>27</sup>, not of profit rates on real productive investment. This is the preferred route because there has been intense financial deregulation after the collapse of the Bretton Woods system in the 1970s (Eichengreen, 2008, chap. 5; Vernengo, 2006).

The equalization of profit rates on real productive investment can only occur as an indirect consequence of the free movement of financial capital. The key idea is that the interest rate represents a cost of opportunity for real investment, as capitalists have the choice of either buying bonds or investing in production. This competition between capitalists inside a country leads to the profit rate to settle at the level of the interest rate. This is an arbitrage condition where capitalists get the same rate of return regardless of where they invest.<sup>28, 29</sup>

So, with only free mobility of financial capital, the argument requires the equalization of interest rates across countries and an arbitrage condition where the profit rate

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<sup>26</sup> See also Dvoskin et al. (2020, p. 31): “once capital flows from one country to another in the form of financial assets, unless purely institutional reasons are advanced (e.g., capital controls, minimum stay requirements, etc.), there does not seem to be economic reasons that may prevent financial capital from taking the form of productive capital”.

<sup>27</sup> The equalization of interest rates is net of country specific risks. So, domestic interest rates are the sum of the basic international rate plus a country premium. The country premium measures some risk of default and it is assumed to be given. Therefore, it can be ignored in the theoretical argument, even if very important for practical analyses.

<sup>28</sup> This arbitrage condition was also present in classical political economy authors. See Panico (1988) and Pivetti (1991) for a survey of how past authors dealt with this issue.

<sup>29</sup> The argument in Shaikh is not very clear whether the nominal interest rate or the real interest rate is the opportunity cost of real investment. Since profit rates are measured at their reproduction cost, it should be the real interest rate. Real interest rates may converge by changing either the nominal interest rate or the rate of inflation. Shaikh explicitly denies changes in the second, arguing that this is the Quantity Theory of Money working in Ricardo (Shaikh, 1999, p. 10, and 2016, pp. 503-9). So, whether the convergence is on nominal or real interest rates, it must act by changes on the nominal one.

tends to the interest rate. I will now evaluate the first condition; the mechanisms necessary to ensure that interest rates converge between countries.

Shaikh's argument relies on differences in interest rates attracting flows of financial capital. If a country has an interest rate higher than the international rate (plus the eventual country risk, see footnote 27), then capitalists from other countries will buy its bonds as they are more profitable. This inflow of capital supposedly generates pressure for the interest rate to fall to the international level. The argument would be mirrored if the country instead had an interest rate lower than the international one.

The difference in interest rates is caused by imbalances in the overall balance of payments (current account plus financial account). With absolute advantage, the current account can be unbalanced (see section 2.3.1 in this chapter). So, the balance of payments is in deficit (surplus) if the sum of the current account and the financial account is negative (positive).<sup>30</sup>

If a country has a deficit in its balance of payments, then there is an outflow of money from it. The flows of money into it are less than the outflows from it, either from trade or financial reasons. According to Shaikh, this net outflow of money puts an upward pressure on the domestic interest rate. A higher interest rate attracts more capital from abroad, eventually closing the gap in the balance of payments. Once the gap is closed, there is no more pressure on the interest rate. The interest rate then falls to its international level:

an ongoing balance of payments deficit implies a net outflow of funds from the country, which will lower liquidity and hence tend to raise interest rates and rates of return on financial assets. The raised rates of return will in turn attract short term international capital inflows to fill the balance of payments gap, which will also raise liquidity and drive domestic (risk-adjusted) rates of return back down towards equality with foreign ones (Shaikh, 1999, p. 16)

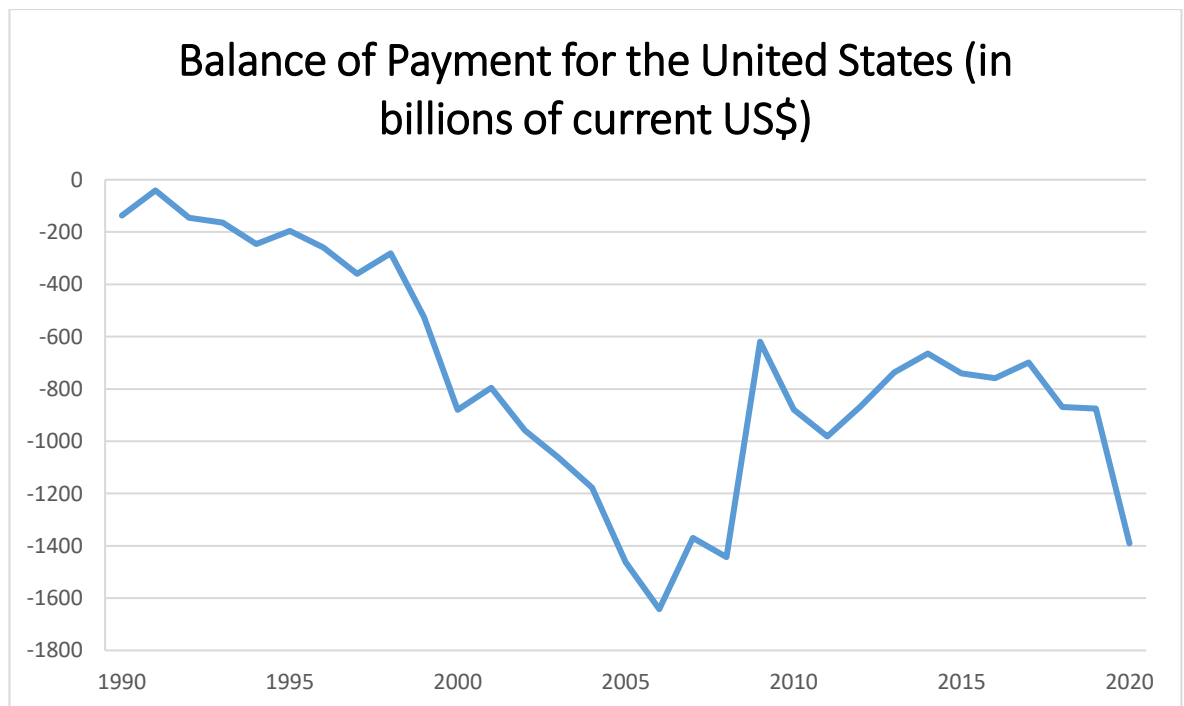
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<sup>30</sup> The accounting version of the balance of payments always sum to zero; it is never in deficit or surplus. However, I am using the term balance of payments in a restricted way, excluding the variations in reserves. The flows of money under discussion appear as variations in international reserves in the national accounting.

Hence, Shaikh substitutes Ricardo's assumption of equilibrium in the trade balance for an overall equilibrium in the balance of payments in the long run.<sup>31</sup>

This mechanism seems to rely on the idea that most countries cannot run persistent deficits in their balance of payments, because they will eventually run out of international currency. Once that happens, the country cannot finance its balance of payments deficit.<sup>32</sup> This argument runs into two problems. The first problem is that, in the current international system, the international currency is the domestic currency from one country. This country is the United States and the international currency is the dollar (Parboni, 1981). The United States is then in a special position that it can use its own currency to finance any amount of external deficit; it can run persistent deficits in its balance of payments (Serrano, 2003; Vernengo, 2021). This seems to be the case. As shown in Figure 2.3 below, the United States has been consistently running deficits in its balance of payments (current account plus financial account) for the past three decades.

**Figure 2.3**



<sup>31</sup> Equilibrium here is used in the very narrow sense of summing up to zero.

<sup>32</sup> This has explicit links with the balance of payment constrained growth literature (Shaikh, 1999, p. 13), where countries may stop their growth pattern because they do not have international currency to finance the increasing amount of imports (Thirlwall, 1979).

Source: Based on World Bank data (<https://data.worldbank.org/>).

The other problem in the argument is a misleading sense of symmetry. As I have shown, Shaikh's adopts an assumption of equilibrium in the balance of payments. One of the implications is that a country should not lose or accumulate foreign reserves on average. While it is true that most countries cannot have persistent *deficits* in their balance of payments, they can run persistent *surpluses* without counteracting forces. A country with a surplus in its balance of payments experiences a net inflow of money; this represents an accumulation of foreign reserves.

For Shaikh's argument to work, there should be a downward pressure on this country's interest rate to stop the excess inflow of money:

the international money flows created by unbalanced payments will lower interest rates in the trade surplus country and raise them in the deficit one, and this interest rate differential will induce financial capital flows from the former to the latter until payments are in balance. (Shaikh, 2016, p. 520)

However, if the Central Bank sets the basic interest rate, then this extra demand for bonds will be automatically met with an equivalent supply of bonds. This is the mechanism that allows Central Banks to set the interest rate in modern capitalism (Wray, 2006; Pivetti, 1991, pp. 15-17). There is no mismatch between supply and demand for bonds. As Lavoie (2000a) argues, the sterilization of foreign flows occurs automatically and at the decision of private actors; there is no pressure on interest rates.<sup>33</sup> So, countries may set their interest rates

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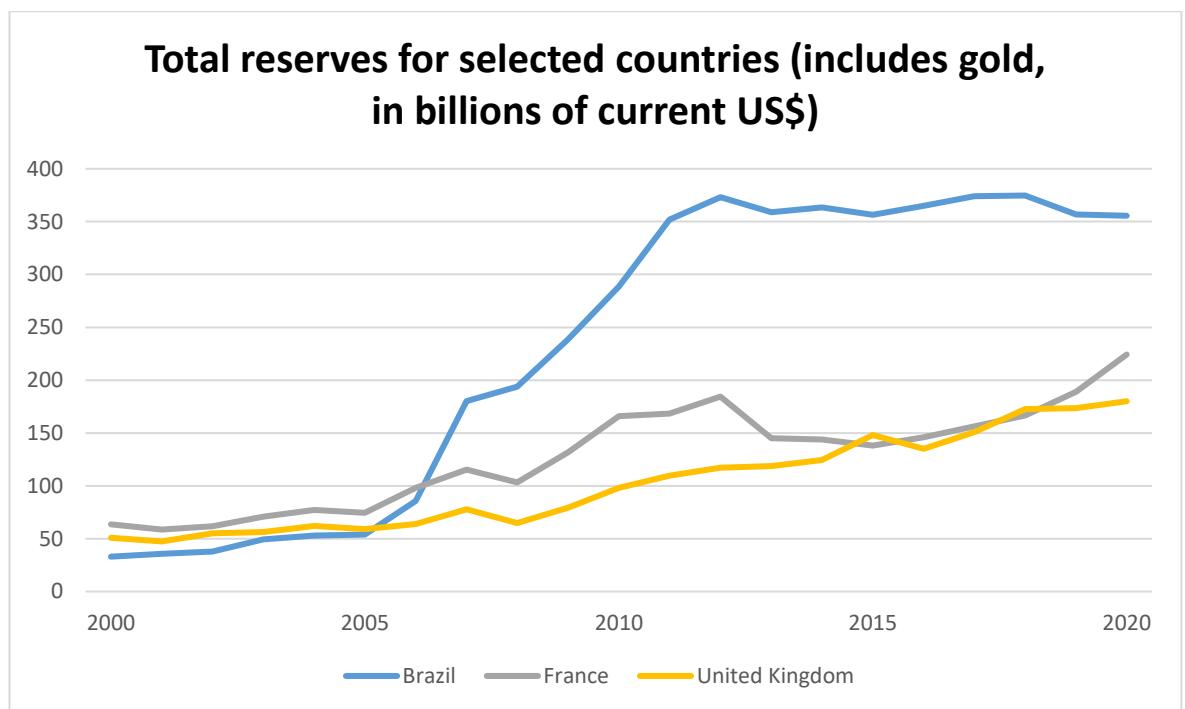
<sup>33</sup> When discussing the Mundell-Fleming model, Serrano and Summa (2015, pp. 256-7) argue the same point:

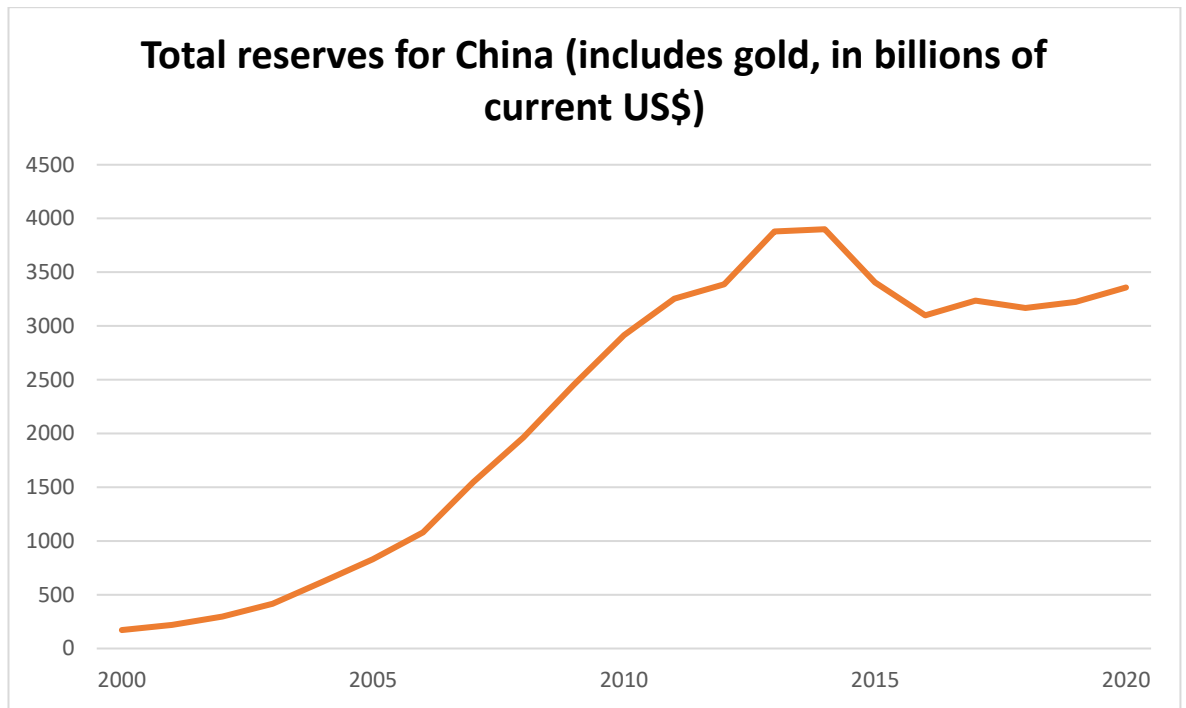
The problem is that if we assume, with a minimum of realism, that in practice the Central Bank operates by setting the basic nominal interest rate, this mechanism makes no sense. In this context, in many cases, the foreign capital inflows that caused the reserves increase will go straight to the purchase of government bonds in the country (or be invested in local private banks and funds that buy and hold these bonds) which has set the domestic interest rate at an attractive level, above the international rate. In this case the 'sterilization' will be voluntary, full, and automatic as the whole of the increase in foreign reserves is offset directly by an equal increase in domestic public debt, and there is no increase in the monetary base (and of course also no increase in the money supply M1). Consequently, the domestic interest rate remains unchanged.

permanently above the international rate (Serrano and Summa, 2015; Aidar and Braga, 2020).

In fact, many countries have persistently accumulated foreign reserves since the early 2000s. This is a corollary of the fact that the United States has had a persistent deficit in their balance of payments: other countries must be accumulating dollars. This goes against Shaikh's concept that the balance of payments must be in equilibrium. Figure 2.4 shows the evolution of foreign reserves including gold in selected countries and China from 2000 to 2020 (China is in a separate graph because of its scale). It is clear that this was a period of massive accumulation of foreign reserves by these countries, with no clear tendency to reverse. Excluding gold from reserves does not alter the trends significantly, see Figure 2.5.

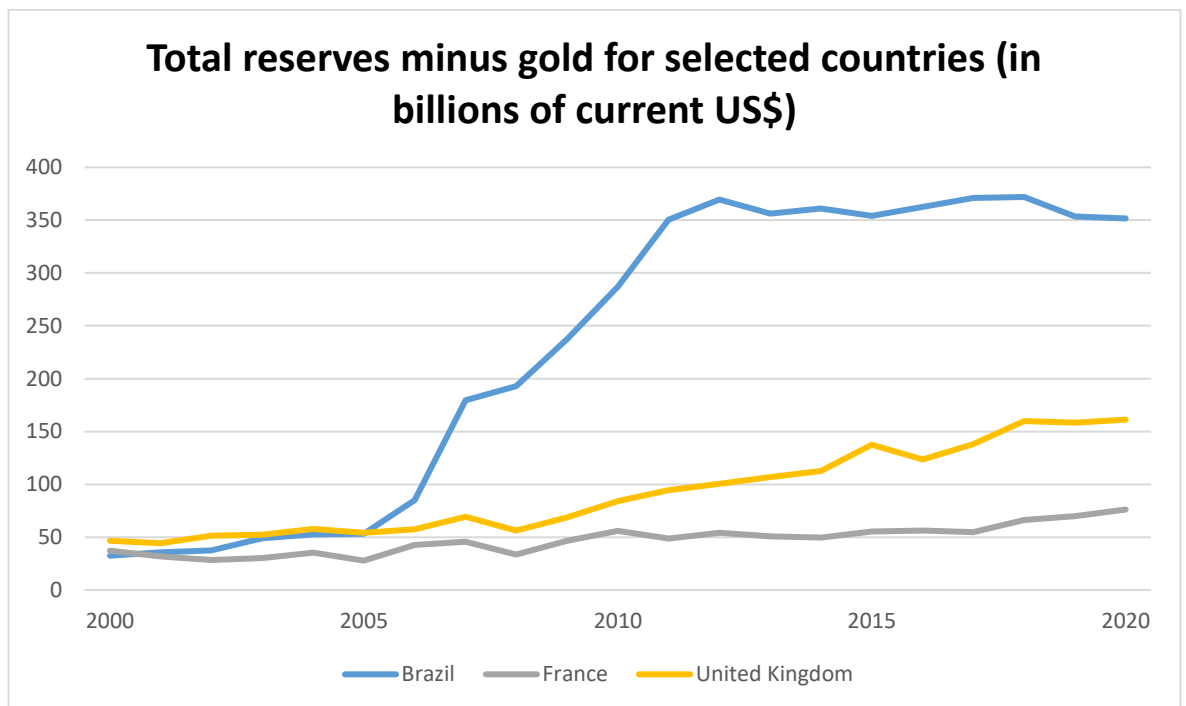
**Figure 2.4**

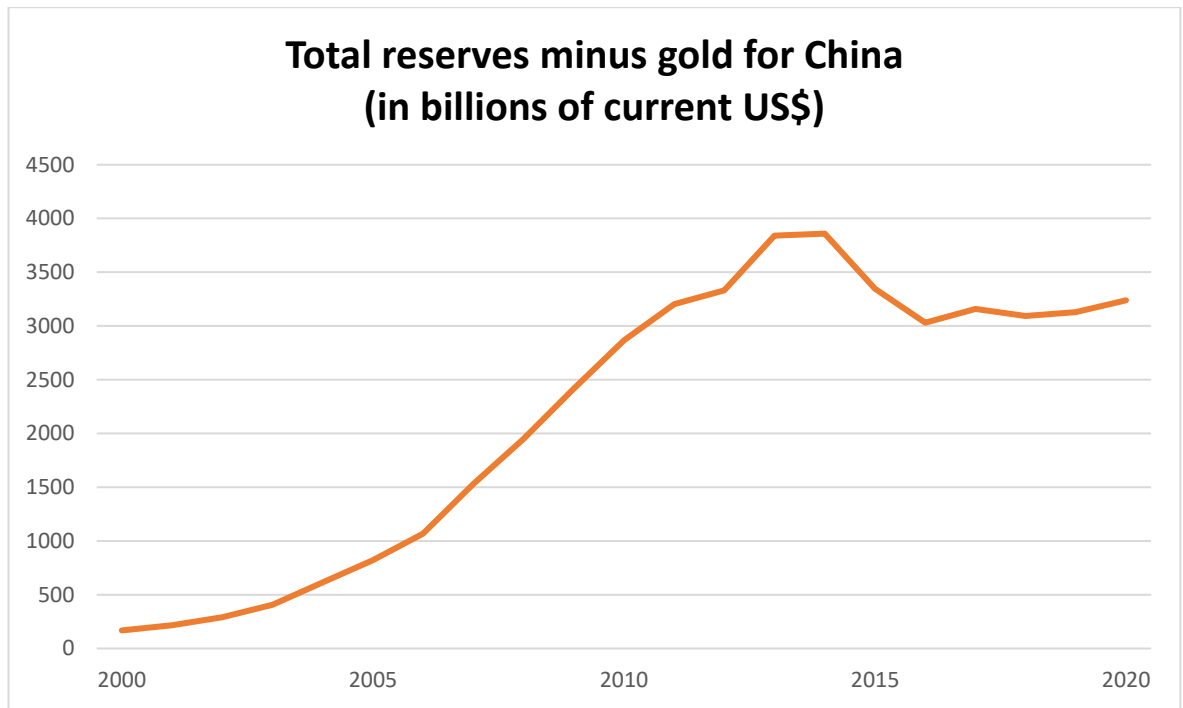




Source: Based on World Bank data (<https://data.worldbank.org/>).

**Figure 2.5**





Source: Based on World Bank data (<https://data.worldbank.org/>).

There is a further related problem of identification with this argument relating to changes in exchange rates. The actual opportunity cost to invest in a foreign country is its interest rate plus the expected variation in exchange rates. For example, an American investing in the United Kingdom must compare the interest rate in the US with the interest rate in the UK plus the expected variation in the exchange rate between the British pound and the American dollar, for bonds of similar maturity. If these are the same, then the rate of return of investing in American or British bonds are the same. The actual rates of return on countries' bonds are equal if and only if the domestic interest rate is equal to the international rate plus the exchange rate variation during the maturity of the bond; this is the uncovered interest parity.<sup>34</sup> However, most of the empirical literature has rejected the validity of the uncovered interest parity (Cieplinsky et al., 2017; Serrano et al., 2021).

<sup>34</sup> Lavoie notes that the Uncovered Interest Parity implies in the real interest parity. This can be easily understood by taking the perspective of an average domestic investor. For example, an American deciding on its portfolio allocation may face three alternatives: 1. invest in real production and earn the normal profit rate; 2. buy American bonds; 3. buy British bonds. All options are of similar maturity. With free mobility of capital inside the United States, options 1 and 2 should give the same real rate of return; the profit rate and the real interest rate on American bonds converge. If there is free mobility of capital between both countries, then



Therefore, there are theoretical and empirical issues with the closure with free mobility of capital and of equilibrium in the balance of payments. Ricardo's idea of persistent differentials in countries' interest rates and profit rates still seems to closely approximate the real world. That does not mean that interest rates do not affect each other; as mentioned previously, most countries cannot sustain an interest rate below the international one. However, there is more freedom in the reverse case and countries can pursue interest rates above international levels.

## 2.4 Conclusion

In this chapter, I have introduced the formal issue addressed by the thesis: the determination of international prices in classical political economy models (see section 2.1.2 in this chapter). I have also evaluated previous attempts in the literature to explore this issue.

I have shown that there have been four main closures to the system of international prices. The first closure assumes that trade must be balanced between countries, as supported by Ricardo and his followers (see sections 2.2.1, 2.2.2, and 2.2.3 in this chapter). The second closure assumes that countries share the production of some goods, as exemplified by Graham (see section 2.2.4 in this chapter). The third closure assumes that countries grow at equal rates, as in Steedman's work (see section 2.2.5 in this chapter). The final closure assumes that there is free international mobility of capital and an international equalization of profit rates, as in the work by Brewer, Parrinello, and Shaikh (see sections 2.3.1 and 2.3.2 in this chapter).

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options 2 and 3 should give the same real rate of return; the real interest rate on American and British bonds converge.

If we do the same exercise from the point of view of a British investor, free international mobility of capital implies in the convergence of domestic real interest rates and domestic profit rates. As Lavoie puts it: "uncovered interest parity implies the equalization of real interest rates between countries - the real interest parity (RIP) theorem." (Lavoie, 2000b, p. 164).

This systematic evaluation of the previous literature answers one of the first questions that I posed in the Introduction:

- What additional trade-related assumptions and closures does the literature employ? (Objective 1a)

For each closure, I evaluated their theoretical and empirical plausibility. Through careful evaluation, I found that the frameworks developed by James Mill and Graham suffered from theoretical inconsistencies. James Mill framework implied two distinct determinations of international prices. Graham, on the other hand, employed circular reasoning by assuming what he intended to explain.

For the other closures, I found them to be at odds with some stylized facts. The closure based on balanced trade is at odds with well-known trends that countries exhibit persistent surpluses and deficits in their current accounts. While the closure based on free mobility of capital predicts an equilibrium of the balance of payments that is not verified, at least in the proposition by Shaikh (1999, and 2016). This fulfils another objective that I posed in the Introduction:

- What are the theoretical and empirical limitations of each different closure? (Objective 1b)

This review points to a gap in the literature: there is a lack of satisfactory solutions to the classical system of international prices and specialization. This paves the ground for the subsequent chapters and for my own contribution to the literature. The next chapters develop an alternative closure to the system of international prices based on given wage disparities; a step-by-step approach is taken where each chapter adds a new layer of complexity.

## Appendix 2.1      Problems with the Cambridge Growth Equation

In this appendix, I discuss the strengths and limitations of the ‘Cambridge growth equation’, proposed by Kaldor (1956) and Pasinetti (1962), as a theory of distribution and/or growth. The reason why this was relegated to an appendix is that it does not impinge very much upon the problems discussed regarding Steedman’s closure to the system of international prices. In a sense, it is more fundamental than the trade part.

This equation draws a one-to-one relationship between the rate of growth ( $g$ ) and the rate of profits ( $r$ ). This relationship is mediated through the country’s marginal propensity to save out of profits ( $s$ ). Under simplifying assumptions:

$$g = sr \tag{2.47}$$

It assumes that the marginal propensity to save out of profits is given, so the rate of profit (and real wages) is determined once one knows the rate of growth. Even more, it assumes that output is at its maximum (either full employment or full capacity utilization): “We shall assume, to begin with, a state of full employment (...) so that total output or income ( $Y$ ) is given” (Kaldor, 1956, p. 95). Hence, “In a state of continuous full employment  $G$  [rate of growth of output,  $g$  above] must be equal to the rate of growth of the ‘full employment ceiling’, i.e., the sum of the rate of technical progress and the growth in working population (Harrod’s ‘natural rate of growth’)” (*ibidem*). In that way, the rate of profits is ultimately determined by the rate of technical progress and the growth of the working population.

In a letter to Garegnani, Sraffa raises some methodological problems with this kind of theory. Garegnani was asking Sraffa about a passage of *Production of Commodities* where Sraffa says that the rate of profits might be determined by the monetary rate of interest.<sup>35</sup>

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<sup>35</sup> “The rate of profits (...) is accordingly susceptible of being determined from outside the system of production, in particular by the level of the money rates of interest” (Sraffa, 1960, p. 33).

Sraffa replies that his intention was not to propose another mechanical theory of distribution.

In his words:

[I] do not have any intention of advancing another mechanical theory that, in one way or another, confirms the idea that distribution is determined by natural, technical, or even accidental circumstances. {Between you and me, here I am referring to the theory (Cambridge as Pasinetti calls it) that makes the rate of profit to depend on the rate of growth} That would make in anyway futile any action, from one part or the other, to modify it [distribution]. (Sraffa, D3/12/111/154, recto, own translation, the passages in square brackets are my clarifications)<sup>36, 37</sup>

The passage in curly brackets was struck through by Sraffa and does not appear in later drafts of the letter. However, it clearly shows that at least at this stage Sraffa disregarded a theory that mechanically determines the rate of profits by conditions like the rate of technical progress and the rate of growth of the working population (or marginal productivity for that matter).

This position is not surprising once one recognizes that a big part of Sraffa's construct was to allow distribution to be affected by political/institutional factors. If distribution is completely determined by technical factors, there is no room for changes in 'class power' to permanently affect it.

Other theoretical critiques have been aimed at the Cambridge equation. The idea here is not to make any advances to growth theory, just to show that there are serious problems with it. So, what follows is an extremely brief introduction to a vast literature. To do so, it will be helpful to show how such a relation is achieved, at least in a very simple model. Kaldor (1956) calls it a Keynesian theory of distribution because it starts from Keynes's (or sometimes Kaleckian) macroeconomic categories.

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<sup>36</sup> Any references to Sraffa's archives are to the online catalogue available at [Trinity College Library, Cambridge: SRAFFA](#).

<sup>37</sup> In the original: "non ho nessuna intenzione di mettere avanti un'altra teoria meccanica che, in una forma o nell'altra, ribadisca l'idea che la distribuzione sia determinata da circostanze naturali, tecniche, o magari accidentali {e qui, sia detto fra di noi, ho in mente la teoria (Cambridge come l'ha battessata Pasinetti) che fa dipendere il saggio del profitto dal saggio di crescita} ma comunque tali da rendere futile qualunque azione, da una parte o dall'altra, su modificarla"

$$Y = C + I \quad (2.48)$$

$$Y = W + P \quad (2.49)$$

$$C + I = W + P \quad (2.50)$$

Equation (2.48) is the typical Keynesian relation for a closed economy without government; it says that output ( $Y$ ) is equal to total aggregate demand: consumption ( $C$ ) plus investment ( $I$ ). Equation (2.49) states that total output is distributed as income to different classes: wages for workers ( $W$ ) and profits for capitalists ( $P$ ). Equation (2.50) just equates production calculated via demand and via income. It can be read in two ways: all income generated comes from expenditures; and all income is spent.

Consumption is whatever workers decide to consume out of their wages plus what capitalists consume out of their profits:

$$C = c_w W + c_p P \quad (2.51)$$

where  $c_w$  and  $c_p$  are the marginal propensities to consume out of wages and out of profits, respectively.

In a usual simplification, assume that workers do not save and hence consume all their income ( $c_w = 1$ ) and capitalists save a positive fraction of their income ( $0 < c_p < 1$ ). Whatever income that is not consumed is saved, the marginal propensity to save out of profits is then:  $s_p = 1 - c_p$ . With these assumptions, the consumption function is:

$$C = W + (1 - s_p)P \quad (2.52)$$

Since workers do not save, savings ( $S$ ) come entirely from profits:  $S = s_p P$ , where  $S$  is total savings. Inserting the consumption function (2.52) into equation (2.50), one is left with:

$$I = s_p P = S \quad (2.53)$$

This is an alternative/Kaleckian way to reach the macroeconomic condition where investment equals savings: Kaleckian because it relies on the differences of propensities to save amongst classes to determine the multiplier, and not on psychological causes as in Keynes. Dividing both sides by  $Y$ , one gets to:  $I/Y = s_p P/Y = S/Y$ . This justifies Kaldor's assertion that "given the wage-earners' and the capitalists' propensities to save, the share of profits in income depends simply on the ratio of investment to output" (Kaldor, 1956, p. 95). And, according to the 'Keynesian' hypothesis, the ratio of investment to output is given.

Another assumption of the model is that of 'full employment': "We shall assume, to begin with, a state of full employment" (Kaldor, 1956, p. 95). We will reinterpret this here as a state of full capacity utilization, which Kaldor seems to imply with 'full employment'. This means that the ratio of output ( $Y$ ) to potential output ( $Y^*$ ) is equal to one:  $Y/Y^* = 1$ . However, potential output is totally determined by technology and the available capital stock today:

$$Y^* = \frac{K}{v} \quad (2.54)$$

where  $K$  is the capital stock and  $v$  is the given capital-output ratio.

The condition for full capacity utilization implies in  $Y = Y^*$  and  $g = g^*$ , with  $g$  the rate of growth of output, and  $g^*$  the rate of growth of potential output. On the other hand, for a given technology, the growth rate of potential output is equal to the growth rate of the capital stock ( $g_k$ ):  $g^* = g_k$ . Therefore, full capacity utilization requires that, at least tendentially, the economy grows at the rate of growth of the capital stock:  $g = g_k$ .

The rate of growth of capital stock is equal to the ratio of net investment to the current capital stock. Which can be tautologically decomposed as:

$$g_k = \frac{I}{K} = \left(\frac{I}{Y}\right) \left(\frac{Y}{Y^*}\right) \left(\frac{Y^*}{K}\right) \quad (2.55)$$

where  $I/Y$  is the ratio of investment to output;  $Y/Y^*$  is the degree of capacity utilization ( $u$ ); and  $Y^*/K$  is the inverse of the capital-output ratio ( $1/v$ ).

From the macroeconomic relations above,  $I/Y$  is equal to the average savings ratio  $S/Y$ . In this case, this is equal to the marginal propensity to save ( $s_p$ ) multiplied by the profit-share ( $P/Y = \pi$ ). Hence, the rate of growth of the capital stock can be rewritten as:

$$g_k = \frac{s_p \pi u}{v} \quad (2.56)$$

Besides that, the rate of profits measure total profits ( $P$ ) over total capital ( $K$ ) and can be decomposed as:

$$r = \frac{P}{K} = \frac{P}{Y} \cdot \frac{Y}{Y^*} \cdot \frac{Y^*}{K} = \frac{\pi u}{v} \quad (2.57)$$

To the best of the author's knowledge, this kind of decomposition was first proposed by Weisskopf (1979). Combining equations (2.56) and (2.57) with the fact that  $g = g_k$ , one is left with:

$$g = s_p r \quad (2.58)$$

This is the Cambridge equation as a simple logical relation. It becomes a full theoretical statement when it is used to argue that the rate of growth determines the rate of profits (or vice-versa). Kaldor argues that based on the price (or mark-up) flexibility. Since it is assumed that the economy is working at full capacity utilization, any increase in the ratio of net investment to output will cause the economy to go beyond its physical capacity (excess demand). This excess demand will inflate prices, eventually causing a reduction in consumption. Since workers consume proportionally more than capitalists and at a fixed

ratio, this will imply a change in income distribution in favour of capitalists. The reverse would happen with a fall in  $I/Y$ .

The Sraffian supermultiplier literature, which was initially developed in the works of Serrano (1995) and Bortis (1997), opened a major line of criticism to this kind of theory. This literature assumes that investment is induced by demand via the accelerator principle. What this means is that capitalists will invest according to the amount of expected demand. It also includes an autonomous component ( $Z$ ) in demand that is neither induced by wages nor by the accelerator; for example, an autonomous consumption by capitalists. In terms of the full expression above, it takes the rate of capacity utilization to converge to a normal position like Kaldor, but not necessarily the full capacity utilization one. With this, it emerges the difference between the average ( $I/Y$ ) and marginal ( $s$ ) propensities to save. The autonomous component appears as:

$$Y = C + I + Z \quad (2.59)$$

The model assumes that consumption comes only from workers, who spend their entire wage on consumption. Therefore, consumption can be expressed as the share of wages ( $\omega$ ) in the total output:

$$C = \omega Y \quad (2.60)$$

Furthermore, the model establishes a relationship between investment and demand. It is assumed that capitalists only invest when they expect to realize their production. This is the accelerator principle; capitalists adjust productive capacity to demand. In its most simple format, this relationship can be characterized with the fixed accelerator<sup>38</sup> where investment is a given proportion of expected demand in the next period:

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<sup>38</sup> The fixed accelerator is highly unrealistic, but it captures well the main features of the model. See Serrano and Freitas (2017) for a development with a flexible accelerator and Girardi and Pariboni (2016) for an application of it to the US case.



$$I = \alpha Y_{t+1} \quad (2.61)$$

We can express the demand in the next period ( $Y_{t+1}$ ) as the demand today plus its rate of growth. So, the investment equation can be represented as:

$$I = \alpha Y(1 + g) \quad (2.62)$$

Substituting conditions (2.60) and (2.61) into equation (2.59):

$$Y = \frac{Z}{(1 - \omega - \alpha(1 + g))} \quad (2.63)$$

where the term in the denominator is the supermultiplier, given by the parameters of the model.

If that is the case, then the economy must grow at the same rate as the autonomous components of demand:

$$g = g_z \quad (2.64)$$

where  $g_z$  is the rate of growth of the autonomous components of demand.

Notice that with the fixed accelerator the ratio of investment to output is given by  $\alpha(1 + g)$ . Therefore, the growth rate of the capital stock (equation (2.55)) can be rewritten as:

$$g_k = \frac{\alpha(1 + g)u}{v} \quad (2.65)$$

If capitalists adjust capacity to demand to maintain a given degree of capacity utilization, it must also be true that in the long run  $g = g_k$ . Substituting this into (2.65) and solving for  $g$ :

$$g = \frac{\frac{\alpha u}{v}}{1 - \frac{\alpha u}{v}} \quad (2.66)$$

A relationship between the growth rate and the rate of profit can also be established.

Joining equations (2.57) and (2.66) and rearranging the terms:

$$g = \frac{r}{\frac{\pi}{\alpha} - r} \quad (2.67)$$

Notice that  $\pi/\alpha$  is just the inverse of the average rate to invest out of profits  $I/P$ .<sup>39</sup> This is not a parameter of the model and will act as an adjusting mechanism. If the economy is growing fast, then capitalists will tend to invest more out of their profits, on average. While if the economy is growing slowly, capitalists will tend to invest less out of profits. In the limit, if the economy is growing at its maximum rate, capitalists invest their entire profits on productive capacity. If the economy is not growing at all, then capitalists will invest a minimum share of their profits just to replace depreciation.<sup>40</sup>

Therefore, the model has an additional degree of freedom; the rate of growth and the rate of profits may move independently from each other. The average rate to invest out of profits will adjust to make sure that condition (2.67) is valid. In this way, the supermultiplier literature criticizes the fixed relationship between  $g$  and  $r$  implied in the Cambridge growth equation. It only requires the existence of autonomous components of demand and that investment reacts to effective demand.

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<sup>39</sup>  $\pi/\alpha = \frac{P/Y}{I/Y} = P/I$ .

<sup>40</sup> In the original formulation of the Sraffian supermultiplier (Serrano, 1995; see also Serrano and Freitas, 2017), the adjusting mechanism is the average propensity to save, which is also equal to the investment share  $I/Y$ . They call it ‘the fraction’. Notice that  $\pi/\alpha$  depends on the investment share and on the profit share; if the profit share is given, then changes in  $\pi/\alpha$  must come from changes in the investment share. It is just another way to represent the same mechanism.

## Appendix 2.2      Calculating international prices with free mobility of capital

In this appendix, I offer a possible interpretation on how to calculate international prices in Brewer's (1985) model (see section 2.3.1 in this chapter). I shall use Steedman's example of country  $X$  and  $Z$  competing in the production of commodities 1 and 2, where commodity 1 is a capital good and commodity 2 is a pure consumption good.

The assumptions of the model are:

- i. Each country has a single method to produce each commodity;
- ii. Capital is completely used up in the period of production: there is no fixed capital;
- iii. Capital is free to move between countries, meaning that there is a tendency for equalization of profit rates;
- iv. The real wage is given by the minimum amount of commodity **2** that workers accept to work;

From assumption i, ii, and iii, the costs of production in country  $X$  are:

$$c_1^X = p_1 a_{11}^X (1 + r) + w^X l_1^X \quad (2.68)$$

$$c_2^X = p_1 a_{12}^X (1 + r) + w^X l_2^X \quad (2.69)$$

while for country  $Z$  are:

$$c_1^Z = p_1 a_{11}^Z (1 + r) + w^Z l_1^Z \quad (2.70)$$

$$c_2^Z = p_1 a_{12}^Z (1 + r) + w^Z l_2^Z \quad (2.71)$$

where  $p_1$  is the international price of the capital good 1; and  $r$  is the international rate of profit.

Assumption iv means that wages in each country are sufficient to buy a given amount of commodity 2:

$$w^X = p_2 b_2^X \quad (2.72)$$

$$w^Z = p_2 b_2^Z \quad (2.73)$$

where  $p_2$  is the international price for commodity 2; and  $b_2^X$  and  $b_2^Z$  are the known amounts of commodity 2 that workers in country  $X$  and  $Z$  can buy, respectively.

Substituting equations (2.72) and (2.73) into equations (2.68), (2.69), (2.70), and (2.71), costs of production can be written as:

$$c_1^X = p_1 a_{11}^X (1 + r) + p_2 b_2^X l_1^X \quad (2.74)$$

$$c_2^X = p_1 a_{12}^X (1 + r) + p_2 b_2^X l_2^X \quad (2.75)$$

and

$$c_1^Z = p_1 a_{11}^Z (1 + r) + p_2 b_2^Z l_1^Z \quad (2.76)$$

$$c_2^Z = p_1 a_{12}^Z (1 + r) + p_2 b_2^Z l_2^Z \quad (2.77)$$

Equations (2.74) through to (2.77) offer a description of *potential* costs. That is, costs that countries should incur if they produce the commodity.

There are four different ways in which production might be distributed in the two countries. First, country  $X$  produces both goods. Second, country  $Z$  produces both goods. Third, country  $X$  produces commodity 1 and country  $Z$  produces commodity 2. Fourth, country  $X$  produces commodity 2 and country  $Z$  produces commodity 1. These four different cases are displayed in Table 2.1:

**Table 2.1**

	Cases			
	I	II	III	IV
Commodity 1	Country $X$	Country $Z$	Country $X$	Country $Z$

Commodity 2		Country $X$	Country $Z$	Country $Z$	Country $X$
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Each possible way to distribute production corresponds to a different system of international prices. For example, in case I country  $X$  produces both commodities; the only relevant costs are those for country  $X$ . So, each specialization case is associated with a system with two equations (one cost equation for each commodity) to determine two variables (the international relative prices and the international profit rate).

The only thing left to determine is which specialization case will be chosen. Since each case generates a different profit rate, we may rank them from highest to lowest. For example, it might be the case that:

$$r^I > r^{II} > r^{III} > r^{IV} \quad (2.78)$$

where the superscript indicates to which case the profit rate refers to. In this scenario, the international rate of profit will be the highest if country  $X$  produces everything (specialization case I).

By assumption, capitalists are free to move their capital to whichever country they want: the logic of capital is to maximize profits. Therefore, capitalists will move the production of both goods to country  $X$  as it offers the highest rate of profit.

This also means that international prices will settle at a level sufficient to cover country  $X$ 's production costs:

$$p_1 = c_1^X \quad (2.79)$$

$$p_2 = c_2^X \quad (2.80)$$

Costs in all other possible cases of specialization will necessarily be higher than if country  $X$  produces both goods. Otherwise, capitalists would move their capital to the option with the lowest costs. So, with free mobility of capital, it is possible to determine specialization

based on absolute costs of production. The decision of where to produce goods depends on which configuration generates the highest rate of profit.

## Chapter 3: International trade in a Pasinetti pure labour model

### 3.1 Introduction

The main legacy of Ricardo's contribution to the economics of international trade is the theory of comparative advantage. Samuelson (1969, p. 9), for example, calls it one of the few propositions "in all of the social sciences which is both true and non-trivial". And for Krugman (2002, p. 35), "Ricardo's idea is truly, madly, deeply difficult. But it is also utterly true, immensely sophisticated – and extremely relevant to the modern world".

The usual interpretation is that comparative advantage represents a major analytical improvement over absolute advantage theory. Ruffin (2005, p. 746), for example, argues that Ricardo's true genius is to work out that a country can gain an advantage, compared to other countries, in its *relative* costs of production, as opposed to the 'fallacy of absolute advantage'. The bulk of the economics profession thus views absolute advantage as a mere steppingstone for trade theory.

There has, however, been some questioning of this deprecation of absolute advantage in studies of classical political economy, as associated with the production-based approach of Sraffa (1960).<sup>41</sup> One particular strand of this literature has developed an external critique of Ricardo's model that abandons the assumption of immobility of money capital between countries (Shaikh, 1999, 2016; Parrinello, 2010; Bellino and Fratini, 2021; Crespo et al., 2020). The introduction of free international mobility of money capital implies that capitalists can move their capital to other countries in search of higher rates of profit (see section 2.3 in Chapter 2). The idea is that countries with lower costs of production, however defined, will support higher rates of profit and hence attract capital. In this way, it is suggested that the driver of international trade and specialization could be lower absolute costs.

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<sup>41</sup> See Parrinello (1973) and Steedman (1979a; 1979b) for some of the key pioneering studies in Sraffian trade theory.

An alternative study advocating the importance of absolute advantage is that of Baldone et al. (2007). Here, the criticism of comparative advantage is not based on the international mobility of money capital, but rather due to the complications associated with trade in intermediate goods. With the fragmentation of production, there is a “lessening of the power of the concept of comparative advantages (...) while it is the concept of absolute advantage that becomes increasingly relevant” (Baldone et al., 2007, p. 1727). Traditional measures of comparative advantage might suggest that a country should specialize in the production of a particular final commodity; but with fragmentation, it might be cheaper for the country to export the intermediate inputs necessary for another country to produce the final commodity – which the original country then imports. It is argued, using a two-country model, with zero profits and traded intermediate capital inputs, that trade patterns can thus be explained by actual costs of producing the commodities: absolute advantage.

There is, however, a dimension to this analysis that has been somewhat neglected: it rests on a fundamental assumption that each country has a given money wage, both measured in a common unit of account (Baldone et al., 2007, p. 1733). This modelling of wage disparities allows for a comparison between money costs (and absolute advantage) between countries which, it may be argued, is more fundamental than Baldone et al.’s focus on intermediate inputs.

The contribution of this chapter is thus to further investigate the role of wage disparities and absolute advantage in a production system with international trade that is more abstract than Baldone et al.’s formulation. The framework employed is perhaps the most abstract available in classical political economy, the two-country system developed by Pasinetti (1993) under pure labour technology, with zero profits and labour the only input to production. My approach is to emphasize the role of money wage disparities in determining trade patterns and international prices. This chapter shows that, even in this simplified model, absolute cost advantages can dominate competition between countries under given



money wages. What sets this contribution apart is that we need not rely on either free mobility of money capital or trade in intermediate capital goods in order to establish a role for absolute advantage in international trade. It is thus a novel closure to the system of international prices based on given nominal wages.

Though Pasinetti has much to say about international trade there has been very little attention to this aspect of his work. International trade is not, for example, considered in the intellectual biography of Pasinetti's work and the secondary literature provided by Baranzini and Mirante (2018). A further contribution here is thus to introduce a formalisation of the model of international trade developed in Chapter 9 of Pasinetti (1993).<sup>42</sup> It will be argued that Pasinetti's step-by-step approach, with the systematic relaxation of restrictive assumptions at each stage of the analysis, can throw light on some of the core aspects of complex trade relationships.

The structure of the paper follows a step-by-step approach. Section 3.2 starts by setting up Pasinetti's two-country model of trade in its most concise form. By starting with Pasinetti's assumption of a uniform ten-fold disparity in technology and wage rates, between the two countries, costs are shown to be the same, providing no inducement to trade. Section 3.3 then introduces absolute advantage into the model by relaxing the assumption of a ten-fold difference in wages. It is shown that under wage disparities one of the countries will have cheaper production costs across all commodities. Finally, by then relaxing the assumption of uniform differences in technology, the possibility of comparative advantage is introduced, together with a consideration of how absolute advantage may also retain its relevance. The final section provides a summary of the contribution and some concluding remarks.

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<sup>42</sup> See also Pasinetti (1981, Chapter 11) and Pasinetti (1988).

### 3.2 The two-country Pasinetti model

Pasinetti (1993, Chapter 9) develops a rudimentary model of international trade in which there are two economic systems, each represented by a separate country. Each system has its own methods of production, with single commodity-producing industries employing direct (unassisted) labour to produce the same  $n$  commodities in each country. This is a pure labour economy in which there are zero profits and all income is allocated to labour. A key restriction is that the free movement of labour is allowed within each system but not between countries. Free movement (trade) of commodities between countries is allowed in principle, depending on the configuration of prices.

A ‘purely hypothetical’ case (Pasinetti, 1993, p. 151) is developed in which there is an advanced country ( $A$ ) and an underdeveloped country ( $U$ ). To formalise this model, labour coefficients for each commodity  $i$  represent volumes of labour per unit of physical output:  $l_i^A$  for country  $A$ , and  $l_i^U$  for country  $U$ . These countries also have their own separate money wage rates ( $w^A$  and  $w^U$ ), which form the basis for the total money costs of producing each physical unit ( $c_i^A$  and  $c_i^U$ ). Since production occurs by means of unassisted labour, the costs of production are made up of the wage bill paid out in each sector. The labour coefficients are combined with the money wages for each country such that

$$c_i^A = w^A l_i^A \quad (3.1)$$

$$c_i^U = w^U l_i^U \quad (3.2)$$

Pasinetti considers the case of a ten-fold difference in the productivity of labour for each commodity produced; that is, country  $A$  is ten times more productive, and hence its labour coefficients are ten times smaller than in country  $U$ :

$$l_i^U = 10l_i^A \quad (3.3)$$

In addition, the money wage available to the producers in country  $A$  is ten times higher than the money wage available in country  $U$  (Pasinetti, 1993, p. 153):

$$w^A = 10w^U \quad (3.4)$$

Substituting (3.3) and (3.4) into (3.1) and (3.2) shows that the tenfold differences in technology and wages cancel each other out; the money cost of producing each commodity  $i$  is the same in each country:

$$c_i^A = c_i^U \quad (3.5)$$

On this basis, Pasinetti has a cost-based theory of prices with  $p_i^A = c_i^A$  and  $p_i^U = c_i^U$  such that under (3.1) and (3.2):

$$p_i^A = w^A l_i^A \quad (3.6)$$

$$p_i^U = w^U l_i^U \quad (3.7)$$

These prices, as determined by costs of production, are what classical political economists called ‘natural prices’ (alternatively as supply-prices for Dvoskin and Feldman (2018a, 2018b)): the minimum price necessary for production to be carried out in each country (see section 2.1.1 in Chapter 2). As stated by Adam Smith: “The commodity is then sold precisely for what it is worth, or for what it really costs the person who brings it to market” (Smith, 2007[1776], p. 47). Ricardo explicitly agrees with Smith: “In the 7th chap. of the Wealth of Nations, all that concerns this question is most ably treated” (Ricardo, Works, vol. 1, chap. 4, p. 89). If labour is the only input to production, what Smith calls cost simply becomes the wage bill.

It also follows from (3.5) that  $p_i^A = p_i^U$ : the prices of each commodity “are exactly the same in both countries” (Pasinetti, 1993, p. 151). This is explained by the differences in wages off setting differences in technology, as explained above. Hence, neither country can

acquire any commodity at a cheaper price (cost) by means of importation. There is no incentive to trade between the two countries in this abstract starting point.

It should be noted that the law of one price is assumed to hold throughout, but the result in (3.5) is not a consequence of it. The law stipulates that the price of a tradable commodity must be the same (adjusted for transport costs and import/export duties) across all countries (see Shaikh, 2016, p. 517). This is simply a non-arbitrage condition: the possibilities of buying cheap in a country and selling dear in another have been exhausted. This assumption does not imply an equalization of costs of production, which may differ between producers even though prices are uniform. Therefore, the equalization of costs in (3.5) is separate from the law of one price, since the convergence of prices is not sufficient to explain cost equalization.

For Pasinetti, this model clearly shows the asymmetry in power between the two countries. The advanced country benefits by having higher wages than the underdeveloped country, and it has nothing to gain from trade with the underdeveloped country. The underdeveloped country is, therefore, unable to trade, since it can only offer the goods at the same price as the advanced country, and has nothing to offer.<sup>43</sup> By denoting the international price of commodity  $i$  as  $p_i$ , it follows that

$$p_i = p_i^A = p_i^U \quad (3.8)$$

Commodity  $i$ 's international price is equal to the price operating in both country  $A$  and country  $U$ . A corollary of this is that relative prices are the same in both countries. Consider commodities  $i$  and  $j$ . Since  $p_i^A = p_i^U$  and  $p_j^A = p_j^U$ , it is evident that:

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<sup>43</sup> For Pasinetti (1993, p. 153) “this aspect of the situation only emerges as a very minor part of the whole picture”. If the underdeveloped country could improve its productivity, say by learning from the more advanced techniques used in the other country, then there is a possibility that opportunities for trade can emerge (see Garbellini (2021) for a study of how the international diffusion of technology affects international trade in a Pasinetti model). Recognising that learning has this important role, our analysis focuses only on price comparisons under given technologies. Future extensions of our analysis could develop the role of technological change and economic growth, drawing on the insights provided, for example, by Pasinetti (1981, pp. 163-6).

$$\frac{p_i^A}{p_j^A} = \frac{p_i^U}{p_j^U} \quad (3.9)$$

Pasinetti also points out a peculiarity of this model. Though the labour theory of value is in operation within each system, it does not operate between the two systems: “relative quantities of embodied labour will continue to regulate commodity prices *within* the boundaries of each country, but not across borders” (Pasinetti, 1993, p. 152, original emphasis). Comparisons between countries take place only in terms of physical, not labour embodied units.

This peculiarity can be demonstrated, using the price equations (3.6) and (3.7) to compare country  $A$ 's ratio of prices for commodities  $i$  and  $j$ :

$$\frac{p_i^A}{p_j^A} = \frac{w^A l_i^A}{w^A l_j^A} = \frac{l_i^A}{l_j^A} \quad (3.10)$$

Since wages are uniform inside country  $A$ , the wage rates cancel out. Thus, relative prices inside country  $A$  are equal to relative embodied labour coefficients, consistent with the labour theory of value.

But consider the ratio of prices for commodities  $i$  and  $j$  between countries  $A$  and  $U$ . Since from (3.4) we know that  $w^A = 10w^U$ , relative prices are:

$$\frac{p_i^A}{p_j^U} = \frac{w^A l_i^A}{w^U l_j^U} = 10 \left( \frac{l_i^A}{l_j^U} \right) \quad (3.11)$$

It is evident here that the cross-country relative prices are not equal to the ratio of embodied labour coefficients. The labour theory of value does not hold at the international level, even under the pure labour assumption. The ratio of wage rates, 10 times higher in country  $A$  than in  $U$ , are critical to the comparison of cross-country prices.

Though Pasinetti does not state the origins of this two-country result, it can be found in David Ricardo's treatment of international trade, where he explores the trade of wine and cloth between Portugal and England:<sup>44</sup>

The same rule which regulates the relative value of commodities in one country, does not regulate the relative value of the commodities exchanged between two or more countries. (...) The quantity of wine which she [Portugal] shall give in exchange for the cloth of England, is not determined by the respective quantities of labour devoted to the production of each, as it would be, if both commodities were manufactured in England, or both in Portugal. (Ricardo, Works, vol. 1, p. 113)

*Illustration.* Assume a two-commodity economy producing corn ( $c$ ) and gold ( $g$ ), as considered by Pasinetti (1993, p. 151). A concrete example of this two-country/two-commodity economy, with illustrative labour coefficients, is provided by Table 3.1.

**Table 3.1 Labour coefficients with uniform ten-fold differences**

	Country $A$	Country $U$
Corn	$l_c^A = 0.5$	$l_c^U = 5$
Gold	$l_g^A = 1$	$l_g^U = 10$

Table 3.1 shows that in country  $A$  it takes half a man-hour to grow one unit of corn and one man-hour to mine one unit of gold. Under the uniform ten-fold difference in technology, for country  $U$  it takes five man-hours to grow one unit of corn and ten man-hours to mine one unit of gold.

For a ten-fold difference in money wage rates, let the hourly wage in country  $A$  be  $w^A = 1$ , and the hourly wage in country  $U$  be  $w^U = 0.1$ .<sup>45</sup>

<sup>44</sup> See Ruffin (2002) and Bhering and Serrano (2019) for similar results from a reconstruction of Ricardo.

<sup>45</sup> Prices in each country are anchored to gold, as assumed by Pasinetti (1993, p. 151): under (3.1) and (3.2), the money wage allows the physical units of output to be measured in units of gold. The money wage rates have been chosen to make the cost of gold in each country (and hence its price) equal to 1, the numéraire. Other wage rates could have been assumed without changing the results below, so long as wages were kept in a proportion 10 to 1. The only implication would be to alter price levels.

From these assumptions regarding technical coefficients and wage rates, it is possible to assess the costs of producing either commodity in one of the countries. By construction, the cost of producing a commodity is just made up of its money wage bill (see equations (3.1) and (3.2) above):

$$c_c^A = 1 \times 0.5 = 0.5$$

$$c_g^A = 1 \times 1 = 1$$

$$c_c^U = 0.1 \times 5 = 0.5$$

$$c_g^U = 0.1 \times 10 = 1$$

**Table 3.2**      **Costs with no incentive to trade**

	Country <i>A</i>	Country <i>U</i>
Corn	$c_c^A = 0.5$	$c_c^U = 0.5$
Gold	$c_g^A = 1$	$c_g^U = 1$

These costs are displayed in Table 3.2. It is immediately obvious that equation (3.5) holds: both countries are producing each commodity at the same cost, so the determination of international prices will be unambiguous. According to equation (3.8) above, the international price of gold will be  $p_g = 1$  and of corn will be  $p_c = 0.5$ . This is a model with no inducement for the two countries to trade with each other.<sup>46</sup>

### 3.3 Absolute advantage

<sup>46</sup> This example also shows that relative prices (relative costs) are governed by embodied labour coefficients within each country, as shown by (3.10). For example, the ratio of costs (prices) for producing the two commodities in country *U* (as shown in Table 3.2) is  $1/2$  divided by  $1$ , which equals  $1/2$ , the same as the ratio of labour coefficients (Table 3.1) of  $5/10 = 1/2$ . Consider, however, the ratio of costs (prices) between countries to produce corn:  $1/2$  divided by  $1/2$ , equal to  $1$ . This is not the same as the ratio of labour coefficients:  $1/2$  divided by  $5$ , which is equal to  $0.1$ . As shown in (3.11), the labour theory of value is not in operation between countries.

We have thus seen how Pasinetti's two-country model is constructed in such a way to exclude between-country differences in costs. Since there are no differences in costs between countries, an international price is established for each commodity by construction. This section introduces differences in absolute costs between countries in Pasinetti's model, keeping his assumption regarding a uniform ten-fold disparity in technologies. As a first step, it considers the notion of absolute advantage.

A country will have an absolute advantage in the production of a commodity if its cost of production is lower than in another country. In Pasinetti's example, country *A* will have an absolute advantage in producing commodity *i* if it can produce and supply it at a cheaper cost than country *U*. Its cost of production must be lower than in country *U*. This is the same definition of absolute advantage as provided by Brewer (1985, p. 178) (see also Bellino and Fratini, 2021, p. 12).

It is important to stress that this definition of absolute advantage represents a departure from the canonical definition. Absolute advantage is usually defined for differences in the quantity of labour required to produce a commodity. For example, Krugman et al. (2018, p. 51) state that: "when one country can produce a unit of a good with less labor than another country, we say that the first country has an absolute advantage in producing that good". This is a purely technical definition based on labour technologies.

In contrast, absolute advantage is defined here as a scenario where a country can produce a commodity at a lower money cost than is possible in another country. This shift in definition brings absolute advantage closer to the classical concept of price competition. One of the roles of competition in classical political economy is the "enforcement of minimum-cost production" among the readily available methods of production (Eatwell, 1982, n. 3). Absolute advantage is not simply a technical condition but rather depends on "political and institutional elements" (Baldone et al., 2007, p. 1735, n. 15), which impacts on the key role provided by wages.



Thus far, in our model, the cost of production is simply the wage bill outlaid on workers, as specified in equations (3.1) and (3.2). Therefore, a country will have an absolute advantage in the production of a commodity if the wage bill necessary to produce that commodity is lower than the wage bill outlaid in the other country. So, the absolute advantage for commodity  $i$  will depend on whether:

$$c_i^A \leq c_i^U \Leftrightarrow w^A l_i^A \leq w^U l_i^U \quad (3.12)$$

If the wage bill necessary to produce commodity  $i$  in country  $A$  is higher than in country  $U$  ( $w^A l_i^A > w^U l_i^U$ ) then the absolute cost of producing it in country  $A$  is higher than in country  $U$ : it is *absolutely* cheaper to produce commodity  $i$  in country  $U$ . The reverse is true if  $w^A l_i^A < w^U l_i^U$ : it is *absolutely* cheaper to produce the commodity in country  $A$ . Where the wage bill is equivalent ( $w^A l_i^A = w^U l_i^U$ ), no country possesses an absolute advantage and hence both countries will tend to produce it simultaneously.

Absolute advantage can be established in the Pasinetti model, maintaining the technical assumption that for each commodity country  $U$  is ten times less productive than country  $A$ , but focusing here on differences in wages. Substituting the relationship between labour coefficients  $l_i^U = 10l_i^A$  into (3.12) gives the condition for absolute advantage as

$$w^A \leq 10w^U \quad (3.13)$$

Thus, whenever the wage in country  $A$  is more than ten times larger than in country  $U$  ( $w^A > 10w^U$ ), it will be *absolutely* cheaper to produce commodity  $i$  in country  $U$ . At this point, we say that country  $U$  has an absolute advantage in the production of commodity  $i$ . The reverse would be true if the wage in country  $A$  was less than ten times higher than the one in country  $U$ :  $w^A < 10w^U$ . If the wage in country  $A$  is exactly ten times higher than the one in country  $U$  ( $w^A = 10w^U$ ), then neither country will have an absolute advantage in the production of commodity  $i$ . This last case is what we saw working in Pasinetti's model.

Notice, by assumption, that technology in country  $U$  is uniformly inferior, meaning that all goods use ten times more labour than in country  $A$ . So, whenever the wages in both countries are not in a ratio of one to ten, one of the countries will be able to supply all commodities at a cheaper price. This means that if country  $U$  has an absolute advantage in the production of one good it will also have an absolute advantage in the production of all goods.

Therefore, whenever country  $A$ 's wage is more than ten times larger than country  $U$ 's, country  $U$  will have an absolute advantage in the production of every commodity. Country  $A$  will be unable to compete in the production of any good. The tendency will be for country  $U$  to produce all goods and for country  $A$  to import everything. The recent literature on trade has explored similar outcomes where one country completely outcompetes the other; this has been referred to as 'an empty economy' (Parrinello, 2010), 'exclusion from trade' (Crespo et al., 2020), and 'desertification' (Bellino and Fratini, 2021).<sup>47</sup> The common feature is that one country is rendered unable to compete. This is an extreme example that emerges from the simplifying assumptions regarding technology. Later, it will be shown that these technological assumptions can be relaxed, generating similar results under a more realistic framework.

Since there are absolute differences in costs, there is an incentive for countries to trade with each other. Say that country  $U$  has an absolute advantage in producing commodity  $i$  because it can supply it cheaper than the other country. Anyone demanding commodity  $i$  in country  $A$  will see an advantage in importing it from country  $U$ . Producers in country  $A$  will be unable to compete with country's  $U$  low production costs and will tend to terminate its production. Countries will thus tend to produce commodities at a cheaper cost than their competitors.

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<sup>47</sup> As mentioned previously, these works achieve such results by abandoning the assumption of international immobility of money capital.

Price competition implies, under the law of one price, that consumers from either country would rather buy from the country that offers the cheapest price. Hence, the international price of any commodity will simply be the price that covers the cost in the country with the lowest production cost. In the case of country  $U$  having an absolute advantage in the production of all goods, the international prices of commodities will be equal to the cost of producing those commodities in country  $U$ . In general, when  $w^A > 10w^U$  the international price of any commodity  $i$  will be:

$$p_i = c_i^U = w^U l_i^U \quad (3.14)$$

At this level of the international prices, producers from country  $A$  are unable to cover its production costs ( $c_i^A > p_i$ ).

This analysis shows that for Pasinetti's two-country model wage disparities are key to establishing conditions under which absolute cost advantages can exist. The role of absolute advantage is shown to be more fundamental than has been established by Baldone et al. (2007). By showing that absolute advantage is important even in the simple pure labour model with a uniform technological disparity, we preclude the need for introducing complications caused by trade in intermediate goods (as in the approach of Baldone et al. (2007)). Pasinetti's abstract foundations bring into clear focus the fundamental importance of wages. Following the logic of Pasinetti's step-by-step approach, the next section will consider the more realistic conditions required for comparative advantage – still within the confines of Pasinetti's pure labour system.

*Illustration.* Modifying our earlier example, an illustration can be provided of how absolute cost differences can emerge, maintaining the same ten-fold difference in technology as in Table 3.1. We now assume that country  $A$ 's wage is thirty times larger than in country  $U$ .

For example, let the hourly wage in country  $A$  be  $w^A = 3$  while the hourly wage in country  $U$  is  $w^U = 0.1$ .

From these technical coefficients and wage rates, it is possible to examine the costs of producing the two commodities, corn and gold, in each country. By construction, using (3.1) and (3.2), the cost of producing a commodity is just its wage bill (combining the wage rate and labour coefficient):

$$c_c^A = 3 \times 0.5 = 1.5$$

$$c_g^A = 3 \times 1 = 3$$

$$c_c^U = 0.1 \times 5 = 0.5$$

$$c_g^U = 0.1 \times 10 = 1$$

**Table 3.3**      **Costs under absolute advantage**

	Country $A$	Country $U$
Corn	$c_c^A = 1.5$	$c_c^U = 0.5$
Gold	$c_g^A = 3$	$c_g^U = 1$

These costs are displayed in Table 3.3, which is equivalent to Table 3.2 from the previous section. From this simple comparison it is easy to see that it is absolutely cheaper to produce both corn and gold in country  $U$  ( $c_c^U < c_c^A$  and  $c_g^U < c_g^A$ ). Due to the thirty-fold disparity in wage rates, country  $A$  cannot compete in the production of either goods. If this situation were to persist, then the tendency would be for country  $U$  to produce and export both goods and for country  $A$  to import them.

As argued previously, if international trade is allowed price competition will ensure that international prices are set by the country with the lowest production cost. In this case, international prices will be equivalent to the costs of production in country  $U$ :  $p_c = 0.5$  and

$p_g = 1$ . At those international prices, country  $A$  cannot cover its cost of production, while country  $U$  can do so.

### 3.4 Comparative advantage

In the analysis thus far, I have assumed that technology is uniformly inferior in one country relative to the other country. Country  $U$  had to employ ten times more workers per unit of output in every industry. The consequence of this assumption is that relative costs, and hence relative prices, are the same in both countries, as shown in expression (3.9). In this section, we follow Pasinetti (1993, p. 178) by relaxing this assumption, still under the rubric of the pure labour model. This will allow us to analyse Pasinetti's classical approach to comparative advantage and to make some connections with the original formulation in Ricardo's writings.

Assume that the technology for each sector in country  $U$  diverges from the equivalent sector in country  $A$ , but in different degrees, depending on the sector. Some sectors might use ten times more workers, some only five times more, some might be on par, and some might even use fewer workers. Technology is assumed as given, meaning that for every sector this disparity in labour inputs will not change in the analysis that follows. This new scenario may be formalized by introducing a variable  $\delta_i$  measuring how much the technology of country  $U$  differs from that of country  $A$  in the production of commodity  $i$ :

$$l_i^U = \delta_i l_i^A \quad (3.15)$$

If  $\delta_i > 1$ , then country  $U$  uses more labour to produce commodity  $i$  than country  $A$ . If  $\delta_i = 1$ , then country  $U$  uses the same quantity of labour to produce commodity  $i$  as country  $A$ . If

$\delta_i < 1$ , then country  $U$  uses less labour to produce commodity  $i$  than country  $A$ . Every commodity has a  $\delta$ -modifier that can vary between commodities.<sup>48</sup>

Inside each country, the labour theory of value still regulates relative costs, because this only depends on the intra-country uniformity of wages (see equation (3.10)). However, relative costs may now differ between countries, in contrast to the analysis in sections 3.2 and 3.3 in this chapter. The relative cost of producing commodity  $i$  with respect to commodity  $j$  might be lower, higher, or the same in country  $A$  as compared to country  $U$ , depending on whether  $\delta_i$  is less than, greater than, or equal to  $\delta_j$ . For example, if  $\delta_i > \delta_j$  then the relative cost of producing  $i$  with respect to  $j$  is lower in country  $A$  than in country  $U$ :

$$\frac{c_i^A}{c_j^A} = \frac{l_i^A}{l_j^A} < \frac{l_i^U}{l_j^U} = \frac{c_i^U}{c_j^U} \quad (3.16)$$

Under a uniform wage rate within each country relative costs are represented by relative labour coefficients. The left-hand equality in expression (3.16) states that relative costs in country  $A$  are equal to its ratio of labour coefficients; the right-hand equality states that relative costs in country  $U$  are equal to its ratio of labour coefficients. The inequality arises since  $l_i^U = \delta_i l_i^A$ ,  $l_j^U = \delta_j l_j^A$ , and  $\delta_i > \delta_j$ .

It is standard procedure in the literature to assert that when expression (3.16) holds then country  $A$  will be compelled to specialise in the production of commodity  $i$  and country  $U$  to specialise in the production of commodity  $j$ . In Pasinetti's words: "this is a case in which, if international trade were allowed, goods would be induced to move across borders. People in  $A$  would buy goods of the first type in  $U$ , where they are cheaper; and similarly, people in  $U$  would buy goods of the second type in  $A$ " (Pasinetti, 1993, p. 159).

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<sup>48</sup> In sections 3.2 and 3.3 the  $\delta$  coefficients are equal to 10 for every commodity.

Under this two-country model, comparative advantage is thus defined when for a particular country the relative cost of producing a commodity is lower than the relative cost of its production of another commodity (see, for example, Steedman and Metcalfe, 1979; Brewer, 1985; Ruffin, 2002). In (3.16), for example, country *A* has a comparative advantage in its production of commodity *i* and country *U* for commodity *j*.

It is possible to use this definition of comparative advantage to interpret the classic cloth and wine example given by Ricardo (see section 2.2.1 in Chapter 2):<sup>49</sup>

England may be so circumstanced, that to produce the cloth may require the labour of 100 men for one year; and if she attempted to make the wine, it might require the labour of 120 men for the same time. (...) To produce the wine in Portugal, might require only the labour of 80 men for one year, and to produce the cloth in the same country, might require the labour of 90 men for the same time. (Ricardo, Works, vol. 1, chap. 7, p. 113-4)

Following Gehrke (2017) and Bhering and Serrano (2019), the numbers in Ricardo's example can be read as the quantities of labour to produce given quantities of cloth and wine: "the four numbers refer to the labour contents of given (unspecified) amounts of the two goods traded" (Gehrke, 2017). In order to translate these quantities into labour coefficients, it is necessary to divide each one by the respective given quantity. In his example, the cost ratio between wine and cloth is lower in Portugal ( $= 80/90$ ) than in England ( $= 120/100$ ).<sup>50</sup> From our definition, this would imply that Portugal has a comparative advantage in the production of wine and England in the production of cloth.

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<sup>49</sup> The interpretation of Ricardo here is strongly influenced by the so-called Sraffa-Ruffin interpretation. Since the time of John Stuart Mill, Ricardo's exposition of comparative advantage has been regarded as incomplete by not determining the international prices. This new strand of literature has roots in Sraffa's short note (Sraffa, 1930) that defends Ricardo from some claims of being wrong. It is argued that Ricardo's exposition is not incomplete, and international prices are determined by a condition of balanced trade and given quantities traded (see Ruffin, 2002; Senga et al. (2017); and Bhering and Serrano (2019)). There is no consensus in the literature regarding the determination of the quantities traded in Ricardo's analysis. For Gehrke (2017) these are unspecified amounts; while Bhering and Serrano (2019) argue that these given quantities are not arbitrary, but actually determined by known levels of effectual demands. This debate is outside the scope of this chapter, it being sufficient for our purposes to assume that the quantities traded are given.

<sup>50</sup> Ricardo specifies the labour costs for levels of production given by quantities actually traded. For example, the 100 men needed to produce cloth in England can be taken to be the amount of labour necessary to produce a given quantity of cloth. From the point of view of the pure labour model adopted in this chapter, these 100 units of labour would equal the unit labour coefficient multiplied by the quantity of cloth produced:  $100 =$

If relative international prices lie in between the interval set by (3.16), then it could be advantageous for country  $A$  to specialize in commodity  $i$  and country  $U$  in commodity  $j$ :

$$\frac{l_i^A}{l_j^A} \leq \frac{p_i}{p_j} \leq \frac{l_i^U}{l_j^U} \quad (3.17)$$

The intuition is quite simple: suppose that the international relative price lies strictly in between the cost ratios (expression (3.17)) and someone from country  $A$  possesses some quantity of commodity  $i$  and wants to exchange it for commodity  $j$ ; then she would find it beneficial to export commodity  $i$  and import commodity  $j$  from country  $U$ , obtaining a higher quantity of  $j$ . The general tendency would then be for country  $A$  to specialize in the production of commodity  $i$  and country  $U$  in the production of commodity  $j$ . If the four coefficients  $(l_i^A, l_j^A, l_i^U, l_j^U)$  are aligned such that (3.17) is satisfied, then there is an incentive for trade to take place. These are what Samuelson (1969, p. 4) refers to as Ricardo's 'four magic numbers'.

Less well known is an additional proviso that must be placed on the theory of comparative advantage: that the four magic numbers only open up the *possibility* of specialisation and trade. It is also necessary, for trade to actually take place, that the costs incurred by production – and hence prices – are competitive. Some justification for this argument can be found in Ricardo's writings.

Consider again Ricardo's example of Portugal and England trading wine and cloth. Ricardo examines what would happen if there was an improvement in wine production in

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$l_c^E Q_c$ . The unit labour coefficient is achieved by dividing the total labour by the given quantity traded:  $l_c^E = 100/Q_c$  (see Gehrke, 2017, pp. 141-2). Since the given quantities traded are the same for Portugal and England, we may compare the unit labour coefficients without knowing their values; Portugal has a comparative advantage in wine production if and only if:

$$\frac{l_w^P}{l_c^P} < \frac{l_w^E}{l_c^E} \Leftrightarrow \frac{\left(\frac{80}{Q_w}\right)}{\left(\frac{90}{Q_c}\right)} < \frac{\left(\frac{120}{Q_w}\right)}{\left(\frac{100}{Q_c}\right)} \Leftrightarrow \frac{80}{90} < \frac{120}{100}$$

The last inequality is given by the numbers in Ricardo's example. Hence, with given quantities traded, comparative advantage can be directly defined by the unit labour coefficients (see also Bhering and Serrano, 2019).



England. Before the introduction of the improvement, the situation is described by Portugal having lower monetary costs for producing wine and England for cloth:

[S]uppose before the improvement in making wine in England, the price of wine here were 50*l.* per pipe, and the price of a certain quantity of cloth were 45*l.*, whilst in Portugal the price of the same quantity of wine was 45*l.*, and that of the same quantity of cloth 50*l.* (Ricardo, Works, vol. 1, chap. 7, p. 115)

The cost of producing wine in Portugal (£45) is lower than in England (£50); also, the cost of producing cloth in England (£45) is lower than in Portugal (£50).<sup>51</sup> It is thus advantageous for Portugal to produce and export wine, while England produces and exports cloth. For any two goods  $i$  and  $j$ , the additional proviso for trade to take place is that costs in each sector are competitive:

$$c_i^A < c_i^U \quad (3.18)$$

$$c_j^U < c_j^A \quad (3.19)$$

Inequality (3.18) establishes that it is absolutely cheaper to produce commodity  $i$  in country A, while (3.19) establishes that it is absolutely cheaper to produce commodity  $j$  in country U. Thus, comparative advantage as a theory of specialization must explain how absolute money costs adjust so the specializing country has the lowest cost of production.

Introducing the law of one price to this analysis, price competition will imply that there is a single international price for each commodity. The international price for each good must then be able to cover the costs incurred in the country with the lowest costs of production. In other words, it is the country with the lowest absolute money cost that determines the international price. This is also present, it might be argued, when Ricardo discusses the impact of England prohibiting the importation of corn from France:

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<sup>51</sup> As argued in section 3.2, Ricardo and the classics were interested in the study of ‘natural prices’, as opposed to ‘market prices’. Natural prices are equivalent to what we have been calling costs of production.

Corn, like every other commodity, has in every country its natural price, viz. that price which is necessary to its production, and without which it could not be cultivated: it is this price which governs its market price, and which determines the expediency of exporting it to foreign countries. If the importation of corn were prohibited in England, its natural price might rise to 6*l.* per quarter in England, whilst it was only at half that price in France. If at this time, the prohibition of importation were removed, corn would fall in the English market, not to a price between 6*l.* and 3*l.*, but ultimately and permanently to the natural price of France, the price at which it could be furnished to the English market (Ricardo, Works, vol. 1, chap. 28, p. 237-238)

The cost of producing corn in England is £6 for a quarter, while in France it is the equivalent of £3. If there is free trade the international price of corn in England will be £3 by importing it from France. At this price English farmers are unable to compete in the production of corn since the international price is insufficient to cover their costs of production.<sup>52</sup>

This interpretation has some resemblance to that of Ruffin (2002, p. 730)<sup>53</sup> who, in a reconstruction of Ricardo, postulates that “the Ricardian pattern of specialization requires that the international prices be”:

$$p_i = w^A l_i^A \quad (3.20)$$

$$p_j = w^U l_j^U \quad (3.21)$$

Equations (3.20) and (3.21) indicate that international prices are determined by the costs of production in the country enjoying comparative advantage; the price of *i* is equivalent to the cost of production of country *A* and the price of *j* to the cost of production of country *U*. The implicit assumption here is that the country with comparative advantage has the lowest absolute cost. Based on the above interpretation of Ricardo, the actual realisation of a

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<sup>52</sup> It is still possible for England to produce some corn if it has lands of better quality that can produce it at a lower cost than France. Thus, the farmers that cannot compete are those working with marginal land. If constant returns to scale are not assumed, more information is required to make assertions regarding farmers in other lands (see Gehrke, 2015).

<sup>53</sup> Gehrke (2015) provides a critical evaluation of Ruffin’s (2002) reconstruction of Ricardo.

position of comparative advantage is also characterized by the establishment of absolute advantage.

In a criticism of comparative advantage, Schumacher (2013) also emphasizes that comparative advantage must be accompanied by absolute advantage. The author calls it a “transformation of comparative production cost advantages into absolute price advantages” (Schumacher, 2013, p. 90). The idea is also based on price competitiveness: “This transformation is vital, because consumers buy goods from whoever offers them at the lowest money price. Consumers are neither aware of nor interested in comparative production costs” (ibid.).

Substituting (3.20) and (3.21) into (3.17) yields

$$\frac{l_j^U}{l_j^A} \leq \frac{w^A}{w^U} \leq \frac{l_i^U}{l_i^A} \quad (3.22)$$

which is the same formalisation provided by Ruffin (2002, p. 730). Expression (3.22) has the following interpretation: if the wage ratio is within these limits, then the two countries will tend to specialize according to their comparative advantages. This is easy to see if we rearrange the first inequality to:

$$w^U l_j^U \leq w^A l_j^A \quad (3.23)$$

This means that country  $U$  has indeed a lower money cost for producing commodity  $j$ , for which it has a comparative advantage. In addition, country  $A$  has a lower money cost for producing commodity  $i$ , for which it has a comparative advantage.

However, we want to emphasize that expression (3.22) is not a simple rewriting of the definition of comparative advantage (expression (3.17) above). To demonstrate this point, it is possible to violate condition (3.22) without breaking with the definition of comparative advantage. This has important implications for specialization and the

determination of international prices. Suppose that, instead of (3.22), the wage ratio is such that

$$\frac{l_j^U}{l_j^A} < \frac{l_i^U}{l_i^A} < \frac{w^A}{w^U} \quad (3.24)$$

From a comparison of the wage ratio with each labour ratio in (3.24) it may be concluded that country  $U$  has lower money costs in the production of both commodities:  $w^U l_i^U < w^A l_i^A$  and  $w^U l_j^U < w^A l_j^A$ .

Price competition would ensure that country  $U$  would tend to produce and export both goods, and country  $A$  imports both. The international prices would be determined by the costs of production in country  $U$ :  $p_i = w^U l_i^U$  and  $p_j = w^U l_j^U$ . And the international relative prices will simply be the ratio of labour coefficients from country  $U$ :  $p_i/p_j = l_i^U/l_j^U$ . Hence, international relative prices are at the right extreme of the interval set by (3.17), but still inside it:

$$\frac{l_i^A}{l_j^A} < \frac{p_i}{p_j} = \frac{l_i^U}{l_j^U} \quad (3.25)$$

Despite international relative prices being compatible with the definition of comparative advantage, it is absolute advantage that would determine trade patterns so long as the ratio of wages remains stable. It would also be erroneous to conclude that country  $A$  is able to compete in the production of commodity  $i$  (due to its comparative advantage) the reason being that country  $U$  can offer it at a cheaper money price (due to its absolute advantage).

Expression (3.17) thus only sets the *potential* for comparative advantage, while expression (3.22) would be required in order for comparative advantage to *actually* determine trade patterns.

Two key results have been provided. First, for comparative advantage to be established the outcome must also be characterized by countries having the lowest cost of production in the commodity in which they enjoy a comparative advantage. From our definition of absolute advantage (see section 3.3 in this chapter), this means that countries must also have an absolute advantage in the production of such a commodity. Second, it is also analytically possible for one of the countries to persistently have the lowest cost of production in goods for which it does not have a comparative advantage. This framework brings absolute advantage to the fore at a fundamental level of abstraction, without requiring either trade in intermediate inputs or the international mobility of capital, as considered in the recent trade literature.

*Illustration.* We can further modify our previous example to illustrate the case of comparative advantage. Let the hourly wage rates have the same values from the previous example:  $w^A = 3$  and  $w^U = 0.1$ . However, suppose that the labour coefficients are now as shown in Table 3.4. There is no longer a uniform ten-fold difference for both sets of labour coefficients; comparing 0.5 with 8, the labour coefficient for corn in country  $U$  is now 16 times larger than that for country  $A$ .

**Table 3.4      Labour coefficients with non-uniform differences**

	Country $A$	Country $U$
Corn	$l_c^A = 0.5$	$l_c^U = 8$
Gold	$l_g^A = 1$	$l_g^U = 10$

From the definition of comparative advantage in (3.16), these labour coefficients mean that country  $A$  has a potential comparative advantage in the production of corn and country  $U$  in gold:  $l_c^A/l_g^A = 0.5 < 0.8 = l_c^U/l_g^U$ .

Since costs are made up of the wage bill, these wage rates and labour coefficients allow us to calculate the costs in each country:

$$c_c^A = 3 \times 0.5 = 1.5$$

$$c_g^A = 3 \times 1 = 3$$

$$c_c^U = 0.1 \times 8 = 0.8$$

$$c_g^U = 0.1 \times 10 = 1$$

These costs are reported in Table 3.5.

**Table 3.5**      **Costs under comparative advantage**

	Country <i>A</i>	Country <i>U</i>
Corn	$c_c^A = 1.5$	$c_c^U = 0.8$
Gold	$c_g^A = 3$	$c_g^U = 1$

It is clear that despite country *A* enjoying a potential comparative advantage in the production of corn, and country *U* in the production of gold, country *U* can produce both corn and gold at a cheaper money cost ( $0.8 < 1.5$  and  $1 < 3$ ). This happens because the difference in wages is more than enough to compensate for the relative technical ‘backwardness’ in country *U*’s production of both commodities. Country *A* will then be unable to compete in the production of either commodity. The tendency will be for production to be concentrated in country *U*, while country *A* imports both commodities for consumption purposes.

Price competition will lead international prices to be set at a level sufficient to cover the costs in country *U*:  $p_c = 0.8$  and  $p_g = 1$ . At those international prices, country *A* cannot cover its cost of production, while country *U* is able to cover its costs.

### 3.5 Conclusion

Pasinetti's writings on international trade have not hitherto been formalised as a mathematical system. Filling this gap in the literature, this paper explores in equation form the structure of the two-country model of international trade developed in Chapter 9 of Pasinetti (1993). This is a pure labour model, in which labour is the sole input of production to be considered under international trade.

The first contribution is to formalise Pasinetti's analytical starting point in which costs of production are the same in each country. This model is based on a uniform ten-fold disparity in technology and wages between two countries, one advanced the other underdeveloped. There are no incentives for countries to trade with each other.

Second, under the same technology as in the first model, absolute cost differences are introduced to the Pasinetti model by allowing wage rates to differ from the ten-fold disparity. Whenever the wage rates between countries are not in the ratio of one to ten, the opportunity arises for one of the countries to produce all commodities at a cheaper cost. The possibility emerges of one country enjoying absolute cost advantage across all commodities. Absolute advantage can therefore be established in this abstract Pasinetti framework without assuming money capital mobility (as, for example, posited by Shaikh, 2016), and without consideration of intermediate capital inputs (as, for example, posited by Baldone et al., 2007) – since this is a pure labour system in which labour is the only input to production. This novel closure shows that wage disparities are key to establishing the conditions required for absolute advantage in this Pasinetti framework.

A final modification relaxes the ten-fold difference in technology between the two countries. Differences in relative costs between the two countries emerge, giving each country the opportunity to specialise in the production of specific commodities that they can produce at (relatively) high levels of productivity. If trade is allowed, each country may export these specific commodities to the other country. Based on a reading of Chapter 7 in Ricardo's *Principles* we show, however, that relative cost differences only afford the

possibility of export-based specialisation. A second condition is required for specialisation to take place: that the absolute cost of producing the commodity is lower than that of the country's competitor. Otherwise, unless the absolute cost (and hence the price) is competitive (lower than can be delivered in the importing country), there will be no incentive for the importing country to purchase the commodity from the other country. Therefore, for a country to capitalise on its opportunity to specialise, as afforded by comparative advantage, it must also ensure that a commodity will display absolute cost advantage to be fit for purpose as export material.

Absolute cost advantage takes centre stage in the determination of international prices and specialization. Even if comparative advantage can be defined, it is absolute cost advantage that dominates international trade. This role for absolute advantage is thus argued to be more fundamental to international trade than has been suggested by writers such as Shaikh and Baldone, who, as indicated above, have focused more on either international mobility of money capital or trade in intermediate goods. As an abstract starting point, Pasinetti's pure labour approach enables the core role played by absolute advantage to be identified with more clarity than is revealed in more complex modelling. The advantage of Pasinetti's systematic approach is that as a next step capital inputs, and the role of profits, can be easily introduced to this rudimentary input-output system.

The next chapter expands the framework by introducing trade in intermediate goods. This introduces an additional degree of complexity because commodities require labour and other commodities to be produced.



### Appendix 3.1 A multi-commodity extension

This appendix extends our approach to a model with two countries and  $n$  commodities, where  $n$  is greater than 2. We show that the key role for money wages and absolute advantage can be established in this more general framework.

Let our two countries compete in the production of  $n$  commodities. Each commodity is produced by unassisted labour. As in section 3.4, we relax the previous assumption of uniform technology across sectors. The cost equations for country  $A$  are:

$$\begin{aligned} c_1^A &= w^A l_1^A \\ &\vdots \\ c_n^A &= w^A l_n^A \end{aligned} \tag{3.26}$$

while for country  $U$ :

$$\begin{aligned} c_1^U &= w^U l_1^U \\ &\vdots \\ c_n^U &= w^U l_n^U \end{aligned} \tag{3.27}$$

As we have seen, the criteria for a country to produce a good is that such a country has the lowest cost of production; this is the definition of absolute cost advantage (see section 3.3 in this chapter). Country  $A$  will produce good  $i$  if its cost of production is lower than in country  $U$ :

$$c_i^A < c_i^U \Leftrightarrow w^A l_i^A < w^U l_i^U \Leftrightarrow \frac{w^A}{w^U} < \frac{l_i^U}{l_i^A} \tag{3.28}$$

Equation (3.28) establishes a boundary condition for where commodity  $i$  will be produced: if  $w^A/w^U < l_i^U/l_i^A$  then country  $A$  has the lowest cost of production and it will produce commodity  $i$ ; if  $w^A/w^U = l_i^U/l_i^A$  then both countries have the same cost and can both produce commodity  $i$  competitively; if  $w^A/w^U > l_i^U/l_i^A$  then country  $U$  will produce this commodity.

A comparison between the absolute costs of all commodities gives us  $n$  boundary conditions. Following the indexing of commodities provided by Dornbusch et al. (1977, p. 823), we may put these boundary conditions in order such that:

$$0 < \frac{l_1^U}{l_1^A} < \frac{l_2^U}{l_2^A} < \dots < \frac{l_n^U}{l_n^A} \quad (3.29)$$

This is very close to what has been referred to as a ‘chain of comparative advantage’ (Deardorff, 2005, p. 1008; see also Metcalfe, 1998, p. 172).<sup>54</sup> Wherever the wage ratio sits with respect to the boundary conditions will determine which country has the lowest cost of production for each good. For example, if  $w^A/w^U < l_1^U/l_1^A$  then country  $A$  produces all goods at a lower absolute cost than country  $U$ . If  $l_i^U/l_i^A < w^A/w^U < l_{i+1}^U/l_{i+1}^A$  then it is absolutely cheaper to produce goods 1 through to  $i$  in country  $U$  and goods  $i + 1$  through to  $n$  in country  $A$ . Finally, if  $l_n^U/l_n^A < w^A/w^U$  then it is absolutely cheaper to produce every good in country  $U$ .

This analysis follows up on the insight provided by Baldone et al. (2007, p. 1735) into the key role of relative wages and absolute advantage in the chain of comparative advantages: without, of course, involving a role for intermediate inputs in this multi-commodity pure labour framework. This Pasinetti-based interpretation brings the analysis much closer to that of classical political economy (Garegnani, 1983a); it provides a possible alternative to marginalist trade theory with its emphasis on perfect competition and market clearing (as summarised by Dornbusch et al., 1977 and Deardorff, 2005).

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<sup>54</sup> I would like to thank an anonymous referee for suggesting the resemblance between my approach and the chain of comparative advantages.

## **Chapter 4: International trade with trade in intermediate goods**

### **4.1 Introduction**

The previous chapter provided an analysis of international trade based on an abstract pure labour starting point in which commodities are produced by labour alone and there are no profits. These assumptions were necessary to formalize some insights by Pasinetti. In order to take the analysis to higher degrees of complexity, this chapter introduces the notion that commodities are produced by means of commodities. As discussed in Chapter 1, section 1.1, this is the main feature of Global Value Chains (GVCs): international trade includes trade in intermediate goods. With this, production can be vertically dispersed between countries.

With intermediate goods, workers have to use instruments of production (tools, machines, raw materials, etc.) to produce commodities. The production of those instruments also requires workers and means of production. Hence, production is circular; it has no beginning or a definite end. The assumption of zero profits will be maintained for now (to be relaxed in Chapter 5).

This setting is very similar to the investigation by Baldone et al. (2007) into the patterns of specialization when trade in intermediates is possible. These authors are especially interested in cases where one country breaks its internal production processes into smaller parts and moves some of those processes into other countries. This is what they refer to as ‘international fragmentation of production’: “With international fragmentation of production, a production process previously undertaken in a single location is split in two or more stages that take place in production sites located in different countries” (Baldone et al., 2007, p. 1728).

The model proposed in this paper is tailored to deal with scenarios in which there is an international fragmentation of production. The existence of produced means of production (intermediate goods) implies that it is possible to analytically break a productive

activity into smaller components. If these intermediate goods are tradable, different countries can produce them at different steps of the process. Then, in order to reproduce itself, each country's production process needs to use imported means of production. This kind of analysis is required to address the analytical difficulties associated with increased globalization of production and the dominance of global value chains.

The present chapter proposes a solution for the determination of international prices in a setting where international fragmentation of production exists. We achieve this by extending the classical theory of value to a situation with circular production involving more than one country. We also show that trade patterns and specialization can emerge as a consequence of the determination of international prices. Evidently, the international price must be enough to cover the costs in the country that produces that commodity but also the country with the lowest costs can only be identified after determining prices.

In search of the fundamentals of international trade, this chapter builds a model similar to the one in Baldone et al. (2007) but in a simpler configuration. Instead of four commodities, the model developed here consists of only two commodities. This simpler model generates the same results in a way easier to grasp. This is just enough to show how a previously integrated activity can be fragmented into 'smaller' activities that are spread between different countries. It investigates the fundamentals of trade in intermediate goods, without unnecessary complications. An added benefit of our simplification is to ensure Sraffa's assumption that at least one basic commodity exists (Sraffa, 1960, p. 8), in contrast to the pure labour model in Chapter 3 and to the formulation in Baldone et al. (2007).

The main contribution of the chapter is to bring to the fore the role played by the assumption of given nominal wages in each country (Baldone et al., 2007, p. 1755). This is part of the novel closure proposed in this thesis (see section 1.3 in Chapter 1). Building on the previous chapter, we show that also when there is trade in intermediates, given wage disparities is needed to establish which country has an absolute advantage in the production

of a particular commodity. Specialization according to absolute advantage does not necessarily coincide with comparative advantages.

## 4.2 Introducing intermediate commodities

In this chapter, I develop a model that builds on the pure labour system developed in Chapter 3, section 3.2. There are two countries,  $A$  and  $U$ , and two commodities, 1 and 2, that can be traded between the countries. To introduce intermediate commodities, we assume in the first instance that commodity 1 is purely used as an instrument of production in the production of both commodities (a capital good). So, commodity 1 is produced by means of itself and labour, while commodity 2 is produced by means of commodity 1 and labour. In Sraffa's (1960) terminology, commodity 1 is a basic commodity. Commodity 2 is a pure consumption commodity; it is not used as input in any process of production. The quantities of the intermediate good together with labour-hours needed to produce one unit of each good defines the methods of production. Each country has a single method of production to produce each commodity. Due to technological disparities, the methods of production can be different between countries. For simplification, technology is given, all capital is circulating capital and there is no joint production.

Collating the technical coefficients into a compact form, it is possible to describe country  $A$ 's methods of production by a matrix of physical inputs and a vector of labour-hours:

$$\mathbf{A}^A = \begin{bmatrix} a_{11}^A & a_{12}^A \\ 0 & 0 \end{bmatrix} \quad (4.1)$$

$$\mathbf{l}^A = (l_1^A \quad l_2^A) \quad (4.2)$$

where  $a_{1j}$  is the input coefficient (a physical amount of commodity 1) that is used to produce one unit of commodity  $j$ ;  $l_j$  is the labour-hour necessary to produce one unit of commodity  $j$ ; and the superscript  $A$  indicates it refers to country  $A$ .

Similarly, a technological matrix and a vector of labour coefficients are defined for country  $U$  as:

$$A^U = \begin{bmatrix} a_{11}^U & a_{12}^U \\ 0 & 0 \end{bmatrix} \quad (4.3)$$

$$l^U = (l_1^U \quad l_2^U) \quad (4.4)$$

According to these given technologies, international fragmentation of production will happen anytime country  $A$  has to import the capital good (to assist in its own production) from country  $U$ , or vice-versa. On this basis, I will now consider how a production-based approach to trade can be developed.

### 4.3 Costs of production

Similar to what was done in the previous chapter (equations (3.1) and (3.2) in Chapter 3), one may define the costs of production for this model.<sup>55</sup> Unlike the previous chapter, the costs of production are not simply the labour costs but also include the costs of intermediate inputs. While the labour costs consist of the labour coefficients times the wage rate, the input costs are represented by the input coefficients multiplied by their respective prices.

Formally, the costs of production to produce commodities 1 and 2 in country  $A$  are best described as:

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<sup>55</sup> Sraffa argues against the use of the term ‘cost of production’ as it was used to mean a one-sided measure (Sraffa, 1960, p. 9). We understand this as a cautionary remark to avoid falling into the pitfalls of previous literature: “This is because these terms [cost of production and capital] have come to be inseparably linked with the supposition that they stand for quantities that can be measured independently of, and prior to, the determination of the prices of the products” (Sraffa, 1960, p. 9). Sraffa uses Marshall’s ‘real costs’ (ibid.) as an example of what he wants to avoid. However, our construction avoids this problem by clearly stating that the costs of production depend on the prices of the products and on distribution. As should become clear, it is expedient for us to make the distinction between cost and prices.

$$c_1^A = p_1 a_{11}^A + w^A l_1^A \quad (4.5)$$

$$c_2^A = p_1 a_{12}^A + w^A l_2^A \quad (4.6)$$

where  $c_j^A$  is the cost of producing commodity  $j$  in country  $A$ ;  $w^A$  is the nominal wage in country  $A$ ; and  $p_1$  is the international price for commodity 1.

If trade happens freely, then the price of commodity 1 in country  $A$  is equal to the international price for this commodity. This is the law of one price as an arbitrage condition. Costs must then be measured at the international price for tradable inputs. Here, the international price ( $p_1$ ) appears as an undefined exogenous variable; the determination of prices will be developed in section 4.5 of this chapter. Equations (4.5) and (4.6) show that the costs of production are composed of input costs ( $p_1 a_{1j}^A$ ) and by the labour costs ( $w^A l_j^A$ ). These equations are the equivalent of equation (3.1) in Chapter 3.

It follows that the costs of production to produce commodities 1 and 2 in country  $U$  are:

$$c_1^U = p_1 a_{11}^U + w^U l_1^U \quad (4.7)$$

$$c_2^U = p_1 a_{12}^U + w^U l_2^U \quad (4.8)$$

where the terms are defined with obvious meanings for country  $U$ .

The cost equations (4.5) through to (4.8) are employed throughout the rest of the chapter, as specifications of potential costs. As argued in section 4.5 in this chapter, the activation of a sector, so that potential costs become actual costs of production, will depend on the absolute cheapness to produce goods. The costs of production, now defined here to include intermediate costs, provide the basis for considering the structure of trade.

#### 4.4 Patterns of trade and specialization

When more than one country is able to produce the same commodities, there is more than one possibility for how they are internationally supplied. For example, commodity 1 might be produced using country *A*'s or country *U*'s methods of production. Each one of these possibilities implies a different geographical distribution of production and a different international division of labour.

Before we move into the determination of the geographical distribution of production, it is helpful to clearly show what the possible cases are. From simple combinatorics, in this model with two countries and two commodities, there are four possible cases. These cases are shown in Table 4.1.

**Table 4.1 Possible geographical distributions of production**

	Cases			
	I	II	III	IV
Commodity 1	Country <i>A</i>	Country <i>U</i>	Country <i>A</i>	Country <i>U</i>
Commodity 2	Country <i>A</i>	Country <i>U</i>	Country <i>U</i>	Country <i>A</i>

Table 4.1 shows which country produces the intermediate good (row 1) and the consumption good (row 2). In case I, for example, all of the production is carried out by country *A* of both commodity 1 (the intermediate good) and commodity 2 (the consumption good); in case II, country *U* is the sole producer of both commodities. For cases I and II, production is concentrated either in country *A* or *U*. These two cases do not include any international fragmentation of production as it is separately concentrated in each country; we shall label them as ‘closed production systems’.<sup>56</sup> The country that does not produce any

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<sup>56</sup> What I refer to as ‘closed production systems’ is very similar to what is usually called ‘autarky’ (for example, Baldone et al., 2007, p. 1763; and Steedman, 1979a, p. 113) or ‘closed economy’ (Mainwaring, 1979). I have chosen to avoid such terminology, as it is often interpreted to mean a country that does not participate in international trade at all. This is not the case for the closed production systems; even the country that is not producing a tradable commodity is still importing them. For example, case I is when country *A* produces both goods and exports the consumption good to country *U*. While country *U* does not produce either good, it still participates in trade by importing from country *A*. The question of whether country *U* can sustain such position for long period of times is a separate issue that can be treated in a second stage of the analysis.



good (country  $U$  in case I and country  $A$  in case II) needs to import the consumption good from the other.

On the other hand, in case III only country  $A$  produces the intermediate good and only country  $U$  produces the consumption good; country  $A$  has to import the consumption good from country  $U$ , and country  $U$  has to import the intermediate good from country  $A$ . Case IV is just the reverse of case III. Since in these last two cases production requires some importation of intermediate commodities, we shall refer to them as ‘integrated production systems’.

Each of these cases has different consequences for the determination of international prices. In the closed production systems, the natural price of both commodities needs to be enough to cover the costs of production in the respective country (country  $A$  in case I and country  $U$  in case II) without interference from the conditions of production in the other country. But in the integrated production systems, the costs of production of the consumption good must take into account the conditions of production of the intermediate good in the other country: international prices must be enough to cover these cross-country costs of production. The next subsections deal with the determination of international prices for these different cases.

#### **4.4.1 Closed production systems**

In this section, I consider the structure of prices for closed production systems, starting with case I, in which country  $A$  produces both commodities: the intermediate commodity to assist in its own production and the consumption good to supply its own and country  $U$ ’s consumption requirements (via exports). Country  $U$  imports the consumption good to supply its demand.

With a cost-based determination of prices, country  $A$  produces the two goods if and only if the prices for both of them are enough to cover their costs of production in country

A. Thus, if case I happens, the international prices will be at the level sufficient to cover the costs in country A. The following relations should hold:

$$p_1^I = c_1^A \quad (4.9)$$

$$p_2^I = c_2^A \quad (4.10)$$

where  $p_1^I$  and  $p_2^I$  are the international prices for commodities 1 and 2 relating to case I (see Table 4.1). Equations (4.9) and (4.10) state that the international prices of both commodities are set at the level of the costs of production in country A.

Substitute conditions (4.9) and (4.10) into the costs of production for country A (equations (4.5) and (4.6)):

$$p_1^I = p_1^I a_{11}^A + w^A l_1^A \quad (4.11)$$

$$p_2^I = p_1^I a_{12}^A + w^A l_2^A \quad (4.12)$$

which is a system with two equations and two unknowns ( $p_1^I$  and  $p_2^I$ ). Solving for  $p_1^I$  and  $p_2^I$  in terms of  $w^A$ :

$$p_1^I = w^A \left( \frac{l_1^A}{1 - a_{11}^A} \right) \quad (4.13)$$

$$p_2^I = w^A \left( l_2^A + \frac{l_1^A a_{12}^A}{1 - a_{11}^A} \right) \quad (4.14)$$

The terms inside the parenthesis are the vertically integrated labour coefficients to produce commodities 1 and 2. As Pasinetti defines it, the vertically integrated labour coefficient “expresses in a consolidated way the quantity of labour directly and indirectly required in the whole economic system to obtain one physical unit of commodity  $i$  as a final good” (Pasinetti, 1973, p. 6). It is convenient to express these vertically integrated labour

coefficients with a new variable; let  $v_1^A = \left( \frac{l_1^A}{1-a_{11}^A} \right)$  and  $v_2^A = \left( l_2^A + \frac{l_1^A a_{12}^A}{1-a_{11}^A} \right)$ . Expressions

(4.13) and (4.14) can be written as:

$$p_1^I = w^A v_1^A \quad (4.15)$$

$$p_2^I = w^A v_2^A \quad (4.16)$$

Since country *A* produces its own intermediate inputs, it is a closed vertically integrated economy, not relying on any imports. Equations (4.15) and (4.16) are equivalents to equation (3.6) in Chapter 3, with vertical instead of direct labour coefficients.

Analogously, the second closed production system happens when country *U* produces both commodities and exports the consumption good to country *A*. In this case, the international prices are set at the level sufficient to cover the costs of production in country *U*:

$$p_1^{II} = c_1^U \quad (4.17)$$

$$p_2^{II} = c_2^U \quad (4.18)$$

where  $p_1^{II}$  and  $p_2^{II}$  are the international prices for commodities 1 and 2 relating to case II (see Table 4.1).

The same procedure, substituting equations (4.17) and (4.18) into the costs of production for country *A* (equations (4.7) and (4.8)), determines the international prices as a function of the nominal wage and the vertically integrated labour coefficients in country *U*:

$$p_1^{II} = w^U v_1^U \quad (4.19)$$

$$p_2^{II} = w^U v_2^U \quad (4.20)$$

The prices that only depend on the conditions of production of a single country (either the set of prices in (4.15) and (4.16) or in (4.19) and (4.20)) are usually called ‘autarky

prices’ (see footnote 56 to this chapter). This term gives the impression of a type of hypothetical country that exists in isolation from others.

However, the respective situations above show that one of the countries imports from the other. Consumption of imports by citizens of a country that is incapable of producing any tradable good may be explained by various factors. For example, these citizens may have money savings or financial bonds that provide them with income to import goods. Alternatively, this country may still sustain a state bureaucracy that provides income to part of its citizens. These factors may be very important in real scenarios, but they would not appear in the modelling of costs of production.

In this regard, Steedman provides a cautionary remark:

It is important that the *comparative* nature of the analysis be fully recognised and that any temptation to interpret it as a covert analysis of the disequilibrium transition from autarky to trade be resisted. (Steedman, 1979a, p. 36)

For this reason, I have decided to not call them ‘autarky prices’ and shall call them ‘closed production prices’. This term emphasizes that in these two cases production happens without imported intermediate goods, but the economies themselves are not closed to trade.

It is important to notice that, for either case, the prices ruling in a single country are not necessarily determined by its own costs of production. There is an asymmetry between the two countries. One of the country’s closed production prices are entirely determined within its own economic system. But the other country’s prices depend entirely on the closed production prices of the other country. For example, in case I the prices are set at country *A*’s cost of production. From the point of view of country *A*, prices conform to its costs of production. The law of one price would ensure that country *U* imports the goods at prices based on country *A*’s costs of production. Hence, from the point of view of country *U*, its own methods of production are not activated, and prices do not conform to its own costs of

production. For this reason, I have chosen to differentiate between prices and costs (see footnote 55 to this chapter).

In the next subsection, we analyse the costs of production and the determination of international prices for the integrated production systems (cases III and IV in Table 4.1).

#### 4.4.2 Integrated production systems

Thus far I have analysed the conditions of production when either country  $A$  or country  $U$  produces everything domestically, the closed production systems. As argued by Baldone et al. (2007), it is possible that the productive process is fragmented between countries. For example, country  $A$  might realize that instead of producing everything it might be advantageous to produce only the intermediate good and send it to be assembled into the consumption commodity in country  $U$ .

Hence, this subsection analyses the international conditions of production when production is fragmented among different countries; this corresponds to cases III and IV in Table 4.1. We shall refer to them as integrated production systems, to emphasize that the productive processes are integrated via trade in intermediate goods.

The first of the integrated production systems is when country  $A$  only produces the intermediate good 1 and exports it to country  $U$  to be transformed into consumption good 2; country  $A$  then imports the consumption good in order to attend its internal demand. In Table 4.1 this corresponds to case III.

With this geographical distribution of production, the international price of the intermediate good needs to be enough to cover its cost in country  $A$  while the international price of the consumption good needs to be enough to cover its cost in country  $U$ . The following equalities should hold:

$$p_1^{\text{III}} = c_1^A \quad (4.21)$$

$$p_2^{\text{III}} = c_2^U \quad (4.22)$$

where  $p_1^{\text{III}}$  and  $p_2^{\text{III}}$  are the international prices for commodities 1 and 2 relating to case III (see Table 4.1).

Substituting conditions (4.21) and (4.22) into the respective costs of production (equations (4.5) and (4.8)) yields, after some algebraic manipulation:

$$p_1^{\text{III}} = w^A v_1^A \quad (4.23)$$

$$p_2^{\text{III}} = w^A v_1^A a_{12}^U + w^U l_2^U \quad (4.24)$$

Since the intermediate commodity is produced only by means of itself, its international price depends only on the conditions of production in country  $A$  (equation (4.23) is the same as equation (4.15)): it depends on the nominal wage rate and the vertically integrated labour coefficient for country  $A$ . However, country  $U$  needs to import the intermediate good in order to produce the consumption good; the cost of production in country  $U$  (equation (4.24)) also depends on the required conditions to produce the intermediate good in country  $A$ .

Unlike the closed production systems, it is not possible to use vertical integration to neatly reduce the price of the consumption good to a quantity of labour units or the wage equivalent from a single country. Vertical integration now occurs between countries. The cost to produce commodity 2 (equation (4.24)) resolves itself into country  $U$ 's direct labour,  $w^U l_2^U$ , plus an indirect use of country  $A$ 's labour,  $w^A v_1^A a_{12}^U$ .

The second integrated production system is when country  $A$  produces only the consumption good 2 by means of imported intermediate goods from country  $U$ ; country  $U$  then imports the consumption good from country  $A$ . In Table 4.1 this corresponds to case IV.

The implications for the determination of international prices is analogous to the previous case. The international price of the consumption good needs to be enough to cover

its cost in country  $A$  while the international price of the intermediate good needs to be enough to cover its cost in country  $U$ . The following relations should hold:

$$p_1^{IV} = c_1^U \quad (4.25)$$

$$p_2^{IV} = c_2^A \quad (4.26)$$

where  $p_1^{IV}$  and  $p_2^{IV}$  are the international prices for commodities 1 and 2 relating to case IV (see Table 4.1).

Substituting equations (4.25) and (4.26) into equations (4.6) and (4.7):

$$p_1^{IV} = w^U v_1^U \quad (4.27)$$

$$p_2^{IV} = w^U v_1^U a_{12}^A + w^A l_2^A \quad (4.28)$$

In this case, the international price of the intermediate good is entirely determined by the conditions of production in country  $U$  (equation (4.27)); while the international price of the consumption good (equation (4.28)) is determined directly by the conditions of production in country  $A$  *and* indirectly by the conditions of production in country  $U$  (through importation of the intermediate good).

The pairs of equations (4.15) and (4.16), (4.19) and (4.20), (4.23) and (4.24), and (4.27) and (4.28) determine the international prices for all the different possible geographical distributions of production.<sup>57</sup> But a criterion is still required in order to choose between the different options. In other words, for example, why and in what circumstances would it be beneficial for country  $A$  to produce everything instead of outsourcing the production of one

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<sup>57</sup> Note that cases where the two countries produce a common commodity at the same time have not been discussed. This would be a semi-specialization case and, while possible, can be subsumed in the cases with no two countries sharing the production of any good. For example, let a variation of case I be where country  $A$  produces both goods but country  $U$  produces at the same time intermediate good 1. That can only persist if the costs of production for commodity 1 are the same in country  $A$  and country  $U$ :  $c_1^A = c_1^U$ . However, if the costs are the same, I may choose one of them to represent the cost of production for commodity 1. Choosing  $c_1^A$  would yield a determination of international prices that is indistinguishable from case I (equations (4.9) and (4.10)).

or both goods to country  $U$ ? Section 4.5 in this chapter will discuss the role played by given nominal wage rates in this determination. This makes it clear that the determination of international prices is intrinsically related to the determination of specialization (i.e., the geographical distribution of production).

In the next section, I offer a closure to the international system based on given nominal wages. This is an alternative to the previous closures available in the literature (see Chapter 2). The emerging pattern of specialization is dictated by absolute cost advantage and not by comparative advantage (to be discussed in section 4.6 to this chapter).

#### **4.5 Wages and absolute advantages**

After specifying the possible geographical distributions of production (Table 4.1), it is important to determine which option prevails. This is a necessary step to define international prices as there is a one-to-one correspondence between these and specialization (see section 4.4 in this chapter). This boils down to a choice of which methods of production to activate; commodity 1 can either be produced with methods from country  $A$  or  $U$ , while it will either be used in country  $A$  or  $U$  to produce commodity 2.

The conventional criterion is the combination of methods that guarantees the highest rate of profit (Pasinetti, 1977, p. 151-2). This cannot be applied to the above model since it is assumed that the rates of profit are zero. However, as Pasinetti shows (ibid.), the highest rate of profit is the same thing as the lowest cost of production. It is possible to apply the notion of cost minimization to our model, this is the classical concept of price competitiveness (see section 3.3 in Chapter 3).

The idea is that the geographical distribution of production chosen will be the one that can offer the commodities at the cheapest price. In our model, the economic sense underlying is that the cheapest way to supply the wage good implies the highest real wages



for workers. Having assumed that commodity 2 is the only consumption good makes it easy to carry out this analysis.

As in the pure labour framework, there is an indeterminacy regarding international prices (see section 2.1.2 and Chapter 3). This is easy to see if we consider one of the systems of international prices for one of the integrated production systems. For example, case III is when country *A* produces commodity 1 and country *U* produces commodity 2. Therefore, the international price for commodity 1 must cover its cost in country *A* and the international price for commodity 2 must cover its cost in country *U* (see equations (4.23) and (4.24) in this chapter). To find international relative prices, just divide these equations to get:

$$\frac{p_1^{\text{III}}}{p_2^{\text{III}}} = \frac{w^A v_1^A}{w^A v_1^A a_{12}^U + w^U l_2^U} \quad (4.29)$$

Which is one equation to solve for three unknowns ( $p_1^{\text{III}}/p_2^{\text{III}}$ ,  $w^A$ , and  $w^U$ ): the system is indeterminate.

To solve these systems of international prices, Baldone et al. (2007) timidly introduce an assumption in one of their examples: “Let unit wages in the two economies be  $W^A = 1$  and  $W^B = 1/5$  when expressed in a common currency.” (Baldone et al., 2007, p. 1733). This means that nominal wages are given from outside the system of production. For the model in this chapter, this means that both  $w^A$  and  $w^U$  are given; this reduces equation (4.29) to only one unknown, making it determinate.

Given nominal wages also fix absolute prices of production for each possible geographical distribution of production. For each of these, the price of the consumption good depends on technology and national wages. These dependencies are shown in equations (4.16), (4.20), (4.24), and (4.28). Therefore, it is possible to compare which combination of methods generates the lowest price for the consumption good.

It might well be the case that the given nominal wages result in a case where:

$$p_2^I < p_2^{II} < p_2^{III} < p_2^{IV} \quad (4.30)$$

In other words, case I generates the lowest price for the consumption good 2, where case I is when country *A* produces both goods.<sup>58</sup> For given nominal wages, the lowest price for the consumption good means the highest real wage for workers in both countries.

If that is the case, then the international prices are determined by the costs of production in country *A*, or by the closed production system I (see equations (4.15) and (4.16)):

$$p_1^I = w^A v_1^A \quad (4.31)$$

$$p_2^I = w^A v_2^A \quad (4.32)$$

For these nominal wages, any other way to distribute production among the countries leads to lower real wages.

However, different nominal wages may give rise to different international prices and patterns of specialization. For example, with different nominal wages, it might be true that:

$$p_2^{III} < p_2^{II} < p_2^I < p_2^{IV} \quad (4.33)$$

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<sup>58</sup> Formally, it is only necessary to take the *ratio* between the nominal wages as given. Divide the numerator and denominator in the right-hand side of equation (4.29) by  $w^U$  to get:

$$\frac{p_1^{III}}{p_2^{III}} = \frac{\frac{w^A}{w^U} v_1^A}{\frac{w^A}{w^U} v_1^A a_{12}^U + l_2^U}$$

which is one equation in two variables ( $p_1^{III}/p_2^{III}$  and  $w^A/w^U$ ); this means that a given  $w^A/w^U$  is sufficient to close the system.

A given wage ratio is also sufficient to compare real wages in the different cases of specialization. For example, case I generates a lower price for the consumption good than case II if and only if:

$$p_2^I < p_2^{II} \Leftrightarrow w^A v_2^A < w^U L_2^U \Leftrightarrow \frac{w^A}{w^U} < \frac{v_2^U}{v_2^A}$$

Therefore, knowing  $w^A/w^U$  is enough to compare the price in both cases. Similar pair-wise comparisons between each possible geographical distribution of production allows to order the cases as in condition (4.30). I have chosen to keep nominal wages as given, instead of their ratio, to stay closer to Baldone et al.'s (2007) formulation. It also makes the role of absolute cost advantage clearer to understand.

The integrated production system III generates the lowest price for the consumption good and the highest real wages.

If that is the case, then the cost of production for commodity 1 in country  $A$  determines its international price; while the cost of production for commodity 2 in country  $U$  determines its international price. In other words, international prices are defined by the integrated production system III (see equations (4.23) and (4.24)):

$$p_1^{\text{III}} = w^A v_1^A \quad (4.34)$$

$$p_2^{\text{III}} = w^A v_1^A a_{12}^U + w^U l_2^U \quad (4.35)$$

Therefore, the choice of a combination of methods to activate depends entirely on nominal wages. This leads to a comparison between *absolute* costs of production (or prices). Specialization patterns are completely determined by absolute cost advantages, with comparative advantage playing no role.<sup>59</sup> For given technologies, different nominal wages imply different geographical distributions of production.

*Illustration.* Here I provide a numerical simulation to show how nominal wages determine the geographical distribution of production based on absolute cost advantages. There are two countries:  $A$  and  $U$ . These countries compete in the production of two commodities: corn (commodity 1) and bread (commodity 2). Corn is produced by means of itself and labour; while the bread is produced by means of corn and labour. The matrices of technical coefficients and the vectors of labour coefficients for countries  $A$  and  $U$  are given by, respectively (see equations (4.1) through to (4.4)):

$$A^A = \begin{bmatrix} 0.5 & 0.2 \\ 0 & 0 \end{bmatrix}; \quad l^A = (1 \quad 2)$$

and

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<sup>59</sup> I come back to the issue of comparative advantage in section 4.6 in this chapter.

$$A^U = \begin{bmatrix} 0.7 & 0.3 \\ 0 & 0 \end{bmatrix}; \quad l^U = (0.7 \quad 1)$$

This means that to produce one unit of corn in country *A* it requires 0.5 units of corn and 1 hour of direct labour; and so on. Then, the cost equations for the method of production in each country are (see equations (4.5) through to (4.8)):

$$c_1^A = 0.5p_1 + 1w^A$$

$$c_2^A = 0.2p_1 + 2w^A$$

and

$$c_1^U = 0.7p_1 + 0.7w^U$$

$$c_2^U = 0.3p_1 + 1w^U$$

where  $p_1$  is the international price of corn, the intermediate good.

From the technical coefficients, it is possible to calculate the vertically integrated labour coefficients if both goods are produced inside either country *A* or country *U* (see equations (4.13) and (4.14) in this chapter). These represent the closed production systems (case I and II in Table 4.1):

$$v_1^A = 2$$

$$v_2^A = 2.4$$

and

$$v_1^U = 2.3$$

$$v_2^U = 1.7$$

The classical process of price competition requires a comparison between prices of production in the different specialization scenarios. Following Baldone et al. (2007, p. 1755),

I introduce an assumption that nominal wages are given in both countries. In particular, nominal wages are:

$$w^A = 2 \text{ and } w^U = 5$$

where both nominal wages are measured in the same unit of account.

With this last piece of information, it is possible to calculate the prices of production for each geographical distribution of production. Therefore, a comparison between the cases becomes possible. These are reported in Table 4.2:

**Table 4.2 Absolute Differences in Costs (for  $w^A = 2$  and  $w^U = 5$ )<sup>60</sup>**

	Cases			
	I	II	III	IV
Price of corn	$p_1^I = 4.0$	$p_1^{II} = 11.7$	$p_1^{III} = 4.0$	$p_1^{IV} = 11.7$
Price of bread	$p_2^I = 4.8$	$p_2^{II} = 8.5$	$p_2^{III} = 6.2$	$p_2^{IV} = 6.3$

It is evident that the cheapest way to produce bread, the consumption good, is when country *A* concentrates all stages of production (i.e., case I produces bread at the lowest price). Country *A* has an absolute cost advantage in all goods. Therefore, Country *U* cannot compete in the production of either good.

The criteria of minimum cost also guarantee the highest real wage in both countries, among the alternative cases. Knowing nominal wages and the price of bread, the real wages are:

**Table 4.3 Real wages (for  $w^A = 2$  and  $w^U = 5$ )**

	Cases			
	I	II	III	IV
Real Wage in <i>A</i>	$w^A/p_2^I = 0.4$	$w^A/p_2^{II} = 0.2$	$w^A/p_2^{III} = 0.3$	$w^A/p_2^{IV} = 0.32$

<sup>60</sup> Numbers in this table are shown with only one decimal place.

$$\text{Real Wage in } U \mid w^U/p_2^I = 1.0 \quad w^U/p_2^{II} = 0.6 \quad w^U/p_2^{III} = 0.8 \quad w^U/p_2^{IV} = 0.8$$

which clearly shows that, under these circumstances, case I generates the highest real wage in both countries.

It is important to emphasize that, with given technologies, the pattern of trade depends solely on nominal wages. For sufficiently different nominal wages, the methods of production activated change. For example, if nominal wages are instead:

$$w^A = 2 \text{ and } w^U = 3$$

Then, the prices of production for each geographical distribution of production are:

**Table 4.4 Absolute Differences in Costs (for  $w^A = 2$  and  $w^U = 3$ )**

	Cases			
	I	II	III	IV
Price of corn	$p_1^I = 4.0$	$p_1^{II} = 7.0$	$p_1^{III} = 4.0$	$p_1^{IV} = 7.0$
Price of bread	$p_2^I = 4.8$	$p_2^{II} = 5.1$	$p_2^{III} = 4.2$	$p_2^{IV} = 5.4$

Now, the cheapest way to produce the consumption good is if country *A* produces corn and country *U* produces bread; this is the integrated production system (case III in Table 4.1). In this case, it is advantageous for both countries to split the production among themselves; there will be fragmentation of production. Country *A* exports corn to country *U* who transforms it into bread; country *A* then reimports the bread for its own consumption.

#### 4.6 What about comparative advantage?

The previous section shows that the novel closure of given nominal wages completely determines international prices and specialization based on absolute cost advantages. There is no need to even define comparative advantage. However, comparative advantage plays a central role in economic theory; as noted before Samuelson says that it is

the only proposition “in all of the social sciences which is both true and non-trivial” (1969, p. 9). This section defines comparative advantage for when there is trade in intermediate goods and shows a very limited role that it may play in international trade analysis.

In Chapter 3, section 3.4 the definition of comparative advantage involved comparisons between cost ratios pertaining to each country: the costs of producing two or more goods in the same country. In the pure labour model from Chapter 3, differences in the cost ratios were reliant on the assumption that technology was different between countries. In the same way, here the technological disparities cause cost ratios to be different. To assess comparative advantages with trade in intermediate goods, it is necessary to find which cost ratios to compare. Section 4.4 in this chapter has shown that there are four different geographical distributions of production with different implications for international prices and domestic costs.<sup>61</sup> I shall argue that relative costs for closed production systems are enough to define comparative advantages.

The literature asserts that the relevant cost ratio for comparative advantage lies in ‘autarky prices’: “In traditional trade models, a country’s comparative advantage arises from the economic conditions existing in autarky” (Baldone et al., 2007, p. 1729). As discussed in subsection 4.4.1, the equivalent of the autarky prices in this model with intermediate goods is the closed production prices (equations (4.15), (4.16), (4.19), and (4.20)). Thus, the characterization of the closed production systems (cases I and II) must be the starting point to define comparative advantages.

To find these cost ratios one needs to measure the relative prices in the closed production systems. The first closed production system (case I) has both international prices defined by country *A*’s costs of production (equations (4.9) and (4.10)), with the ratio between them determining the cost ratio between commodities 1 and 2 for country *A*:

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<sup>61</sup> Notice that costs of production are functions of the international prices.

$$\frac{p_1^I}{p_2^I} = \frac{c_1^A}{c_2^A} \Rightarrow \frac{p_1^I}{p_2^I} = \frac{v_1^A}{v_2^A} \quad (4.36)$$

This is the cost ratio for country *A*, which in case I produces both commodities and exports the consumption good. Since costs are proportional to vertically integrated labour coefficients, the cost ratio will just be the ratio between the vertically integrated labour coefficients.

One can do the same thing for case II, where country *U* produces both commodities and exports the consumption good. The cost ratio is equal to the ratio of country *U*'s vertically integrated labour coefficients:

$$\frac{p_1^{II}}{p_2^{II}} = \frac{c_1^U}{c_2^U} \Rightarrow \frac{p_1^{II}}{p_2^{II}} = \frac{v_1^U}{v_2^U} \quad (4.37)$$

In general, countries exhibit different cost structures due to disparities in technology; the actual labour productivities tend to be different. This can be caused by particular technological differences, different labour markets, institutional setup, etc. Without loss of generality, I may order the commodities in such a way to make the relative cost of producing commodity 1 in country *A* lower than in country *U*:

$$\frac{v_1^A}{v_2^A} < \frac{v_1^U}{v_2^U} \Rightarrow \frac{p_1^I}{p_2^I} < \frac{p_1^{II}}{p_2^{II}} \quad (4.38)$$

The difference in these cost ratios (in equation (4.38)) are what defines comparative advantage. A country has a comparative advantage in the production of a good if it can produce that good relatively cheaper than the other country. This is the same definition of comparative advantage used in the pure labour model in section 3.4, Chapter 3. In the case of equation (4.38) above, country *A* has a comparative advantage in the production of commodity 1 and country *U* in the production of commodity 2.



At this level, comparative advantage as a theory only provides a classification of countries according to their cost ratios. Comparative advantage as a theory of specialization not only classifies countries but also makes predictions. The theory predicts that there is a tendency for the country to specialize in the production of goods for which it has a comparative advantage. Even if the prediction does not hold (countries do not specialize according to their comparative advantages), the classification might still prove useful.

In the above example (condition (4.38)), country *A* has a comparative advantage in commodity 1 and country *U* in commodity 2. If the prediction also holds, country *A* should focus its production on commodity 1 and country *U* on commodity 2. This corresponds to case III of the possible geographical distributions of production (see Table 4.1). On the other hand, case IV could (for this example) be called an *anti*-comparative advantage as it implies the inverse of the trade pattern predicted by comparative advantage.

The classification emerging from comparative advantage is useful inasmuch as it removes its antithesis (case IV) from the realm of the possible geographical distributions of production. Case IV is when country *U* produces the intermediate good 1 and country *A* the consumption good 2 (the reverse of comparative advantage); that could only be the case if country *U* produces the intermediate good 1 absolutely cheaper than country *A* and country *A* produces the consumption good cheaper than country *U*. This is the basic notion of price competitiveness; consumers are indifferent to where commodities are produced and tend to go for the cheaper option for goods of similar qualities (see section 3.3 in Chapter 3; Eatwell, 1982, n. 3). From comparative advantage (condition (4.38)), if country *U* has the lowest cost to produce the intermediate good it also has the lowest cost to produce the consumption good.<sup>62</sup> Therefore, case IV is untenable.

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<sup>62</sup> If  $\frac{p_1^I}{p_2^I} < \frac{p_1^{II}}{p_2^{II}}$  and  $p_1^I > p_1^{II}$ , then it is necessary that  $p_2^I > p_2^{II}$ .

Hence, the problem of choosing where to produce each commodity reduces to the comparison of three possible geographical distributions only. A new table of possibilities is provided by Table 4.5:

**Table 4.5**      **Reduced possible cases after comparative advantage**

	Cases		
	I	II	III
Commodity 1	Country <i>A</i>	Country <i>U</i>	Country <i>A</i>
Commodity 2	Country <i>A</i>	Country <i>U</i>	Country <i>U</i>

Comparative advantage allows for a reduction in the number of possible cases, but it does not define specialization by itself. However, even this limited role loses its usefulness with more complicated settings; with many countries and many commodities, it becomes extremely difficult to analytically define comparative advantage (see a similar argument in Dvoskin and Ianni, 2021).

As section 4.5 in this chapter argues, international prices and specialization are completely determined by absolute cost advantages when nominal wages are taken as given. Comparative advantage, even when it can be defined, can only be used as a very general proxy of the direction of trade; but it cannot define it. It is still possible that a country forgoes the production of a good in which it has a comparative advantage.

## 4.7 Conclusion

This chapter has extended the arguments from the pure labour model (Chapter 3) to a scenario where production and trade encompass intermediate goods. As argued in Chapter 1, this captures the essence of Global Value Chains. The model maintains the idea of given technologies and a zero-profit rate.

The construction of the model follows from Baldone et al. (2007) where the authors deal with international fragmentation of production. The first part of the argument was to explore the idea of trade in intermediate goods as the basis of international fragmentation. This allowed us to present a simpler case with two goods instead of four as in Baldone et al. (2007).

With given technologies, this chapter shows how costs are defined and their dependence on prices (section 4.3). The costs now include the cost of labour *and* the costs of intermediate inputs. Since the intermediate inputs can be traded internationally, these costs form the basis of analysing trade in intermediates. The chapter then categorises all possible cases for the geographical distribution of production (section 4.4). Some cases do not involve any fragmentation of production: the closed production systems in which all production is confined to a single country (subsection 4.4.1). In other cases, parts of the productive process take place in different countries: the integrated production systems (subsection 4.4.2).

Section 4.5 introduces the novel closure based on given nominal wages. The main contribution of the chapter is to argue that given nominal wage rates determine, together with given technologies, absolute cost advantages. This was implicitly assumed in Baldone et al. (2007, p. 1755), but here it plays a central role. This novel closure with given nominal wages is thus enough to define which geographical distribution of production can offer goods at the cheapest international price. The chapter thus extends the results from the pure labour model (Chapter 3) to include trade in intermediate goods.

Section 4.6 questions the relevance of comparative advantage for international trade analysis. It contributes by showing that comparative advantage can be defined as a comparison of cost ratios for the closed production systems. These systems do not include imported inputs, so in some sense production is closed; but they still allow for international trade. Comparative advantage offers a limited role; it only defines the range in which trade

is mutually beneficial for both countries. It does not, however, determine international prices and/or the pattern of specialization.

Therefore, this chapter argues that, with trade in intermediate goods, absolute cost advantage dominates the determination of international prices and specialization. Comparative advantage plays a minor role and can be avoided altogether. The arguments in this chapter serve as a basis for the next generalisation: the following chapter (Chapter 5) includes a positive rate of profit in this model and shows how the results hold.

## **Chapter 5: International trade with positive profit rates**

### **5.1 Introduction**

Chapter 3 examined the structure of trade in a pure labour setting, while Chapter 4 introduced trade in intermediate goods. Both chapters maintained the assumption of zero profit rates. This chapter introduces a new layer of complexity that allows consideration of capitalist conditions of production. A capitalist system of production presupposes the existence of at least two classes that participate in production and share the surplus: workers and capitalists. More specifically, capitalists own the means of production that are used in production while workers supply their labour-power to the productive process. Workers' participation is remunerated in wages; capitalists are paid a percentage of the capital that they have advanced as means of production.

Wages have already been considered in the previous chapters. But, to consider a capitalist production system requires the introduction of a new income variable, namely the rate of profit. In formal terms, the production systems from the previous chapters have to be adapted to include positive rates of profit. This brings the analysis very close to that of Sraffa's price equations (Sraffa, 1960). The rate of profit in each country is measured as a percentage accrued to capitalists on top of advanced capital.

The idea of using Sraffa's price equations to study international trade has precedents in the work of Steedman (1979a), Parrinello (1973), and others (collected in Steedman, 1979b). One of the main goals of these contributions was to revisit Ricardo's approach to international trade in response to Sraffa's reformulation of classical political economy. Despite the strengths of this reformulation, it can, however, be seen as embodying some of Ricardo's limitations. For the most part, it presupposed an international system where the only stable configuration was characterized by balanced trade (see section 2.2.1 in Chapter 2). Moreover, this limitation was extended further to a dynamic setting by imposing the assumption that trading countries must grow at the same rate, at least on average:

[T]he following analysis of growing, trading economics will, unfortunately, have to be carried out under that same assumption, the uniform and constant rate of steady growth now being uniform not only for those output and labour quantities relating to a given country but also as between countries. (Steedman, 1979a, p. 110)

The present chapter attempts to free the analysis from a closure based on a uniform rate of growth (see section 2.2.5 and the Appendix 2.1 in Chapter 2). In this way, it is possible to establish the fundamentals of international trade, regardless of the patterns of growth. This does not imply a denial of possible links between countries' growth rates, but these considerations can be investigated after having achieved the fundamentals of international trade.

More recently, a new closure has been pursued by many authors such as Parrinello (2010), Shaikh (1999, 2016), Crespo et al. (2020), Bellino and Fratini (2021), among others. A common thread among these works is the assumption that, in the modern international capitalist system, capital is free to move between countries. This is framed as an external critique of the way Ricardo separates domestic from international trade by the absence of free movement of capital in the latter case (see section 2.3 in Chapter 2). This new assumption implies that there is a tendency for the establishment of a uniform international rate of profit between countries. As argued in Chapter 2 this literature attempts to establish a role for absolute advantages in international trade.

In the same vein, this chapter also argues for a preminent role for absolute advantages using a two-commodities-two-countries example. However, it manages to do so without the specific assumption regarding the international mobility of capital. In this sense, it advocates for absolute advantage to play a more fundamental role in international trade than in the existing literature. Assumptions regarding the international mobility of capital can be introduced later without altering the main conclusions.

With respect to Ricardo, the main point of departure of the analysis here is the abandonment of the mechanism that ensures that nominal wages comply with a condition of

balanced trade (see section 2.2.1 in Chapter 2). Building from chapters 3 and 4, I introduce the notion that nominal wages are, at least at a first approximation, independent of the trade balance. Any possible effects from the trade balance on wages could be studied at a second stage of analysis.

In this chapter, I propose a novel formulation and closure for the system of international prices and the pattern of specialization. This is an alternative to the closures available in the literature, as it does not rely on strong assumptions of balanced trade or equilibrium in the balance of payments. Instead, this new closure relies on setting the rates of profit and nominal wages as given, following Pivetti (1991, p. 171). These variables are determined by the historical process of conflict distribution, which is affected by socio-political factors.

Formally, the given profit rate ensures that the structure of (relative) costs inside a country is known; while given nominal wages allows for a comparison between absolute costs in different countries. Comparing absolute costs of production between different countries guarantees that the emerging pattern of specialization is compatible with the classical process of price competition. These concepts will be made more precise throughout the chapter.

The chapter is organized in the following way. Sections 5.2 and 5.3 analyse the methods and costs of production when there are positive rates of profit. Section 5.4 scopes out the possible geographical distributions of production and their implications in terms of international prices. Section 5.5 introduces the assumption that interest rates determine profit rates, based on Sraffa (1960) and Pivetti (1991). This is enough to determine relative prices for closed production systems, but not for integrated production systems. Section 5.6 deals with the novel closure for international prices and specialization following Pivetti's insights. It also argues that absolute cost advantages are essential for an analysis of international trade. Section 5.7 proposes a definition of comparative advantage that is compatible with Sraffa's

price equations. It also shows why the notion of comparative advantage may still play a limited role in international trade, even if it is not the main determinant of specialization and international prices. Sections 5.8 and 5.9 generalize the arguments to more realistic settings. Finally, section 5.10 provides some links to the previous literature and argues that our contribution is independent of the assumption regarding the degree of international capital mobility.

## 5.2 Introducing positive profit rates

In this chapter, I develop a model that builds on the model of trade in intermediate goods developed in Chapter 4. As before, there are two countries,  $A$  and  $U$ , and two commodities, 1 and 2. Commodity 1 is purely used as an instrument of production in the production of both commodities (a capital good); commodity 2 is a pure consumption good. The quantities of the intermediate good together with labour-hours required to produce one unit of each good define the methods of production. Each country has a single method of production for each commodity; both commodities can be traded between the countries. Due to technological disparities, the methods of production are possibly different between countries. For simplification, technology is given, all capital is circulating and there is no joint production.

So far, the methods of production are the same as in the previous chapter. What this means is that the matrix of technical coefficients and the labour vectors are represented in the same way (equations (4.1) through to (4.4) from Chapter 4). For country  $A$ :

$$\mathbf{A}^A = \begin{bmatrix} a_{11}^A & a_{12}^A \\ 0 & 0 \end{bmatrix} \quad (5.1)$$

$$\mathbf{l}^A = (l_1^A \quad l_2^A) \quad (5.2)$$

and for country  $U$ :



$$\mathbf{A}^U = \begin{bmatrix} a_{11}^U & a_{12}^U \\ 0 & 0 \end{bmatrix} \quad (5.3)$$

$$\mathbf{l}^U = (l_1^U \quad l_2^U) \quad (5.4)$$

where  $a_{1j}$  is the input coefficient (a physical amount of commodity 1) that is used to produce one unit of commodity  $j$ ;  $l_j$  captures the labour-hours necessary to produce one unit of commodity  $j$ ; and the superscripts  $A$  and  $U$  indicate which country is being referred to.

What distinguishes the analysis in this chapter is the emergence of a positive rate of profit. The rate of profit is a percentage on top of capital advanced that is absorbed by capitalists. By assumption, capital consists solely of the instruments of production expended (and used up as circulating capital) in the productive cycle; wages are not part of this advanced capital.

The introduction of a positive rate of profit does not change the description of the methods, but it does alter the cost equations. In the next section, I discuss each country's cost equations with positive profit rates.

### 5.3 Costs of production

While the description of the methods of production is the same as before, the costs of production must now include the positive normal rates of profit. What this means, with a cost-based determination of prices, is that prices must be able to cover material costs (inputs and labour) and also the appropriation of surplus by capitalists (the positive profit). This is a point well understood by classical political economists, as articulated by Marx:

The price of production includes the average profit. We call it price of production. It is really what Adam Smith calls *natural price*, Ricardo calls *price of production*, or *cost of production*, and the physiocrats call *prix necessaire* (Marx, 1991[1894], p. 300 emphases in the original)

Therefore, the costs of production for commodities 1 and 2 for country  $A$  can be represented as:

$$c_1^A = p_1 a_{11}^A (1 + r^A) + w^A l_1^A \quad (5.5)$$

$$c_2^A = p_1 a_{12}^A (1 + r^A) + w^A l_2^A \quad (5.6)$$

where  $c_j^A$  is the cost of producing commodity  $j$ ;  $p_1$  is the international price of the intermediate good;  $w^A$  is the nominal wage; and  $r^A$  is the uniform rate of profit for country  $A$ . Equations (5.5) and (5.6) show that the costs of production consist of the replacement of circulating capital used up in production ( $p_1 a_{11}^A$  and  $p_1 a_{12}^A$ ), the labour costs ( $w^A l_1^A$  and  $w^A l_2^A$ ), and profits upon advanced capital accruing to capitalists ( $p_1 a_{11}^A r^A$  and  $p_1 a_{12}^A r^A$ ). This last term is measured at the uniform rate of profits; and the inclusion of this profit term is the only difference with respect to the analysis in the previous chapter (equations (4.5) and (4.6) in Chapter 4).

Analogously, from the point of view of country  $U$ , its costs of production are:

$$c_1^U = p_1 a_{11}^U (1 + r^U) + w^U l_1^U \quad (5.7)$$

$$c_2^U = p_1 a_{12}^U (1 + r^U) + w^U l_2^U \quad (5.8)$$

The cost equations (5.5) through to (5.8) form the basis of the analysis in this chapter, as specifications of potential costs of production. Their specification will only change when dealing with more complex settings. As in chapters 3 and 4, the transition from potential costs to actual costs of production depends on whether the goods are actually produced in that country. It has been argued, based on the mechanism of price competition, that whether the production of these sectors is realised depends on the absolute costs to produce these goods as compared to the other country.

Notice that potential costs are defined for unspecified commodity prices. With a cost-based determination of prices, prices are set at the level that covers the cost of production

for the cost-minimizing methods. Therefore, the determination of prices and the patterns of international production are intrinsically related. These issues will be explored in the analysis that follows.

#### 5.4 Patterns of trade and specialization

In this system, there are two countries competing to produce two commodities. Four cases (indexed by roman numerals), or types, of complete specialization can be identified, akin to those cases displayed in Table 4.1 in Chapter 4. The table is reproduced here for convenience:

**Table 5.1**      **Conceivable geographical distributions of production**

	Cases			
	I	II	III	IV
Commodity 1	Country <i>A</i>	Country <i>U</i>	Country <i>A</i>	Country <i>U</i>
Commodity 2	Country <i>A</i>	Country <i>U</i>	Country <i>U</i>	Country <i>A</i>

Each case implies a different geographical distribution of production with complete specialization. Complete specialization is here defined when each commodity is produced by a single country. For example, case I occurs when country *A* produces both commodities and country *U* imports the consumption good 2.

Cases I and II have all production concentrated in a single country; I label them as ‘closed production systems’. On the other hand, cases III and IV have production dispersed between countries, and more importantly countries import inputs from each other; these are called ‘integrated production systems’ (see section 4.4 from Chapter 4).

Since each case has a different configuration of production, the *relevant* cost of production equations can differ. For example, case I happens when country *A* produces both commodities; therefore, the price of these commodities must be enough to cover the costs of

production in country  $A$ . And for case II to work it is necessary that the international prices are enough to cover the costs of production in country  $U$ . However, the integrated production systems require that the international prices cover the cross-country costs of production.

What this means is that the determination of necessary international prices changes between the different cases. More importantly, there is a one-to-one correspondence between the international prices and the patterns of specialization: if one knows the long-period position for international prices, it should be possible to infer the pattern of specialization and vice-versa.

The next two subsections provide a systematic exploration of how the patterns of specialization relate to international prices. It shows that the introduction of positive rates of profit has implications for the method of vertical integration (considered in Chapter 4) which is replaced by that of the reduction to dated quantities of labour (Sraffa, 1960, chap. 6).

#### 5.4.1 Closed production systems

As argued above, there are two possible geographical distributions of production that concentrate production in either country  $A$  or country  $U$ . These are the closed production systems. The structure of prices and costs will be considered for these systems, starting with case I where country  $A$  produces both commodities and exports the consumption good to country  $U$ .

With a cost-based determination of prices, for country  $A$  to produce (and be able to export) both commodities it is necessary that their international prices be enough to cover the costs of production in country  $A$ . Hence, the following relations should hold:

$$p_1^I = c_1^A \quad (5.9)$$

$$p_2^I = c_2^A \quad (5.10)$$

where  $p_1^I$  and  $p_2^I$  are the international prices for commodities 1 and 2 inside case I, respectively. The last relations in (5.9) and (5.10) indicate that the costs of production in country  $A$  determine international prices for both goods.

Substituting the necessary prices from (5.9) and (5.10) into the cost equations for country  $A$  (equations (5.5) and (5.6)):

$$p_1^I = p_1^I a_{11}^A (1 + r^A) + w^A l_1^A$$

$$p_2^I = p_1^I a_{12}^A (1 + r^A) + w^A l_2^A$$

which, solving for  $p_1^I$  and  $p_2^I$ , become:

$$p_1^I = w^A \left[ \frac{l_1^A}{1 - a_{11}^A (1 + r^A)} \right] \quad (5.11)$$

$$p_2^I = w^A \left[ l_2^A + \frac{l_1^A a_{12}^A (1 + r^A)}{1 - a_{11}^A (1 + r^A)} \right] \quad (5.12)$$

Let the terms inside square brackets in equations (5.11) and (5.12) be expressed as  $L_1^A$  and  $L_2^A$ , respectively. Based on Sraffa (1960, chap. 6),  $L_1^A$  and  $L_2^A$  are the result of a process called ‘reduction to dated quantities of labour’ if both commodities are produced inside country  $A$ .<sup>63</sup> It is important to notice that these terms are themselves functions of the technical conditions of production *and* the rate of profit ( $r^A$ ), in contrast with the direct labour coefficients in Chapter 3 and the vertically integrated labour coefficients in Chapter

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<sup>63</sup> The reduction to dated quantities of labour is an alternative way to represent the methods of production. Technically,  $L_1^A$  and  $L_2^A$  are the values to which the reductions converge if taken to their limits. This is achieved by the same process of vertical integration considered in Chapter 4, with the exception that the each ‘past’ labour term is weighted by  $(1 + r)^s$ , where  $r$  is the ruling rate of profit and  $s$  is how far back one has gone in the reduction. The procedure to calculate these reductions is aptly described by Sraffa (1960, chap. 6). For example, the reduction to dated quantities of labour for commodity 1 in country  $A$  is:

$$p_1^A = w^A [l_1^A + l_1^A a_{11}^A (1 + r^A) + w^A l_1^A (a_{11}^A)^2 (1 + r^A)^2 + \dots]$$

The expression inside square brackets is the dated quantities of labour. Mathematically, it is an infinite geometric series with ratio  $a_{11}^A (1 + r^A)$ . If the ratio is less than one, then the series converge to the value presented in equation (5.11) (for more details on the mathematical process see also Pasinetti, 1977, pp. 89-92; Kurz and Salvadori, 1995, pp. 165-168; and Steedman, 1977, chap. 5).

4. Concisely, the international prices of both commodities can be expressed as functions of the nominal wage and the dated quantities of labour:

$$p_1^I = w^A L_1^A \quad (5.13)$$

$$p_2^I = w^A L_2^A \quad (5.14)$$

Equations (5.13) and (5.14) show that the prices of commodities depend also on the distribution among classes because the dated quantities of labour depend on the rate of profit; this is a key result established by Sraffa (1960). Money prices depend on the nominal wage, the technical coefficients, and the rate of profit. Since country *A* produces everything, this result is indistinguishable from Sraffa's 'closed' production model. These equations replace the vertically integrated systems from Chapter 4 (equations (4.11) and (4.12)).

Similarly, one could find an expression for the international prices associated with case II as functions of the nominal wage and the dated quantities of labour in country *U*. Case II is when country *U* produces both commodities; so, the international prices must be enough to cover the costs in country *U*:

$$p_1^{II} = c_1^U \quad (5.15)$$

$$p_2^{II} = c_2^U \quad (5.16)$$

Substituting conditions (5.15) and (5.16) into equations (5.7) and (5.8) gives:

$$p_1^{II} = w^U L_1^U \quad (5.17)$$

$$p_2^{II} = w^U L_2^U \quad (5.18)$$

where  $L_1^U$  and  $L_2^U$  are the dated quantities of labour for commodities 1 and 2 if country *U* produces both.

Equations (5.13), (5.14), (5.17), and (5.18) fully characterize the necessary international prices for the closed production systems. It should be clear that a comparison

of which country produces any good absolutely cheaper requires both a distributive closure and knowledge of nominal wages; this will be explored further in section 5.6 in this chapter.

In the next subsection, I investigate the conditions of production for the integrated production systems (cases III and IV).

#### 5.4.2 Integrated production systems

Up to this point, we have analysed the conditions of production when all production processes are concentrated in one country. The analysis now turns to cases where production is fragmented between the two countries (cases III and IV in Table 5.1). For these integrated production systems, the conditions of production in the country that produces the capital good (commodity 1) affects the costs of production of both countries. Because of that, the distributive conditions in one country affect the costs in the other.

The first case of an integrated production system is where country  $A$  produces the intermediate good 1 and exports it to country  $U$  to be transformed into the consumption good 2; country  $U$  then exports the consumption good to country  $A$ . This corresponds to case III in Table 5.1. Evidently, the relevant costs of production are the cost of producing commodity 1 in country  $A$  (equation (5.5)) and the cost of producing commodity 2 in country  $U$  (equation (5.8)).

For case III to happen, the international price of commodity 1 must be enough to cover its cost in country  $A$ , while the international price of commodity 2 must cover its cost in country  $U$ . These conditions can be represented as:

$$p_1^{\text{III}} = c_1^A \quad (5.19)$$

$$p_2^{\text{III}} = c_2^U \quad (5.20)$$

where  $p_1^{\text{III}}$  and  $p_2^{\text{III}}$  are the international prices associated with case III for commodities 1 and 2, respectively.

Furthermore, the law of one price guarantees that the price of tradable commodities is the same in both countries (barring transport costs, which are assumed to be negligible as a first approximation). This justifies Ricardo's claim that "it is the natural price of commodities in the exporting country, which ultimately regulates the prices at which they shall be sold, if they are not the objects of monopoly, in the importing country" (Ricardo, Works, I, p. 238). The cost of production (or natural price) of the producing country determines international prices; the price in the importing country is defined by the international price.

Substituting conditions (5.19) and (5.20) into the cost equations (5.5) and (5.8), it is possible to determine the international prices as functions of the two nominal wages ( $w^A$  and  $w^U$ ), the two profit rates ( $r^A$  and  $r^U$ ), and the technical coefficients. Solving it for  $p_1^{\text{III}}$  and  $p_2^{\text{III}}$ :

$$p_1^{\text{III}} = w^A L_1^A \quad (5.21)$$

$$p_2^{\text{III}} = w^A L_1^A a_{12}^U (1 + r^U) + w^U l_2^U \quad (5.22)$$

The international price of commodity 1 depends only on country  $A$ 's conditions of production because there are no inputs imported into country  $A$  (i.e., equation (5.21) is equal to equation (5.13)). But, on the other hand, the international price of commodity 2 depends on the conditions of production of both countries which is caused by the commodity being produced in country  $U$  with intermediate goods from country  $A$ . This result is just a consequence of the simplifying assumptions, in particular of the idea that the intermediate good only uses itself as input; otherwise (i.e., production of commodity 1 requires commodity 2 as input), both prices would depend on the technology and distribution in the two countries.

This means that the dated quantities of labour for commodity 2 resolve into weighted amounts of labour from both country  $A$  and country  $U$ . In itself, this is a dated quantity of



labour if properly defined. The weights of the reduction include the profit rates from country  $A$  and from country  $U$ .<sup>64</sup> Country  $U$  provides the direct labour used,  $l_2^U$ , while country  $A$  provides the indirect labour, which is weighted as  $L_1^A a_{12}^U (1 + r^U)$ . Since  $L_1^A$  is a function of country  $A$ 's rate of profit, the international price of commodity 2 depends on the distribution of income in both countries.

The second integrated production system, and last geographical distribution of production, is when country  $A$  produces the consumption good 2 and country  $U$  produces the intermediate good 1 (case IV in Table 5.1).

The determination of international prices is analogous to the previous case, but the relevant cost equations are now based on the cost to produce commodity 2 in country  $A$  and the cost to produce commodity 1 in country  $U$ .

In order to work, this geographical distribution of production requires that the international price of commodity 1 to be enough to cover its cost in country  $U$ ; while the international price of commodity 2 must cover its cost in country  $A$ :

$$p_1^{\text{IV}} = c_1^U \quad (5.23)$$

$$p_2^{\text{IV}} = c_2^A \quad (5.24)$$

Substituting conditions (5.23) and (5.24) into the cost equations for commodity 1 in country  $U$  (equation (5.7)) and for commodity 2 in country  $A$  (equation (5.6)):

$$p_1^{\text{IV}} = w^U L_1^U \quad (5.25)$$

$$p_2^{\text{IV}} = w^U L_1^U a_{12}^A (1 + r^A) + w^A l_2^A \quad (5.26)$$

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<sup>64</sup> Equation (5.22) can also be represented as an infinite geometric series (see footnote 63 in this chapter) in the following way:

$$p_2^{\text{III}} = w^U l_2^U + w^A [l_1^A a_{12}^U (1 + r^U) + l_1^A a_{12}^U (1 + r^U) a_{11}^A (1 + r^A) + \dots]$$

which has also a ratio of  $a_{11}^A (1 + r^A)$ . If the ratio is less than one, then the infinite series converge to the value in equation (5.22).

The value to which the series converge is the dated quantity of labour; this involves two types of labour: from country  $A$  and from country  $U$ .

For this geographical distribution of production, the conditions of production in country  $U$  determine the price of the intermediate good 1. The price of the consumption good 2 depends on the conditions of production of both countries, as is obvious from equation (5.26).

The duplets of equations (5.13) and (5.14), (5.17) and (5.18), (5.21) and (5.22), and (5.25) and (5.26) characterize the international prices for each conceivable geographical distribution of production: the prices necessary to cover the relevant costs of production. So, there is a one-to-one relationship between the ongoing pattern of specialization and the ruling international prices. In other words, to determine the pattern of specialization is equivalent to determine international prices. However, so far, the analysis is not enough to determine either one of them. Notice that each geographical distribution of production has two equations (one for each good) and six variables (the two nominal wages, the two rates of profit, and the two prices). The systems of production are clearly indeterminate; the next sections introduces elements to make them determinate.

## **5.5 Relative prices and the indeterminacy of international prices**

Section 5.4 in this chapter shows how international prices depend on the patterns of specialization and vice-versa. This section investigates the rate of exchange between commodities for each specialization case. This is the same as defining relative prices for each price system (see section 2.1 from Chapter 2).

### **5.5.1 Relative prices in closed production systems**

The two closed production systems (cases I and II in Table 5.1) happen when either country  $A$  or country  $U$  concentrate the entire productive system. Analytically, these are akin to the closed economy frameworks (see footnote 56). So, relative prices are evaluated at the level that allows either country  $A$  or country  $U$  to produce both goods competitively.

In case I, country  $A$  produces both goods. International prices must be enough to cover the costs of production in country  $A$  (equations (5.13) and (5.14)):

$$p_1^I = w^A L_1^A \quad (5.27)$$

$$p_2^I = w^A L_2^A \quad (5.28)$$

To evaluate relative prices in this specialization case, divide equation (5.27) by (5.28) to get:

$$\frac{p_1^I}{p_2^I} = \frac{L_1^A}{L_2^A} \quad (5.29)$$

Since workers get paid the same wage rate regardless of the sector, wages disappear from relative prices.

Equation (5.29) is somewhat misleading because it appears that relative prices are entirely determined by technological conditions. However, the dated quantities of labour ( $L_1^A$  and  $L_2^A$ ) are complicated functions of the rate of profit ( $r^A$ ). Even if capitalists are paid the same profit rate in both sectors, it is not possible in general to eliminate its influence from relative prices. This is one of the important contributions provided by Sraffa (1960).

Therefore, to determine relative prices it is necessary to introduce an additional assumption regarding one of the distributive variables. An exogenously determined distributive variable is a well-known feature of linear production models with positive profit rates (see section 2.2.5 in Chapter 2).<sup>65</sup> The given variable could be either the real wage or the rate of profit; the former option is that chosen by classical political economists and Marx (see Garegnani, 1984), while the latter is the one used by Sraffa for parts of his book (Sraffa,

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<sup>65</sup> Sraffa (1960, chap. 2) refers to these as ‘production with a surplus’, which is more general than just positive profits. It is more general in the sense that the surplus generated may be absorbed by different classes, and not only as profits for capitalists.

1960, §44). Bharadwaj (1963) refers to this procedure as ‘value through exogenous distribution’.

Following Sraffa’s suggestion, the rates of profit are taken to be “determined (...) by the level of the money rates of interest” (Sraffa, 1960, p. 33).<sup>66</sup> This kind of determination was explored further by Pivetti (1991) and Panico (1988). So, the profit rate in country *A* is set at the level of the interest rate in country *A*:

$$r^A = i^A \quad (5.30)$$

The profit rate need not be exactly equal to the interest rate. This interest rate represents the return on assets free of risk. Productive investment carries some inherent risk; indeed, different productive sectors may be more or less prone to risks. This means that, for real investment to happen, the profit rate in each sector must be somewhat above the interest rate “in consideration of the security, cleanliness, ease, or any other real or fancied advantage which one employment may possess over another” (Ricardo, Works, vol. 1, p. 88; see section 2.1.1 in Chapter 2). Pivetti calls this excess of profit over interest as the “normal profit of enterprise” and says that the only requirement is that this normal profit of enterprise is “a sufficiently stable magnitude, and one which is independent of *i* [the interest rate]” (Pivetti, 1991, pp. 25-26). Therefore, given the stability of these normal profits of enterprise, it is possible to abstract from their existence and treat the profit rate as equal to the interest rate.

Fixing the rate of profits also determine the dated quantities of labour, as these are functions of the rate of profit and the given technology. If the dated quantities of labour are well determined, so are relative prices. To indicate the dependence of relative price on distribution, it may be convenient to express it as:

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<sup>66</sup> This suggestion generated an intense debate on how to interpret Sraffa’s remark and on how an exogenous determination of the rate of profits would look like (see Panico, 1988; Pivetti, 1991; Serrano, 1993). I do not intend to solve or even contribute to this debate. For the argument, it is sufficient to assume that the rates of profit are determined outside of the system of production.

$$\frac{p_1^I}{p_2^I} = \frac{L_1^A(i^A)}{L_2^A(i^A)} \quad (5.31)$$

where the parentheses show that dated quantities of labour depend on the rate of profit, which is determined by the money rate of interest.

The same exercise can be done for the closed production system II, where country  $U$  concentrates all production. In this scenario, international prices must cover the costs of production in country  $U$  (see equations (5.17) and (5.18)). The costs of production are determined by the dated quantities of labour, which are functions of the rate of profit. By the same procedure, take the rate of profit in country  $U$  to be determined by the money rate of interest:

$$r^U = i^U \quad (5.32)$$

So, the relative price in this closed production system is:

$$\frac{p_1^{II}}{p_2^{II}} = \frac{L_1^U(i^U)}{L_2^U(i^U)} \quad (5.33)$$

What this means is the traditional method of classical political economy (see section 2.1.1 in Chapter 2) is sufficient to determine relative prices in closed production systems. In the next subsection, I consider what happens if one applies this method to the integrated production systems.

### 5.5.2 Relative prices in integrated production systems

The previous subsection investigated the determination of relative prices for closed production systems and how these depend on the rate of profit. In this section, I investigate

the same thing for the integrated production system. As shall become evident, the same method is not sufficient to determine relative prices in these scenarios.

The first integrated production system is when country  $A$  produces commodity 1 and country  $U$  produces commodity 2 (case III in Table 5.1). If that is the case, then the international price of commodity 1 must cover its cost of production in country  $A$ ; whilst the international price of commodity 2 must cover its cost of production in country  $U$ . Since country  $U$  imports commodity 1 as an intermediate good, the cost of production of commodity 2 in country  $U$  depends on the conditions of production of both countries (see section 5.4.2 in this chapter). This determination appears in equations (5.21) and (5.22), reproduced here for convenience:

$$p_1^{\text{III}} = w^A L_1^A \quad (5.34)$$

$$p_2^{\text{III}} = w^A L_1^A a_{12}^U (1 + r^U) + w^U l_2^U \quad (5.35)$$

To determine relative prices, one need only divide equation (5.34) by (5.35):

$$\frac{p_1^{\text{III}}}{p_2^{\text{III}}} = \frac{w^A L_1^A}{w^A L_1^A a_{12}^U (1 + r^U) + w^U l_2^U} \quad (5.36)$$

The dated quantities of labour are functions of the rates of profit, which means that (5.36) is one equation in four variables ( $r^A$ ,  $r^U$ ,  $w^A$ , and  $w^U$ ). It is, therefore, an indeterminate equation.

Employing the same method as in section 5.5.1, we may set the rates of profit as equal to the rates of interest:

$$r^A = i^A \quad (5.37)$$

$$r^U = i^U \quad (5.38)$$

This reduces (5.36) to one equation in two variables ( $w^A$  and  $w^U$ ), which means it is still indeterminate. The distribution between workers in both countries is still affecting the system.

The same problem appears for the other integrated production system (case IV in Table 5.1). This is when country  $A$  produces commodity 2 and country  $U$  produces commodity 1. The international prices are shown in equations (5.25) and (5.26); to find relative prices just divide one equation by the other:

$$\frac{p_1^{IV}}{p_2^{IV}} = \frac{w^U L_1^U}{w^U L_1^U a_{12}^A (1 + r^A) + w^A l_2^A} \quad (5.39)$$

Even by setting profit rates as equal to interest rates (as in (5.37) and (5.38)), this is still one equation in two variables ( $w^A$  and  $w^U$ ); it is an indeterminate equation.

What this section shows is that there is an indeterminacy of international prices (see section 2.1.2 in Chapter 2). The traditional method of classical political economy of setting one distributive variable as given is not enough to determine international relative prices for the integrated production systems. In the next section, I explore a novel closure to the system of international prices based on given nominal wages.

## 5.6 Monetary determination of the terms of trade

In this section, I argue that there is a connection between the indeterminacy of the terms of trade (see section 5.5.2 in this chapter) and the definition of absolute advantage. So far I have shown the characterization of the different geographical distributions of production (section 5.4). I now turn to a discussion on how to determine the terms of trade and the related question of which geographical distribution of production prevails.

Section 5.4 in this chapter showed that for each geographical distribution of production there is a corresponding price system. On the other hand, section 5.5 introduced

the assumption of given profit rates. It may be convenient to reproduce here the characteristics of each price system: with given profit rates, there are two price equations (one for each good) and four variables (the two nominal wages and the two prices). These are indeterminate systems. This section introduces the last piece that makes the systems capable of determining international prices.

As argued in section 5.4, in this model with two countries and two tradable commodities, there are four conceivable geographical distributions of production. Each one carries its own required pattern of international prices to cover the costs of production (equations (5.13), (5.14), (5.17), (5.18), (5.21), (5.22), (5.25), and (5.26)). So, there is a one-to-one correspondence between the determination of the terms of trade and the pattern of specialization.

What, it might be argued, should the criteria to determine the pattern of specialization be? In keeping with the classical political economy notion of price competitiveness as a cost minimization process (Eatwell, 1982; Salvadori and Signorino, 2011), the relevant criteria should be minimum cost. In other words, a country produces and exports a good if it can supply that good at the cheapest cost. This is the same condition applied to chapters 3 and 4 (equations (3.12) and (4.28)).

In the particular setting studied here, the condition of cost minimization is coherent if it is capable of generating the highest real wage. After having fixed the rates of interest (equations (5.37) and (5.38)), the residual income variables are the real wages. Under our simplifying assumptions, the only wage good is the consumption good 2; hence, real wages will be the highest whenever the money price of commodity 2 is the lowest with respect to nominal wages. That means that a comparison of the price of the consumption good 2 in the different geographical distributions of production is enough to investigate the process of international price competition.



Simply fixing the rates of profit (as in equations (5.37) and (5.38)) is not enough to establish the pattern of specialization. The reason is easy to see if one attempts to compare the money price of the consumption good in two geographical distributions of production. For example, consider the closed production systems (cases I and II in Table 5.1). Country *A* will prefer to produce both commodities instead of buying from a vertically integrated production in country *U* (i.e., case I is chosen when compared to case II) if and only if:<sup>67</sup>

$$p_2^I < p_2^{II} \Leftrightarrow w^A L_2^A < w^U L_2^U \quad (5.40)$$

Inequality (5.40) is none other than the condition that country *A* has an *absolute* cost advantage in the production of commodity 2 (see equations (3.12) in Chapter 3 and (4.28) in Chapter 4). In other words, if the integrated process in country *A* produces the consumption good at an absolutely cheaper price than the equivalent integrated process in country *U*, then the former will be able to generate higher real wages.

In sum, the notion of price competitiveness requires a comparison between absolute costs of production; but the classical closure of exogenously fixing one of the distributive variables (in this work, the rates of profit)<sup>68</sup> is insufficient. Therefore, there is a missing piece that allows a comparison between absolute costs. Our contribution is to determine absolute costs by introducing an assumption regarding nominal wages; this, together with given profit rates, fixes absolute costs in the different geographical distributions of production.

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<sup>67</sup> For simplicity, from now on we will omit the rate of profit from the argument of the dated quantities of labour functions. The profit rates is assumed to be at the same level as the money rate of interest throughout. So, whenever the reader sees  $L_i^j$  it should be understood as  $L_i^j(r^j = i^j)$ .

<sup>68</sup> Classical political economists took the real wage as given. The idea of taking the rate of profit as given was explored by Sraffa (1960) and is discussed in section 5.5 in this chapter. The problem looks exactly the same if one sets the real wage as given.

Following Pivetti (1991), nominal wages are assumed given.<sup>69</sup> These are affected by socioeconomic conflicts over distribution that resolve themselves, through institutions, in a given level of the nominal wages:

The *money* wage rate in our system of equations is now taken as given. The money wage is the direct outcome of wage bargaining and depends on economic as well as institutional conditions, such as the levels of employment and the forms of organization of the workers. (Pivetti, 1991, p. 71, emphasis in the original)

It is only possible to properly measure the prices associated with each pattern of specialization as money prices with given nominal wages.<sup>70</sup>

After grounding money prices on nominal wages, it is unambiguous to find the pattern of specialization that produces the consumption good at the cheapest price. The given nominal wage rates determine a unique set of money prices for each specialization pattern; these prices can be compared to find the cheapest configuration (the one with the highest real wages). This is the same thing as arguing that the absolute costs are given by the nominal wage rates; and, if the latter are relatively stable, then absolute costs determine the direction of trade. Below I provide an illustration to show how this works.

*Illustration.* Here I provide a hypothetical scenario to show how nominal wages determine absolute costs and the pattern of trade (for given profit rates). There are two countries: *A* and *U*; these countries compete in the production of two commodities: corn (commodity 1) and bread (commodity 2). Corn is produced by means of itself and labour; while bread is produced by means of corn and labour. The matrices of technical coefficients and the vectors

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<sup>69</sup> I would like to thank Gustavo Bhering who, in an informal conversation, suggested me to adopt Pivetti's closure.

<sup>70</sup> Technically, it would also be possible to ground the system on a given nominal price for some commodity. This could be interpreted as the result of capitalists' bargaining over distribution (Okishio, 1977; Serrano, 2010). However, with international competition, a given nominal price for some commodity (or even a bundle of commodities) loses some of its strength, while a given nominal wage remains a concrete notion.

of labour coefficients for countries  $A$  and  $U$  are given by, respectively (see equations (5.1) through to (5.4)):

$$A^A = \begin{bmatrix} 0.5 & 0.2 \\ 0 & 0 \end{bmatrix}; \quad l^A = (1 \quad 2)$$

and

$$A^U = \begin{bmatrix} 0.7 & 0.3 \\ 0 & 0 \end{bmatrix}; \quad l^U = (0.7 \quad 1)$$

This means that to produce one unit of corn in country  $A$  it requires 0.5 units of corn and 1 hour of direct labour; and so on.

The costs of production in each country are then (see equations (5.5) through to (5.8) in this chapter):

$$c_1^A = 0.5p_1(1 + r^A) + 1w^A$$

$$c_2^A = 0.2p_1(1 + r^A) + 2w^A$$

and

$$c_1^U = 0.7p_1(1 + r^U) + 0.7w^U$$

$$c_2^U = 0.3p_1(1 + r^U) + 1w^U$$

Cost equations are measured at the international price for commodity 1 ( $p_1$ ), which is uniform across countries due to the law of one price for tradable goods.

Following Sraffa's remark (see section 5.5 in this chapter), we assume that the rates of profit in each country are set at the levels of the nominal rate of interest; these are assumed to be:

$$r^A = i^A = 0.1$$

$$r^U = i^U = 0.15$$

which means that capitalists in country *A* receive 10% of advanced capital as net profits; and capitalists in country *U* receive 15%.<sup>71</sup>

From these assumptions, it is possible to calculate the dated quantities of labour if both goods are produced inside either country *A* or country *U*. These are the closed production systems (cases I and II of the geographical distribution of production; see equations (5.13), (5.14), (5.17), and (5.18)):

$$L_1^A = 2.22$$

$$L_2^A = 2.48$$

and

$$L_1^U = 3.59$$

$$L_2^U = 2.24$$

These dated quantities of labour are proportional to the relative prices in the closed production systems.

As argued in section 5.5, knowing profit rates and the dated quantities of labour is not enough to determine absolute costs of production; whereas the absolute costs of production are the only way to measure which geographical distribution of production produces which good at the cheapest price. Therefore, we introduce an assumption regarding nominal wages, such as:

$$w^A = 2 \text{ and } w^U = 5$$

where both nominal wages are measured in the same unit of account.

The information so far is sufficient to calculate absolute prices of production of both goods for all possible geographical distributions of production. These are shown in the table below:<sup>72</sup>

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<sup>71</sup> These are normal profit rates as defined for long-period positions (see section 2.1.1 in Chapter 2). At any time, an individual capitalist may receive more or less than the normal rate of profit.

<sup>72</sup> The numbers reported in this table have been rounded to two decimal places.

**Table 5.2** Absolute Differences in Costs (for  $w^A = 2$  and  $w^U = 5$ )

	Cases			
	I	II	III	IV
Price of corn	$p_1^I = 4.44$	$p_1^{II} = 17.95$	$p_1^{III} = 4.44$	$p_1^{IV} = 17.95$
Price of bread	$p_2^I = 4.98$	$p_2^{II} = 11.19$	$p_2^{III} = 6.53$	$p_2^{IV} = 7.95$

From Table 5.2, it is evident that the cheapest way to produce bread under these circumstances is if country *A* concentrates all stages of production (i.e., case I is the cheapest configuration to procure the consumption good). Country *U* cannot compete in the production of any good, despite any possible comparative advantage (see section 5.7 below).

Cost minimization is the process that selects the pattern of specialization. The lowest cost guarantees the highest real wage in both countries. For this example, the real wages are:

**Table 5.3** Real wages (for  $w^A = 2$  and  $w^U = 5$ )

	Cases			
	I	II	III	IV
Real Wage in <i>A</i>	$w^A/p_2^I = 0.4$	$w^A/p_2^{II} = 0.2$	$w^A/p_2^{III} = 0.3$	$w^A/p_2^{IV} = 0.3$
Real Wage in <i>U</i>	$w^U/p_2^I = 1$	$w^U/p_2^{II} = 0.4$	$w^U/p_2^{III} = 0.8$	$w^U/p_2^{IV} = 0.6$

which clearly shows that, under these circumstances, case I generates the highest real wages in both countries.

This pattern of trade may be different if nominal wages are different. For the same configuration of techniques and profit rates, nominal wages sufficiently different will generate alternative geographical distributions of production. For example, if nominal wages are instead:

$$w^A = 2 \text{ and } w^U = 1$$

Then, the prices of production for each geographical distribution of production are:

**Table 5.4 Absolute Differences in Costs (for  $w^A = 2$  and  $w^U = 1$ )**

	Cases			
	I	II	III	IV
Price of corn	$p_1^I = 4.44$	$p_1^{II} = 3.59$	$p_1^{III} = 4.44$	$p_1^{IV} = 3.59$
Price of bread	$p_2^I = 4.98$	$p_2^{II} = 2.24$	$p_2^{III} = 2.53$	$p_2^{IV} = 4.79$

which indicates that now country  $U$  will tend to concentrate all stages of production because case II is the one with the lowest costs to produce bread. Country  $A$  cannot compete in the production of any good.

It is also possible to find a configuration of the nominal wages for which case III is chosen. Case III is the one where country  $A$  produces corn and country  $U$  produces bread. For illustrative purposes, this geographical distribution of production will happen when the nominal wages are, for example:

$$w^A = 2 \text{ and } w^U = 3$$

If that holds, then for the same technologies and rates of profit, the costs of production in each specialization case are:

**Table 5.5 Absolute Differences in Costs (for  $w^A = 2$  and  $w^U = 3$ )**

	Cases			
	I	II	III	IV
Price of corn	$p_1^I = 4.44$	$p_1^{II} = 10.77$	$p_1^{III} = 4.44$	$p_1^{IV} = 10.77$
Price of bread	$p_2^I = 4.98$	$p_2^{II} = 6.72$	$p_2^{III} = 4.53$	$p_2^{IV} = 6.37$

Table 5.5 indicates that, under these circumstances, it is cheaper to produce corn in country  $A$  and bread in country  $U$ .

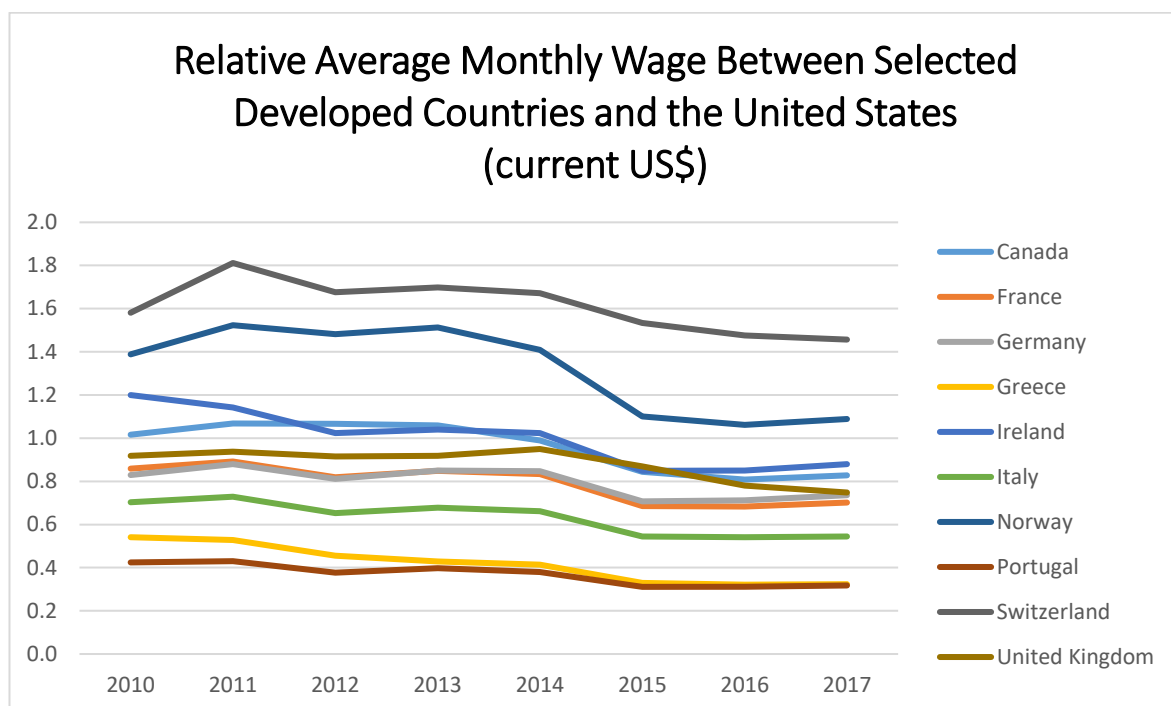
For reasons that shall become clear in section 5.7, it is not possible to find positive nominal wages for which the integrated production system IV is the most competitive.

What this section shows is that, under the novel closure proposed here, absolute cost advantages dominate international trade; it is not even necessary to define comparative advantage. The given nominal wages, together with profit rates, are sufficient to determine the costs of production and the pattern of specialization based on cost minimization. International prices are simply defined by the country with the lowest cost of production.

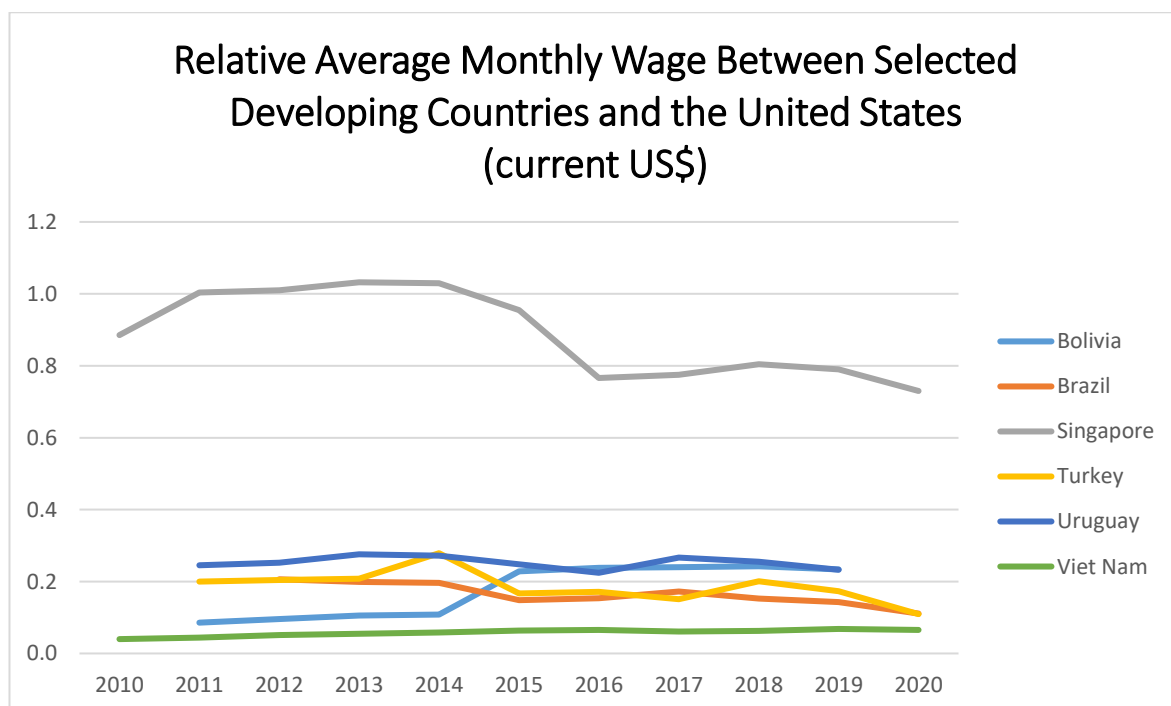
### **5.6.1 Plausibility of assuming given nominal wages**

The analysis in this chapter is predicated on the notion of given nominal wages; this was already present in Chapter 3 and Chapter 4 as a development of the arguments made in Baldone et al. (2007). In this chapter, however, this assumption forms the main tenet of the alternative closure proposed in this thesis. Therefore, some justification for this is required. The assumption revolves around the idea that nominal wages in different countries maintain a persistent ratio to each other when measured in the same unit of account. Compiled data for average nominal wages in various countries is scarce, but there are some sources that paint a reasonable picture.

Figure 5.1 below show the ratio between average nominal wages for a selected group of developed countries and the average nominal wage in the United States between 2010 and 2017. Figure 5.2 shows the same information for a selection of developing countries from 2010 to 2020, based on a different data source. All wages are measured in current US dollars.

**Figure 5.1**

Source: Based on UNECE data.

**Figure 5.2**

Source: Based on ILOSTAT data.



What these graphs show is that there is persistent stability of the ratio of countries' nominal wages with respect to the United States. While a comparison between countries is unwarranted due to differences in statistical methodologies, the evolution in time for a given country seems to reinforce the assumption of a given ratio between nominal wages.

Sometimes there is a structural break in the time series, but the ratio tends to stabilize at a new level. For example, in Figure 5.1, this ratio falls for most countries between 2014 and 2015 which could be explained by the strong appreciation of the American dollar vis-à-vis the Euro. In Figure 5.2, the ratio in Singapore falls between 2014 and 2016 but then stabilizes at a new level. While the opposite happens in Bolivia between 2014 and 2015.

The assumption of persistent ratios between countries' nominal wages seems to find some validity in stylized facts. This persistency lasts for enough time to be considered as a given for a long period theory of price formation, at least as a first approximation. The validity of this assumption could be better understood with more data points and with a detailed statistical analysis; this is left as a future exercise.

## **5.7 What about comparative advantage?**

Section 5.6 in this chapter argues that the monetary closure to international prices proposed in this thesis implies a crucial role played by absolute cost advantages. This is in line with results obtained in Chapter 3 for a pure labour model and in Chapter 4 when introducing trade in intermediate goods. The only difference is that with positive rates of profit, it was necessary to introduce an assumption regarding the profit rate. However, given nominal wages are still sufficient to determine international prices and specialization based on absolute costs of production. The obvious question is: is there any role for comparative advantage?

The notion of comparative advantage emerged in the history of thought to sustain that both trading countries could benefit from free trade. The idea involves a comparison

between relative costs (or domestic prices) and it is straightforward; using Ricardo's example: if it is *relatively* cheaper to produce cloth in England and wine in Portugal, then both countries *could* benefit from importing the relatively cheaper good from the other country (see section 2.2.1 in Chapter 2).

It is evident that, before defining comparative advantage, it is important to know the domestic relative costs. Inside the labour theory of value from Ricardo, domestic relative costs are proportional to the labour spent directly and indirectly to produce the commodities. This was so established in the history of thought that the idea of comparative advantage became almost indissociable from embodied labour ratios.<sup>73</sup> These labour ratios were then enough to establish which country had a comparative advantage in the production of which goods.

### 5.7.1 A Sraffa-inspired formulation of comparative advantages

Despite the long-lasting association between comparative advantages and embodied labour ratios, Steedman and Metcalfe (1979) argue that the possibility of establishing the direction of trade (which country exports and which country imports each commodity) from embodied labour ratios breaks down when domestic relative costs are not proportional to these. This is true because embodied labour ratios cannot explain relative costs inside a country.<sup>74</sup> Therefore, to define comparative advantage it is necessary to understand how domestic relative costs are determined.

Following this reasoning, comparative advantage can still be defined by using cost ratios: "the direction of trade then is determined entirely by the relation between the *no-trade*

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<sup>73</sup> Even authors such as Taussig (1934) and Haberler (1936), who were consciously moving away from a labour theory of value, would start the analysis with domestic costs as ratios between labour costs.

<sup>74</sup> This issue with the definition of comparative advantage did not emerge in the previous chapters because in there the cost-ratios were equal to embodied labour ratios (see equations (3.10) and (4.25)). However, the introduction of the positive profit term precludes the identification of domestic cost-ratios with embodied labour ratios.

price ratios” (Steedman and Metcalfe, 1977, p. 102, emphasis added). There are two parts to this assertion: first, it implies a redefinition of comparative advantages based on cost-ratios instead of labour ratios; second, it argues that these cost-ratios are capable of determining the pattern of specialization (i.e., the direction of trade). The first part of the argument holds, and I show how it can be defined below. However, with respect to the second part of the assertion, I offer a critical evaluation and argue that the cost ratios are not enough.

A proper definition of comparative advantages involves a dissociation of domestic relative costs from embodied labour ratios. What Steedman and Metcalfe (1977) refer to as ‘no-trade price ratios’ is provided by a Sraffian closure to what I have been calling the closed production systems. These measure how much it costs to produce a good in terms of another if both are produced by the same country; and they are analogous to the cost-ratios in the closed production systems ( $p_1^I/p_2^I$  and  $p_1^{II}/p_2^{II}$ ). So, the cost ratios necessary to define comparative advantage can be found by dividing the prices of the two commodities in each closed production system (see section 5.5.1 in this chapter). For example, the cost-ratio in country *A* (see equations (5.13) and (5.14)) is:

$$\frac{p_1^I}{p_2^I} = \frac{L_1^A}{L_2^A} \quad (5.41)$$

while for country *U* the cost-ratio is (see equations (5.17) and (5.18)):

$$\frac{p_1^{II}}{p_2^{II}} = \frac{L_1^U}{L_2^U} \quad (5.42)$$

As argued in section 5.5, these cost-ratios are not proportional to embodied labour ratios as they incorporate the positive rates of profit (see equations (5.31) and (5.33))

Equations (5.41) and (5.42) form the basis for defining comparative advantage. Comparative advantage is defined in the following way: country *A* has a comparative

advantage in the production of commodity 1 and country  $U$  in the production of commodity 2 whenever:

$$\frac{p_1^I}{p_2^I} < \frac{p_1^{II}}{p_2^{II}} \Leftrightarrow \frac{L_1^A}{L_2^A} < \frac{L_1^U}{L_2^U} \quad (5.43)$$

which is analogous to equation (4.38) in Chapter 4, but with dated quantities of labour instead of vertically integrated labour coefficients.

The reason for defining comparative advantage as such is straightforward. If countries  $A$  and  $U$  can trade at a relative price that lies inside the ratio in (5.43), both of them would have access to one commodity cheaper than it could produce itself. For example, consider what happens if the international relative price ( $p_1/p_2$ ) is:

$$\frac{p_1^I}{p_2^I} < \frac{p_1}{p_2} < \frac{p_1^{II}}{p_2^{II}} \quad (5.44)$$

Then, from the point of view of country  $A$ , it could import the consumption good 2 cheaper than it could produce itself. On the other side, producers in country  $U$  would be able to import the input good 1 cheaper than they could produce it. This allows both countries to achieve a better functional distribution of income: either profit rates or real wages increase.

This is not a new result and it has been aptly discussed by Steedman and Metcalfe (1979, p. 101) when they argue that the *with-trade* rate of profit is higher than the *no-trade* rate of profit for given wage rates. To show this, suppose condition (5.44) holds; hence, country  $A$  has a comparative advantage in the production of 1 and country  $U$  in the production of 2. If country  $A$  specializes in the production of the intermediate good 1, then the international price for commodity 1 must cover its cost in country  $A$ . The only relevant cost of production in country  $A$  is the cost to produce commodity 1 (equation (5.1)):

$$p_1 = p_1 a_{11}^A (1 + r^A) + w^A l_1^A$$

which, dividing both sides by  $p_2$ , transforms into a negative relationship between the profit rate and the real wage, mediated by relative prices:

$$\frac{w^A}{p_2} = \frac{p_1}{p_2} \frac{(1 - a_{11}^A(1 + r^A))}{l_1^A} \quad (5.45)$$

Furthermore, equation (5.45) establishes a positive relationship between the real wage and the relative price of commodity 1 in terms of commodity 2, for a given profit rate. If country  $A$  produces both commodities, then their relative price is  $p_1/p_2 = p_1^I/p_2^I$ . While if country  $A$  can trade at terms of trade as set by (5.44) and specialize in commodity 1, then the international relative price will be higher:  $p_1/p_2 > p_1^I/p_2^I$ . The real wage will also be higher because workers in country  $A$  are able to buy the relatively cheaper consumption good from country  $U$ .

The analysis for country  $U$  would be analogous. If the effective international relative price sits in between the ratios of dated quantities of labour (condition (5.44)), then country  $U$  could achieve a higher rate of profit or a higher real wage when it specializes in the production of the consumption good 2.

So, a very general definition of comparative advantage for the two-countries case can be: if there exists an interval (like condition (5.44)), where at least one class will be better-off in each country by specializing in the production of a good (or bundle of goods), then we say that these countries have a comparative advantage in the production of the good that they specialize.

Not only that, but this definition of comparative advantage also emphasizes that the range of comparative advantages depends on income distribution. The dated quantities of labour that determine the cost ratios (equation (5.43)) are functions of the interest rates; so, for different interest rates, the relationship could be reverted. For example, if  $r^A = i^A$  and  $r^U = i^U$  it could happen that:

$$\frac{L_1^A(i^A)}{L_2^A(i^A)} < \frac{L_1^U(i^U)}{L_2^U(i^U)}$$

which is the same as condition (5.43), implying that country  $A$  has a comparative advantage in commodity 1 and country  $U$  in commodity 2.

However, for different interest rates  $r^A = i^{A'} \neq i^A$  and  $r^U = i^{U'} \neq i^U$  it could happen the inverse:

$$\frac{L_1^A(i^{A'})}{L_2^A(i^{A'})} > \frac{L_1^U(i^{U'})}{L_2^U(i^{U'})}$$

which would represent a reversal in the pattern of comparative advantage, without any change in technology: country  $A$  has a comparative advantage in commodity 2 and country  $U$  in commodity 1.<sup>75</sup>

Hence, the patterns of comparative advantage can only be defined for, at most, some ranges of the distributive variables. For example, country  $A$  could have a comparative advantage in commodity 1 for  $0 < r^A < r_1^A$ , a comparative advantage in commodity 2 for  $r_1^A < r^A < r_2^A$ , and again a comparative advantage in commodity 1 for  $r_2^A < r^A < r_3^A$ , and so on. These effects are just a consequence of the complicated relationships of relative prices on distribution as shown by Sraffa (1960) and this formulation requires a given distributive variable.

We now return to the second part of Steedman and Metcalfe's assertion regarding the ability of cost ratios to determine specialization. This reformulation of the definition of comparative advantage can only determine the ranges in which specialization would be mutually beneficial: notice that there are infinitely many international relative prices that would respect condition (5.44). By itself, it is incapable of determining the terms of trade;

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<sup>75</sup> Dvoskin and Ianni (2021) argue that the possibility of reversal of comparative advantage is sufficient to discard the concept from the economics of international trade.

hence, it is incapable of determining the actual trade patterns. Comparative advantage thus has a weak definition here, in that it does not determine the direction of trade.

The fact that comparative advantage is incapable of determining the terms of trade has been known for a long time; it is a reflection of the indeterminacy of the terms of trade in a classical setting (see section 2.1.2 in Chapter 2). This is behind James Mill's mistake and Stuart Mill's classification of Ricardo as erroneous/incomplete (see sections 2.2.2 and 2.2.3 in Chapter 2).<sup>76</sup> The point is that the reformulation of comparative advantage based on Steedman and Metcalfe (1977) still carries this limitation.

It is important to highlight the generality of this weak definition of comparative advantage. Capitalists could always benefit from cheaper wage goods or foreign inputs. Since the relative prices for the closed production systems will generally be different (except for a fluke), there will always be a scope to procure relatively cheaper inputs.

### 5.7.2 Why define comparative advantages?

Given these limitations, the question that naturally emerges is why define comparative advantages at all? Besides the history of thought perspective, comparative advantage may still play a role in the analysis even if it is not the main determinant of trade flows (as in this thesis). Comparative advantage eliminates some *conceivable* patterns of trade from the realm of *feasible* patterns of trade.

So, even if comparative advantage cannot determine the direction of trade, it determines what the direction of trade *cannot* be. For example, suppose that the international relative price lies outside of the interval of comparative advantage (condition (5.44)). For example:

$$\frac{p_1^I}{p_2^I} < \frac{p_1^{II}}{p_2^{II}} < \frac{p_1}{p_2}$$

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<sup>76</sup> For a modern statement on the indeterminacy of the terms of trade, see Vasudevan (2012).

If that is the case, the system would become contradictory. This is easy to see: from the point of view of country *A*, it can buy relative cheaper consumption good (commodity 2) in the international market. From the logic in equation (5.45), country *A* would benefit from specializing in commodity 1 and importing commodity 2. The same would be true of country *U*, it would also benefit from specializing in commodity 1 and importing commodity 2. No country would want<sup>77</sup> to produce the consumption good, as it is relatively cheaper to import it for both countries. This violates a basic condition that all commodities must be produced somewhere if any consumption good is to be produced (Steedman, 1979a, p. 110).

Therefore, the definition of comparative advantage helps to eliminate those contradictory patterns of specialization. Any term of trade that lies outside of the realm of comparative advantages would imply an unfeasible pattern of specialization. In the case in this chapter, this means that any geographical distribution of production where country *A* produces the consumption good 2 *and* country *U* produces the intermediate good 1 could not be a persistent position; there would be a tendency to deviate from that situation.

Since we assume that  $L_1^A/L_2^A < L_1^B/L_2^B$ , this eliminates one of the conceivable geographical distributions of production, namely case IV in Table 5.1. Hence, there are only three feasible geographical distributions of production. These are represented in Table 5.6:

**Table 5.6 Feasible geographical distributions of production**

	Cases		
	I	II	III
Commodity 1	Country <i>A</i>	Country <i>U</i>	Country <i>A</i>
Commodity 2	Country <i>A</i>	Country <i>U</i>	Country <i>U</i>

<sup>77</sup> Faccarello (2017) rightly criticizes this kind of anthropomorphization of countries. Capitalist economies usually do not take decisions at this level, rather it is individual producers that decide on production. However, the metaphor is simple and pedagogic. It is also fair to use the metaphor once it has been shown that the country's 'desires' match a better outcome for individual producers. This is guaranteed by the fact that the real wages (or the rate of profits) increase with specialization.



Cases I and II are the closed production systems and case III is the only feasible integrated production system. Notice that case III conforms to the trade pattern predicted by comparative advantage. By now it should be evident that the definition of comparative advantage does not determine either the terms of trade or the geographical distribution of production. Its function lies solely in eliminating unfeasible patterns of specialization.

So, comparative advantage plays a very minor role in this monetary closure to the system of international prices. It can only eliminate a pattern of specialization that cannot happen. It is still absolute cost advantage (as developed in section 5.6) that determines international prices and specialization. Comparative advantage can only be used as a very crude proxy of what the direction of trade is. It is still possible for a country to be unable to compete in a good in which it has a comparative advantage.

The next sections return to the monetary closure to international prices. Its results are generalized for more complex settings.

## 5.8 Different wage baskets

Up to this point, the analysis has relied on the assumption that the wage basket consisted of a single good (commodity 2) in both countries. As a consequence, the composition of the wage basket was the same in both countries. In this section, I generalize the argument for when workers include more than one good in their wage baskets. I also let the wage baskets differ between countries.

To do so, I will maintain all assumptions regarding the methods of production and costs (see sections 5.3 and 5.4 in this chapter) but allow workers to also consume commodity 1. Therefore, commodity 1 is still the sole mean of production, but it may also enter the wage baskets (it is not a *pure* capital good); while commodity 2 is still a pure consumption good. There are only two things that change: first, workers take the price of commodity 1 into

consideration; second, the composition of the wage basket may not be uniform between countries. Formally:

$$w_r^A = \frac{w^A}{p_1 b_1^A + p_2 b_2^A} \quad (5.46)$$

and

$$w_r^U = \frac{w^U}{p_1 b_1^U + p_2 b_2^U} \quad (5.47)$$

where  $w^A$  and  $w^U$  are the nominal wages;  $w_r^A$  and  $w_r^U$  are the real wages;  $p_1$  and  $p_2$  are the international prices of commodities 1 and 2; and the  $b_j^i$ s represent of the proportion of commodity  $j$  that enters into the wage basket in country  $i$ , such as  $\sum_j b_j^i = 1$ .

For the monetary determination of international prices to work, there must exist a geographical distribution of production that minimizes the cost of *both* wage baskets.<sup>78</sup> Otherwise, the geographical distribution that minimizes the cost of the wage basket for country  $A$  may not minimize it for country  $U$ : the choice would be contradictory depending on which country is used as a parameter.

The proposition that such geographical distribution of production exists is not trivial. The proof is in three steps. First, we show that there is a geographical distribution that minimizes the cost/price of commodity 1. Second, we argue that there is also a geographical distribution that minimizes the cost/price of commodity 2. Finally, we show that both geographical distributions of production are the same; hence, it minimizes the cost/price of any linear combination of commodities 1 and 2.

To prove the first part of the argument, one need only consider the money price of production for commodity 1 in all four geographical distributions of production. These are

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<sup>78</sup> Alternatively, it maximizes both real wages.

entirely determined by the given profit rates and nominal wages (see section 5.6 in this chapter). Hence, there will be a rank of geographical distributions from the lowest to the highest cost/price for commodity 1. The one with the lowest price for commodity 1 also maximizes workers' purchasing power in terms of commodity 1.

By the same logic, there will be a geographical distribution of production that minimizes the price of commodity 2. It will also maximize workers' purchasing power in terms of commodity 2. This proves the second part of the statement.

Finally, it is necessary to prove that the geographical distribution of production that minimizes the price of commodity 1 is the same as the one that minimizes the price of commodity 2. Notice that the price of commodity 1 enters as an input into the costs of production for commodity 2. This implies that, irrespective of the country analysed, the cost of production for commodity 2 depends *positively* on the price of the input good 1. This is easy to see by taking the first partial derivative of the cost of production for commodity 2 in either country (equations (5.6) or (5.8)):

$$\frac{\partial c_2^i}{\partial p_1} = a_{12}^i(1 + r^i) > 0 \quad (5.48)$$

where  $i$  stands for either country  $A$  or country  $U$ . Therefore, in either country, the cost of production for commodity 2 is the lowest whenever the price of the input good 1 is the lowest. If the price of commodity 1 is the same in two or more specialization cases (as in Tables 5.3, 5.4, and 5.5), one must choose which among the specialization cases has the lowest cost for commodity 2. Regardless, there is a geographical distribution of production that minimizes the price of commodity 1 and also has the lowest price for commodity 2.<sup>79</sup> This proves the last part of the argument.

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<sup>79</sup> This is a consequence of the argument that the technique with the highest real wage has the lowest labour commanded price, or lowest money costs (see Pasinetti, 1977, pp. 159-60).

Therefore, this geographical distribution of production has a higher purchase power of workers in both commodities. This must also be true for any linear combination of the commodities. In particular, the purchasing power in terms of the wage baskets (equations (5.46) and (5.47)) will also be the highest. So, for given nominal wages, the geographical distribution that maximizes the real wage in country  $A$  also maximizes it in country  $U$ .

This justifies the assumption that there is only one consumption good. This does not affect the results as a higher real wage in terms of this single consumption good also imply a higher real wage in terms of any basket of goods.<sup>80</sup> As a consequence, it also justifies the assumption that the wage basket is the same in all countries. One may proceed with these simplifications without loss of generality.

### 5.9 Generalization to two countries and many commodities<sup>81</sup>

In this section, I provide a generalization of the argument for when there are two countries competing in the production of  $n$  commodities, with  $n > 2$ . This generalization does not add anything new to the intuition; but it serves mainly to argue that the monetary determination of international prices is not confined to the simple case of two countries and two commodities.

It is easy to adjust the model so it can deal with a situation where two countries compete in the production of  $n$  commodities ( $n > 2$ ), with all commodities tradable. There is no joint production or fixed capital.

For each country, there will be  $n$  equations to express the costs of production. So, for country  $A$ :

$$c_1^A = [p_1 a_{11}^A + \cdots + p_n a_{n1}^A](1 + r^A) + w^A l_1^A$$

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<sup>80</sup> This argument relies on the idea that the composition of the wage basket does not change *because* of changes in prices. So, the comparison must have the same wage basket in the situation ‘before’ and ‘after’ trade.

<sup>81</sup> Using a very similar argument, Appendix 5.1 to this chapter extends the argument for when there are  $m$  countries and  $n$  commodities, for  $n > m$ .

$$c_2^A = [p_1 a_{12}^A + \dots + p_n a_{n2}^A](1 + r^A) + w^A l_2^A$$

$\vdots$

$$c_n^A = [p_1 a_{1n}^A + \dots + p_n a_{nn}^A](1 + r^A) + w^A l_n^A$$

which can be compactly written in its matrix form as:

$$\mathbf{c}^A = \mathbf{p}\mathbf{A}^A(1 + r^A) + w^A \mathbf{l}^A \quad (5.49)$$

where  $\mathbf{c}^A$  is a row-vector of costs;  $\mathbf{p}$  is a row-vector of international prices;  $\mathbf{A}^A$  is the matrix of technical coefficients;  $r^A$  is the rate of profits;  $w^A$  is the nominal wage rate; and  $\mathbf{l}^A$  is a row-vector of direct labour coefficients. All relative to country  $A$ .

With obvious meanings, the equivalent system for country  $U$  is:

$$\mathbf{c}^U = \mathbf{p}\mathbf{A}^U(1 + r^U) + w^U \mathbf{l}^U \quad (5.50)$$

In line with Sraffa's closure, we assume that profit rates are given by the money rates of interest ( $i^A$  and  $i^U$ ):

$$r^A = i^A \quad (5.51)$$

$$r^U = i^U \quad (5.52)$$

We also assume that the real wage in both countries is measured by a fixed basket of goods:<sup>82</sup>

$$w_r^A = \frac{w^A}{\mathbf{p}\mathbf{b}} \quad (5.53)$$

$$w_r^U = \frac{w^U}{\mathbf{p}\mathbf{b}} \quad (5.54)$$

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<sup>82</sup> The assumption that workers consume the same basket of goods is not crucial to the argument and can be relaxed (see section 5.8 in this chapter).

where  $\mathbf{p}$  is the international price vector; and  $\mathbf{b}$  is a given column-vector with entries equal to the proportion of each good consumed. The scalars  $w_r^A$  and  $w_r^U$  measure how many wage baskets the workers can buy with their nominal wages.

Substituting conditions (5.51) and (5.52) into equations (5.49) and (5.50), the relevant cost systems with the possibility of trade are:

$$\mathbf{c}^A = \mathbf{p}\mathbf{A}^A(1 + i^A) + w^A\mathbf{l}^A \quad (5.55)$$

and

$$\mathbf{c}^U = \mathbf{p}\mathbf{A}^U(1 + i^U) + w^U\mathbf{l}^U \quad (5.56)$$

where the vector of international prices  $\mathbf{p}$  is not yet defined but is the same in both countries.

Now it is not possible to give an exhaustive list of all possible geographical distributions of production as in the two-countries-two-commodities case (see section 5.4 in this chapter). For each commodity, there are two alternative methods to produce it: either in country  $A$  or in country  $U$ . Therefore, by simple combinatorics, there are  $2^n$  possible geographical distributions of production.

However, the definition of the closed production systems is the same as in the two-countries-two-commodities setting. For the first one, country  $A$  concentrates all production. The international price of all commodities must be enough to cover country  $A$ 's costs of production:

$$\mathbf{p}^I = \mathbf{c}^A \quad (5.57)$$

where  $\mathbf{p}^I$  is the row-vector of international prices associated with the closed production system case I. Substituting condition (5.57) into equation (5.55), the vector of prices emerge as a function of the nominal wage rate, and the dated quantities of labour if everything is produced in country  $A$ :

$$\mathbf{p}^I = w^A \mathbf{L}^A \quad (5.58)$$

where  $\mathbf{L}^A = \mathbf{l}^A (\mathbf{I} - \mathbf{A}^A (1 + r^A))^{-1}$  is a row-vector with each entry equal to the respective dated quantity of labour; it is a function of the rate of profits ( $r^A$ ).

For the second closed production system, country  $U$  produces all commodities domestically (case II). The international prices of all commodities must be enough to cover their respective costs in country  $U$ :

$$\mathbf{p}^{II} = \mathbf{c}^U \quad (5.59)$$

where  $\mathbf{p}^{II}$  is the row-vector of international prices associated with this geographical distribution of production.

Substituting condition (5.59) into equation (5.56) and solving for  $\mathbf{p}^{II}$ , one gets:

$$\mathbf{p}^{II} = w^U \mathbf{L}^U \quad (5.60)$$

The international prices for case II are functions of country  $U$ 's nominal wage and the dated quantities of labour ( $\mathbf{L}^U$ ) if everything is produced inside country  $U$ .

As argued previously, it is not feasible to list all possible geographical distributions of production. However, we may show a representative one that allows general comparisons. For example, define the specialization pattern  $k$  (with  $k < n$ ) where country  $A$  produces all goods 1 through to  $k$  and country  $U$  produces goods  $k + 1$  through to  $n$ .<sup>83</sup> The international price of each commodity must be enough to cover the cost of the country that produces it. This condition can be written in vector form as:

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<sup>83</sup> This is representative because any specialization pattern can be described by it with a proper re-ordering of commodities (see Appendix 3.1 to Chapter 3).

$$\mathbf{p}^{(k)} = \begin{pmatrix} c_1^A \\ \vdots \\ c_k^A \\ - \\ c_{k+1}^U \\ \vdots \\ c_n^U \end{pmatrix}^t \triangleq \mathbf{c}^{(k)} \quad (5.61)$$

where  $\mathbf{p}^{(k)}$  and  $\mathbf{c}^{(k)}$  are the vectors of international prices and costs associated with this particular geographical distribution of production.

Define:

- $\mathbf{\Pi}^{(k)}$  is a diagonal matrix of profit rates, with elements  $\pi_{ii} = (1 + i^A)$  for  $1 \leq i \leq k$  and  $\pi_{ii} = (1 + i^U)$  for  $k + 1 \leq i \leq n$ ;
- $\mathbf{\Omega}^{(k)}$  is a diagonal matrix of nominal wage rates, with elements  $\omega_{ii} = w^A$  for  $1 \leq i \leq k$  and  $\omega_{ii} = (1 + w^U)$  for  $k + 1 \leq i \leq n$ ;
- $\mathbf{A}^{(k)}$  is a matrix of technical coefficients such as the first  $k$  columns are equal to the first  $k$  columns in  $\mathbf{A}^A$  and the rest of the columns are equal to columns  $k + 1$  through  $n$  from  $\mathbf{A}^U$ ;
- and  $\mathbf{l}^{(k)}$  is the row-vector of direct labour coefficients, with country  $A$ 's direct labour coefficients for the first  $k$  entries and country  $U$ 's direct labour coefficients for entries  $k + 1$  through  $n$ .

Using these definitions, the relevant system of cost equations can be written as:

$$\mathbf{c}^{(k)} = \mathbf{p}^{(k)} \mathbf{A}^{(k)} \mathbf{\Pi}^{(k)} + \mathbf{l}^{(k)} \mathbf{\Omega}^{(k)} \quad (5.62)$$

Substituting condition (5.61) into equation (5.62) and solving for  $\mathbf{p}^{(k)}$ :

$$\mathbf{p}^{(k)} = \mathbf{l}^{(k)} \mathbf{\Omega}^{(k)} (\mathbf{I} - \mathbf{A}^{(k)} \mathbf{\Pi}^{(k)})^{-1} \quad (5.63)$$



which shows the international prices as functions of the nominal wages and the dated quantities of labour for this integrated system. With appropriate indexing, we can write any of the  $2^n$  possible geographical distribution of production as an equivalent equation (5.63). Some of these systems may have negative prices; these systems may be discarded as they do not have economic significance. However, there will always be systems with positive prices because at least the closed production systems are economically meaningful (equations (5.58) and (5.60)).

The set  $K$  represents all geographical distributions of production in which all prices are positive. The cardinality of set  $K$  is at least 2 from the closed production systems, and at most  $2^n$  if every geographical distribution of production has positive prices.

Each geographical distribution of production belonging to  $K$  is a system in  $n$  equations and  $n + 2$  variables (the  $n$  prices and the two nominal wages). What is important is that, given nominal wages ( $w^A$  and  $w^U$ ) completely determines the money prices of production for every geographical distribution of production. Notice that all of them are a particular linear combination of the nominal wages, weighted by the appropriate dated quantities of labour.

Hence, it is possible to compare the *absolute* cheapness to produce any commodity (or bundle of commodities) among all systems with positive prices. In particular, we may find the geographical distribution of production that minimizes the cost of the wage bundle (see equations (5.53) and (5.54)):

$$\min_{k \in K} p^{(k)} b \quad (5.64)$$

To find the system with the minimal cost of the wage bundle is the same as finding the system that maximizes real wages (the residual variable). This provides enough justification as to why the geographical distribution of production is chosen based on the

*absolute* cheapness of production. This finishes a proof of existence for a geographical distribution of production that minimizes costs and maximizes real wages.

### 5.10 Brief remark on the degree of international capital mobility

Up to this point, the analysis has assumed non-uniformity of profit rates between countries. This follows from Ricardo's remark that capital is relatively immobile internationally (see section 2.2.1 in Chapter 2). As mentioned previously (section 2.3 in Chapter 2), some of the modern literature on absolute advantages has questioned this assumption. They criticize the idea of comparative advantages based on the idea that there is a tendency for uniformity of the rates of profit between countries (see Parrinello (2010); Shaikh (2016); Crespo *et al.* (2020); Bellino and Fratini (2021); among others).

It would represent too much of a detour to discuss which assumption fits better with the current configuration of the international economy. What this section intends to achieve is to clarify that the monetary determination offered in this chapter (see section 5.6) does not depend on either assumption.

Notice that the assumption regarding the profit rates was introduced to determine relative costs in the closed production systems (see equations (5.30) and (5.32)). Following Sraffa's suggestion, the rates of profit were assumed to be equal to the money rates of interest. The only requirement is that the profit rates are known before production. There is no analytical difference if profit rates are uniform or not between countries.

Therefore, the idea of free mobility of international capital could be easily introduced in the framework proposed in this thesis. This free mobility of capital establishes a uniform money rate of profit ( $i^*$ ) (see section 2.3.2 in Chapter 2); and equations (5.30) and (5.32) could be replaced by a single equation:

$$r^A = r^U = i^* \quad (5.65)$$

The rest of the analysis would follow in exactly the same way. There would be no implications to either the definition of comparative advantages or to the relevance of absolute advantages. So, our analysis provides a more fundamental role for absolute advantages that is independent of the assumption regarding the international mobility of capital.

## **5.11 Conclusion**

This chapter has extended the monetary determination of international prices to a capitalist system of production where capitalists own the means of production. This meant the abandonment of the assumption of zero profit rates from chapters 3 and 4. It has shown what are the necessary steps to establish the monetary determination of international prices in this more complex scenario.

The chapter started with the main building blocks of the analysis such as technology and the determinants of costs of production. It was shown that there is a one-to-one correspondence between the determination of international prices and the pattern of specialization since one implies the other. The chapter then explored to what extent comparative advantage and absolute advantage could act as the determinants of international prices.

The main contribution of the chapter has been to propose a novel closure to the system of international prices: a closure that relies on Pivetti's (1991) monetary theory of distribution. Following his suggestions, we take the rates of profit as governed by the money rates of interest and also the nominal wages as given. Together with the given technology, these two new assumptions formed the basis for the new closure.

The first of these assumptions is required because of the circularity of the production system. These kinds of models require that one of the distributive variables is given from the outside. Classical political economists closed the system with a given real wage; while Sraffa

(1960) showed that a given profit rate is also possible. Fixing the rates of profit by the money rates of interest achieves this result, as suggested by Sraffa (1960).

This assumption regarding profit rates allowed for a determination of relative prices in the closed production system. However, the integrated production systems remained indeterminate because of an unknown distribution between workers in different countries. This is how the indeterminacy of the terms of trade from section 2.1.2 in Chapter 2 reappears in this Sraffa-inspired formulation.

The second assumption fixed the nominal wages in each country, in line with the previous chapters. At this stage of the analysis, fixing nominal wages amounts to fixing the money costs in both countries. In other words, it defines the *scale* of prices and not only their relative values. The scale of prices is useful as it allows a comparison between the costs of producers in both countries, even with different profit rates and/or real wages.

This novel closure argues that absolute cost advantages dominate international trade; it is also supported by the classical process of price competition. With respect to the previous chapters, this extends the validity of the monetary closure to more general frameworks. The monetary closure proposed implies that absolute advantage is the main driver of specialization. This novel closure is able to determine the direction of trade based on the criteria of minimum cost of production.

Section 5.7 rethinks the usefulness of comparative advantage for a theory of international prices and specialization. It provides a definition of comparative advantage with positive profits and imported inputs. Comparative advantage is defined as differences in relative costs between the closed production systems. This led to a weak definition of comparative advantages in which the only possible assertion is that there is space for both countries to benefit from trade. It is weak insofar as it cannot determine international prices and/or the direction of trade.

Finally, the chapter relaxed some of the assumptions. First, it allowed workers from each country to consume different wage baskets. Second, it showed how the argument can be readily extended to a situation with two countries competing in the production of  $n$  commodities. These extensions are intended to show that this thesis's contributions do not rely on simplifying assumptions.

### Appendix 5.1 A multi-country-multi-commodity model

I now explore the case where there are  $m$  countries and  $n$  commodities, with more commodities than countries ( $n > m$ ). Each country has one method of production for each of the  $n$  commodities. As in the previous section, all commodities are tradable and there is no joint production or fixed capital. So, the domestic cost equations are a system of  $n$  equations. For country  $A$  this system in matrix form is:

$$\mathbf{c}^A = \mathbf{p}^A \mathbf{A}^A (1 + r^A) + w^A \mathbf{l}^A \quad (5.66)$$

with  $\mathbf{c}^A$  a row-vector of costs;  $\mathbf{p}^A$  a row-vector of prices;  $\mathbf{A}^A$  the matrix of technical coefficients;  $r^A$  the rate of profits;  $w^A$  the nominal wage rate; and  $\mathbf{l}^A$  the row-vector of direct labour coefficients. All relative to country  $A$ .

Equivalent systems of cost exist for every country:

$$\begin{aligned} \mathbf{c}^B &= \mathbf{p}^B \mathbf{A}^B (1 + r^B) + w^B \mathbf{l}^B \\ &\vdots \end{aligned} \quad (5.67)$$

$$\mathbf{c}^m = \mathbf{p}^m \mathbf{A}^m (1 + r^m) + w^m \mathbf{l}^m$$

If countries can freely trade among themselves, then the law of one price holds as a non-arbitrage condition:

$$\mathbf{p}^A = \mathbf{p}^B = \dots = \mathbf{p}^m = \mathbf{p} \quad (5.68)$$

where  $\mathbf{p}$  is the international vector of prices.

Same as before, we assume that the rate of profits in each country is given by the money rates of interest:

$$\begin{aligned} r^A &= i^A \\ &\vdots \end{aligned} \quad (5.69)$$

$$r^m = i^m$$

Furthermore, we assume that workers measure their real wages against a fixed basket of goods. Every country shares the same wage basket; so, the purchasing power of workers (the real wage) might be different from country to country, but the composition of the wage basket is the same:

$$\begin{aligned} w_r^A &= \frac{w^A}{\mathbf{p}\mathbf{b}} \\ &\vdots \\ w_r^m &= \frac{w^m}{\mathbf{p}\mathbf{b}} \end{aligned} \tag{5.70}$$

where  $w_r^A$  through to  $w_r^m$  are the real wages; and  $\mathbf{b}$  is a column-vector with each entry  $b_j$  representing the proportion of commodity  $j$  that enters into the wage basket.

Substituting conditions (5.68) and (5.69) into equations (5.66) and (5.67), the relevant cost equations with the possibility of trade are:

$$\begin{aligned} \mathbf{c}^A &= \mathbf{p}\mathbf{A}^A(1 + i^A) + w^A\mathbf{l}^A \\ &\vdots \\ \mathbf{c}^m &= \mathbf{p}\mathbf{A}^m(1 + i^m) + w^m\mathbf{l}^m \end{aligned} \tag{5.71}$$

It is also not feasible to provide an exhaustive list of all possible geographical distributions of production. For each commodity, there are  $m$  alternative methods to produce it: one for each of the  $m$  countries. So, there are up to  $m^n$  possible geographical distributions of production (some of them may have negative prices).

However, the determination of the closed production systems looks exactly the same. Remember that the closed production systems have one country that concentrates the production of all goods. So, for each of the  $m$  closed production systems, the vector of

international prices ( $\mathbf{p}^{(m)}$ ) must be equal to the respective vector of costs; but, the vector of costs is proportional to the dated quantities of labour if that country concentrates production:

$$\begin{aligned} \mathbf{p}^I &= w^A \mathbf{L}^A \\ \mathbf{p}^{II} &= w^B \mathbf{L}^B \\ &\vdots \\ \mathbf{p}^{(m)} &= w^m \mathbf{L}^m \end{aligned} \tag{5.72}$$

where  $\mathbf{p}^I$ ,  $\mathbf{p}^{II}$ , ..., and  $\mathbf{p}^{(m)}$  are the vector of international prices associated with each closed production system.

As in the previous section of two countries and  $n$  commodities, we may use a representative system for the integrated production systems (i.e., when production is dispersed among countries). This is necessary because, as argued previously, there are too many possible geographical distributions of production.

So, for example, assume that in the integrated production system  $k$  country  $A$  produces commodity 1, country  $B$  produces commodity 2, ..., country  $m - 1$  produces commodity  $m - 1$ , and country  $m$  produces commodities  $m$  through  $n$ . That means that each country produces a single commodity except for country  $m$  that produces  $n - m + 1$  commodities. The international prices associated with this geographical distribution of production ( $\mathbf{p}^{(k)}$ )

$$\mathbf{p}^{(k)} = \begin{pmatrix} c_1^A \\ c_2^B \\ \vdots \\ c_{m-1}^{m-1} \\ \hline c_m^m \\ \vdots \\ c_n^m \end{pmatrix}^t \triangleq \mathbf{c}^{(k)} \tag{5.73}$$



where  $\mathbf{p}^{(k)}$  and  $\mathbf{c}^{(k)}$  are the row-vectors of international prices and costs associated with this particular geographical distribution of production.

Define:

- $\mathbf{\Pi}^{(k)}$  is a diagonal matrix of profit rates with first entry equal to  $(1 + i^A)$ , second entry equal to  $(1 + i^B)$ , ...,  $(m - 1)$ th entry equal to  $(1 + i^{m-1})$ , and entries  $m$  through  $n$  equal to  $(1 + i^m)$ ;
- $\mathbf{\Omega}^{(k)}$  is a diagonal matrix of nominal wage rates with first entry equal to  $w^A$ , second entry equal to  $w^B$ , ...,  $(m - 1)$ th entry equal to  $w^{m-1}$ , and entries  $m$  through  $n$  equal to  $w^m$ ;
- $\mathbf{A}^{(k)}$  is a square matrix of technical coefficients such as the first column is equal to the first column in  $\mathbf{A}^A$ , the second column is equal to the second column in  $\mathbf{A}^B$ , ..., the  $(m - 1)$ th column is equal to the  $(m - 1)$ th column in  $\mathbf{A}^{m-1}$ , and the rest of the columns are equal to columns  $m$  through  $n$  from  $\mathbf{A}^m$ ;
- and  $\mathbf{l}^{(k)}$  is the row-vector of direct labour requirements with the first entry equal to the first column in  $\mathbf{l}^A$ , the second entry equal to the second element in  $\mathbf{l}^B$ , ..., the  $(m - 1)$ th entry equal to the  $(m - 1)$ th element in  $\mathbf{l}^{m-1}$ , and entries  $m$  through  $n$  equal to elements  $m$  through  $n$  in  $\mathbf{l}^m$ .

Using these definitions, the relevant system of cost equations for specialization pattern  $k$  is:

$$\mathbf{c}^{(k)} = \mathbf{p}^{(k)} \mathbf{A}^{(k)} \mathbf{\Pi}^{(k)} + \mathbf{l}^{(k)} \mathbf{\Omega}^{(k)} \quad (5.74)$$

Substituting condition (5.73) into equation (5.74) and solving for  $\mathbf{p}^{(k)}$ :

$$\mathbf{p}^{(k)} = \mathbf{l}^{(k)} \mathbf{\Omega}^{(k)} (\mathbf{I} - \mathbf{A}^{(k)} \mathbf{\Pi}^{(k)})^{-1} \quad (5.75)$$

which represents the necessary international prices as functions of nominal wages ( $\mathbf{\Omega}^{(k)}$ ) and the dated quantities of labour for this integrated system.

It is clear that, with appropriate definitions of  $\mathbf{\Pi}^{(k)}$ ,  $\mathbf{\Omega}^{(k)}$ ,  $\mathbf{A}^{(k)}$ , and  $\mathbf{l}^{(k)}$ , it is possible to express any geographical distribution of production as an equivalent system (5.75). Some of these systems may have negative prices; we may discard these systems as they are not economically significant. We know for sure that the closed production systems have positive prices, so there are at least  $m$  viable systems.

Define set  $K$  as the set of all patterns of specialization with positive prices. The cardinality of set  $K$  is at least  $m$  from the closed production systems and at most  $m^n$  if all systems have positive prices.

What is important is that the money prices of every system are completely determined by known nominal wages (for given profit rates). Hence, we can apply the same criteria of cost competitiveness to find the ‘best’ system as the one with the lowest *absolute* costs/prices. In particular, we may find which of the systems minimizes the cost of the wage bundle (see equation (5.70)). Formally this can be expressed as the minimization problem:

$$\min_{k \in K} \mathbf{p}^{(k)} \mathbf{b} \quad (5.76)$$

The system with the lowest price for the wage bundle is the same as the system with the highest real wages (the residual variable). This is a proof of existence based on the criteria of lowest cost (or highest real wages).

## **Chapter 6: Conclusion**

This thesis starts from the observed need to understand the rise of Global Value Chains (GVCs) and their consequences. The GVC phenomenon is distilled to its fundamental characteristic: trade in intermediate goods. But before introducing intermediate goods, the thesis takes a step back and analyses the theories of international trade from a classical production-based approach. The focus of the thesis is on the determination of international prices.

The thesis delves into the main ways in which classical political economy tries to explain international prices. The guiding concept is the specific closures available in the literature. By identifying shortcomings in the literature, both theoretical and empirical, the thesis delineates the gaps to be filled.

The thesis fills these gaps by asserting the relevance of absolute cost advantages in the theory of international prices, based on the classical concept of price competition. This is done in a systematic way: following the methodological approach formulated by Pasinetti (1981, 1993), I pursue a layered step-by-step approach where at each stage additional complexities are introduced. Each layer generalizes the achievements from the previous layer, adding robustness to the results.

In the first step, I formalize some of Pasinetti's insights on international trade using a pure labour model. Based on wage disparities, I show that competition between countries is regulated by absolute cost advantage. With a given technology, differences in wages are sufficient to evaluate which country can produce the goods at the cheapest price. This notion of absolute advantage is the same as the classical concept of price competition.

In the second step, I introduce trade in intermediate goods into the framework: countries may import some of their input requirements from other countries. Drawing from an example in Baldone et al. (2007), I show that wage disparities imply an absolute cost advantage also when there is trade in inputs.

In the third step, I introduce positive rates of profit into the analysis. This brings the framework closer to that in Sraffa (1960). With positive rates of profit, it is necessary to introduce an assumption regarding distributive variables; following Sraffa (1960) and Pivetti (1991), I show that given profit rates define cost ratios inside trading countries. However, this is not enough to define cost ratios between countries. To do so, I show that wage disparities are sufficient to determine international prices based on absolute costs advantage.

In this chapter, I offer a summary of the contributions from this thesis. I also point to possible routes that future research may take.

## **6.1 Contributions**

In section 1.2 of Chapter 1, I introduce the research questions for the thesis and its objectives. In this section, I delineate each contribution of my research as it relates to these questions and objectives.

The first objective is to understand how the classical political economy literature examines international trade. Chapter 2 tackles this by offering a systematic survey of the main contributions from the classical political economy literature. It contributes by organizing the literature according to a central theme: the extra assumptions that are employed to close the system of international prices. The chapter critically evaluates each closure, identifying problems according to their theoretical structure and empirical plausibility.

Chapter 2 identifies three main closures in the history of thought: balanced trade, equal growth rates, and free international mobility of capital. The first closure is associated with Ricardo and other classical economics (sections 2.2.1, 2.2.2, and 2.2.3). It establishes equilibrium in the trade balance as the only stable position for trading relationships. As argued, this struggles to conform to the modern world where countries run persistent trade deficits and surpluses. The second closure is associated with Steedman's work (see section

2.2.5). It argues that countries grow at an equal rate so they may maintain trading relationships without one outgrowing the other. It is basically the same as an equilibrium under balanced trade but set in a dynamic setting; it suffers from the same empirical problems as associated with Ricardo. It also struggles to adjust to the fact that countries do not tend to grow at the same rate.

The last closure is associated with modern classical political economists such as Brewer, Shaikh, and Parrinello (see section 2.3). It relies on the idea that the modern world is characterized by free mobility of capital between countries which leads to the establishment of a uniform international rate of profit. The international equalization of profit rates links the productive structure in trading countries. The main drawback of this closure is that it implies a long-run equilibrium in the balance of payments. However, the international system is organized around one country that controls the international currency (namely the US dollar); meaning that it can finance persistent deficits in its balance of payments. It also struggles to conform to stylized facts as countries are not in a balance of payments equilibrium, even as a long-run tendency.

The main contribution of the thesis is to free the analysis of international trade from these closures, whilst keeping within the rubric of a classical political economy framework. To do this, the thesis contributes with a novel closure based on wage disparities. This provides an alternative framework to think about international trade and competition.

The second objective is to evaluate the role of two key concepts, absolute and comparative advantage, from a classical political economy perspective. This is achieved in successive stages. These re-definitions of absolute and comparative advantage form the basis for a reconsideration of their roles in international trade. Chapter 3 builds a pure labour model, following Pasinetti (1993). As far as I am aware, it is the first formalization in the literature of Pasinetti's insights on international trade. It argues that absolute advantage should be defined in terms of the lowest cost of production, where the cost of production is

understood as the labour coefficient multiplied by the nominal wage. On the other hand, comparative advantage is defined by the conventional measure of labour coefficient ratios.

Chapter 4 generalizes these definitions for a situation in which there is trade in intermediate goods. Absolute cost advantage emerges as the lowest cost of production; the cost of production now includes the wage and intermediate input costs. The chapter offers an analytical separation between situations when all production is concentrated in one country (closed production systems) and when countries use imported inputs (integrated production systems). Regarding comparative advantage, it shows that this can be defined based on the ratios of vertically integrated labour coefficients for closed production systems. The vertically integrated labour coefficients capture labour that enters directly and indirectly into the production of a commodity, expanding from the pure labour restrictions of Chapter 3.

Chapter 5 generalizes these definitions further to include positive rates of profit. Absolute cost advantage as the lowest cost of production must include wage costs, input costs, and the normal profit rate. This chapter shows that a closure based on Pivetti (1991), with given profit rates and given nominal wages, is sufficient to determine absolute cost advantage. Absolute cost advantage then determines both international prices and the pattern of specialization. Comparative advantage is defined based on Sraffa's (1960) concept of dated quantities of labour for closed production systems; it only plays a limited role in the analysis by eliminating some conceivable patterns of specialization.

Regardless of the level of abstraction and complexity, the thesis argues that absolute cost advantage is the main determinant of international prices and specialization. The thesis shows that comparative advantage has only a limited role; it only defines the boundaries in which mutually beneficial trade is possible. Absolute cost advantage, however, is essentially the classical concept of price competition and must be valid, irrespective of whether comparative advantage is valid or not.

The final objective of the thesis is to explore the role of nominal wages in the determination of absolute cost advantage. In the pure labour model in Chapter 3, I argue that absolute cost advantage depends on wage disparities as compared to technological disparities. Wage disparities larger than technological disparities may lead to one country having lower costs of production in all goods; the other country cannot compete even in commodities for which it has a comparative advantage.

Chapter 4 generalizes this result to include trade in intermediate goods. It expands from an illustration in Baldone et al. (2007) to show how an assumption of given nominal wages leads to a pre-eminence of absolute advantages in the determination of international prices and specialization. The chapter shows that this result relies solely on given wage disparities, instead of on the existence of trade in intermediates as Baldone et al. (2007) argue.

Chapter 5 develops this argument further, by using this assumption to close a Sraffa-inspired system of international prices, with trade in intermediate goods and positive rates of profit. Following Pivetti (1991), Chapter 5 contributes by showing how given profit rates and nominal wages determine international prices and specialization. This precludes the strong assumptions associated with balanced trade, equal growth rates, or free international mobility of capital. Chapter 5 also offers some generalizations for when there are more than two countries and/or commodities.

Summing up, the thesis contributes with a novel closure to the system of international prices based on given wage disparities. This is shown to hold in a production-based framework, from the simplest to more complex configurations.

## **6.2 Limitations and future research**

There are clear theoretical limitations with the model proposed in the thesis. To overcome these limitations means to consider complexities that more closely reflect real-

world considerations. In this section I explore how future work may address these limitations; I also point to connections with other areas of economics and possible empirical investigations.

One limitation of the thesis is that it assumes away fixed capital and joint production. These are important topics in any theory of production and there is a substantial literature on them following a classical political economy framework (see Pasinetti, 1980; Schefold, 1989; Lager, 2006). Therefore, subsequent works can implement these features into the model to investigate if the main propositions hold or if modifications are needed. This would allow for consideration of complexities that more closely reflect real-world production.

Another limitation of the thesis is the absence of trade policies such as duties and tariffs on imported goods and taxes on exported goods. These are important real-world elements in international trade relations. Further research can include these policies into the production framework proposed in this thesis.

The inclusion of trade policies also opens other research possibilities. Some of the discussions on growth and development advocate for protectionist policies; one of the basic arguments is that countries should and have implemented tariff protection to promote their industries and key sectors. This is true for the ‘infant industry’ argument (Hamilton, 1791; List, 1909), the ‘import substitution industrialization’ model (see Frieden, 2017, chap. 13), and it has been argued that most historical examples of industrial development relied on protectionist policies (Chang, 2002). The framework in this thesis can be used to analyse such policies aimed at raising domestic sectoral competitiveness. For example, it can be used to measure how much of an import tariff is necessary to protect a particular sector from foreign competition.

Another interesting topic to explore is how introducing transport costs affect the results. When there are significant geographical distances to traverse, transport costs become even more significant. Introducing these costs may allow for a proper distinction of relevant



markets. For example, it could be the case that Brazil and China produce poultry meat. However, due to transport costs, Brazilian poultry cannot compete in Asian markets while Chinese poultry cannot compete in Latin American markets. World competition gets reduced to regional competition; there may be more than one world producer with the lowest costs once transport costs are introduced.

Another possible route is to explore the connections between this thesis and Keynesian macroeconomics, especially open economy macroeconomics. One relevant research agenda is the Balance of Payments Constrained Growth models. In its more simple formulations, these models usually assume that the terms of trade are constant: “if relative prices measured in a common currency do not change over the long run” (Thirlwall, 1979, p. 49). Since this thesis aims at explaining long run or normal international prices, it can be used as a foundation for evaluating this assumption.

Moving away from pure theory concerns, the theoretical framework proposed in this thesis can also be employed for empirical analysis. As mentioned in the introduction (see Chapter 1), the key role played by GVCs provides motivation for this research. So, it is only logical to apply it to a study of GVCs. There are possible links between this thesis’s framework and previous empirical research using input-output methods (see Timmer et al., 2015; Escaith and Miroudot, 2016; and the survey by Johnson, 2018).

This thesis is based on the idea that nominal wages, or their ratios, can be taken as given. Some evidence is provided for this hypothesis in terms of stylized facts (see Figures 5.1 and 5.2 in Chapter 5). Thus, a possible area to explore in the future is a thorough empirical analysis of this hypothesis, with econometric methods employed to investigate the robustness of this assumption. It can also be used to explain what causes such persistent ratios in nominal wages, when measured in a common currency.

## References

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