

THE STRUCTURE OF PRODUCTION AND PORTFOLIO DECISIONS OF
INVESTMENT

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ANDRES FELIPE CANTILLO

M.A., University of Missouri-Kansas City, 2013

B.A., Universidad Nacional de Colombia-Bogota, 2004

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Andres Felipe Cantillo, Candidate for the Doctor of Philosophy Degree.

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ABSTRACT

Orthodox portfolio theory is at the center of the way neoclassical economics understands private investment and economic policy. Nonetheless, this theory is highly vulnerable to multiple criticisms, and its empirical validity is doubtful. This dissertation proposes an alternative to orthodox portfolio theory. The methodological core rests on the fact that the future in economics is fundamentally uncertain. This work proposes a methodology that refocuses the epistemic problem of decision-making, from predictive methods, to the generation of a language that acknowledges society's capacity to create its economic future.

The two analytical methods used here: 1- The Potential Surprise Function and 2- The Sraffa-Pasinetti framework, are compatible with this aim. The present dissertation identifies and develops a new concept that, in spite of its crucial importance, has remained

hidden in the literature: The notion of the production commitment. The latter projects itself as the general form of money and financial assets. The present dissertation shows how the financial and the productive sides of the economy are inherently connected. Collective production requires division of labor. Division of labor requires the formulation of production commitments. The latter are, by definition, based on expectations.

By unveiling the production commitments in the Sraffa-Pasinetti framework, the present work proposes a way to assess the compatibility of the current structure of production and the required structure of production commitments, with the existing structure of financial assets. The proposed methodology generalizes the inter-sectoral approach proposed by Keynes' General Theory, with the inter-industry side.

The structure of production is in continuous transformation due to the effects of production commitments, innovation and surprise. A language compatible with this transformative character of the economy is required. This is the role of the potential surprise function. Because of its capabilities of communicating more fully all the factors that intervene in economic decisions, this language more accurately reflects the way decision-makers view the future. The Sraffa-Pasinetti framework depicts the structure of production, production commitments unveil its expectational character, and the potential surprise function provides a way to communicate those, in monetary terms.

APPROVAL PAGE

The faculty listed below, appointed by the Dean of the School of Graduate Studies, have examined a dissertation titled “The Structure of Production and Portfolio Decisions of Investment” presented by Andres Felipe Cantillo, candidate for the Doctor of Philosophy degree, and certify that in their opinion is worthy of acceptance.

Supervisory Committee

Jan Kregel, Ph.D., Committee Co-chair and Research Director
Department of Economics

Erik K. Olsen Ph.D., Committee Co-chair
Department of Economics

John F. Henry Ph.D.
Department of Economics

Peter Eaton Ph.D.
Department of Economics

Yong Zeng Ph.D.
Department of Mathematics and Statistics

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To the memory of Professor Frederic S. Lee

INTRODUCTION

Every act of production entails division of labor. Division of labor requires a set of reliable commitments of production. The importance of production commitments has remained hidden. Smith (1776) explained the underpinnings of division of labor and its influence in the productive and price systems. Nevertheless, he failed to recognize the implications of the corresponding commitments of production.

Theories that have tried to explain debt markets (that is, financial assets) have grown apart from theories that explain production. In some of those paradigms, the role of money in the division of labor is to serve as a medium of exchange. One example is the quantitative theory of money. According to this theory, changes in the quantity of money can only affect the level of output indirectly through distortions in prices (Friedman, 1968).

Heterodox approaches are not exempt from this trend. Modern Monetary Theory has centered its attention on explaining the institutional role of money as an instrument for keeping track of debts and as a requirement for the payment of taxes (Wray, 2012). Stock flow consistent models have concentrated on the credit/debit relationships between sectors and how these imbalances evolve over time (Godley & Lavoie, 2012). Although these theories connect production to money, their approach lacks an important aspect of this relationship which emerges directly from the division of labor: The production commitment.

Keynes (1936) is closer to Smith (1776) in that the focus of his economic theory is labor. Unlike Smith, Keynes is not concerned with the way labor is divided among

industries and the relation of this division with prices, profits and rents (Keynes, 1936, p.4). Instead, Keynes focused on the determinants of the current level of employment. Like Smith, Keynes does not mention or explain the notion of production commitment implied in his argument. Keynes takes as given the division of labor across industries in order to explain the determinants of the current aggregate level of employment. The rationale for this change of focus lays on his discovery of involuntary unemployment. Firms, and not workers, decide how much labor they want to hire based on their expectations of future proceeds. Those expectations can be divided in two types: Short run expectations (held by the producers of wage or consumption commodities) and long run expectations (held by the producers of investment commodities). Since wages are paid post-factum, investment expectations affect the current level of employment and thus, the expectations of wage goods industries. Changes in hiring by the producers of wage goods also affect expectations held by the producers of investment goods. Within this interwoven and transmutable network of short and long run expectations, Keynes singles out the loose thread of investment as the driving force of the current level of employment. Keynes monetary analysis shows that the money interest rate in conjunction with the marginal efficiency of investment explain the current level of investment. As long as current investment does not jeopardize the value of future private investment, there can be as much investment expenditure as desired in order to sustain a given level of employment.

Keynes centered his analysis on the division of labor between the production of consumption and investment sectors while taking as given the division of labor across industries. This analytical simplification leaves unexplained the inter-industry character of

the production commitments whilst keeping their inter-temporal dimension. In failing to identify the importance of production commitments in his analysis, Keynes missed the opportunity to generalize his analysis to the case in which inter-industry commitments are not given.

Other theories centered their efforts in the inter-industry relations and developed connections between the inter-industry and inter-sectoral sides of the economy. Like the classics¹ Sraffa (1963) was concerned with understanding distribution and its relationship with prices. By assuming self-replacement, Sraffa was able to take the influence of expectations as given. With his proposed notion of sub-systems, Sraffa (1963, p. 89) sought to determine the quantity of labor directly and indirectly required for the production of commodities. Pasinetti (1973) extended the implications of this analysis with his notion of vertical integration. With the concept of vertical integration Pasinetti managed to reclassify industries in consumption and investment sectors. Pasinetti connected Sraffa's and Leontief's inter-industry analysis with the inter-sectoral analysis of consumption and investment commodities. This is a crucial step in finding a connection between the structure of production represented by Sraffian models, and Keynes' inter-sectoral analysis. Nevertheless, like his classical predecessors, Pasinetti failed to identify the implicit structure of production commitments associated with his representation of the structure of production.

¹ This term is used here in the same way Keynes (1936, p. 3) did.

The present dissertation makes explicit the structure of production commitments implied in the analysis of the structure of production. This provides a way to connect Keynes inter-sector analysis of monetary production with the inter-industry analysis. Money is a special type of promise that can only be fulfilled with new production or the redistribution of current production. Financial assets are promises made in monetary terms. By using the notion of production commitments it is possible to measure the amount of financial leverage in relation to the production commitments required by a given structure of production. The monetary value of inputs (including labor whose value is measured by the wage bill) and the associated production (also measured in monetary terms) to which they are committed, can be compared to the current monetary value of financial assets and their respective committed cash flows so as to make an assessment of the functionality of these two sides of the economy. Even though measured in monetary terms, within the Sraffa-Pasinetti framework, capital still preserves its role within the productive structure of the economy. The technical input-output relationships of production and their self-replacement are an important factor, but not the only one, in the formulation of expectation. Innovation and surprise affect the formulation of production commitments and the resulting productive structure.

Within a monetary economy, decisions of production are made based on expectations (Keynes, 1936, p. vii). The realization of the importance of production commitments is not aimed at reducing the level of uncertainty in the economy. The inherently simultaneous character of layers of production commitments which are being

continuously formulated, requires a framework that understands the process of formulation of expectations in monetary terms. Shackle (1949 *et al*) provides such an alternative.

Orthodox portfolio theories are based on the idea that it is possible to make a statistical assessment of monetary returns. This idea is intimately intertwined with the rational expectations hypothesis, the market efficiency hypothesis and with the quantitative theory of money. All these approaches overlook the importance of the production commitments, their fallibility and their relationship with money and financial assets. A new approach to portfolio investment decisions is proposed here, based on the notion of the production commitment. This has not been done before. The beginnings of such a theory are proposed in the course of the following pages. This main contribution is sustained by three pillars: The first makes explicit the notion of production commitments in the analysis of production and money. The second develops, in analytical terms, the structure of production commitments associated with a given structure of production. The third proposes a way of formulating expectations that allows for the transmutation of the structure of production.

Chapter one explains the role of production commitments in the division of labor. In addition, it makes an assessment of orthodox portfolio theory and makes the case for the need of a new paradigm that explains investment. This chapter shows that one of the weaknesses of orthodox portfolio theory is that it implicitly assumes that the inter-industry analysis can be obtained by default from the inter-sector analysis. One of the reasons for that, is its complete denial of production commitments. A contrast is made with Sraffa's own interest rates, a centerpiece of Keynes' *General Theory*. This chapter also explains the

relation between Pasinetti's analysis of production and Keynes' *General Theory*. According to the proposed perspective, production commitments are the way in which money and monetary assets are related to production.

The Second chapter makes explicit the commitments of production implied by the Sraffa-Pasinetti analysis of vertical integration. This exposes a closer connection between Keynes' monetary inter-sector analysis and the Sraffa-Pasinetti analysis of production. The Sraffa-Pasinetti framework can be used as part of the process of expectation formation. As a result, it is possible to use a given structure of production in order to make an assessment of the amount of leverage in the economy. Chapter 3 shows that the structure of production, and production commitments can be used as part of an expectational language suitable for the formation of expectations in a monetary economy. Chapter 4 proposes a way to formulate investment expectations which dovetails with the transmutable character of monetary economies; it is the third element in the proposed expectational language. The conclusions chapter explains the implications for monetary policy and economic theory.

The main conclusions of the present dissertation can be summarized as follows: since production requires the formulation of production commitments, economic production is expectational. Production requires the commitment of labor across industries and between sectors. Financial assets must be grounded in production if they are not to be merely redistributive. In a monetary economy, commitments do not need to conform to a given structure of production. It is necessary to analyze the conditions under which such correspondence can occur. One way to do this is with the use of the Sraffa-Pasinetti framework. This analysis can be used as part of a method for the formulation of

expectations about how the economy works. Unlike orthodox portfolio theories, this method takes into account the monetary character of economies. It is possible to reformulate investment expectations with a language that is not constrained by rationality. Shackle's potential surprise function offers a way to express expectations that complements Keynes' analysis of investment. The continuous origination of the current economic mosaic is better understood with a language that acknowledges the creativity of decision-makers and their particular circumstances of time and place. Those are always out of reach from the economic analyst. These conclusions highlight the production commitment as a central notion in economics. Commitments of production are the missing link that connects the structure of production to expectations and to the monetary character of economies. This type of analysis has not been done before.

The concept of division of labor has been extensively developed in the literature. Smith (2007 [1776] pp. 3-14) explained the underpinnings of this notion and some of its most salient implications. Nonetheless, as Schumpeter (1954, p. 187) and Marx (1990 [1867], p. 468) point out, other authors prior to Smith had already laid down its foundations. For a survey on the literature about division of labor see Marx (1990 [1867], pp. 439-491), Marshall (1961 [1920]) and Schumpeter (1954, p.1237). The dissertation begins with the notion of division of labor in its general form of co-operation as explained in Marx (1990, [1867], pp. 439-454). Marx, however, did not explicitly identify production commitments with co-operation. Nor did he develop the relationship between production commitments and money.

Money and capital are gradually introduced in the argument. The former takes a general form within co-operation, through its role in the formulation of production commitments. The latter is meant to denote produced means of production. Chapter 2 specifies the role of the distributional variables (profits and wages) within the productive structure in general. This is done without dealing at length with distributional issues. A detailed analysis of distribution in connection with the present dissertation is left for future inquiry. Such query would require, amongst other topics, a complete discussion of the reproduction schemes explained in Marx (1990 [1884]) which surpasses the scope of this dissertation. A step in this direction is taken by connecting production commitments to money, and the latter to expectations, and the evolution of the structure of production within a Sraffian/Keynesian framework. Since wages and profits are socially established, the units in which profits and wages are measured account for labor and capital in two ways: as social products and as productive resources. This allows to define consumption in such a way that it includes factors like the human aspects in the work place and environmental considerations.

The deterministic role that is sometimes associated to investment by using probabilistic models of investment (like the two factors approach to investment put forth by orthodox portfolio theory criticized here), mutilates the multidimensional character of investors as human beings. Marx (1990 [1890]) diagnosed this pathology in specialized workers under capitalistic manufacture. A complete comparison between Marx's and Schumpeter's (Schumpeter, 1961) ideas is left for further research. As a mere contention, it can be argued that Marx, Schumpeter, Keynes and Shackle all wanted to rescue

dimensions of human behavior hijacked by economic orthodoxy. From Marx's² point of view, true entrepreneurship and co-operation can only occur outside a class-based system. For Schumpeter, Keynes and Shackle, entrepreneurship and co-operation can occur within capitalism. Because of its generality, the analytical framework presented here is intended to be used in conjunction with both approaches. It is compatible with monetary decisions of investment in which creativity and innovation are accepted as part of the economic phenomenon. This is one of Shackle's contribution to the expectational structure of production.

Two final points must be made in order to clarify the direction argument. The present monograph solves the major problem spotted by Schumpeter (1954, p. 280) in Keynes (1936) in regards to the development of a monetary theory of production. As Schumpeter (1954) rightly points out, the analysis of *The General Theory* limited to an inter-sectoral framework. Nonetheless, it is argued here that Keynes' framework offers the possibility of complementation with the Sraffian-Pasinetti framework and its implicit expectational character. Schumpeter (1954) proposed as solution to this the aforementioned limitation. Unlike Schumpeter however, this dissertation is not framed in a Walrasian framework. Lastly, as a by-product of the joint expectational inter-industry/inter-sectoral analysis, this dissertation entails the beginnings of the consolidation between the production and financial macroeconomic identities.

² *Ibid.*

CHAPTER 1
PRODUCTION COMMITMENTS, THE STRUCTURE OF PRODUCTION AND
PORTFOLIO THEORY

1.1 The Division of Labor, Commitments of Production and Money

Production occurs in a collective fashion by means of the division of labor. Labor may be divided amongst producers and across groups formed by them³. It can be divided horizontally, which occurs simultaneously and necessarily among different producers, or vertically meaning that it occurs sequentially through time. The crucial difference between vertical and horizontal division of labor is the importance assigned to the producer's wear and tear (that is, on their plant and equipment) and their *aging*⁴. The division of labor has the capacity to generate inherently collective production which is different from the simple addition of individual productions. If inherently collective, the division of labor increases productivity and/or combines the physical properties of different productions obtaining new properties not found without the aforementioned combination.

³ Generally considered, a producer is an entity whose individuality or collectivity depends on the units chosen and the level of aggregation. For instance, a firm cataloged as an individual producer is also a collective entity: a group of other cataloged individuals (the firm's departments or the people who are part of them). This general consideration acknowledges the collective dimension of seemingly individual entities. More importantly, as will be explained below, the role of producers is socially constructed. Division of labor must be contextualized within a given level of aggregation.

⁴ Such importance can be defined by the character of producers as *going concerns*.

In a going economy⁵, inherently collective production (abbreviated collective production) under the circumstances of the division of labor requires the capacity of making reliable promises or commitments of production. Bakers dedicate themselves to producing bread because they believe that they will be able to obtain other requirements for sustenance from other producers. Neither producer would specialize if they did not rely on the other producer's commitment to produce the goods required for their sustenance. The bakers in need of meat would not specialize in producing bread if they could not rely on the butcher's commitment. The commitment can take many forms, verbal, written, tacit or merely instinctive⁶.

⁵ I use the concept of *going economy* as defined in Lee (2011) although the theoretical framework is different from the one proposed by the author. Lee defines the notion of a going economy as follows:

As a theoretical concept and a methodological approach, the economy as a going concern is abstracted from its historical origins and situated historically. That is, it represents a 'currently' functioning working capitalist economy complete with structures, agency, social fabric, and social activities. Hence, the structures that give the economy its form, the organizations and institutions that structurally organize and coordinate economic activity, and the agency or acting person that initiates and directs economic activity operate interdependently, contemporarily, although not necessarily synchronically. So while the structures, organizations, and institutions provide the framework for the economy to be a going concern, to continuously generate economic activities, it is the acting person that makes it happen or not—the economy does nothing on its own accord. (Lee, 2011, p. 1283).

⁶ This analysis is not restricted to a barter economy. Broadly considered, production commitments, whether in their tacit or explicit form, are required for a collective production in which division of labor operates. Such requirement does not imply the pursuit of individual benefit or any other particular motivation. The proposed relation between division of labor and production commitments occurs in species other than humans, in cells and other collective entities (Marshall, 1961, p. 242). This relation can be consciously or unconsciously achieved. In both cases is necessary for the division of labor to occur. There are multiple forms in which commitments are formulated, and motivations for their establishment. The present dissertation concentrates in making those commitments explicit

Every act of production must begin with the social acceptance of the commitment⁷. Before engaging in a process of production a producer needs the means for carrying it on which are in turn the outcome of past productions (a production based merely on inputs from nature is autarchy; the input labor is the outcome of past productions). Original production or production where labor is combined with other inputs for the first time is equivalent to a situation of autarchy in which no other producers, aside from the ones that currently provide labor, are required for the production process. Original production is the opposite of a collective production economy. From the point of view of living organisms, no process of production is autarchic.

The social acceptance of a commitment comes in the form of the availability of labor and inputs for a particular production process. If society (the collective) provides a particular production process with inputs, the energy spent in the production of those inputs will be channeled through that particular production process. The aforementioned social availability of inputs comes in the form of accumulated stocks by the producer, a deliberate social decision or even instinctively. Social production is what grants a producer its role and meaning in the collective production process. Once production has taken place and the product is exchanged for other goods, or submitted for social use, the producers clear their promise and/or receive other necessary goods. Provided that the benefits of the division of labor exceed a situation of autarchy, and that producers receive inputs in exchange for their

in modern capitalist economies. A similar exercise can be made for other types of economies.

⁷ The depth of the division of labor depends on the extent of such acceptance.

production thus allowing further commitments, each producer will repeat, correct or retreat from the collective production.

The nature of production commitments is collective in that they must be collectively accepted and collectively settled through the acquisition of inputs and the supply of the final product. It is a more or less limited commitment to the economy as a whole in exchange for access to the collective production. The length of the settlement of those *production commitments*, the frequency, their extent and the kinds of production which comprise their content depends, at least initially, on the technical relations of the processes involved.

Within that year, there are sub-processes of production and division of labor. Thus, the production processes are made up of sub-processes and of *sub-commitments of production* meaning that a particular promise or process is part of a larger one. In some circumstances they may be equivalent. For instance, this would be the case if individuals could make promises to the collective production the same way a group of them (that is, a factory) does. This difference has implications for the individuals or the groups who make the commitments in terms of, whom they make such promises, and what they expect to receive at the fulfillment date.

Every going concern is first and foremost indebted to its own survival and will. Every promise and sub-promise, every collective and individual production commitment is made in exchange for the means of production required for carrying it on. Every promise-maker, individual or collective, depends on a wide diversity of other promise-makers for the provision of inputs. They are also indebted to a wide variety of other promise makers

for the sale of production. In modern economies it is virtually impossible and undesirable to make commitments of exchange in advance with all who are involved. Decisions of purchase come from new engagers, new decisions of production, or from a sudden urgency about decisions already made. Most economies (excluding the early, communal forms) have taken the path of making their commitments through a collective token: money. In the same way money facilitates exchange, it also serves the purpose of making commitments of production. Money grants general purchasing power to the producer so that they can make their decisions of production in order to fulfill the corresponding commitments. In addition, the general purchasing power of money means that it is not specific as to the particular good or service that it will purchase, and so serves the purpose of granting freedom to its holder: the freedom to choose whatever they want to buy with it.

The purchasing power of money bears no relation to the technical requirements of its production. Thus, even though money grants the collective production process some autonomy necessary in order to overcome the obstacles mentioned above, the fact that production commitments are made in its terms also imply a dislocation of those commitments. In the absence of money, the commitments of production would be attached to the technical characteristics of each production process. In a monetary economy there is a detachment of the production commitments from their corresponding technical relations. Promises are generic in terms of money as opposed to specific in terms of the physical goods to be produced⁸.

⁸ The relation between production commitments and production presented above can be used to understand most (if not all) types of economies in which collective

There are many ways in which the *commitments of production* can be made other than with money. Other ways of committing production involve customs, habits, instincts or social agreements. Other ways of committing production different from money would render different results. The economy depicted here is a monetary economy in which the validation of the commitments of production is done through monetary exchanges.

1.2 Monetary Commitments of Production: Consequences

In a monetary economy, the horizontal component of exchanges is driven by monetary prices; their vertical component, by money interest rates, relations of ownership, money wages and profits. Comparisons in terms of value among commodities is done through monetary prices; inter-temporal comparisons, through present monetary values. These are also the tools by which economic theory aggregates different kinds of production. The most widely used form of aggregation is the classification in sectors (for instance, consumption, investment and government expenditure). Economic theory has tried to establish relationships among those economic aggregates. However, the aforementioned detachment of monetary production commitments from the technical characteristics of production renders such endeavors incomplete. Non-monetary

production takes place. In comments to the present chapter, Professor John F. Henry has brought to my attention that production commitments existed as an early form of money in ancient Egypt, and possibly Mesopotamia and China. According to Dr. Henry, production relations were maintained even after those economies transitioned to more modern forms of money. In Egypt, for instance, commitments to the priest were configured in *debens*, and not in the corresponding physical quantities of production. This dissertation however, focuses on the analysis of a modern capitalist monetary economies.

production commitments are specific to each commodity. They are inherent to the social process of division of labor. On the other hand, metaphorically speaking, monetary commitments add multiple rotation axes to production, creating a system in which prices and interest rates may not (and most possibly will not) be jointly determined. Aggregated monetary measurements overlook these implications and assume that the relationships among producers are the ones established between the aggregated categories. Notwithstanding, concomitantly with these inter-sector relations, there are inter-industry relations not taken into consideration and whose effect is crucial in the evolution of economic aggregates.

The General Theory takes into account this drawback. It complements the analysis of aggregate sectors (Kahn's short period analysis of supply) with Sraffa's commodities' *own interest rates*. These two analyses are both innovations with respect to Keynes' *Treatise on Money*. They are the foundation of Keynes' monetary theory of production (Kregel, 1985, p. 134).

Kahn's short period analysis of supply concludes that "Investment generates the savings required to finance it" (Kregel, 1985, p. 134). Although not apparent at first sight, this result has implicit in it a collection of production commitments. The equality between aggregate savings and investment is another way of saying that the commitments proposed have been accepted. The people who accept the commitments wait (save); the ones who propose them, produce (invest). They may be (but not necessarily are) the same person or group. Thus, the categories of saving and investment have a counterpart in terms of specific commitments of production. In turn, specific commitments of production have expression

in the aggregate monetary quantities of savings and investment. Nevertheless, one set of relationships does not determine the other.

Sraffa's commodities' *own rates of interest* depict more explicitly the role played by the inter-industry relations in the interaction between sectors. Sraffa (1932, p. 42) opposed Hayek's use of Wicksell's natural rate of interest. According to Sraffa, Hayek asserts that:

The starting-point and the object of Dr. Hayek's inquiry is what he calls 'neutral money'; that is to say, a kind of money which leaves production and the relative prices of goods, including the rate of interest, 'undisturbed', exactly as they would be if there were no money at all. (Sraffa, 1932, p. 42)

The implication of Hayek's approach is that the natural rate equates savings and investment in the same way prices equate supply and demand for each good. One equality is the precondition for the other. Both prices and interest rates reflect all the inter-industry and inter-sector relations. Productive activities, including the existing structure of competition, dovetail with consumption and investment decisions. Sraffa on the other hand, was concerned with the effects of imperfect competition and the accumulation of savings of any kind, including the ones "in money or natural form [inventories]" (Kregel, 1985, p. 134). Changes in the structure of competition cause price fluctuations that do not necessarily reflect conditions of production or demand. In addition, the accumulation of stocks in kind or money creates speculation and price changes. The change of these inter-industry relations creates a dichotomization of all prices: each price is divided in spot (current price) and forward (price of future delivery) versions. This lays the foundations for the *own interest rates* concept. Furthermore, following Sraffa (1932) both the inter-

sector relations and the inter-industry relations are combined so as to explain the role of money as an important factor affecting the level of employment *and its direction*. This prompts Kregel's (1985) implication that whereas Kahn's short period analysis of supply brought about the principle of effective demand that explains unemployment through the inter-sector relations, it, by itself, lacks an explanation for the instability of the economy imbedded in Sraffa's *own rates of interest*.

Sraffa's concept of *own interest rates* in conjunction with Kahn's short period supply analysis explain unemployment and the inherently unstable character of the economy in *The General Theory*. Monetary commitments of production detach the periods of production of all goods from each other and homogenize their technical differences within inter-temporal decisions of consumption and investment. This homogenization occurs through the money interest rate that makes comparable the decisions of granting specific promises of production. They are only differentiated through their inter-temporal characteristics but not through their technological specificities. In spite of being homogenized in monetary terms, the concept of *own rates* teaches us that those decisions are not homogeneous. Between different moments there is a transformation of the inter-industry relations that affect prices which is not captured by the money interest rate. Thus, the inter-industry side of the economy can and most possibly will move independently from the money interest rate. This provides the conditions for instability. Since the inter-industry relations matter, even though homogenized through money, equal lengths of production commitments are not the same when they refer to different producers. The changing character of the inter-industry side of the economy prevents any type of self-adjustment in

the inter-sector side and vice versa. At times, production activities may show regularities, but they are not provided by the technical relations of production. This dichotomized but conjoint character of the inter-industry and inter-sector relations brought about by the appearance of monetary commitments of production and their subsequent instability, provides a role for uncertainty, time and expectations.

It is in this context that Kregel (1985, p. 138) presents an alternative analysis proposed by Joan Robinson. Robinson favored a study of the economy in historical time. This can be accomplished by the reconciliation between Keynes and Sraffa's analysis and the consequent conjoint analysis of inter-industry and inter-sector relations. Kregel's observation that "*Sraffa's relations imply no particular causal relations*" (Kregel, 1985, p. 138), can be complemented with the causal relations proposed by Keynes. Such complementation, as proposed below, requires the use of Sraffa's *Production of Commodities by Means of Commodities* in addition to his *own rates of interest* notion.

1.3 Portfolio Theory Based On Probabilistic Risk Is The Basis For The Neoclassical Analysis Of Inter-Sector Relations. Keynes Inter-Sector Relations Must Be Complemented With A Portfolio Theory Based On The Structure Of Production

Other theories have followed Hayek instead of Keynes in regard to the interaction between the inter-industry and inter-sectors dimensions of the economy. This is the case of portfolio theory which is the foundation for orthodox finance. This theory has been fully merged into the neoclassical theories of decision-making, investment and capital. Put briefly, the neoclassical portfolio theory asserts that assets' monetary returns can be treated

as if they were random variables. The expected return of a portfolio is equal to the linear combination of those random variables. The variance of this linear combination, used as a proxy for uncertainty, depends on the variance and the covariance of asset returns in portfolio. Diversification decreases the variance of the portfolio's expected return.

This theory was first proposed and perfected by Markowitz (1952), (1959) and Tobin (1958), although Hicks (1935) has earlier hints towards it (Markowitz, 1999). Based on it, Sharpe (1964), Lintner (1965a) and Lintner (1965b), deduced a capital asset pricing theory coherent with General Equilibrium Theory. As a result, decisions of investment are only differentiated by their monetary return whose risk is assumed to be diversifiable. Systemic fluctuations of the economy as a whole (that is, booms and crises) are supposed to be rare events. There is a probabilistic structure concomitant with the productive structure of the economy that explains individual returns. This makes plausible the use of an analytical device: an agent capable of representing the discount rate of the economy as a whole and with it, the corresponding decisions of consumption and investment at the aggregate level. This probabilistic assessment of monetary relationships renders the inter-industry analysis redundant in spite of its importance for the calculation of investment returns.

In *The General Theory*, the inter-industry relations are not redundant. They are given (Keynes J. M., 1936, p. 4). Keynes' assertions on the inter-sector dimension are limited and at the same time broad enough to be applicable to any particular inter-industry relations without assuming that the latter can be deduced from the former. This method springs from the role of money which is not based on probabilistic risk as in the Markowitz-

Tobin portfolio theory. Instead, *The General Theory* relies on the properties of money and liquidity preference theory. The *own interest rates* derived from the properties of money explain that it is the best yielding asset in moments of crisis. For this reason it “rules the roost” in the economy. Liquidity preference explains why decisions between money and other assets are subject to uncertainty. Money represents the decisions of the economy as a whole about what it wants to produce. No probabilistic structure can reflect this decisive character which is made of commitments of production. These two pillars (the properties of money and liquidity preference) along with the Marginal Efficiency of Capital which gather’s investors’ expectations, depict inter-sector relationships that are general to any particular set of inter-industry relations⁹. The systematic fluctuations of the economy represented by changes in the level of employment are produced by this monetary character of the economy. As a result, uncertainty and demand take the place of probabilistic risk in the assessment of aggregate monetary quantities. The missing datum that brings about uncertainty to the inter-sector relations is the one that is to be set by human volition: aggregate demand. This conclusion applies to any set of inter-industry relations in the same way money represents an undefined set of goods. The incorporation of the inter-industry relations would show the specific form that the conclusions of *the General Theory* would take, were they to be framed as a particular set of those relationships.

⁹ This is another way of stating Keynes’ equilibrium in presence of unemployment. Full employment is not a unique state towards which the economy tends, but one of many other states all of them equally possible from the theoretical stand point.

Neoclassical portfolio theory and its derived Capital Asset Pricing Model have been attacked in various fronts. Roll asserts that “(a) No correct and unambiguous test of the theory has appeared in the literature, and (b) there is practically no possibility that such a test can be accomplished in the future.” (Roll, 1977, p. 129). Fama and French (2004, p. 41) point out that there is a lack of correspondence between the orthodox portfolio theory and the observed behavior of financial returns, rendering neoclassical portfolio theory useless. The observed excess of systematic fluctuations contradicts the assumed normality of asset returns (Mandelbrot, 2004, p. 66). The controversy between defenders and attackers of orthodox portfolio theory has not been settled (Fabozzi, 2009, p. 265). There are serious doubts about its usefulness and no alternative seems to provide a better explanation for diversification and asset pricing. Furthermore, there is space for the proposal of a more effective explanation.

Keynes’ theory, complemented by the inter-industry analysis, is a viable alternative for understanding investment decisions and the evolution of the structure of production. This type of analysis is what is lacking in orthodox portfolio theory. In the context of changing structures of production (like the ones produced by innovations) and systemic fluctuations (economic cycles) it is necessary to analyze the possible impact of financial decisions on the level and direction of the general level employment and vice versa. This analysis includes decisions at the firm and government levels. Chapter 20 of *The General Theory* entitled “The Employment Function” proposes that this type of analysis should be conducted. The employment function is the inverse of the aggregate supply function. According to Keynes, it is useful to calculate the effect of changes of aggregate demand on

the employment level of certain industries and firms. Aggregate demand is measured in units of employment. Thus, it is possible to relate fluctuations in aggregate demand to changes in the level of industrial employment. Some industries have higher elasticity of employment than others. Economic policy must be oriented accordingly. This relation is also important in the way inflation may affect some industries. Keynes' proposal goes in line with his method of conducting the argument in two stages: One that focuses on the technical relations of production (for instance the aggregate supply function or the supply price of machine equipment) and one that gathers uncertainty and expectations (that is, aggregate demand and the liquidity preference theory).

One focus of the Post Keynesian literature has been on understanding the inter-sector relations derived from the *General Theory*. Keynes' analysis has been complemented with the inclusion of ownership relations represented by the distributive role of profits and wages (explored by the Cambridge school¹⁰) and the surplus/deficit relations between sectors (explored by Modern Monetary Theory¹¹ and Stock-Flow consistent models¹²). Minsky¹³ analyzed how those relations progressively become more ambitious under a generalized perception of inter-sector stability. However, this literature awaits complementation with the inter-industry analysis.

¹⁰ Kaldor (1956) and Pasinetti (Pasinetti L. , 1962) et al.

¹¹ For instance, Wray (2012).

¹² Godley and Lavoie (2012) inter alia.

¹³ For example, Minsky (1982).

1.4 Complementing Inter-sector Monetary Relations with the Inter-industry Analysis

Within some boundaries, in a monetary economy for each inter-sector configuration there are multiple possibilities of inter-industry relations. Conversely, for each inter-industry configuration, there is a multiplicity of inter-sector configurations. The structure of production is a particular combination of inter-industry and inter-sector configurations. Going concerns manage parts of the structure of production and make promises of production on their behalf. The excess of finance¹⁴ in some process of production disrupts the established coherence between the inter-sector and the inter industry relations. It is thus necessary to analyze simultaneously the inter-sector and the inter-industry relations¹⁵. Whereas the former represents the length and extent of production commitments, the latter represents the specific form that those commitments take in the context of the division of labor. The joint configuration of these two dimensions of the economy is attached to the flow of money throughout sectors and across industries. This connection explains the financial viability of going concerns. There have been two significant attempts to make a simultaneous treatment of these two dimensions of the

¹⁴ As will be explained in Chapter 2, the excess of finance is judged with respect to a given structure of production. It occurs when part of the structure of production receives more inputs than needed for the given productive structure to take effect. The amount of finance in part of the structure of production is measured in the amount of inputs that it receives in order to fulfill the respective production commitment.

¹⁵ This is done in chapter 2 where the notion of vertical integration in connection with the production commitments is introduced.

economy without subordinating one to the other: one by Richard Goodwin¹⁶ and the other by Luigi Pasinetti. In what follows, attention will be fully given to Pasinetti's attempt because he explicitly developed an interface between Sraffa's and Keynes' analysis.

1.5 Pasinetti's Integration of Inter-industry and Inter-sector Analysis

Pasinetti uses the notion of vertical integration¹⁷ (in what follows referred to as integration) formalized in his 1973 article in order to propose a model of structural dynamics that takes into account the change in productivity across sectors and industries. Pasinetti (1981, p. 111) demonstrated that at a given point in time the integrated analysis bears a one to one correspondence with the inter-industry representation of Leontief's input-output framework. Pasinetti (2003, pp. 304-306) [1985] showed that the same holds true for the inter-industry framework proposed by Sraffa (1963). In addition, Pasinetti (1993) argued that it is possible to understand the core elements of economic growth by analyzing an integrated model and its dynamics. The argument is that the integrated coefficients are more stable through time than the inter-industry coefficients. In spite of this fact, Pasinetti acknowledges that it is necessary to deepen the understanding of the

¹⁶ See for instance Goodwin (1974) and (1976). The main difference between the two approaches is that Goodwin uses normalized general coordinates which keep the interdependencies among sectors in the background through the indirect influence of aggregate demand (Pasinetti, 1990, p.163). Pasinetti on the other hand reclassifies the original system according to their final sectors: consumption and investment. As long as aggregate consumption and the level of employment that justifies such consumption matters for economic analysis, the inter-sectoral relations must be explicitly analyzed.

¹⁷ This concept will be explained below.

evolution of the productive structure that emerges as a result of the interaction between the integrated inter-sector dynamics and the inter-industry dynamics.

In 1988, Pasinetti explained that when subsystems (a concept proposed by Sraffa (1963, p. 89)) are allowed to grow in terms of productivity, there are as many natural rates of profit as there are subsystems in the economy¹⁸. This implies that, in spite of being technically interdependent, there is a degree of freedom present in each of those subsectors. This degree of freedom is linked to the one provided by the accumulation of surplus in an economy with basic and non-basic commodities. This degree of freedom gives the aggregate demand its role (Pasinetti, 2003) [1985]. Keynes and Sraffa are related at this point, just as they were in chapter 17 of *the General Theory*.

The interaction between (1) the inter-industry and the integrated sectors, (2) the existence of a natural rate of profit for each sub-sector and (3) Keynes' treatment of the relation between the *own interest* rates notion and the role of uncertainty results in a Post Keynesian theory of finance, necessary for understanding structural economic dynamics. The coordinated expenditure of labor (accumulated and otherwise) in particular production processes is essential to keep collective production functioning. A decision to finance a

¹⁸ Similarly, Sraffa asserts that "...there might be at any one moment as many 'natural' rates of interest as there are commodities..." (Sraffa, 1932, p. 49). In this respect, Pasinetti (1988) is more explanatory of Sraffa (1932) than of Sraffa (1963) as the latter left undeveloped the notion of sub-systems and hence, the concept of growing subsystems. Thus, Sraffa (1963) presents a scheme in which there is a single natural rate of profit across industries. Pasinetti is able to depart from this assumption through the structural adjustments produced by a growing aggregate demand. Commodity interest rates differ both because of production and demand conditions. The latter are in turn driven by human factors.

production process is a decision to devote social resources for carrying it on. It is necessary to understand the implications of this decision process in the context of a monetary economy whether it is centrally planned or decentralized.

The aim of the present inquiry is to offer an analytical device that takes into account the one-to-one correspondence highlighted by Pasinetti (1981, 2003 [1985] and 1988) between the inter-industry and the inter-sector analysis and its dynamics. In order to do so, it will be necessary to explore the relationship between the types of financial assets (bonds, equities, money) and the respective analysis of production: inter-industry and inter-sector. The latter has a level of integration that separates the economy into consumption and investment goods sectors. By intersecting these two spheres it will be possible to formulate a description of decisions of financial and real investment. Financial assets in the world of Sraffa and Pasinetti can be introduced as claims on the future surplus and as titles of ownership on the intermediate goods. From the vertically integrated perspective they are bonds and money. From the inter-industry perspective they are equities. It is necessary to connect these two dimensions of the financial side of the productive economy in order to better describe it. In terms of dynamics, the economy sometimes moves along the bonds-money axis privileging long and short run analysis over the particular industries in which investment is carried on, and sometimes it moves closer to the inter-industry axis giving more weight to the analysis of the technological interdependencies. This description in turn constitutes an alternative explanation to portfolio decisions of investment. Inasmuch as this analysis is in principle descriptive, it is compatible with the principles of fundamental uncertainty.

1.6 The Notions of Integration and Inter-Industry Analysis

The importance of integration for economic analysis is highlighted by Pasinetti in his 1973 paper. The key idea is to connect the net production with the resources that produced it. Essentially, the analytical process of integration associates the quantities of each final good with the quantities of labor and capital (measured in terms of units of integrated capacity of production as will be explained below) that produced them. In his 1973 paper, Pasinetti had linked this notion with Keynesian economics:

Keynesian macro-economic analysis is also generally carried out in terms of vertically integrated magnitudes (net national income, net savings, new investments, consumption, etc.). (Pasinetti, 1973, p. 1).

Thus, Pasinetti found the connection between those integrated magnitudes and the inter-industry analysis developed by Sraffa (1963). In more modern terms he showed that Keynesian macroeconomic analysis can be empirically grounded. In order to achieve his goal Pasinetti used Sraffa's concept of sub-systems (1963). Pasinetti (2003) explained that Sraffa came up with this notion in order to achieve more generality than the alternative idea of dated quantities of labor. Whereas the latter is limited because it only serves well for a single commodity, the former notion of sub-systems applies to an economy with various commodities. In Pasinetti's words:

Thus, each sub-system i is essentially an analytical construct that represents a self-contained economic system which produces physical quantity Y_i , as net product, and absorbs physical quantity L_i of labor as net input, while at the same time reproducing all the means of production (no less and no more) necessary for this purpose, through a self-replacing process. (Pasinetti L, 2003, p. 303)

Pasinetti (1973) extends this notion to a surplus producing economy with capital and more than one commodity. The outcome of this extension is the idea of integrated sectors. With this notion, Pasinetti is able to measure the quantities of labor and capital used in the production of each unit of physical net output. This allows him to formulate prices in terms of wages and profits. These two achievements turn out to be important in terms of linking the theory of production to Pasinetti's theories of distribution, growth and structural dynamics. What is interesting about this exercise is the straightforward connection of integrated sectors with Leontief's and Sraffa's analysis of production. This is achieved with algebraic manipulations and a small set of assumptions that later on can be dropped for additional generality. Thus, one can argue that the notion of integration is a very robust concept.

In Pasinetti (1981), the author shows more clearly the connection between the concept of integration in the context of structural change, and Leontief's input output framework. Pasinetti chooses to make this connection because of the wide influence of Leontief's analysis. The author explains that any economic system ordered and analyzed with Leontief's framework has a one-to-one correspondence with an *integrated* analysis. This implies that at each moment in time, one can be translated into the other. Hence, both types of analysis are complementary. This is remarkable because there are different aspects of the economy that are illustrated by each type of analysis taken separately. Even more, the relation between the two types of analysis is not one of logical causality in which a state reflected by one of them logically implies a particular configuration in the other, but a relation of perspective; of necessary coincidence. Thus, it is possible to derive the inter-

sector coefficients represented in the integrated analysis from the inter-industry coefficients in the inter-industry analysis, but the correspondence between the two changes in a crucial way with time. As both are complementary, the next step is to analyze the interactions between them and its implication on the dynamic character of the economy. However, Pasinetti asserts that this analysis is not possible. He then took the path of arguing that the integrated coefficients are more stable through time. Hence, their analysis explains the dynamic aspect of the economy. However, in his 1993 book he argued that it is necessary to analyze the interaction between the integrated analysis and the inter-industry analysis.

The path followed in order to untangle this relationship has been the inclusion of institutions that explain the dynamics of consumption and technology (Baranzini & Scazzieri, 1990). However, it is proposed here that a more analytic perspective can be used based on the inclusion of financial assets. As mentioned above, Pasinetti also established the connection between Sraffa's 1963 analysis and Keynes by using an integrated analysis. In two papers Pasinetti (1988, 2003) showed that Sraffa's inter-industry analysis bears a one-to-one correspondence with Keynes' inter-sector analysis. Pasinetti (2003) explains the relation between the inter-industry analysis presented by Sraffa and the integrated analysis presented by Keynes. Pasinetti uses the notion of subsystems in order to find the connection between the aggregate quantities of final output and the inter-industry analysis. In addition, Sraffa's analysis of production studies two cases: 1- the production of basic goods and 2- the production of non-basic goods. In the first case, the circular analysis is sufficient to understand prices. In the latter, on the other hand, there is surplus. Thus, its

distribution is determined outside the sphere of production. Pasinetti's integrated analysis is the analytical device that "unambiguously" separates the two aspects of the economy: the one that produces the surplus and the one that pertains to the circular process:

There is however an analytical device that allows us to separate in an unambiguous way what pertains to the surplus from what pertains to the circular process. I am referring to what Sraffa, by looking at the economic system from an inter-industry point of view, has called the method of the 'subsystems'; and I myself, by looking at it from a final demand point of view, have called the method of the 'vertically integrated sectors. (Pasinetti L. , 2003, p. 300)

This requires the use of the notion of subsystems in order to trace back the resources used in the production of final goods. The end result is the formulation of prices of goods in terms of labor and integrated units of capacity of production. At any point in time there is a one-to-one correspondence between the inter-industry analysis carried on in Sraffian terms (given a level of aggregate demand over the surplus and thus its production) and the integrated analysis (Keynesian analysis of final quantities taking as given the inter-industry relations). However, this correspondence is specific to each present moment. It occurs differently in different times. Pasinetti nevertheless points out that the integrated analysis has the advantage of keeping more stable coefficients through time. Technology is what produces the change in the relationship. Pasinetti concludes that there is a clear connection between Sraffa and Keynes and that both types of analysis are complementary.

The connection between Sraffa and Keynes takes a new turn through Pasinetti (1988) where he argues that there are as many natural rates of profit as there are industries in the economy. This resembles Sraffa's own rates of interest. In addition, this result shows that the inter-sector dynamics must be complemented with the inter-industry dynamics.

In conclusion, Pasinetti's notion of integration has proven to be very useful on two fronts: 1- It links the economic theories of Sraffa and Keynes to the observable quantities as presented in the traditional input-output framework; and 2- It shows that both approaches (Sraffa and Keynes) are complementary. The question of the interaction between the inter-sector and the inter-industry analysis nonetheless, remains unanswered. Pasinetti argued that the integrated inter-sector coefficients are more stable through time. This may be the reason why he focused in these types of relationships in his 1993 book. However, he argued that it is necessary to further this analysis. Although the route proposed by him and others like Baranzini and Scazzieri (1990) has been the institutional dynamics of consumption and technology, the approach taken here suggests a system based on the inclusion of financial assets in the inter-sector and inter-industry dynamics.

1.7 Pasinetti's Integration, Division of Labor and Money

In a going economy with division of labor, the most basic form of credit and debit relations is the production commitment. More complex forms like money and other financial assets spring from it. Sraffa's sub-systems and Pasinetti's integration are a suitable representation of this kind of economy. Sub-systems and integration identify the self-replacing structure that produces each commodity in the net output. This identification takes into account the division of labor because it includes the labor that directly and indirectly intervenes in the production of each commodity as represented by a given structure of production.

The self-replacement axiom has important theoretical implications. Going economies require self-replacement in order to have permanence¹⁹. Analytically, the statement of self-replacement translates a set of contemporaneously observed transactions between industries into a set of input-output relations among those industries. It transforms the horizontal structure represented by the inter-dependencies among industries into an inter-temporal or vertical structure where labor is applied subsequently in stages of production as part of an input-output flow. In this context, all investment is made in terms of committed labor.

The assumption of self-replacement is thus essential on analytical and practical grounds. Analytically, it is the foundation of the notion of structure. In practice, it is required for the actual operability of processes of production. The structure of production in turn sustains the promises of production and the division of labor. A modification of the system of production promises has the capacity of affecting the structure of production if it generates new self-replacement systems.

Hence, any system of promises of production has associated with it a structure of production whose interconnections can be depicted with Sraffa's notion of subsystems. Any promise of production that does not correspond with an existing or an emerging self-replacing structure is redundant and will not be fulfilled. It is possible to use the notion of

¹⁹ This is a point already made by Marx:
“Whatever the social form of the production process, it has to be continuous, it must periodically repeat the same phases. A society can no more cease to produce than it can cease to consume. When viewed, therefore, as a connected whole, and in the constant flux of its incessant renewal, every social process of production is at the same time a process of reproduction.” Marx (1990 [1890], p.711).

subsystems in order to identify *redundant* promises of production however concealed they may be in the intricate bundle of financial assets existing in a monetary economy. Money is one of those financial assets and its existence must also be justified with the structure of production and its respective system of promises of production. It is then possible to hypothesize that the complex system of financial assets can be simplified to its core meaning in terms its implied promises of production.

When the notion of ownership is introduced in the analysis, financial assets not only need to reflect the structure of production but also the structure of ownership and the respective flows of wealth between social classes. This latter dimension is subordinated to the material aspects of production represented by the structure of production.

Production decisions within the context of collective production must be framed in the structure of production and its respective structure of commitments. Like the structure of production, the latter has horizontal and vertical components. Financial assets must have vertical and horizontal components *compatible* with those of the promises of production if the structure of the economy is to be in state of self-replacement. Profits and returns can be distributed in a variety of ways. Nonetheless, they must also be coherent with the structure of production.

CHAPTER 2
THE FINANCIAL STRUCTURE IMPLICIT IN THE SRAFFA-PASINETTI
FRAMEWORK AND THE INTER-SECTOR ANALYSIS OF THE GENERAL
THEORY

The aim of the present chapter is twofold: (1) Show that there is a financial structure implicit in the Sraffa-Pasinetti input-output production model and (2) use this financial structure in order to connect the Sraffa-Pasinetti framework to Keynes' inter-sector monetary analysis of production. The combination of these two perspectives offers a method for the joint study of the financial and productive structures of the economy. The aforementioned objectives are achieved through the unexplored role of the *production commitment*.

Pasinetti's concept of vertical integration extracts the inter-sector analysis of consumption and investment relations from Sraffa's inter-industry analysis. Keynes proposes a monetary analysis of the inter-sector relations of production by taking the inter-industry relations as given. Vertical integration within the framework of Keynes' inter-sector monetary analysis provides a point of reference for the formation of expectations. This analysis is based on the structure of production commitments implied by a given productive structure. Expectations affect the level of employment and its direction (Keynes, 1936). They are the drivers of the structure of production. This is characteristic of a monetary economy in which *production commitments* take the form of monetary assets.

Every economy has a productive structure which is formed by *recurrent* input-output relations. Every going structure of production requires production commitments amongst its decision making entities. The financial structure of the economy is formed by financial promises represented by the existing financial assets. All production commitments are financial assets. Not all financial assets are production commitments. Financial promises can only be repaid if their structure of payments dovetails with the structure of payments of their implied production commitments. By comparing the financial and the productive structures of the economy it is possible to assess the solvency of the productive system. Economic theory has failed to focus on either the inter-sector or the inter-industry dimension of the productive and financial structures. Theories are differentiated by their focus on one or the other of these dimensions. Both dimensions must be analyzed simultaneously. The missing link between the two, is the notion of *the production commitment* whose role has been overlooked in the literature. The productive role of money is better understood when its distribution across industries is analyzed in conjunction with its inter-sector distribution. These are also the two dimensions of financial commitments. In order to consider these two dimensions of financial decisions, expected monetary returns of investments must be expressed with a non-distributional language; one that is not constrained by the unidimensional character of the inter-sector analysis as is the case of traditional portfolio theories. This way of forming expectations has the potential of explaining the kaleidic re-configuration of the structure of production.

Furthermore, the importance of connecting the inter-industry side to the inter-sectoral side of the economy lays in the fact savings, whether they are kept in the form of

physical commodities or money, entail first and foremost, the existence of production commitments. Keynes' aggregative approach in which, given a set of expectations, aggregate consumption, aggregate savings and aggregate investment interact in order to set the level of employment, is incomplete. It is not enough to say that unemployment is caused by an imbalance between the industries that produce consumption commodities (in expectation of future aggregate consumption) and the ones that produce investment commodities (in expectation of future aggregate investment). There are inter-industry connections within the consumption and investment industries and between them whose imbalance also causes unemployment. Keynes' monetary theory of production only takes into account the aggregate relations between consumption and investment. This analysis is generalized here, with the Sraffian-Pasinetti framework. As a result, the financial aspects of *The General Theory* applied to the relation between consumption and investment, are here generalized so as to include the relations between n industries. This is what Keynes began, but did not finish in chapter 17. Thus, not only do different degrees of liquidity preference impact the level of employment, generating demand for bonds with longer or shorter pay-back structures. Also, the types of assets purchased, represented by equities and other industry-specific assets play a key role. And it is the monetary value of inputs allocated to various industries, and their industry and even firm-specific payback structures, whose expectation is generated to a great extent by the structure of production, what paints a more complete picture of the drivers of aggregate unemployment. Such connection between the aggregate side of the economy represented by aggregate consumption, aggregate investment and aggregate savings, and the more disaggregated

inter-industry analysis is achieved here through the general monetary notion of production commitments. In the more aggregated framework of the general theory, expectations of sectors of the economy waiting to consume and waiting to invest, represented by the holding of money, were the culprits of fluctuations in the level of employment. With the notion of production commitment, waiting to spend in one industry with respect to any of the others may also cause unemployment and changes in the structure of production due to the implicit structure of production commitments.

The first section of the present chapter describes how the intra-periodic relations of production expand into the inter-periodic realm, and the kinds of production commitments required for the sustainability of the system of production. By projecting a given structure of production into the inter-periodic realm, the notion of vertical integration seeks to trace back the quantities of labor required for the production of each commodity in the net output. Such calculation however is based on the assumption that the current structure of production is replicated through time. Additional assumptions need to be made about the demand preferences in order to explain the evolution of the productive system. The first section explains the expectational character of this analysis by unveiling the *commitments of production* implicit in the Sraffa-Pasinetti framework. Even though vertical integration is not a firm grounding for a labor theory of value, it is a useful concept for the formation of expectations and the formulation of production commitments based on a given structure of production.

Having uncovered the financial structure within the Sraffa-Pasinetti framework, the second section explains how Keynes' *General Theory* makes a financial assessment of the

inter-sector dimension of the economy. *The General Theory* takes the inter-industry relations as given. The third section shows how the notion of *production commitment* connects Keynes' monetary analysis of the inter-sector relations with the Sraffa-Pasinetti analysis of the structure of production. Finally, investment decisions in a monetary economy are driven by monetary results. In order to account for the observed and expected structures of production and their respective production commitments, monetary investment decisions must be formulated in terms of a non-additive language. Once the relations of production have been accounted for by analyzing the structure of production, monetary expectations must allow for fluctuations in the scalar monetary realm generated by changes and innovations in the multidimensional world of relationships of production. Monetary expectations formed in this way do not assume that the monetary realm is derived from the productive realm or vice versa. These two realms are the result of the originative and transformative character of economic decisions.

2.1 Intra-period Vs. Inter-period Analysis, Production Commitments and Expectations

Production is an interwoven flow of input-output relations at various levels, each of them more or less repetitive in relation with a period of reference. A process of production is formed by sub-processes which in turn are made of smaller sub-processes. A going process of production requires the continuous replenishment of inputs at all levels. This periodic character of production makes necessary the analysis of the conditions under which the economy reproduces itself. In Pasinetti's interpretation of Sraffa's model of

production of commodities by means of commodities (in what follows referred to as the Sraffa-Pasinetti framework), those conditions take the form of replacement prices²⁰. This analysis must be complemented with the uncovering of its implicit expectational character. The aim of the present section is to untangle this expectational aspect. As a result, an alternative concept of finance is proposed based on the notion of production commitments. This framework uses the inter-industry and inter-sector dimensions to establish the compatibility between structures of production and their respective financial structures.

2.2 The Self-Replacement Mechanism in the Sraffa-Pasinetti Framework with no Growth

In the Sraffa-Pasinetti framework described in Pasinetti (1973), the period of production (the year t) has two moments: The beginning of the *year* and the end of the *year*. Production occurs between those two moments and is explained by the relationships between them. No time elapses between the end of a period and the beginning of the next one. $X_{(t)}$ and $Y_{(t)}$ are respectively the total and net production generated at the end of the period. Net production ($Y_{(t)}$) is obtained by subtracting from $X_{(t)}$, the replacements necessary to restore the initial stocks of commodities for the next period's production. Stocks of labor $L_{(t)}$ and capital $S_{(t)}$ must be available at the beginning of each period so that production can be replicated. Part of the net output goes to consumption in the form of

²⁰ The reader unfamiliar with the Sraffa-Pasinetti framework is directed to the appendix for a brief explanation.

wages required for the reproduction of labor. The remaining part goes to ‘new investment’. In this basic model ‘new investment’ does not increase the stock of capital. Capital is made available in the form of input commodities. ‘Old investment’ restores capital to its initial level by compensating for depreciation. A stationary economy is assumed in which there is no change in technology or population.

In Pasinetti’s basic model, each industry j produces one type of commodity. Each industry is defined by the inputs required for the production of its particular commodity. The j th column of the technical coefficients a_{ij}^θ represents the quantities of each direct input commodity i to be spent during the year by industry j in the production of one unit of commodity j . Each industry must have available a quantity a_j of labor per unit of output at the beginning of the year in order to deliver x_j units at the end of the period. Industry j must begin the period with a stock of capital commodities equal to a fraction a_{ij} of the final output x_j to be produced. The fixed portion of the stock of capital in industry j depreciates throughout the year at a constant rate δ_j . The amount of capital depreciated, along with the circulating capital spent in production, comprises the quantity of input commodities spent in production. This quantity is denoted by a_{ij}^θ . This is the amount of input commodities that has to be replaced in each industry in order to reproduce the economy for the next period.

2.3 Alternative Interpretations of the Leontief Inverse Matrix

If equation (A.1) in the appendix is rearranged so that the level of total output is expressed as a function of the net output, the following expression is obtained:

$$X_{(t)} = (I - A_{\theta})^{-1}Y_{(t)} \quad (1)$$

The net output $Y_{(t)}$ is multiplied by a matrix of coefficients known as the Leontief inverse matrix. A variety of possible interpretations of the matrix have been proposed (Pasinetti, 1973, p. 5). The following argument proposes two kinds of interpretations: Intra-periodic and inter-periodic. The self-replacement assumption projects the intra-periodic inter-industry relations onto the inter-periodic realm. The effective self-replacement of the structure of production requires the fulfillment of the implicit production commitments. The unveiling of those production commitments uncovers the expectational character of the Leontief inverse matrix. Multiple interpretations of the Leontief inverse matrix illustrate the various ways in which production commitments can be made within a single structure of production.

The first of these interpretations presented here, is the one proposed by Pasinetti in (1973 and 1977)²¹. According to this interpretation, the Leontief inverse matrix represents the quantity of commodities required for the production of each unit of net output Y_t . Each component α_{ij}^{θ} of the Leontief inverse matrix represents the direct and indirect quantities of commodity i required, *in the economic system as a whole*, for the net production of one unit of commodity j . Commodity i is required directly as input in industry j and indirectly as input in other industries that provide inputs to industry j . The economy must produce a

²¹ See equations A.4-A.6 in the appendix.

quantity of commodity i large enough to replace the direct and indirect expenditure of commodity i , and to produce the required net output. This is an intra-periodic interpretation because it refers to a single period of production.

Under this interpretation, row i of the Leontief inverse matrix represents the total quantity of commodity i required directly and indirectly for the production of one unit of net product in all industries. In other words, it is the total quantity of commodity i that needs to be spent in the whole economy in order to produce one unit of net output in all industries. Each column j represents the quantities of heterogeneous commodities that the economy needs to spend directly and indirectly in the economic system as a whole for the net-production of one unit of commodity j .

Pasinetti (1977) provides a second interpretation in which the Leontief matrix is calculated with a Taylor expansion. According to this procedure, under a set of assumptions²² (Pasinetti 1977, p.66), the Leontief inverse matrix can be calculated with the following formula:

$$(I - A_{\theta})^{-1} = I + A_{\theta} + A_{\theta}^2 + A_{\theta}^3 \dots \quad (2)$$

By replacing (2) in (1) the following expression is obtained:

$$X_t = (I + A_{\theta} + A_{\theta}^2 + A_{\theta}^3 \dots)Y_t = IY_t + A_{\theta}Y_t + A_{\theta}^2Y_t + A_{\theta}^3Y_t \dots \quad (3)$$

Equation (3) shows that, in addition to producing each unit in the net output (Y_t is a column vector of ones), the economy must also produce the direct production requirements whose production coefficients are given by matrix A_{θ} . The production of the

²² The mathematical conditions are not relevant for the present analysis.

direct requirements is also ruled by the technical coefficients described in matrix A_θ . In order to produce A_θ units of production requirements, it is necessary to spend A_θ inputs indirectly. This is the equivalent of A_θ^2 units of product required indirectly for the production of one unit of each commodity in the form of net output. The remaining terms in the sequence follow the same chain of reasoning. Equation (3) is interpreted by Pasinetti as showing the stages or rounds of production directly and indirectly involved in the production of a required amount of net output. Each year the economy advances one stage until it produces the required unit vector of net output. This is an inter-period interpretation because the input-output relations occur between periods.

A third interpretation based on the aforementioned Taylor expansion can be proposed in which the series represents, within a single year, the different stages required for the production of the commodities in Y_t . Before becoming part of the net output, each product is a mere *orientation* of productive resources; a stage in its productive chain. Products work their way from their early stages of production, to the final stage when they become part of the net output. Production occurs gradually and in stages as described by equation (3). Each period comprises all stages of production of all and each one of the final commodities. Due to the assumption of self-replacement, the maturation of inputs into outputs that each commodity experiences from period to period (second interpretation) is equivalent to the third interpretation in which all stages of production are represented simultaneously within a single period. This is an intra-periodic interpretation.

A fourth interpretation consists in understanding equation (3) as a description of the production of the required unit vector of net production in gradual increments of

production. Each stage represents a percentage of completion of the production goal. This alternative focuses on the production of each stage as a proportion of the final output instead of the generation of inputs that will be used for production in a subsequent stage. This is an intra-periodic interpretation.

A fifth interpretation can be proposed in which the Taylor expansion shows the continuous stream of input-output inter-industry flows within each production year. Each stage represents the time rate at which inputs are continuously being supplied. The rates are determined by the terms of equation (3) which denote the inter-industry flows of commodities per unit of time. The coefficients in equation (3) are defined in terms of quantities per year. This standard measurement of time can be replaced by a fraction based on a different time-scale simply by dividing the matrix of coefficients of the Leontief inverse matrix by the equivalent units of the new standard. Producer industries can thus be understood as continuously receiving a stream of inputs and providing a stream of output. From this point of view, industries do not accumulate inventories. Unlike the first alternative, in this interpretation industries do not wait until the end of the year in order to replace the spent inputs.

The interpretations above show that the same equations can be used to explain what occurs inside a period of production and what occurs between periods. Once the intra-periodic relationships of production are established, the inter-periodic relations are obtained by default or vice versa. If the production coefficients are the same from period to period, and provided that the self-replacement assumption holds, the input-output

relations within a single period are the same as the input-output relations from period to period. This allows multiple intra and inter-periodic interpretations.

Different interpretations have different implications in regards to the actual workings of the system. For instance, from the point of view of the fifth interpretation, all inputs are used in the same year in which they are produced. From the point of view of the first interpretation, the outputs of one period will be the inputs of the next one. In the latter case, all inputs advance one stage per year passing from the producer industry to the user industry. The importance of this extrapolation of the intra-periodic input-output relations into the inter-periodic relations of production will be more evident below, where the vertically integrated quantities of labor and capital will be explained.

2.4 Division of Labor among Industries and the Nature of Production Commitments in the Context of a Self-replacing Economy

By definition, specialization implies that a particular producer will dedicate its resources to the production of a particular output. By doing so, it excludes herself from the production of other commodities. Producers depend on each other for the provision of inputs. Repeated specialization requires the commitment of productive resources, counting on other producers' commitments. Pasinetti's basic model describes an economy with division of labor in which each industry is in charge of the production of one commodity. The effective division of labor amongst industries requires the formulation of reliable production commitments by all industries. In this type of economy, industries are dependent on each other for the provision of inputs and the absorption of their production.

A self-replacing and viable economy of this type requires the fulfillment of the commitments of production made for the supply of inputs and the absorption of output. Those commitments are necessary for the division of labor and the survival of the productive entities amongst which labor is divided. Production commitments are expectational in the sense that they are promises for future fulfillment. In this section, a notion of commitment of production in connection with the Sraffa-Pasinetti framework is introduced.

In accordance with the first interpretation of the Leontief inverse matrix presented in the previous section, each industry j has to make the commitment of producing the direct and indirect quantity of commodity j required in the production of a given amount net output. This means that industry j must make a commitment to produce $\alpha_j^\theta = \sum_{i=1}^n \alpha_{ij}^\theta$ units of product for delivery at the end of the period for each unit of the corresponding net output.

The second interpretation of the Leontief inverse matrix implies that all industries make the commitment to offer their product in progressive quantities each year as described by the Taylor expansion. In order to do so, they have to use the inputs produced in each previous year. If inputs are available from the previous stage, production can take place in the subsequent stage as described by the Taylor expansion. All industries start their production far back in time with a negligible quantity of inputs in the proportions indicated by the coefficients of production. The chain of production ends with the desired unit of output produced in the final stage.

The third interpretation implies a commitment of production by each industry j to advance one stage per year in the production of commodity j in the form described by the Taylor expansion. In the fourth interpretation on the other hand, all industries make the commitment to accomplish a percentage of the production goal in successive stages. The fifth interpretation demands the commitment of continuous replenishment of inputs by all industries. Produced inputs are used as they are produced in a continuous flow. There is no accumulation of inventories.

The aforementioned five ways of interpreting the Leontief inverse matrix at the light of the production commitments are not the only possible ones. Once a particular interpretation is identified as the one that better reflects the characteristics of a given productive system, the sub-commitments of production that occur inside each industry must conform with the more aggregated structure. This is the case of commitments made by firms within each industry, and commitments made by divisions within each firm.

2.5 Vertical Integration and Production Commitments

Equations (A.4)-(A.6) describe the concept of vertical integration. For each one of the commodities in the net output, it is possible to identify the self-replacing structure that produces commodity i , while restoring the initial conditions of production for the next period. This is also Sraffa's notion of sub-system. Pasinetti (1973) notes that the Leontief inverse matrix provides equations (A.5) and (A.6) with a special meaning. In particular, the following two expressions are singled out in Pasinetti's analysis:

$$a_{[n]}(I - A_{\theta})^{-1} = v \quad (i)$$

$$A(I - A_{\theta})^{-1} = H \quad i = 1, 2, \dots, m. \quad (ii)$$

Where v is a $1 \times m$ vector formed by components v_i , and H is an $m \times m$ matrix formed by column vectors denoted as h_i . Definition (i) is interpreted by Pasinetti as the direct and indirect quantity of labor required for the production of commodity i in the net output. Since the Leontief inverse matrix represents the direct and indirect quantities of commodities required for the production of commodity i in the final output, and $a_{[n]}$ is the row vector of quantities of labor required per unit of total output, the multiplication of these two terms is equal to the direct and indirect quantities of labor required for the production of vector $Y_{i(t)}$. Similarly, since A arranges the stocks of capital required per unit of output, the multiplication of the Leontief inverse matrix by A is equal to the direct and indirect quantities of capital required for the production of $Y_{i(t)}$. Each component v_i of the row vector V represents the vertically integrated quantities of labor used to produce $Y_{i(t)}$. Each column vector h_i represents the set of heterogeneous commodities required in the form of capital, in the economy as a whole, for the production of each commodity in the net output. Each one of these sets is a vertically integrated unit of productive capacity. Finally, since consumption and investment goods are both part of the net output, it is possible to identify the subsystems underlying both types of commodities. Through the use of the notion of vertical integration, it is possible to analytically divide the commodities produced in two sectors: consumption and investment. Consumption takes the form of wages. New investment in this stationary model takes the form of luxury or non-basic commodities.

The interpretation of the notion of vertical integration proposed here differs from Pasinetti (1973, 1985, and 1988) and Bortis' (2002, 2003 and 2012). Instead of using it to try to calculate the quantities of capital and labor required for the production of commodities, here is used as a method for measuring the quantities of labor and capital that must be committed for a given structure of production. Commitments of production can be reformulated in terms of vertically integrated quantities of labor and capital. Instead of expressing the commitments required by all industries, production promises can be redefined in terms of vertically integrated quantities of labor and capital. The j^{th} component of the scalar vector V represents the quantity of labor that must be committed directly and indirectly in order to produce one unit of the j^{th} commodity in the net output. Likewise, the j^{th} column of matrix H represents the quantity of commodities that must be committed in the form of capital for the production of one unit of commodity j . The different ways in which labor and capital may be committed can be described by using the interpretations of the Leontief inverse matrix presented above.

For instance, under the first interpretation of the Leontief inverse matrix, the commitments to offer labor and capital in all industries are made at the beginning of the year in order to make those resources available at the end of the year or, equivalently, at the beginning of the next one. The quantities of capital and labor are specified by H and V . Wages restore the labor capacity of workers who have no other option but to offer their labor. Wages provide the conditions under which labor is to be executed. In essence, the producers of wage goods make the commitment to produce the amount of consumption commodities required for the payment of wages at the end of the period. The Leontief

inverse matrix specifies the quantity of wage goods that would provide the direct and indirect quantity of labor required by all sub-systems in the next period. From this point of view it can be said that the quantity of labor available for the next period is indirectly promised by the producers of wage goods through their respective production commitments. Likewise, the producers of capital commodities promise to make available the amount new and old investment necessary for the replacement of the economy and the generation of the corresponding net output. This is a way to describe the division of labor by the sectors that produce consumption and investment goods.

2.6 Dynamics within the Sraffa-Pasinetti Framework and the Production Commitments

According to Pasinetti's period of production, the supply of commodities is decided at the beginning of the period (Pasinetti, 1981, pp. 29-49). Demand, on the other hand, is linked to the payment of wages and profits at the end of the period (ibid). From this analysis Pasinetti extracts a full employment condition which is, according to the terms in which his analysis is conducted, macroeconomic in nature. Simply put, this condition states that

... to achieve full employment, the only requirement that is imposed is that the *sum* of all types of demand be such as to imply a total over-all expenditure equal to total potential national income. (Pasinetti, 1981, p. 46)

Put differently, Pasinetti (ibid) asserts that

Each sector i must be endowed with that stock of productive capacity which is necessary to produce the amount of commodity i which is demanded. (Pasinetti, 1981, p. 47)

The fulfillment of this condition is sufficient for the estimation of a viable system, that is, one that produces more than what it takes in the form of commodity inputs. It also implies that the system has solutions with economic meaning. Pasinetti derives these conclusions from the original production schema (Equations A1-A3). The full employment condition captures an essential aspect of *The General Theory*. It states that there is a fundamental breach between individual decisions and macroeconomic outcomes. The level of employment is the result of all the inter-industry and inter-sector interdependencies in the economy acting together.

Under a capitalist market economy, production commitments take the form of financial/monetary arrangements. A decision to commit production is a determination made mostly by firms. The outcome those decisions depends on the aggregate behavior of the economy. The latter is the result of decisions to commit production. Those decisions, to a considerable extent, need to be made simultaneously. No individual industry or firm has the capacity to modify the aggregate level of employment at will for it is the result of the joint interaction of the inter-industry and inter-sector relations. This breach between the way commitments are made, and individual and aggregated outcomes is concomitant with the one that exists between the beginning of the period and the end of the production period.

In accordance with Pasinetti's full employment condition, if the amount and composition of the wage bill is equal to the quantity and composition of the production of consumption goods, the vertically integrated quantity of labor expressed in terms of wage goods must equate the direct and indirect quantity of consumption goods required for the production of a given commodity. From this perspective, Pasinetti's inter-industry

condition of full employment is equivalent to his inter-sector condition of full employment according to which workers do not save; the wage is completely allotted to consumption. The rest of the surplus must be allocated to new investment. Production commitments must be formulated in accordance with the required vertically integrated quantities of capital and labor.

The fulfillment of the production commitments made at the beginning of the period is a necessary condition for the self-replacement of the economy. However, nothing ensures that commitments are going to be fulfilled. The generalization of the Sraffa-Pasinetti framework does not lie on extending its analysis from the case of fixed production coefficients to the case in which coefficients may vary. Sraffa warns the reader that this ought not to be the case. Instead, the generalization proposed here lies on the idea that self-replacement may not occur. This is the case in which production commitments are not effectively fulfilled. Self-replacement is a particular case that can be used to formulate expectations and production commitments. The notion of vertical integration which transcends the period of production can be used as a structured expectation based on the quantities of capital and labor directly and indirectly required for the production of the net output, provided that the assumption of self-replacement holds. Vertical integration is based on what is observed during a period of production which is then extrapolated to other periods through the self-replacement assumption. Hence, in practice, the assumption of self-replacement and the subsequent fulfillment of the production commitments are mere figments of imagination at the beginning of the period. This does not render the notion of vertical integration useless, but it deprives it from its long run character and puts it in the

expectational realm. The current observation of the structure of production and its perceived inertia grants vertical integration the status of a structured expectation.

In a monetary economy production commitments are made with financial assets. If the vertically integrated quantities of labor and capital are expressed in terms of the same numeraire, it is possible to establish the functionality or dysfunctionality of a given structure of production commitments with respect to a current or expected productive structure. In a monetary economy the commitments of production are formulated in terms of monetary contracts or finance allocated to the payment of wages or to capital formation. Each one of those commitments have a monetary value attached to them. Along with production commitments there are financial commitments whose content is based on monetary assets and not on production. Financial commitments however must be backed with new production or with the distribution of a given amount of production. All financial promises expire and all holders of financial promises have a purpose for them. Financial assets cannot be repaid without new production or redistribution of existing production. If the amount of financial commitments implies a larger quantity of monetary production commitments in relation to the amount required by a given (expected) structure of production, the economy is overleveraged with respect to that particular structure. In this way, the identification of the production commitments within the Sraffa-Pasinetti framework shows that there may be a disruption between the beginning of the period and the end of the period of production and between individual decisions and aggregate outcomes. Yet, the assumption of self-replacement can be used as part of the formation of

a grounded expectation. In fact this is what Keynes did in *The General Theory* when he asserted in chapter 12 that

It is reasonable, therefore, to be guided to a considerable degree by the facts about which we feel somewhat confident, even though they may be less decisively relevant to the issue than other facts about which our knowledge is vague and scanty. For this reason the facts of the existing situation enter, in a sense disproportionately, in to the formation of our long term expectations; our usual practice being to take the existing situation and project it into the future, modified only to the extent that we have more or less definite reasons for expecting a change. (Keynes, 1936, p.148)

The analysis of monetary assets is more complete when the structure of production is taken into consideration. Let the financial aspect of production commitments expressed in terms of money be defined as the relation between the monetary value of inputs and the monetary value of the output that is to be produced with those inputs. This includes the monetary value of the inter-industry transactions, the hiring of workers and their inter-sector equivalents expressed by the monetary value of the vertically integrated quantities of labor and capital. The *financial aspect of production commitments expressed in terms of money* can be legitimately compared with the monetary financial commitments (exchange of money in the present for money in the future). The monetary value of X dollars in production commitments represented by the cash outflows required for the purchase of input commodities and hired labor, and the inflows of cash corresponding to the sale of output with a monetary value of say Y dollars, can be compared with a financial asset whose current price and cash outflows amount to X dollars and whose future price and cash inflows are thought to be Y dollars. In this way the financial structure of any financial asset and of the economy as a whole can be compared with the financial aspect of production

commitments measured with money. Both the productive structure expressed in monetary terms and the financial structure can be measured with national accounting techniques.

The financial aspect of the structure of production can be expressed with the vertically integrated quantities of labor and capital. The notion of vertical integration connects the direct and indirect quantities of labor and capital required for the production of commodities. By doing so, it is possible to transcend the current period of production in order to cover the bulk of financial assets which are not constrained to the happenings of a single period of production. The different ways of committing labor and capital can be cataloged with the various ways of interpreting the Leontief matrix explained above. This division of the economy between labor and capital also allows for the analysis of the distributional aspect of the economy; that is, the distribution of the surplus in wages and profits.

2.7 Interpretation of the Quantities of Labor and Capital

Previous sections have made explicit the production commitments in the Sraffa-Pasinetti framework, and have shown a connection between those production commitments and the financial structure of the economy. This section develops a closer relation between the Sraffa-Pasinetti framework and Keynes' general theory. Pasinetti (1973) proposed that the connection between Sraffa's inter-industry analysis and Keynes' inter-sector analysis can be based on Sraffa's concept of sub-systems and Pasinetti's vertical integration. Bortis (1997, 2003) tried to develop a closer connection between Pasinetti and Keynes through

the Marxian reproduction schemes. The latter was not achieved without cost. Bortis had to exclude from his analysis the role of expectations.

Bortis (1997, p. 221) contended that, in order to find the linkages between Keynes' and Sraffa's analysis, it was necessary to eliminate the crucial role of expectations and uncertainty. Bortis argued that institutions replace the role of uncertainty in the analysis of long-run production trends. Bortis (2002, p.84-5) argues that the connection between Keynes and Sraffa must use Pasinetti's vertical integration, but in order to do so, it is necessary to dispose of Keynes' marginal efficiency of capital, and replace it instead with the long-run normal rate of profit which is more coherent with chapter 17 of *The General Theory*. Bortis (2003, p.419) complements this argument by stating that the analytical focus should abstract short term behavioral fluctuations, and focus in a notion of long term equilibrium that is institutional in character, evolves at a comparatively slower pace, and is based in expectations based on present circumstances and are less liable to sudden changes. Bortis envisions the focus on the long run trend of normal levels as an analytical device driven by expectations that are less liable to change. However, Bortis (2003, p. 422) again disposes of Keynes' notion of the marginal efficiency of capital asserting that:

... is associated with uncertainty and expectations. Indeed, investment decisions are now decisively based on comparisons between the *objectively given* realized and normal profit rates, which enables us to evacuate largely the subjective and psychological elements of Keynes' analysis that Sraffa disliked so intensely, and provides a very strong link between Sraffa and Keynes. Bortis (2003, p. 422)

Thus, even though Bortis acknowledges the need for putting together the inter-industry and inter-sectoral sides of the economy through Pasinetti's vertical integration under a Keynesian framework, he is eliminating key aspects of the latter. This view is re-

enforced latter in Bortis (2012, pp. 146-147) where the author concludes that uncertainty, which drives the subjective aspects of *The General Theory*, and Sraffa's prices of reproduction are incompatible. The idea is then, to replace the latter with a mark-up pricing principle which in turn brings about the Marxian scheme of reproduction in its basic form : $M - C \dots P \dots C' - M'$ (Bortis, 2012, p.167). The idea is then, to use long period analysis as the part of the economy that changes slowly, and use prices, wages and profits as the distributional aspect decided by society. Nonetheless, as Earnest Mandel notices in the introduction to *Capital Volume 2*, this is a misuse of Marxian reproduction schemas, for it was in the evolution of the structure of production that Marx was interested the most. In addition, the focus of this dissertation is not to assume that there are long-run coefficients in Sraffa's framework. Sraffa's analytical device was used by him in order to analyze distributional issues, but it can be extended to the analysis of changes in the aggregate level of output and employment whose dynamics are produced by the changing character of short and long-run expectations. Thus, $M - C - M'$ is not tight here, to a mar-up theory but to the notion of the production commitment.

Thus, the alternative proposed here aims at making a more comprehensive integration between the Sraffa-Pasinetti framework and Keynes *General Theory* inclusive of expectations and uncertainty. The quantities of committed labor and capital play a crucial role in the present argument. In this section, an additional step is taken by explaining what is meant by wages and the quantities of labor and capital in both approaches.

Sraffa considered that wages are paid *post factum*:

We shall also hereafter assume that the wage is paid *post factum* as a share of the annual product, thus abandoning the classical economists' idea of a wage 'advanced' from capital. (Sraffa, 1963, p.10)

The notion of production commitments applied to wages makes a bridge between the classics and Sraffa at this respect. At first sight, the payment of wages seems to be a compensation for the laborers' efforts. However, from the point of view of the productive system as a whole, wages constitute the promise to supply the labor required for the use of capital in a subsequent period. The promise to supply labor is a promise to the suppliers of capital commodities. In turn, the commitment to produce capital commodities is not made to the workers, but to the suppliers of wage goods who will sell their output to the hired workers. The self-replacement assumption plays a key role in this interpretation. In terms of the actual workings of the economy, the wage and its converse, the supply of labor and consumption, justify the use of capital commodities. The promise to produce wage commodities for the payment of wages is a promise to supply labor. The employment of that labor requires the fulfillment of the promise to produce the corresponding capital commodities.

In the model of production of commodities by means of commodities, the employment unit is the set of goods (the wage) required in order to make available the labor force at the beginning of the period of production. An abstract unit of labor, the wage unit, is constructed to measure the standard quantity of labor. In spite of its apparent denial of the institutional factors that differentiate labor, the wage unit allows for a social definition of an employed man. The measurement of the quantity of labor in employment units takes into account the survival needs of the human body and the social definition of

employment. From this point of view, full time workers may be, in fact, only partially employed if they are underpaid. A worker is socially underpaid if the existing wage does not allow them to fully express their humanity. The latter, like the wage unit, is not restricted to the physical boundaries of the individual's human body.

This institutional character of the wage unit is also compatible with the coefficients of production in the Sraffian framework, which are considered a long run relationship between the quantity of labor and output. Institutional factors and production coefficients are both expected to change relatively slowly. Sraffa and Keynes define the wage unit following the same method but with a different angle. Whereas the former takes an inter-industry point of view, the latter takes an inter-sector point of view. Sraffa asserts that:

The quantity of labour employed in each industry has now to be represented explicitly, taking the place of the corresponding quantities of subsistence. We suppose labour to be uniform in quality or, what amounts to the same thing, we assume any differences in quality to have been previously reduced to equivalent differences in quantity so that each unit of labour receives the same wage.p10 (Sraffa, 1963, p.10)

Later he asserts that,

We call w the wage per unit of labour [the wage unit], which like prices will be expressed in terms of the chosen standard. (Sraffa, 1963, p.11)

For his part Keynes asserts that:

For, in so far as different grades and kinds of labour and salaried assistance enjoy a more or less fixed relative remuneration, the quantity of employment can be sufficiently defined for our purpose by taking an hour's employment of ordinary labor as our unit and weighting an hour's employment of special labor in proportion to its remuneration; i.e. an hour of special labour remunerated at double ordinary rates will count as two units. We shall call the unit in which the quantity of employment is measured the labour unit; and the money-wage of a labour unit we shall call the wage unit. Thus, if E is the wages (and salaries) bill, W the wage-unit, and N the quantity of employment, $E = N \cdot W$. (Keynes, 1936, p. 41)

Whereas Sraffa is standardizing over “differences in quality” Keynes is standardizing over different degrees of “special labor”. The former focused on an inter-industry approach. The latter was carrying his analysis from an inter-sector perspective. Sraffa, from an inter-industry perspective, focused on the fluctuations of the wage unit in relation to the appropriation of a given surplus. Keynes, from an inter-sector perspective, took the wage unit as given, so that he could analyze the fluctuations in the aggregate level of employment. Whereas Sraffa took as given the standard in which the wage unit is measured, Keynes with the use of Sraffa’s ‘own rates of interest explained how the economy selects that standard. Like the wage unit, the monetary unit is the standard in which other financial instruments are measured. Whereas Sraffa concentrates on issues regarding prices and distribution, Keynes focused on the impact of economic decisions on the level of employment. Sraffa (1963, p.33) shows how profits can be taken as given so that their effect on prices can be analyzed. Profits in turn are “*susceptible of being determined from outside the system of production, in particular by the level of the money rates of interest*” (Ibid, 1963). This paragraph also shows the eclectic and survey-like methodology of Sraffa’s inquiry. He takes the profits rate, as opposed to the wage rate, as the independent variable. Profits can be determined before prices, and are in general driven by factors outside the system like the money interest rate. The latter was the task undertaken by Keynes in the *General Theory*. The fact that profits can be set before prices in Sraffa, opens the door for the role of expectations. Sraffa like Keynes also uses the Marshallian one-thing-at-a-time method.

In regards to the measurement of capital, Pasinetti uses the units of vertically integrated productive capacity. This measurement takes into account the quantities of circulating and fixed capital. In self-replacing state, this quantity of heterogeneous commodities is equivalent to the direct and indirect amount of commodities required for production. For his part, Keynes (Keynes, 1936, p.43) is skeptical of using the quantity of capital as part of his theoretical analysis. Since he is analyzing the “the behavior of the economic system as a whole”, he uses two units: money and labor.

But when we are aggregating the activities of all firms, we cannot speak accurately except in terms of quantities of employment applied to a given equipment. (Keynes, 1936, p. 40)

Thus, ‘fresh capital’ and consumption are measured in hours of labor paid for, given an existing amount and composition of capital (Ibid, p. 44). Here there seems to be a bigger difference between the Sraffa-Pasinetti framework and Keynes. Nonetheless, this is another example of Keynes’ inter-sector approach versus Sraffa’s inter-industry approach. Keynes takes as given the existing capital structure in order to analyze the fluctuations in the aggregate level of employment. Such fluctuations are not explained under the assumption of self-replacement. In Sraffa, from an inter-industry perspective, self-replacement is driven by the price system. In Keynes’ inter-sector analysis, self-replacement is not relevant. In the inter-industry analysis proposed by Sraffa built upon self-replacement, expectations do not play a crucial role. Both types of analysis are not opposite. They are complementary. It is proposed here that Sraffa’s self-replacing mechanism does not rule out expectations. It takes them as given meaning that their change is not being analyzed. Thus, Sraffa’s prices are not long run prices. They are a system of

prices given by expectations based on a particular structure of production. In Keynes, the inter-industry relations of production are not ruled out as irrelevant. They are taken as given meaning that their change is not being analyzed. Keynes focuses on the fluctuations of the aggregate level of employment due to changes in expectations.

2.8 The Sectors Consumption and Investment, commitments of production and vertical integration in Keynes' General Theory

All production is for the purpose of ultimately satisfying a consumer. (Keynes, 1936, p. 46)

For Keynes, the current level of employment depends on the desire to hire by firms. The quantity of labor hired by firms depends on the expected proceeds. Firms intersect their expectations of proceeds at different levels of employment (the supply price) with what they believe to be the most possible level of proceeds (the demand price) in order to decide the level of employment that they want to offer.

The relevant expectation horizon depends on the expected length of the payback period. The length of the payback period has a supply component explained by the technical characteristics of the commodity produced by each firm. Firms can either supply their commodity to other firms or to consumers. The supply of commodities between firms is in part ruled by their technical interdependencies.

The expected length of the payback period also has a demand component which, in turn, explains the timing and the quantity expected to be sold. This demand component is driven by expectations. If firms expect to sell their product to consumers, their expectation

must be based on the current level of employment. If firms expect to sell their product to other firms, their expectation must be based on the buyer's future expectations.

Part of the current level of employment in the private sector is set by the producers of wage goods. The latter only receive part of the proceeds from their decisions to hire due to the effect of the marginal propensity to consume. The remaining part of the level of employment is set by firms who plan to sell their products to other firms in the form of future investment.

The amount of employment, as determined by the amount of private investment, depends on the factors that explain investment expenditure. These are the money interest rate in conjunction with the marginal efficiency of investment. Once the prospective stream of proceeds of an alternative project of investment is established, firms compare it with other investments. The marginal efficiency of an investment project cannot fall below the money interest rate if it is to be undertaken. Otherwise, the investor would not part with liquidity in order to engage in the investment project. Transaction and precautionary motives for holding money depend on the level of income. This epitomizes the given character of inter-industry relations. Uncertainty about the inter-industry relations is assumed to be zero so that the uncertainty about the level of employment can be analyzed. The speculative motive in conjunction with animal spirits explain the current investment expenditure and the level of employment derived from it. Investors who part with liquidity in order to invest it, accept the promise of a future stream of income derived from their sales to other firms. The existence of a well-structured financial market allow investors to make monetary promises which need not to be backed with future production. Likewise,

employment based on current investment need not to be backed by the future use of produced capital equipment. The advantage of producing *unproductive* goods and services as a result of government policies in order to increase the current level of employment is that such policy does not imply a reduction in the future prices of capital commodities. In this way, it allows the private sector to increase investment in the future which in turn prompts an increase in current demand.

Keynes is concentrating on the expectational and monetary aspect of the productive system. This method unveils the important interaction between money and expectations from the inter-sector point of view. The form in which income is saved is important in order to establish whether such type of decision implies the creation of employment. Being two sides of the same transaction, savings and investment are always equal. Whoever saves part of their monetary income, is purchasing an asset. Assets have value for as long as they can be repaid, and that can only occur with the generation of the corresponding income. In turn, income can only be produced with employment.

Keynes' inter-sector focus has implicit in it an implied notion of production commitments. The inter-industry dimension of the commitments of production is given by the supply side of Keynes analysis. The latter is taken as given through an existing level of capital equipment to which various levels of employment are associated. The uncertainty about the demand of specific kinds of commodities is not tackled by Keynes' analysis. Keynes concentrates on the quantities to be demanded of those commodities. Thus, in terms of the quantity of employment, what matters is the quantities of consumption and investment commodities to be produced. The inter-sector dimension of the production

commitments are implied in by the fact that current employment is the promise of future consumption and that current employment depends on the expectations of future employment. This is analogous to the way financial markets are organized in terms of current and future interest rates. Current interest rates depend on the expectations about future interest rates. The configuration between the two mechanisms does not necessarily procure full employment. Monetary assets promise to be repaid, investment productive assets promise to be used and employment promises to be paid. All those promises depend on each other for their fulfillment. Nothing guaranties that they will be kept. In order to have investment it is necessary to have people willing to hold assets. In order to invest, it is necessary to part with liquidity. Workers must accept the promise of a monetary payment. Those promises must bear a relationship with each other in such a way that the balance is kept so as to sustain a given level of employment. Nothing ensures that the economy acting on its own accounts will keep that balance.

Keynes (1936, p.164) acknowledges that, in addition to conducting monetary and fiscal policy, the government must calculate the marginal efficiencies of the various industries. This can be done with the analysis of the structure of production presented above. In conjunction with Keynes' analysis, this theoretical framework based on the notion of *the production commitment* connects Keynes' monetary inter-sector analysis with Pasinetti's production analysis.

The possibility of hoarding money for speculation opens up the possibility to withholding the commitment part of the structure of production, without committing any production at all, and thus jeopardizing the re-placement of the structure of production.

These two sides of the productive process: The commitment part and the technical relations of production, is what must be reconciled in a financial accounting system. What the input-output analysis in conjunction with the production commitments does, is to generalize this whole argument, to the case in which the economy is further partitioned, in order to consider, not only the savings and consumption sectors, but also the multiplicity of industries within them. Thus, what Keynes did in terms of his criticism of the loanable funds theory in relation to production of consumption and investment commodities, is generalized here to the case of multiple industries within those two sectors and the interrelation among them. In the same way reducing consumption does not imply increasing investment, decreasing expenditure on one industry does not imply increasing expenditure in the others. Keynes talked about this possible inconsistency in terms of bonds/money decisions. The generalized structure includes other types of assets like stocks. In this way, the economy is thought to have not only term-specific savings (Bonds of various maturities), but assets that represent both term-specific and industry-specific savings. Remember that the value of a capital asset depends on what it promises to produce and sell, which in turn depends on its role within the division of labor within the structure of production. It is proposed here, that a contribution is made by providing language by which decision-makers can keep a harmonic evolution between the structure of production commitments, expectations of monetary proceeds, production and employment.

In order to complement this framework, chapter 4 proposes a methodology that can be used by governments and the private sector for the formation of their expectations in

the context of this monetary economy. Such methodology is required for the explanation of the continuous evolution of the structure of production.

CHAPTER 3

PRODUCTION COMMITMENTS AND THE STRUCTURE OF PRODUCTION: TWO OF THE THREE ELEMENTS OF AN EFFECTIVE LANGUAGE FOR THE FORMATION OF EXPECTATIONS IN A MONETARY ECONOMY.

Society must manage its expectations if it is to achieve its goals in terms of production. The first step is to communicate those expectations accurately in such a way that all factors relevant to the decision making process are taken into consideration. Reason and logics must be part of this process. In addition, it is necessary to include emotions, innovation and surprise. Expectations described with the language of probability do not fulfill this requirement. Shackle's potential surprise is more complete. The potential surprise language can be used in conjunction with the input-output framework and its corresponding production commitments in order to communicate society's expectations. Expectations of proceeds drive the levels of employment and output in a capitalist monetary economy. The potential surprise function is able to describe the re-production of the current structure of production, while giving room for the unexpected. Thus, unlike rational probabilistic models, the potential surprise language allows for innovation and surprise without discarding what is considered conventionally possible. This view of affairs re-focuses the problem of expectations, from trying to build models for accurate prediction, to offering a language that more accurately reflects aspirations about a structure of production. The latter is continuously under construction. The structure of production is

the result of decisions made on the basis of the formulation of production commitments. The goal is not social planning but social awareness for a better decision-making process.

The objective of the present chapter is to show that the notions of production commitment in conjunction with the structure of production are two of three important elements for the formulation of an expectational language compatible with the postulates of fundamental uncertainty. The need for the methodological need for the creation of such language will become clearer in chapter 4.

Chapter 1 showed that a division of labor economy requires the formulation of production commitments. In turn, the formulation of production commitments represent the creation of an expectation, in this case, an expectation about future production. As explained in chapter 2, production commitments are also based on other expectations like the ones referred to the workings of the structure of production. In short, expectations are the movers of productive resources. This is the core of monetary production economies. The present chapter offers an interpretation of Keynes' *General Theory* at the light of these points.

The basic postulates that form the underpinnings of the argument are as follows: In economies in which uncertainty is a fundamental phenomenon, expectations must be the subject of analysis. Economic decisions whose outcome is uncertain, are based on expectations. Expectations create -as opposed to discover- the future. It is best for economics to focus on the elaboration of a language suitable for the formulation of expectations. The latter are originative in nature. Shackle's view of time has been pivotal for the development of the aforementioned ideas. The present solitary moment, the moment

in being, the time of the experience, is the time-unit for economic analysis. Economic science is expectation: Expectation from the part of the observer (the analyst) and expectation from the part of the economic actors. This implies that time is open to economic non-empty decision. This in turn means that the economic phenomena is susceptible to surprise, innovation and history.

After having studied the nature of production commitments and their role within the structure of production, it is necessary to establish the standpoint of the analyst. In this regard, there are two main categories: 1-The analyst who is a player in the economic arena (that is, an investor). 2- The scientist who is observing the economic phenomenon without planning to take part in it. In both cases, as will be explained in chapter 4, the most accurate approach (at least until proven otherwise) is to treat knowledge as expectation. In this way, expectation and economic knowledge become, alongside the economic phenomenon, objects of study. One of the most important implications of this method of analysis is that expectations held by scientists and economic decision-makers create the economic phenomenon. From a general point of view, investors are scientists when trying to untangle the phenomenon that affects decisions and outcomes. In addition, there is no reason for assuming that decision-makers cannot come up with an understanding of the economic phenomenon in the same way scientist do. And when the latter generate economic knowledge that is perceived as useful, investors generally try to take advantage of it. In this context, strategies and knowledge are not rational or irrational, but synergic and non-synergic. This is the grounding in which the notion of production commitment is born, and with it, the expectational interpretation of the structure of production. The latter has been

described with the widely known input-output framework. Nevertheless, the concept of the structure of production is not constrained to the tools provided by linear algebra. Yet, the traditional input-output framework offers a useful way of describing the economic phenomenon without adhering to a particular theoretical approach. In fact, it offers a way to catalogue a variety of economic theories. Because of the direct connections that it offers between the distributional side of the economy (distribution between wages and profits), the inter-sectoral side of the economy (Consumption and Investment) and the total level of output, this framework can be used to depict theories that focus on one of these aspects, while taking the remaining ones as given. This descriptive versatility has the quality of helping describe economic expectation as a classificatory science. Even more, it allows the formulation of expectations in the form of intentions of production: the production commitments required for the structure of production to be built. The latter is the financial side of the economy expressed in its most general form. When production commitments take a monetary form, expectations must be expressed accordingly.

By making explicit the connection between the structure of production and the production commitments, it is now possible to observe a particular characteristic of monetary expectations: They refer to a phenomenon yet to be constructed. Even more, those expectations take part in the construction of the structure of production. Equally important is the fact that monetary values in different moments in time refer to structures of production that are fundamentally different. Given the complexity of the productive structure, and in spite of some recognizable patterns, the structure of production undergoes continuous change. Expectations must include an idea of the structure of production to be

constructed. In other words, expectations are as influential for the reproduction of the observed structure of production, as they are for its transformation. Because of the importance of monetary values, it is also necessary to have a language, formulated in scalar monetary terms, that takes into account the continuous transformation of the economic phenomenon. This can be achieved with the potential surprise function²³. It is in this context that production commitments, the productive structure and the potential surprise function can complement Keynes' and Sraffa's analysis. Keynes (1936) highlighted the importance of fundamental uncertainty and financial decisions on changes in the level of output and employment. Sraffa (1963) focused on analyzing distribution for a given level of output and employment, and introduced the notion of vertical integration by which it is possible to connect the inter-industry and inter-sectoral sides of the economy. The latter is the centerpiece of the interface between Keynes' and Sraffa's analysis described in chapter 2.

3.1 The Potential Surprise Function in *the General Theory*

In order to understand how production commitments, the structure of production and the potential surprise function can be used together in an expectational language, let us start by connecting the potential surprise function to the scheme of *The General Theory*.

²³ Appendix 2 explains Shackle's expectational language known as the Potential Surprise Function. The reader unfamiliar with this language is advised to read Appendix 2, as most of the argument in the present chapter and in chapter 4 uses it as a central part of the argument.

In spite of the crucial importance of the role of fundamental uncertainty in *The General Theory*, Keynes did not develop in full a theory of expectations. Subsequent papers were more explicit in the need for such analysis²⁴. This was the task undertaken by Shackle which resulted in the proposal of the potential surprise function.

There are three parts of *The General Theory* in which the potential surprise function dovetails. The first one, is in footnote 3 in page 24 (Keynes, 1936, p. 24):

An Entrepreneur, who has to reach a practical decision as to his scale of production, does not, of course, entertain a single undoubting expectation of what the sale-proceeds of a given output will be, but several hypothetical expectations held with varying degrees of probability and definiteness. By his expectation of proceeds I mean, therefore, that expectation of proceeds which, if it were held with certainty, would lead to the same behavior as does the bundle of vague and more various possibilities which actually makes up his state of expectation when he reaches his decision.

Keynes was not as interested in creating a method for accurately predicting future proceeds. He was skeptical of such possibility as he explains in chapter 12 of *The General Theory*. Keynes' focus was to define expectations as the cause for decision and action. This enabled him to define expectation of proceeds as the value that summarizes the decision-maker's set of possible outcomes. Such a set and the corresponding expectation are not defined as a rational assessment of the future. They are defined by their power to propel the decision-maker into action. This involves rational and non-rational arguments. The power of proceeds' expectations is not defined by their predictive accuracy, but by their power to convince the business-woman/man into action. The need for prediction and the motivations for action are two related but different aspects of decision. The former, more

²⁴ For instance, Keynes (1937).

often than not, is proven wrong. The latter is a crucial factor in the human decision-making process.

When the language of probability used in the quote above is put in the context of the whole argument of the *General Theory*, the conclusion is that Keynes lacked a more accurate way of expressing expectations about a fundamentally uncertain future. The fact that entrepreneurs face multiple hypothesis about the future, implies that those hypothesis are rival. The occurrence of one of those futures rules out the possibility of the occurrence of the alternative ones, and when a decision is made, the set of possibilities is fundamentally transformed. The language of probability is inaccurate in this context because it assumes that the list of events and premises is complete, which is never the case when innovation and surprise are possible, and when the corresponding decision has not been made yet. This requires a non-distributional language in which the complete set of events is not necessarily known.

Keynes' passage quoted above refers to expected proceeds measured in monetary (and thus scalar) terms. The combination of rational, non-rational and scalar factors can be described with the potential surprise function. The present chapter focuses on showing some of the analytical uses of the potential surprise function and its relation with the production commitments and the structure of production explained in chapters 1 and 2.

There is another fundamental reason for the need of a non-additive language: the changing nature of the structure of production. The passage quoted from *The General Theory* above was aimed at explaining the decisions of hiring by firms. Keynes did this with two functions:

$$Z = \varphi(L) \quad (1)$$

$$D = f(L) \quad (2)$$

Equation (1) is the aggregate supply function. Equation (2) is the aggregate demand function. The aggregate supply function relates various levels of aggregate employment L to their respective expectations of proceeds, Z . $\varphi(L)$ represents the expectation of proceeds that firms would require to have if they were to hire L workers²⁵. The aggregate demand function relates businesses' current expectations of proceeds D that correspond to each level of hiring L . The equilibrium level of employment is reached when $D = \varphi(L)$, that is, when the businesses' current expectations coincide with the expectations that firms need to have in order to hire L workers. Both Z and D are expressed in monetary terms. L is measured in the units of employment described in chapter 2 of the present dissertation.

In order to reach a consensus about the current monetary value of expectations Z and D which apply for the economy as a whole, it is necessary to find a way by which each firm is able to communicate their own beliefs about Z and D for their own business. The aggregation of those beliefs is what renders Z and D for the economy as a whole.

Each firm i asks herself the following two questions: 1- If we hire l_i workers, how much would we earn in proceeds? 2- How much in the form of proceeds do need to expect

²⁵ Although Keynes uses marginal analysis for the definition of the shape of the supply function, this type of analysis can be replaced with any other type of analysis that relates levels of hiring by firms and the corresponding required expectations of proceeds.

if we were to hire l_i workers? The answer to question 1 is d_i . The answer to question 2 is z_i . The summation of d_i for all $i = 1, 2 \dots n$ firms in the economy renders D . The summation of z_i for all $i = 1, 2 \dots n$ firms in the economy renders Z . The summation of l_i for all firms is equal to L . For each firm, if $d_i < z_i$ for a given l_i , firm i will consider a smaller payroll until $d_i = z_i$. Firms make this type of analysis each time they need to decide how much employment they will hire. More generally, firms make this type of analysis for labor and for other productive inputs. Keynes' inter-sectoral perspective focuses on labor. But this type of analysis can also be conducted from the point of view of the inter-industry perspective proposed in chapter 2. Firms make this type of analysis whenever they decide how many productive resources they want to commit to production. It is also important to note that the interdependence among firms is an important factor in the estimation of each firms' z and d . In Keynes' inter-sectoral framework, part of that interdependence is taken into account by the impact in the consumption goods industry's expectations, by changes in the levels of hiring by the producers of capital commodities. The generalization of this interdependence, so as to include, not only the interdependence among the sectors of investment and consumption commodities, but also the interdependence between industries was the goal of chapter 2. The over or under-valuation of inputs (including labor) committed to production is judged, more generally, with respect to the capacities of the productive structure, and not just with respect to the consumption-investment relations. Such dysfunctional situation in the more general analysis, is analogous to what occurs when there is an excess or lack of investment. In both cases, Keynes' inter-sectoral analysis, and the inter-industry one, the consequence of over-finance (for instance, through

the over-pricing of assets) is the un-fulfillment of expectations, and a subsequent re-adjustments in the level of employment and inputs' prices. Neither firms, nor industries or sectors want to over or under-commit productive resources. In addition, it is not desirable to constrain innovation with a probabilistic language. Shackle's language provides firms, industries and sectors with a language that is coherent with these objectives.

Since Z and D are both expectations of monetary proceeds referred to a fundamentally uncertain future, they can be expressed with Shackle's non-distributional language of the potential surprise function. Keynes' period of production is a transversal cut in the interwoven relations of production and expectations. Z , D and L occur at the beginning of Keynes' period of production. D and Z are the expectations of proceeds to be realized at the end of the period of production. It is possible to draw a potential surprise function²⁶ that relates the set of expected proceeds that correspond to the current level of employment. The potential surprise function assigns a degree of potential surprise y to each possible level of proceeds under consideration (Z or D represented by x in appendix 2) by firms given any current level of employment. Provided the degrees of desirability of different levels of proceeds, it is possible to locate the focal points which are the object of attention by firms, and the inner range with a zero degree of potential surprise assigned to them.

Z is based on the current businesses conditions which explain firms' willingness to offer a given level of employment. This willingness is driven by the current state of

²⁶ Appendix 2.

business. For this reason, Z is less susceptible to manipulation. D , on the other hand, entirely refers to expected events at the end of the period. Keynes divides D in two components: D_1 (Expectation of proceeds at the end of the period generated by the sale of consumption goods) and D_2 (Expectation of proceeds generated by the sale of investment commodities at the end of the period). D_1 is explained by the marginal propensity to consume. D_2 depends on the state of long run expectations. For a given level of current employment at the beginning of the period L , there is a gap created by the marginal propensity to save that must be filled with the production of investment commodities. The latter is driven by D_2 . D_2 is in turn explained by the state of long run expectations.

In addition to the equilibrium between D and Z , amongst all possible levels of employment under consideration, there is only one that corresponds to the restoration of the initial level of employment. D_2 is the factor that has to adjust if the initial level of employment is to be restored. The importance of this particular level of D_2 can be understood with the following quote from chapter 12:

It would be foolish, in forming our expectations, to attach great weight to matters which are very uncertain. It is reasonable, therefore, to be guided to a considerable degree by the facts about which we feel somewhat confident, even though they may be less decisively relevant to the issue than other facts about which our knowledge is vague and scanty. For this reason the facts of the existing situation enter, in a sense disproportionately, into the formation of our long-term expectations; our usual practice being to take the existing situation and to project it into the future, modified only to the extent that we have more or less definite reasons for expecting a change.”(Keynes, 1936, p.148).

Thus, it is accurate to postulate that the sub-set of D that reproduces the current level of employment, is an important referent when investors are forming their expectations. This subset of D also has the characteristic of being an equilibrium point. For

any current level of employment that remains unchanged, $D = Z$. Let us assume that this is not the case. Then, entrepreneurs would hire a number of workers that is different from what their requirements indicate. Thus, the level of aggregate demand that reproduces the current level of employment, D^* , is a momentous equilibrium in the Keynesian sense. In addition, in the context of the potential surprise function, it is accurate to postulate that D^* is part of the inner range, meaning that it is one of the values that has a near zero potential surprise. The reason for this is that we usually “...take the existing situation and ...project it into the future to the extent that we have more or less definite reasons for expecting a change.”(ibidem).

Keynes was not mainly concerned with the conditions for the reproduction of a given initial level of employment. This only was an intermediate step required for the explanation of changes in the aggregate level of employment and output. Reaching full employment becomes more difficult as the level of employment nears the target. It is required to have higher and higher levels of D_2 in order to cause an increase in the production of machine equipment that fills the gap between D and the requirements of Z at levels close to full employment. This occurs due to the effects of the marginal propensity to save as the level of output increases.

Although the obstacles for the reproduction of an initial level of employment are fewer than the ones required for the achievement of full employment, the achievement of both scenarios is affected by the monetary character of the economy. Keynes formulated such obstacles in inter-sectoral terms. By dividing production into two camps (consumption and investment commodities), Keynes was able to understand one of the

dimensions in which money plays a key role in the economy: the one referred to the inter-sectoral dimension in which there is only bonds of different maturities and currency. In chapter 13 of *The General Theory* he showed that it is not possible to predict future interest rates based on the existing term structure, and that the interest rate depends on the liquidity preference (Keynes, 1936, p.168-169). In chapter 12 he showed that the public's liquidity preference is guided by speculation when it pertains to stock prices. All Keynes conclusions were based on an inter-sectoral perspective which takes as given, but does not disregard, the inter-industry side of the economy. Furthermore, an important contribution is made here by extending his analysis to include a more complete version of the economy that also includes the inter-industry relations.

Chapter 2 of the present dissertation showed that it is possible to give an expectational interpretation to the input-output analysis. Input-output analysis, like Keynes', is framed in a period of production. It is possible to complement Keynes analysis by including the three key elements of an expectational language proposed here. The connection is achieved through the expectational character of Pasinetti's vertical integration and the vertically integrated quantities of labor and capital explained in chapter 2.

The monetary value of the vertically integrated quantities of labor, capital and inputs are respectively the monetary value of labor, fixed, and circulating capital that must be committed in advance in order to produce a desired level of output which is assumed to be self-replaced at the end of the period. D_1 and D_2 are partitions in the output vector $Y_{(t)}$. The latter can be multiplied by the price vector in order to be expressed as a monetary

value. As explained in chapter 2 of the present dissertation, the vertically integrated quantity of labor V is the amount of employment that must be committed in the economy as a whole that corresponds to D for the current and subsequent periods so that the economy can remain in state of self-replacement. The same is true for H which is the vector of capital commodities that must be committed in advance. In this way, D is re-expressed as a vector, and the current level of employment takes into account the inter-sectoral and the inter-industry relations. It is a more complete description of D in conditions of self-replacement.

The corresponding commitments of production expressed by V and H not only take into account the inter-sectoral relation between consumption and investment. They also account for the inter-industrial aspect of the economy. The associated financial commitments also take into account both dimensions. The conclusions in this regard rely on the assumption of self-replacement which is not trivial in Keynes' argument as explained above.

It is important to observe that, if the economy self-replaces from period to period, this encourages the formulation of longer term commitments, in line with the dynamics proposed by Minsky (1982). The longer the economy remains in a state of self-replacement, the higher the level of surprise by anticipation assigned to deviations from that trend, the narrower the inner-range around D^* , which prompts firms to taking positions with higher financial leverage. Those positions are validated as long as self-replacement occurs, which requires the financial commitments to be

made along the vertically integrated production commitments, and as long as their structure of payments conforms to the existing structure of production.

Depressions are also explained through the shortening of finance. This process can be depicted with the use of the dislocating structure of production. Recessions occur because of the unwillingness from the part of firms, to make production commitments. The severity of crisis depends on the length of the term of production commitments. The shorter the term in which firms are willing to commit production, the higher the severity of crisis.

The role of investment and government intervention remains as in Keynes (1936), only modified by the more detailed matrix form of Z and D and the inclusion of production commitments as the key financial aspect of the economy. The success of economic policy in restoring a given level of employment lays on its ability to prompt the necessary structure of production commitments that sustains it.

The complexity of the problem has not been reduced with this modification, but it is now possible to dilucidate its specific form. For instance, in absence of self-replacement, it is not possible to create a one-to-one correspondence between a monetary value of expected proceeds, and the corresponding cash flows provided by structure of production. Different structures of production may render the same levels of proceeds. Equal structures of production may render different levels of proceeds. The description of the structure of production, and its inclusion in Keynes'

analysis in conjunction with the potential surprise function renders a way to accurately depict this kaleidic character of the economic phenomenon.

Suppose that firms expect self-reproduction to occur. This expectation is self-reinforcing. However, as Minsky (1987) pointed out, this stability is destabilizing. As shown above, self-replacing implies a situation in which $Z = D$ and the level of employment remains at the same level or at a predictable one. Self-replacement also implies that D is near or in the inner range of the potential surprise function. One possible outcome is that production commitments can extend beyond a single period of production into the future and extend further and further, as the expectation of the reproduction of the economy gains grip in the minds of businesses. There is a family of those commitments associated with the existing productive structure as explained in chapter 2. The longer the horizon of those productive commitments, the more unstable the relationship between them and the structure of production, and the more difficult it is to elucubrate their fulfillment.

With every subsequent self-replacement iteration, levels of D that deviate from those expected by the self replacement of the economy are assigned progressively higher and higher degrees of potential surprise, and the inner range starts to close down around the D that corresponds to self-replacement. So in addition to the instability of the structure of production described in the previous paragraph, there is also instability been harvested in the minds of decision-makers. Any deviation from the reinforced trend for D are perceived as highly (pleasantly or unpleasantly) surprising. Any actual deviation would produce abrupt changes in the decisions.

With the elongation of the production commitments associated to a self-replacing structure of production, there is also a broadening in the possible ways in which production commitments can be combined and permuted and which can still be compatible with the self-replacement of the structure of production. Thus, not only the longer horizon produces instability, but also the increase in the multiple ways in which the concomitant production commitments can be arranged and re-arranged. With this increase in the financial complexity of the structure of production, there is also an increase in the fragility of the system, as the number of possible modifications in the commitment structure increases.

The aforementioned conclusions hold also in cases in which the economy does not simply self-replaces, but grows over time with self-repeating patterns like the ones proposed in Pasinetti (1987). Nonetheless, the consequences in terms of stability are the same as the ones explained above. An assumed certainty about changes in the structure of production has the same implications as an assumed constant and self-repeating structure of production. The former is only a generalization of the latter. Constancy implies certainty.

Finally, in the case of a self-replacing economy, prices are replacement prices. Commitment of production are formulated in terms of the inputs required for the production of commodities (Chapter 2). In this context, the own interest rates for each commodity are simply the net output of each commodity divided by its respective coefficient in the Leontief inverse matrix. Thus, own interest rates are predictable for all future periods if self-replacement is supposed to hold. Neither Sraffa nor Keynes assumed that this was the case in reality. Sraffa is clear on this when, in the preface of *Production*

of Commodities he makes it explicit that he is not assuming constant returns to scale. His work is merely analytical.

Keynes' analytical unit was a single period of production. He did not theorize about the occurrences in a sequence of periods. His focus was on changes in the level of output and employment within a single period. Whenever he ventured outside a single period, he referred to money. Keynes' theory of the interest rate and liquidity preference does not assume self-replacement, and whenever equilibrium is mentioned, no analysis is made of its stability or its continuation in future periods. Production commitments are made with money. Prices change with the structure of production and with them the interest rates. Since the interest is in essence an inter-temporal relation of prices, specifically commodities and money, it is not accurate to establish a logical relation between interest rates in different periods.

When self-replacement is assumed to hold, instability a-la Minsky emerges in the system. If equilibrium is assumed to hold, there is a decrease in the liquidity preference prompting investors to purchase longer term financial assets. As long as equilibrium is sustained, the financial commitments are fulfilled along with the level of employment required for its sustainment. Nevertheless, this longer-term financing of the economy, as Minsky pointed out, entails instability. Longer positions in financial assets makes the economy more vulnerable to small changes in decisions of investment. This, along with the uncertain character of the stock market and its independence from the structure of production in monetary economy, brings about crisis.

Keynes focus on the analysis of expectations and their impact on the current level of employment are methodologically compatible with Shackle's present solitary moment. Keynes analysis of expectations is based on the present solitary moment. In regards to the role that Keynes assigns to the government, it is important to note that it is mostly directed at impacting expectations of future demand D . From the point of view of the commitments of production, government intervention is aimed at creating commitments. Keynes was only concerned with the monetary value of government expenditure and with its impact within the period of analysis under consideration.

The conjugation of the structure of production, commitments of production and the potential surprise function adds to Keynes' inter-sectoral framework. For now the finance, whether generated by the government or by private investors, has a tool for the formation of their expectations in the face of an uncertain future. Any finance or commitment of production that goes beyond a given analytical period of production can now be formulated in terms of an expected structure of production and its corresponding current expected monetary values. This complements the process of the formation of expectations in Keynes' framework, with the Sraffian structure of production that takes into account the inter-industry relations, a financial structure understood as a set of production commitments, and Shackle's potential surprise function, which takes into account the importance of monetary expectations which are in turn related to a structure of production that is continuously subject to kaleidic transformations. Finally, it is important to note that the capacity of financial investment to constructively impact the structure of production by increasing or decreasing the level of output, is an inter-sectoral presentation of a

characteristic of the economic process that also has an inter-industry facet. The more general notion of production commitment has the advantage of covering these two dimensions of the economic phenomenon. Like the analysis of expectations, the analysis of production commitments is based on the present solitary moment. Their constructive role in the economy is a manifestation of the originaive power of economic decisions.

The remainder of this chapter offers an explanation of methodological use of the structure of production for the formation of expectations. The next chapter will do the same for the potential surprise function.

3.2 The Expectational Character of the Structure of Production

Every phenomenon observed through time can be viewed as a set of input-output relations. Conveniently chosen time-space levels of observation delineate the scope and filters of the observer. Relations among the component entities of the observed phenomenon can be thought of as a continuum of inflows and outflows. It is the observer who defines the levels of detail and duration of those entities. Everything that occurs flows from and to those constructed entities. In this way, input-output relations have embedded in them an implicit epistemology. Rather than postulating that observed input-output structures represent the economic phenomenon as is, these relationships are a device for mapping the economic phenomenon. As in any other map, the scale of the input-output analysis changes in accordance with the level of detail required by the observer, and its coordinate system is to be established by convention.

The Input-output analysis shows a productive system in the making. Commodities are depicted as being the result of the transformation of other commodities and/or as being inputs themselves. In this way, commodities exist as separate entities in the measurement period under consideration. The simultaneous presentation of inputs and outputs gives meaning to the changing character that we observe in reality while the period length under consideration justifies their description as separate entities with a defined level of permanence. The period length chosen defines the criteria by which industries and goods are considered well defined entities. However, this does not imply that they are constant in reality. Their transformation is occurring in the process that continuously transforms inputs into outputs.

The description of production processes with the input-output framework can be illustrated with a simple but revealing example. The analysis of the growth of a single plant (a tree for example) can be analyzed by using various plants of the same species in different stages of growth, or by observing the growth of a single plant through time. It is commonly assumed that the latter can be inferred from the former. Previous stages of growth can be seen as part of the inputs provided to further stages. However, it is not accurate to assume that the growth of a forest can be inferred from the observation of a single plant. Likewise, it is not possible to deduct the growth of a single plant by observing different plants at different stages. The observation of stages and growth in the case of biological entities, gives valuable information about the genetics of the systems being analyzed. Nevertheless, this analysis does not cover all relevant aspects that affect the growth of individual plants and the forest. Like in the case of the simultaneous representation of plants at different

stages, the input-output analysis is a simultaneous representation of various stages of production. However, that representation does not provide certainty about the particular circumstances of each individual industry/commodity. And just in the case of trees, it would be incorrect to assume certainty where there is none. Using Shackle's terminology, doing so would require the denial of the fact that the economic aspects of human life are only one of the colors of the spectrum of human affairs²⁷.

In the input-output analysis, each inputs' *orientation* is to, eventually, be transformed into the corresponding final output/s. By taking at the same time products, at different stages of production, some being the inputs to others, it is possible to find the production coefficients. According to the argument in the previous paragraphs, such relation does not imply knowledge or certainty about the destiny of each commodity in the structure of production²⁸.

²⁷ This example contrasts with Marshall's example (Marshall, 1961 [1920], p. 314-322) in which firms are pictured as trees in the forest. Stronger and pioneer firms grow bigger than the rest. In this way, they take more light and resources which in turn makes them bigger. Those firms eventually perish, and by doing so, they open space to others that take their place. This illustration however does not apply to economies whose structure is in continuous transformation. Internal and external economies (analogous to non-systemic and systemic risk) are described in the context of an economy in which there is certainty and representative producers have meaning (See chapter 1 for a critique). Nonetheless, this approach does not explain the current structure of production, nor does it help understand its evolution through time in the general case of monetary economies with involuntary unemployment.

²⁸ This differs with Bortis (2012) *et al*, in which production coefficients are supposed to reflect long run relationships and determine the normal levels of economic variables.

This is the representation of an ecosystem whose permanence implies its reproduction. The contemporaneous coexistence of goods at different steps in their productive chain, in proportional relations with one another in continuous transformation through the different stages of the production process, assumes that the relations involved will be repeated, with the same goods at different stages and with different goods in the same stages that the former occupied. This is what the notion of reproduction entails.

The longest run (if such thing exist) of all things (in this case commodities) is their unrecognizable transformation. Permanence and constancy is only transitory and relative to the chosen period of analysis. Self-replacement gives epistemic existence to the co-existing entities (commodities and industries). But it does not imply knowledge about their production. For that reason, the description of production with this method is expectation.

Input-output analysis illustrates the living world of commodities and industries where species seem unchanged in the brief period of time in which they find their co-existence. Parts of the structure of production digest one another in the process of transformation of commodities. In spite of their apparent permanence, all entities in the structure of production are in continuous evolution. Their apparent separation in individual entities however, goes in sharp contrast with the fact that that all outputs are inputs to something else until the end of the universe (if so is the case): the final output of all transformations.

An interesting aspect of this methodology is that, on one hand it allows us to try to grasp the stages of every process of production in the economy as if all its stages occurred at once as registered by the input-output analysis. An apparent drawback is that such

simultaneous record does not ensure that the commodities will in fact be taken to their next stage. Nevertheless, this represents a twofold advantage. First, it acknowledges the fundamentally uncertain character of economic processes. Second, it characterizes every process of production as the blending and transformation of various inputs whose confluence is merely incidental (Inputs can be used in various ways) and whose outcome cannot be but merely transitory. This latter advantage is merely analytical. It is compatible with the definition of the 'economic entities' and is referred only to the short run considered. The self-replacement assumption gives support to the assertion that the things that exist today as registered in the short run, will transcend the short run. In the input-output approach things don't cease to exist when the short period measured ends. The self-replacement assumption reflects this consideration.

The coefficients of production estimated by the input-output analysis can thus be considered social constructs. The technical relations of production are established in such a way that they sustain the going social and biological relations involved (Lee, 2011). Thus, in addition to the epistemic need for the permanence of economic entities, there is a pragmatic need that is based on the survival of the agents in charge of their construction.

3.3 Input Output Analysis and Keynesian Uncertainty

In the same way Keynes' aggregate supply price Z represents a set of hypothetical levels of production and their respective expectations of proceeds, input-output analysis depicts a set of hypothetical sequences. This is reflected in the simultaneous input-output relations which, although not showing a necessary sequence of stages, describe the

orientation of goods as inputs and outputs. Each stage of production is oriented towards the production of output at a further stage, without implying prediction or causality. That allows the simultaneous of various stages representation. This simultaneous representation gives us an idea of the following stage for each good. Nonetheless, since they do not represent a sequence. The orientation that each of them have due to the place that they have in their own productive chain in relation to the others in the period of measurement of the matrix, makes possible to formulate as many hypothesis as there are inputs and outputs. Using the tree analogy, a hypothesis is made that each tree will keep growing and thus reaching the next stage. However, since different trees are describing each stage, it is more possible that something may happen to each of those trees that may impede their growth to the next stage.

It is as though there was a trade off between two types of analysis: 1) The insight gained from the historical observation of a single entity (i.e productive system) and from this knowledge, its extrapolation into the future, and 2) The insight gained from the current observation of goods in various stages which gives an indication as to how one may be transformed into the other. The necessary character of sequence of the former replaces observation with inference, whereas the hypothesis made based in the latter replaces sequence with interpretative observation. The former infers spatial relations from time, whereas the latter infers time relations from space. From the analyst's point of view, it may be possible to find a desirable middle point between the two types of analysis. The advantage of the input-output analysis is that hypothetical relations of sequence are based on the inter-industry purchases, while keeping the corresponding sequence as a mere

hypothesis held in the present solitary moment. This is the nature of an expectation based on the characteristics of the input-output approach.

3.4 Input Output and proof of the expectational character of social averages

The expectational character of the socially constructed averages in the input-output framework can be proved by noticing that there is an infinite number of combinations between inter-sector and inter-industry relations and time horizons to be considered. Since the details of the circumstances of time and place in which economic decisions occur are ungraspable by any economic analysis (Hayek,1945) then, it is necessary to acknowledge the expectational character of any such attempt.

The proposal of the input-output as part of an expectational language could be justified from the point of view that each decision maker has a partial view of the whole economy, that can be accurately represented by the input output framework for it allows an accurate communication of beliefs about the productive system. The big picture is always constructed ex-post. The better communication may help to better potentiate the innovative character of economic theory. It is better to speed up the spread of decisions and innovation, processes which are themselves chaotic and inexplicable, than to let them disseminate in a disorderly manner. If ordered, the communication of innovations subtract distortion to an already inherently chaotic process.

The relevance of the input output relations is relative to the going concern involved. In an economy that is not centrally planned, the input-output relations relevant (and the

timing of their estimation) for each going concern tend to be different for each one of them.

The input-output for the economy as a whole can only be known ex-post.

CHAPTER 4

SHACKLE'S POTENTIAL SURPRISE FUNCTION AND THE FORMATION OF EXPECTATIONS IN A MONETARY ECONOMY²⁹

I like models that try to understand the forces that drive the economy. What I don't agree is with models that take into account those forces, but forget the main one which is the fundamental uncertainty.

G.C. Harcourt (Personal communication, Cambridge-Michaelmas Term, 2009)

Shackle's criticisms of the neoclassical theory³⁰, his interpretation of Keynes' *General Theory* in the light of fundamental uncertainty³¹ and his analysis on the history of economic thought³² are his most recognized contributions to economics. Shackle (1972) explains the role of uncertainty in economic theorizing and criticizes the neoclassical connection between rational choice and determinism. Based on Keynes (1930) and (1937), Shackle (1974) uses the Swedish notions of *ex ante* and *ex post* to explain the *General Theory*. Shackle (Shackle, 1967a) analyses the history of economic thought from 1926 to 1939 and highlights the rupture with the paradigm of perfect competition. One of his most important theoretical contributions, the potential surprise function, simply put, explains that crucial decisions are made by focusing in the most salient, arresting and plausible

²⁹ Most of the content in this chapter is published in Cantillo (2014), which is an article of my authorship.

³⁰ Shackle (1972) *inter alia*.

³¹ Shackle (1974), Shackle (1968), etc.

³² For instance, Shackle (1967a).

conjectured outcomes. Imagined possibilities that are too surprising to take seriously are dismissed. The potential surprise function has been criticized mainly because of its apparent deficiency in the analysis of more than two assets (Ford, 1994, p. 190)³³. Some sympathetic criticisms have tried to overcome this and other difficulties of the potential surprise³⁴. Shackle's approach to uncertainty has been criticized on the grounds of its supposedly nihilistic consequences³⁵ and its apparent conflict with other Post Keynesian themes like the furthering of Neo-Ricardian and evolutionary approaches³⁶ or the lack of analysis of social power³⁷. Nonetheless the literature has underemphasized the fact that the potential surprise function complements Keynes' *General Theory*. The present chapter is aimed at correcting this trend. More concretely, I argue that the attributes that allow

³³ A full analysis of this critique is out of the scope of the present paper. Suffice is to say that it springs from Ford's attempt to use the potential surprise function as a criterion for portfolio selection and not as an *expectational* language. The latter interpretation, which will be explained below, implies that the hopes and fears expressed by Shackle's potential surprise can refer to single and multiple asset portfolios. Shackle's potential surprise does not require a full analysis of investment alternatives. Only the highest and the lowest alternatives in the gambler's map need to be considered. This means that Shackle's decision problem can be framed as one between two rival portfolios. The specialist reader, to whom this footnote is mainly addressed, may consider that this is a slight digression from Shackle. A presentation of a more complete argument on this matter is left for a further inquiry.

³⁴For example, Vickers (1994, pp. 213-252), Katzner (1989) and Katzner (1992).

³⁵ Coddington (1982, p. 486).

³⁶ note 31 contains a brief discussion on this critique.

³⁷ Dixon (1986, pp. 589-590).

Shackle's potential surprise to explain the originative character of decisions also make it suitable for communicating expectations in the context of a monetary economy³⁸.

This paper extends Shackle's approach by proposing a conception of aggregate economic process that is constantly under construction by decisions in a non-deterministic fashion. Space cannot have meaning without an associated idea of time. Likewise time cannot have meaning without a correlative idea of space. The temporal and spatial aspects of uncertainty are intertwined. That is why according to Shackle, the present moment is also solitary. The future is uncertain and the past is interpretative memory if and only if the individual circumstances, including the relationships with other individuals, are also unknowable. Taking the present solitary moment as the starting point in the analysis provides an explanation of the collective, aggregate and recordable economic phenomena that also recognizes the innovative character of individual decisions. On one hand the collective character of the aggregate economy remains unproven in the present solitary moment. It is only a mere figment in the expectations and memories of individuals. The overall market outcome is perceived as collecting and processing decisions. Individuals see themselves as affected by their circumstances and the decisions of other individuals. On the other, the unproven feature of this collective entity allows them to recognize their capacity to form part in the creation of the aggregate economic outcomes.

³⁸ According to Keynes "A monetary economy, we shall find, is essentially one in which changing views about the future are capable of influencing the quantity of employment and not merely its direction" (1936, p. vii).

Subjective emotions and judgments drive behavior in monetary systems that, unlike barter economies, permit indeterminate outcomes. What originates in the mind can produce something novel in the ‘outside’ economic world. Shackle gives us a language to make a bridge between the subjective on the one hand and what is perceived as external and measurable on the other. Those individual aspects involve feelings and emotions which can only be experienced individually. We feel before we rationalize; this is the meaning of being conscious. The *quantum* aspects of continuous time and space are represented by the permanently innovative character of consciousness. Those feelings and emotions are also the foundations of inspiration, creativity and decision. In economics these aspects take the form of scalar monetary quantities. The communication of those cannot be accomplished through determinism³⁹. Shackle’s language is a communication tool of perception formulated in scalar monetary terms. By communicating the individual aspects of perception it is possible to identify agreements and disagreements. Only part of those has to do with reason. The permanent possibility that each individual has of bringing something new to the world is the mirror image of their experience which permanently brings something new to their conscious being. It is necessary to bring those individual and creative aspects of consciousness to the permanent transformation of economic circumstances. In the case of the analyst, it might be possible to say that the study of the economic arena would be clearer if they and the decision makers both used the same

³⁹ Determinism is the philosophical notion according to which every event has a cause and there is a single course for history (Hargreaves-Heap & Hollis, 1987). The assumption of determinism implies that knowledge is an attribute of reality.

language to express their expectations. Apart from that, the unraveling of the economic phenomenon depends on the actual decisions whose outcome can only be experienced *ex post*.

The notions of “*ex ante*” and “*ex post*” play an important role in Shackle’s theory. This idea consists simply in distinguishing the imaginary events and situations assigned by some individual to a still-future calendar interval, from the events and situations which appear in the record of that interval after it has passed into history. Myrdal called that conception of the contents of a segment of calendar time, which a person may entertain when he stands at the threshold of that segment, an *ex ante* view, and the numerical values composing that view *ex ante* quantities, while the account which has been recorded when the interval is past is the *ex post* view and its composing numerical values are *ex post* quantities. (Shackle, 1965, p. 49)

These notions allow Shackle to connect two different moments without having to deduce one from the other. So could his potential surprise function. This is the use that I propose for Shackle’s language. I use Shackle’s epistemic notions in order to highlight the implications of the unproven character of determinism. In the context of a monetary economy this requires the use of an adequate *expectational*⁴⁰ language. Shackle’s language (the potential surprise function) is compatible with the main features of the monetary economy explained in *The General Theory*. Keynes’ equilibrium methodology is compatible with Shackle’s kaleidic analysis. Shackle’s language provides the decision

⁴⁰ Shackle (1972, p. 414).

makers and the analyst with a way to deliberate about their expectations. The outcome of such process can only be experienced ex post as pointed out in *The General Theory*. This is also Shackle's point. Government and agents have the capacity to participate in the creation of their aggregate economic future.

4.1 The Unproven Character of Determinism

But the second of my two kinds of economic dynamics will by many economists be denied the status of science, because it is introspective. I am myself at loss to understand why a man's sense perceptions should be scientific while his self-perceptions are to be dismissed as delusory. This attitude is the opposite of "Cartesian doubt, for Descartes founded his belief in the existence of something real in the cosmos on the existence of a being which had feelings and thoughts: *Cogito, ergo sum*. (Shackle, 1967b, p. 24)

A necessary condition for the existence of any assertion about economic phenomena (for instance any of the present ones) is that there must be at least an individual (the analyst) that experiences those assertions. Without settling the discussion about the possibilities of collective experience, it is plausible to say that at least in principle those assertions are a matter of individual perception and/or reasoning. Without denying the possibility that individuals can be conscious of what others are conscious of, I think I, and possibly you, stand in firm ground if we acknowledge its unproven character. The individual aspects of experience, on the other hand, are perceived by each of us in particular; our perception of them grants them the possibility of existence. This is an axiomatic statement. Instead of assuming that shared impressions about reality are permanent and the same for all individuals, I invite the reader to explore the origins of their perceived consensual character.

Let us take a step further and notice that the economic phenomenon, as we perceive it, is formed by a set of causal relations that mark the difference between two realms: the past and the future. Somewhere between these two extremes we locate the present. These three elements: past present and future form our notion of time. The existence of thoughts and perceptions need, at least, to be experienced in the present moment of each individual. Past events exist, at least, in the present memory of each one of us. Future events exist at least in each individual's present imagination (Shackle, 1965, p. 189). Present events are being experienced. We do not deny that past events truly happened or that the analysis of causal relations that renders some idea of what the future may bring is useless. However, there is no proof of their existence other than in our present memory and imagination.

The future is permanently under construction. Thus, the past does not have all the seeds from which the present moment germinates. The past is subject to interpretation⁴¹. Shackle (1969, p. 39) supports this point by explaining that

It is plain that the answers which history gave to certain questions will be identically stated by many men no matter when we consult them...Yet all such facts are the mere surface of things. The meaning which is found in them, the emotional colour that they wear, what they stand for in imagined history are private to the individual mind.

Shackle's present solitary moment is where all memories, expectations and perceptions occur. By focusing on it we do not have to prove, disprove or assume the

⁴¹ Only in cases where we recreate our logical reasoning (for instance, controlled experiments), we can claim that those capacities contained in our commonly shared logical frame would be sufficient for helping us unveil permanent causal mechanisms. Those recreations are as self-sufficient and self-contained as the logical system that analyzes them. However, this is not the case of the economic arena.

possibility of knowledge. The latter is merely a strongly held belief⁴²; a hypothesis susceptible of permanent evaluation.

Even though determinism is not a proven hypothesis, it could be argued that it is a useful assumption. However, treated in this way, it would prevent us from understanding key elements of decision and the theory-making processes. In its most general and basic form we experience the present moment through sense and self-perception which are not necessarily rational. There are innumerable circumstances and events that occur in the present solitary moment. To tackle those, we are not only equipped with reason but we are also endowed with senses, emotions and other psychological traits. If we assumed that the economic world is determinable, our analysis of decision making would only involve rational arguments and would assign a secondary role to important elements of the way we perceive. Self-perception does not emanate from rationality; rationality is a form of self-perception.

In spite of this skeptical position we can justify our beliefs in the meaning of concepts, words, and any statement in general without having to prove that knowledge is possible. We need such justification in order to explain the faculties, concepts and entities that we use in order to generate expectations and memories. They can be justified with the idea that they are useful from a perspective in which order, permanence, magnitude and

⁴² In section 2 the term belief will be changed for the more accurate Shackle's notion of disbelief.

their socialization⁴³ are permanently under construction as opposed to ready made categories. Although Shackle did not develop this implication of his argument, it is proposed here as an extension.

The ultimate indispensable permissive condition of knowledge is the repetition of recognizable configurations. These patterns or stereotypes form a hierarchy in our minds. A pattern of sense-impressions, perhaps from more than one sense, is pinned down as an object or an event. The occurrence, over and over again, of similar objects or events establishes a class of objects or events, a *concept*. Such concepts themselves can then form the building-blocks of more complex and inclusive configurations. Science tells us what to count on, what to rely on. But in doing so it merely imitates and refines the process by which we build, each of us for himself, the homely technology of everyday living. The means of its doing so is the power of survival and re-appearance of types of configuration. Such classes of configurations can have as their medium of subject matter the most extreme diversity of impressions or phenomena. (Shackle, 1972, p. 6)

Supposedly 'known' concepts and ideas are fixed in our memories not because they are true or real but because we regard them as useful. Imagination provides us with new ideas which eventually may or may not be considered useful. The ones that are useless keep a status of mere figments. The criterion of usefulness accepts the possibility of creating new notions not necessarily deduced from the past. With this criterion we also

⁴³Shackle (Shackle, 1966, pp. 112-118) for example, did consider the analysis of the social construction at the light of his theory of expectations. In fact, Shackle's aim of creating an *expectational* language would not make sense under an entirely subjectivist position.

allow ourselves a trial and error process of new concepts and ideas whose outcome is relative to a set of particular present circumstances. We can hypothesize that surviving⁴⁴ concepts tend to acquire a higher standing without ruling out the possibility of evidence in the opposite direction or the creation of new concepts.

I have always thought of each moment as the child of its predecessor in the decision-maker's mind, inheriting characters though also undergoing mutations. (Shackle, 1969, p. 38)

It is important to note that Shackle's use of the evolutionist metaphor is only illustrative. Innovation is assimilated, in the previous quote, to mutation. However, this does not imply that the dynamics described by biological mutations are the same that explain the emergence of novelty. The biological aspects, the physical context and the general circumstances in which an individual perceives affect their definition of reality but do not determine it. In such process there is always room for inspiration which is not tied down to experience or evolution. Inspiration according to Shackle (rightly so) occurs *ex nihilo*⁴⁵.

⁴⁴ For a possible relation between Shackle's notion of time and evolution see Ford (1994, pp. 42-43). Although Shackle did not elaborate in the evolutionary paradigm, he did have an affinity for a more general framework that connects different moments without necessarily implying that one is logically deduced from the other. Some paradigms compatible with this principle are the notions *ex ante* and *ex post* put forth by the Swedish school, and Shackle's kaleidic analysis. This exemplifies that self-perception is a more general faculty of which logic is a particular form. We can possess the memory of the repeated occurrence of an event a before b without necessarily asserting that the occurrence of a implies or implied the occurrence of b.

⁴⁵ Neither pre-determined nor determined outside the moment in being (the present solitary moment which is the time of the experience).

All our concepts and ideas occur in the present moment. The flowing present moment provides us with sense impressions and the opportunity to decide. No thought exercise can replace this time of the experience where perception, thoughts, reasoning, imagination and decision occur.

But, for the individual mind, only one moment is actual, the *moment-in-being*, the 'present'. Because economics is concerned with the actions and conduct of men, it is concerned with their decisions. But decisions take place in the individual mind. It follows that economics must be concerned with the essence and nature of the moment-in-being of the individual person. (Shackle, 1983, p. 106)

4.2 Scalar Monetary Quantities, the Realm of the Form and the Need for a New Language

In the present solitary moment economic phenomena appear to us as represented by scalar physical and monetary quantities. The scalar monetary quantities are the canvas on which we depict our expectations. Profits, wages, interest rates, and prices are important economic entities on which we rely to make economic decisions. They represent our expectation of exchange for physical quantities of goods, services or access to monetary quantities in the future. However, there is no clear relation between our decisions based on scalar monetary quantities and what outcomes those decisions lead to. On one hand we have to base our expectations on the scalar monetary quantities (the scalar monetary realm) but on the other, we cannot be sure of the relationship between those and the non-monetary characteristics of goods, services, technologies, techniques and forms of organization that are part of the broader spectrum of human affairs and which are relevant for economic decisions. This hyper-dimensional context is named by Shackle (1972, pp. 40-43) as the

realm of the form. Although the monetary character of economic decisions is relevant, the non-monetary aspects of them must also be taken into account in the decision-making process. For instance, the elaboration of a project of investment not only involves the monetary cost of the machine equipment and its prospective return. Aspects like the design of techniques of production, the day-to-day management of the project and the personal involvement of the investors are not necessarily determined by and do not necessarily determine the monetary outcomes.

Some deterministic theories deduce that there is a stable correspondence between these two realms. In Shackle's words, they assume a pre-reconciliation of expectations⁴⁶. An example of this method of research is the rational expectations approach proposed by Muth (1961). In this approach the analyst is able to know the "true" model of the economy. Thus, the agents in the model should be able to discover such model. Agents can predict the movement of scalar variables. Thus, they are able to make rational choices which in turn validate the model. This also allows them to find a functional relation between the scalar monetary realm and the realm of the form⁴⁷. The functional correspondence is the result of the assumption of rationality which in turn derives from determinism. The rational expectations approach has shown that it is possible to generalize this conclusion to any

⁴⁶ Shackle (1972, p. 124).

⁴⁷ Although in Shackle (For instance Shackle (1972, p. 79)), relationships in the monetary domain do not determine and are not determined by material causes, the latter affects the former and vice versa. The eventual reconfigurations in the monetary realm can always be explained ex post as having a material cause. However, this is not always the case ex ante.

theory that claims that deterministic knowledge about the behavior of the scalar monetary quantities is possible⁴⁸.

When determinism is not assumed, the form and the monetary realms affect each other but do not necessarily determine each other. The present cannot be predicted or experienced beforehand. The realm of the form belongs in the time of the experience. Making a monetary payment is not equivalent to consuming a good, receiving a service or conducting a project of investment. The difference produces a detachment between the monetary and the non-monetary aspects of a decision. In this context money acquires asset properties and the assumption of a functional correspondence between the scalar and the form realms of the economy breaks down. The way Shackle proposes to take into account the effect of the realm of the form on those monetary quantities is through the creation of a non-deterministic⁴⁹ language of expectations. He wants to find a way to communicate this non-deterministic character in scalar terms.

Whereas a language based on a deterministic assumption rules out the possibility of a non-deterministic world, a language that does not make that assumption is open to consider the possibility of an eventual proof in favor of determinism⁵⁰. With a non-deterministic language we can justify the perceived order as the result of an ongoing

⁴⁸ See for instance Sargent and Wallace (1973, p. 328).

⁴⁹ This expression is used here to signify that determinism has not been proven, does not need to be disproved, and is not a necessary or a desirable assumption.

⁵⁰ Science is confined to a concern only with the shadows of reality (Shackle, 1965, p. 189).

construction. Order has meaning within a non-deterministic language. On the other hand, novelty and surprise lack their most fundamental meaning within a deterministic language. The acquisition of knowledge takes time and cannot be predicted⁵¹. With the proposed non deterministic language, in the doubtful event that determinism could be proven, our former strongly held expectations could still acquire the character of knowledge as such. Put another way, from a determinist perspective order is the rule to be discovered and novelty is the exception to that rule. However, this line of thought leads to absurd conclusions. For we do not experience a novelty until it happens and the set of unknown novelties⁵² cannot be *known*. From Shackle's non-deterministic approach, innovation is the rule out of which order is constructed.

Instead of paving the way for determinism as in the rational expectations approach, it opens the possibility of assigning a crucial role to essential factors that, along with reason, intervene in the process of expectations formation and decision making. The analyst and the agents see themselves as originators of expectations. In the present moment every statement about the economy is an expectation. They are part memory, perception and imagination. Our perception of the economic phenomena is permanently disturbed by the occurrence of events and situations not taken into account. Imagination mimics the innovative character of the economic phenomenon. In doing so, it "... merely imitates and refines the process by which we build, each of us for himself, the homely technology of

⁵¹ Ludwig M. Lachmann quoted by Shackle (1972, p. p.iv).

⁵² An analysis of the characteristics of such set is left for a further research.

everyday living” (Shackle, 1972, p. 6). Agents and analysts do not discover the true model; they create it. Thus, the ability to communicate ideas about the formation of expectations and their spread between individuals takes the place of the capacities of prediction as the main aim of economic analysis. What comes out of an economic interaction and communication of expectations that uses a non-deterministic language can only be experienced, interpreted and perceived ex post. The permanent dynamic interaction between analyst and agents through their creative expectations and decisions replaces the deterministic notion of equilibrium. This view seems very Hayekian⁵³ in nature. According to Hayek, the decisions makers’ “... particular circumstances of time and place...” (Hayek, 1945, p. 522) cannot be known to the analyst. There is always some information that can only be revealed through the economic interaction and the price mechanism. There is an infinitely large and detailed amount of information out of the scope of any computational system other than the market itself. Shackle’s argument is fundamentally different. It is not our limited computational capabilities what renders pretentious any aspirations of replacing the unfolding economic processes with knowledge. On the contrary, it is the acknowledgement of the originative element of expectations. For among the particular circumstances of time and place we ought to place expectations as the most important one. In the recognition of the originative power of expectations lies our faculty to create new information. In addition, this ability per se does not guarantee a socially desirable outcome (for instance, through the action of the price mechanism as proposed by Hayek). In order

⁵³ For instance Hayek (1945).

to explore this creative ability we need to appeal to other elements in addition to reason. Shackle's proposed language based on the potential surprise function aims at such enquiry. Any language is a convention. Furthermore, the potential surprise function is not the only possible one. It is feasible to construct other languages equally useful in the description of scalar monetary quantities in a non-deterministic fashion.

4.3 Shackle's proposed language: The Potential Surprise Function

Shackle did not intend with his language of the potential surprise function to solve the problem of uncertainty. He wanted to propose an *expectational* language adequate for a monetary economy:

Here we sought to argue for a language able to conceive expectation as a source and origin of history rather than as a branch of arithmetic. (Shackle, 1972, p. 408)

The degree of autonomy and power that expectations have in a monetary economy makes it possible and necessary to create a language formulated in scalar monetary terms. Such language must take into account the bidirectional effect between the monetary and the form realms. The eventual reconfigurations between the two realms are provided by innovation, surprise, simultaneity of decisions and the time of the experience (Shackle, 1972). This creates the separation between the moment in which expectations are formed and the moment in which the result of those expectations is obtained. The need for the creation of an *expectational* language in this context posits the puzzle of combining a variety of factors: the innovative character of the realm of the form, its effect on the scalar monetary realm, the need to formulate our expectation in those scalar terms and their effect

on the realm of the form, the lack of a functional correspondence between the two realms, and the possibility and need of analyzing the scalar monetary realm. Put another way Shackle asks:

What must be the character of a language, a symbolism and a formal notation which can allow for the far-reaching, surprising and unanticipable implication of this starting-point for analysis? (1972, p. 365)

According to Shackle (1972, pp. 22-23), the language of probability does not provide a valid bridge between individual expectations and their circumstances. It assumes that we possess the complete list of events that may occur. This assumption rules out the possibility of novelty and surprise. It is possible to argue that the language of probability takes into account all possible outcomes through the inclusion of the set of real numbers in its domain. This would occur if there was a stable correspondence between the realm of the form and the scalar monetary realm⁵⁴. Such correspondence would imply determinism. Thus the language of probability is ill-suited for solving the aforementioned puzzle.

The potential surprise is better equipped, as Shackle explained at length. Put briefly, Shackle⁵⁵ changed the idea of knowledge of the future for the more general and perception-oriented notion of standing. Different values of the scalar variable of interest are associated with different degrees of disbelief that in turn establish the feeling of surprise by anticipation: the potential surprise. By taking into account the rival character of alternative

⁵⁴ One way of expressing such lack of correspondence between these two realms in the context of time series analysis is the concept of ergodicity explained by Paul Davidson (Davidson, 1982 *et al*) only with the caveat that this is not the only way of describing this phenomenon.

⁵⁵ For instance Shackle (1958) and (1952).

outcomes, the expression of disbelief avoids giving standing to an outcome in detriment of another. The standing of each outcome is analyzed independently.

The values in the inner range of the potential surprise function are those with an assigned zero degree of potential surprise. There is a maximum degree of surprise that can be imagined at any present moment. Values away from the inner range are assigned progressively higher degrees of potential surprise.

Shackle proposes to assign degrees of ascendancy to possibilities by relating the enjoyment by anticipation with the associated degrees of potential surprise of each value of the variable that is being considered. In order to have the same ascendancy, an increase/decrease in the value of a desirable variable must be associated with a higher/lower degree of potential surprise.

By finding the highest/lowest enjoyment by anticipation in conjunction with the lowest associated degree of surprise, the decision maker encounters the two values of the variable that would call their attention the most: the focal points. A process of standardization locates the values of the variable that afford the decision maker the same ascendancy as the focal points, but with an associated zero degree of potential surprise. These values are the standardized focal outcomes. They allow the comparison of the focal outcomes of different alternatives of, say, investment. Shackle summarizes his language in the following way:

To summarize this conception, we suggest that an enterpriser who is deciding whether to invest or not will place himself in imagination in the position of having actually laid out a cash sum on constructing concrete equipment, and will then weigh against each other the two elements of the immediate mental experience which this position would afford him: the enjoyment by anticipation of the greatest

gain whose attractiveness is not undermined by association with too high a degree of potential surprise, and the suffering, by anticipation, of the greatest loss whose unpleasantness is not weakened by being associated with too high a degree of potential surprise. It is these two *extremes* which will focus the enterpriser's attention. (Shackle, 1949, p. 5)

Or in even more common sense terms:

I would like to suggest an alternative formula which the business man might use, and to ask whether in fact he does not sometimes use it, in his inmost and private thoughts: 'At best, we might make a profit of such and such, a very attractive thing; at worst we would make a loss of such and such; can we stand that? And if we can stand it, is the hope of that first-rate success worth the knowledge that we stand to lose this other amount?' (Shackle, 1966, p. 167)

The decision maker compares different alternatives by finding the respective pairs of standardized focal outcomes for each of those alternatives. Shackle creates a gambler preference map whose coordinates are formed by the standardized focus gain and loss of each project. To each of those pairs there is an associated indifference curve which represents the set of projects that are equally attractive. An investor is indifferent between any two projects when the higher focus gain of one of them is compensated by a larger focus loss. The project selected is the one with the highest associated indifference curve.

In order to explain whether an entrepreneur would defer their decision to invest, Shackle (1958, pp. 36-44) analyzes possible shifts in the potential surprise function due to conjectured changes of information. The entrepreneur will decide to remain liquid if the gambler's indifference map suggests that it is compelling to wait until additional information becomes available.

4.4 Potential Surprise as a Bridge

Shackle's *expectational* language helps bridge the two realms (the monetary and the form realms) by analyzing the time of the experience which is the moment when the future is under construction; the present solitary moment. It appeals to the most important drivers of human volition: senses, emotions and, in general, sense and self perceptions. Reason is not disregarded but is assigned an ancillary role; to confirm the coherence of premises formed by perceptions:

My concept of focus elements ...is...a natural psychic entity, the fusion of thought and feeling at the core of the act of decision. (Shackle, 1966, p. 105)

Thus, the way in which expectations take into account the non-determinate character of the realm of the form is through the monetary and scalar scrutiny of beliefs and emotions articulated by reason. A deterministic position that assumes knowledge can solve the decision problem with a mere reasoning exercise. It replaces decision with knowledge. In this sense, material things are assumed to move thoughts. Shackle's more humble idea acknowledges that, at any present moment, there is experience to come. Hence, Shackle's language allows us to recognize that there is, outside any possible thought-exercise of the individual, a world of situations that may or may not come into being depending on how decisions based on solitary expectations happen to interact.

Our decisions change the world and generate new information and new possibilities. Only one member of the set of rival possibilities can come into being. The occurrence of one prevents the occurrence of the rest. Possibilities mapped by each potential surprise function are non-additive. An increase in the standing of one outcome does not necessarily imply a decrease in the standing of an alternative one. The opposite

occurs within the orthodoxy's language of probability according to which the increase in the likelihood of one outcome necessarily implies a decrease in the alternative ones.

Shackle's language refers to what the decision maker is experiencing in a particular present moment. Thus, unlike traditional utility functions, the ascendancy function refers to enjoyment by anticipation that also accepts the crucial character of the time of the experience and the possibility of surprise. It does not represent actual pleasure like the neoclassical model. In addition, enjoyment by anticipation and standing are inseparable in the ascendancy function. This contrasts with the expected utility theory in which probability and the preference towards risk are formed independently from the individual's preferences over the variable of interest. In the potential surprise, the notion of standing and enjoyment by anticipation share the feature of being volitional. In the expected utility theory, preferences and probabilities are pre-established. The environment and its opportunities already exist 'out there'. This is why money is a veil according to the latter.

The continuity of the potential surprise function also helps us describe important traits of novelty. According to Shackle, the economic scene is continuous and innovation occurs in the continuous flow of dynamic time. In the infinitely small continuous flow of time, the variety of small novelties is infinite. Every impact in the economic context starts as a very small origination of information. Every present moment is full of those little transformations. They gain importance in the mind of the decision makers at different speeds. The ones that develop faster are the ones that prevail as conventional thinking. For instance, in the case of a decrease in the standing of a variable (from zero potential surprise

to a positive value) "... the range of values carrying nil potential surprise will ordinarily merge imperceptibly into those carrying some positive degree..." (Shackle, 1949, p. 13).

When the decision maker realizes that a re-orientation⁵⁶ has taken place, it has already occurred. The interpretation is not as in the 'butterfly effect', where tiny variations cause great impacts. Every novelty is small at the beginning. It is not possible to keep track of all the small orientations that are occurring in every present moment.

Shackle's language takes into account the originative and crucial aspects of decision and novelty. In doing so, this approach solves the puzzle of reconciling the non-determinate realm of the form with the *expectational* scalar realm. This achievement makes it compatible with the key character of a monetary economy in which decisions on scalar monetary quantities explain the individual and social creation of outcomes.

4.5 Keynes' Monetary Economy and the Potential Surprise Function

By using the Swedish⁵⁷ notions of ex ante and ex post and the concept of windfall profits from the *Treatise*⁵⁸, Shackle's doctoral dissertation republished in 1968 identifies surprise as an important concept in the theory of effective demand. If the private sector is to generate the investment necessary to fill the demand gap created in the consumption

⁵⁶ "By orientation we intend to name the idea of the meaning which the business man sees in his collection of material possessions" (Shackle, 1972, p. 427).

⁵⁷ Myrdal (1939, pp. 45-47 et al).

⁵⁸ Keynes (1930, pp. 124-25).

goods sector as the level of income increases, there must be new information that incentivizes the required planned investment. In spite of the importance of this implication,

The General Theory has nothing, virtually, to say about how expectations are formed. (Shackle, 1968, p. xxiv)

Shackle's potential surprise gives us a language to think about and discuss the formation of expectations. The analyst, government and investors formulate rival hypothesis about the future monetary outcomes of their decisions. The imaginative aspect of their expectations and their decisions create new information. Potential surprise is introspective while its manifestation in the form of decision and communication changes what we experience. Paradoxically, the introspective character is what gives the potential surprise function the capacity to serve as a language for socializing the subjective aspects of expectations. The communication and coordination of those subjective aspects is key to understanding the non-deterministic dynamics of aggregate production. A first fundamental principle for completing this task is the recognition of the subjective aspects of experience, and their manifestation through decisions and deliberation. Expectations and individual perception are subject to sudden changes. That is why having a language by which we can adequately communicate expectations is a step forward in providing a vehicle for the permanent interaction between the individual and society. This is what I mean by the collective aspects of experience. Specifically, the introspective deliberation of scalar outcomes with the potential surprise function fits with the innovative character of the aggregate economic phenomenon. The connection between the scalar monetary quantities is provided by the originaive character of expectations (decisions). The potential

surprise function is a communication and decision tool for free individuals in a monetary economy. Such language presumes the preservation of that freedom whatever its outcome may be. With the potential surprise function agents and analysts alike possess a criterion by which they can decide individually. Yet, because of its ability to transmit through words or decisions the individual aspects of perception, it can help them reach agreements without binding them to a deterministic principle. In this way they can also take into account the possibility of disagreement and novelty.

In addition, the potential surprise function complements Keynes' notion of liquidity⁵⁹. The latter represents decision over the purchase of an available set of goods and services, owing to a non-determinable set of options in the future (Marshall as quoted by Hicks (1976, p. 138)). Liquidity is thus an open window for new tastes, decision and expectation. This is analogous to the non-deterministic character of potential surprise which considers the current options of exchange and the possibility of non-determinable surprising future alternatives. By acknowledging the originative character of liquidity, Shackle's language gives a central role to notions like bullishness and bearishness through the rival character of focal gains and losses:

The value which a person sets on a speculative asset is essentially and logically (and not merely as a matter of mathematical convenience) the sum of two components of opposite sign: there is the positive component deriving from the hopes and the negative component springing from the fears which the possession of a speculative asset engenders. The two variables of which the value is thus a function, the hope of gain and the fear of loss, are in the general case mutually independent. Thus it is valuable to have a device which can display the separate movements of these variables, and not merely take account of their resultant or net

⁵⁹Ford (1994, pp. 336-399) presents a survey on the literature about this relationship.

effect. By this means, for example, we can classify the kinds of events which move one and not the other, which move them in opposite direction or in the same direction, and in similar or in different degrees; and this may enable us to disentangle many complexities of the movements of the market value of speculative assets. (Shackle, 1949, p. 5)

The potential surprise function can also explain eventual conventions which occur when actual outcomes coincide repeatedly with the inner range and/or when the inner range of a number of individuals coordinate. Thus, under this approach conventions can be understood as formed in the basis of beliefs held in common and not designed and constructed on the basis of the reduction of uncertainty. Shackle himself radically regarded most conventions as fragile and providing only an illusion of order. But the extension of his argument proposed here regards them as a useful way of theorizing. Their effect in economic analysis and behavior can play an important role:

Even the randomness of the disposition of the coloured pieces at any moment of repose suggests the *conventional* character of the economy 'at rest'. The economy is in the particular posture which prevails, because particular expectations, or rather, particular agreed formulas about the future, are for the moment widely accepted. These can change as swiftly, as completely and on as slight a provocation as the loose, ephemeral mosaic of the kaleidoscope. A twist of the hand, a piece of 'news', can shatter one picture and replace it with a different one. We must not push the comparison far, for Keynes explained each temporary pattern as a natural result of certain circumstances. These circumstances themselves, and their abrupt transitions one into another, he left unexplained. Nonetheless the kaleidoscope comparison suggests a name for Keynes's method: *kaleido-statics*. (Shackle, 1965, p. 48)

The possible occurrence of those conventions is what provides the foundation for inevitably momentous economic theorizing. Shackle tackles such possibility with two analytical devices: 1- His notion of Kaleidic analysis (Shackle, 1972, pp. 76-79), and 2- His proposal of a classificatory system (Shackle, 1965, pp. 184-196). The first of these instruments proposes that the periods of order in the economy are the result of eventual coordination of beliefs. At any moment there are co-existing rival opinions about the future of economic variables. There is also the possibility of innovation and tactical surprise which are necessary for the functioning of a monetary economy. As a result, new orientations and conventions take the place of the previous ones changing the premises upon which order and logical reasoning previously relied. Thus, although each economic momentous order springs from the previous one, it is not logically deduced from it⁶⁰. In order to tackle this kaleidic character Shackle proposes to create a theoretical system that classifies economic moments as opposed to trying to find a theory that conceives all those moments of the economy as part of a single logical structure.

⁶⁰ Carvalho (1983, p. 268) explains that the idea of mechanism, necessary for evolution, conflicts with Shackle's present solitary moment. However, the eventual construction of order in Shackle's kaleidic analysis and the logical disruption between moments expressed in the notions *ex ante* and *ex post* widely used by him (which resemble the process of mutation and inheritance) exemplify that his methodology has some affinity with evolution. Carvalho also asserts that Sraffa's and Shackle's views are "(...) radically different." (1983, p. 277). Nonetheless Shackle's (1958, p. 32) notion of neutral outcomes can be used to explain self-replacement states.

4.6 Shackle's Interpretation of the Keynesian Equilibrium

These two analytical instruments as well as the potential surprise are compatible with Keynes's method of theorizing. Like any expectation, the formulation of economic theory is a present thought. In Keynes, these statements sometimes take the form of equilibrium. However this does not contradict what has been said hitherto. In the *General Theory*, the use of equilibrium in the formulation of a theoretical expectation is an analytical device that takes into account the uniqueness of our current perceptions and at the same time allows for the use of reasonable arguments by taking some elements of our expectation as given. Shackle explains the relationship between his language of expectation and Keynes method of theorizing based in equilibrium as follows:

The high paradox of the General Theory took many years to declare itself to me. This book in fact uses a partial equilibrium method for a whole-system non-equilibrium purpose. There is partial equilibrium. Since something is held constant for the sake of the argument which cannot be constant in life. In Marshall, that thing was the prices of other goods and the incomes of individuals. In Keynes, it is expectations. And it is the inconsistency of expectations which provides the whole meaning of the argument. (Shackle, 1968, p. xxiv)

Shackle complements the argument quoting Joan Robinson⁶¹ who shows how Keynes solved the paradox in the *General Theory* that tries to make a static analysis of a dynamic economy:

Short-period analysis is concerned with the equilibrium of a system with a given stock of capital and with given expectations about the future. Past history is thus put into the initial conditions, so that the analysis is static in itself, and yet is part of a dynamic theory. (Shackle, 1966, p. 265)

⁶¹ Robinson (1952).

From Shackle's perspective, Keynes's notions of equilibrium and convention are interrelated. Equilibrium is the logical configuration of expected future events given the perception of past and present contexts. As an expectation, equilibrium is the conventional belief based in reason. This does not imply that things are going to remain equal, or that a determinist view has been taken into consideration. Present expectations are unique. This means that the only expectations held in a particular present solitary moment are the ones that are held at that moment. The need for making sense of them is what maintains equilibrium as an alternative of analysis based on logical reasoning. Shackle's argument is extended here by stating that logic is a human instinct necessary for the eventually successful coordination of activities. Hence, more than showing the truth, logic along with expectations form a coordination tool. Shackle gives two possible reasons for non-kaleidic continuity in economic events, at least over short periods:

It is thus possible to allow ourselves a short-term predictive dynamics of the economy as a whole. Two distinct logical bases on which such an analysis might be built seem to present themselves. On one hand, we could abstract from the possibility of 'new thoughts', we could assume that everything which enters the minds of individuals within a certain interval has sprung in an explainable way from what their minds contained at some initial moment and from the events which those initial decisions have directly or, via subsequent determinate and therefore empty 'decisions', have directly led to. Or on the other hand we could appeal in some fashion to the 'law of the large numbers' and to the fact that a decision, however ultimately momentous, will require some time to produce its visible effects, and that during this period of incubation, or of the marshalling and

progressive engagement of resources in the early stages of the action-scheme the economy's affairs will be carried on according to pre-existing plans. (Shackle, 1967b, p. 27)

Furthermore, equilibrium is the logical device that allows formulating a momentous expectation which is in turn historically contingent. Thus, it provides with a logical device while still being coherent with the consequences of fundamental non-deterministic uncertainty. Like the potential surprise function, Keynes's equilibrium is part of an *expectational* language. This methodological compatibility between Shackle and Keynes concludes the argument in favor of a complementary role of the potential surprise function in *The General Theory*.

CHAPTER 5

CONCLUSIONS

The key to the maintenance of a given level of employment and its corresponding production in quantity and in kind, is the social awareness of the structure of production that it wants to build and sustain. The first step in order to achieve that is to have a common language that allows to describe the key aspects of the structure of production and the process by which it is built. Such language was the main purpose of this dissertation. A key element in collective production is the formulation of production commitments which are inherent to division of labor. Production commitments are the core of the financial structure that underlies a functional structure of production. The generation of a production commitment is in essence the creation of an expectation. In a fundamentally uncertain future, expectations are originaive. This means that they are non-deterministic. Furthermore, they involve institutional, psychological and other social factors. Shackle's potential surprise function helps to express monetary expectations without assuming determinism. Input-output relations frame the structure of production without making deterministic assumptions. In conjunction with their implicit production commitments and the potential surprise function, this language generalizes the postulates of Keynes' *General Theory* to include the inter-industry relations and not just the inter-sectoral ones. In this context, the main recommendation of economic policy is to find the way to create reliable production commitments. Those production commitments must go in line with a commonly perceived structure of production. It is generally believed that this can be

accomplished through the increase in the money supply, but it is not necessarily the case. Likewise, government expenditure per-se, does not generate employment or increases in the level of output. The government must take into account the input-output channels through which government expenditures generates its impact, and the corresponding effect on the production commitments. The main impact of any economic policy is on the optimism or pessimism of the entities in charge of formulating production commitments and carrying them on. The previous pages offer the analytical foundations for this type of analysis.

At any moment in time there is a confluence of input-output relations. The conditions for the maintenance of those relations do not necessarily entail teleological equilibrium. Instead, they connote an expectational notion of equilibrium. Those conditions are a useful point of reference for the formulation of expectations about the economy. Both the transformation and the maintenance of a given structure of production require intention from the part of the economic decision makers. Intention is not merely rational. It is, in more general terms, originative in the sense that it continuously brings something new to the world. It constantly creates new information. Is creative in nature.

The structure of production is in continuous transformation. Innovation and surprise are continuously making changes. The structure of production is complex in the sense that the level of information required for making decisions always surpasses the decision-makers' capacities in a fundamental way. Furthermore, until proven otherwise, the observed structure of production must remain in the expectations realm. Its historical recount and its construction are both the result of volition.

The important role of production commitments in the structure of production has remained unexplored in the literature. However, it has been shown here that production commitments are the link between the financial and the productive sides of the economy. Production commitments, like expectations, belong to the present solitary moment. They can be used for theorizing about a fundamentally uncertain economy like the one we live in. Production commitments, like any other type of commitment, are expectational.

Keynes' general theory is formulated in terms of expectations. The supply and demand prices that form "the substance of the General Theory of Employment" (Keynes, 1936, p.25) are both expectational entities. Keynes theorized about those in an inter-sectoral way. He analyzed the relation between the consumption goods and capital goods industries, their respective expectations, and the monetary interest rate. The latter includes a detailed study of the price of bonds, but leaves for others, a more specific treatment of a more complete case that includes different types of financial assets like stocks. Chapter 12 of The General Theory shows the lack of a functional connection between the financial and the real sides of investment. The money interest rate is ruled by dynamics which are different to the productive side of the economy. The present dissertation makes a contribution in that direction.

Shackle noticed that Keynes did not elaborate a theory about how expectations are formed, compatible with a monetary economy. Shackle's language of the potential surprise function is an advancement of Keynes' expectational analysis. It provides a way to formulate expectations compatible with a monetary economy in which "...changing views about the future are capable of influencing the quantity of employment and not merely its

direction."(Keynes, 1936, p. vii). The present dissertation made a contribution in that respect. The literature has not elaborated on the direct connection between Shackle's potential surprise function and Keynes' General Theory. The potential surprise function is just one of the ways in which a language for economic science can be used in the face of a fundamentally uncertain phenomenon. Acknowledging the needs for such language, and what its role would be in making economic decisions, is an important step in understanding the nature of the economic phenomenon.

The analysis of the relations of consumption and investment (the inter-sectoral relations) and their concomitant financial side represented by the choice between bonds and money, are an important step in understanding monetary economies. This analysis however, requires complementation. The inter-sectoral relations also involve inter-industry relations. The analysis of these two aspects of the economy was first proposed by Sraffa's appendix A in page 89 of his *Production of Commodities by Means of Commodities*, and further developed in Pasinetti (1973). Nonetheless, Pasinetti proposed that relationship is one that can be used for a labor theory of value. Pasinetti made the mistake of extrapolating the relations of consumption and investment beyond a given period of production, in order to trace back the origins of the observed structure of production, and its future evolution. This prevented Pasinetti from understanding Sraffa's analysis of distribution as a classificatory device. Instead, Pasinetti sought to use Sraffa's relation between wages and profits, as a description of the economic phenomenon, and not, as Sraffa proposed, as a "prelude to a critique of economic theory". The present dissertation, on the other hand, uses Keynes' single-period analytical device in conjunction with the Sraffa-Pasinetti framework

in order to propose an inter-sectoral+inter-industry analysis. This is both a classificatory device for theories, and a way of theorizing about a fundamentally uncertain phenomenon. Keynes knew that his expectational analysis could not transcend the single period of production that he was referring to. In spite of this fact, in the same way Sraffa did not assume constant returns to scale, Keynes's argument in *The General Theory* does not require the assumption of short run. Both are analytical devices for the expectational way of theorizing proposed here. Sraffa's structure of production and self-replacement complement Keynes' expectational analysis. The present dissertation frames Sraffa's self-replacement device within Keynes' conventional equilibrium explained in chapter 12 of *The General Theory*. When forming our long term expectations, we usually take the existing situation and "...project it into the future, modified only to the extent that we have more or less definite reasons for expecting a change." (Keynes, 1936, p. 148). Sraffa's self-replacement assumption in the context of *The General Theory* is an important aspect of how expectations are formed in the economy. Another contribution of the present dissertation was show how both Sraffa's and Keynes analyses can be described with Shackle's potential surprise function.

Keynes explained the role of money from an inter-sectoral point of view. The money interest reflects the different degrees of liquidity in which the public keeps their savings. The liquidity provided by the financial markets is a double-edged sword. On one hand it allows for the reformulation of investment decisions. On the other, it operates in disregard for the decisions made in the productive side of the economy. The money interest rate is driven by factors that are different from the ones that drive productive investment.

The latter however is affected by the former. In chapter 17 of *The General Theory* Keynes explains that the interest rate is a relation between current and future prices that can be applied to any type of commodity. From Keynes' inter-sectoral perspective, the marginal efficiency of money rules the roost among all other forms of financial investment. The supply price of money does not increase when there is an increase in its expected return. Thus, the marginal efficiency of capital (in contradistinction to consumption), must equate the money interest rate as the latter sets a limit below which no investment project with a lower return will be purchased. The marginal efficiency of capital of each investment project must be compared with the money interest rate that resembles the cash-flow of the project under evaluation. This is the way in which the amount of investment is set in the economy according to Keynes' *General Theory*.

The fact that in a monetary economy, decisions of saving in different liquid forms are made independently from decisions of investing in the purchase of productive capital goods as Keynes shows, makes necessary an explicit analysis of how these two aspects of the economy affect one another. This type of analysis contrasts with current portfolio theory which forms the cornerstone of orthodox finance (insert appendix). The latter is still a very special case in which the supply price and the demand price of the consumption and capital industries only equate at the level of full employment.

Provided that the only relevant distinction that needs to be made is the one that separates the economy into consumption and investment sectors, Keynes analysis is an accurate depiction of a monetary economy. Decisions to save are independent from decisions to invest which causes the economy to decant at levels of employment lower than

full employment. The equality between unspent money income (Savings) and investment most possibly occur at levels lower than full employment. In order to solve the problem, Keynes proposed that the government must create employment by investing in projects that do not jeopardize the marginal efficiency of capital in the private sector. That is, projects that are socially necessary but which are not attractive from the private point of view.

The analysis of The General Theory however, requires complementation in two ways, both of them developed in this dissertation. 1- It is necessary to include the inter-industry relationships, and 2- the inclusion of the hidden and up until now implicit production commitments. Keynes' inter-sectoral relations involve production commitments. On one hand, wage goods industries must provide their output at the end of the period so that they can pay the inputs used, buy new ones, and make a profit. The producers of capital goods must provide their output at the end of the period. Wage good industries must count on the capital good industries for the production of capital, and the producers of capital goods must count on the producers of wage goods for the production of labor. The supply and demand prices in both types of industries reflect this inter-dependency or, in more specific terms, division of labor between sectors. The equality between supply and demand prices can only be reached when the money interest rate is equal to the marginal efficiency of capital, or in other words, when the expected cash-flow of all investment projects in the economy equate the corresponding cash-flows implied by the outstanding bonds. In order for this to effectively happen, the consumption goods produced in the wage industries must be demanded, and the capital goods produced in the investment goods industries must also be purchased accordingly by the consumption goods

industries. The production commitments in Keynes framework take the form of consumption goods industries promised by the wage goods industries to the capital goods industries, and capital goods promised to the consumption goods industries by the investment goods producers. Any lack of fulfilment of such commitments is reflected in defaults, changes in the interest rates, the level of employment, and ultimately, in the capital composition of the structure of production. Nothing ensures that such compatibility will occur. In other words, it is possible to observe over/under-production of investment goods, and over/under production of consumption commodities both defined in relation to one another and with respect to the current level of employment. One of the main functions of money is to serve as a way to formulate production commitments. Money that does not entail, implicitly or explicitly, directly or indirectly a production commitment, is thus a reflection of an imbalance between the production and consumption goods industries in the aforementioned way. In this way, any income that is not used for the purchase of capital goods remains unspent (saved). That monetary amount is precisely the present value of the capital commodities committed for delivery at the end of the period.

The role of production commitments is more visible in Sraffa's model of production of commodities by means of commodities in which the self-replacement mechanism plays a crucial role in explaining prices and distribution. The existence of various industries implies that there must be division of labor among them. Division of labor requires the formulation of production commitments. Otherwise, it does not persist through time. Thus, the inter-industry analysis further complements the character of production commitments in Keynes' framework. The final use of commodities in consumption and investment as

determined by the choice of the period length is important for the financial structure of the economy. In addition, within each one of those sectors there is a set of inter-industry relations.

Sraffa's structure of self-replacement transcends a single period of production. The notion of sub-systems proposed by Sraffa and perfected by Pasinetti develops this connection. However, neither Pasinetti nor Sraffa noticed that it entails an associated structure of production commitments. This structure of production commitments implies that producers in each industry borrow the inputs required for production. Such loan is paid in kind when the respective output is supplied to the structure of production. This terminology allows to connect this analysis with Sraffa's own interest rates (Sraffa, 1932) and thus Keynes' chapter 17 of *The General Theory*. The relation between the inputs provided in exchange for the formulation of a production commitment at the beginning of the period, and the net output supplied at the end of the period is the own interest rate of the commodity produced by a particular industry when it is used as the numeraire of the economy. Hence, the financial structure of the economy includes the inter-industry inter-dependencies and the interest rate has a real component, based on the division of labor and the corresponding gain in productivity. Keynes' monetary analysis transcends the single period of production by including self-replacement in the form of expectation.

Prices of different structures of production are only comparable to the extent that they reflect a common criteria, like a consumption basket and its corresponding employment units like the ones proposed in Keynes (1936). Such homogenization nonetheless, is irrelevant when inter-industry relations and their dynamics are involved.

Prices change in a crucial way with the structure of production which is in continuous transformation. For this reason, this dissertation has taken the approach of focusing on the conjugation of the financial and the productive structures of the economy through the inclusion of originative expectations. Production decisions in a monetary economy require the formulation of expectations about scalar monetary values like prices and interest rates. Those monetary values depend on the subsequent dynamics of the structure of production.

This transformative character of money must be combined with perceptions of the structure of production. The right way to compare different monetary values in different analytical periods is with a non-additive language like Shackle's potential surprise function. The market cannot compute the whole financial structure of the economy and supply the corresponding interest rate a-la Hayek (Hayek, 1945). A central planner cannot do this either. The benefits of using a language suitable for the uncertain character of the phenomenon at hand cannot be overstated. It must be a priority of policy to create an accurate language for the communication of expectations in a monetary economy. A language that does not constrain uncertainty but channels it into the productive forces of society. In this way, decision makers can communicate and spread more accurately their expectations about the economy given their particular circumstances of time and place. Thus, the measurement of the structure of production, and its corresponding structure of production commitments must be a matter of the highest priority in economic policy. The usage of a language compatible with innovation and surprise in regards to expected monetary values must also be an element of economic policy. It is not proposed here that the government should establish the content of those expectations, or dictate the shape of

the structure of production in the whole economy. However, by improving communication, decision makers can interact more creatively in the economic arena. In this context, it is important to keep in track of the production commitments been made, the corresponding structure of production that would emerge of those commitments, and the cash flow structures of the outstanding financial assets in the economy. All these elements must be harmonically combined with each other if the construction of a given structure of production is to take place. Financial assets are a vehicle in which money today is transformed into tomorrow's money. The model of production of commodities by means of commodities can be used for the calculation of cash-flow structures compatible with a given structure of production as explained in chapter 2. Such calculation is expectational and originative.

Any expenditure by the government, any decision in terms of monetary policy must take into account these aspects of the economy. In the monetary realm for instance, this implies that the monetary authority should not only constrain its monetary policy to the purchase or sale of government treasures. Central banks should also be prepared to purchase and sell stocks and other kinds of financial assets, in order to make the financial structure of the economy compatible with a given and targeted structure of production. Government expenditure must be directed in accordance with this same principles of compatibility.

One of the most widely used tools of finance is the notion of present value. This notion assumes that the value of any asset must be equal to the future cash flows that it is expected to generate during its existence or end of tenure whichever comes first. This

calculation assumes that there is a comparable bond with the same payment structure as the one offered by the productive asset under scrutiny. This calculation can be replaced with one that includes the structure of production in the form explained above. Vertically integrated quantities of capital and labor and their current monetary values are a more accurate way to calculate the present value of a productive asset contingent to a given structure of production. In this way, future values are not brought to the present with the use of compounding interest rates, but through the specific trajectory of the assumed structure of production. This calculation, in the form of monetary value is based on the productive role of an asset, as opposed to merely on an assumed compounded interest rate.

Keynes (1936), from an inter-sectoral perspective, showed that the interest rate is affected by factors which are different from decisions in the investment sector. The latter are affected by the former. In other words, the current level of employment is affected by monetary factors. Keynes showed how there may be lack of finance in the investment sector, in relation to what is necessary for full employment. Keynes did not explicitly mention that money only has value within a going economy. As long as labor is necessary for production, a going economy requires the sustenance of a given level of employment. In order for money to have any value, it is necessary that the economy is functioning. Money with no production or an existing set of commodities is worthless. The interest rate of any given amount of money in this case is negative, reducing the value of money to zero if no production is generated. The independence between the money interest rate and investment decisions explained in *The General Theory* imply that the money interest rate does not adjust in order to create the investment expenditure necessary for the creation of

full employment. This is another way of saying that the production promises required for the value of money to be sustained are not necessarily fulfilled and that the money interest rate by itself does not provide the necessary mechanism for the fulfillment of production promises. Wage goods industries produce labor. Investment goods industries produce capital. In order for the economy to be sustainable, it is necessary that both sectors fulfill their promises. Keynes grasped this with his notion of conventional equilibrium explained in chapter 12 of *The General Theory*.

The role of money in the division of labor has been clear since Smith's *Wealth of Nations*. What remains less clear is how to value such role. The connection between real and monetary prices remains elusive under a scientific method whose aim is to predict monetary and real prices of the economy. Such goal is precisely the denial of the main characteristic of monetary economies in which expectations have the capacity to create, as opposed to discover economic circumstances. The role of money can only be understood in the context of a going economy. In the most extreme case of a non-going economy, that is, one in which there is no output, money is valueless. The sustenance of monetary prices through time require a functional economy. Under the assumption of a going economy, that is, with a given level of output and employment, prices are sustained by assumption. Money is merely a numeraire. Keynes divided the economy in the consumption and investment sectors. The division of labor between these two sectors made evident that the economy is most possibly not a self-replacing one. This analysis is constrained to an analytical production period in which the level of employment and output may change. Prices of consumption goods and capital goods may change. Consumption and investment

decisions do not govern the money interest rate. The value of money is thus linked to the level of economic activity and the relation goes both ways. One of Keynes achievements was to unveil this character of money which remained hidden throughout the classical literature⁶². Since the level of economic activity is liable to change from one period to the next, Keynes concentrated in one of the sectors of production. Precisely the one that concerns the livelihood of people: Labor. The current level of employment as determined by the wage and capital goods industries is the key of Keynes' general theory of employment. Keynes realized that the production of consumption goods, in relation to the production of capital commodities, may be such that makes the economy unsustainable for the next period. The fact that the money interest rate does not correct this maladjustment as the classics would postulate, is a reflection of a notion whose importance has remained unacknowledged in the literature: The notion of production commitment. Saved money income is only valuable if the level of employment provided by the consumption and capital industries is sustainable beyond a single period of production. In other words, the division of labor between the consumption and capital goods industries must be reproduced for the next period. This can only occur if the level of output of the labor that emerges as a result of commitments made at the beginning of the period is effectively exchanged between the two sectors. In Keynes, such exchange may not occur. That is the reason for the unpredictability of future money interest rates. The fact that more/less money may be

⁶² I use Keynes' (Keynes, 1936, p. 3) definition of the classics. He refers to "the classics" as those economists who took as given the level of output and employment, and concentrated in the analysis of value and distribution.

saved than what is necessary for the maintenance of a given level of employment is the consequence that more productive resources may be devoted to industries than what is required by this two-sectors representation of the structure of production. This occurs through the channeling of money to each sector of the economy for the purchase of inputs including labor. Thus, Keynes shows that there is a loose factor in production decisions, connected to the level of employment, and that influences the re-production of the economy. That loose factor is money, but from the point of view of the division of labor among sectors, is the production commitments. Their sustenance, and the consequent reproduction of the economy is what assigns value to money. The interest rate, is thus, unpredictable for future periods. It depends on the level of employment and output. If all money in the economy is saved, and none is dedicated to the purchase of inputs in the economy, implying that no production commitments are made, and assuming that there is no other way of committing production like production orders, then the economy becomes stagnant and, under the most extreme conditions of crisis, money becomes valueless. In this sense, commitments of production unveil a financial aspect of the economy that had remained hidden but whose importance is paramount for the understanding of the role of money in production. Money, in this sense is subordinate to what is occurring in the economy in terms of the production commitments. Commitments, on the other hand are not surrogate to the sustenance of a given structure of production. They only complement the conditions under which it can occur.

The classical theory furthered by orthodox finance have stated that the inter-sectoral balance between consumption and investment is restored by the money interest rate. This

is ingrained in their assumption that the level of employment is given, and thus, consumption and investment decisions are driven by Say's law. The amount of resources committed to the production and investment sectors is regulated by the interest rate which is both real and monetary. Keynes showed that this is a very particular state of the economy as nothing ensures that the assumed given level of employment will be maintained or that the latter actually reflects the social aspects of employment.

Keynes derives his conclusions about economic policy and investment decisions, from the role of uncertainty about the value of money, the level of money income and employment. His analysis was complemented, from an inter-industry perspective, by Pasinetti (1973 and 1984). Pasinetti's approach however, tried to make Keynes' analysis with the classical labor theory of value. He achieved that by diminishing the role of expectations. One of the main tasks here was to show that expectations are in fact implicit in the model of production of commodities by means of commodities. This was achieved through the notion of production commitment. The structure of production is looked as the set of production commitments that need to be made in advance if order for it to be constructed and reproduced. More production may be committed than necessary in some industries in the economy. This type of imbalances bring about changes in the level of employment, the money interest rate and the level of output. The self-reproduction of the economy is a reference point. Self-reproduction however, does not rule out uncertainty. If anything, the expectational character of the general theory is enriched through the inclusion of the structure of production. This is a more informed expectation about the economy. This interpretation of the model production of commodities by means of commodities

provides a better way of conducting economic policy and economic decisions in general. Now the key aspect of finance is not the degree roundaboutness of investment projects, but the role of those in the construction of an imagined productive structure. Future interest rate and monetary outcomes still remain unpredictable. This creative character of expectations is tractable with Shackle's potential surprise function as explained in the previous chapters. Now Keynes inter-sectoral analysis is not merely formulated in terms of consumption and capital industries but in the form of consumption and investment commitments, given by a prospective structure of production. Consumption and investment relations and financial commitments are now generalized to include the connections between industries. Monetary values and interest rates are not comparable in different structures of production. That generates the need for a non-additive language like the potential surprise function.

It must be a priority from the part of decision-makers (Governments and investors), to frame their decisions within an expected structure of production. Uncertainty is still relevant. A self-replacing structure of production is only one possible event in an undermined set of uncertain ones. Such possibility has conventional character. For that reason is an important reference point. Thus, the analysis must include a scalar language that does not constrain the possibility of creation, innovation and surprise. The consideration of the structure of production in financial decisions, whether they are conducted by the government or by the private sectors, must be a guiding principle of decision making. Such consideration must acknowledge the creative power of decisions. The method of analysis explained in the pages of the present dissertation lays the

foundations for a new approach for including the structure of production within the context of decision making under uncertainty.

5.1 The Structure of Production, Production Commitments and Money

All endeavors require the commitment of resources. All endeavors entail a motive. Nothing warrants the effective fulfillment of commitments. Only the committer knows her intention of fulfillment. That knowledge is knowledge in the present solitary moment. Everything else is reliance, hope, trust and memory.

The decision to save a given amount of money in the economy is coupled with the degree of liquidity in which those savings are going to be kept, and the time horizon. Keynes generalizes the classics' case in which the various degrees of liquidity preference are decided through calculated risk, and the time horizon depends on the time-preferences of individuals. Since productivity and technology are taken given in the classical model, individuals only need to decide the time horizon which provides the expected income through the assumed technical relations of productivity and rational calculation. In this way, the classical model assumes that savings of various liquidities and time horizons are always compatible with the future incomes generated by the corresponding production. Thus, the money interest rate or structure of interest rates reflecting various liquidities and time-horizons, is a subordinate of the various incomes generated by future productions. The aggregate level of employment committed to various productions (that is wage and investment goods) tends to its full level, because savings and investment and the competitive forces in the labor market imply such relationship. Decisions of production in

the consumption and investment goods industries obey Say's law, are driven by labor and capital productivity and the money interest rate is obtained by default, reflecting the technical and hedonistic relations mentioned above. Demand for labor is explained by the marginal product of labor. Supply of labor is determined by the marginal disutility of labor.

Keynes' generalization consist in deconstructing the classical model in some of its main components. In the labor market, instead of assuming that firms always receive their marginal productivities of labor and capital, Keynes identifies the two moments in the firms' decision process: one in which they formulate their expectations (the aggregate supply and demand prices), and one in which those expectations are evaluated at the light of the actual occurrence of events. Thus, one of Keynes' main generalization is to point out that no logical premise can connect those two moment unequivocally. This contrasts with the classical theory in which there is a logical link, either through deterministic or probable cause.

The assertion that the classical theory is based on a given level of employment can be replaced by the classical generalization of a level of output that is changing with a predictable pattern. A constant level of employment is a special case of predictability of which predictable change is a more general one. The latter however, is still a special case in which the kaleidic gap between two moments explained in the paragraph above does not exist.

The causes for this gap are multiple. The marginal propensity to consume prevents the current level of employment from creating the corresponding demand in order to sustain it (Say's law in the wage goods industries) as the level of output and employment is

increasing. This makes the level of employment more unstable and dependent on the level of investment. The no-fulfillment of the second postulate of the classical theory implies that neither the real wages nor the labor supply decrease as the level of employment falls in spite of eventual increases in labor productivity. In addition to these causes, the current level of employment in the investment goods industries depends on the future demand for investment goods which is highly volatile and uncertain.

The volatility of investment brings about an additional element of generalization of the classical theory. Since Say's law does not necessarily hold, the money interest rate behaves independently from the real interest rate which in the classics mediates in the decisions investment-consumption. Decisions to differ expenditures through time are not in continuous correspondence with production decisions in the consumption and investment goods industries and their expectations. Thus Keynes decomposes investment decisions in the equality between the present value of expected proceeds and the supply price of investment goods on the one hand, and the comparison of the latter with the money interest rate. The use of the notion of present value in the definition of the marginal efficiency of capital implicitly entails a comparison between the cash-flow which is being analyzed, and a financial asset with the same structure of payments. The classic's special case consists in assuming that the marginal efficiency of capital and the money interest rate are one and the same, when in fact this is not necessarily the case. Decisions to hold savings in more or less liquid form which are driven by the money interest rate (given an array of expectations), are not necessarily affected by decisions to produce and purchase investment goods and their

expected cash-flow. It is in identifying all these moving and displacing parts that Keynes is more general than the classics.

In the classical model, any commodity can fulfill the role of money. For this reason, when the direction of employment changes from the consumption goods industries to the investment goods industries due to an increase in the demand price of the latter, this change in the real interest rate of capital equipment is concomitant with a higher money interest rate. In this regard, money behaves just like any other commodity, increasing its price when its costs of production increase as a result of a rising demand. Chapter 17 of *The General Theory* explains that money has the particular characteristics of low employment elasticity of production and substitution, and high liquidity premium over carrying cost. This further explains why the money interest rate and the real interest rate have factors that make them move independently from one another. Those characteristics also allow money to fulfill its role in the production process. Money is used as a medium of exchange, unit of account and store of value. An additional function of money which has remained overlooked in the literature is that of being the way in which production commitments are formulated. It is worth noting that whereas the latter are a necessary condition for a division-of-labor economy to operate, it is not a requirement that production commitments have to be formulated in monetary terms. In a monetary economy however, that is the case. The commitment of labor to the production of consumption or investment commodities is in part financed by the workers through the post-factum payment of money wages. Workers are promised a money wage when they start working. The remainder is financed by the committed capital whose monetary value originates in the role of the means of production

in the division of labor. Looking at the economy this way further generalizes Keynes' argument. Like money, production commitments can only have value in the context of an economy that is expected to remain going. Thus, labor must be divided between the production of consumption and capital goods in such a way that workers and capital are able to continue with their productive roles. Keynes formulated this condition in the form of the maintenance of a given level of employment. The money interest rate thus plays a crucial role in the direction of employment through the allocation between the production of consumption and investment commodities, and in the aggregate quantity of employment. It is as if the economy made its decisions of production in two stages: 1- How many units of labor to employ in the economy as a whole, and 2- where should those units be allocated. The classics concentrate in the latter; the former is obtained by default. Keynes explains the dynamics affecting both dimensions of the economy jointly, and each one of them separately. When talking about the direction of employment, Keynes classified the economy in consumption and investment commodities. Decisions of production in both industries most possibly will sustain the aggregate level of employment at lower than full employment. From this inter-sectoral point of view, money is a loose factor that allows the division of labor between these two sectors in a dysfunctional way or, what is more, the formulation of no labor commitment at all. Any increase in the liquidity preference however, is conducted with the expectation of the preservation of, at least some of the value or, in severe circumstances, with the expectation of minimizing losses. Those expectations however will not be effectual, if the economy ceases to function as a result. Thus, in order to keep its value, the existing circulating money must entail, to a larger or lesser degree,

the commitment of productive resources. In this way, Keynes argument, re-expressed at the light of the production commitments, means that resources of production (labor and capital) can be committed in excess or of what is socially desirable, or in a way that is insufficient for full employment which grants access to consumption to all members of society.

Thus, although not in the forefront, production commitments remain in the background of The General Theory. Production commitments remain implicit in the properties of money explained in Chapter 17. For no such an asset can exist in an economy that is not viable, and production commitments must be made in sustainable economies where there is division of labor. Production commitments remain hidden in the transactions motive that partly explains the demand for money. The productive yield of assets “q” is tacitly used in the context of a division-of-labor economy. Otherwise, the comparisons in terms of relative prices between assets would lack relevance. The crucial aspect of identifying the role of money in the formulation of production commitments lays partly on making explicit the productive role of money, and more importantly, on observing that it is that role what actually matters in regards to money. All the other functions of money are subordinate to its role in the formulation of production commitments.

This way of refocusing the monetary theory of production has various outcomes. Keynes’ inter-sectoral approach must be complemented with the channels through which money and resources flow across industries. This was achieved through the use of Pasinetti’s vertical integration in its expectational form. Thus, Keynes argument was further generalized in the previous pages to include commodity specific production

commitments as opposed to just sector-specific production commitments. Such reformulation does not replace the role of money. Money, and its various degrees of liquidity and pay-back structures represented by the broad spectrum of financial assets still requires the formulation of monetary expectations represented in chapter 3. Those expectations, unlike the orthodox portfolio model, are creative expectations as opposed to predictive. They are a vehicle for the social agreement about the type of productive structure to be built, without constraining innovation.

Chapter 1 criticized the standard portfolio model for reducing the problem of portfolio decisions to the ranking of investment alternatives in accordance to their levels of risk and return, the former being measured with any measurement of statistical dispersion (for instance, standard deviation) and the latter assumed to be a random variable. The present dissertation has shown that this purely scalar treatment of investment is, at its best, an incomplete treatment of the problem of portfolio decisions of investment, remitted only to a very special and unrealistic case. The introduction of production commitments circumvents the complex system of financial assets and reduces it to a simple principle: Liquidity must entail the formulation of productive commitments; otherwise, it will eventually lose its value. Thus, any system of financial assets must be backed by an expected structure of production. There is multiple ways of combining financial assets that conform a particular structure of production. Chapter 2 used the multiple interpretations of the Leontief inverse matrix to illustrate this point. This tool of analysis can be used in order to compare the financial and productive structures of the economy in order to make an assessment of their compatibility. This empirical analysis surpasses the theoretical

character of this dissertation. However, this dissertation has created the tools for such an assessment which consist in the expectational use of the model of production of commodities, the production commitments, and the potential surprise function. A language that uses these three elements provides a vehicle by which society can construct the productive structure. The present value of any asset must be calculated by understanding its role in the expected productive structure. Productive assets have value if they are expected to be used. Financial assets represent the commitment side of the productive assets. In a monetary economy, money intervenes fundamentally in this process. Nevertheless, what is essential to the process of production in a division of labor economy is the formulation of production commitments. If money is not fulfilling accurately its role in society, with the identification of the underlying production commitments it is now in capacity to find alternatives for the financial organization of production.

Neither Pasinetti, nor Keynes or even the classics like Smith or Ricardo identified the crucial role of production commitments in division-of-labor economies, let alone the role of those in the financial structure of the economy. By explaining this connection, the present dissertation makes a significant contribution to economic theory and to the way society organizes production.

In order to clarify the implications of this analysis further, take for instance the case in which all income is saved and no income is consumed or invested. This is only possible ex-ante. Ex-post, savings always equals investment. If none of the savings is effectively spent, there will be no more production or income created. This means that the economy will eventually run out of commodities to be purchased by the accumulated savings. This

is an example in which the production commitments represented by the accumulated savings are not fulfilled. This is what occurs during crisis. Since savings stop circulating throughout the production process of the economy, they eventually become illiquid and lose all their value. Now let us assume the intermediate case in which part of the savings is spent. Some of those savings (or equivalently money) start circulating in the productive process across sectors, in the form of consumption and investment, and across industries in the form of input-output relations. In this second case, the part of the economy that saves is implicitly accepting production promises. The part of the economy that spends savings is making production commitments. In this way, the liquidity of savings is backed by the going character of the economy. The use of savings for the production of income in a division of labor economy is what provides savings with their liquidity. Savings are not only used for generic investment. They are also used for the purchase of specific types of inputs. The wage bill is financed by the workers who receive their wage post-factum. They promise to commit their labor force in production in exchange for the payment of wages at the end of the payroll period. The use of savings for the purchase of a given input entails the lending of that input, to the particular production process for which it is used. In exchange for the lending of inputs, production processes make the commitment to generate an output. In a going division-of-labor economy, those outputs are part of a structure of production that, to a given extent, is expected to be re-placed. Thus, it is through the role of money in committing production that the financial and the productive sides of the economy are interconnected. Henceforth, in judging what the right amount of savings in the economy should be, society must take into account the input-output channels through

which those savings are expected to circulate. The various money interest rates of the economy only reflect the scalar shadows of those. A scalar value for the interest rate can only be obtained after those productive channels through which savings is expected to circulate, have been identified. Part of the savings of the economy can remain uncommitted to the productive process and part is multiplied through the multiplier process of money. However, it is the part of ex-ante savings which is spent back in the economy the one that sustains the value of the unspent portion. The idle portion of savings, like the rate of unemployment, are indifferent to the self-replacing economic system.

Thus, the main policy prescription that emerges is that society must first, establish the type of structure of production that it wants to create. This renders the required production commitments by the various parts of the economy. Second, identify the respective resources that must be committed in each part of the structure of production and the period of time allotted for the corresponding production commitments to be fulfilled. This includes the commitment of a quantity of labor. Third, estimate the monetary value of the required inputs. Taking into consideration that the economy is, to a given extent, expected to be replaced, the monetary value of outputs (monetary prices) must replace inputs in each part of the economy that spent them. The lengths of pay-back periods is established by the structure of the production commitments in the respective part of the economy. Lending and interest rates must obey this rule of financing by granting loans with pay-back periods and interest rates that act in accordance with the expected of production and its commitments. This analysis can only be expectational under the current monetary system. Some room needs to be left to uncertainty. A non-distributional scalar

analysis must be used for the formulation of creative expectations in the context of fundamental uncertainty. Chapters 3 and 4 of the present dissertation achieved that goal. The structure of production is part of the proposed language, but is not its totality. Some leeway must be left for innovation and surprise. Through the use of these tools, monetary and fiscal authorities can design policies that without constraining innovation. Investors are endowed with a suitable language for the communication of their expectations. These elements altogether are expected to improve the communication of the particular circumstances of time and place, so out of reach of market mechanisms, an omniscient social planner, or a powerful private entity.

5.2 Classics, Keynes and the Notion of Production Commitment

The classics assumed that money is a veil; a mere medium of an exchange that will and/or should occur amongst all producers in the economy. In this case, all production in a division-of-labor economy is to be sold in the long run, at the equilibrium prices. The own-interest rates of all commodities, and the interest rates in terms of a single commodity (that is, the money rate of interest) are all obtained concomitantly with the equilibrium prices. Consumption-investment relative prices (that is, the interest rates) are just a way to aggregate individual relative prices in the two aforementioned categories. Labor and capital markets are just another point of view for looking and the consumption-investment decisions. The level of monetary prices does not matter as long as relative equilibrium prices are not disturbed. Keynes showed that this is only a very special case of a more general one in the consumption-investment exchanges are ruled by the money interest rate.

Since Say's law does not hold, prices in a division-of-labor monetary economy, prices are liable to change due to commodity-specific factors and due to changes in the aggregate level of employment and vice versa. Money is thus essential in the consumption-investment allocations of the economy. The producers of each commodity have uncertainty about the sales of their respective products. Keynes' gave an initial step in building a theory coherent with the inherently uncertain character of division-of-labor monetary economies. He showed that the money interest rate is, amongst all other own-interest rates, the one that dominates the consumption-investment allocations. The productive role of money is one in which it sets a floor below which no other own-interest rate in the economy can fall, if the respective commodity is to be produced. With this argument, Keynes was able to circumvent all the inter-industry relationships, and focus on the consumption-investment exchanges their consequences on the labor and capital markets in the way explained above. All own interest rates, including the money interest rate, reflect expectations and not merely relative productivities like in the classical model. In this way Keynes used one of the dimension of money represented by its liquidity, in order to explain the consumption investment relations and their connection with the aggregate level of employment. Liquidity representing decisions of waiting as opposed to spending.

The theory of national accounting implies that savings and investment are always equal at the end of the measurement period. This occurs because of the two points of view from which the economic activity is measured: Income and production. The value of income is necessarily equal to the value of production. Thus, the income generated in production that remains unspent in consumption goods, must necessarily equate the value

of production that remains unsold which can only be represented by either means of production or inventories both of them part of the inventories category. No income generated through production remains unspent.

With Keynes' separation of the beginning and end of the period of production, savings out of income generated at a previous period affect future demand for consumption and investment commodities whose decisions of production are taken at the beginning of the period. What is more, the marginal propensity to consume creates a gap between the income generated within a given period and the way it is spent.

Income can either be spent within the defined period in consumption or investment, or can be used to increase the stock of wealth. The latter, within the period of reference, is equivalent to investment. That perspective however obscures the fact that wealth, like any other asset, owes its meaning to the asset properties in which it is accumulated as explained by Keynes in chapter 17. According to this chapter, assets owe their character to their carrying cost, liquidity premium and yield. All these three factors are expectational. Carrying cost represents the loss of value if the particular asset is kept as is, and not exchanged or used for production. That loss of value depends partly on the physical properties of the asset, but it also depends on its exchange value with the other commodities of the existing structure of production, and its future value in relation with the future productive structure of the economy. The yield of the asset depends on the gain in terms of itself if it is used in the existing productive structure for production. Liquidity premium depends on how easily is the given commodity expected to be exchanged with other commodities. The classics assumed that the savings and thus investment produced during

one period of production would be transformed jointly into production in subsequent periods. The identification of the asset properties by Keynes, on the other hand, shows that the destruction of wealth does not occur concomitantly with the transformation of capital into production. At the very best, this is a special case in which financial, physical and structural properties of assets are all conflated. The establishment of these properties however, make explicit the fact that the destruction of wealth depends on the configuration of the structure of production and its dynamics. The classics would be able to establish the dated quantities of labor through market prices. Chapter 2 of the present dissertation showed how this is solved by Sraffa. The important point is to note that the asset properties of wealth (accumulated savings) are another aspect in which the expectational character of the structure of production is made evident.

Classical economists propose a labor theory of relative prices and value. Relative prices are set in accordance with the relative direct and indirect quantities of labor used to produce each commodity. The expression “indirect” is used here to include the case of an economy in which labor is used for the production of capital commodities. The conclusion in both cases of an economy with or without capital commodities, is that commodities are more/less expensive depending on the relative quantities of labor required for their production. Keynes’ noticed that this theory of value does not consider fluctuations in the total quantity of output and employment. The classical theory of value can hold true at any level of employment and at any quantity of commodities produced in the economy. Except for the special case in which the two postulates of the classical theory hold, classical theory has virtually nothing to say about changes in employment and output. Once the level of

employment is established, classical theory does explain the distribution of that employment in the production of various commodities. Classical theory can be used to explain the effects of changes in the distribution of output between wages and profit, on relative prices. And only in the very special case in which both postulates of the classical theory of labor hold, the classical theory of value takes into consideration the level of employment in the economy as a byproduct of the formation of prices. Nonetheless, as Keynes rightly pointed out, classical theory left unexplained a general theory of employment within their framework. In order to fill this gap, Keynes considered what happens to relative prices as the total level of employment changes. In the special case in which both classical postulates hold, when the level of employment decreases, wages must rise in line with the subsequent higher productivity and in order to incentivize labor supply. However, this is not the general case, as it is not up to workers to change their supply of labor like the producer of any commodity would in response to changes in price, and workers tend to accept lower wages (and not higher wages as the rejected classical postulate would suggest) when the level of employment is decreasing. This situation occurs when there is unemployment which is what economies experience most of the time. Lower wages in presence of unemployment imply that the balancing factor in the demand for wage goods in the classical case, does not operate in the more general one. As a result, in Keynes' more general case, there is involuntary unemployment. In this way, consumption commodities emerge as a relevant category for economic analysis. The complement of this category is capital commodities. And these are the roots of Keynes' two sectors approach in *The General Theory*. The total level of employment is set by decisions in the consumption and

capital goods industries. Decisions of employment in the consumption goods industries are explained by the marginal efficiency of capital. Employment decisions in the capital goods industries are set by the marginal efficiency of capital in conjunction with the money interest rate. In the special classical case, the various interest rates and degrees of liquidity preferences are fully correspondent with the money incomes generated by the various production processes. In Keynes' more general case on the other hand, due to the special characteristics of money, this may not necessarily be the case. The destruction of monetary savings most generally will not be in line with the destruction of physical capital in production. Money income most generally will not be used in line with hiring in the consumption and capital industries. Thus, there is nothing in the behavior of relative prices that ensures full employment. Full employment must be socially and intentionally attained through the action of the state through fiscal and monetary policies. The flows of money, irrelevant in the classical case in which relative prices are the only driving force, become relevant in Keynes' more general case. Current and expected monetary flows have the capacity to affect the general level of employment and its direction. Keynes' *General Theory* analyzed the inter-sectoral aspects of those monetary flows. The analysis of inter-industry aspect of monetary flows serve as a necessary complement to the analysis of the *General Theory*. This was one of the main goals of the present dissertation. The maintenance of a given level of employment requires a specific configuration of hiring in the consumption and investment industries. In addition, hiring must be distributed across industries taking into account the input-output relationships. Thus, the present dissertation represents an additional generalization to the inter-sectoral analysis of the general theory.

The General Theory, implicitly states that the distribution of labor amongst sectors must be justified with a corresponding effective demand, for the current level of employment to remain at a given level. The input-output analysis was used here to extend this idea to the inter-industry analysis. Pasinetti connected the inter-industry and inter-sectoral analysis in a long-run model of the economy. The present dissertation unveiled the expectational character of Pasinetti's analysis which makes it more accurately compatible with Keynes' *General Theory*. Keynes however did not realize that his inter-sectoral monetary analysis entails an interwoven network of production commitments. This network is more clear when looking at the division of labor required for the inter-industry relations to occur. Production commitments are the general form and the productive form of money. This analysis is also more general than the neoclassical one in which production commitments are established from the start with the initial conditions of the model. The expectational analysis presented here acknowledges the creative character of expectations and production commitments. Thus, a language that allows actors to deliberate about a structure of production that is, at any present moment, yet to be created, and that acknowledges this creative character of economic decisions, is more compatible with the economic phenomenon as it is currently being experienced. The inter-industry relations in conjunction with the inter-sectoral relations in the context of a monetary analysis like the one proposed by Keynes (1936) require making explicit the role of production commitments in the economy. Now, monetary savings, and the different forms and liquidity in which liquidity can be held, must be compatible with the division of labor across industries as well as sectors. From the production commitments point of view, the

monetary value of inputs in each part of the structure of production, and the corresponding cash-flows which are highly dependant on the inter-sectoral and inter-industry relationships that affect a particular business, must be a specific relation with the cash flows of all financial assets in the economy in order to sustain a given level of employment. The puzzle tackled by the present dissertation is to find a criteria by which such compatibility can be assessed in the form of an expectation. Financial assets are scalar relationships of money today in exchange for money in the future. The structure of production on the other hand consists of a variety of qualitative aspects which can only be uniquely scalarized in the special classical case. In the general case studied here, the composition of production commitments is jointly analyzed with their inter-sectoral character. The amount of money committed today for the production of specific commodities has an inter-sectoral dimension that must take into account the inter-industry channels through which it occurs. The inter-industry relations, in a way, can be summarized with their corresponding inter-sectoral form through Pasinetti's vertical integration used in its expectational form. That inter-sectoral form is the one that must be identified in the specific economy being analyzed in order to compare it with the inter-sectoral form implied by the existing structure of financial assets. Doing this would require to compare the current value of monetary assets with the monetary value of productive assets, and their respective payback structures. These are the specific circumstances of time and place whose complexity is so large that neither computers nor the market would be able establish. In addition, this analysis is based on the notions of Keynesian equilibrium and Sraffian self-reproduction which are themselves expectational. Thus, the outcome of this analysis is also expectational.

Shackle's language of potential surprise presents itself as a useful way of deliberating about it. This dissertation creates a method by which the functionality of the financial and the productive structures can be analyzed.

APPENDIX 1

SRAFFA-PASINETTI'S BASIC MODEL OF VERTICAL INTEGRATION

Pasinetti (1973) proposes that the productive structure of the economy can be modeled with the following system of equations:

$$(I - A^\theta)X_{(t)} = Y_{(t)} \quad (\text{A.1})$$

$$a_{[n]}X_{(t)} = L_{(t)} \quad (\text{A.2})$$

$$AX_{(t)} = S_{(t)} \quad (\text{A.3})$$

Where I is the identity matrix, $X_{(t)}$ is an $m \times 1$ vector whose components are the total quantities produced of each commodity i ($i = 1, 2, \dots, m$). In this economy, commodities are produced by means of commodities. A^θ is an $m \times m$ matrix whose components $[a_{ij}^\theta]$ represent the quantities of commodities per unit of total output ($X_{(t)}$) spent in the form of circulating capital (completely spent within the year of production t) and fixed capital (partially spent during the production period) in the production of commodity i by the industry j . A constant fraction δ_j of fixed capital drops out of the production process every year. $Y_{(t)}$ is an $m \times 1$ column vector that represents the net output of the economy after taking into account the replacements of the circulating and fixed capital spent in production. This economy is assumed to be viable, meaning that it produces a net output.

The components of the $1 \times m$ row vector $a_{[n]}$ represent the quantities of labor measured in *men-years* required for the production of one unit of the respective

commodities in the total output $X_{(t)}$. Hence, the scalar $L_{(t)}$ is the total amount of labor required for the production of $X_{(t)}$. A is an $m \times m$ matrix whose components $[a_{ij}]$ represent the total stock of capital required at the beginning of the year for the production of one unit of each commodity in $X_{(t)}$. Each column in matrix A represents the commodities directly required for the production of one unit of commodity j . $S_{(t)}$ is an $m \times 1$ vector that contains the quantities of each commodity in the form of capital stocks required at the beginning of year t for the production of $X_{(t)}$.

Within this framework, Pasinetti isolates each commodity in the net output in order to identify the *self-replacing part* that produces each of them. This is done by proposing the following set of equations derived from equations 1.1-1.3:

$$X_{(t)}^{(i)} = (I - A^\theta)^{-1} Y_{i(t)} \quad (\text{A.4})$$

$$L_{(t)}^{(i)} = a_{[n]} (I - A^\theta)^{-1} Y_{i(t)} \quad (\text{A.5})$$

$$S_{(t)}^{(i)} = A(I - A^\theta)^{-1} Y_{i(t)} \quad (\text{A.6})$$

Where $Y_{i(t)}$ is an $m \times 1$ column vector whose components are all zeroes except the i^{th} one. Thus, $X_{(t)}^{(i)}$, $L_{(t)}^{(i)}$ and $S_{(t)}^{(i)}$ are the quantities of total output, labor and capital stocks required for the production of commodity i in the net output. These quantities include the replacements necessary to restore the initial conditions of production. Together, equations A.4-A.6 represent a sub-system for commodity i .

The term $(I - A^\theta)^{-1}$ is known as the Leontief matrix. Each one of its elements represents the quantities of all commodities required in the whole economic system for the

production of commodity i as a final product $Y_{i(t)}$ (meaning that it can be used as a consumption or investment commodity). Pasinetti proposes that $a_{[n]}(I - A^\theta)^{-1}$ and $A(I - A^\theta)^{-1}$ can be interpreted as the direct and indirect quantities of labor (in the case of the former) and capital (in the case of the latter) required for the production of $Y_{i(t)}$.

Pasinetti renames the two aforementioned terms in the following way:

$$a_{[n]}(I - A^\theta)^{-1} \equiv V \quad (\text{A.7})$$

$$A(I - A^\theta)^{-1} \equiv H \quad (\text{A.8})$$

Each one of the components of vector V , $[v_i]$, represents the direct and indirect quantities of labor required in the whole economic system in order to produce commodity i as a final output while restoring the initial production capabilities. Likewise, each one of the column vectors that form matrix H , $[h_i]$, represents the heterogeneous collection of commodities required directly and indirectly in the form of capital stocks, for the production of commodity i as a final product. Together, v_i and h_i are the vertically integrated sectors of commodity i .

Pricing system in the basic model:

$$p = a_{[n]}w + pA^\theta + pA\pi \quad (\text{A.9})$$

Where p is an $m \times 1$ column vector of prices, w is a scalar that represents the wage rate and π is the uniform rate of profits.

Meaningful solutions, full employment and viability conditions:

According to Pasinetti (1977, p. 62-63) the condition of viability is necessary for the Sraffa-Pasinetti framework to have meaningful solutions (non-zero solution for prices). Viability implies the generation of a positive net output. Pasinetti (1981, p. 33-35) and Pasinetti (1981, p. 46-48) is more explicit in asserting that viability implies full employment, as total expenditure (C+I) must equal potential national income. Pasinetti (1977) and (1981) coincide in defining the condition as the capacity of the system to generate a surplus. Due to the assumption of self-replacement, such capacity must be matched the corresponding expenditure in consumption and investment goods. In Pasinetti (1981, p. 34) Structural change Pasinetti is interpreting the demand coefficients as proportions of the total level of employment.

APPENDIX 2

THE POTENTIAL SURPRISE FUNCTION AND THE ASCENDANCY FUNCTIONS

Figure 1 shows the way in which Shackle, for instance Shackle (1969), usually explained the language of the Potential Surprise Function.

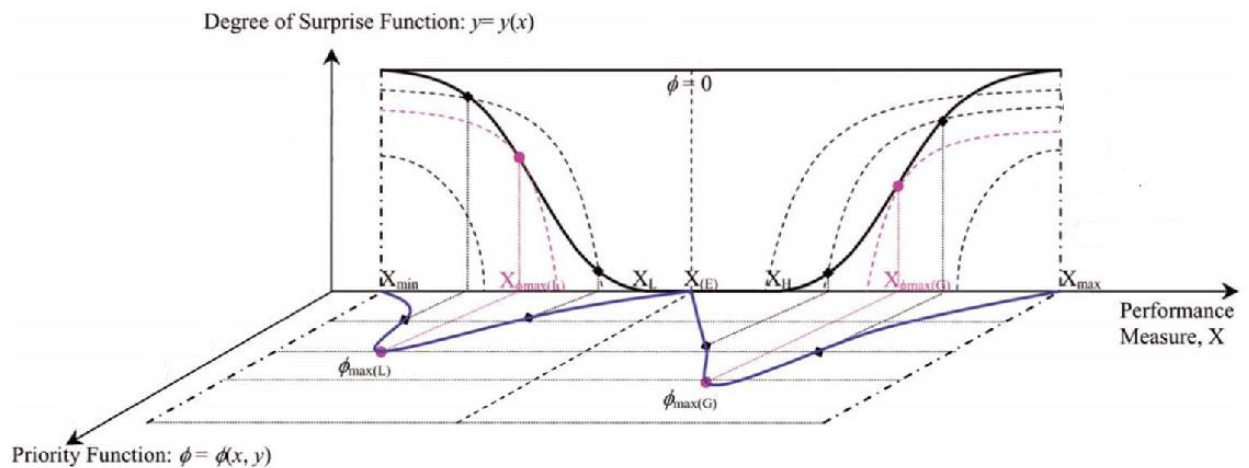


Figure 1: The Potential Surprise Function. Source: Zongzhi (2009).

Figure 1 shows two functions simultaneously: 1- The Potential Surprise Function denoted by $y = y(x)$, and 2- the ascendancy function denoted by $\phi = \phi(x, y)$. A decision-maker/analyst faced with uncertainty about the value that a variable of interest x may take in the future, can use the potential surprise function to express her/his state of surprise by anticipation, for different hypothesized values of x . In figure 1, extreme values of x are associated with higher potential surprise. Values of x located in the $X_L - X_H$ segment generate a zero degree of potential surprise. In addition to surprise by anticipation, each

value of x produces a degree of enjoyment by anticipation. The combination of different degrees of surprise y and different degrees of enjoyment by anticipation renders the function $\phi = \phi(x, y)$ which represents the degree of attention that each hypothetical value of x produces in the decision-maker/analyst's mind. More extreme values of x produce more enjoyment or pain by anticipation and therefore, attract the attention of the decision-maker/analyst. Thus, ϕ is a positive function of x to the right, and a negative function to the left, of a neutral outcome $X_{(E)}$ established by the decision-maker. However, more extreme values of x also have associated with them higher degrees of potential surprise, which reduces their capacity to attract the attention of the decision-maker/analyst. Thus, ϕ is a decreasing function of y . At some point/s ($\phi_{\max G}$ towards the right and $\phi_{\max L}$ towards the left) the increase in the potential surprise outweighs the desirability/pain of those more extreme outcomes. This reduces the capacity of those outcomes to attract the attention of the decision-maker/analyst, prompting a reduction in ϕ . This is described in the ϕ versus x plane. There are two values of x that are the *focus* of attention by the decision-maker/analyst because they afford the highest desirability/pain, without being too surprising if they were to occur. These are the two focal points $\phi_{\max G}$ and $\phi_{\max L}$. These are the two values in which decision-makers and analysts concentrate their attention, in order to make a decision. The arch-shaped curves in the y versus x plane are indifference or level curves of the three-dimensional function ϕ function. Their role is to identify $\phi_{\max G}$ and $\phi_{\max L}$. The merit of this scheme is that it is a language that can be used to express belief as opposed to knowledge. Such language has the capacity to represent decision as it is experienced by the decision-maker/analyst, that is, as a situation in which

the world changes once the decision is made and where there is a possibility for innovation and surprise. Decision-makers make their decisions in situations in which each course of action is a rival course of action. Decision-makers is not constrained by rationality. There is place for optimism and pessimism in their decision processes. The way the decision-maker/analyst orders her/his pairs of focus gain and loss for each alternative course of action, will explain her/his decision. Shackle ordered these pairs with what he called the gambler's indifference map which is not necessary to explain at this stage of the argument. What is important is that decisions-makers/analysts have now at their disposal a language that allows them to communicate their expectations without assuming rationality. This takes into account emotions and creativity at the moment of making a decision. Furthermore, amongst other things, it takes into account the creative role of production commitments, in the construction of the structure of production and its maintenance. The scalar character of this language is also handy for dealing with monetary production commitments and monetary quantities in general.

It has been brought to my attention by Professor Olsen, that the potential surprise function should be complemented by the specification of the units in which the y axis is measured. He asserts that the y axis should be measured in cardinal terms in such a way that the potential surprise reflects the decision maker's feeling of surprise in a scale from zero to n . For instance, decision makers may decide to express their level of surprise on a scale from 1 to 10. This is a fair point. Such common scale would complete the communication of the feelings of surprise amongst decision makers.

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VITA

Andres Felipe Cantillo was born on January 29, 1980, in Bogota, Colombia. He was educated in private schools and graduated from Colegio H.H. Corazonistas in 1996. He was accepted to the Universidad Nacional de Colombia where he graduated with a merit award for his dissertation titled “Shackle: Tiempo e Incertidumbre en Economia.” en 2004. His degree was a Bachelor of Arts in Economics.

After working as a managerial trainee in the franchiser of Pepsi in Colombia for two years and a half, Mr. Cantillo began a master’s program in Economics at the University of Missouri-Kansas City. He was awarded the Master of Arts in Economics in December, 2013. During his Master’s coursework, Mr. Cantillo was awarded the G.L.S. Shackle Studentship in 2009 offered by St. Edmund’s College at Cambridge University. In 2010 Mr. Cantillo was awarded a Graduate Teaching Assistant position and was admitted to the Ph.D. program in the economics department at UMKC.

In 2014 Mr. Cantillo published a paper titled “Shackle’s Potential Surprise Function and the Formation of Expectations in a Monetary Economy” and in the fall 2015 obtained an instructor position at Missouri State University. Upon completion of his degree requirements, Mr. Cantillo plans to continue his career in higher education, combining teaching and research.

Mr. Cantillo is a member of the Post-Keynesian Economics Study Group and the American Economic Association.