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## CLASSICAL THEORIES OF REPRODUCTION AND NATIONAL ACCOUNTING

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### Introduction

The world of commerce presents itself as a huge mass of commodities produced in different locations which are transported to many different places where they are used in the production of other new commodities or are themselves consumed. Roads and waterways act like veins upon which vehicles transport commodities, the lifeblood of society, to sites for production and to consumers for personal consumption. The commodities sold on the market are connected by vast networks which generally operate independently of government agencies or the direction of any one organization or person. Yet, the numerous individual acts of circulation take place so that, in general, the effective demands of producers and consumers are met by forthcoming supply. To the casual observer the matching of commodities produced with commodities demanded appears as a great mystery. Those who have attempted to represent this process theoretically have suggested that the process of economic reproduction is a lot like the planets in the universe (Koshimura 1951), or blood in the body (Quesnay 1972 and Marx 29: 60), regulated by a definite yet concealed order. They envisioned a process of reproduction in which the different components of capital are renewed unevenly. Just as blood is renewed more quickly than muscle, and muscle more quickly than bone, different types of capital are renewed at different rates. And, just as a body must be constituted with certain definite proportions of blood, muscle, and bone to continue to function properly the economy must also fulfill certain specific conditions for its own reproduction.

The time which passes in the production process and the circulation process can be accounted for empirically. Unfortunately, relatively few contributions have been made in this area. Most economists focus on one or another aspect of reproduction and abstract away from the process as a whole. Neoclassical economists generally focus on exchange, addressing questions of supply and demand, while mostly ignoring issues of production, circulation, and reproduction. Where production and circulation are taken up, they are done so in very general ways. Most classical economists focus on production, but ignore turnover, realization, and the circuits of capital. Common to both groups is the failure to analyze the process of reproduction in its entirety or to give the categories of reproduction empirical content.

The Neoclassical conception of a simple linear flow of commodities originating in a distant point, and after the application of land and labor, arriving on the market as a mass of finished consumption goods contrasts sharply with the circular conception embraced by Marx and the classical economists. In the classical conception, commodities act both as intermediate inputs and final outputs in a general circular flow of commodities. The Neoclassicals view of production as a one way movement from "factors of production" to "consumer goods" offers no theoretical insight for national income accounting. Leontief noted that attempts to conceptualize the process of production as circular flow within the Neoclassical framework have failed (1966: 77). In contrast, the classical conception, in which commodities act as both inputs and outputs in a circular movement, shows the complex interrelations which exist in production and circulation. Unfortunately, even this circular flow framework is frequently presented as if there is one big lump of commodities advanced at the beginning of the year which generates a mass of commodities at the end of the year. This simple conception is useful for certain abstract theoretical questions, but fails to provide a sufficient basis for understanding the actual workings of the national economy. These two failures, the failure to conceptualize the process of production as circular flow of commodities and the failure to conceptualize the circular flow framework outside of a one year interval, have contributed to the oversight in integrating turnover and reproduction into national income accounting.

On the surface, the data which makes up the national accounts looks comprehensive, but further examination shows its many shortcomings. The failure of the dominant theoretical traditions to view the process of reproduction as important has been coupled with the failure of government agencies to collect and assemble data into categories used for the analysis of reproduction. The inability to view the process of social reproduction in its entirety has contributed to the unfortunate situation in which there is widespread incompatibility of data assembled by the various government statistical agencies. The capital stock and depreciation data is collected by several sources and none is directly commensurable with the input-output tables. Even the Bureau of Economic Analysis' data on capital stock and depreciation is not fully compatible with the input-output tables. The input-output tables themselves have changed form several times, and no effort has been made by the government to revise earlier versions to make them compatible with latter versions. This incompatibility is widespread. Employment data is organized by

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different agencies and fails to distinguish between productive and unproductive labor. The information on turnover is gathered by the U.S. Department of the Treasury based on income tax returns. Price indices are constructed using a very questionable methodology. The lack of a general and consistent collection strategy among the various government statistical agencies can be attributed to their failure to see the usefulness of the accounts and their relationship to the process of reproduction as a whole.

While theory ultimately underlies the categories used in data collection, convention is the basis upon which the national accounts are maintained. Conventional accounting categories do not match the categories used by the classical economists, thus necessitating the reconciliation of data to reflect the theoretical categories of the classical economists (Shaikh and Tonak 1994). Despite the theoretical vacuum in national accounting, considerable progress has been made in making it possible to empirically reproduce the taxonomy of the economy which Marx envisioned in volume II of Capital. This, however, presupposes an understanding of the theory of reproduction.

The theory of reproduction has been mostly neglected. Francois Quesnay's famous tableau and Karl Marx's schemes of reproduction are almost entirely disregarded. Yet, the reproduction schemes in Quesnay and Marx are blueprints which show the production and circulation conditions which must be met for the economic system to renew itself. They represent theoretical constructions which systematically outline the structural factors which limit and facilitate production and circulation. The schemes address the replacement of commodities used up and the conditions which must be met for growth. The contributions of Popov, Litoshenko, and Leontief are also ignored, if read at all. With only a few exceptions, little effort has been made to test the classical economic theories with empirical data. The gap between theory and evidence can be bridged and is a task which needs to be completed. Quesnay, Smith, Ricardo, and Marx did not have the detailed information available to them to carry out thorough empirical investigations of their theoretical hypotheses.

The strong similarities between Marx's theory of reproduction and input-output accounts provides the basis for empirically capturing Marx's schemes of reproduction. The theoretical structure which lies behind the input-output accounts is due, in large part, to the efforts of Soviet economists to represent Marx's schemes of reproduction empirically. Rendering Marx's categories compatible with the input-output accounts is made easier by this kinship.

Input-output economics has its origins in the classical tradition of Quesnay and Marx in which the economy is viewed to have a physical surplus. Similar to classical economics there is the notion of surplus embedded within the input-output accounts. The close association of input-output economics with the classical economic tradition can be traced through three major efforts to represent the process of social reproduction empirically. Each of these attempts has been met with cynicism and misunderstanding. They are mostly forgotten, and yet they are invaluable in providing the theoretical framework for understanding how the process of reproduction can be approached empirically. The first effort evolved with Francois Quesnay, whose theory of reproduction was based on his understanding of the physiology of the human body. Quesnay's familiarity with physiology allowed him to conceptualize economic reproduction as similar to the reproduction of an organism. Marx formulated the second major effort in volume two of Capital where he attempted to extend Quesnay's initial efforts by analyzing sectors (or departments), the forms of capital, and turnover. This volume has been mostly neglected both inside and outside the Marxist tradition. Third, a group of Russian economists built on Marx's schemes of reproduction to understand the process of social reproduction in the Soviet economy in the 1920's in order to anticipate supply bottlenecks. One very important member of this group, Wassily Leontief emigrated to the United States and began research on the U.S. economy. Leontief developed the input-output accounting framework which is now widely used in national accounts. The development of input-output accounts represented a huge step forward in extending Marx's own work. Yet, many of Marx's categories today are not adequately dealt with in the input-output accounts.

Unfortunately, the theoretical formulations of the classical economists have been largely forgotten and abandoned, and the lines which distinguish the alternate approaches have been blurred. Input-output economists have turned their attention to empirical questions, largely abandoning theoretical issues in favor of "policy" work. Consequently, while input-output economists have been influential in showing the empirical weakness of some approaches, they have failed to develop the largely forgotten theoretical foundation of the classical economists. The task of filling in Marx's categories of reproduction with empirical content remains mostly unfulfilled. While the development of input-output accounts represents a huge step forward in extending Marx's own work, there are many further extensions which need to be considered to understand what needs to be done. Also, careful consideration must be given to developing the categories necessary to understand reproduction. For this we must consider the theories advanced by Quesnay, Marx, and the early Soviet economists.

### I. Francois Quesnay's Theory of Reproduction

Writing in the eighteenth century, Quesnay was the first to articulate a theory of the economy in which both circulation and production were viewed as integral aspects of social reproduction. Using his understanding of physiology, which he learned first as a butcher and later as a surgeon, Quesnay was able to develop the fundamental categories and core structure of classical political economy. His theoretical scheme, distinguished by its conception of a circular flow of commodities, served as the underlying blueprint upon which Adam Smith, David Ricardo, and Karl Marx constructed their own theories. Quesnay's method of measuring inputs and outputs in physical magnitudes allowed him to address questions of growth and distribution consistently and systematically. Quesnay's theory of reproduction and accumulation, though modified particularly with respect to defining productive labor, remains largely intact within the classical tradition (Shaikh 1994). Quesnay is responsible for

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discovering that it is the rate of reinvestment out of the net product which plays a dominant role in the rate of accumulation. While some downplay this contribution as obvious, neither Quesnay's method nor his contribution should be belittled.

Quesnay's comparison of the circular flow of blood in and between the organs of the body with the circular flow of commodities in and between classes within society provided the first comprehensive theoretical framework for understanding the process of production and reproduction as a whole. Quesnay saw in economic society that the numerous acts of circulation could be grouped together in their social movement as a mass of circulation between the major economic classes of society. The comparison of the economy with the physiology of the body led Quesnay to many important theoretical insights. Building on his understanding of physiology, Quesnay showed through a simple diagrammatic table what would otherwise be difficult, if not impossible, to grasp. In a letter to Mirabeau, Quesnay said:

...the zigzag, if properly understood, cuts out a whole number of details, and brings before your eyes certain closely interwoven ideas which the intellect alone would have a great deal of difficulty in grasping, unraveling, and reconciling by the use of the method of discourse. Moreover these ideas themselves would be very elusive if they were not fixed securely in the imagination by the Tableau. Neither in themselves nor in their interrelationship will it now be possible for them to escape us, or at any rate it will be very easy to picture them as a whole in their order and interconnection at a single survey, so that we can contemplate them at our ease without losing anything from sight and without the mind having to worry about putting them in order. (in Meek 1963: 117)

As Quesnay himself stresses, the advantage of his model is that it abstracts from unnecessary detail and replicates the social movement of wealth through circulation and exchange by representing it as one movement. Quesnay views the economy as a circular flow of goods rather than as a linear outcome (Sraffa 1960: 93). Reproduction involves both the production of new commodities and also the renewal of used up ones.

Quesnay's contribution represents the first significant step for classical political economy because it is the first systematic account of both production and reproduction. By developing the distinction between productive and unproductive labor he established the foundation for understanding reproduction. Quesnay provided a lasting service to economic theory by moving economic analysis, which prior to his work was almost entirely focused on exchange, into the sphere of production and showing that profit arises out of production rather than circulation. In doing this Quesnay was able to link the concept of capital directly with the concept of surplus. More importantly he demonstrated that if the social product was to reproduce itself, a portion of the product had to be put back into production. Not only did a portion of the product need to be put back into replacing means of production, but a portion had to be set aside for the subsistence of production workers. After these allocations were made the use of the remaining surplus or net product determined the rate of accumulation.

Quesnay's theory of reproduction demonstrates with clarity and simplicity the key determinants of reproduction and growth. It highlights the fundamental issues involved in analyzing reproduction, including the distinction between productive and unproductive labor, investment, and consumption. Quesnay's model is simple because it abstracts from the difficult issues associated with value and price, technical change, fixed capital, money, realization and turnover. But, this simplicity is also its biggest weakness. In addition to working at the level of one commodity, the framework fails to address the differing composition of inputs necessary to produce particular outputs. Several aspects of the theory of reproduction, including developing an understanding of productive and unproductive labor, technical change, turnover, money, and realization need to be developed to understand the process of reproduction in its full complexity. These are precisely the issues which Marx took up systematically in volume two of Capital.

#### *A. Neoclassical economists on Quesnay*

Quesnay's contributions have been downplayed by neoclassical economists. Some have suggested that Quesnay's work is nothing but "a vast mystification" -- obscure and unintelligible (Gray 1931). Samuelson claimed that Quesnay's prestige arose from "mystification and abracadabra (Samuelson 1982: 47)." Mark Blaug also showed outright contempt for Quesnay's work. In the introduction to a collection of relevant articles on Quesnay, he introduced Quesnay as an outdated obscurantist. Blaug said: "Francois Quesnay is one of those economists that students and even many of their teachers must leave unread: so intricate is his reasoning, so convoluted are his calculations, and so steeped is his every word in the outdated political philosophy and economic circumstances of eighteenth century France that only years of study can make any sense of his writings (Blaug 1991: ix)." The cautious silence with surrounds Quesnay is no doubt the result of malicious interpretations by supposedly respectable historians of economic thought, like Blaug, who suggested that Quesnay's work be left unread.

The reason for the apparent inability to appreciate Quesnay's work may be attributable to the significant differences between neoclassical production theory and the classical theory of reproduction. Sraffa (1960: 93) highlighted these differences: "It is of course in

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Quesnay's Tableau Economique that is found the original picture of the system of production and consumption as a circular process, and it stands in striking contrast to the view presented by modern theory of a one-way avenue leads from 'Factors of production' to 'Consumption goods'." Regardless of what vulgar economists think of Quesnay's work it remains a pillar upon which the classical tradition, the Marxian tradition, and modern input-output analysis.

### ***B. Marx on Quesnay***

Karl Marx drew heavily from Quesnay's theory to develop his own understanding of production and reproduction. With perhaps the notable exceptions of Smith and Ricardo no economists' work is more highly regarded by Marx. Like Quesnay, Marx used the physiology of the body as a basis from which to understand social reproduction. He said: "In the human body, as in capital, the reproduction of the various constituent parts does not take place in equal periods of time. Blood is renewed more quickly than muscle, muscle more quickly than bone, which in this respect may be considered as the fixed capital of the human body (Marx, *Collected Works*, vol.29, p.60)." While Marx clearly admired Quesnay's work in much the same way he admired Smith and Ricardo, Marx's theory of reproduction is distinguished by its significant extensions and modifications.

Quesnay's schemes lack the theoretical rigor of Marx's in several important respects. Quesnay failed to account for fixed capital and reduced his inquiry of reproduction to one of annual circuits. He also limited his study to the flow of one commodity without distinguishing between types of capital. Additionally, his theoretical construction is left at the very abstract level and fails to account for money and different rates of turnover.

Other classical economists fail to address shorter than annual turnover periods. For example, Sraffa and the NeoRicardians abstract away from the reproduction schemes altogether, and reduce the whole process of reproduction and growth to the annual flow framework. While assuming that all inputs are advanced at the beginning of the year and realized at the end may clarify specific theoretical issues, this approach it is insufficient for the study of such issues as the allocation of money capital and prices of production. Ultimately, the turnover of circulating must be known to calculate the necessary value of the capital advanced.

## **II. Marx on Reproduction**

Marx's analysis of reproduction addressed five main areas; investment, forms of capital, turnover, money, and the interlinking of individual capitals in a whole economic system of reproduction. Marx argued that the role net investment plays in accumulation is a key determinant for reproduction. This argument was built up in part five of volume one of Capital and also in the Theories of Surplus Value. Second, the metamorphoses of capital involves its movement through distinct forms and is taken up in part one of volume two of Capital. Third, Marx analyzed how different individual circuits of capital require different durations of time. Fourth, Marx showed that the whole process of reproduction depended on the realization of profit into the form of money. Finally, Marx showed how the circuits of individual capitals were interlinked and necessarily presupposed certain technical conditions for the reproduction and circulation of the total capital. Specifically, Marx addressed the renewal of the total capital (fixed and circulating) from the perspective of two types of capital - constant capital (means of production) and variable capital (labor power). These five issues comprise the bulk of Marx's attempt to move beyond Quesnay's work to explain the process of reproduction more concretely.

### ***A. Investment-- Simple and Expanded Reproduction***

Marx took up the question of simple and expanded reproduction in chapters 23 and 24 of volume one of Capital. Marx advanced essentially the same argument as that found in Quesnay's Tableau. He argued that the rate of accumulation depended upon the way in which the surplus product was used.

Annual production must in the first place furnish all those objects (use-values) from which the material components of capital, used up in the course of a year, have to be replaced. After we have deducted this, there remains the net or surplus product, which contains the surplus-value. And what does this consist of? Only of things destined to satisfy the needs and desires of the capitalist class, things which consequently enter into the consumption fund of capitalists? If that were all, the cup of surplus-value would be drained to the very dregs, and nothing but simple reproduction would ever take place. (I: 726)

In volume one of Capital Marx, like Quesnay before him, attempted to show the basic conditions necessary for social reproduction to occur. He argued that the rate of reinvestment out of the net product determined the rate of growth.

Like in Quesnay's Tableau, the distinction between the production of the national output and its consumption critically underpinned Marx's understanding of production and reproduction. Unlike Quesnay, who defined productive labor with reference to agricultural, Marx defined productive labor in terms of wage-labor and capitalist production (Marx 1969: 152). Marx argued that for labor to be productive it must be both production labor and also wage-labor which creates surplus-value. Shaikh and Tonak (1994) developed the theoretical foundations of Marx's distinction of productive and unproductive labor by analyzing the basic activities of social reproduction, including production, distribution, social maintenance, and personal consumption. They noted that all these activities are a part of social reproduction, but that only production directly results in the creation of new wealth (1994: 28). They observe that Marx's distinction between productive and unproductive labor is even more refined. They also found that the specific social relation under which labor is organized, for direct use, for sale, and for sale for profit

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determines if it is productive of surplus value or not. They argued that only labor which is both engaged in production and labor which is exchanged against capital is productive of surplus value.

Marx used the distinction of productive and unproductive labor, in the same way that Quesnay used the distinction, to show that the product of all labor does not produce new wealth but from the social perspective represents social consumption. Like Quesnay, Marx argued that accumulation is largely contingent upon new investment out of the net product.

### ***B. Metamorphoses of Capital: Form***

Marx wrote volume two of Capital with the intention of developing the issues involved in reproduction which Quesnay left unresolved. Most of the focus in this volume centers on the circuits of capital and turnover. Marx laid out an initial presentation of the circuit of capital in volume one to explain the commodity and the distinction between use-value and value and also to develop his theory of money. He noted that the process can be broken into stages which exist in time and take place through space. The acknowledgment of a spatial and temporal existence in economics is crucial because it represents a material rather than an ideal conception of production and distribution. In the material, commodities exist in space and are produced through space. Workers through their material actions regulate and control the metabolism of nature. They intervene, so to speak, and confront nature to appropriate the materials of nature by setting into motion their own bodies to meet their own material needs.

The transformation of nature by labor into commodities and the exchange of commodities on the market taken together represents the "social metabolism" which so concerned Marx. The social metabolism of capital takes place through phases. Marx associated the process in which capital changes form and goes through phases with the life-cycles of biological reproduction. The reproduction of the economic system is very much like the reproduction of living organisms because both pass through phases and forms in their reproduction. The lifespan of capital is limited not only by production but also circulation. Capital is advanced for production, used in production, and eventually realized for profit in exchange.

Economic events represented in the social metabolism of capital progress in time and through space. The transformation of means of production takes place ideally in the mind prior to its material transformation. In production means of production are physically molded into commodities. The production of commodities require movement through both space and time. In the labor process means of production are brought together with labor power to produce new use-values. At the end of the production process new commodities come into existence, presumably with greater value and distinct material properties than those used as inputs. The act of exchange on the market takes place abruptly and represents a transformation in form. The forms which capital takes (money, means of production and labor power, goods in process, and commodities waiting to be sold) make up the metamorphoses or lifecycle of capital. The transformation of nature by labor into commodities and the exchange of those on the market taken together represents a "social metabolism." The two spheres in the metabolism of capital; the sphere of production and the sphere of circulation constitute the lifespan of capital.

The circuit of capital can be divided into three stages. In the first stage the capitalist appears on the market as a buyer of the commodities, labor power and means of production (Marx II: 109). At the moment of exchange the capitalist exchanges money for commodities **M-C (LP and MP)**. In the second stages the purchased commodities are productively consumed in the production of commodities. A greater sum of value is produced than the sum of the elements of production **C...P...C'**. In the third stage the capitalist returns to the market as the seller and realizes in money the surplus value generated in production. Thus, the circuit of money capital is represent by the transformation of use-value into forms **M-C...P...C'-M'**. From the perspective of use-value capital passes through a series of metamorphoses in which capital assumes different forms. Each of these forms fulfill specific functions. We call **M** money capital, **P** productive capital, and **C** commodity capital. Only after capital has fulfilled the function corresponding to the specific form in which it is in can it evolve into different forms. Through space and time capital changes its form. Marx says "the forms are therefore fluid forms" with each form preceding the others (Marx II: 184). The return of capital to one form is determined by its stay in another form. Capital is both the money held with the intention of being advanced and the commodities used in production and also in inventory which are thrown into this process with the intent of being drawn out later with a profit.

### ***C. Turnover***

The transformation of capital takes place not only through space and form, but also through time. If commodities didn't require time for production then they could be produced with boundless facility. In such a situation no time would elapse between the ideal conception of the commodity and its actual existence. The differing time periods which elapse are called turnover times. A circuit of capital varies according to the capital advanced and the industry which uses it. The year is the standard benchmark from which the classical economists evaluate the rate of turnover of particular capitals. All capital which turns over in a year or less is called circulating capital and all capital which takes more than a year is designated fixed capital.

The number of turnovers circulating capital takes in a year tells us how long it takes capital to complete its life-cycle within a year. If capital completes four turnovers in a year then it completes its cycle in three months. If the turnover time amounts to more than a year than we call it fixed and deal with it under the heading fixed capital. The formal distinction between fixed and circulating capital arises only for the different turnovers of the productive capital in the production process. The difference in turnover arises from the different ways in which the components of productive capital is transferred to the product. Circulating capital is entirely consumed within a year and fixed capital is only partially consumed.

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Marx breaks constant capital into two constituent parts which he calls circulating constant capital and fixed constant capital. The portion of constant capital which maintains its specific use form in the production process in relation to the products which it helps to transform for more than a year Marx calls fixed constant capital. Examples of this include buildings and machinery. The extent which it gives up (depreciates) is determined by the average duration of its function from the time it enters production to the time in which it is completely used up (Marx II: 237). Constant circulating capital by contrast is fully consumed in both its use-value and value aspects in the course of a year. Nevertheless fixed and circulating capital are not independent capital investments. Both are necessary in production even though investment decisions may be represented as different spheres of investment and may be and generally are staggered in time.

### ***1. Circulating Capital***

Unlike Neoclassical usage of the term capital where capital is understood as only fixed plant and equipment, the classical economists use the term capital to describe money advanced for plant and equipment (fixed capital) and also for intermediate inputs and labor power (circulating capital). Fixed capital is distinguished from circulating capital by the fact that it remains in production for longer than one year. Circulating capital exhibits turnover times less than a year. Unlike fixed capital, circulating capital is completely absorbed into circulation and returns from it whole within a one year cycle. The part of capital which is fixed, the actual machines and structures, continuously throughout a given year give up (or depreciate) only a portion of their value.

While capitalists function as the organizers for production and exchange, they are constrained by the fact that capital itself must be tied up in the production process and also by the fact that the realization of the value of their commodities before further investments can be made. The number of products produced in a given period of time and how frequently capital can be valorized in a given period of time to reproduce and multiply depends on the turnover or velocity of circulation. The repetition of the production process is restricted by the amount of time which elapses during the transformation involved in production and realization. If there were no circulation time required in the production and realization of commodities, the production process could be repeated limitlessly. Capital could be advanced without limit and the very notion of value creation would be nonsensical. The transformation would occur in reality as quickly as it is processed in the mind. In this unrealistic case no time would pass and the whole meaning of value would disappear.

Marx went to considerable length to examine this process and to show the forms in which capital is tied up in its metamorphoses of form. He argues in the first part of volume two of Capital that goes through phases as it transforms itself from one form to another. Circulation and production proceed in both time and space. When metals are extracted from a mine or commodities moved from their point of production to its site of consumption this takes place through space and time. Marx characterized the return back to an initial form as a circuit of capital. Each of these forms identified above represent phases of time as financial capital, productive capital, and commercial capital.

Capital passes through various economic moments which are divided between two great sections of time. On one side is the production time and on the other side is the time needed for circulation. These two sections of time account for the vast majority of time needed to complete a full circuit of capital. In circulation and production, capital appears as a unity of two moments. The circuit of capital is completely renewed when the periodic process returns to an earlier form. This periodic process Marx calls turnover. The duration of turnover is limited by principally two moments: production-time and circulation-time. Differences in the duration of turnover between industries and firms can originate from either factor.

The time necessary to complete a circuit is determined largely by spatial considerations. The change of location of the object of labor and labor itself limit the speed with which means of production can be transformed. Marx illustrates this. He says: "the cotton that is moved from the carding shop into the spinning shed, coal lifted from the pit to the surface" are examples of the movement in space and the time consumed in this movement (Marx II: 227). Further a product can only be sold when it is transported from its place of production to its place for sale. The product moves from the sphere of production to the sphere of consumption. The sum of production time and circulation time represents the total turnover time. It is spatial movement which ultimately limits the speed with which products can be produced. The overall time which elapses in production and in circulation also limits the availability of capital and hence restrict the valorization process. Capital can only be advanced when it returns to the money form. To increase profitability capitalists generally accelerate the process of production and limit the time goods are stored.

Capitalist firms in different industries must advance different amounts of capital depending on the turnover of circulating capital. The cloth maker may lay out fresh capital on wages and material for one week and realize the product within that time span. With the money from the realized product he can hire the worker back for the next week without having to raise additional capital. In contrast a car producer may have to lay out capital for wages and raw material week after week for a month. In this example, the business of the cloth producer requires an outlay of one week while the business of the car producer requires four times as much circulating capital (see Marx II: 307). One can see from this example that profitability is significantly affected by turnover. The two producers in the course of one month may pay the same amount of money for raw materials and wages but the car makers really advances four times what the cloth maker advances because of the turnover times of circulating capital.

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## 2. *Fixed Capital*

With fixed capital only a small portion of the capital is transferred (depreciated) to the product in the course of a year. Unlike circulating capital fixed capital does not circulate in its use form. Instead its value circulates and does so only "bit by bit, in the degree to which it is transferred to the product that circulates as a commodity (Marx II: 238)." A part of its value it always remains fixed as long as it functions. In the circulation of fixed capital, value is transferred from fixed capital to the commodity in the form of depreciation. Marx said of this peculiarity "value thus acquires a dual existence. A part of it remains tied to its use form or natural form, which pertains to the production process, while another part separates off from this form as money (Marx II: 242-243)." A machine with the value of \$100,000 which lasts for five years does not need to be renewed for five years. During these five years its value circulates "bit by bit" as it is depreciated until at the end of five years it is completely transformed back into money. In the material or use value sense, fixed capital is tied down and nondisposable until it has been fully used up. The turnover times of capitals differ according to their different spheres of investment. The assets which comprise fixed capital have differing lifespans. For example the plant and equipment used in the rail industry including locomotives, bridges, tunnels, rail, rail stations all have different lifespans from the plant and equipment used in say textiles. These differing turnover times must be accounted for in our analysis of reproduction.

## 3. *Depreciation*

As fixed capital is used up, the value fixed in it steadily declines (is depreciated) until it is completely worn down. Generally depreciation does not express itself in the outward or physical disassembling of plant and equipment but in the throwing off of value from fixed capital.

### *D. Money in Reproduction*

Money is the principal mover through which each individual capital steps onto the scene and commences the process of production and circulation. It gives the first "impulse" to the whole process of reproduction and critically underlies the smooth functioning of reproduction (Marx 1981: 430). In the first stage of the circuit of capital the capitalist appears with money on the commodity market as a buyer. He converts a sum of money into a sum of commodities. M-C (LP and MP). Only after means of production and labor power have been purchased can the production process be set in motion. The turnover of individual capitals must repeat itself afresh at definite intervals and this itself presupposes that money is available to continually initiate this process.

In the absence of a developed credit system, the purchase of sufficient means of production and labor power to initiate production capitalists requires the accumulation of a money hoard sufficient to meet the costs of capital. Since the proportions in which the production process can be expanded is not arbitrary but prescribed by specific technical factors, money must be built up into a hoard of latent money capital (Marx 1981: 430). The formation of hoards appears as a part of the process in which capital operates (Marx 1981: 162). The extent that the turnover period is governed by the length of the working period which is itself determined by the material character and duration of the production process. The dependence on money capital can be overcome by the credit system. If the credit system breaks down and recedes back into a monetary system, monetary hoards become essential and can limit the whole process of reproduction.

Commodity production presupposes commodity circulation, and commodity circulation presupposes the representation of commodities in money and monetary circulation. When capital is in the money form, Marx called it latent capital because productive capital cannot be set in motion to generate surplus-value. Thus, Marx showed that under a money system the duration of turnover forces greater advances of money capital for longer times. Production is itself limited by the extent of money capital available to individual capitals. He noted that the limitation imposed under a monetary system are overcome by the credit system and the forms of association related to joint-stock companies (1981: 433). Credit acts like a lubricant which accelerates the rate of turnover.

A collapse of the credit system could bring business and the whole process of reproduction to a halt. Marx argued that when the credit system collapses the monetary system reasserts its significance. Under a monetary system even small disturbances in the money market slow the process of reproduction dramatically (Marx 1981: 434). Exchanges between producers are mediated by money capitalists who accumulate profits by monetary circulation itself. When money is hoarded exchange becomes more difficult because less money is in circulation hence limiting the pace of reproduction.

### *E. Reproduction of the Total Capital*

The turnover of individual capitals represents only specific moments in the movement of social reproduction and act as integral links in the movement of the total capital. Marx considered the process of reproduction from the standpoint of the replacement of the individual components of the whole social capital. He argued that from the perspective of social capital individual capitals are only fractions of the total social movement and act as integral links in the movement of the total capital. The metamorphoses of individual capitals are considered from the standpoint of the replacement of the individual components of commodity capital. Marx argued that it cannot be presupposed that the individual commodity input requirements of individual capitals are always available on the market and considered how the capital used in production is replaced and how the movement in the social capital is intertwined with the consumption of surplus value by capitalists and of wages by workers (II: 469). Marx took up this

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concern by developing the distinction between constant capital and variable capital and surplus value. Using this distinction Marx broke the total social product into two departments. The part of the value of the annual product which replaces constant capital is the product of Department I and the portion of the annual product which produces means of consumption is the product of Department II.

Certain specific conditions must be met for simple reproduction to occur. Quesnay showed that outputs produced had to equal or exceed the inputs used. For Marx the conditions of simple reproduction not only included the replacement of existing capital but its replacement in specific proportions. Marx argues that reproduction is conditioned by the mutual relations of input components used in the production of the social output. Neither labor nor intermediate input alone are capable of reproducing the existing product. Thus, social reproduction necessitates the reproduction of means of production and also labor in a specific proportion. The simple reproduction of the existing product requires that the value of the product of department two at least equal the value added of the whole economy. Marx represented this condition of simple reproduction as  $\Pi_{(c+v+s)} = I_{(v+s)} + \Pi_{(v+s)}$ . More specifically, a condition of simple reproduction is that the value of the components  $v+s$  of the commodity capital of department I equal to the value of the constant capital used in department II (II:478). The value of the output of department I represents the constant capital consumed in the course of production. Simple reproduction, of course, is inconsistent with capital, which itself presumes self expansion. Despite this observation analyzing the extreme condition of simple reproduction illustrates how reproduction must be considered from the standpoint of the replacement of the individual components of capital. In expanded reproduction the stringent conditions associated with simple reproduction are not applicable. Reproduction on an expanded scale requires that the input requirements associated with the production of expanded output be met. This means that an additional amount of the output of department I be retained by department I.

In contrast to simple reproduction where it is assumed that the whole surplus product is spent on means of consumption, in expanded reproduction a part of the surplus product is retained and invested in additional means of production. In the hypothetical transition from simple to expanded reproduction the surplus product which was used to purchase the output of department II (means of consumption) in simple reproduction is converted and used as additional means of production for department I in expanded reproduction. Thus, in expanded reproduction (or capitalist accumulation) the value added of department I cannot be equal to the value of constant capital used in department II. The immediate effect of a transition from simple to expanded reproduction is that fewer elements of constant capital produced in department I which were formerly used in the production of department II are redirected for use in department I (II: 572). Thus, a material constraint for expanded reproduction is that sufficient output of department I be produced to meet the demands of investment.

Marx's theory of reproduction represents an improvement over Quesnay's theory in at least five distinct ways. First, he developed the distinction between productive and unproductive labor to demonstrate the origins of wealth and hence the most immediate possibilities of reproduction. Second, he laid down the theoretical foundation for understanding the forms of reproduction which capital must go through to realize profit. Third, he showed that turnover times are staggered across industries and limit the possibility for capitalist expansion. Fourth, he illustrated that money can limit the pace of accumulation. Finally, Marx integrated these conditions into a general model to show reproduction in a more general way. These five advances discussed above illustrate the information which needs to be gathered to give Marx's theory of reproduction empirical content.

### *ii.) Perspectives on Marx's Theory of Reproduction*

Marx's efforts to illustrate the process of reproduction schematically have been largely ignored. In the preface to volume two of *Capital* Engels forewarned that the book would not be popular because it "contains no political fodder." In a letter to Lavrov in 1884 Engels wrote: "The second volume is purely scientific, only dealing with questions from one bourgeois to another (Mandel :11). In a separate letter he anticipated that the lack of political material would make volume two a "great disappointment (Mandel : 11)." He continued by noting that "the second volume will always remain a sealed book" in which "official economic literature" would observe a "cautious silence with regard to it." Rosdolsky noted that the schemes of reproduction went mostly unnoticed by the German Marxist literature at the turn of the century. Volume II of *Capital* "simply remained in total oblivion (1977: 460)." But, for a period debates around Marx's schemes of reproduction consumed the Marxian literature.

The debates in Germany in the early part of this century turned the attention of the Marxist tradition towards the schemes of reproduction but failed to develop Marx's effort, and instead focused on the political implications rather than extending Marx's analysis theoretically or empirically. These debates focused on whether the schemes demonstrated a harmonistic view of capitalism or one characterized by crisis. Many social democrats viewed the schemes of reproduction to be a vindication of their view that capitalism was a social system with limitless possibilities. This harmonist perspective was advanced by social democrats like Kautsky, Bauer, and Hilferding (Rosdolsky 1977: 450). In contrast, breakdown theorists, like Luxemburg () and Grossman (), attempted to show that the harmonist perspective was completely misplaced. Luxemburg argued that reproduction necessitated external demand. Grossman argued that a falling rate of profit would give rise to "breakdown." While the schemes of reproduction became the centerpiece of the debates between "neoharmonist" and "breakdown" theorists, no effort was made to extend these schemes or to do empirical work on reproduction.

### III. Extensions of Marx's Theory of Reproduction and Input-Output Economics

One little known but very significant attempt in the 1920's was made to extend Marx's schemes of reproduction to the conditions of reproduction in the Soviet Union. Famous Soviet economists such as Popov, Litoshenko, and Leontief were

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brought together by the Soviet Central Statistical Association as a select group to provide a theoretical and empirical foundation for understanding the bottlenecks plaguing the Soviet Union (Spulber 1964). These economists, similar to Quesnay and Marx before them, were pioneers who confronted the difficult task of explaining reproduction theoretically. But, not only did they have to explain reproduction in theory, they had to develop an empirical accounting framework and offer suggestions for resolving supply bottlenecks. They approached this project by applying and developing Marx's theoretical framework of reproduction and constructing an accounting scheme that could trace the flows of commodities at a very disaggregated level (Spulber 1964: 3).

Quesnay and Marx's theory of reproduction served as the foundation upon which the accounting scheme used in the "Balance of the National Economy" was constructed. Popov and Litoshenko recognized Marx's scheme could provide the methodological foundation upon which a national balance would be computed (1964: 7). They used Marx's schemes of reproduction as the starting point for devising their input-output balance (Spulber 1964: 3). Popov noted that while Quesnay and Marx were concerned with "purely theoretical solution to the problem of reproduction" the balance offered a "statistical basis" for showing how the social economy is reproduced under specific empirical conditions.

They viewed the balance as furnishing the material foundation for analyzing theoretical hypotheses of the classical economists by providing the statistical evidence necessary to make sound evaluations of their theory. The balance was viewed more as a statistical operation which would show how goods are produced and distributed in a given year (Popov 1964: 5-6). Litoshenko (1964) envisioned an accounting scheme that would track the flow of goods within a given year to measure the flow of economic activity and measure the economic interdependence thus serving the function of an income statement. He also visualized a table which would act like an "instantaneous photograph" which would show the real quantities of material in various stages of processing roughly corresponding to M-C-M'. This table would function very much like a balance sheet in financial statements (Litoshenko 1964: 32-33). Unfortunately efforts to bring the business accounting framework to the national economy have not been pursued.

The "Balance of the National Economy" should be judged as a remarkable achievement in the theory of reproduction. It was the first attempt to show that Quesnay's and Marx's efforts could be given empirical content. Stalin viewed the project differently. He saw the effort as a "game with figures (Spulber 1975: 27)." He dismissed Popov and "liquidated" many of his coworkers in various purges (Spulber 1975: 27). The project was regarded as "antimarxian" and consequently further work had to be done in complete secrecy (Hardt et. al. 1967: 71). Hardt and his coauthors wrote "Stalin's negative attitude was probably the main reason for the almost complete evanescence of the study of the overall balancing methods in the Soviet Union (Hardt et. al. 196: 71)." In the 1950s the Soviets resumed their work on tables similar to the "Balance" for planning purposes.

The perspective that the analysis of reproduction developed was extended by the Soviet economists is not popular amongst Western economists. Mierynck, for example, contended that the Russian economists "borrowed" their ideas from Western input-output economists and wrongfully claimed credit for it (1965: 85). Richard Stone (1986: 13) argued that while it is possible to suggest precursors to input-output analysis "...all this does not quite add up to input-output analysis." Left to their own interpretation input-output economists would prefer to entirely credit Soviet economists for the development of input-output economics.

For all the protestations of Western economists to the contrary, a great intellectual debt is owed to the Soviet economists and Marx for their roles in laying out the theoretical foundation upon which the input-output accounts are built. One member of the group who worked on the "Balance," Wassily Leontief, developed the first input-output tables for the U.S. economy. This effort was positively received, and for it Leontief later received the Nobel Prize in economics. Leontief (1976: V) in the preface to his book said that the Harvard economic research project represented an attempt to lay an elaborate foundation for the empirical study of long-run problems. The ultimate aim of the project was to establish an internally consistent 'tableau economique.' In the formative years of input-output analysis the stress was clearly on constructing a framework for understanding reproduction and long term trends.

For ideological reasons, work on the input-output accounts in the United States was stopped in the 1950s. The input-output accounts were perceived to be a threat to the "private enterprise system" because they were viewed as a step towards "push button planning." In the 1950s it was thought that input-output economics would lead to a "super planning agency (Business Week 1951: 98)." The "chilling" image of a "robot-managed age" led to an extreme reaction by business leaders (Business Week 1952: 23). At least one businessman foresaw it as a potential threat capable of "replacing democracy." The concern about the political implications of planning eventually led to the abandonment of the input-output program (Business Week 1953: 26). Mierynck (1965: 79) said that "... because of the curtailment of funds in 1953, there was a period of more than five years during which government agencies in the United States could not engage in such analysis." The perceived threat to "private enterprise" ultimately halted the development of input-output accounting and every effort to give credit where it was due.

Perhaps hoping to avoid further confrontation input-output economists moved to portray input-output accounting a "value free" science which merely provided tools "free from political ideology" (Mierynck 1965: 88). This perspective now dominates the work in input-output economics. The extension of input-output analysis to empirical applications has been the central focus of the input-output literature. During World War II the input-output accounts were used to successfully predict serious shortages in steel (Leontief 1987: 862). In more recent decades input-output models have been developed to explain interregional flows and developments, Keynesian multiplier analysis, energy input analysis, military spending, and even environmental pollution.

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One consequence of the focus on policy is that the relation of input-output economics to the classical economic tradition and the theory of reproduction have been mostly forgotten. The ideological overtones of the 1950s put input-output economists on the defensive, and they deflected criticisms of being Marxian by distancing themselves from the origins of their own approach. While there was some discussion of Quesnay's Tableau, there was virtually no discussion of Marx's schemes of reproduction. Moreover, in recent years input-output economists have stressed the relation of input-output economics to Walrasian general equilibrium models rather than its true origins in the classical tradition (Hatanaka 1970: 8). By highlighting the similarities of the input-output economics to neoclassical economics, they have legitimized input-output economics in the mainstream. The link between input-output economics and the classical tradition has been so severely severed that some input-output economists internalize this view and argue that the theoretical background of interindustry economics is provided by the general equilibrium model of Walras and Pareto (Hatanaka 1960: 8). Chenery and Clark (1993: 1). The draping input-output analysis in the robe of Walrasian general equilibrium has had the effect of leaving input-output economics suspended in a theoretical vacuum. The subtle incorporation and representation of input-output economics as neoclassical has obscured the elementary principles of the classical approach which underlies the input-output accounts. As a consequence of all the attention devoted to policy analysis and neoclassical economics, input-output economists no longer view understanding social reproduction as a worthy objective.

A few notable exceptions to this general trend include the works of economists like Luigi Passinetti (1977), Anwar Shaikh (1984, 1994), Ed Ochoa (1984) and Michel Julliard (1982) who have attempted to extend the input-output accounts to the study of reproduction and also the hypotheses of the classical economists. Passinetti (1977) stressed the similarities between Sraffa's analysis and input-output economics and suggested that these accounts can be used to test classical economics. However, Passinetti never extended his comparisons to the empirical world. Shaikh (1984) showed that labor values are excellent approximations of market prices. In his book on measuring the wealth of nations, he utilized the input-output accounts to measure variable capital, surplus-value, and productivity growth (). Julliard, Bertrand, and Pisani-Feri (1982) showed that the input-output accounts can be used to compare Marx's departments systematically. The theory reviewed in the above sections and the work of Passinetti

While in a few key respects input-output economics represents a clear advance over previous work on reproduction, it also suffers from major shortcomings. Its achievement is mainly that it goes beyond accounting for annual flows of the net product to include the commodity flow inputs used in the production of the total output. But, in many crucial respects the input-output accounts are crude and undeveloped. While input-output accounts are analogous to the income statements in corporate reports, no effort has been made to develop a corresponding balance sheet or "snapshot," as was suggested by the Soviet economist Litoshenko in his work on the "Balance," to determine the rate of turnover, the stock of capital on hand, and the rate of capacity utilization. With respect to Marx's theory of reproduction there are at least six major shortcomings. First, the sector classification schemes are different for the different base years and are never adjusted and made consistent for all the base years. The nonexistence of a set of compatible tables can be attributed to the lack of intertemporal work done in input-output economics today. Second, the input-output accounts do not specify the wage basket used to reproduce productive workers. Third, they fail to make the distinction between productive and unproductive labor. Fourth, capital stock and depreciation data have been collected haphazardly and inconsistently and very little effort has been made to make it compatible with the input-output tables. Fifth, no effort has been made to determine the rate of turnover of the capitals advanced by industries. Finally, little work has been done to test the validity of price indices which critically underlie question of intertemporal measurement. In light of Marx's developed theory of reproduction it is obvious that input-output economics suffers from major shortcomings. Despite the number of shortcomings in input-output framework for the analysis of reproduction these deficiencies can be overcome. The gaps between Marx's analysis and the input-output accounts can be filled.

This task of filling these gaps must begin by identify them through careful study of the theory reproduction.

#### IV. Data Needs

Let us consider the basic data that we will need to fill in the categories which Marx used in in his theory of reproduction. Using Shaikh (1995) and Passinetti's (1977), the variables we need for matrix manipulation include.

- l = row vector of labor coefficients
- A = input-output coefficients matrix
- D = depreciation coefficient matrix
- K = capital coefficients matrix
- T = turnover times
- U = capacity utilization
- w = wages (value added component)
- t = indirect taxes (value added component)
- X = total industry output
- Q = total commodity output
- e = price index vectors

The specific details on how the data is collected and the issues involved in assembling this data are covered in the next chapter

and appendices A through G.

## Conclusions

My review of the classical economists works on reproduction shows that their attempts to understand the process of reproduction in the economy involved the theoretical construction of a taxonomic model analogous to the taxonomy of the body. As in Quesnay the flows of blood in and between the organs of the body were matched by models which envisioned the flow of commodities and money in and between sectors of the economy. This taxonomy involved understanding the sources and flows of income, the rate of turnover, and distribution across sectors and classes. For Quesnay the taxonomy was organized around agriculture and distribution of its product to different classes. For Marx the taxonomy involved many theoretical categories including an understanding of the existing social relations, the role of investment and consumption, the change in forms in the circuit of capital, the duration of turnover, the role of money, and the division of the economy into two departments. I have also demonstrated that the taxonomy that lies behind input-output accounts are related to efforts of Quesnay and Marx. Despite their similarities they failed in certain respects to replicate the work of Marx, whose analytical scheme remains the most developed theoretical foundation for understanding reproduction. These tables and national accounts can be made even closer to the taxonomy which Marx envisioned. However, modifications must be made to develop the empirical categories in Marx's framework, including the development of the distinction between production and consumption, flows and stocks and the rate of turnover, fixed capital and depreciation.

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