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Vladimir N. Pokrovskii

Econodynamics

The Theory of Social Production

Second Edition

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Preface

While studying and teaching *Methods of Mathematical Modelling of Economic Processes*, I have been confused about some discrepancies between various parts of the economic theory. There was an impression that the economic theory exists in independent fragments. Especially upsetting for me, a person who began the study of economic theory with *Das Kapital*, was the fact that Marx's theory seems to have no concern in mainstream economics.

I realised later that I was not the sole person to feel a deep dissatisfaction with the situation with the economic theory and its ability to describe reality. To say nothing of the numerous papers, there are many books devoted to a critique of mainstream economics (Nelson and Winter, 1982; Kornai, 1975; Beaudreau, 1998; Keen, 2001). There is a special online *Real-World Economics Review* (http://www.paecon.net/) opposing the mainstream theories. The people who are engaged in ecology are traditionally confronting the conventional economic thinking and are looking for physical terms to explain the phenomena of production (Costanza, 1980; Odum, 1996). Some physicists are trying to find new approaches to the analysis of economic situations (Mantegna and Stanley, 1999).

This book contains no critique of any theories. It is devoted to understanding the principles of production and contains a consecutive exposition of the technological theory of social production, which can also be understood as the theory of production of *value*. In the foundation of the theory are laid the achievements of classical political economy. The labour theory of value is completed, after Marx's hints in *Das Kapital*, with *the law of substitution*. The latter states that, when interpreting value, one has to consider that the workers' efforts in the production of things are substituted with the work of production equipment. A new important concept of *substitutive work, as a value-creating production factor*, was introduced and used to formulate the appropriate theory. The adequacy of the theory has been tested by using historical data for the U.S. economy.

The book is written by a physicist for the scientifically literate reader who wishes to understand the principles of the functioning of a national economy. The book contains a discussion of conventional models (Leontief's input–output model, the

classical Walras market theory and others) and can be considered as a textbook for students of various specialities who have the necessary preparation in physics and mathematics and a desire to study economic problems. I think the monograph could be interesting for energy specialists, who are engaged in planning and analysing the production and consumption of energy carriers, and for economists, who want to know how energy and technology are affecting economic growth.

The appropriate formulation of the theory has a long history. This monograph was launched, in fact, as a revision and enlargement of my book *Physical Principles in the Theory of Economic Growth*, issued by Ashgate Publishing in 1999. However, it appears that the proper description of the theory has required the text to be completely rewritten and new material to be added, so that I have the opportunity to present a new book with a new title. I have used this edition to clarify the concepts and methods of the theory as far as it was possible for me at the moment.

I am grateful to many people who support and encourage me in my work. I especially would like to separate a few persons, with whom I have had the opportunity to discuss many relevant topics: Robert Ayres, Bernard Beaudreau, Sergio Ulgiati, Andre Maisseu, Michail Gelvanovskii, Grigorii Zuev and Irina Kiselyeva. Some issues became clearer for me after a discussion on the *generalised labour theory of value* with members of the *Socintegrum forum* (http://socintegrum.ru/); I am thankful especially to Valerii Kalyuzhnyi and Grigorii Pushnoi. Finally, I would like to express special thanks to my editors Maria Bellantone and Mieke van der Fluit at Springer.

Moscow, Russia Vladimir N. Pokrovskii

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Notation and Conventions[1]

A	input-output matrix with components a_i^j;
B	capital-output matrix with components b_i^j;
$B = \dfrac{Y}{L}$	labour productivity;
E	primary energy used in production;
E_P	primary substitutive work used in production;
I	gross investment in production system;
I_j	gross investment of product j;
I^i	gross investment in sector i;
I_j^i	gross investment of product j in sector i;
K	value of production equipment in production system;
K_j	value of production equipment of kind j in production system;
K^i	value of production equipment in sector i;
K_j^i	value of production equipment of kind j in sector i;
L	labour in production system;
L^i	labour in sector i;
M	amount of circulating money;
M_0	amount of circulating paper money;
N	number of population;
p	price of substitutive work as a production factor;
p_j	price of product j;
P	substitutive work
P^j	substitutive work in sector labelled j;
Q_j	quantity of product j in natural units;
R_j	value of stock of non-material product j;

[1] Latin suffixes take values $1, 2, \ldots, n$ and numerate products and sectors. As a rule, the upper suffix numerates sectors, the lower suffix numerates products. The rule about summation with respect to twice repeated suffixes is sometimes used.

The chapter number and the number of a formula in the chapter are shown in references to formulae.

S entropy;
t time;
$U(\cdot)$ utility function, welfare function;
$u(\cdot)$ subjective utility function;
W value of national wealth;
W_j value of national wealth of kind j;
w price of labour, wage;
X_j gross output of product j;
Y final output, gross domestic product;
Y_j final output of product j;
Z^i production of value in sector i;
α technological index;
α^i technological index in sector i;
$\beta = \dfrac{\Delta Y}{\Delta L}$ marginal productivity of labour at $P = const$;
β_i marginal productivity of labour in sector i;
$\gamma = \dfrac{\Delta Y}{\Delta P}$ marginal productivity of substitutive work at $L = const$;
γ_i marginal productivity of substitutive work in sector i;
$\delta = \dfrac{1}{K}\dfrac{dK}{dt}$ rate of real growth of capital stock;
$\tilde{\delta}$ rate of potential growth of capital stock;
ε substitutive work requirement;
$\bar{\varepsilon} = \varepsilon\dfrac{K}{P}$ non-dimensional technological variable;
ε^i substitutive work requirement in sector i;
$\bar{\varepsilon}^i = \varepsilon^i\dfrac{K^i}{P^i}$ non-dimensional technological variable for sector i;
η rate of real (effective) growth of substitutive work;
$\tilde{\eta}$ rate of potential growth of substitutive work;
Θ index of labour productivity growth;
λ labour requirement;
$\bar{\lambda} = \lambda\dfrac{K}{L}$ non-dimensional technological variable;
λ^i labour requirement in sector i;
$\bar{\lambda}^i = \lambda^i\dfrac{K^i}{L^i}$ non-dimensional technological variable for sector i;
μ rate of capital depreciation;
ν rate of real (effective) growth of labour;
$\tilde{\nu}$ rate of potential growth of labour;
$\xi = \dfrac{\Delta Y}{\Delta K}$ marginal productivity of capital;
$\xi^i = \dfrac{\Delta Z}{\Delta K^i}$ sectoral marginal productivity;
Ξ marginal productivities tensor with component $\xi^i_j = \dfrac{\Delta Y_j}{\Delta K^i}$;
ρ price index;
τ time of technological rearrangement.

Chapter 1
Introduction: Concept of Value and Production Factors

Abstract It is enough to look at the contents of economic courses to become easily convinced that the common thing for all of them is 'a substance' of value. It is convenient to use the name economic dynamics (econodynamics) for the discipline. It investigates the processes of emergence, motion and disappearance of value, just as hydrodynamics investigates processes of motion of liquids; electrodynamics, those of changing electric and magnetic fields; thermodynamics, processes connected with the motion and conversion of heat. In this chapter, the concept of value is reviewed, and the role of basic production equipment, as a set of sophisticated devices which allow human beings to attract energy from natural sources for the production of useful things, is discussed.

1.1 A National Economy at a Glance

The enormous growth of the human population through the centuries is connected with special features of the population. In contrast to any other biological population inhabiting the Earth, humans have invented highly sophisticated artificial means of supporting their own existence, while developing a great level of co-operation of members of their society. Since Palaeolithic times, clothing, shelter and fuel have become necessities of life almost as fundamental as food itself. Since Palaeolithic times the organisation of human society has also been progressing.

Modern society presents itself as a huge hierarchal organisation, including the government, firms, banks, colleges, libraries and so on. It is a very complex organisation, and every one of the members of the society, in some way, is included in the system. The society, as an economic system, produces everything that is needed for survival of the community: both the means for supporting human existence and the means for generating such support.

A huge amount of artificial things are accumulated by societies: buildings, transport routes, bridges, production equipment, energy supply systems, sanitation systems and so on. Aside from the tangible things, a society accumulates a great amount of intangible objects: knowledge of the laws of nature, principles of organisation of society, items of literature and arts and so on. Both the tangible and intangible constituents of *the wealth of the society* are equally important for maintaining the existence of human communities.

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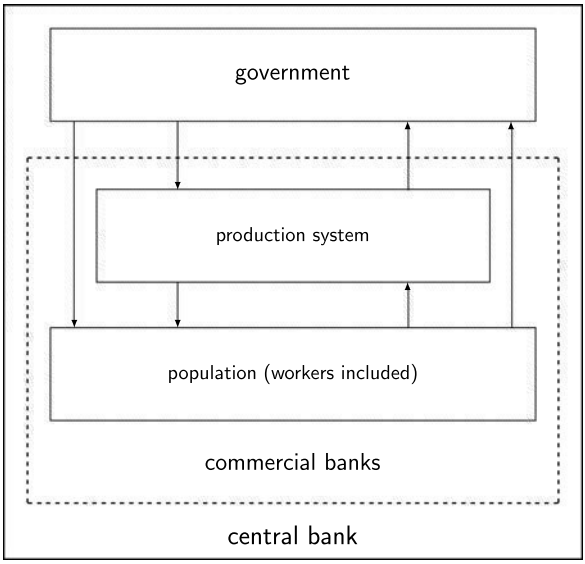

Fig. 1.1 The architecture of a national economy. The central bank and commercial banks create a money medium for the activity of economic agents. The production system creates all products and generates the fluxes of products to workers and between production units. The fluxes of money, depicted in the picture, are moving in opposite directions. Households are buying products, and money is returning to the producers. The government receives its part of produced value in the form of taxes, which, in different amounts, are returning to the economic agents. Each flux of money is a result of negotiation and agreement between corresponding agents

All (tangible and intangible) objects have been created by *the production system* of the society, which includes firms, plants, institutes, schools and so on. The production system takes minerals and ores from the environment, transforms natural substances into finished and semi-finished things, the latter are transformed into other things and so on, until all this is finally consumed, and the substances are returned into the environment as waste. This is the material side of production.

To discuss the mechanism of motion of products, one needs to consider human beings, and their desire to consume and, consequently, to produce. In developed societies, man does not consume only those products which he produces. The exchange of products, which, in fact, is the exchange of efforts, is a general phenomenon in modern societies. Man exchanges his services for an intermediate product—*money*—and then exchanges the money for products he wants. Therefore, simultaneously with the motion of products, one discovers the motion of money, which has to be considered as a separate, special product. The money is circulating in the economy, providing the exchange of products. Modern money is paper money and records on the accounts in the central and commercial banks and, thus, is inherently useless. Modern money is nothing more than a certificate that its owner has a right to get a certain set of products. The value of modern money derives only from the fact that it can be exchanged for the product.

The real production and *the money system* are intervened with each other, thus one can think that an appropriate description can be achieved when these phenomena are studied together. One can consider the production system and population as being immersed in a money system of the society, as shown schematically in Fig. 1.1. The money medium is created by the government, the central bank and many commercial banks. The central bank issues the bank notes and coins—the primary money—which is distributed to the commercial banks. The mechanism of issuing assumes that all paper money is circulating among economic subjects: practically no paper money is contained in commercial banks. The central bank also provides commercial banks with credits, so that the commercial banks can provide the customers with credit money. The records on the accounts of customers are non-paper money, which are created by the commercial banks. The central bank and commercial banks introduce an uncertain amount of the circulating money in coins, bank notes and cashing deposits in the system consisting of the government and the many customers of the commercial banks.

The subject of discussion in the proposed monograph is a theory of the social production system, and the latter is represented by many interacting enterprises. The architecture of the production system appears complex, but in a simple approach the production system can be considered as a set of the interacting pure sectors. In the most elementary case the production system can be considered as the only sector. This heuristic model of the society allows us to develop the theory of the production system in a simple, so-called macroeconomic approach.

1.2 The Concept of Value

The notion of *product* appears to be one of the fundamental concepts of economic theory. It can be defined as something which is produced to be consumed. It does not matter whether the moment of consumption coincides with the moment of production as, for example, in the case of transport services, or does not coincide. In the latter case the product exists for some time in its material or non-material form. Also it is insignificant whether the product is intended to satisfy the needs of the producer or is prepared for sale.[1]

[1]Let us pay attention to the distinction of the concepts of *a product* and *a commodity*. The latter is defined as something that is made for sale that is for an exchange at which value is disposed. From here some people wrongly conclude that the thing made for the producer's consumption does not possess value. This statement has been rejected by Marx [1, Chap. 1, Sect. 4]: "Since Robinson Crusoe's experiences are a favourite theme with political economists, let us take a look at him on his island. Moderate though he be, yet some few wants he has to satisfy, and must therefore do a little useful work of various sorts, such as making tools and furniture, taming goats, fishing and hunting. Of his prayers and the like we take no account, since they are a source of pleasure to him, and he looks upon them as so much recreation. In spite of the variety of his work, he knows that his labour, whatever its form, is but the activity of one and the same Robinson, and consequently, that it consists of nothing but different modes of human labour. Necessity itself compels him to apportion his time accurately between his different kinds of work. Whether one kind occupies a

According to the statements of the researchers,[2] the product can be considered as the unity of *use-value* and *production-value*, which allows products to participate in the processes of exchange. In the exchange, the products oppose each other, and the use-value of one product stands against the use-value of another. Products with various use-values can be compared due to the fact that the production-values of all products differ only in quantity, not in quality. Thus, the property that allows the products to be compared and exchanged is their *exchange value* or just *value*, which is an attribute of a product, just as mass is an attribute of matter.

One believes that the products are exchanged on average according to their values. This is an axiom which gives a relative measure of value, and allows one to ascribe a certain quantity of value to the products and to estimate the value of a set of products. Value is measured in conventional money units, which are set when the recognised means of circulation (money) are introduced into the economic system (see Chap. 3). Due to the overall exchange with the help of the money, all commodities can be evaluated, and this is considered as an estimation of their *value* in arbitrary money units (dollars, pound sterlings, euros, etc.). One can estimate, for example, a multitude of services and things produced by a nation for a year. This quantity is called the Gross Domestic Product (GDP).

The mechanism of exchange has been scrutinised. Some scholars emphasised the demand side of the phenomenon and argued that there is no value without utility, so that value ought to be considered as a market estimate of the utility of a thing. Other scholars argued that there are some things (water and air, for example) which have utility without market value, and thus, to understand the meaning of value, one has to refer to the supply side and take into account the production costs of things. It was understood later (the contributions of Walras [3] and Marshall [4]

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greater space in his general activity than another, depends on the difficulties, greater or less as the case may be, to be overcome in attaining the useful effect aimed at. This our friend Robinson soon learns by experience, and having rescued a watch, ledger, and pen and ink from the wreck, commences, like a true-born Briton, to keep a set of books. His stock-book contains a list of the objects of utility that belong to him, of the operations necessary for their production; and lastly, of the labour time that definite quantities of those objects have, on an average, cost him. All the relations between Robinson and the objects that form this wealth of his own creation, are here so simple and clear as to be intelligible without exertion, even to Mr. Sedley Taylor. And yet those relations contain all that is essential to the determination of value."

[2]Still Aristotle, analysing the exchange of various things, wrote "... all things that are exchanged must be somehow comparable" [2, Book 5, Sect. 5]. Marx [1, p. 14] wrote: "... when commodities are exchanged, their exchange value manifests itself as something totally independent of their use value. But if we abstract from their use value, there remains their value as defined above. Therefore, the common substance that manifests itself in the exchange value of commodities, whenever they are exchanged, is their value." The brief history and the analysis of concept of value are exposed, for example, by A.N. Usoff in a work "What is value" (http://www.usoff.narod.ru/Us4.htm, in Russian). Having begun with concepts of use-value and production-value, Usoff has shown how it is necessary to introduce the concept of value, free from the pre-prepared interpretations. Everyone who was studying in a higher educational institution in the USSR until 1990 knows the statement that 'value is the expenses of labour.' However, there is no indispensability to reduce concept of value to expenses of labour in advance. Factorial theories of value, that is the reduction of value to labour, capital and other universal factors of production, are considered in the following section.

used to be especially stressed) that both the cost of production (supply) and utility (demand) were interdependent and mutually determinant of the value of things. It had appeared to be fruitless to argue whether demand or supply determines value, as, in Marshall's words, "we might as reasonably dispute whether it is the upper or under blade of a pair of scissors that cuts a piece of paper, as whether value is governed by utility or costs of production."

The motion and transformations of products in an economy can be described as fluxes of value, which appears at the first touching the substances of nature with the hand of a human being, moves together with the material substance of a product, leaving its material form, transfers into other substances, and disappears at final consumption. The study of these processes is a subject of an empirical science that can be called *economic dynamics* (*econodynamics*). Econodynamics itself can be defined as a science which investigates the processes of emerging, moving and disappearing of value, and is hardly interested in its material carriers. The concept of value in econodynamics is as important as the concepts of energy and entropy in physics. Now we have the fragments of this science only, and one of the fragments—the theory of production—is described in this monograph.

Note that, due to some difficulties with the concept of value, modern scholars of economy are trying to avoid that concept; the concept of utility is used instead. The political economy of the nineteenth century has turned into the *economics* of our days, which is defined as "...the study of how societies use scarce resources to produce valuable commodities and distribute them among different groups" [5, p. 5].

Both econodynamics and economics study one and the same object: the national economy, whereas econodynamics, in contrast to economics, gives us the opportunity to restore the scientific traditions of studying the society.

1.3 Production System in More Detail

To create and maintain national wealth, that is, things that are useful for human beings, *a social production system* was invented and maintained by humans, and this is just what distinguishes human populations from other biological populations. The production system consists of many production units, such as enterprises, factories, plants and firms that create all the things that man needs. The investigation of the laws of production is one of the central issues of econodynamics.

From a material point of view, the process of production is a process of transformation of raw materials into finished and semi-finished goods, semi-finished goods into other semi-finished and finished goods and so on, until the finished commodities can finally be used by human beings. The products are always consumed by human beings, so the products always have to be created. Figure 1.2 shows the main constituents of the production-consumption system as it is imagined due to the remarkable achievements of the classical political economy and neo-classical economics. One can refer to Blaug [6] to follow the fascinating history of approaches to understanding and describing the economic production-consumption system.

1.3.1 The Law of Substitution

Any description of the production system of economy assumes that a specific motion takes place. The task of the production system is to change forms of matter, that is, to transform, for example, ores of different chemical elements into an aircraft, which can fly. One can observe how clay transforms into pots, how clay, sand and stone transform into buildings, how ores and raw materials transform into a car. To produce a good or a service, some specific work[3] must be done. Modern technologies assume that this work can be done by a human being himself and/or by some external sources, such as energy sources, simultaneously. To grind corn into flour, for example, one can use a hand mill, a water mill, a wind mill or a steam mill. In these cases, as in many others, the production equipment is some means of attracting external sources of energy (water, wind, coal, oil, etc.) to the production of things; the workers' efforts are substituted by the work of falling water, or wind, or heat. No matter who or what does the work, all of the work must be done to obtain the final result which should be compared with the consumed energy and the workers' efforts.

Different mechanisms and appliances are invented to perform the work. Some of these are handled by a man only, and some of them allow the man to attract energy from external sources. This is a material realisation of technology: production equipment.

It is possible that the first person to write about the functional role of machinery in production was Galileo Galilei. He realised that all machines transmitted and applied force as special cases of the lever and fulcrum principle. A prominent historian of science and technology, Donald Cardwell [7], wrote that Galileo in his notes *On Motion* and *On Mechanics* recognised that "the function of a machine is to deploy and use the powers that nature makes available in the best possible way for man's purposes… the criterion is the amount of work done—however that is evaluated—and not a subjective assessment of the effort put into accomplishing it" (pp. 38–39). The advantage of machines is to harness cheap sources of energy because "the fall of a river costs little or nothing."

The relevance of machinery to economic performance was clearly recognised by Marx [1], who described the functional role of machinery in production processes in Chapter XV, *Machinery and Modern Industry*, of *Das Kapital* as follows:

> On a closer examination of the working machine proper, we find in it, as a general rule, though often, no doubt, under very altered forms, the apparatus and tools used by the handicraftsmen or manufacturing workman: with this difference that instead of being human implements, they are the implements of a mechanism, or mechanical implements (pp. 181–182). The machine proper is therefore a mechanism that, after being set in motion performs with its tools the same operations that were formerly done by the workman with similar tools. Whether the motive power is derived from man or from some other machine, makes no difference in this respect (p. 182). The implements of labour, in the form of machinery,

[3] One can understand work as a process of conversion of energy in technological processes from one form to another, for example, from mechanical into thermal form.

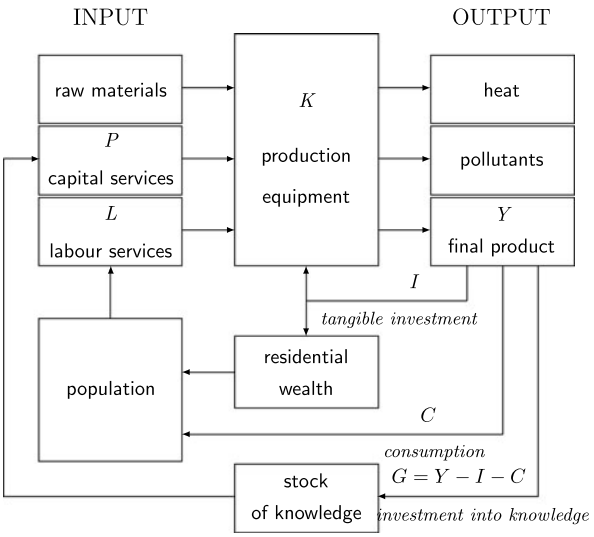

Fig. 1.2 Fluxes in the production–consumption system. To produce a thing or a service, apart from production equipment K, one needs raw materials (ores, water, air, energy carriers and so on), worker efforts L and some factor which can be conventionally called capital services P. The last factor is closely connected with production equipment—capital stock K, but different from it. Though capital services P can be considered formally as an independent production factor, it is hardly possible to find any other interpretation for it different from the amount of work of production equipment, which is done with the help of external energy sources instead of the workers' efforts. The output of the production process is a multitude of things and services, which are measured by their total value Y. A part C of final product Y is directly consumed by human beings, and a part I goes to enhancement of the production system through an increase in the stock of production equipment, so that the production system itself is a subject of evolution. The production processes are accompanied by the emergence of heat and pollutant fluxes, but this is another side of the problem, to which we shall not pay much attention in the monograph

> necessitate the substitution of natural forces for human force, and the conscious application of science instead of rule of thumb (p. 188). After making allowance, both in the case of the machine and of the tool, for their average daily cost, that is, for the value they transmit to the product by their average daily wear and tear, and for their consumption of auxiliary substances such as oil, coal and so on, they each do their work gratuitously, just like the forces furnished by nature without the help of man (p. 189).

Hence, both physicists and political economists recognised the important role of machinery in production processes as having to do with the *substitution of workers' efforts by the work of machines moved by external sources of energy*, while the extent of this substitution depends on the technology per se. It is important to keep in mind that while capital is a necessary factor input, work can only be replaced by work, or put differently, work cannot be replaced by capital.

Note that by contrast with Smith and Marx, who focused on physical labour, here and in the following text, we regard all possible energy-driven activities of workers including supervision of any kind, that is, the extended concept of labour (human capital) is used.

1.3.2 The Generalised Labour Theory of Value

Over the centuries researchers have tried to understand how things get value, or, in other words, to find a certain universal source of wealth, and the first candidate for this role was the land. Benjamin Franklin, known for his works on electricity, was one of the first to formulate the statement that a measure of value is the work spent by labourers [8]. This idea appears to be central in the political economy of the beginning of the nineteenth century and was especially developed in works of Adam Smith [9], David Ricardo [10] and Karl Marx [1]. These great scholars had no doubt that the production-value was equivalent to the employment of labour only, which gave foundation to *the labour theory of value*. According to Smith, "value of any commodity... to the person who processes it and who means not to use or consume it himself, but to exchange it for other commodities, is equal to the quantity of labour which enables him to purchase or command." According to Marx, "all commodities are only definite masses of congealed labour time." Every economist would agree that labour is the most important factor of production, but the situation appears to be more complicated. The production-value, generally speaking, does not reduce to the expenses of labour; something else should be added to the theory.

One can guess that the 'something' that is needed in the theory is Marx's phenomenon of 'the substitution of natural forces for human force.' Indeed, after understanding this phenomenon, Marx could suggest that it affects the mechanism of production of value. To understand how gratuitous work influences the value of the products, he could analyse the performance of two similar enterprises. He could suggest that the first of the enterprises uses a technology which requires some amounts of labour L and substitution work P, and, to produce the same quantity of the same product, the second enterprise uses a technology with the quantities $L - \Delta L$ and $P + \Delta P$ for production factors. So far as the products are considered to be identical, the exchange values of the products of either enterprise on the market are equal, despite the difference in labour consumption. Therefore, Marx could continue to argue, value cannot be determined by labour only, but the properly accounted work of natural forces ought to be considered. To produce the same quantity of value, the decrease in workers' efforts ought to be compensated by an increase in work of external sources, so that one can write the relation

$$-\beta \Delta L + \gamma \Delta P = 0,$$

where productivities β and γ of the corresponding production factors are introduced. Thus, equally with human efforts, the work of natural forces appears to be an important production factor. It is easy to see that the quantity β/γ determines the amount of gratuitous work of external sources which is needed to substitute for the unit of human work to get an equal effect in the production of value.

In the general case, the work performed by labour L and substitutive work P has to correspond to a set of products, which has the exchange value Y, and one can write, assuming that the production system itself remains unchanged, the relation

between differentials of the quantities

$$\mathrm{d}Y = \beta\,\mathrm{d}L + \gamma\,\mathrm{d}P. \tag{1.1}$$

The coefficients $\beta > 0$ and $\gamma > 0$ correspond to the value produced by the addition of the unit of labour input at constant pure substitutive energy consumption and by the addition of the unit of work of production equipment at constant labour input, respectively; in line with the existing practise, these quantities can be labelled as marginal productivities of the corresponding production factors. The two production factors, the workers' efforts and the work of external sources of energy, can substitute for each other and, in this sense, be equivalent, so that labour is eventually, using Adam Smith's words, "the only universal, as well as the only accurate measure of value, or the only standard by which we can compare the values of different commodities at all times, and at all places."

The discussed mechanism of substitution formalises Marx's statements. Really, by substitution of a labourer's work by forces of nature, that is, by substitution of efforts of people by the work of external forces of nature using production equipment, work operates in a complex of workers' efforts plus work of the equipment. Thus, the work of machines can be appreciated only so far as this work does what people wish, replacing their efforts. Consequently, a measure of value, certainly, can be the labourers' work only. It is possible to say also, according to Marx, that only labourers' work creates value, but Marx, unfortunately, did not complete the theory of substitution to the logical end. Taking into account the effect of substitution, one can say that the only universal and accurate measure of value is the work of labourers or other agents used for production.

1.4 The Law of Production of Value

The material and non-material results of production—buildings and machinery, cars and planes and other things among which human beings live—are characterised by value, so that one can speak about both the production of things and the production of value. The classical and neo-classical traditions relate the production of value Y in money units to quantities of universal value-created factors, the so-called production factors which one needs to create a set of products. According to Smith, Ricardo and Marx, labour ought to be considered as the only value-creating factor, that is, output can be considered as a function of consumption of labour L

$$Y = Y(L). \tag{1.2}$$

However, it appears to be impossible to explain the growth of productivity of labour, that is, the growth of value of commodities produced by units of labour in units of time Y/L using this simple hypothesis. To explain empirical facts, other production factors (land and capital, first) in line with labour have been introduced.