

# EINSTEIN'S CRITERION\* APPLIED TO LOGICAL MACRO-ECONOMICS' MODELING

\*See Page 2 and Ref 2

## ABSTRACT

A fully comprehensive representative model of our national macroeconomics is derived from first principles, using the absolutely minimum necessary amount of analytic logic. Two vital features of the procedure for portraying our society are that it is to be modeled by using a diagram, and that it is in the form of a system. This presentation of the structure is essential, for us to properly understand about how our whole macroeconomics system works and to explain and analyze it. Two basic assumptions are necessary to reduce the otherwise undefined complex society to a manageable model. These are firstly that the system connects a number of particular types of traded exchanges of goods, services, access rights, legal documents, etc., and secondly that they pass between various pairs of discrete unique role-playing agents or entities. The many similar exchange activities are idealized aggregates within the paths of the system. It is found that only a limited number of kinds of these exchanges are needed, and that an even smaller number of the entities suffice to cover the whole system. Derived from the general nature of our society, there are but 10 necessarily different kinds of these exchanges and they are sub-divided and included in a table of 19 specific mutual flows of money, being exchanged for goods, services, etc. It is found that these flows need to pass between only 6 entities. From the resulting tabulated list, a block-and-flow diagram or model is drawn. Since the minimum number of activities were logically determined and incorporated using the least number of individual entities, it is concluded that this system is the simplest possible, yet still being a sufficiently complete model of our society, arranged in an absolutely ideal, logical and best scientific form, for further use.

## 1. INTRODUCTION—THE PROBLEM

It may seem impertinent to present yet another way for the modeling of our social system, but the past number and variety of strange claims that have been spread about it (and continue to be broadcast too), have caused so much confusion that we really need to finally get it right. The task of determining exactly of what our society consists and how it works is difficult, but far from impossible--after all, it is about us! However, describing it by words alone causes both its concept and expression to become too complicated in our minds' eyes and the resulting images tend to mutate over time. Then a suitable macroeconomics model is needed for its resolution into a practical formulation, suitable for subsequent analysis. Such a model is seen here to consist of a system (which has a number of elements that are interconnected). These two pre-conditions for understanding our society, the concept of it as a system and the ability for it to be modeled are absolutely essential with regard to what follows.

The motivation for this work comes from the author's difficulty in applying recent teaching texts to this theoretical subject. His attempts to properly envisage and structurally model our social system, using currently existing descriptive information have failed. Dissatisfaction in reaching this goal has prompted him to revise the past methods--to aim at an improved realization of this strangely ill-defined subject, to better appreciate its nature, to seek out and to obtain more scientific knowledge about it.

We need to represent in a nutshell, a nation of several million families, having very many different attitudes and policies, which perform a variety of self-centered activities--each providing for his and her specific economic needs and livelihoods. Previously this variegated macroeconomics situation was treated as a simplified yet scaled-up version of what you or I might do, had we to fulfill a more general role but one which still relates to our own performance and behavior. However, this approach does not allow for what many others do, nor does it properly account for how their separate activities influence each other. Since the individual only plays a very small part, we find ourselves subjectively confined in a very limited situation, which fails to properly picture how society at large acts and how it is arranged. Only by modeling the whole of society as a system does it become possible to take a sufficiently less personal and more objective viewpoint, being suitable for use in teaching and research, see Ref [1].

**EINSTEIN’S CRITERION\* APPLIED TO LOGICAL MACRO-ECONOMICS’ MODELING**

*\*See Page 2 and Ref 2*

**2. GENERAL DESCRIPTION OF PROGRESS TOWARD MODELING SYSTEM STRUCTURE**

2.1 Envisaging the System

Within what was once a natural environment, the operation of our society has gradually, subtly and suitably, evolved to at least partly satisfy human needs. Were our concept of it to continue to appear as a collection of diverse individuals about which no general aspect is unique, it would seem to be much too complex. Then we would be unable to understand how this motley mixture might work. We could only manage to make some general Platonic statements about it, but when we try to get at the facts, the subject would become vague. At best, we would need to examine each person in society, and look at the various contributions he/she makes with respect to many of the others. Fortunately, this complicated presentation can be sorted into a number of separate kinds of specific activities.

A rather obvious general assumption is that our society has different parts that interact along specific paths. This is in the form of a system. Without losing completeness, the introduction to it of some associated discrete elements is both possible and necessary for us to increase our knowledge of it. This assumption of it being a system is the first step enabling us to understand how our society works.

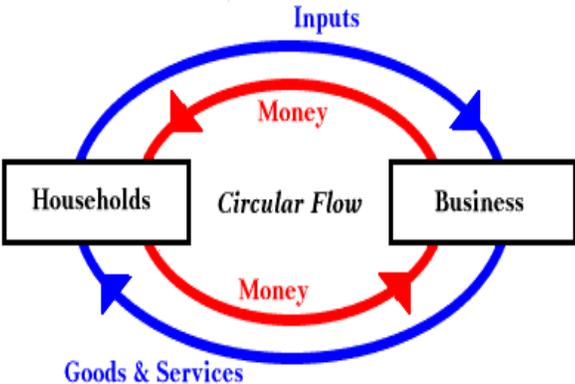
2.2 Envisaging the Model

However, such a system and its connections still are too difficult to retain unaltered in our memory. Some of them will change every time we mention another of its features! So we need to describe it in the form of a definite and particular diagram. The model for representing our social system here is derived essentially by using an organized, logical, process. It presents the arrangement of it in a most complete yet concise form, which meets Einstein’s criterion for a good scientific theory, that: “everything should be made as simple as possible, but no simpler” of Ref [2]. This approach begins from taking certain detailed existing ideas about our more-closely connected social relationships.

The engineering method of systems analysis is appropriate here. Our society is a man-made system, which has evolved, engineered and developed (however badly), so as to sustain us all. As a system, it works through a number of independent agencies (or entities), each having its own properties and connecting activities, to seamlessly represent our entire social system of national macroeconomics. Thus the complexity is replaced by a more astute and exact method of definition and thought. (This model previously enabled the author to better understand how our social system works, Ref [3].)

**3. THE DEVELOPMENT OF A PRACTICAL MODEL OF OUR SOCIAL SYSTEM**

3.1 The Traditional Two-Sector Model and its Implications



Firstly we consider the most simple kind of situation, as described in past elementary economics text-books where a “two-sector system” is presented, see the diagram. This picture was originally drawn and shown by Frank H. Knight in 1933, Ref [4], where he named it “The Wheel of Wealth”. It will be extended at a later stage of our analysis, to cover the whole system.

This model consists only of Households and Business sectors. The Business sector is producers who are farmers, transporters, industrialists, manufacturers,

## EINSTEIN'S CRITERION\* APPLIED TO LOGICAL MACRO-ECONOMICS' MODELING

\*See Page 2 and Ref 2

service-providers, etc. Workers from the Households sector are employed by the Business sector to provide laborious "Inputs" in the diagram--to grow, gather, refine, carry, assemble and otherwise make and supply all kinds of useful "Goods and Services"--whilst the Business sector manages the means and methods for these coordinated economic activities to take place.

Borrowing on the values that the new goods have just acquired, the Business sector (or producer) then remunerates the workers, paying wages for their efforts in making these output items. As soon as the goods are sold and paid for, this loan can be returned whilst starting another cycle of operation. In practice this is a continuous process, with the simultaneous participation of many firms.

The Households sector consists of a large number of families, who support and encourage their workforces and spend their earnings on a range of durable and consumable goods and services, with which to provision, provide for and maintain themselves and their homes. Individual workers may produce only a few kinds of goods (as output), but as Households they consume a greater variety, although each kind is used in much smaller quantities than what comes from their own specialized labor. Our prior knowledge of their combined efforts explains about how this simplified system interacts and works.

In this diagram, the circulation of the 2 money-flows (in red) is seen to oppose the flow of labor and of produce (in blue), so this model presents us with a general picture of the most basic kinds of economic functions. Here, all of the working activities are shown to produce all of the goods and services. Were it needed to show everybody's separate activity, the model would become very complex and impractical. However, with the assumption of aggregate activities, the total amounts of labor and produce are taken instead. Although each individual's contribution varies in quantity, quality, strength, etc., they are lumped together, as being of a particular or idealized kind. These two assumptions, of the aggregate quantity and of the idealized participation, allow us to greatly simplify the representation.

What is not usually mentioned about this model is that by describing the situation in this way, these agents or entities have ceased to be real people who are actively contributing to our society. They have been transformed into representations of the functions they perform. So when more entities are added (see below), their treatment (as role-players) applies to their functions, which perform idealized simplified aggregate activities. To emphasize this matter, the notation to be used for these entities below is set in CAPITAL LETTERS. Real people combine these roles and activities in mixed variable amounts, so the same words with lower-case letters still apply to this more general situation.

### 3.2 Trading Exchanges and Multi-Sector Extension, to Represent the Whole Society

We will expand on the 2-sector illustration, to include in its most simple yet complete form all of the major aggregated macroeconomics activities, to better represent our whole society or Big Picture of the national economy. Our society has a natural and familiar form, from which these activities are hereby classified, according to all of the different kinds of trading exchanges that occur between the entities. Due to use of the two assumptions of aggregate and idealized money/goods flows, it is seen that only a limited number of idealized entities are needed to further describe the complete system. The statements of these two vital assumptions set off our thinking process along somewhat different lines to those of the past. It is surprising to the author that prior to this approach nobody else seems to have taken it into consideration for all of our society at large, when viewed from this greater distance.

This discovery of a limited number of macroeconomics exchanges passing between what is found to be a comparatively small number of entities, logical as it now seems, has not been previously applied, although it is implied in wanting to broaden the two-sector model. (Indeed, one famous writer's work about the economy even claimed that some "withdrawals and injections" from the two-sector model are present, see Ref [5], but for him to envisage additional sectors proved to be just too much!)

# EINSTEIN'S CRITERION\* APPLIED TO LOGICAL MACRO-ECONOMICS' MODELING

\*See Page 2 and Ref 2

## 3.3 The 10 Kinds of Macroeconomics Transactions

We now examine all of the different kinds of macroeconomics trading exchanges that actually occur within our system. This allows us to include the assumption of the aggregated functional activities, which have discrete natures. They are initiated and propagate from the various idealized entities (which may also be also expressed as role-players, having the ability to control one or more of their incoming and outgoing macro-economic flows and their related functions).

All of the specific kinds of activities that occur in our social system are presented below. They fall into a comparatively small number of classes. Using algebraic notation, a bold-faced capital letter is used below, to indicate the flow of money for each category, along with brief descriptions of it. Suffices are added later, when the sub-divisions of these flows follow (in a table, below).

- a) 4 Kinds of Taxes (T), obligatory periodic sums, which are paid to the GOVERNMENT.
- b) 2 Kinds of Ground-Rents (R), are regularly conveyed to the LANDLORD, for the right of access to useful sites of land or other natural resources, such as the electro-magnetic wave spectrum (for purposes of communication, etc).
- c) 2 Kinds of Hire-Fees (H), are systematically remitted to the CAPITALIST for the right of access and use of certain durable (production) capital buildings, machinery, vehicles, goods, etc., to cover their investment cost, maintenance expenses and obsolescence. This includes that of home occupation, so a real home-owner is functioning as both a HOUSEHOLDER and as a CAPITALIST.
- d) A Money Transfer (HI), normally passes as a social "understanding". Such social understandings exist for example, between workers and consumers within a family, but are not shown here. However, in the case of the transfer between the LANDLORD and the CAPITALIST, which have other very different macro-economic properties (see below), this transfer activity is separately included. (In certain earlier methods of teaching economic theory, it was wrongly claimed that they are the same, as in Ref [6], but hopefully this past confusion is now ended.)
- e) Wages (W), earnings which are continuously remunerated to the workers within the HOUSEHOLDER, for their labor.
- f) 3 Kinds of Purchases (C), are particular and frequent payments when trading between the HOUSEHOLDER, the CAPITALIST and the GOVERNMENT.
- g) 2 Capital Outlays (I) and (M), as discrete money investments. They are in shares of limited-liability companies, in mortgages, and in national bonds from the Treasury, respectively. The non-redeemable shares subsequently may be sold as second-hand items, whilst the sums covering the mortgages and bonds (and sometimes certain shares too) are returned to their sources, after specified time intervals.
- h) Savings (S), are contractual time-limited returnable loans, borrowed by the FINANCE INSTITUTION.
- i) 3 Kinds of Returning Interest  $r_i\Sigma(I)$ ,  $r\Sigma(M)$ ,  $r_s\Sigma(S)$ , at different rates, are based on the specific kinds of investments, in company shares (I) , bonds (M) and savings (S) respectively. In the case of company shares, the interest is usually called dividends, although in practice it is the same thing.
- j) Landed Prospect Sales and Acquisitions (Lsp), is an activity between different pairs of landlords, when land ownership changes hands (with help from the banks). The buyer's money is supplied to the

## EINSTEIN'S CRITERION\* APPLIED TO LOGICAL MACRO-ECONOMICS' MODELING

\*See Page 2 and Ref 2

buyer as a loan from a bank. After the sale and purchase, the sum is almost immediately returned by the seller to the same or another bank as a loan. Thus, on aggregate the banks are temporary lenders. The new landlords are often in debt, but they collect the ground-rent and speculate in the rising value of their prospects. Land is not regarded here as being an item of durable capital goods, not having been produced by using labor. Consequently its transaction requires a separate classification.

Activities that are contained within an entity, such as the exchange of partly made goods (as working-capital within the PRODUCER entity), do not constitute a significant macro-economic function here. The scale of the model does not allow for this. This concept also applies to the last item j) above, where landlords buy and sell their sites between themselves, (with temporary bridging loans from the FINANCE INSTITUTION), with only the title deeds passing between the owners. So on aggregate, in terms of trade, here there is no action that involves pairs of entities, it being solely contained in the LANDLORD. For this model the buildings are taken durable capital and do not fall into this category.

Throughout our social system, these various exchanges are continuous so that whilst certain loans are being returned others are being advanced elsewhere. Increases and reductions in the total money in the system can occur, with it accumulating in small amounts for use in purchases, it being newly issued by the GOVERNMENT, or even being destroyed by them. What actually is being categorized here is a rate-of-flow of money and a corresponding return-rate of the values of the goods, services, access rights, valuable documents, etc., along regular paths. To properly explain all of these various types of macro-economic activities or functions, no other kinds of flows need to be listed.

### 3.4 The 6 Entities

Having covered all the trade-exchanges, the entities are identified as the pairs of role-players, between which the money-flows, goods, etc., are steadily passing. These functional entities are written here in capital letters, and each first (bold-face) letter being used to identify it in the 3rd and 4th columns of the table to follow, where they directly relate to the various kinds of macro-economic activities. The six entities are:

**LANDLORD, HOUSEHOLDER, CAPITALIST, PRODUCER, GOVERNMENT and FINANCE-  
INSTITUTION.**

Each entity plays at least one unique, idealized and characteristic action, which has both in-flowing and out-flowing quantities. They are all needed to properly describe their role-playing functions and to cover all of the various exchange activities.

The above explanation about the form of these macro-economic exchanges of money and goods etc., runs parallel to the derivation of the entities themselves. This is a kind of chicken-and-egg situation, because the entities seem to arise naturally and simultaneously with the more exact determination of the numerous social goods and money-transfer activities.

The "Business sector" of the previous diagram is now called the PRODUCER entity. What first seemed to be an impossibly complex set of transactions is reduced to these 10 categories: a) to j) above. In the following table, some rearrangement and sub-division of them is introduced, resulting in 20 kinds of exchange, as listed on their particular rows. The money flows on the left correspond and oppose the right-hand column flows of the various utilities of goods, private and public services, access rights, infrastructures and loans.

# EINSTEIN'S CRITERION\* APPLIED TO LOGICAL MACRO-ECONOMICS' MODELING

\*See Page 2 and Ref 2

## 3.5 The Tabulated Various Flows, and the Diagram as a Model of our Social System

The naming of the various flows and their relationship with their pairs of entities are shown below:

| SUMMARY OF THE SUB-DIVIDED 20 KINDS OF MONEY-FLOW RATES AND UTILITIES |                                  |          |  |  |
|---|----------------------------------|----------|--|--|
| DESCRIPTION OF MONEY-FLOW RATE AND ITS ALGEBRAIC SYMBOL               | ENTITIES FROM/TO                 |          | RECIPROCAL FLOW- RATE OF WEALTH OR UTILITY |  |
| 1.a) Tax on Personal Income   | <b>Th*</b>                       | <b>H</b> | <b>G</b>                                   | Social and National Security                             |
| 2.a) Tax on Land-Value (Revenue)                                      | <b>Tl*</b>                       | <b>L</b> | <b>G</b>                                   | Improvements to Surroundings                             |
| 3.a) Tax on Purchases (V.A.T.)  | <b>tp*</b>                       | <b>P</b> | <b>G</b>                                   | Industrial/Rural Services                                |
| 4.a) Tax on Property (Durable Goods)                                  | <b>tc*</b>                       | <b>C</b> | <b>G</b>                                   | Social and Urban Services                                |
| 5.b) Ground-Rent (on Residential Land)                                | <b>Rh<math>\phi</math></b>       | <b>H</b> | <b>L</b>                                   | Access to Land for Living on                             |
| 6.b) Ground-Rent (on Productive Land)                                 | <b>Rp<math>\phi</math></b>       | <b>P</b> | <b>L</b>                                   | Access to Land for Working on                            |
| 7.c) Yield, within the Productive Process                             | <b>Hp<math>\phi</math></b>       | <b>P</b> | <b>C</b>                                   | Use of Durable Capital Goods                             |
| 8.c) Hire-Fees (Domestic)   | <b>Hh<math>\phi</math></b>       | <b>H</b> | <b>C</b>                                   | Use of Residences and "Non-Productive" Durable Goods     |
| 9.d) Organized Money-Transfer   | <b>HI*</b>                       | <b>L</b> | <b>C</b>                                   | "Understanding" Between <b>C</b> & <b>L</b>              |
| 10.e) Wages (Gross Earnings)  | <b>Wp</b>                        | <b>P</b> | <b>H</b>                                   | For Labor (Service)                                      |
| 11.f) Purchases (Consumption)   | <b>Ch</b>                        | <b>H</b> | <b>P</b>                                   | For Consumer Goods/Services                              |
| 12.f) Capital Outlay (True investments)                               | <b>Cc</b>                        | <b>C</b> | <b>P</b>                                   | For Durable Capital Goods                                |
| 13.f) National Appropriations   | <b>Cg</b>                        | <b>G</b> | <b>P</b>                                   | For Supply of Public Services, Goods and for Emergencies |
| 14.g) Investments and Mortgages Loans                                 | <b>I</b>                         | <b>F</b> | <b>C</b>                                   | Shares and Contracts (Credits)                           |
| 15.g) Bank Loans for Re-Circulation                                   | <b>M</b>                         | <b>F</b> | <b>G</b>                                   | National Bonds (Credits)                                 |
| 16.h) Savings (and Outgoing Loans)                                    | <b>S</b>                         | <b>H</b> | <b>F</b>                                   | Bank Certificates (Credits)                              |
| 17.i) Dividend/Interest on Investments                                | <b>ri <math>\Sigma(I)</math></b> | <b>C</b> | <b>F</b>                                   | For the Use of Total Credit $\Sigma(I)$                  |
| 18.i) Interest in National Bonds                                      | <b>r <math>\Sigma(M)</math></b>  | <b>G</b> | <b>F</b>                                   | For the Use of Total Credit $\Sigma(M)$                  |
| 19.i) Interest on Savings   | <b>rs <math>\Sigma(S)</math></b> | <b>F</b> | <b>H</b>                                   | For the Use of Total Credit $\Sigma(S)$                  |
| 20.j) Land Sale and Purchase  | <b>Lsp</b>                       | <b>L</b> | <b>L</b>                                   | Within the same entity, not used                         |

\* Non-contractual, socially obligatory money-flow.

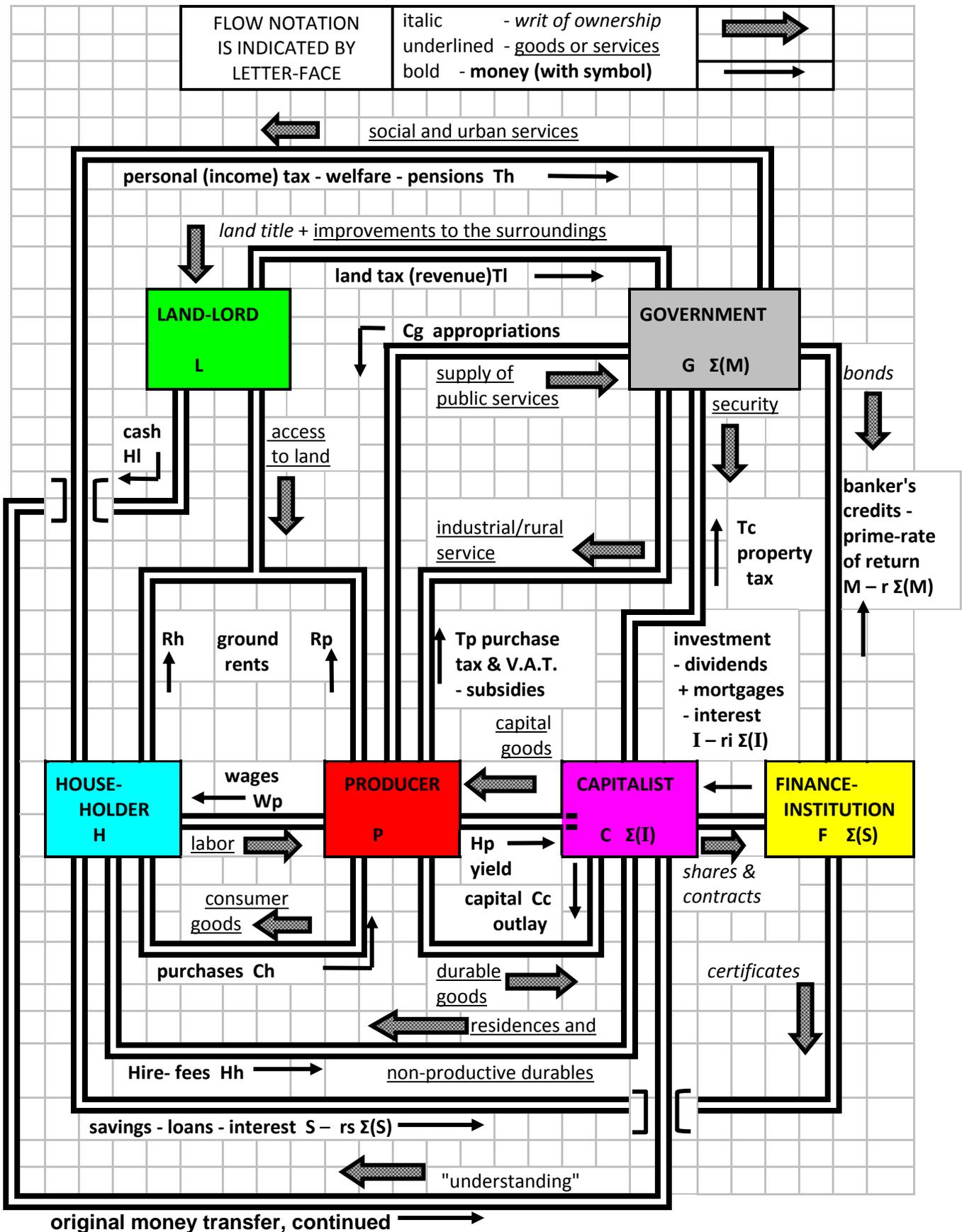
$\phi$  As a return, for access rights to a site, or for hire and use of durable capital goods. In this latter case it covers their investment cost and interest, wear, maintenance, replacement due to obsolescence, etc.

The small letters a) through to j), after each numbered line, correspond to the list of macroeconomics transactions in paragraph 3.3.

From this data one can draw the complete diagram or model of our macroeconomics social system, which is shown on the next page. In the diagram, the money flows are indicated by algebraic symbols and the thin black arrows. The goods, services, valuable legal document, money being saved/loaned, access right to natural resources or to the durable capital goods, etc., are indicated by the words and fat filled-in arrows. This diagram represents the structure of and completely models our macroeconomics or social system. This model is a unique way for the presentation of the whole of our social system, intended for teaching and for research into the exact scientific applications and use.

# EINSTEIN'S CRITERION\* APPLIED TO LOGICAL MACRO-ECONOMICS' MODELING

\*See Page 2 and Ref 2



# EINSTEIN'S CRITERION\* APPLIED TO LOGICAL MACRO-ECONOMICS' MODELING

\*See Page 2 and Ref 2

## 4. CONCLUSIONS

4.1 This study provides an easily understood yet fully comprehensive seamless working-model, expressed as a diagram, for describing our social system. In this derivation, the smallest number and simplest, least kinds of features and details have been properly and formally assembled. This presentation accords with Einstein's criterion for a good scientific explanation or theory, Ref. 2. Consequently this model contains vital information of the minimum kind, suitable for mathematical analysis and theoretical scientific research.

4.2 In the past, similar assumptions have been made, often with only part of the system being considered and without any formal explanation about what is implied. It is hoped that by writing about them in the manner presented here, the reader can see not only where the past work misled many students, but can also appreciate the way that a more sensible and logical approach must inevitably take us. These few assumptions are impossible to avoid, if we wish to make sense out of the whole complicated array of our society. Often, previously they are unstated, which makes the older representation harder to comprehend.

4.3 Once this attitude is taken and the assumptions formally stated, the rest follows, as if we are logically being directed along it. In this approach, having decided to try to understand the whole thing, we are led into taking certain inevitable steps and proceeding in a specific manner. These activities mean that we find the money passing in one direction, on a reciprocal path and in exchange for physical consumer-goods, durable capital goods, private and public services, valuable legal documents, sums of money being saved or loaned, access rights to natural resources or to durable capital goods, etc.

4.4 This idealized solution, makes macroeconomics a true theoretical science, as compared to earlier methods and their resulting specifically chosen but more detailed models. Having first prepared the basis and later the new model, our results better explain both the nature and working of our existing social system as a whole. It greatly improves upon the past ways of describing it--about of what it consists, which previously and regrettably was a pseudo science. Although the past explanations of theoretical macroeconomics have been much criticized for their failure to be sufficiently systematic and precise (and to attain an exact-science status), this achievement was not reached until now.

## 5. REFERENCES

1. Chester, David H. *A Mechanical Model for Teaching Macroeconomics*.  
SSRN 2600103, 2015.
2. Einstein, Albert. *On the Method of Theoretical Physics*. Paraphrased from his Herbert Spencer Lecture, Oxford (10 June 1933),  
*Philosophy of Science*, Vol. 1, No. 2 pp. 163-169, April 1934.
3. Chester, David H. *Consequential Macroeconomics—Rationalizing About How Our Social System Works*. Lambert Academic Publishing, Saarbüchen, Germany, 2015.
4. Knight, Frank H. *The Economic Organization*. University of Chicago, 1933.
5. Lipsey, Richard G. *An Introduction to Positive Economics*. 4<sup>th</sup> Edition,  
Weidenfeld and Nicolson, London, (1963) 1975.
6. Fetter, Frank A. *Capital, Interest, and Rent*. Murray N. Rothbard, Ed.  
Kansas City: Sheed, Andrews, and McMeel, Inc. 1977.