Micro Takes over Macro

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Abstract: An analytical innovation enhances microeconomics, enabling it to answer **all** questions of macroeconomics. It combines the production and consumption decisions of the individual in one model. For each individual, it identifies the customers of what he sells, and the suppliers of what he buys. It specifies the exchange relations between the suppliers and the customers. These relations deal with value (quantities and prices), payment (subsistence, barter, money, and bond) and intermediation (entrepreneurship, transaction costs, institutions), all of them integrated. It is easier done than said with the input-output table. There is no further need for a separate macroeconomics.

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1. Introduction

Microeconomics can be easily enhanced, enabling it to answer all macroeconomic questions. This makes economic analysis both simpler and more powerful. The main benefit is that we can now leave behind the disputes that plagued macroeconomics. We can now handle macro issues with greater confidence, and with little reason for dispute.

There is virtually no dispute in microeconomics, because it uses analytical tools that produce compelling arguments and theorems. The disputes in macroeconomics arise mainly from the lack of accepted analytical tools. Luckily, we can now use a new analytical tool to produce compelling theorems on macro issues.

Prevailing microeconomics deals with an isolated individual's consumption decisions separately from the production decisions. Why not specify the individual's source of income by listing the customers individually and showing how much each buys from the individual? We of course list the suppliers from whom our individual buys, ordinarily by denoting the kinds and quantities of different purchases. The familiar input-output table offers a simple format for this. But then we can take the next step, and list the sales and purchases of all individuals.

The gain from the input-output table is that we can readily use it in ways it was not used before. Now, we can specify the exchange relations between the buyers and sellers and see how those relations affect the kinds and quantities of output, both at the individual and at the aggregate level at once.

As we analyze the exchange relations, we see that the buyer cannot represent the seller, and the intermediary cannot represent either the producer or the consumer. The concept of representative individual does not work. The most crucial insight is that there are four different means of payment, each affecting output in a different way. We also find that the actions of the intermediary affect the equilibrium. In the end, we can discuss all macro issues if we discover how the many individuals jointly determine the aggregate outcomes which cannot be represented by any one individual.

Section 2 enhances microeconomics by putting the individual in relation to his suppliers and customers. Section 3 applies input–output table to market relations. Section 4 shows how macro issues are handled. Section 5 presents five theorems. There is a short comment at the end.

2. Enhancing Microeconomics

Prevailing microeconomics suffers from a self-imposed limitation. It looks at an isolated individual, and does not specify how she is related to other market agents. For example, in the theory of consumer behavior, the isolated consumer is supposed to have a lump of income in the budget. There are surely some customers to whom the individual sells the output to earn the income in the first place, but they are not shown in the analysis.

It is not hard to list the supplies underlying the individual's income. Then the consumer's budget constraint becomes the individual's demand-supply equation. It paves the way to reach the aggregate demand-supply equation.

The input-output table is already familiar (See Leontief 1986). In it, we use a row to show the supplies of the individual producer, and use a column to show the demands of the same individual. But then there is no good reason to look at the supplies and demands of one individual only. We can simply look at the demands and supplies of all individuals at once.

The fun is that we can use the input-output table to explore the exchange relations between individuals in very simple and new ways. Before long, we discover that the table is a unified model of the economy, answering micro and macro questions with shocking simplicity. The key trick is to recognize that there are some very definite exchange relations between the buyers and sellers (often involving intermediaries in their midst). We specify three such relations, each affecting the kinds and quantities of output in a different way.

It is very easy to formalize the relations. In the first step, let us formalize exchange itself. Let us begin with barter. Let x denote the traded output, and let a first subscript denote its seller, while a second subscript denotes its buyer. Let us adopt the convention that each different kind of good is sold by a different seller, so that the first subscript also denotes the kind of the good. Then let the vector [$\mathbf{x} = (x_{jk}, x_{kj})$] be called an exchange. Here, agent j sells x_{jk} to agent k, who pays back with x_{kj}. The two outputs are payments for each other.

Suppose that there are *n* different kinds of goods in the economy, and hence *n* different individual sellers. Suppose that we look at agent k. Let the sales to his customers be identified by the vector [$x_{k1}, x_{k2}, x_{k3},\ldots x_{kn}$]. Let us also list the purchases from his suppliers by ($x_{1k}, x_{2k}, x_{3k},\ldots x_{nk}$).

We can easily study the value relation between agent k and every other individual. Each of his customers must give him a payment of exactly the same value of the sale to that particular customer. Likewise, each one of his suppliers must be given a payment of the exact value of his purchase. Denoting the value of x_{jk} by $v_{jk}=p_j x_{jk}$ (where p_j is price of x_{jk}) we must have [$v_{1k} = v_{k1}, v_{2k} = v_{k2}, v_{3k} = v_{k3,}\ldots, v_{nk} = v_{kn}$]. We can learn much by studying the budget balance equation [$\Sigma_j v_{jk} = \Sigma_j v_{kj}$].

But it would be silly to pass up the opportunity to show the sales and purchases of every individual. Indeed, we must consider all individuals, because the proverbial saying 'everything depends on everything else' is true here. What an individual can do is dependent on what another individual does.

When we put all individuals together with their sales and purchases, we get the familiar input output table. Let us describe the entire economy with this table. Hence let us have the exchange matrix **X**

$x_{11}, x_{12}, x_{13}, \quad \ldots \quad x_{1n}.$
$x_{21}, x_{22}, x_{23}, \quad \ldots \quad x_{2n}.$
$x_{31}, x_{32}, x_{33}, \quad \ldots \quad x_{3n}.$
$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$
$x_{n1}, x_{n2}, x_{n3}, \quad \ldots \quad x_{nn}.$

Let us now specify the three kinds of market relations. They involve value, payment, and intermediation.

Value Relation over the Quantities of Output:
The first relation is based on quantities of the output that pay for each other. How much must x_{jk} be in order to be exchanged against x_{kj}? What is the relation between these quantities? We say that the two goods that pay for each other must be of equal value. This is the value relation. It is expressed as an equation and serves as an equilibrium condition. The familiar budget equation is a more complex form of this relation. The budget equation says that the total value of all purchases (including savings as a purchase of bonds) must be equal to the total income (which is the sum of the values of all sales plus any borrowing.) But we need to begin earlier, with the statement that in each transaction, the buyer must pay the seller with a payment of exactly the same value as the good.

The value of an output is defined by multiplying the quantity by the price. Thus suppose that (p_j, p_k) are the prices of the goods while the quantities are (x_{jk}, x_{kj}). Let the values be [$v_{jk}= p_j x_{jk}$] and [$v_{kj}= p_k x_{kj}$]. Then the value relation is specified as the equilibrium condition $v_{jk}=v_{kj}$.

Payment Relation over the Kinds of Output:
The second exchange relation is based on the kinds of the traded outputs. The question is: what kind of output must x_{jk} be in order to be traded against x_{kj}? We are looking for a payment relation to determine how one kind of good may or may not become the payment for another kind of good. This payment relation exists between the kinds of goods that are payments for each other.

Before we begin to look for answer, let us remember that we must figure out how to explain entrepreneurial actions to create net pure profit. The exchange must be gainful. We take it as an axiom, and call it Menger Dictum in honor of Carl Menger (Menger 1871/1976). The exchange must be gainful in the sense that the seller of something must get a higher level of utility from what he gets in payment than from what he sells. Thus consider agent j. He sells x_{jk} and buys x_{kj}. To make this exchange gainful, his utility from x_{kj} must be higher than his utility from x_{jk}. Formally, let $U^j(x_{jk})$ be the utility of x_{jk} to agent j, and let $U^j(x_{kj})$ be the utility of good x_{kj} to J. Then we need [$U^j(x_{kj}) > U^j(x_{jk})$.] Similarly for agent k, we must have [$U^k(x_{kj}) < U^k(x_{jk})$]. The direction of preference must be of opposite order over the same pair of goods. It may come as a shock at the first reading that this inconsistency of preference orders is indeed a necessary condition for exchange. This condition is double coincidence, and it must be met in any exchange, whether money is used or not.

The problem of conflict resolution now takes a specific form. The same exchange must satisfy both the value relation and the payment relation. Thus all three of the following must be true at once.

Value relation for both j and k:	$v_{jk}=v_{kj}$.
Payment relation for j:	$[U^j (x_{kj}) > U^j (x_{jk})]$
Payment relation for k:	$[U^k (x_{kj}) < U^k (x_{jk})]$

At first glance, one may feel that there is no way to resolve this odd situation. But we get lucky here. We turn the input-output table inside out to show that all these conditions hold at once, as in the next section. The key to see that the kind is not the same as the quantity. Two things may be of equal value, but they can be of unequal utility. Indeed, they must be of unequal utility to satisfy Menger Dictum.

Since individuals are independent, there is no problem if the different individuals have different preferences over the same set of goods. The only requirement is that they must find an opportunity to achieve net gains by an act of exchange. The difference in preference offers an opportunity for gainful trade. The market's drama begins as one man's junk is another man's gem. Thus j happens to own x_{jk}, but he prefers x_{kj} to x_{jk}, while the owner of x_{kj} thinks that x_{kj} is of lower utility to him than x_{jk}.

Even if we did not talk about utility, we could readily see that a producer who specializes in the production of one good produces it at a lower cost than something of equal market value that he does not produce. This is a very old idea, but sadly, Pareto did something to make us forgetful of this, and indeed led us to believe the opposite.

Perhaps the hardest problem for readers familiar with prevailing microeconomics is to recognize that Pareto Optimality is a mistake based on a major misconception of exchange as allocation. An exchange occurs between two different people, but an allocation occurs to only one individual. If an agent buys both x_{kj} and x_{jk}, then the marginal utilities of both goods must be necessarily equal if their values are equal. The same thing means that the ratio of marginal utilities of two things must be the same as the ratio of their prices. But this holds if and only if one individual buys both goods. It does not hold when one good is bought and the other good is sold. The very essence of exchange is that the good sold has lower utility then the good bought with it, but they are of course necessarily of equal market value, because they pay for each other.

There are more serious objections to Pareto Optimality. Goods belonging to one person go to another person in the market through an exchange. There is therefore no legitimate issue in economics about distribution apart from exchange. There is a legitimate problem of distribution in politics, where the taxpayer is compelled to pay tax without compensation, and somebody else gets a subsidy out of it without paying for it. The tax-subsidy issue is decidedly not an exchange problem in politics. There is a politically determined distribution as one way transfer. Economic analysis is not applicable to one-way transfers.

Arrow's impossibility theorem is a generalization of Pareto Optimality and is more generally mistaken. We show in the next section that indirect exchange can occur if and only if the preference orders over a set of three or more goods are (linearly) inconsistent. Exactly the same preferences that led Arrow to suppose that it is impossible to formulate a social welfare function give rise to indirect trade to maximize utility. Indirect exchange allows each agent to get the most preferred good, thought that very same good is the least preferred by somebody else. Indirect exchange helps the agent to get rid of the good he likes less, in exchange for what he likes most.

Intermediation Relations over Prices and Payments:

The third market relation is an intermediation relation. An intermediary is one who is neither a producer nor a consumer; and yet who buys and sells the output, and arranges payments for them. The theoretical problem is that this intermediary performs a function that is present even in case of simple barter. Conceptually, in barter, at least one of the two agents must act as an intermediary to settle both the prices and the means of payments, namely, finalize an agreement. Thus suppose that the producer as an optimizer produces a certain output, and has chosen a supply price equal to marginal cost. But the same biological individual can now become a different economic individual. As an entrepreneur, this individual buys from himself the goods at a price equal to marginal cost, and then strives to sell it at a higher price. Arranging the means of payment is more complicated, but we will soon talk about it.

Intermediation is explicit in indirect trade, in which an individual's customers are different from his suppliers. Some intermediary must be present to make it possible for one's customers to indirectly compensate one's suppliers.

The intermediation process defines the institutional context of exchange. It answers questions like how can strangers ever find each other. Why would they pay instead of plundering each other? How do they legitimize the exchanges? How do they organize them? What happens if a buyer refuses to pay, or a seller refuses to sell to some individual? Formalizing these is extremely tricky. We need to consider the notion of transaction cost, which is above and beyond the production cost. Transaction cost is incurred when trying to bring together the buyers and sellers to organize a transaction. We recognize that the sole reason the intermediaries are allowed to exist is that they cut down transaction costs which is beyond the control of both the producer and the consumer.

3. Analyzing Market Relations with the Input output Table

To use the input-output matrix to analyze the market relations, we will do something that has never been done before. We apply the value and payment relations to explore the symmetry property of the matrix. In a matrix, symmetry exists if the element in row j and column k is the same as the element in the row k and column j.

Convert all quantities into their corresponding values, namely, replace the x_{jk} by v_{jk}. Then the value relation is stated as $v_{jk}=v_{kj}$ for all (j, k). For microeconomics, we can analyze this relation to study both the quantities and the prices. But let us focus here on how to study macro issues. We will see that the value relation requires the matrix to be symmetric. However, the payment relation permits an artificial device to serve as payment of the required value so that the lack of symmetry in real output is repaired by the presence of artificial payment.

First, let us take $v_{jk}=v_{kj}$ as exchange equation (2), and simply add it on both sides over all j=1,2,3,..,n to get equation (3) as $[\Sigma_j v_{jk} =\Sigma_j v_{kj}]$ for each agent k. Next, let us add both sides over all k agents to get equation (4) as $[\Sigma_k\Sigma_j v_{jk} =\Sigma_k\Sigma_j v_{kj}]$. This last one is clearly the starting point for prevailing macroeconomics: the equality of aggregate demand $\Sigma_k\Sigma_j v_{kj}$ with aggregate supply $\Sigma_k\Sigma_j v_{jk}$. But the fun lies elsewhere.

For fun, let us impose the restriction that k=j, that is, the buyer must be the same individual as the seller. It is clearly a case of subsistence. It is described by equation (1) as $v_{jj}=v_{jj.}$ Let us put all four equations together for ease of comparisons.

Equation (1)	$v_{jj}=v_{jj}$	Equation of Subsistence
Equation (2)	$v_{jk}=v_{kj}$	Equation of Barter
Equation (3)	$\Sigma_j v_{jk} =\Sigma_j v_{kj}$	Equation of Money
Equation (4)	$\Sigma_k\Sigma_j v_{jk} =\Sigma_k\Sigma_j v_{kj}$	Equation of Bond

One may notice that if equation (2) holds, then (3) and (4) will also hold as identities. The fun is that equation (3) holds by violating equation (2), and equation (4) holds by violating equation (3). And of course equation (2) holds by violating equation (1). These are true equations; they are not derived from equation (2).

First, equation (1) describes the natural economy of subsistence in which a consumer must himself produce what he wants to consume. Production includes gathering and hunting. It is especially important to see hunting as a natural phenomenon. Strong predators (and cannibals) simply kill and eat the weak prey, and never pay. There is no payment in nature. We must note that transfers within a family do not constitute exchange, and one-way transfers are not payments. In nature, people do not produce anything to give them willingly to strangers for free, nor do they get anything for free from willing strangers. The only natural option of getting something belonging to a stranger is to hunt or plunder.

Humanity struggled long and hard to abolish the natural law of plunder (of the weak by the strong). They fought to establish the institutional right of payment. Human society set up rules to compel the buyer to pay the seller. Hence the transition from equation (1) to equation (2) is possible only with the creation of institutions that impose the value relation: the stranger as buyer must pay the seller with something whose value is equal to that of what is bought. Sadly, plunder still goes on.

Equation (2) holds if there is barter. Barter requires double coincidence in kind. What happens if there is no double coincidence in kind? If and only if a condition called multiple coincidence exists, intermediaries can create an artificial double coincidence by introducing money. Let us explain this with an example of three-way trade.

Suppose that Knut Wicksell is studying the trade pattern among Sweden, Norway, and Denmark. We do not want to look at matters of value here. So we will let another chapter explain how it happened that prices and quantities were chosen such that each country had precisely 1 (billion kroner) worth of goods to export, and exactly the same amount to import.

We want to focus only on matters of payment. Here is the problem. Sweden has 1 billion kroner worth of Swedish goods x_s, and Norway wants to import the same. Norway of course had 1 billion kroner worth of Norwegian goods x_n, but Sweden does not like those goods. Instead, Sweden prefers the Danish goods x_d worth exactly 1 billion kroner. First, we must satisfy ourselves that if there is any exchange, then the goods that pay for each other must be of equal value. But why would anybody bother to sell what he already has just to get something else of the same value after all the hassle of trade? The axiomatic answer is that despite the equality of value, it must be the case that the agent prefers what he gets to what he gives up for it. Thus Sweden prefers x_d to x_s. But Sweden also prefers its own good x_s to the Norwegian good x_n.

Now, there is no double coincidence between either (x_s, x_n) or (x_s, x_d). Sweden wants to sell and Norway wants to buy x_s, but Norway wants to sell and Sweden DOES NOT want to buy x_n. No barter between Sweden and Norway is possible. Next, Denmark

wants to sell and Sweden wants to buy x_d; but Sweden wants to sell x_s, Denmark DOES NOT want to buy x_s. No barter is possible between Sweden and Denmark either.

The lack of double coincidence cannot be overcome by anything, because it means that between the two agents, there is one good that has no demand, and another good that has no supply. Thus between Sweden and Norway, there is no demand for Norway's good x_n, and no supply of what Sweden wants to buy (Denmark's good x_d). Between Sweden and Denmark, there is no supply of Norway's good x_n which Denmark demands, and no demand for Sweden's good x_s which Sweden supplies.

A real solution is possible if a third country joins the two and at once brings the missing supply and the missing demand. Thus if Norway joins Sweden and Denmark, then Norway demands what Sweden supplies (but Denmark does not demand), and Norway supplies what Denmark demands (but Sweden does not supply). With three countries here, every good has both demand and supply. This condition is called multiple coincidence. It is possible to create an artificial double coincidence, only if this multiple coincidence exists.

Imagine that on the advice of Wicksell, Sweden undertook to do the oddest job. Sweden does not like the Norwegian good x_n, because that good gives lower utility than what Sweden already has. Yet Sweden buys the Norwegian goods. This demand is artificial, because it is done without an intention to consume. Next, Sweden is not the producer of Norwegian good, and yet Sweden creates an artificial supply, by selling what it did not produce. The effect is that the Norwegian good is used as commodity money.

Notice for microeconomics that Sweden has acted entrepreneurially. It took a risk of getting something of lower utility from Norway, in the hope of getting something of higher utility from Denmark. More importantly, by demanding something without an intention to consume, the entrepreneur has destroyed the link between marginal utility of consumption and the price. Since Sweden does not consume x_n, it might as well be of zero utility to Sweden. Again, by supplying something without producing, the same entrepreneur has destroyed the link between the marginal cost of production and the price. Since Sweden does not produce x_n, it might as well be of zero marginal cost. It is just one more step to see that the transaction cost of using commodity money is higher than the same for using fiat money. If fiat is available to do the same cost, Sweden will take the fiat instead of x_n and pay with the fiat instead of x_n.

Indeed, Wicksell may create money even without using any paper at all. He could advise the three countries to accept a transfer of claims on real output. Thus Sweden sells its good to Norway and has a claim on Norway, which can be transferred to Denmark. In that case, Denmark meets the obligation of Norway to compensate Sweden on behalf of Norway. But then Norway also meets the obligation to Sweden by delivering Norway's own good to Denmark on behalf of Sweden. Money is the tool to achieve this transfer. It can appear if and only if there is a senior, a trusted payment-maker who ensures that each seller receives a payment in real goods. Anybody who can manage transfers of claims and obligations on real output can issue fiat money.

Notice that the preferences over the three goods are exactly those that led to Arrow's Impossibility Theorem. We have $[U^s(x_d)<U^s(x_s)<U^s(x_n)]$, $[U^n(x_d)<U^n(x_n)<U^n(x_s)]$, and $[U^d(x_s)<U^d(x_d)<U^d(x_n)]$, respectively showing the preferences of Sweden, Norway, and Denmark. It is impossible to generate a coalition with a common preference order for any two or three agents. But indirect trade occurs here, and gives the most preferred good

to each country to maximize social welfare. Arrow is mistaken about this. For details on how to study consistency of choice, please see Gani 2003.

Let us go back to the exchange equation (3). It holds by violating equation (2). How can an individual balance the total personal budget, selling precisely as much as buying, and yet violate the barter condition? Quite simply, by selling the real good to some customer and taking nothing real from that customer, and then buying some real good from someone else, without selling any real good back to that supplier. In terms of real products, the individual can incur a deficit with some suppliers, and surplus with some customers. To balance the budget, the sum of deficits must be equal to the sum of surpluses. Thus Sweden can incur a deficit with Denmark by buying Danish goods without giving any Swedish goods in exchange, and then accumulate a surplus with Norway by selling real goods to Norway without getting back any real goods from Norway. This can work if and only if there is money to transfer the surpluses to the deficits, namely, to arrange a transfer such that Norway delivers real goods to Denmark on behalf of Sweden.

Knut Wicksell (1902/1935) considered a three-way trade among the countries mentioned above. In his honor, we can construct the Wicksell Matrix which resolves the most baffling issue in macroeconomics. Let the value of output be normalized to unity. This is a necessary condition that values of the goods exchanged must be equal. The following matrix shows the trades among three countries:

	Sweden	Norway	Denmark
Sweden	0	1	0
Norway	0	0	1
Denmark	1	0	0

Here, each country's total sales is equal to its total purchases, satisfying Equation (3). Yet for each transaction, the condition $v_{jk}=v_{kj}$ or equation (2) is violated. This is possible if and only if money is used. The transpose of the Wicksell Matrix shows where the money must be. Let us call it the Keynes Matrix. It is given by

	Sweden	Norway	Denmark
Sweden	0	0	1
Norway	1	0	0
Denmark	0	1	0

The Wicksell Matrix says that Sweden sells 1 unit worth of real goods to Norway, but Norway sells no real goods to Sweden. Again, Norway sells 1 unit worth of real goods to Denmark, but Denmark sells no real goods to Norway. Lastly, Denmark sells 1 unit worth of real goods to Sweden, but Sweden sells nothing real to Denmark.

In that case, how is payment made? That comes in the Keynes Matrix. Sweden gives 1 unit of money to Denmark, who in turn sells one unit of money to Norway, who in turn sells 1 unit of money to Sweden. Suppose Norway has the money in the first place. Then Sweden gives real goods to Norway and gets money; then Sweden gives the money to Denmark and gets the real goods; and lastly, Denmark gives the money to Norway for the real goods. At the end, the money comes back to where it was. The job of money is to transfer claims on output (which necessarily implies transfer of obligations on output). And that is that.

The Wicksell Matrix settles, with no further room for doubt, that money as a means of payment cannot be neutral with respect to output and employment. Goods traded under indirect trade cannot be traded without money, and that settles it.

Let us now consider equation (4), which requires that all individuals together in the economy must balance aggregate demand for real goods to the aggregate supply. This of course is the starting point for conventional macroeconomics. But it is the fourth equation in our treatment. Most interestingly, we reach equation (4) by violating equation (3). How can all individuals collectively balance their aggregate sales and aggregate purchases if they are allowed to violate the personal budget balance? We must introduce bonds as means of payment to permit this. The individual who earns a revenue larger than he spends on purchases must lend the surplus to purchase a bond. Any individual who incurs a deficit by buying more than he sells must sell a bond to borrow funds from the others who have surplus to spare. The requirement is that the total value of deficits (debts) must be equal to the total value of surplus (loans); that borrowers borrow just as much as lenders lend.

The bond can be handled in three ways. First, the producer can accumulate an inventory of real output and carry it forward to the next period. In that case, it is a subsistence bond. Secondly, the owner of the surplus revenue can directly arrange a barter deal to lend the real output to a borrower. These possibilities are very limited. The most likely manner for a bond transaction is that the lender accumulates revenue in the form of money, and lends the money, so that the borrower can buy whatever kind of good he needs rather than having to take the real output of the lender.

4. Dealing with Macro Issues

All macro issues are about aggregates. Using the input-output table as we have done, any aggregate can be directly derived from the decisions at the individual level, without ever having to link it to another aggregate.

The four equations of exchange offer simple ways to deal with all macro issues. A fifth equation may be added by summing up the trades of all nations. That equation can study liquidity and international debt, but let us not go into that here. Let us consider two simple tricks to handle macro issues.

First, we can decompose aggregate output into four parts according to the four different means of payment. Secondly, we can construct a payment circuit to show how money circulates in its circulation path and affects the prices, demands, supplies, output, and employment. Since more than 90% of all output in a modern economy is indirectly traded with money, the practical importance of studying how money circulates cannot be overstated. The payment circuit gives as a completely new theory of money, and leaves us very little room to disagree.

All macro issues are centered on the equilibrium between aggregate demand and aggregate supply. The actual occurrence of involuntary unemployment and instability of aggregate output (depression/stagnation, booms, inflation, and stagflation) raise questions about the inherent ability of the market mechanism to reach a continuous state of stable full employment. The new tricks in analysis help us dissect the issues by looking into the exchange relations.

The decomposition of aggregate output is helpful, because it reveals the different factors that affect the different parts of output according to the means of payment. The failure of aggregate demand to stay equal to aggregate supply is analyzed by studying the circulation failures of money and bonds. The biggest trouble arises from the peculiar manner of circulation of money as shown below. The payment circuit offers a simple way to analyze the issues of monetary macroeconomics.

Decomposition of aggregate output

We can easily decompose the aggregate output in the input-output matrix. A detailed exposition is found in Chapter Six of Gani 2003. The task is to use the four exchange equations to separate the output for each equation.

The technique of decomposition is quite simple. First, begin with the value matrix, which is the exchange matrix of x_{jk} entities converted into their corresponding market values v_{jk}. Secondly, subsistence output is simply the output in the principal diagonal of the value matrix, where the two subscripts are identical. It means that the producer is the consumer. A subsistence matrix is made by keeping the diagonal elements of the value matrix, and setting all off-diagonal elements to zero.

Thirdly, a trade matrix consists of traded output. This is easily derived by setting the diagonal elements to zero and keeping the off-diagonal elements of the value matrix. Our job is to split this into three separate matrices showing output traded by barter, by money, and by bond. To prevent confusion with money, let us look at the bond first. Add an extra row as the last row and an extra column as the last column to the value matrix. Fill this extra column with zeros. If the individual has a surplus of revenue over expenditures, put the surplus in the extra row in his column to indicate purchase of bonds (or lending). If the individual incurs a deficit, put it in the extra row in his column to indicate a sale of bond (or borrowing). Put a negative sign for the borrower. With this, the sum of sales and purchases for all individuals must be balanced. To find the bond matrix, set all elements of the value matrix to zero except for the extra row and extra column representing the bonds. The sum of the positive elements must necessarily be equal to the sum of the negative elements. The bond matrix does not represent output directly, but merely indicates the value of output that must be traded by using bonds. To prevent double counting, we must put a negative sign to indicate the deficit.

Fourthly, the augmented trade matrix must now be split between barter and money. Notice that the augmented matrix necessarily means that the budgets of each agent are balanced (though it may include positive or negative bonds for balancing).

To find the barter matrix, consider the barter possibility $b_{jk}=b_{kj}$ as the smaller of the two values (v_{jk}, v_{kj}) for every pair of agents (j, k). The idea is that if both (v_{jk}, v_{kj}) are positive, then the agents can offset the smaller of the two in barter directly. Next, replace both (v_{jk}, v_{kj}) values by their corresponding barter possibility b_{jk} which is also set equal to

b_{kj}. Simply put, replace both (v_{jk} ,v_{kj}) values by the smaller of the two for each pair of values (v_{jk}, v_{kj}). The matrix of barter possibilities b_{jk} is the barter matrix.

Fifthly, define w_{jk}= (v_{jk}-b_{jk}), and w_{kj}=(v_{kj}-b_{kj}) as barter impossibility. One of these w_{jk} values must be zero by construction, since the barter possibility is equal to the smaller v_{jk} value. The other must be positive if there is any trade between j and k at all. This is the remainder of the output over the barter possibility that is impossible to pay in barter. And we have already made sure that no question of borrowing is admissible here, because that has already been considered. This must be settled by using money. The matrix of w_{jk} elements is named Wicksell Matrix. It shows the output against which there is no output from the buyer. The output in the Wicksell Matrix cannot be traded without using money.

Technically, the decomposition of the aggregate output is complete. The sum of the subsistence, barter, Wicksell and bond matrices gives the original value matrix. Note that the sum of the bond matrix is zero by construction. Neither money nor bond adds or subtracts any real output, but the Wicksell matrix measure the value of output which cannot be traded without money, while the bond matrix shows the value of output (ignoring the negative bonds) that cannot be traded without bonds.

It is crucial to recognize that money is not a store of value, and it is not used to meet a budget deficit. It indeed is a fiat device to permit indirect trade. It is also necessary to realize that money cannot arise endogenously to of savings or borrowing decisions of individuals, while the bond does arise endogenously. Money must be created externally by seniors.

Analysis of Output

The decomposition of output is helpful in setting many thing straight. Perhaps the most important insight from the decomposition is that output is dependent on the structure of payment. This dependence can be broken down into effects on employment and on stability.

Let us begin with employment. For subsistence output, there is nothing to prevent full employment, simply because one who must work for himself to survive cannot possibly fire himself. But full employment under subsistence is severely limited. First, the extremely small scale of production to meet the needs of the individual household is the main barrier to technological progress. The absence of specialization very greatly reduces the efficiency. Secondly, the absence of trade makes it impossible to assemble the various inputs needed to undertake the production of all but the most rudimentary products, mostly made with a few kinds of natural ingredients. Historically, the natural subsistence economy ensures the lowest possible level of output.

Next, barter expands output beyond subsistence. Ordinarily, barter is limited inside small localities and occurs among people known to each other. Its most authentic expression is the formation of cooperative labor brigades in traditional agriculture. One peasant works for friends when they need help, and in turn, gets their help when he needs it. It is usually informal, and there may not be much concern about exact balance of payments. It may take the form of mutual gifts of produce.

The problem with full employment begins with the appearance of indirect trade. The crux of the problem is that the individual has a customer who cannot supply what he needs in payment, and he himself needs supplies from someone who will not accept his own output in payment. There must be some arrangement to transfer his claim on real

output from his customer to his supplier. This means that money must be used as a means of payment, and that some senior must be present to create and issue the money.

We must wait for the next subsection on payment circuit to explain why shortage of money persists in the world awash with money, even when there is inflation. This is because money can be issued only by a trusted senior, who must be a lender and must never be a borrower. And the creator of money, such as the FED may refuse to lend to certain people and in the required amount. That indeed is the only cause of involuntary unemployment. We must look at the Wicksell Matrix and ask how money is to get into the picture. Full employment is prevented by a shortage of money, which in turn occurs because the bankers who issue money may refuse to lend to some producers. They have of course their own reason for the refusal, but that does in no way help the unemployed.

The gist of the argument on unemployment is that it is impossible under subsistence and barter. It is possible only in a monetized economy.

Next, consider stability of output. As an empirical matter, neither tastes nor technologies change abruptly to cause economy wide fluctuations. We can be pretty certain that no business cycle is possible under subsistence or under barter. We must note that natural disasters such as floods or pestilence or drought affect output, but that has nothing to do with business cycles. In short, there can be no real business cycle in a non-monetized subsistence or barter economy.

Instability can and does occur in a monetized economy because of the ability of banks to abruptly change the supply of money and monetized bonds. Bankers lend many to a few large borrowers to allow them to engage in gambles in the stock and bond markets and other speculative ventures. They may create fiat and supply money far in excess of the need for money. But they may as well suddenly panic when a few large borrowers fail, and they shrink the supply of money. They never care about the need for money, especially as economist never gave them a way to measure the need for money. It is our hope that Wicksell Matrix will be the first step towards rationalizing the supply of money according to need.

The key analytical issue is the propagation or transmission mechanism for instability. It is more commonly known as the multiplier effect. Let us briefly explain the character of the propagation problem. First, consider subsistence. Every producer is independent, and is unaffected by what the others are doing. Obviously, there is no way to affect anybody else. Next, consider barter. It is necessarily limited between two individuals. It is of course possible that one man oversupplies something, but this cannot affect anybody else. The oversupplier must sooner or later learn to match his supply to demand.

Let us consider the savings-investment equilibrium under barter. We must remember that there is no money here. Suppose that there is a hoarder who has a surplus (real output, not money), but refuses to lend it. Obviously the prospective borrower is unable to borrow and hence must fail to consume the output that would be coming out of the borrowing. The prospective lender may fail to find a borrower no matter how low the interest rate is. It really means that one has oversupplied some output and cannot dispose of the surplus even by giving it out on credit. But that cannot affect anybody else. And that is indeed the end of the story. One man's surplus goes to rot while another suffers a deficit of consumption. It cannot affect any other agent. The failed borrower cannot affect another producer, because barter must mean that another producer can sell to the buyer

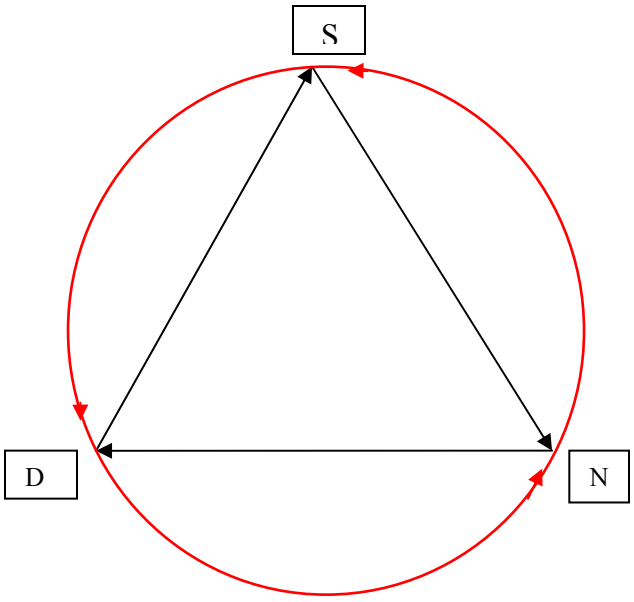
directly. The picture changes dramatically if we go to a monetized economy. The key difference is that in barter one can pay with his real goods, but when money is used one cannot pay with real output directly. If demand is equal to supply at the equilibrium price, there is nothing to prevent trade under barter. But exactly when demand is equal to supply for every good at precisely the market-clearing price, no indirect trade is possible without money. We have more to say on this after we introduce the payment circuit.

However, we must mention that a bond as a store of value affects output very differently than money. People who must borrow in order to buy some output are obviously going to fail to buy the output if the lenders would not lend. Likewise, if the borrowers are not hopeful about profitable investments, they may refuse to borrow. But the point still remains that lending and borrowing is essentially a barter deal between the lender and the borrower, and it cannot be done indirectly, that is, one cannot borrow by transferring the debt obligation or lend by transferring the creditor's claim. It therefore lacks the propagation mechanism. The failure of one borrower to borrow of course disables him, but nobody else. Why would other borrowers be affected? If one saver fails to lend the surplus, why would it affect other lenders?

We construct the exchange matrix only after we know all the market clearing prices. But price theory cannot rescue the issue. There is no sensible explanation of why the interest rate would not adjust to clear the market for loans. Whether it is real good or loan in barter, the maladjustment between demand and supply must be temporary. Quantities and prices must adjust to clear the market in the long run.

Using a payment circuit:

A payment circuit is a simple graphical representation of the Wicksell Matrix, showing the direction in which real goods move from the producer to the consumer, while a reverse flow of money fulfills the payments. The crucial part of the graph is that it must be a complete circuit, so that the money returns to the point of origin after transferring all real goods. It is analogous to an electric circuit. The electron must return to its point of origin, otherwise, no flow of electron is possible.



The triangle above shows real goods going from S(weden) to N(orway) to D(enmark) to S(weden). Money flows in the opposite direction. Each good pays for a second good and is paid for by a third good. Thus N pays for D but is paid for by S. The propagation mechanism grows out of the contagion through the agent in the middle. What is done to N by S is done to D by N. In barter, a deal between N and S would leave D unaffected.

Since the same piece of money must be repeatedly used to transfer the claims on output, if it is withdrawn, all remaining agents in the circuit become disabled from conducting any trade. Thus say Norway had the money in the first place, and decided not to spend it. Then Sweden cannot have it, and hence cannot pay Denmark. In turn, Denmark cannot have the money and hence cannot give it to Norway. All trades are aborted. This occurs precisely when demand is equal to supply and the price is precisely the market clearing one. The problem is payment, not value. Though the real goods have demand and supply, they cannot be transferred for lack of double coincidence. Money creates artificial double coincidence. When money is not circulating, the trades are stopped. This situation cannot happen under barter.

There are three major points here. First, we must study the supply of money as a means of payment from the issuers. Secondly, we must distinguish between money and a unit of account on the one hand, and between money and a store of value on the other hand. Third, we must consider the manner of circulation of money.

Supply of Money

Bankers create and supply fiat money as loans in the modern world. They do not care at all about the need for money. Economists never taught them about the need for money as precisely measured by the Wicksell Matrix. Indeed, economists are not sure what money is. They use various measures like M1, M2, M3 to see how money much money there is, without any sense of how much is needed.

Classical quantity theory thought of money as a unit of account, and it could never explain the source of money. Friedman's idea of a helicopter throwing money gives a sense how money supply was visualized.

Keynes thought of money as savings which arose endogenously from individual decisions. It confuses between bonds (store of value) and money as means of payment. As already indicated, the mismatch between savings and investment can affect only the two people (the lender and the borrower) and cannot affect anybody else. For multiplier effect to propagate the instability, money must circulate as a means of payment. Keynesian theory of depression can be very easily presented with the payment circuit. Thus suppose that 1 unit of money changes hands ten times, and that unit of money is hoarded. Then although all other agents have real goods for which both demand and supply exist, no further trade is possible. Involuntary unemployment is inevitable. The solution lies in putting the money back into circulation. New investment is not the answer to the failure of old investment.

Instability in a monetized economy can be created by and only by the bankers. They are able to issue too much money to create inflation. And they can reduce the supply of money to impose a depression. They can impose simultaneous inflation and depression at once, refuse to give money to some producers, while deluging other borrowers who inflate some sectors. Please see Gani 2003 for some details.

Character of Money

Money must be a means of payment. If something fails to be a means of payment, it cannot be money. A unit of value and a store of value have really nothing to do with money, but the literature is thoroughly confused about the distinctions.

The idea of money as merely a unit of account is the root of the idea of neutrality of money. Both old and new classical schools think of money as a unit of account. Let us take a quick look at the latest wisdom on money from the Lucasian expositions.

The gist of the Lucasian theory is that rational people expect that an increase in the money supply leads to an increase in the nominal prices and leaves real prices unaffected. Rational people react by changing the money prices in tune with the changing supply of money, leaving the real prices unaffected. Since real prices determine the supplies and demands, a change in money supply cannot affect them. The supply of labor, for example, cannot be affected by changing money wages.

First, Lucas fails to make the necessary distinction between a movement along a supply curve and the shift of a supply curve, failing to grasp the most rudimentary theory of price. A given supply curve reflects a given technology and resource endowment. If the technology or factor endowments remain the same, the curve remains the same. On this curve, a prior change in price leads to a subsequent change in supply. A higher price elicits a larger supply and a lower price leads to a lower supply for the ordinary upward sloping supply curve.

Now, a change in technology or endowment shifts the supply curve. If there is a population growth to enlarge the factor endowments of labor or if discoveries lead to other factor endowments to increase, the supply curve shifts to the right so that at the same old real price, a greater amount is supplied. Indeed, a technological breakthrough may cut down marginal cost so that the real price goes down and/or supply goes up. In short, it is patently absurd to suppose that a larger labor force can be employed if and only if there is a higher real wage. Indeed, a larger labor force can be employed without any increase in the real wage at all. So long as the marginal cost of labor reproduction remains the same, the real wage necessary to employ them remains the same.

Secondly, we must consider how money enters into circulation. Suppose that the money already in circulation is enough to trade the current volume of output. It must mean that each producer has enough money to finance the current level of production. That must mean that a producer will have no reason to borrow new money merely to raise the prices of inputs (wages of labor). Therefore, even if bankers are willing to create new money and lend it, producers will not borrow it.

Producers will have reason to borrow new money if and only if they have found unused factors which they think they can employ profitably. It is not necessary that the real factor prices must be raised to hire the hitherto unemployed factors. The reality of competition is that a new project requires at least some experienced workers who already have jobs, and they generally need a higher wage to be persuaded to join a new project. Suppose that this puts an upward pressure on wages, which end up raising product prices, so that in the end, the real wage stays the same as before. Lucas believes that this means that no additional workers have been hired. But real output and employment is higher, as new workers have been hired, even though the real wage is the same as before.

Thirdly, monetary policy has effect, because the authorities can manipulate the constraints. No matter what one expects, when the authorities reduce the money supply,

the producers cannot overcome the shortage by other means. Again, when the authorities make more money available at lower interest, the producers do not want to pass up the opportunity to borrow money to finance new projects that could not be financed before. It is not true that monetary policy works only by fooling people.

Circulation of Money

There is one serious new point that the payment circuit reveals. Since the creation of new money is practically costless, there is no reason to pursue the long circulation policy under which the same piece of bearer cash must change hand several times. The banks can easily introduce a short circulation, in which each producer will directly borrow the money from the issuer, and use the money as a single-use check. The short circulation will remove the transmission mechanism and prevent the instability from spreading. For details, please see Gani 2003.

5. Five Macroeconomic Theorems

By using the decomposition of output and the payment circuit, we can deal with the central issues of macroeconomics with simple theorems. Fuller details are found in Gani 2003.

Theorem 1: Output depends on the structure of payments.

The decomposition of output according to means of payment leaves no room for doubt that the output depends on the means of payment. There are several new insights. First, the minimum output in an economy is given by subsistence matrix. The economy cannot produce any smaller output. There is nothing to prevent the producers to produce what they themselves consume from their own production. Secondly, trade enlarges the output much beyond subsistence, but not without the proper means of payment. Barter is severely restrictive, but nevertheless enhances the size of output so far as barter is possible.

The most important insight is that the output in the Wicksell Matrix cannot be sustained without using money. Again, the bond must be used to finance the output whose demand depends on borrowing.

Theorem 2: Involuntary unemployment is caused by shortage of money.

The Wicksell Matrix demonstrates that involuntary unemployment can occur just when demand is equal to supply at the market clearing prices, because of the absence of money to permit the indirect trades.

The shortage of money in a monetized economy can occur if the issuer of money refuses to lend money to some producers, but compel them to get money only from customers. The long circulation regime imposes unnecessary waiting for the fiat means of payment to arrive by compelling agents to use the same piece of money repeatedly in any given payment circuit. The danger is that an agent who happens to have the cash may hoard it, and disable the others in the circuit from using money. The Keynesian multiplier effect works when we use a payment circuit to show it. But it does not work if we look at the savings-investment equilibrium. A shortage of investment in one sector cannot affect the demand for the output of any other sector unless the investment is monetized. A bond lacks a propagation mechanism, and its failure cannot affect unrelated sectors.

Theorem 3: The Persistence of Excess Debt

Fiat money can be issued as and only as a loan. The issuer cannot sell the money against real output, because in that case, the payment circuit will have one buyer of real output who does not offer any real output. That will break the circuit. The issuer can also not give it out for free, because the only goal of money is to manage the claims on real output, and that goal cannot be met unless the user of money delivers some real output to earn the money to settle the debt, essentially by returning the money to the issuer.

The Wicksell Matrix and the underlying multiple coincidence imply that ordinary producer of real output must borrow money precisely when their budgets in real terms are balanced. The debt in fiat money is not a real debt, but an obligation to the issuer to fulfill the claims on output. This debt is excess debt, because it is incurred even as the budget is precisely balanced.

The true burden of excess debt is the extremely high fee for the use of fiat money. Bankers treat it as real capital and charge a heavy interest rate. The true cause beneath the accumulation of debts of the developing nations is the extremely high interest. We propose that the fee for using fiat money should be rationalized to the level of cost incurred to manage the money. Our guess is that this cost cannot be any higher than 1/5 of one percent for large national economies.

Theorem 4: Stagnation is caused by long circulation of money

Long circulation imposes an unnecessary waiting for the money to circulate, compared to short circulation. The time wasted in waiting for the money to arrive through the circuit aborts output and hence aborts capital accumulation. The sluggish circulation of money is the only possible source of stagnation. But it can be remedied very easily by using the short circulation. Instead of using 1 unit of money n times, use n units of money once each.

Theorem 5: undue instability is caused by arbitrary issue of money

Instability of output is undue when it occurs without any change in tastes or technologies or endowments. It can occur because the bankers can arbitrarily change the supply of money without any regard for the need for money. Only money has a propagation mechanism associated with the payment circuit. Instability cannot spread unless the output is monetized. The arbitrary power of the bankers to change the money supply must be institutionally regulated to make sure that the supply of money stays continuously equal to precisely what is needed, as measured by the Wicksell Matrix.

The biggest perversion of money is that it may be degraded into bonds. Fed up with the perennial liquidity crisis under the long circulation regime, most producers are compelled to build up cash reserves instead of interest-bearing bonds. This impedes the flow of money and aborts output through the lengthening of the period of wasteful waiting. But the greater danger is that bankers may issue money to finance the purchase of existing assets such as stocks and bonds, futures and options, and other financial instruments that have no relation to the current output. Without any change in the fundamentals, the stock prices may be pushed up and down by the bankers, as they finance speculators to play gambles with the stocks.

Instability cannot be propagated under subsistence or barter. It can occur only under money. And that can occur only if the issuers mismanage its supply.

6. Concluding Commentary

Macroeconomics deals with the important economic issues facing the nation. It cannot pass up the opportunity to use the new analytical tool which reveals how the activities of individuals generate the overall outcome through various exchange relations. In particular, the proposal to use the short circulation regime to remove the instability-propagating mechanism needs serious attention. It is also important to take serious notice of the unreasonably high fee for using fiat money, leading to perennial excess debt.

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