A Pictorial Notation to Illustrate Balance Sheet Changes

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Abstract

This article presents a pictorial notation for illustrating any economic activity which results either in changes to balance sheets, or in the provision of services. In particular, the author believes that the notation will make the 'money view' of economics easier to understand for students new to the concepts. It may also be of interest to users of stock-flow consistent (SFC) models.

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Introduction

The balance sheet is a very important tool to illustrate ideas in economics, particularly in banking and finance. For example, a bank loan[1] of $1,000 can be illustrated as in Figure 1.

Borrower	
A	L
+ £1000 Deposit	+ £1000 Loan

Bank	
A	L
+ £1000 Loan	+ £1000 Deposit

Figure 1: Bank loan as changes in balance sheets

This shows that the borrower has a new deposit asset and a new loan liability; and that the bank has a new loan asset and a new deposit liability.

However, this representation does not clarify that the creation of the borrower's deposit asset and the bank's deposit liability are logically atomic—one side of a debt cannot exist without the other side. We can consider the creation of both sides of a new debt as a single atomic *action*.

The simultaneous creation of the *two* new debts, however, is *not* logically atomic, but a *transaction* consisting of two separate actions. A bank could create a deposit for a person *without* receiving an IOU in exchange. In fact, that is exactly how a bank pays wages to an employee, or pays a dividend to a shareholder.

By itself, the action creating a deposit debt decreases the bank's net worth by the deposit, and simultaneously increases the borrower's net worth by the deposit. The action thus *transfers* some of the bank's net worth to the borrower. Similarly, the action creating a loan debt *transfers* some of the borrower's net worth to the bank.

This motivates illustrating an action as an arrow from the person[2] whose net worth decreases to the person whose net worth increases. The bank loan example can then be represented as in Figure 2.

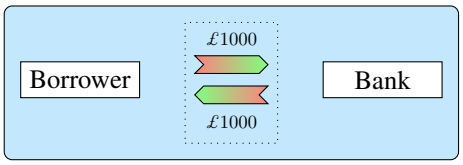


Figure 2: Bank loan as two 'Create new debt' actions

The arrow's colour gradient shows that, in each case, net worth is being transferred from the debtor (pink end) to the creditor (green end). (The dotted box indicates that the two actions form a transaction).

The diagram neatly illustrates that the bank lending process is an exchange of IOUs, as explained by (Mehrling 2017).

This paper shows that there are exactly 8 types of economic action, and offers a way to illustrate them using this intuitive arrow notation.

[1] For this example, we ignore interest.

[2] Throughout this paper, the word *person* means either a natural person or an institution with a balance sheet.

1 The Atomic Actions

1.1 Balance Sheets

To enumerate the different types of actions, we first consider balance sheets.

A person's balance sheet consists of:

- Tangible assets (things owned by the person),
- Debt assets (things owed *to* the person), and
- Liabilities (things owed *by* the person)

together with a balancing net worth entry. An example is in Figure 3.

Assets	Liabilities
House (11 High Street, Sometown) Car (reg. `XY 08 WSE`) Wristwatch (Acme Watches model Q) £1,000 (Savings — Bank B)	£125,000 (Mortgage — Bank A) **Net Worth:** **House + Car + Wristwatch** **− £124,000.**
Total: House + Car + Wristwatch + £1,000	Total: House + Car + Wristwatch + £1,000

Figure 3: An example person's balance sheet

Notice that in this paper, balance sheets consist of the assets and liabilities themselves, not some monetary value for each[3]. Similarly, the net worth consists of the difference between the heterogeneous sum of the actual assets and the heterogeneous sum of the actual liabilities. While this means that net worth cannot be expressed simply as a single value in some homogeneous unit of account, a crucial advantage is that net worth is a direct measure, unaffected by people's sentiment or behaviour, and is independent of inflation or even the existence of money at all.

Even though Figure 3, does not show specifically which house, car and wristwatch are part of the net worth (and column totals), this is just to make the example more concise. Net worth must always be considered to consist of the specific *assets and liabilities listed in the balance sheet. Clearly houses, cars and watches are not fungible.*

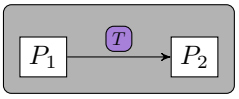
1.2 Enumerating the Atomic Actions

Any atomic action which changes a person's balance sheet must either add or remove a tangible asset (T), a debt asset (C) or a liability (D). Typically, it also changes another person's balance sheet. We can categorise action types by the type(s) of change.

For each type of action below, two diagrams are shown: first the changes to the balance sheets (on a grey background), then an arrow showing how participants' net worths change (on a light blue background).

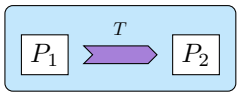
[3]Mathematically, balance sheet entries could be considered as being enormous vectors, but the mathematics of balance sheets and actions are simple enough that an informal understanding is all that is required.

1.2.1 Transfer of Tangible Asset

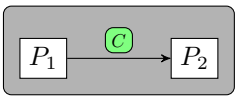


Tangible asset T is transferred from P_1 to P_2.

P_1's net worth decreases by T, and P_2's net worth increases by T, so this transfers T of P_1's net worth to P_2.

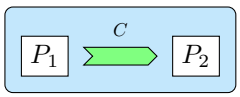


1.2.2 Transfer of Debt Asset

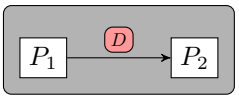


Debt asset C is transferred from P_1 to P_2.

P_1's net worth decreases by C, and P_2's net worth increases by C, so this transfers C of P_1's net worth to P_2.

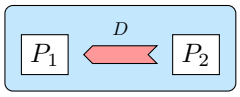


1.2.3 Transfer of Liability



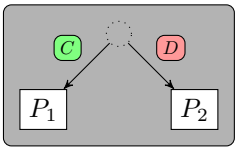
Liability D is transferred from P_1 to P_2:

P_1's net worth *increases* by D, and P_2's net worth *decreases* by D, so this transfers D of P_2's net worth to P_1.



Notice that the transfer of net worth is in the opposite direction to the transfer of the liability, since P_2 now owes the debt previously owed by P_1.

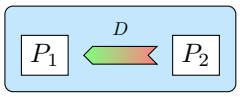
1.2.4 Creation of New Debt



P_2 agrees to owe P_1 a new debt. P_2 has a new liability D equal to P_1's new debt asset C.

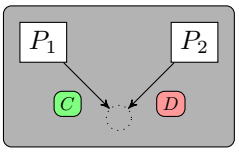
The arrows starting from the dotted circle indicate that the debt asset and the liability appear from nowhere. They were not on anyone's balance sheet before.

P_1's net worth increases by C, and P_2's net worth *decreases* by D $(= C)$, so this transfers D of P_2's net worth to P_1.



The colour gradient indicates that net worth is transferred from the debtor (pink) to the creditor (green).

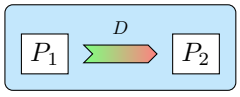
1.2.5 Write-off of Existing Debt



P_1 agrees that P_2 no longer owes the debt represented by P_2's liability D and P_1's equal debt asset C.

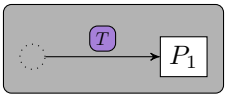
The arrows ending on the dotted circle indicate that the debt asset and the liability disappear. They are no longer on anyone's balance sheet.

P_1's net worth decreases by C, and P_2's net worth increases by D $(= C)$, so this transfers D of P_1's net worth to P_2.



The colour gradient indicates that net worth is transferred from the creditor (green) to the debtor (pink).

1.2.6 Production

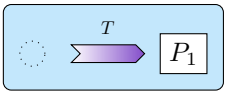


P_1 produces a new tangible asset T.

The arrow starting from the dotted circle indicates that the tangible asset comes from nowhere: it is newly-produced. It was not on anyone's balance sheet before.

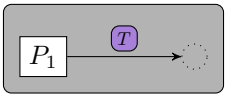
This is the only action which adds to one person's net worth without taking an equal amount from another person's net worth, although it does generally involve some effort or sacrifice on the part of the producer—this *may* involve another action.

Production can be represented as a transfer of net worth from nowhere.



The colour gradient from white to purple represents the tangible asset coming into being.

1.2.7 Consumption

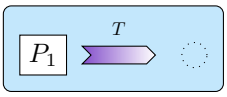


P_1 consumes an existing tangible asset T.

The arrow ending on the dotted circle indicates that the tangible asset goes to nowhere: it is consumed. It is no longer on anyone's balance sheet.

This is the only action which takes away from one person's net worth without adding an equal amount to another person's net worth. It does typically give the consumer some benefit, such as obtaining nutrition and pleasure from eating a sandwich, although consumption can also mean damaging the asset, such as accidentally dropping and smashing a mobile phone.

Consumption can be represented as a transfer of net worth to nowhere[4].

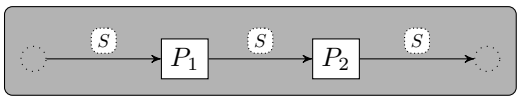


The colour gradient from purple to white represents the tangible asset fading from being.

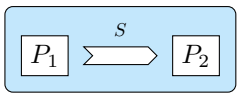
1.2.8 Service Provision

For completeness, it is useful to be able to represent the provision of services, such as one person, P_1, cutting the hair of another person, P_2, even if neither's balance sheet is affected. A service typically benefits the recipient, and requires effort and sacrifice by the provider.

Say (1971: Chapter XIII) reasoned that service provision, such as the advice of a doctor, is equivalent to the simultaneous production, transfer and consumption of an *immaterial product*.



In principle then, this could be represented with 3 of the existing arrows: production, transfer of a tangible asset, and consumption. However, it seems clearer to use a single white arrow to represent provision of a service.



1.3 The 8 actions

Table 1 summarises the 8 action types, showing how any atomic and logically-consistent set of balance sheet changes can be represented with a single arrow showing a transfer of net worth.

[4]Some assets can be partially consumed, such as when 500mAh is used of a battery with an original charge of 1100mAh. This can be represented as the simultaneous consumption of a 1100mAh battery and production of a 600mAh battery.

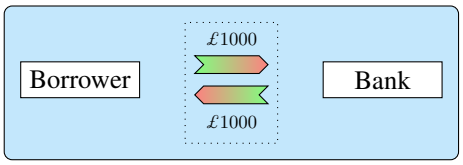
Person 1	Person 2	Action Type	Notation
$+T$	-	Production	P_1
$+T$	$-T$	Transfer tangible asset	P_1 P_2
$-T$	-	Consumption	P_1
$+C$	$+D$	Create debt	P_1 P_2
$+C$	$-C$	Transfer debt asset	P_1 P_2
$+D$	$-D$	Transfer liability	P_1 P_2
$-C$	$-D$	Write off debt	P_1 P_2
-	-	Provide service	P_1 P_2

Table 1: The 8 atomic actions

2 Examples

2.1 Repaying a bank loan

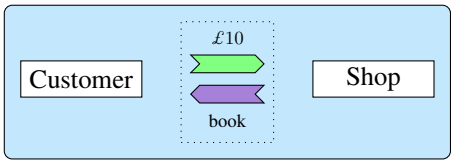
In this example, a customer repays a bank loan of £1,000.



Repaying a loan is the simultaneous write-off of two debts, undoing the original creation of two debts when the loan was made.

2.2 Buying a book from a shop

Here, a customer buys a book from a shop, paying cash.



There are two actions:

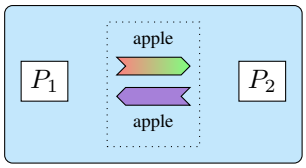
1. A transfer of a debt asset—the cash—from the customer to the shop.
2. A transfer of a tangible asset—the book—from the shop to the customer.

The cash is a debt owed by the central bank. It was owed to the customer and is now owed to the shop.

Note that if the customer paid by debit card or cheque, the diagram would be identical, but now the debt asset being transferred would be £10 of a bank deposit.

2.3 Paying a debt

Person P_2 gives person P_1 the apple which they had previously promised to give them.



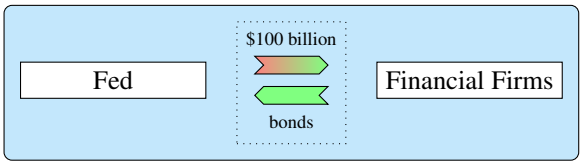
There are two actions:

1. P_2 transfers a tangible apple to P_1.
2. P_1 writes off P_2's debt of one apple.

The transaction leaves both people's net worth unchanged.

2.4 Quantitative Easing

A central bank buys an existing debt asset, paying with newly-created reserves.



There are two actions:

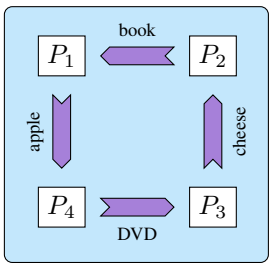
1. The creation of a new debt—reserves—by the Fed owed to financial firms,
2. The transfer of a debt asset—the government bonds—from the financial firms to the Fed. This is a debt for the face value plus the coupons.

In fact, there are many actions—one new debt and one transfer of debt asset for each individual bond and each coupon—but they can be aggregated with no fallacy of composition.

The bonds are a debt owed by the government. It was owed to the financial firms, and is now owed to the Fed.

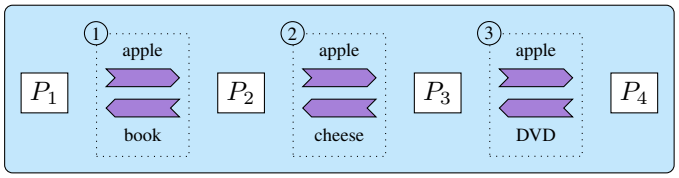
2.5 A 4-way Transaction

Four people have each produced a tangible asset, but want to exchange it for a different tangible asset. P_1 has an apple and wants a book, P_2 has a book and wants some cheese, P_3 has some cheese and wants a DVD, and P_4 has a DVD and wants an apple. If they can arrange to meet together, they can perform the transaction.



2.6 Using barter to simplify a 4-way transaction

Having 4 people meet together to exchange goods is generally impractical. But there are ways to break the single transaction into multiple, simpler transactions. One way is barter, where a tangible asset is transferred not for the receiver's consumption, but simply as a way to transfer net worth.



The end result is identical to the situation where the 4 people met together, but only requires two of the people to meet at any one time. A single large transaction has been broken into 3 smaller transactions.

2.7 Using money to simplify a 4-way transaction

Barter has some disadvantages, such as people needing to know many exchange rates: between what they actually want and whatever they might be offered in an individual transaction. Tangible assets used for payment may also have costs of transporting, may get damaged in transit, and may perish before they can be used. Money is a useful alternative.

Figure 4 shows P_1 borrowing £1 from the bank (1) to buy the book (2). The money then circulates through the remaining people (3,4), until P_4 buys the apple from P_1 with the £1 (5). P_1 can then use the £1 to repay the loan to the bank (6).

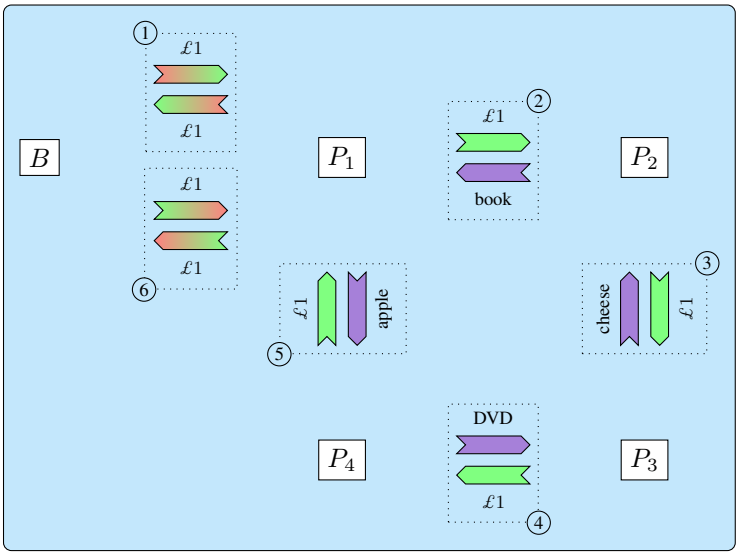


Figure 4: Using money to break a complex transaction into simpler transactions

Again, the final result is identical to the original 4-way transaction, but it does not

require anyone to temporarily accept something with limited use to them, and potentially perishable, solely as a means of obtaining what they actually want.

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