Review Article

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The Double Entry System of Accounting

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The author recounts Professor Ijiri's works throughout his academic career.

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Memorial Symposium for Professor Yuji Ijiri

1. "An Introduction to Corporate Accounting Standards: A Review" by Yuji Ijiri, <https://doi.org/10.1515/ael-2017-0058>
2. "Axioms and Structures of Conventional Accounting Measurement" by Yuji Ijiri, <https://doi.org/10.1515/ael-2017-0057>
3. "Yuji Ijiri: Accounting for a Better Society" by Shyam Sunder, <https://doi.org/10.1515/ael-2017-0045>
4. "Yuji Ijiri: On Accountability" by Jonathan Glover, <https://doi.org/10.1515/ael-2018.0004>
5. "Ijiri and His Influence in Japan" by Yoshitaka Fukui, <https://doi.org/10.1515/ael-2017.0048>
6. "The Double Entry System of Accounting" by John Fellingham, <https://doi.org/10.1515/ael-2018.0001>
7. "An Interdisciplinary Journey with Professor Yuji Ijiri" by Haijin Lin, <https://doi.org/10.1515/ael-2017.0056>

First, appreciate the beauty of the thing.

It was never my privilege to be on the same faculty as Professor Ijiri, so the perspective offered is that of something of an outsider: an outsider with deep respect and affection for Professor Ijiri as a scholar, and one profoundly affected by Professor Ijiri's understanding of, and appreciation for, the elegant double entry system of accounting. While all of the ideas I speak of about double entry were certainly inspired by Professor Ijiri's work, not all of them are explicitly in his writings—I don't think—but given the incredible volume and breadth of his work, I would not be surprised if he had worked out much more than I am currently familiar with.

It always appeared as if Professor Ijiri approached any scholarly endeavor from this point of view: first, appreciate the beauty of the thing. The approach is particularly appropriate for double entry accounting, the beauty of which was captured and analyzed by no one more elegantly and scholarly than Professor Ijiri. Those of us fortunate to have access to his writing, and on more rare and memorable occasions, access to his presentations and conversations, could not help but be impressed in fundamental ways.

Double entry accounting is a linear system and can be represented in numerous ways: one way is a directed graph, or slightly more rigorously, a connected planar graph. The T-accounts are represented by the nodes in the graph, and the arcs connecting two nodes are journal entries. Debits and credits can be captured by "directing" the arcs—arrowheads on the debit T-account, for example. Journal entry amounts can be attached to the arcs and T-account balances to the nodes; the directed graph supplies a visual representation of the flow of amounts through the double entry system.

One way to appreciate beauty is to look for two things: simplicity and power. The directed graph representation of the double entry system is relatively simple, and the implications are powerful and far reaching, as they apply to all graphs (of all sizes), as long as they have arcs and nodes. One way to describe a general result is a famous theorem from Leonhard Euler: The number of nodes minus one plus the number of enclosed regions equals the number of arcs (see, for example, Trudeau, 1993). Another way is to use accounting words: The number of T-accounts minus one plus the number of loops equals the number of journal entries.

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There is also a linear algebraic expression about the matrix underlying the system: The dimension of the row space plus the dimension of the null space equals the number of columns in the matrix. For many of us the linear algebra insight came from studying Professor Ijiri's work on the generalized inverse of a matrix. See, for example, Professor Ijiri's lovely book entitled *The Foundations of Accounting Measurement* (Ijiri, 1967).

Simplicity and power are ways to evaluate beauty, but there is still a "beauty is in the eye of the beholder" problem. Let's appeal to authority and rely on Plato for a judgment of beauty. The famous "Platonic" solids have been studied for their beauty since classical times. They are three dimensional objects, polyhedra, the faces of which are all the same. A tetrahedron, for example, has four faces all of which are identical equilateral triangles.

Euler conceived of adding another dimension to a planar graph and came up with a beautiful relationship about an important class of polyhedra—the number of faces plus the number of vertices minus two equals the number of edges. Euler's formula connected shapes with numbers in a fundamental way, and a lot of credit for the invention of topology appropriately belongs here (see Richeson, 2008).

Employing the same scholarly curiosity and starting from the same appreciation for beauty, Professor Ijiri added another dimension to double entry accounting. One of the results was the famous system of triple entry accounting (Ijiri, 1986). Speculations on alternative histories are, by definition, rife with counterfactuals, but here goes anyway. If Professor Ijiri had predated Leonhard Euler, it is plausible (actually more than plausible to me) the generalization from planar graphs to polyhedra would have effectively been accomplished by Professor Ijiri and his students as the generalization from double entry accounting to triple entry. And accounting would be viewed as a foundational science for an important part of mathematics, and some, or even most of the credit for inventing topology would have accrued to the intellectual and academic discipline of accounting.

Graphs and matrices as discussed so far capture the static properties of the double entry system. But Professor Ijiri also emphasized its dynamic aspects. Here is a quote from a book of his we studied when I was a doctoral student, the aforementioned *Foundations of Accounting Measurement*, (Ijiri, 1967 p. 109).

An increment and a decrement in the present or future resources of an entity are tied together by a causal relationship. That is, we should describe the double entry system not statically but dynamically.

An important word is the last: dynamically. The double entry system allows for the treatment of stocks and flows. Indeed, most of the journal entries with cutting power affect both a stock and a flow account. The existence of both stocks and flows distinguishes accounting as an information source, and combining stocks and flows into a ratio, that is, dividing total flows by total stocks, accesses a fundamental property of any dynamic system: that is, the rate of growth.

And here, as in so many places, the scholarship of Professor Ijiri connects with and illuminates other important academic lines of inquiry. In the information theory of Claude Shannon and John Kelly, for example, there exists a fundamental connection between information and rate of growth. Indeed, for some cases the connection between information and growth is as strong as it can be, in fact, it is an equality (see Kelly, 1956; Shannon, 1948).

The equality between growth and information is simple to state yet powerful in implication, and once again we have the simplicity and power components of beauty. I once heard physicist Steven Weinberg saying something like this, "just because the math is beautiful doesn't necessarily mean the physics is correct, but it usually does." And speaking of physics ...

Let's connect double entry accounting to one more academic endeavor which Professor Ijiri has also written about: quantum physics. Quantum processes are linear just like the double entry system, and, furthermore, Nature has its own double entry system: quantum entanglement.

Quantum objects exist in a state of superposition where they are neither plus nor minus, say, but mysteriously both at the same time. When the ambiguity of one of two entangled objects is resolved, the other entangled object is resolved instantaneously in exactly the same way, even though the two objects might be separated by an arbitrarily large distance. Einstein, being a little skeptical, referred to the phenomenon as "spooky action at a distance." But the quantum double entry effect is empirically verifiable: whatever happens to one object also happens to the other.

Once again, Professor Ijiri draws important connections between accounting and another academic discipline. However, when we read his work, we don't get the impression he is explaining to us what the important connections are, or which ideas and endeavors will prove to be fruitful and the most career enhancing. Rather, the impression is that he is inviting us to appreciate the beauty of the thing. Then we can work out some connections for our own selves. This is a very valuable gift he gives us, good advice and cherished, for which we are deeply and sincerely grateful. And it is a profound legacy.

References

- Ijiri, Y. (1967). *The foundations of accounting measurement: a mathematical, economic, and behavioral inquiry*. Houston: Scholar Book.
- Ijiri, Y. (1986). A framework for triple-entry bookkeeping. *The Accounting Review*, 61(4), 745–759.
- Kelly, J. (1956). A new interpretation of information rate. *The Bell System Technical Journal*, 35, 917–926.
- Richeson, D. S. (2008). *Euler's Gem: the polyhedron formula and the birth of topology*. Princeton, NJ: Princeton University Press.
- Shannon, C. E. (1948). A mathematical theory of communication. *The Bell System Technical Journal*, 27(3), 379–423.
- Trudeau, R. J. (1993). *Introduction to graph theory*. New York, NY: Dover Publications.