

Kaoru Yamaguchi

The primary exponent of System Dynamics in Economics

A terminated beginning

- Forrester developed system dynamics in response to the weaknesses of mainstream economic modelling
- MIT staff seminar on November 5, 1956
 - “During the last three months I have read a small part of the literature on economic models and models of the industrial firm, considering it from the viewpoint of one who is new to the field”
- He was horrified by the techniques economists used then:
 - “One of the striking shortcomings of most economic models is their failure to reflect adequately the structural form of the regenerative loops that make up our economic system...
 - Present models neglect to interrelate adequately the flows of goods, money, information, and labor...
 - Many models are formulated in terms of systems of simultaneous algebraic equations. These impress me as particularly unsuited to the kind of behavior being studied...”

Misplaced confidence

- Forrester was very confident that “system dynamics” would transform economics:
 - “I am very certain that the models that now become possible will be effective and of great importance in understanding and managing the individual industrial firm.
 - **With respect to the national economy as a whole, I expect the models that can be constructed in the next five years to be many times better than those of the past.**
 - Whether “many times better” is enough to bring economic models to a useful and effective capability has yet to be determined.”
- That did not happen, for 2 reasons...
 - Neoclassical economists were extremely hostile to the first economics-oriented model *The Limits to Growth*
 - Randers expected economists to be delighted with a technology that freed them from having to assume equilibrium; instead, Neoclassicals saw that as a threat
 - **The National Model that Forrester thought would be quickly forthcoming was never really completed, as Kaoru notes...**

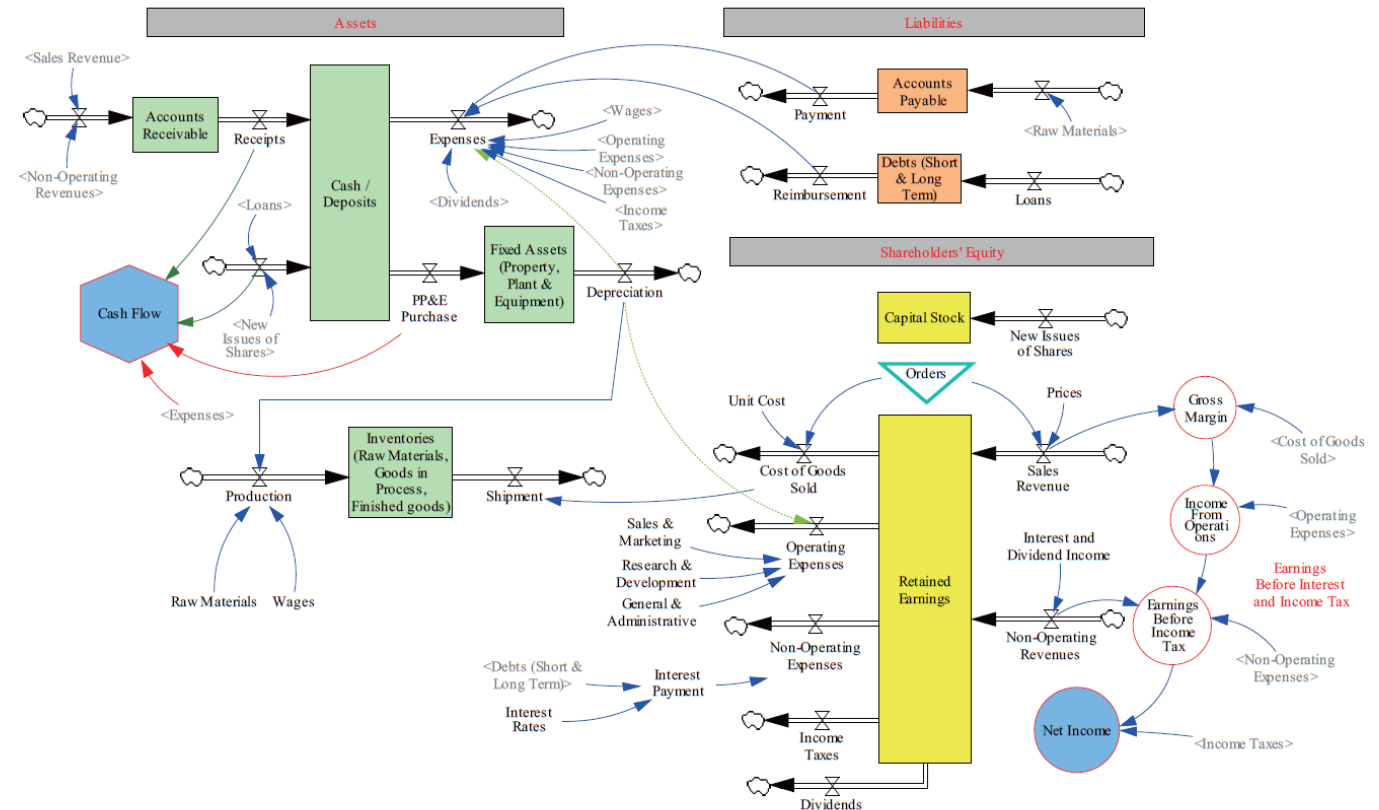
Unfinished Business

- “I was a late comer to the research community of system dynamics.
- While my step-by-step macroeconomic modeling was advancing, some researchers have kindly suggested at the conferences that I should review the research papers on the National Model project that was led by Prof. Jay Forrester ...
- Unfortunately, the national model itself was not available ...
- I visited Prof. Jay Forrester ... [in 2010] He told me that the national model is still going on, and I may have no chance to take a look at it until it's completed.
- Even so, the conversation turned out to be very fruitful to me, out of which I got convinced that my modeling approach on the basis of accounting system dynamics is quite different from his modeling method.”
- The key innovation Kaoru developed **within existing SD programs** was accounting
- System dynamics, on its own, wasn't enough
- To model a capitalist economy properly, Kaoru realized, you had to model its accounting...

An alternative approach

- “I strongly felt it necessary to cover accounting system in my system dynamics class.
- Yet, my search for SD-based accounting system turned out to be unsuccessful,
- giving me an incentive to develop a SD method of modeling financial statements and accounting system from scratch.”
- This was a **crucial** advance!
- Failure of original NM builders to develop an accounting framework may be why they never completed the job
- **Kaoru’s accounting framework:**
- Using this framework, Kauro effectively achieved Forrester’s ambition of building a system dynamics model of the National Economy ...

Figure 3.10: Accounting System Dynamics Simplified



A National Model in Vensim

- The difficulty now is interpreting it and using it for economic management
- This is one complicated model!...
- At this point, system dynamics tools are letting Kaoru down:
- The “spaghetti diagram” problem

Afghanistan Stability / COIN Dynamics

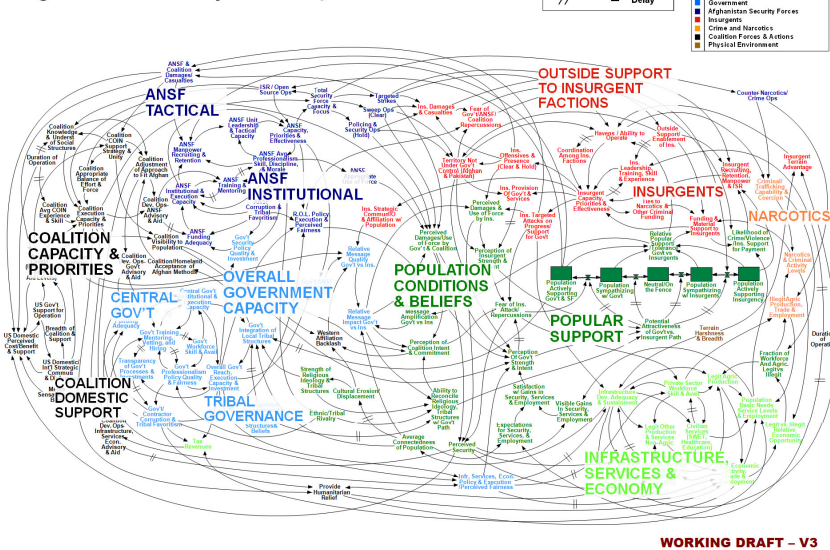
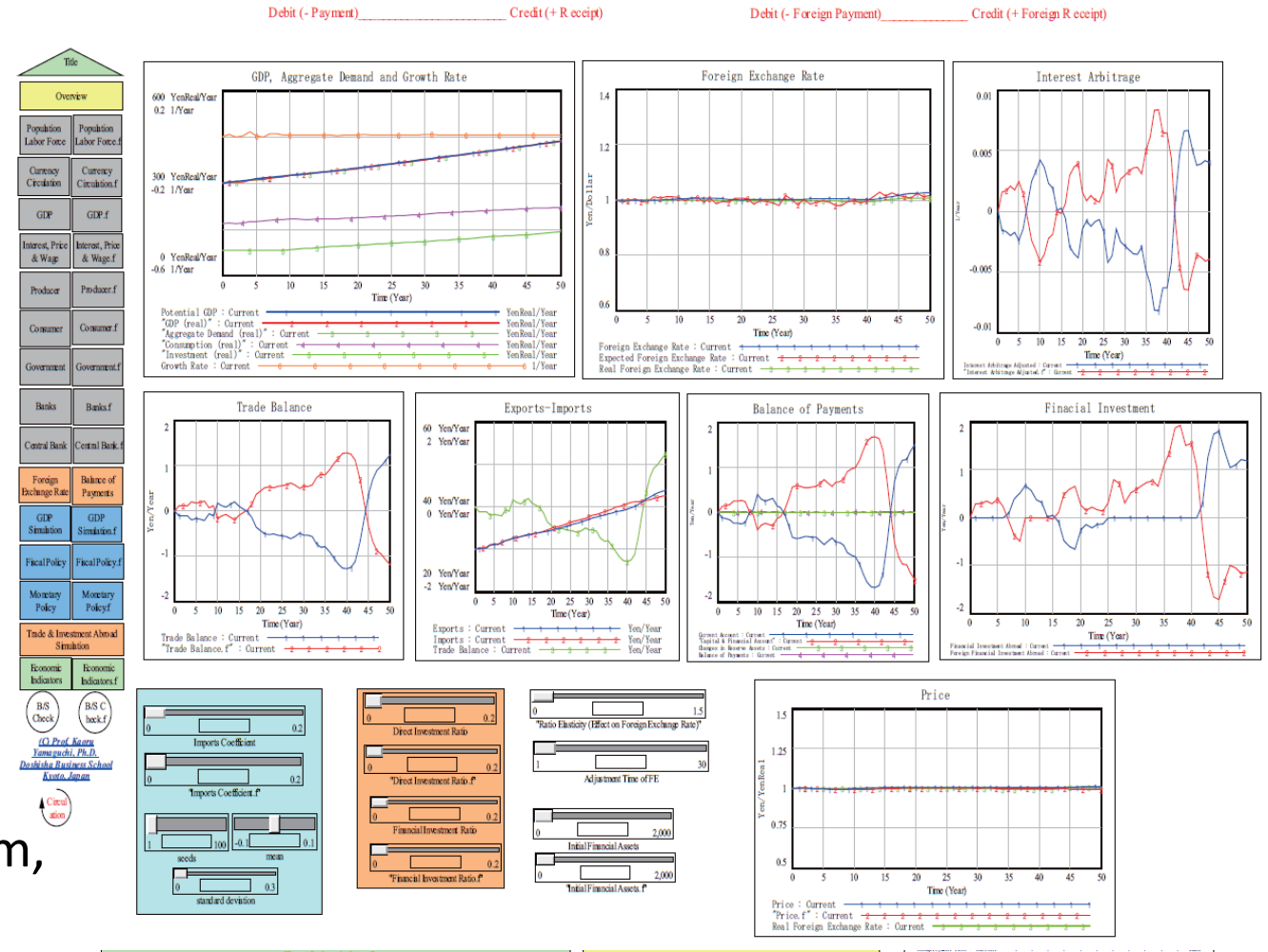


Figure 15.14: Simulation Panel of Trade and Investment Abroad



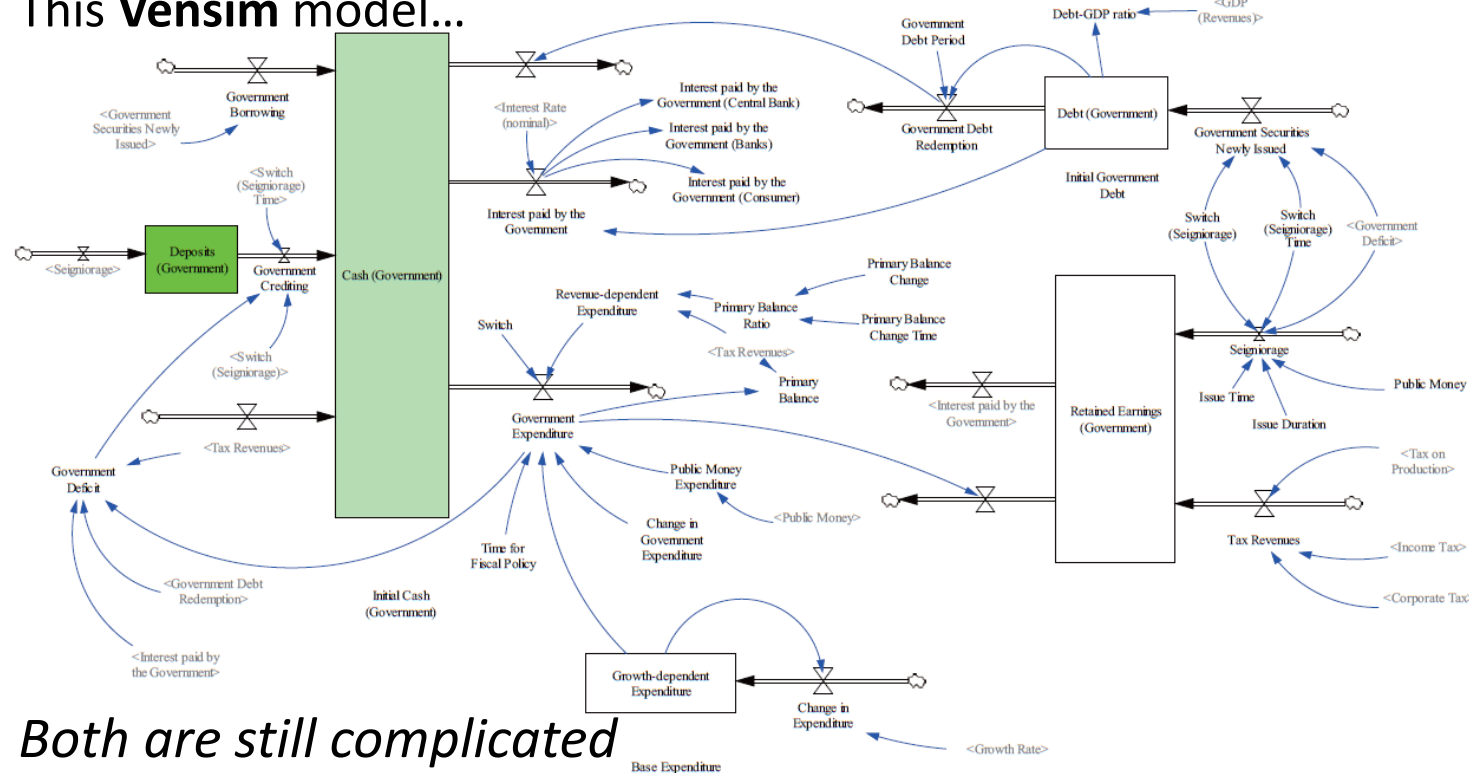
- The author understands the diagram, but the audience does not
- This is why I invented Ravel...

Enter Ravel

- Like Kaoru, I regarded an accounting framework as critical
- But rather than creating one within an existing program
- I created **Ravel**, a program based on double-entry bookkeeping
- This **Vensim** model...

- Is equivalent to this **Ravel** model...

Figure 17.12: Transactions of Government



- *Both are still complicated*
- But the double-entry table can be understood line by line
- The flowchart accounting framework cannot...

Treasury						
Flows ↓ / Stock Vars →	Asset		Liability		Equity	A-L-E
	Deposits _{Gov}	Bonds _{CB}	Bonds _{Banks}	Bonds _{Consumers}	Treasury _{Equity}	0
Initial Conditions	0	0	0	0	0	0
Government Deficit	-Deficit				-Deficit	0
Bond Sales	Primary _{Auction}		Primary _{Auction}			0
Bond Interest to CB	-Int _{CB}				-Int _{CB}	0
Bond Interest to Banks	-Int _{Banks}				-Int _{Banks}	0
Bond Interest to Consumers	-Int _{Consumers}				-Int _{Consumers}	0
Secondary Market Sales			-Secondary _{Sales}	Secondary _{Sales}		0
Open Market Operations		OMO	-OMO			0

Central Bank					
Flows ↓ / Stock Vars →	Asset		Liability		Equity
	Bonds _{CB}	Deposits _{Gov}	Reserves	CB _{Equity}	0
Initial Conditions	0	0	0	0	0
Government Deficit		-Deficit	Deficit		0
Bond Interest to CB		-Int _{CB}		Int _{CB}	0
Bond Interest to Banks		-Int _{Banks}	Int _{Banks}		0
Bond Interest to Consumers		-Int _{Consumers}	Int _{Consumers}		0
Bond Sales		Primary _{Auction}	-Primary _{Auction}		0
Open Market Operations	OMO		OMO		0

Private Banks					
Flows ↓ / Stock Vars →	Asset		Liability		Equity
	Reserves	Bonds _{Banks}	Deposits	Banks _{Equity}	0
Initial Conditions	0	0	0	0	0
Bond Interest to Banks	Int _{Banks}			Int _{Banks}	0
Bond Interest to Consumers	Int _{Consumers}			Int _{Consumers}	0
Government Deficit	Deficit		Deficit		0
Bond Sales	-Primary _{Auction}	Primary _{Auction}			0
Secondary Market Sales		-Secondary _{Sales}	Secondary _{Sales}		0
Open Market Operations	OMO	-OMO			0

Consumers					
Flows ↓ / Stock Vars →	Asset		Liability		Equity
	Deposits	Bonds _{Consumers}		Consumers _{Equity}	0
Initial Conditions	0	0		0	0
Bond Interest to Consumers	Int _{Consumers}			Int _{Consumers}	0
Government Deficit	Deficit			Deficit	0
Secondary Market Sales	-Secondary _{Sales}	Secondary _{Sales}			0

For the Future

- Accounting finally enables system dynamics to be successfully applied in economics
- We now need to encourage a new generation of economists to use system dynamics
 - The incumbents are too far gone to communicate with, let alone worry about!
- We need a new generation which is excited by the system dynamics method
- But for that to happen, the system dynamics technology must be exciting
- The dated interfaces of Vensim, Stella are a hindrance to that future
 - Too opaque to be exciting
 - Too hard to use compared to modern GUI systems
- This is one reason why Kaoru's *magnum opus* did not get the recognition it deserves:
- We need system dynamics books to rank in the top 1000s,
 - Not outside the top million
- We will need new tools to get there...

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A richly-deserved award

- Kaoru richly deserves the ***Friede Gard Award*** for his pioneering development of the system dynamics method in economics
- **The prize we all deserve is a means to make system dynamics exciting to new students!**

