

Modeling Bank Networks: Easier Said than Done

James Spillmann and Charles Webb

University of Michigan – Complex Systems 270

INTRODUCTION

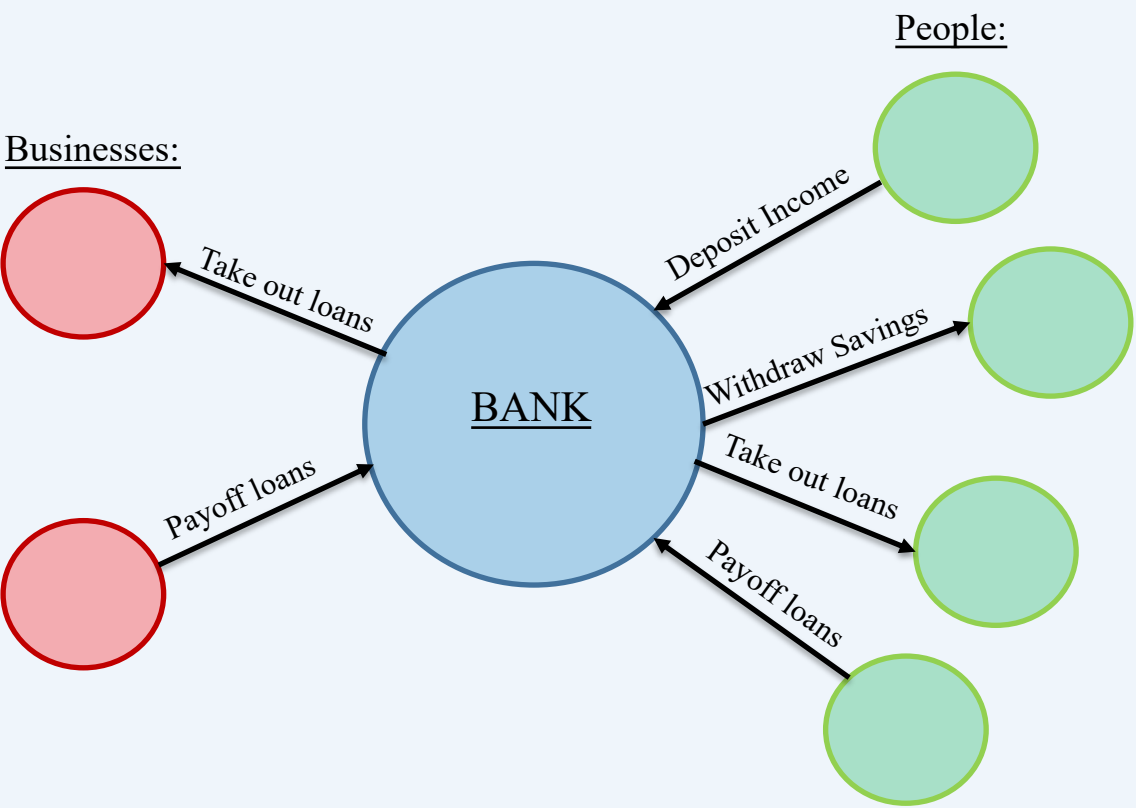
The goal of this model is to model the cashflow of banks, businesses, and individual account holders as interest rates fluctuate.

To break it down by situation as real macroeconomics demonstrates:

If interest rates are low, banks are able to borrow at lower rates and have more capital to lend to businesses and consumers. Borrowing will be cheaper as you lock in at lower rates meaning consumers and businesses are more willing to make larger purchases and loan money from the bank. In an economy of high spending and economic growth, interest rates will rise.

If interest rates are higher, borrowing money is more expensive meaning consumer spending and overall economic activity will slow. This may limit a bank's lending capacity and impact their profitability. In a weak economy with slow credit, there will be a lower demand for credit, leading to lower interest rates.

The model's possible transactions look like:



To attempt to model this behavior this model has 3 different classifications of nodes. Every node has an amount of cash and a list of loans that they either loaned out or was loaned to them. People can have accounts with the bank. This money is classified as belonging to the bank but the person has access to it and it contributes to their net worth.

Every update of the model:

- People will make their monthly income and deposit into a bank account. They then spend 50-100% of their paycheck on life necessities. People nodes will maintain a 10-30% cash/net worth ratio. Depositing money into banks if they have too much cash and withdrawing it if otherwise.
- Businesses are initialized with some money and then simply buy supplies. If they spend too much money on supplies, they will take out a loan from the bank rather than spending cash.
- Banks will collect on their loans. They will then maintain their 10-30% cash/loan ratio. If they have too much cash, they will loan out money. If they have too many loans out they will borrow cash from other banks.

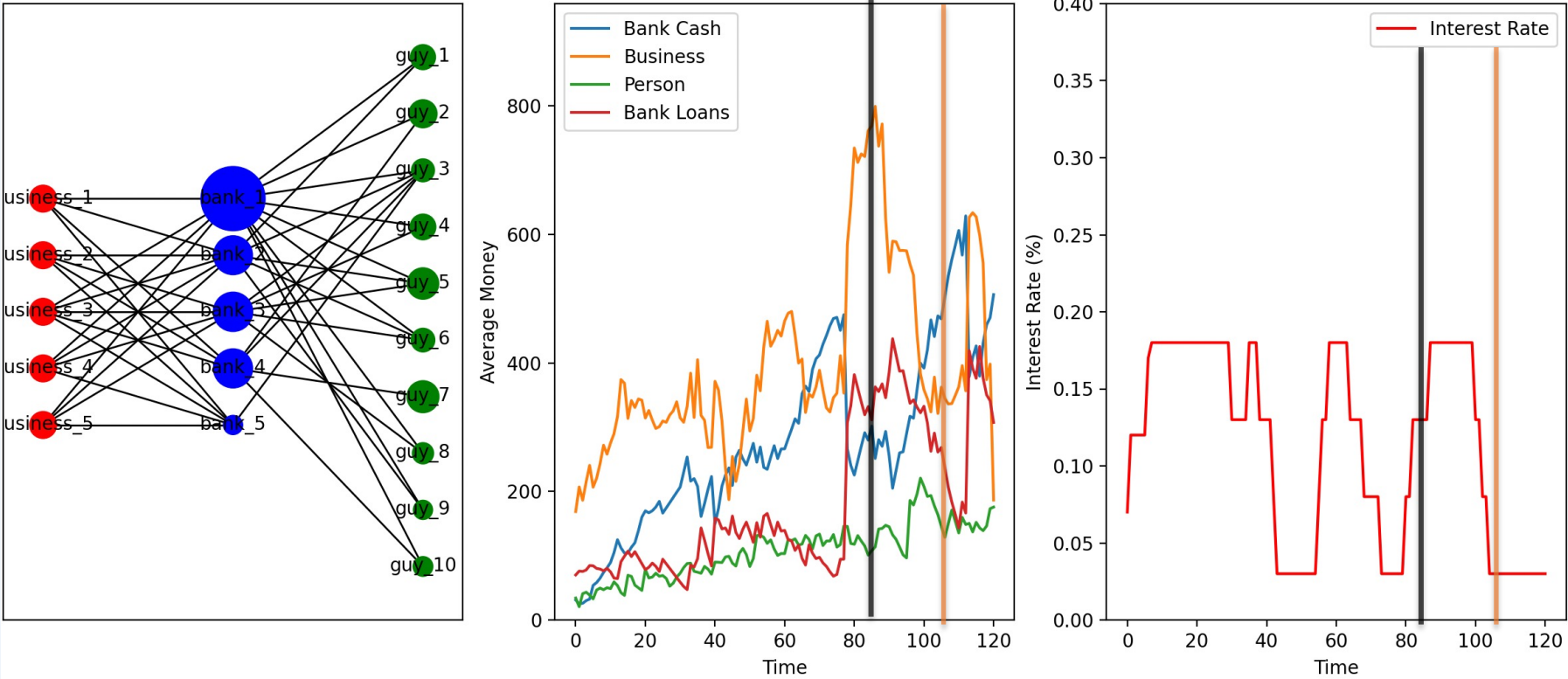
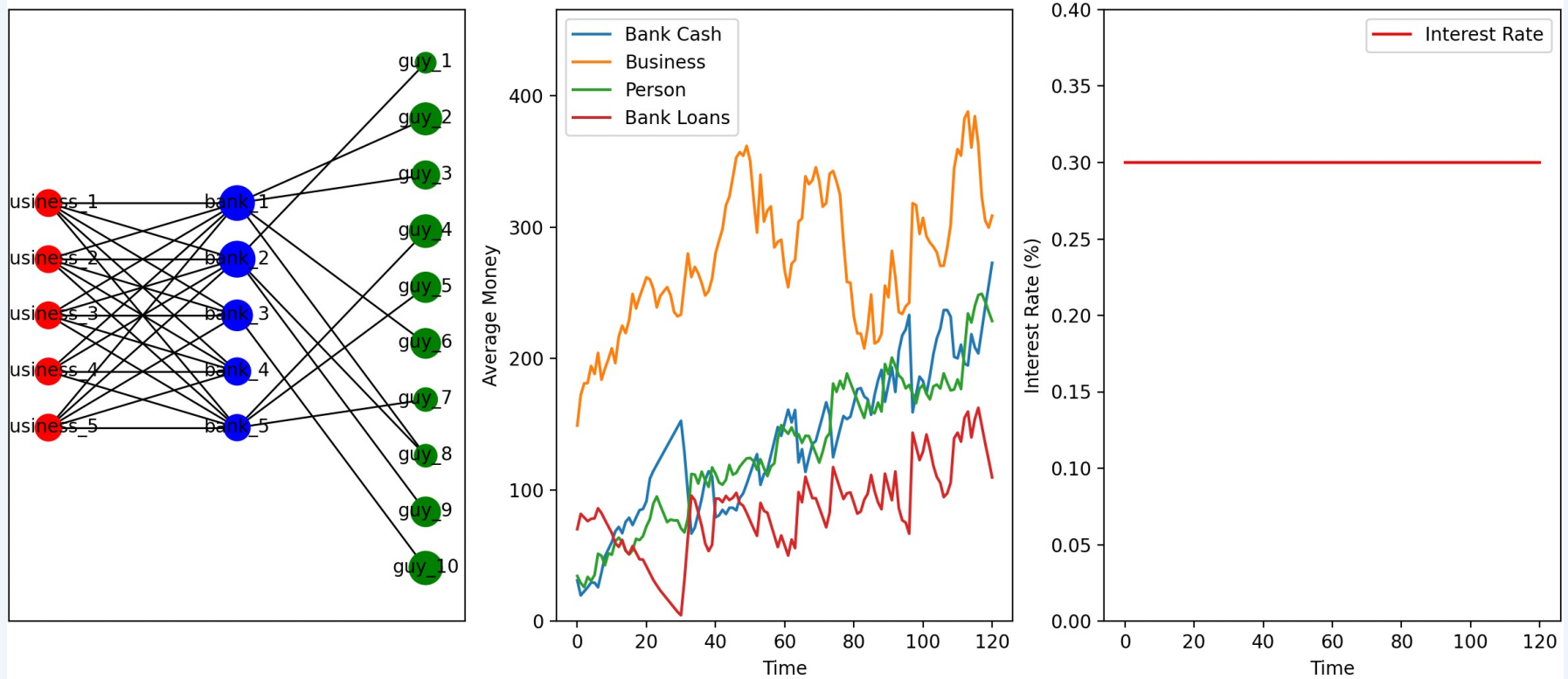
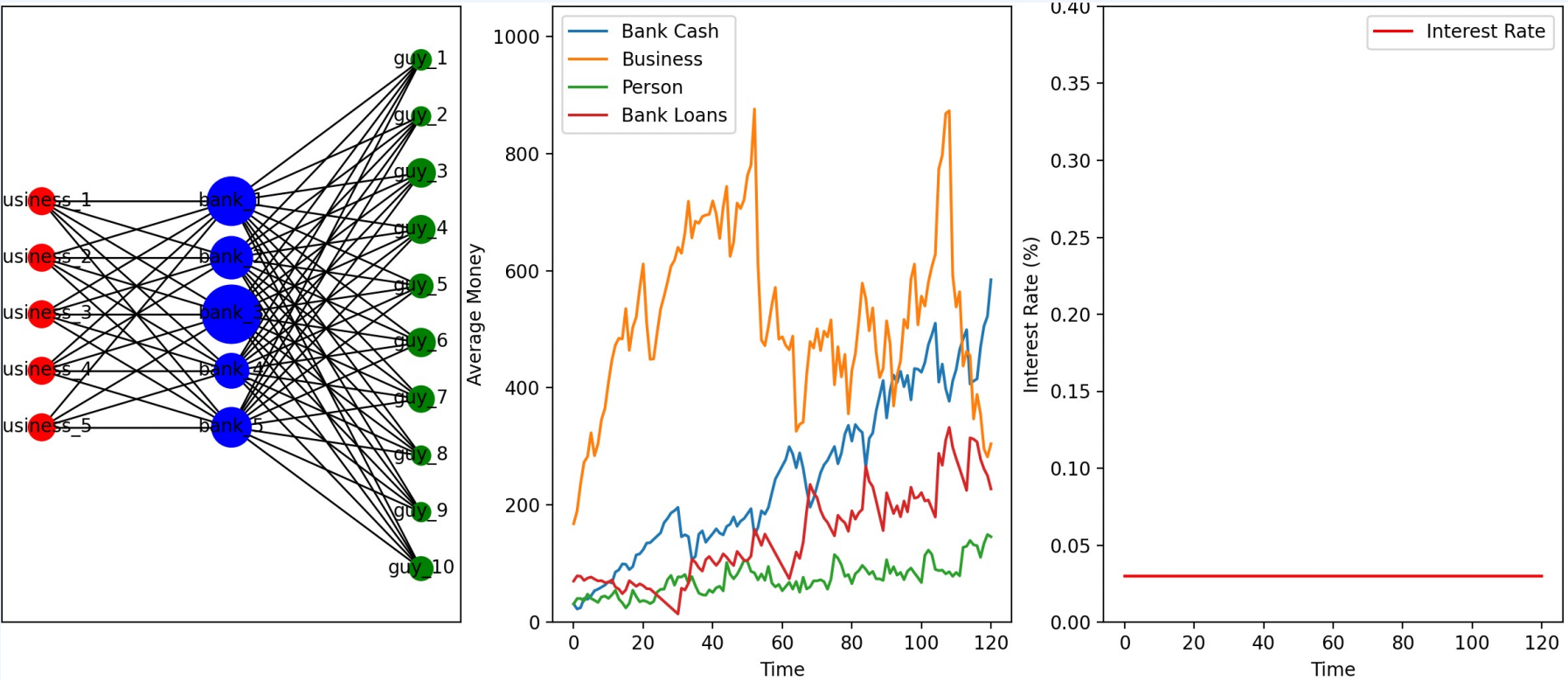
While over simplified, these behaviors are designed to simulate real economic activity.

RESULTS

- When interest rates are fixed low. Businesses and person nodes have a lot of capital.
- Every person node has maxed out the amount of bank accounts they can have to maintain less than 30% cash on hand.
- Businesses peak at an average of \$900 per business at timestep 50.
- Banks get rich at the end because of all the accounts and loans issued at 3%. Banks borrow at most \$300 per bank.

- When interest rates are fixed high (30% in this example). Businesses and person nodes have significantly less capital.
- Every person node makes at most 1 additional bank account because they have little cash.
- Businesses peak at an average of \$390 per business at timestep 110.
- Banks make less money as they borrow less. Banks borrow at most \$120 per bank.

- When interest rates are allowed to fluctuate, the market flips 6 times in this run.
- At timestep 80 (black line) interest rates rise to slow business cashflow and allow the banks to make returns on their loans. Their average loan to cash ratio exceeds 100% at this point
- At timestep 100 (green line), the market flips. Interest rate drops to allow for more market activity. Banks cash increases and loans drop. Business cash drops as they get less loans.



CONCLUSION

This model DOES NOT predict actual market happenings and should not be used by economists. However, this model is successful at modeling a reactive interest rate and how business, bank and personal cashflows are impacted by it.

To scale up this network, the person accounts should be retied to the businesses to create a loop of cashflow, more similar to real life. This model has a one directional cashflow as money spawns in as a persons income and then flows out via business spending.

The behavior of banks is representative of how a bank should operate to maintain a cash to equity ratio consistent with US solvency laws. If a bank has too much cash, it will loan more frequently to increase its equity. Although if it has too much equity, it SHOULD get bailed out by the federal government or other banks so that it can pay its account holders. In this model, if a bank does not have the cash to pay its account holders it simply crashes and the model exits.

To expand this model to simulate crashing behavior, we would need to add entities to bail out banks to avoid a global economic crash.

