

# Wage flexibility and macroeconomic instability

in an agent-based model with endogenous money

Pascal Seppacher

Centre d'Etudes en Macroéconomie et Finance Internationale - Université de Nice Sophia Antipolis

First International Symposium  
in Computational Economics and Finance  
Sousse, February 25, 2010

## 1 An Agent-based Macroeconomic Model with Endogenous Money

- Keynesian thinking : a complex thinking
- Three (post-)Keynesian concepts
- Agents & interactions
- Agent-based Computational Modeling

## 2 Simulations

- Baseline simulation
- Flexibility shock
- Minimum Wage

## 3 Conclusion

# 1 An Agent-based Macroeconomic Model with Endogenous Money

- Keynesian thinking : a complex thinking
- Three (post-)Keynesian concepts
- Agents & interactions
- Agent-based Computational Modeling

## 2 Simulations

## 3 Conclusion

# Keynesian thinking : a complex thinking

(...) after we have reached a provisional conclusion by isolating the complicating factors one by one, we then have to go back on ourselves and allow, as well as we can, for the probable interactions of the factors amongst themselves. This is the nature of economic thinking. (...)

It is a great fault of symbolic pseudo-mathematical methods of formalising a system of economic analysis (...) that they expressly assume strict independence between the factors involved (...) [These methods] allow the author to lose sight of the complexities and interdependencies of the real world (...)

J.M. Keynes, *The General Theory of Employment, Interest and Money* (1936)

# Real world modeling

Economics is a science of thinking in terms of models joined to the art of choosing models which are relevant to the contemporary world.

J.M. Keynes, *Letter to Roy Harrod* (1938)

The idea that it is comparatively easy to adapt the hypothetical conclusions of a real wage economics to the real world of monetary economics is a mistake. It is extraordinarily difficult to make the adaption, and perhaps impossible without the aid of a developed theory of monetary economics.

J.M. Keynes, *A Monetary Theory of Production* (1933)

## Monetary production economy

In a monetary production economy, 'firms need finance in order to set up and carry on any kind of production'.

A. Graziani, *The monetary theory of production* (2003)

## Economy with endogenous money

In an economy with endogenous money, 'money supply is endogenously determined by demand for bank credit from market forces'

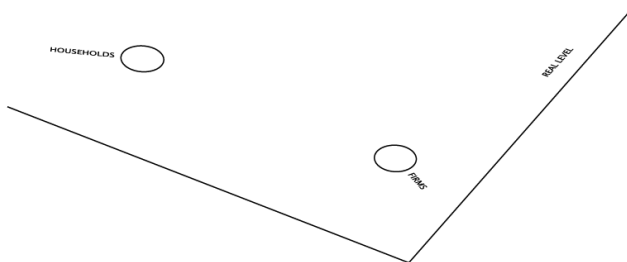
B.J. Moore, *L'endogénéité de l'offre de la monnaie* (2003)

## Entrepreneur economy

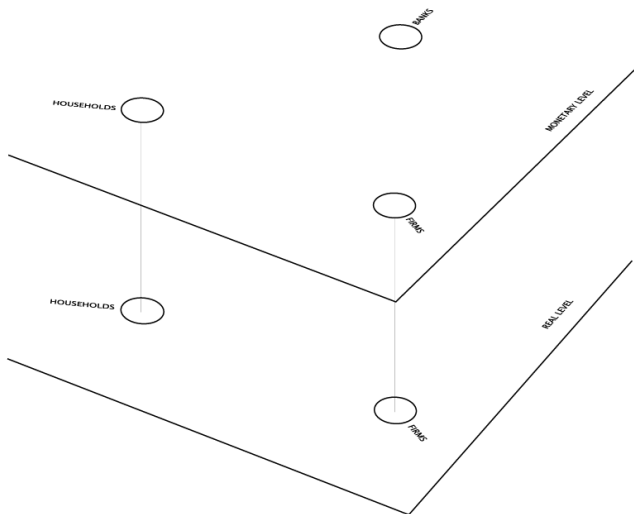
In an entrepreneur economy, firms have 'no object in the world except to end up with more money than [they] started with'.

J.M. Keynes, *The Tilton Papers, Collected Writings* (1933)

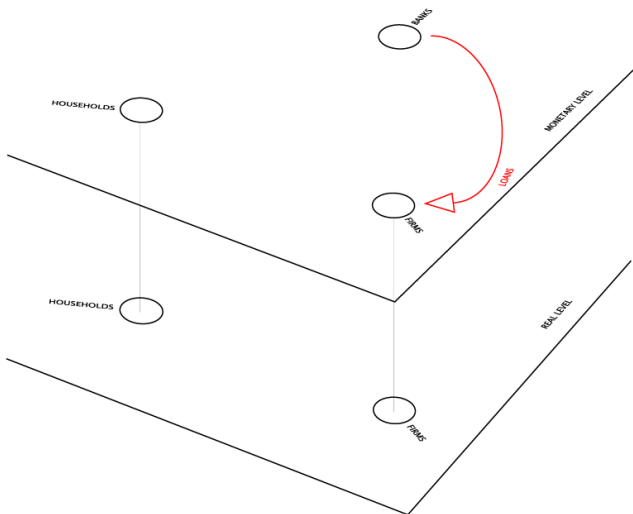
# Real level



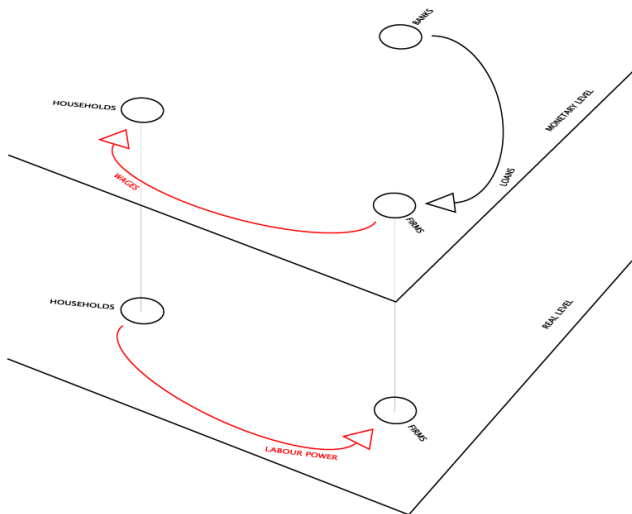
# Monetary level



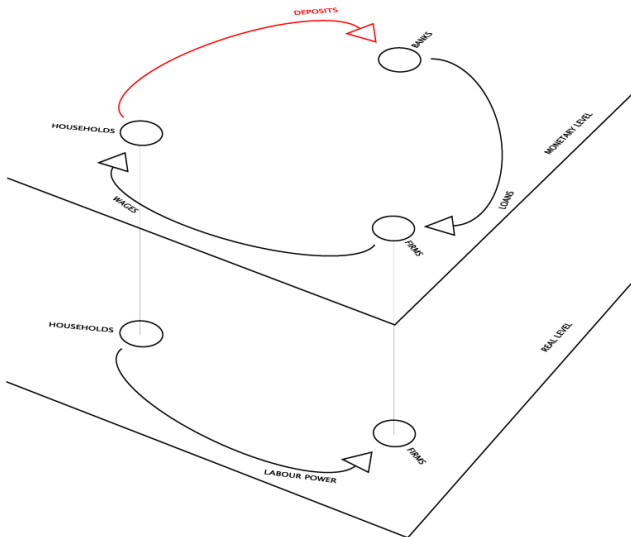
# Money enters the system by the way of bank credit.



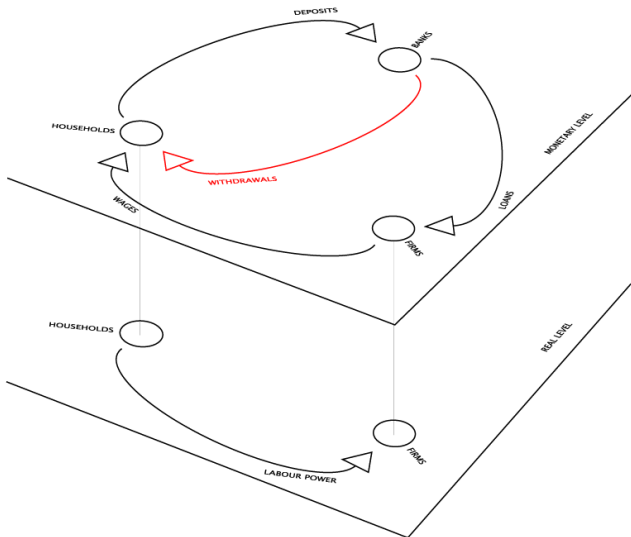
In exchange for wages, households work for firms.



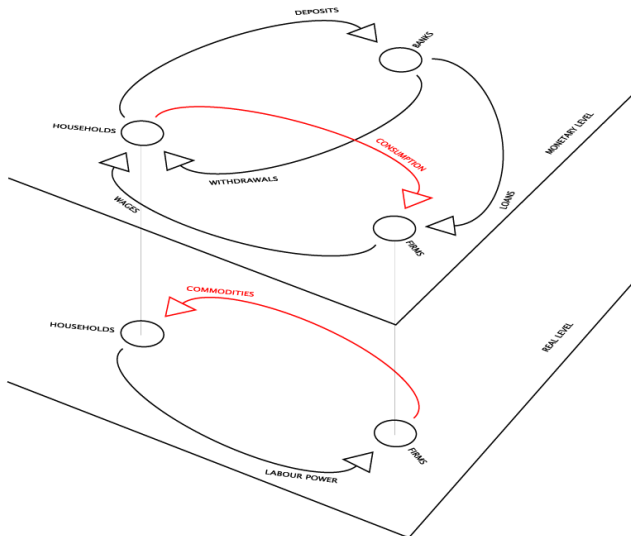
# Wages are deposited in bank accounts.



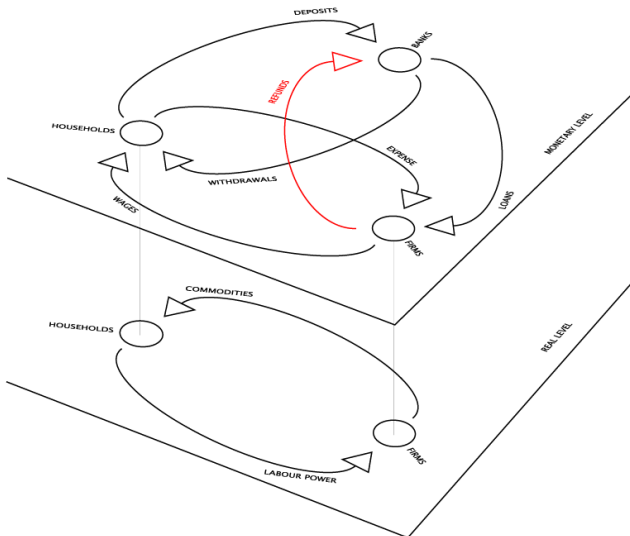
# Households withdraw money.



# Households spend money on consumption.



# Firms repay their debts to the bank.



# Agent-based Computational Modeling

Such models do not rely on the assumption that the economy will move towards a predetermined equilibrium state, as other models do. Instead, at any given time, each agent acts according to its current situation, the state of the world around it and the rules governing its behaviour.

J. Doyne Farmer & Duncan Foley, *The Economy Needs Agent-Based Modelling* (2009)

Agent-based computational methods provide the only way in which the self-regulatory capabilities of complex dynamic models can be explored so as to advance our understanding of the adaptative dynamics of actual economies.

A.Leionhufvud, *Agent-based Macro* (2006)

# Heterogenous agents & endogenous money

## An agent-based model

- 1000 households,
- 100 firms,
- 1 bank.

## A monetary production economy model

- bank credit is the only source of money creation,
- production financing is the only motive of credit.

## A computational model

- implemented in Java,
- in-line interactive software.



# 1 An Agent-based Macroeconomic Model with Endogenous Money

## 2 Simulations

- Baseline simulation
- Flexibility shock
- Minimum Wage

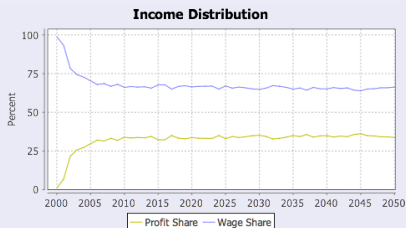
## 3 Conclusion

# Baseline simulation

Launch simulation

The model exhibits :

- a stable rate of return,
- a stable real wage,
- a stable income distribution.



The stabilization of the income distribution is not directly deductible

- nor from microeconomic behavior assigned to agents
- neither from structure imposed by monetary flows.

# The stability of income distribution : an emergent property

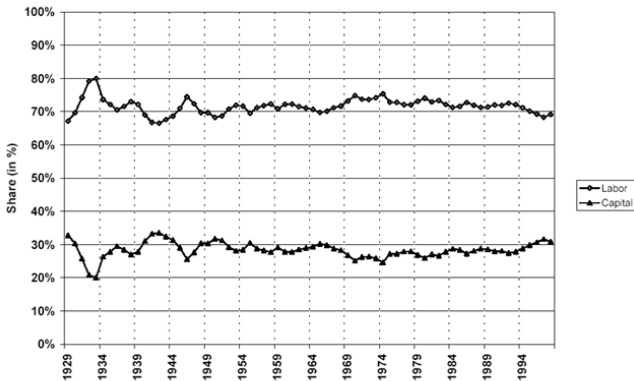
The stability of the proportion of the national dividend accruing to labour (...) is one of the most surprising, yet best-established, facts in the whole range of economic statistics, both for Great Britain and for the United States.

(...) the result remains a bit of a miracle.

J.M. Keynes, *Relative Movements of Real Wages and Output* (1939)

# The stability of income distribution : a stylised fact

Figure 9: Factor shares in the U.S. corporate sector, 1929-1999



Source: Authors' computations based on National Accounts  
(NIPA Table 1,16; CFC and net interest have been included in the capital share)

T. Piketty et Saez (2001), *Income Inequality in the United States* (2001)

# Flexibility shock

In this experimentation we simulate a flexibility shock by changing the households resistance to cuts in money wages ( $r$ ).

- before the shock  $r = 8$
- after the shock  $r = 3$
- shock year = 2030



Launch simulation

## Reduction of the money-wage & Instability

(...) the precise question at issue is whether the reduction in money-wages will or will not be accompanied by the same aggregate effective demand as before measured in money (...)

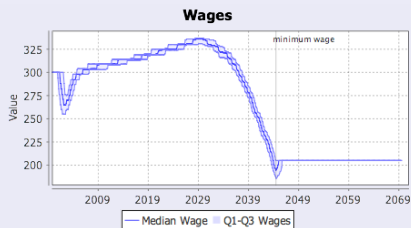
For if competition between unemployed workers always led to a very great reduction of the money-wage, there would be a violent instability in the price-level. Moreover, there might be no position of stable equilibrium except in conditions consistent with full employment (...)

J.M. Keynes, *The General Theory of Employment, Interest and Money* (1936)

# Minimum Wage

In the current experimentation we simulate the introduction of a minimum wage ( $\bar{w}$ ), restoring rigidity in the labor market after the flexibility shock.

- $\bar{w} = 205$
- *year* = 2045



Launch simulation

# Stickiness

In fact we must have some factor, the value of which in terms of money is, if not fixed, at least sticky, to give us any stability of values in a monetary system.

J.M. Keynes, *The General Theory of Employment, Interest and Money* (1936)

- 1 An Agent-based Macroeconomic Model with Endogenous Money
- 2 Simulations
- 3 Conclusion**

# Conclusion

## Main results

- agent-based macroeconomic model,
- with endogenous money,
- emergent properties :
  - ▶ income distribution stability,
  - ▶ role of sticky money-wages.

# Conclusion

## Limitations & prospects

- a very simple model,
- no investissement,
- no financial market,
- one single bank,
- a closed economy,
- but no theoretical obstacle to the extension of the model to those complexity features

# Conclusion

## Policy design and forecasting

Such economic models should be able to provide an alternative tool to give insight into how government policies could affect the broad characteristics of economic performance, by quantitatively exploring how the economy is likely to react under different scenarios.

In principle it might even be possible to create an agent-based economic model capable of making useful forecasts of the real economy, although this is ambitious.

J.D. Farmer & D. Foley, *The Economy Needs Agent-Based Modelling* (2009)