# Overview

on considere une economie constituee de:

- 02 secteurs: rural et urbain

- 02 secteurs urbains: formel et informel

- 02 secteurs informels: avance et retarde

les formes de dualismes considerees sont:

- le dualisme geographique (urbain/rural)

- le dualisme technologique (avancee/retarde)

- le dualisme du marche du travail (formel/informel)

On a donc 04 secteurs $k$ dans lequel sont regroupes les entreprises:

- un secteur rural ($k = 1$)

- un secteur urbain formel ($k = 2$)

- un secteur urbain informel avancee ($k = 3$)

- un secteur urbain informel retardee ($k = 4$)

| | Secteur 1 | Secteur 2 | Secteur 3 | Secteur 4 |

| --- | --- | --- | --- | --- |

| Region | Rural | Urbain | Urbain | Urbain |

| Type de travail | Informel | Formel | Informel | Informel |

| Acces au credit | Non | Oui | Oui | Non |

| Biens produits | Agricoles | Manufacturees | Manufacturees | Intermediaires |

| Technologie | Retardee | Avancee | Avancee | Retardee |

On a egalement 06 categories $z$ de menages:

| Categorie | Secteur | Statut | Description |

|:-:| --- | --- | --- |

| 1 | rural | entrepreneur | paysans |

| 2 | urbain formel | entrepreneur | entrepreneurs formels |

| 3 | urbain informel | entrepreneur | entrepreneurs informels |

| 4 | urbain formel | salaries | salaries formels |

| 5 | urbain informel | salaries | salaries informels |

| 6 | urbain | \*aucun\* | chomeurs |

Une approche en termes d'informalite base sur le concept de degre d'informalite.

On regroupe des les normes qui sont les regles formelles que doivent resspecter une entreprise dans un cadre institutionnel donne. Distinguons alors deux normes:

- les normes du travail (regles formelles regissant la relation salariale)

- les normes de credit (regles formelles regissant l'acces au credit bancaire)

on peut alors segmenter le marche du travail en deux segments:

- le marche du travail formel (ou les participants respectent les normes du travail)

- le marche du travail informel (ou les participants respectent les normes du travail)

on peut egalement segmenter le marche du credit en deux segments:

- le marche du credit formel (ou les participants respectent les normes du credit)

- le marche du credit informel (ou les participants respectent les normes du credit)

les niveaux d'informalite sont alors:

| Niveaux | Respect des normes |

|---| ---|

|Informel (0)| Ne respecte aucune norme|

|Semi-formel (1)| Ne respecte qu'un groupe de normes |

|Formel (2) | Respecte toutes les normes |

si l'on note:

- $n$ le degre d'informalite

- $n^N$ le respect des normes du travail

- $n^L$ le respect des normes du credit

on a:

$$

n = n^N + n^L

$$

Pour l'emploi on peut donc definir une structure de l'emploi comme un repartition des emploi entre le secteur prive et public et le segment formel et informel du marche du travail:

| |Travail Formel|Travail Informel| $\Sigma$ |

|--- | :-: | :-: | :-: |

| Secteur Prive | $N\_{F1}$ | $N\_{F2}$ | $N\_{F}$ |

| Secteur Public | $N\_{G}$ | | $N\_{G}$ |

| $\Sigma$ | $N\_1$ | $N\_2$ | $N$ |

Pour l'informalite on peut egalement definir une repartition des firmes dans un secteur $k$ comme suit:

| |Travail Formel|Travail Informel| $\Sigma$ |

|--- | :-: | :-: | :-: |

|Credit Formel | $Z\_{Fk11}$ | $Z\_{Fk12}$ | $Z\_{Fk1.}$ |

|Credit Informel | $Z\_{Fk21}$ | $Z\_{Fk22}$ | $Z\_{Fk2.}$ |

| $\Sigma$ | $Z\_{Fk.1}$ | $Z\_{Fk.2}$ | $Z\_{Fk}$ |

## Purpose and Patterns

## Entities, State Variables, and Scales

## Process overview and scheduling

# Design Concepts

## Basic Principles

## Emergence

## Adaptation

## Objectives

## Learning

## Prediction

## Sensing

## Interaction

During each period of the simulation agents interact on six types of spaces:

* Regions: all agents interact with neighbors;
* Goods markets: households interact with firms;
* Labor markets: households interact with government and firms;
* Credit market: firms interact with banks;
* Deposit market: households and firms interact with banks;
* Bonds market: government interact with banks and central banks.

### Matching protocols

Following Riccetti et al. (2014), we explicitly model agents' dispersed interactions by assuming that agents on the demand and supply sides of each market interact through a common matching protocol. In each period of the simulation, ‘demand’ agents are allowed to observe the prices or the interest rates charged by a random subset of suppliers (whose size depends on a parameter χ reflecting the degree of imperfect information). Agents' switch from the old partner to the best potential partner selected in this random subset with a probability Prs which is defined, following Delli Gatti et al. (2010a), as a non-linear (decreasing when the price/interest represents a disbursement for the demander, increasing otherwise) function of the percentage difference in their prices pold and pnew. The shape of this function is governed by the ‘intensity of choice’ parameter ε 4 0: higher values of ε 4 0 imply a higher probability of switching.11 In some cases, some suppliers exhaust inventories available for sale, possibly leaving some customers with a positive residual demand. We then allow demand agents to look for other suppliers within the original random subset of potential partners in order to fulfill it. Markets interactions are ‘closed’ when demand agents have fulfilled their demand, when there are no supply agents willing or able to satisfy their demand, or if demanders run out of deposits to pay for demanded goods.

### Economic transactions and financial transfers

Agents' interactions generate several types of economic transactions and financial transfers. As argued before, a clear-cut description of the types of real and financial flows taking place in the model is a key aspect for assessing the accounting and logical consistency of a model. Hence, we classify the flows arising in the model as follows:

Deposit transfers: If agents involved hold their deposits at the same bank, payer's deposit is decreased and receiver's increased. Otherwise, also a reserve transfer for the same amount from the payer's bank to the receiver's bank takes place. The same occurs when an agent decides to move its deposits to a new bank.

Dividends and deposits interests: Firms pay dividends through deposit transfers. Interests on deposits are paid by simply increasing customers' deposits by the required amount. The same occurs for dividends, when the receiver holds a deposit at the paying bank. Otherwise, also a reserve transfer for the dividend amount from the paying bank to the receiver's bank takes place.

Private workers' wages: wages of private workers by firms are paid via a deposit transfer, as explained above.

Public servants' wages and dole: public workers' wages and unemployment benefits give rise to the same type of transfers. The receiver's deposit is increased while reserves are subtracted to the government account at the Central Bank and transferred to the receiver's bank.

Taxes: firms' and households pay taxes using their deposits. Accordingly, the payer's bank transfers reserves for the same amount to the government account at the Central Bank. Banks pay taxes by transferring reserves to the government account at the Central Bank.

Purchases of real goods: transactions in real goods are cleared via a deposit transfer. Contextually, also real goods motivating the transaction are transferred from the seller's to the buyer's asset side.

Purchases of bonds, repayment, and interests: Bonds are a liability for the government and an asset for banks and the Central Bank. Central Bank's purchases increases its liabilities (i.e. reserves, that is legal money) while also increasing the government account at the Central Bank. Interests on bonds are immediately re-distributed to the government. Commercial banks purchases of bonds are cleared via a transfer of reserves from banks to the government current account at the Central Bank. Bonds repayments and bonds interest payments give rise to the opposite flows.

Loans creation, repayment, and interests: Loans and matching deposits are created endogenously and ex-nihilo as explained above. Interest payments and principal repayments (reducing the stock of loans) give rise to the same type of transfers. If borrower's deposit bank coincides with the lending bank, the payment is realized by lowering the borrower's deposit. If the borrower's moved his deposits to another bank, also a corresponding reserves transfer from the borrower's bank to the lending bank takes place.

Cash advances creation, repayment, and interests: Cash advances are a loan extended by the Central Bank to commercial banks which is matched by a temporary increase of banks' reserves (a liability for the Central Bank). Conversely, cash advances repayments extinguished the loan while reducing commercial banks' reserve accordingly. Interest payments give rise to the same type of transfer, reducing private banks' reserves. Interests on cash advances are distributed to the government by increasing its deposit account at the Central Bank.

## Stochasticity

## Collectives

## Observation

# Details

## Initialization

we adopted the six-step strategy proposed by Caiani et al. [1]. This strategy involves:

1. creating an aggregate version of the agent-based model
2. constraining it to a real stationary state (SS) associated with a nominal steady growth of prices and wages 
3. numerically solving the constrained model with reasonable values of parameters to obtain initial values of stocks, flows and prices
4. distributing these initial values uniformly across agents created within each sector
5. determining the original amount, outstanding values, age of durable stocks
6. setting the initial network configuration by assigning randomly contractors or suppliers to agents

presenter les matrices de stocks et flux a obtenir

Ce modele s’inspire du modele GROWTH de Godley et Lavoie [2]. Dans ce modele on considere qu’il n’ya pas d’inventaires ou de capital fixe.

Table . Balance sheet of Dual Monetary Economy

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Households | Firms | Banks | Government | Central bank |  |
| HP Money |  |  |  |  |  |  |
| Cash Advances |  |  |  |  |  |  |
| Deposits |  |  |  |  |  |  |
| Bonds |  |  |  |  |  |  |
| Loans |  |  |  |  |  |  |
| Equities |  |  |  |  |  |  |
| Balance |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

On suppose qu’il n’y a pas de changement dans la valeur des fonds propres (on suppose que les marches financiers sont inexistants)

Table 2. Transactions matrix of Dual Monetary Economy

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Households | Firms | Banks | Government | C. bank |  |
| Consumption |  |  |  |  |  |  |
| Wages |  |  |  |  |  |  |
| Transfers |  |  |  |  |  |  |
| Taxes |  |  |  |  |  |  |
| Interests on advances |  |  |  |  |  |  |
| Interests on bonds |  |  |  |  |  |  |
| Interests on loans |  |  |  |  |  |  |
| Interests on deposits |  |  |  |  |  |  |
| Entrepreneurial profits |  |  |  |  |  |  |
| Central Bank profits |  |  |  |  |  |  |
| Change in advances |  |  |  |  |  |  |
| Change in bonds |  |  |  |  |  |  |
| Change in HP Money |  |  |  |  |  |  |
| Change in loans |  |  |  |  |  |  |
| Change in deposits |  |  |  |  |  |  |
| Change in equities |  |  |  |  |  |  |
| Loan defaults |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

### Computation of initial stocks, flows and prices

We divided the SS system of equations of the aggregated model in four sub-systems or block. Description de la methode de resolution

#### Firms stationary state equations

The first block contains the equations which refer to firms.

mesurer la mise en oeuvre d’une politique public a travers le concept d’intensite de l’instrument

let x be the variation and y the rate, such that:





For example, let’s consider  a deposit, we can write:





For each category of firms :













for firms of modern sector















for firms of rural or urban traditional sectors :











#### Banks stationary state equations

the third refers to banks and the public sector (government and central bank).





















#### Households stationary state equations

the second presents the set of equations related to households and rural households















urban households:



















With bank equities computed we can now calculate hosueholds equities:





#### Public sector stationary state equations

the third refers to banks and the public sector (government and central bank).

















### Creation of agents, networks and environment

presentation des agents, de la méthode de creation des networks, du placement des agents dans l’environment.

## Input Data

parametres

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Code** | **Description** |
|  | g\_ss | Grow rate of prices and wages in stationary state |
|  | N\_E1 | Number of entrepreneurs in sector 1 |
|  | N\_E2 | Number of entrepreneurs in sector 2 |
|  | N\_E3 | Number of entrepreneurs in sector 3 |
|  | N\_W1 | Number of employees in sector 1 |
|  | N\_W2 | Number of employees in sector 2 |
|  | N\_W3 | Number of employees in sector 3 |
|  | N\_WG | Number of employees in public sector |
|  | N\_U | Number of unemployed |
|  | phi1 | Productivity in sector 1 |
|  | phi2 | Productivity in sector 2 |
|  | phi3 | Productivity in sector 3 |
|  | w1 | Initial wage in sector 1 |
|  | w2 | Initial wage in sector 2 |
|  | w3 | Initial wage in sector 3 |
|  | w\_G | Initial wage in public sector |
|  | w\_min | Minimum wage |
|  | tau | Tax rate |
|  | rho | Dividend policy |
|  | m | Markup rate |
|  | alpha\_b1 | Propension to consume goods 1 in urban region |
|  | alpha\_a2 | Propension to consume goods 2 in rural region |
|  | theta\_W | Desired liquidity share of wage bill |
|  | theta\_E | Initial equity share of banks assets |
|  | theta\_M | Initial bank liquidity ratio |
|  | theta\_Zbar | Reglementary portion of minimum wage dedicated to dole |
|  | r\_D | Interest rate on deposits |
|  | r\_L | Interest rate on loans |
|  | r\_B | Interest rate on bonds |
|  | r\_A | Interest rate on cash advances |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## Submodels

**References**