The financial market in EURACE

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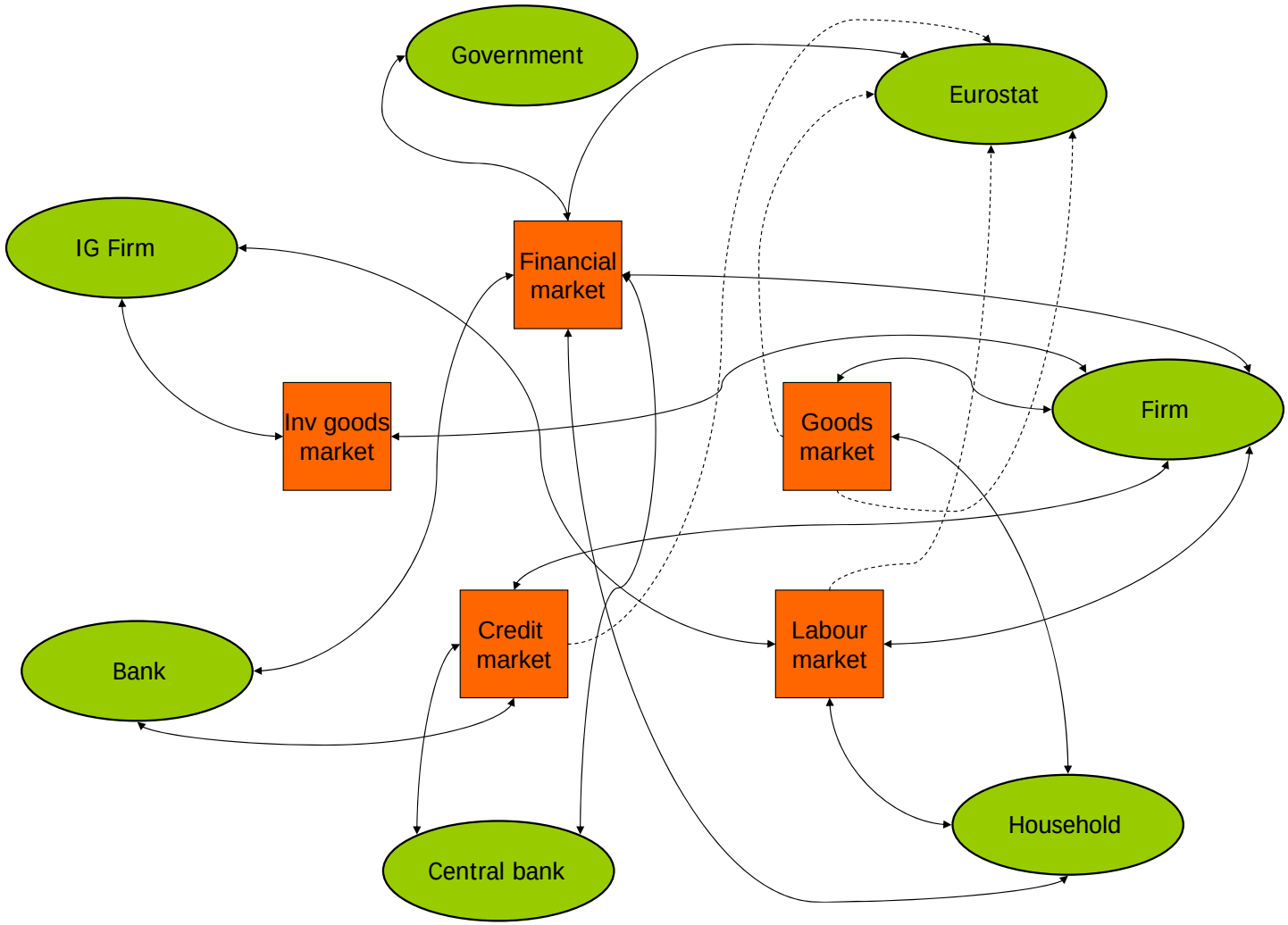
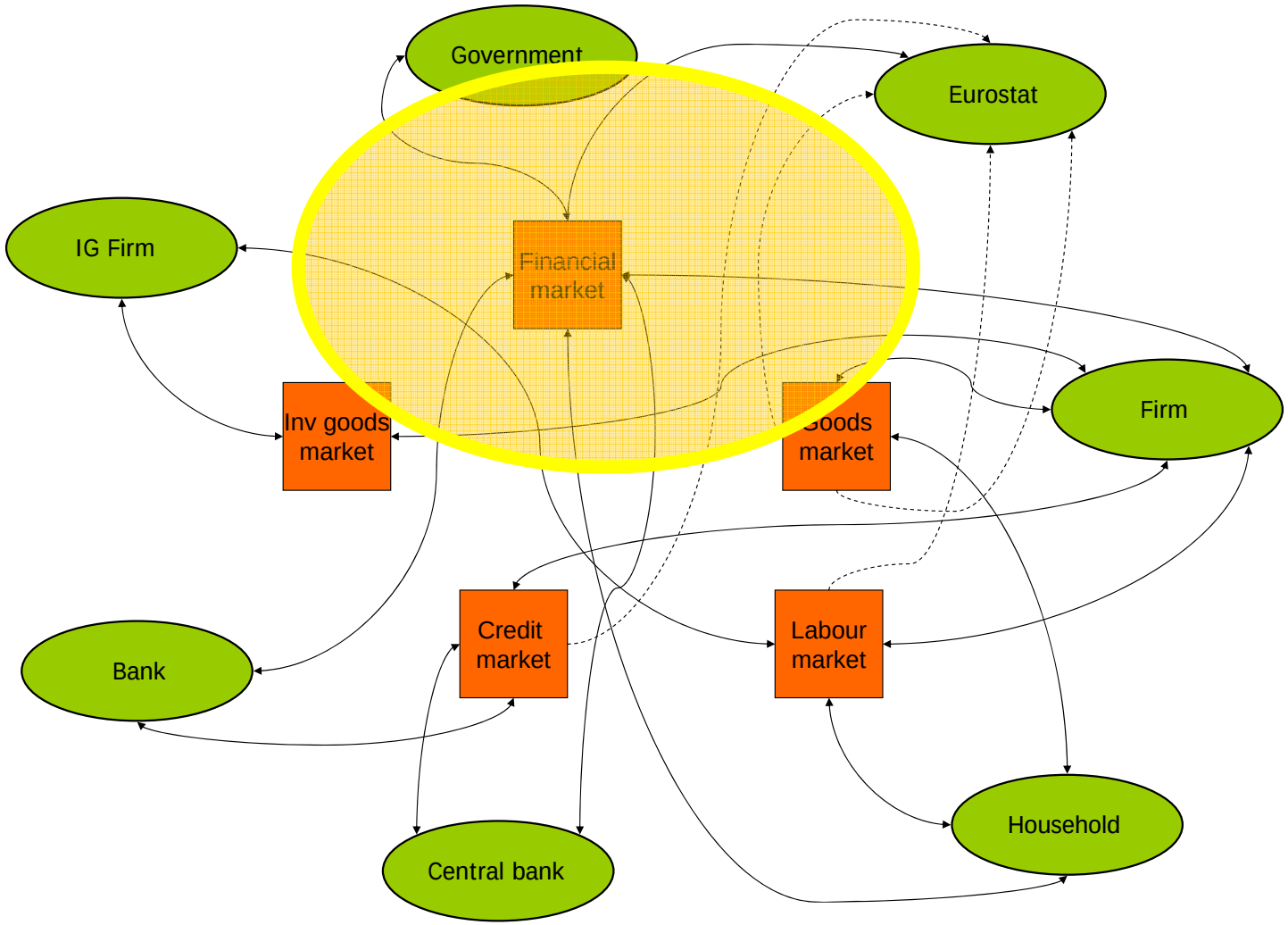
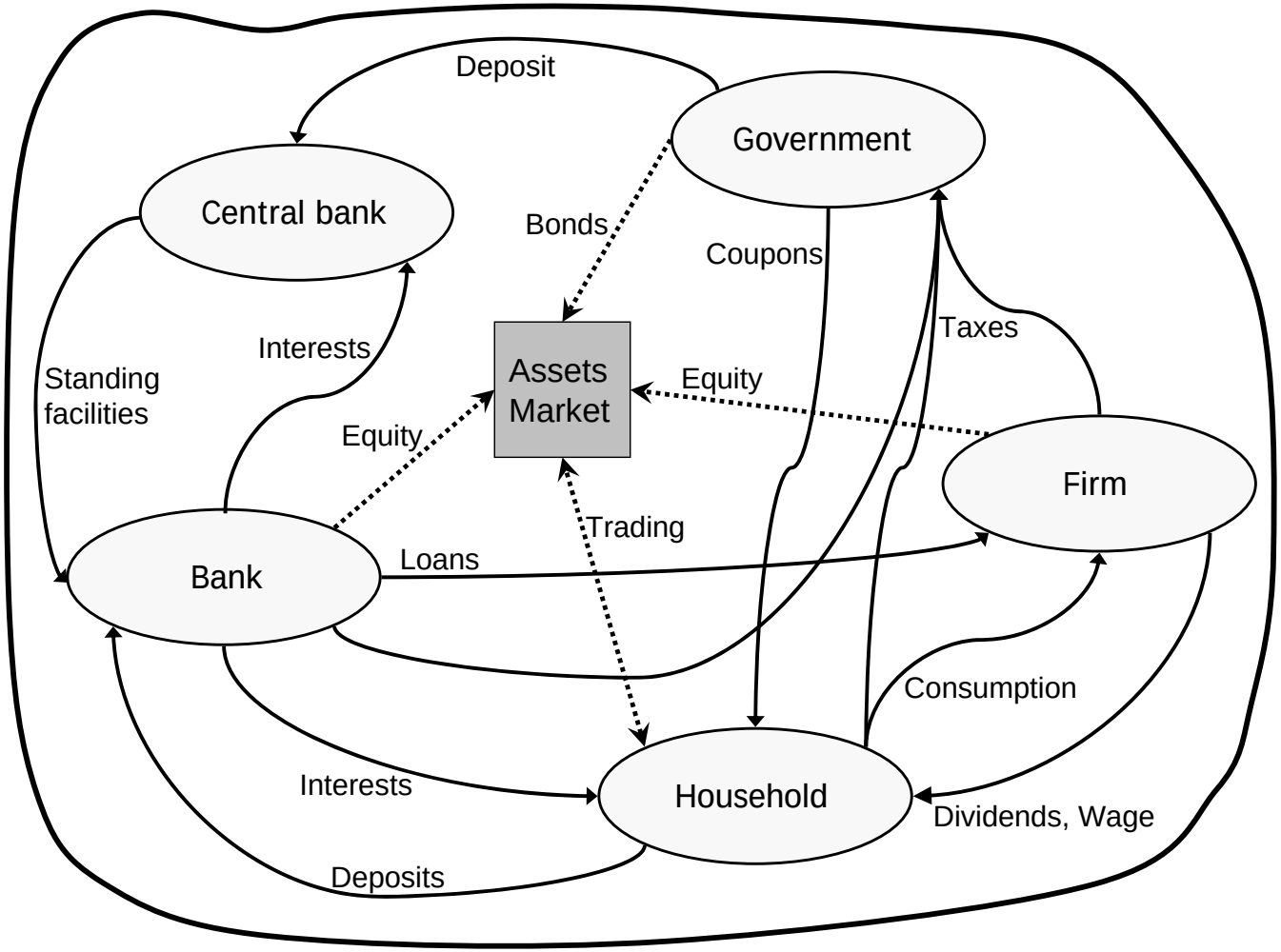
The EURACE framework



The EURACE framework

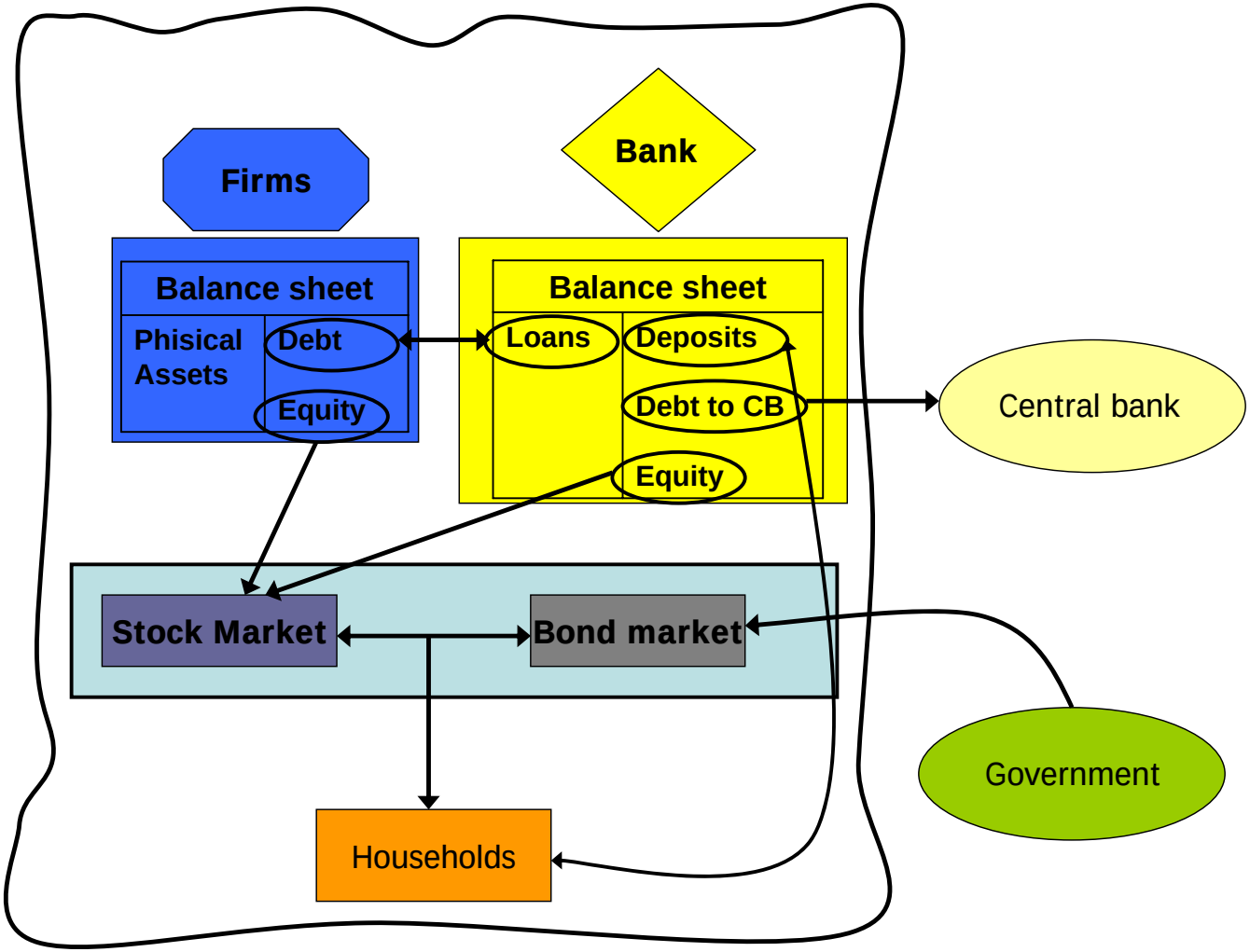


The financial market of EURACE



Balance sheets

AFE



Firms

- A^j: endowment of physical capital for each firm j
- θ^j: fraction of earnings paid to shareholders, i.e., $\mathcal{N}^j d^j_\tau = \theta^j_\tau \pi^j_\tau$
- $\widehat{\pi}^j_\tau = \pi^j_\tau - \mathcal{N}^j d^j_\tau$: retained earnings
- Firm bankruptcy: firm's assets value is set to 0

Earnings payout policy (under study)

- θ^j varies depending on the difference between the return (cost) on equity (ROE) and the cost of debt r^L:
  - θ^j is increased if ROE higher than r^L
  - otherwise θ^j is decreased
- the ROE is computed as the ratio between net earnings and market value of equity (i.e., stock market capitalization)

Other actors in the financial market

- The commercial bank
  - collects households saving accounts setting the deposit rate at a discounted values with respect to the central bank policy rate r_τ
- The central bank
  - implements monetary policy setting the policy rate r_τ which is the cost of money borrowed by the commercial bank
- Governments
  - Governments issue long-term bonds in order to finance the budget deficit
  - Bonds have a face value which is paid at the maturity date, and pay fixed coupons to bondholders anchored to the central bank policy rate

Households

- Households are simultaneously taking the roles of workers, consumers and market traders
- They receive a labor income if employed and an unemployment subsidy if unemployed
- Households' saving-consumption decisions are modelled according to the theory of buffer-stock saving behaviour: consumption depends on a precautionary saving motive, determined by a target level of wealth to income ratio
- They can either invest their savings in the asset market or can put them in a saving account that pays a fixed, risk-free interest rate

Forward horizon and evaluation period

- each household *i* forms beliefs about assets future returns according to a given forward horizon h^i (around 3 months), considering both price returns and cash flow yields (dividends and coupons)
- The probability of beliefs updating and market entry is $\frac{1}{h^i}$
- The implied idea is that households are able to foresee assets trends only for short periods of time, also if they plan to hold their assets for a longer period of time
- Besides, each household *i* is characterized by an evaluation period ϵ_i which is a multiple of the forward horizon and is used to compute preferences and evaluate investments

Stylized behaviors

- expected price returns depend on three stylized behavior:
  - random: returns are random draws from a gaussian distribution
  - chartist: returns depend on past price trends, computed in a backward time window
  - fundamentalist: returns are computed considering expected fundamental price at the given forward horizon h^i as:

$$p^i_{f_j} = \left(E^j_\tau + \sum_{k=1}^{h^i} \widehat{\pi}^j_{\tau+k} \right) / \mathcal{N}^j$$

- Composing the three terms and adding expected cash flow yields $y^e_{j,i}$ (i.e., dividends for stocks and coupons for bonds), households determines a set of total expected returns $\rho_{j,i}$ as

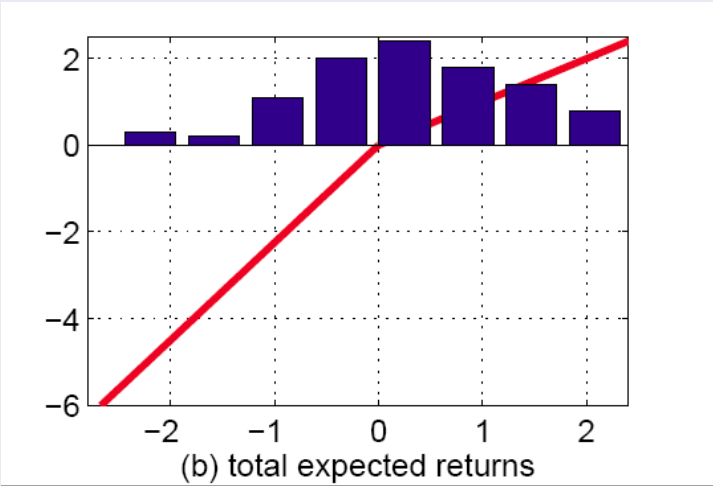
$$\rho_{j,i} = \alpha^r_i \rho^r_{j,i} + \alpha^c_i \rho^c_{j,i} + \alpha^f_i \rho^f_{j,i} + y^e_{j,i}$$

where α^r_i, α^c_i and α^f_i are household's weights that sum to one.

Beliefs formation

- households build a mental histogram $H[\rho_{j,i}]$ where the set of total expected returns is grouped in M_i bins. A large number of bins M_i means the household is more careful when examining assets past performance.

The histogram and the value function



- The prospect in form of histogram. The value function represents the psychological characteristics of the household

Preferences based on Prospect Theory

- beliefs are modeled through a prospect, characterized by a set of total expected returns with the relative probability, e.g. $\left[(-0.02,0.25)\ ,\ (-0.01,0.5)\ ,\ (0.01,0.25)\right]$
- the value function is then used to compute utilities as $U = \sum_{\rho} prob(\rho) V(\rho)$ where:

$$\begin{aligned} V(\rho) &= \lambda\rho \quad (\rho < 0) \\ V(\rho) &= \rho \quad (\rho > 0) \end{aligned}$$

  $\lambda > 0$: loss aversion
- utilities are finally normalized and mapped into assets weights by means of a linear transformation.

Myopic loss aversion

- the prospect is iterated n times according to the evaluation period of the household which is a multiple of the forward horizon

Mental accounting

$n = 1$
Prospect: $\left[(-0.01,0.5)\ ,\ (0.02,0.5)\right]$
$U = 0$ $(\lambda = 2)$
Iterated Prospect: $\left[(-0.02,0.25)\ ,\ (0.01,0.5)\ ,\ (0.04,0.25)\right]$
$U = 0.005$ $(\lambda = 2)$

- loss aversion combined with a short evaluation period is called myopic loss aversion

Order issuing

- In order to issue orders, the i-th household evaluates a limit price $L_t^{i,a}$ for each asset a, given by

$$L_t^{a,i} = P_{t-1}^a(1 + \widehat{\rho}_t^{a,i}) \,.$$

  where $\widehat{\rho}_t^{a,i}$ is the expected return for the next day
- Next, each household computes the newly desired asset holdings $q_t^{a,i}$, given by the integer part of

$$q_t^{a,i} = \frac{\omega_t^{a,i}\left(X_t^i - C_t^i\right)}{L_t^{a,i}} \quad \forall a,$$

  where $\omega_t^{a,i}$ are the new desired asset weights determined according to the preference scheme, and $\left(X_t^i - C_t^i\right)$ is the amount of resources available for the financial market

Order issuing II

- Finally, the household decides to issue buy or sell orders so as to cancel the gap $\Delta q_t^{a,i} = q_t^{a,i} - q_{t-1}^{a,i}$ between its current portfolio and the desired one. Each order is a limit order characterized by a limit price $L_t^{a,i}$ and a quantity $\Delta q_t^{a,i}$.

- If $\Delta q_t^{a,i}$ is positive the i-th household issues a buying order for asset a, if $\Delta q_t^{a,i}$ is negative it is a selling order.

The clearing mechanism

- the price formation process is centralized and modeled according to a clearing house mechanism
- Buying and selling orders are collected by the clearing house that builds cumulative demand and supply curves on a common price grid. The price P_t^a that clears the market, at the crossing point between demand and supply, is chosen in order to maximize the transaction's amount
- All the traders whose limit prices are compatible with the clearing price ($L_t^{i,a} \geq P_t^a$ for buyers, $L_t^{i,a} \leq P_t^a$ for sellers) are selected for the transaction; however some of them will be rationed.
- A priority order is randomly generated and agents carry out their transactions following the order. When all the amount of stocks is traded, agents in the successive positions are rationed

The clearing mechanism

- Matching of the demand $f_h(p)$ and of the supply $g_h(p)$ curve