

# Inequality and Policy Changes: The case of the decline of inflation in open economies

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- Strong evidence on household inequality inside countries and differences of inequality across countries.
- How important is this evidence for policy evaluation?  
Not just the equity effect but even when the focus is on efficiency.
- We evaluate a policy change which should take into account this inequality: the decline in average inflation (the most widespread and sustained policy change in the last decades).
- Compatible with empirical evidence on transactions patterns

# Empirical evidence on transactions

- High income individuals use cash and cash plus checks for a smaller fraction of their transactions than low income individuals.
- The fraction of household wealth held in liquid assets decrease with income and wealth.
- A nontrivial fraction of households does not own a checking account and/or does not use credit cards to perform transactions.

## Questions:

- To evaluate welfare costs of inflation is it relevant to take into account the effect on inequality across households?
- How important is, for that question, that the model is able to replicate empirical facts on transaction?
- How strong is the assumption of a closed economy for the results? Or how important is that the policy is taken simultaneously within a set of countries that trade with the one under analysis?
- How important is the different distributions across countries to understand the welfare cost of inflation?
- Given the results of previous answers how could we measure the consequences of the observed change of regime from high to low inflation?

## Set up:

- Deterministic model: the change of regime is a change of average inflation, and cost of inflation driven by monetary distortions.
- Monetary model where there is just one consumption good and no capital, technology linear in labor.
- The inflation tax would be compensated by the more similar one: the consumption tax. We would have a lower bound for the effects of the change of regime.
- Households differ on:
  - Exogenous differences in labor productivity
  - Differences in initial wealth.
  - Heterogeneity results from the joint distribution of labor efficiency and the initial wealth.
- Open economies with countries identical in every dimension except on distribution of characteristics across households.

# Environment

- Monetary economy
  - Households held money because it is an alternative means of payment to costly credit.
  - Technologies of transactions with constant or increasing economies of scale.
- Households choices over consumption and leisure and over cash and credit payments.
- Exogenous government consumption financed by proportional taxes on consumption and on money.

# Literature

- Erosa and Ventura (2002)
- Albanesi (2007)
- Correia (1999)

# Households

$$U_i = \sum_{t=0}^{\infty} \beta^t \frac{(\hat{u}(C_{it}, N_{it}))^{1-\sigma}}{1-\sigma}$$

$$\hat{u}(C_{it}, N_{it}) = C_{it} - \chi N_{it}^{\varphi}, \quad \chi > 0, \varphi > 1$$

s. to

$$P'_t(1 + \tau_c)C_{it} + wP'_t s_{it} + M_{it+1} + B_{it+1} \leq wP'_t E_i N_{it} + M_{it} + (1 + R_t)B_{it}$$

where  $\tau_c$  represents the tax on consumption expenditures,  $R$  the nominal interest rate and  $w$  the wage rate.

$$s_{it} = l(C_{it}, m_{it})$$

$$\lim_{t \rightarrow \infty} \left[ d_t \left( m_{it} + \frac{B_{it}}{P'_t} \right) \right] = 0$$

where  $d_t = P'_t / (P'_0(1 + R_0)(1 + R_1)\dots(1 + R_t))$



- Intertemporal budget constraint

$$\sum_{t=0}^{\infty} d_t(1 + \tau_c)C_{it} + \sum_{t=0}^{\infty} d_t w l(C_{it}, m_{it}) + \sum_{t=0}^{\infty} d_t R_t m_{it} = \sum_{t=0}^{\infty} d_t w E_i N_{it} + A_{i0}$$

where  $A_{i0} = \frac{m_{i0}}{(1+R_0)} + \frac{B_{i0}}{P'_0}$ .  $P'_0$  could play a role. Undetermined.

## • Stationarity

$$(1 + \tau_c)C_i + wl(m_i, C_i) + R_t m_i = wE_i N_i + (1 - \beta)A_{i0},$$

$$N_i = \left[ \frac{wE_i}{\chi\varphi(1 + \tau_c)(1 + wl_{ci})} \right]^{\frac{1}{\varphi-1}}$$

$$-l_{mi}w = R$$

# No economies of scale (CRS)

The homogeneity of degree one of  $l$

$$-l'\left(\frac{m_i}{c_i}\right) = \frac{R}{w}$$

**Result 1:** Transaction technologies with CRS:  $\frac{m_i}{c_i}$  constant across households.

$$\left[ (1 + \tau_c) + wL \left( \frac{w}{R} \right) + RH \left( \frac{w}{R} \right) \right] C_i = wE_i N_i + (1 - \beta) A_{i0},$$

Gorman aggregation.

$$(1 + \tau_c)(1 + wl_{ci})C_i = wE_iN_i + (1 - \beta)A_{i0},$$

$$P_i = (1 + \tau_c)(1 + wl_c) = P$$

Utility index can be written in this case as

$$v_i = \left[ \frac{[wE_i/P]^{\frac{\varphi}{\varphi-1}}}{(\chi\varphi)^{\frac{1}{\varphi-1}}} \left(1 - \frac{1}{\varphi}\right) + (1 - \beta)A_{i0}/P \right]$$

## Result 2: (Friedman Rule)

$$v_i = \frac{1}{P} \left[ \frac{[wE_i]^{\frac{\varphi}{\varphi-1}}}{P^{\frac{1}{\varphi-1}} (\chi\varphi)^{\frac{1}{\varphi-1}}} \left(1 - \frac{1}{\varphi}\right) + (1 - \beta)A_{i0} \right]$$

$$A_{r0} \geq 0.$$

A decrease of inflation increases  $v_r$  and therefore  $P$  declines.

# Method

*Definition:* Policy 2 is equity improving in relation to policy 1 iff policy 2 dominates policy 1 in relative differential, that is :

$$\frac{v_i^2}{v_j^2} > \frac{v_i^1}{v_j^1}, \text{ for } i < j \quad (1)$$

*Proposition* : Policy 2 dominates policy 1, if:

$$1) \alpha(p)^2 \geq \alpha(p)^1,$$

$$\alpha(p) = \frac{P[w/P]^{\frac{\varphi}{\varphi-1}}}{(\chi\varphi)^{\frac{1}{\varphi-1}}} \left(1 - \frac{1}{\varphi}\right)$$

and

$$2) \frac{E_i^{\frac{\varphi}{\varphi-1}}}{A_{i0}} \geq \frac{E_j^{\frac{\varphi}{\varphi-1}}}{A_{j0}} \text{ when } A_{s0} >, \text{ for all } i \text{ and } j \text{ such that } v_i \leq v_j.$$

**Proof.** For  $A_{i0} < 0$

$$\frac{v_i}{v_j} = \frac{-A_{i0} \alpha(p) \frac{E_i^{\frac{\varphi}{\varphi-1}}}{\beta(-A_{i0})} - 1}{A_{j0} \alpha(p) \frac{E_j^{\frac{\varphi}{\varphi-1}}}{\beta A_{j0}} + 1}$$

$$\frac{\widehat{v}_i^2}{v_{j1}} \simeq \widehat{\alpha(p)}_1^2 \left( \frac{\alpha(p)}{v_i^1 v_j^1} \right) \left( \frac{E_i^{\frac{\varphi}{\varphi-1}}}{-A_{i0}} + \frac{E_j^{\frac{\varphi}{\varphi-1}}}{A_{j0}} \right)$$



## Compensating inflation with a VAT tax

$$\alpha(p) = \frac{P^{\frac{-1}{\varphi-1}}(w)^{\frac{\varphi}{\varphi-1}}}{(\chi\varphi)^{\frac{1}{\varphi-1}}} \left(1 - \frac{1}{\varphi}\right).$$

$w/P$  increases.  $w$  is constant  $P$  declines.

Then  $\alpha(p)$  increases.

**Result 3:** A decline in inflation compensated by an increase in the consumption tax rate improves welfare distribution.

**Result 4:** A decline in inflation compensated by an increase in the consumption tax is a Pareto movement. Even when the agent is a debtor, and real debt increases, the agent is better off.

# Economies of scale

- Budget constraint:

$$(1 + \tau_c)C_i + wl(m_{it}, C_{it}) + R_t m_{it} = wE_i N_i + (1 - \beta)A_{i0},$$

- Transactions technology

$$l(m_{it}, C_{it}) = k\left(1 - \left(\frac{m}{C}\right)_i\right)^2 C_i + \left(1 - \left(\frac{m}{C}\right)_i\right) \bar{N}$$

$$(1 + \tau_c)C_i + R \left(\frac{m}{C}\right)_i C_i + w \left[ k\left(1 - \left(\frac{m}{C}\right)_i\right)^2 C_i + \left(1 - \left(\frac{m}{C}\right)_i\right) \bar{N} \right] = wE_i N_i + (1 - \beta)A_{i0},$$

The choice of  $\left(\frac{m}{C}\right)_j$  is such that

$$\left(\frac{m}{C}\right)_j = 1 - \frac{R}{2wk} + \frac{\bar{N}}{2kC_j}$$

1)  $m_i = C_i$

2)  $m_j = (1 - t_j)C_j$

$$\left[ (1 + \tau_c) + R \left(\frac{m}{C}\right)_j + wk \left(1 - \left(\frac{m}{C}\right)_j\right)^2 \right] C_j + w \left(1 - \left(\frac{m}{C}\right)_j\right) \bar{N} = wE_j N_j + (1 - \beta)A_{j0},$$

$$P_j = (1 + \tau_c) + R \left(\frac{m}{C}\right)_j + wk \left(1 - \left(\frac{m}{C}\right)_j\right)^2$$

$$\partial \frac{P_j}{\left(\frac{m}{C}\right)_j} = R - 2wk\left(1 - \left(\frac{m}{C}\right)_j\right) = \frac{w\bar{N}}{C_j} > 0$$

**Result 5:** When transactions technology is *IRS*,  $\frac{m}{C}$  is no more constant across households. "Rich" agents ( $j$ ) held a lower share of cash for transactions than "poor" agents.

No longer Gorman aggregation.

**Result 6:** The effective price of consumption declines with consumption. Therefore *IRS* amplifies the inequality across households.

**Result 7:** Inflation acts like a regressive tax on consumption.

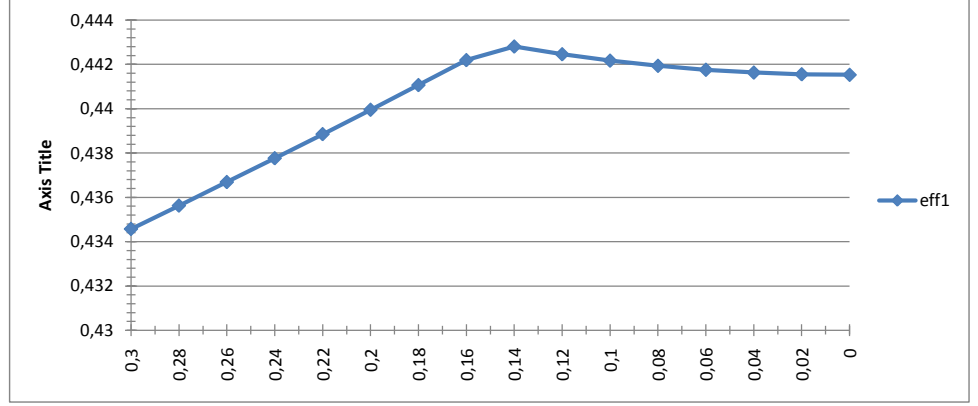
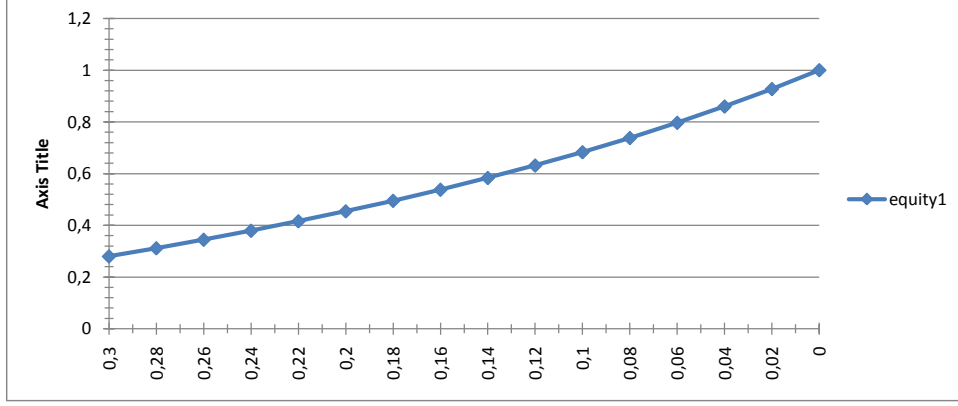
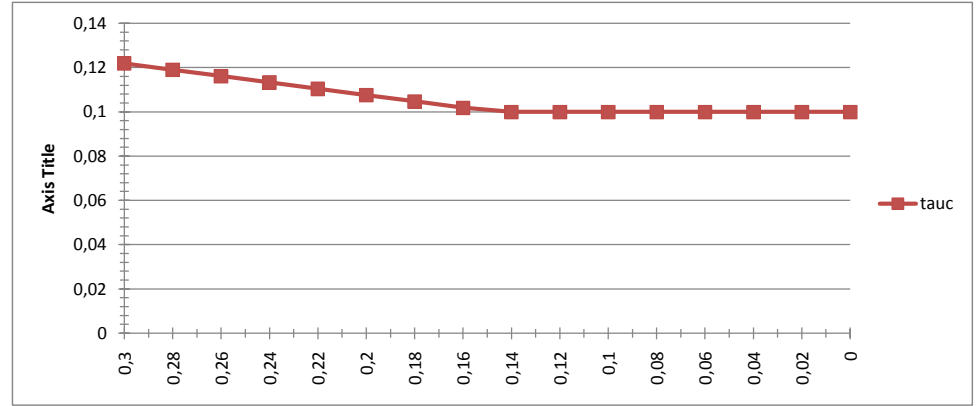
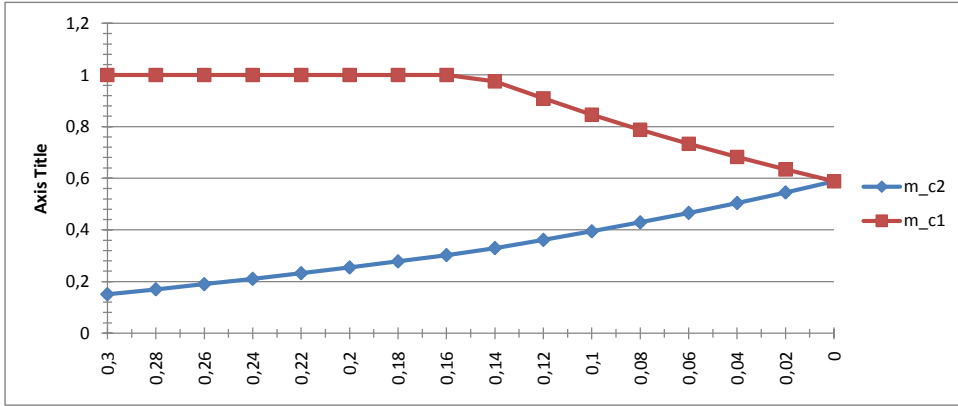
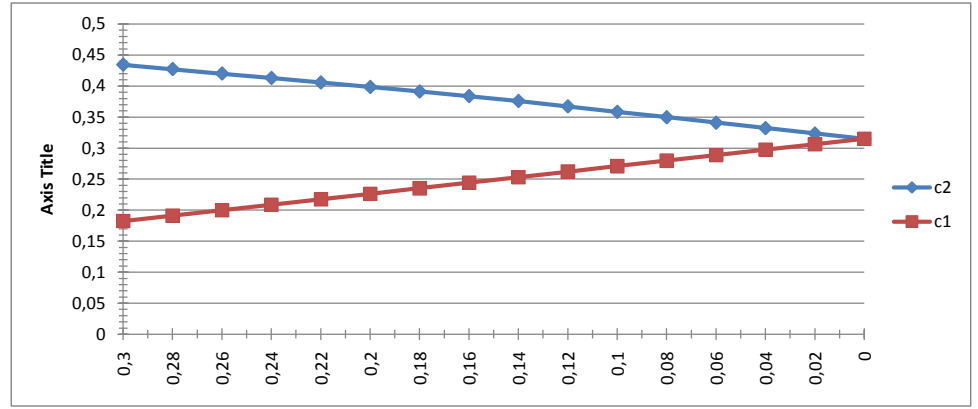
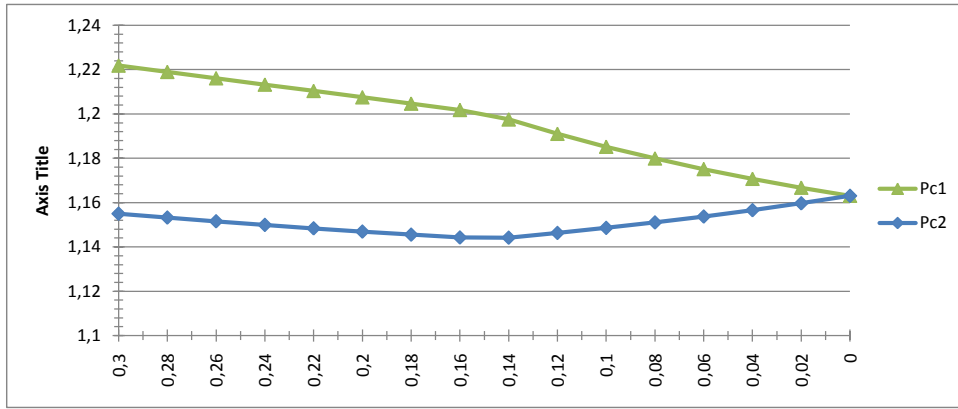
$$\frac{dP_j}{dR} = \partial \frac{\partial P_j}{\partial R} + \frac{\partial P_j}{\partial \left(\frac{m}{C}\right)_j} \frac{\partial \left(\frac{m}{C}\right)_j}{\partial R} > 0.$$

$$\frac{d\frac{P_i}{P_j}}{dR} > 0$$

## The numerical solution

**Result 8:** When households are heterogeneous a pure redistribution policy increases efficiency.

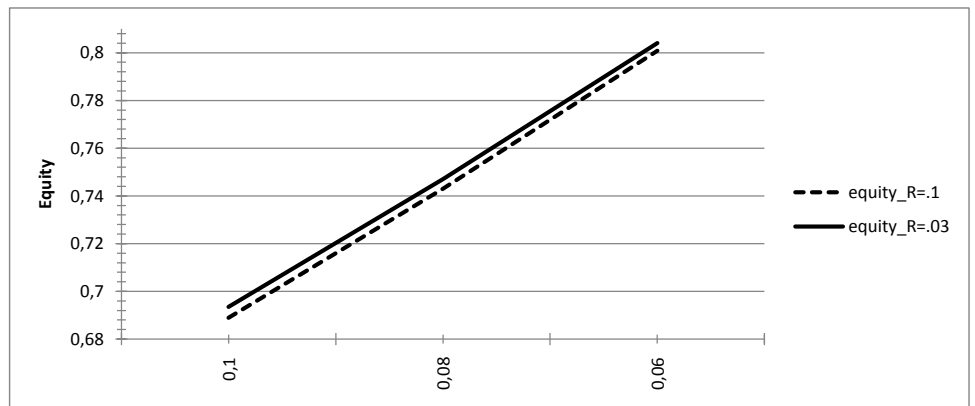
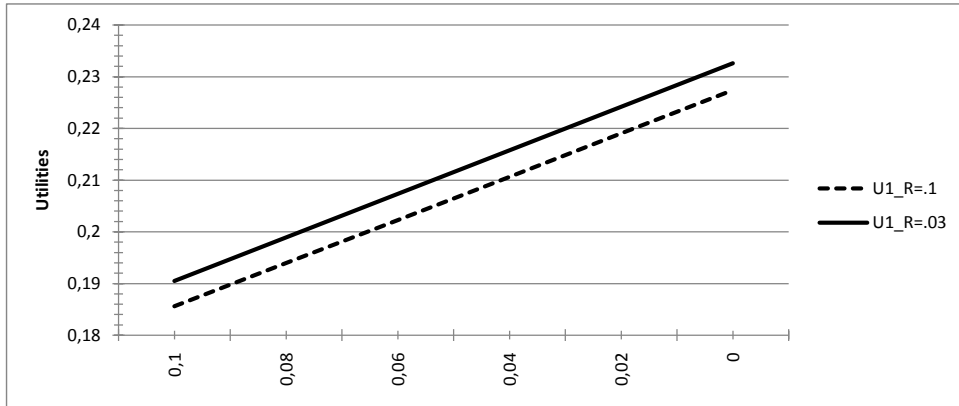
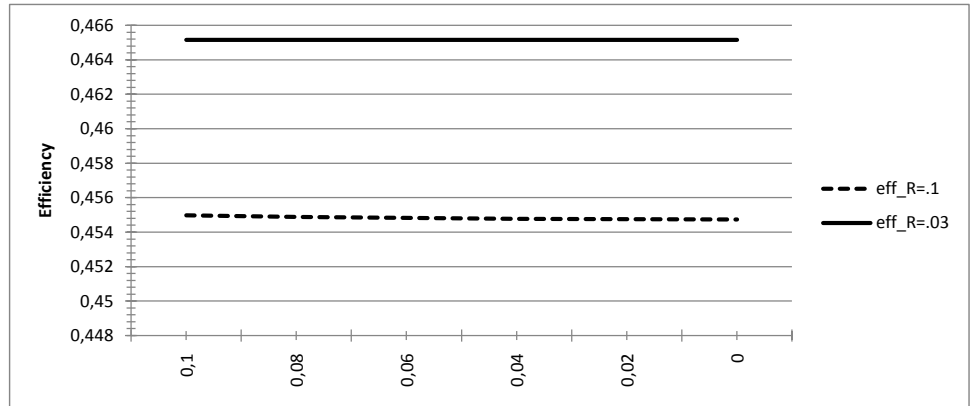
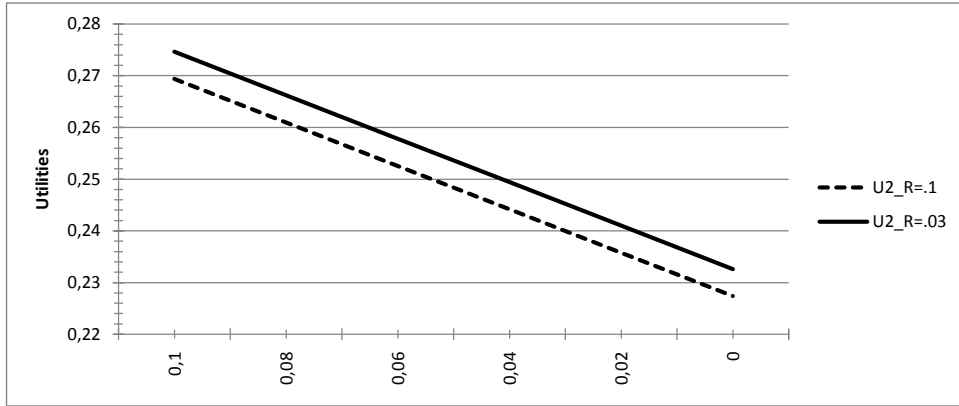
Figure 1: Nominal interest Rate equal 0.1  
 (the difference in endowment is in the horizontal axis)



**Result 9:** The decline of inflation in a closed economy has a significant effect on efficiency and a positive effect on equity. The magnitude of these effects are the same irrespective of the exogenous heterogeneity.

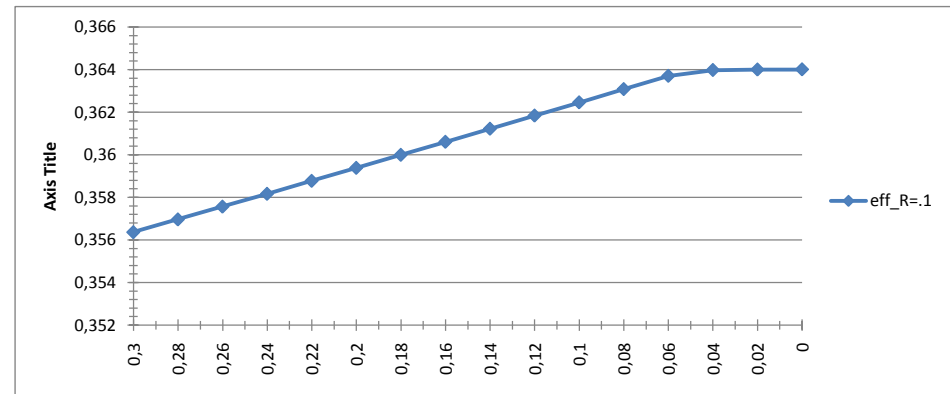
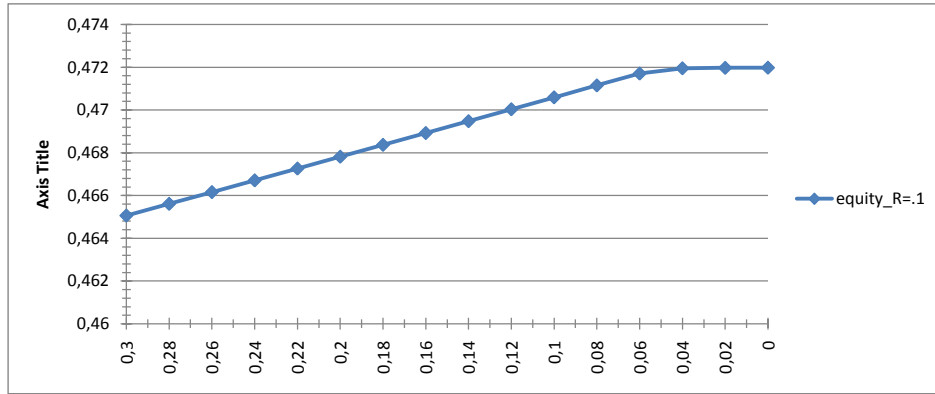
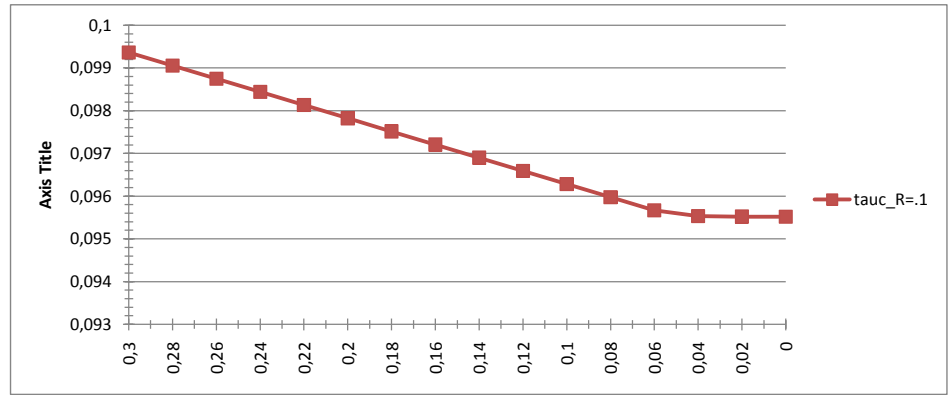
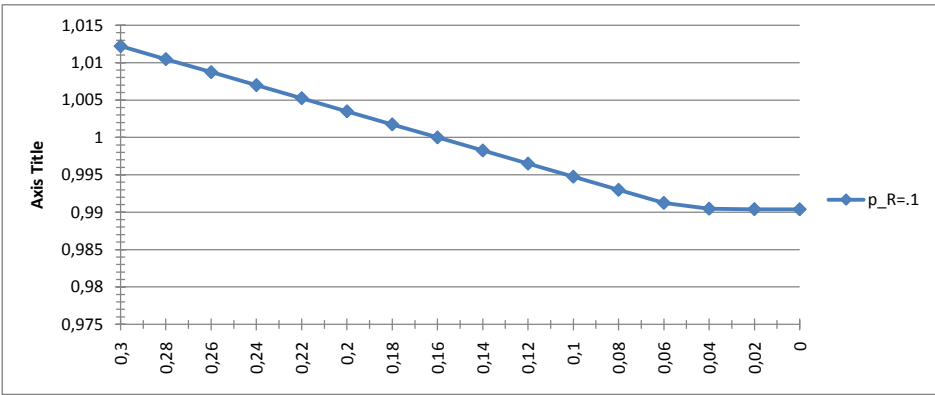
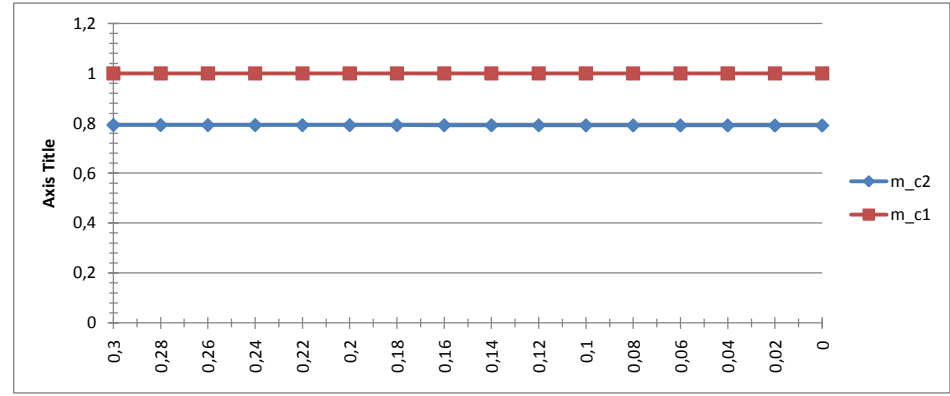
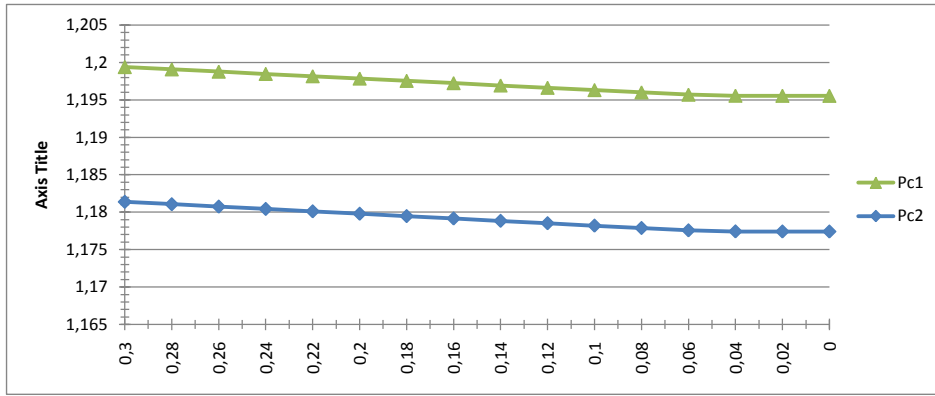


Figure 2: Change in Inflation with Non-negative Wealth  
 (the difference in endowment is in the horizontal axis)



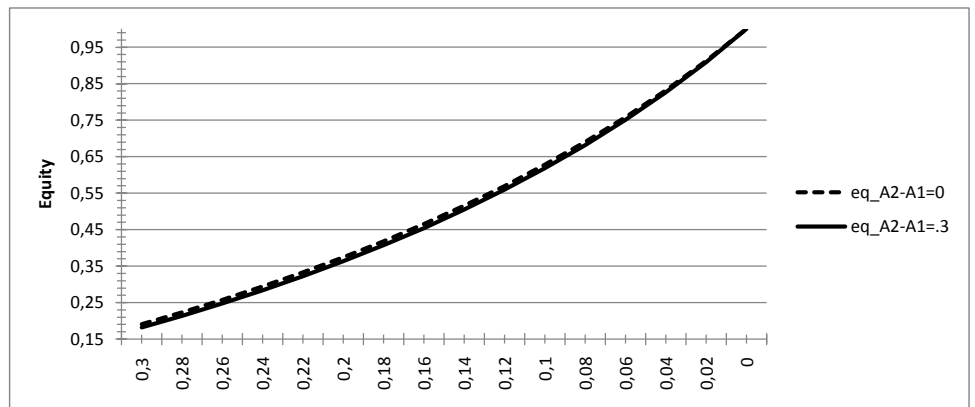
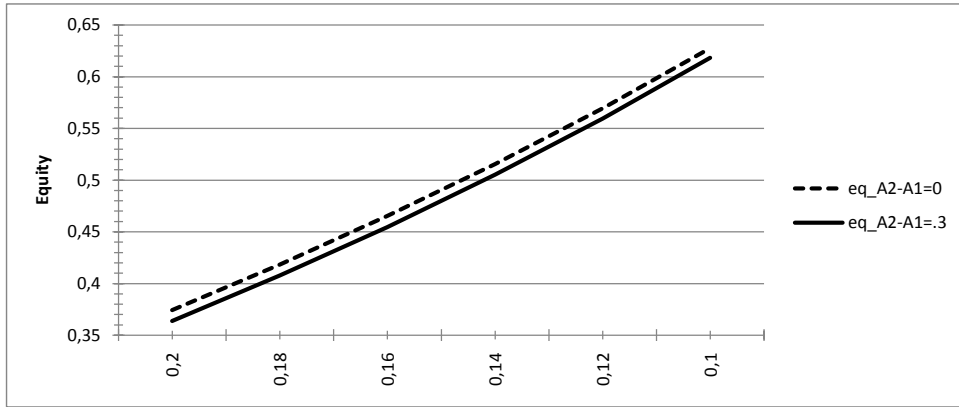
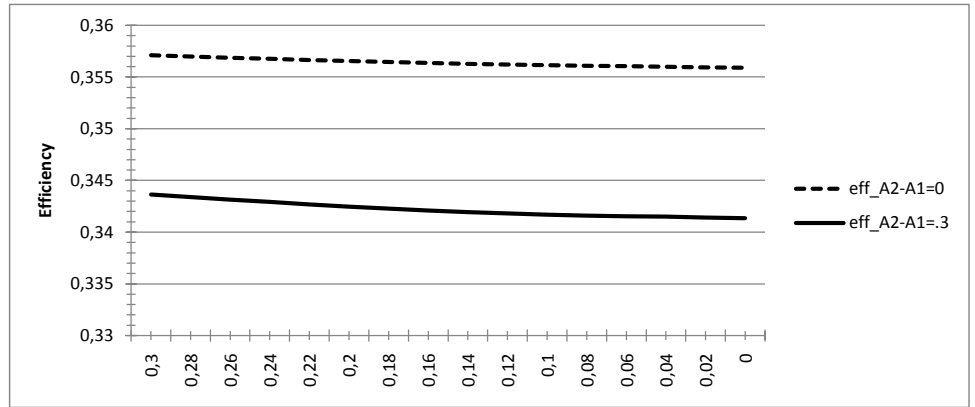
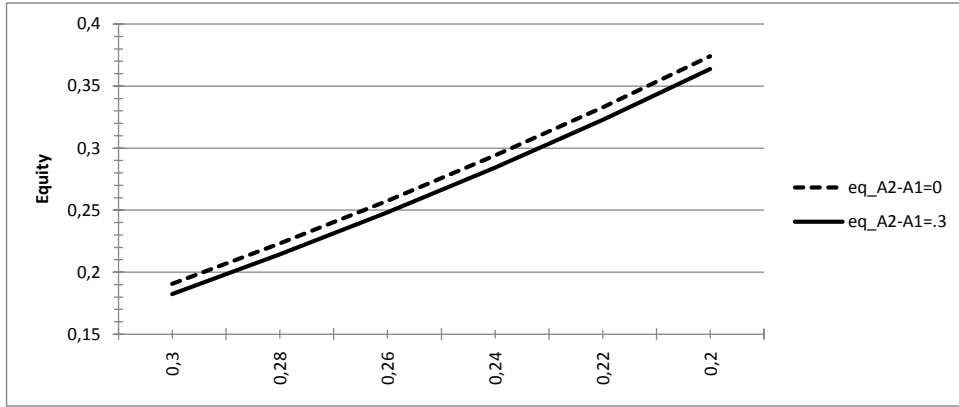
**Result 10:** In open economies, for a given distribution of characteristics in the home economy, the higher the inequality in the foreign country the higher the efficiency in the home country for a given interest rate. The terms of trade decline with the inequality of the foreign country.

Figure 3: The country has a constant distribution of wealth, and nom. int. rate=0.1  
 (the difference in the distribution of initial wealth of the second country is in the horizontal axis)



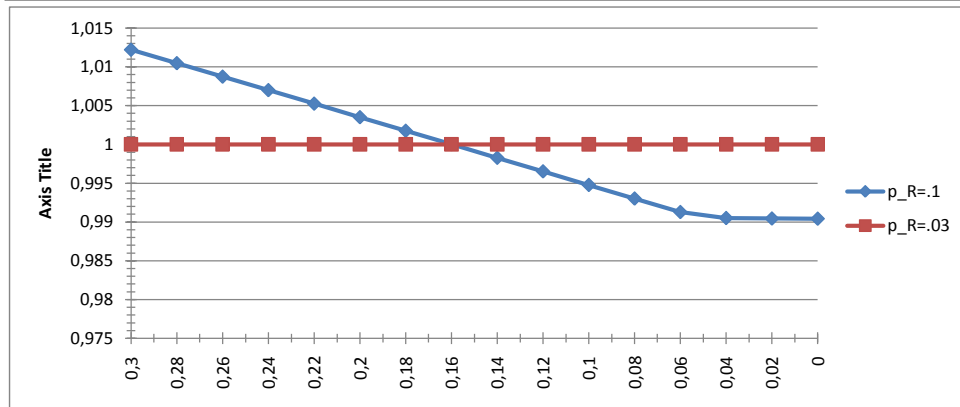
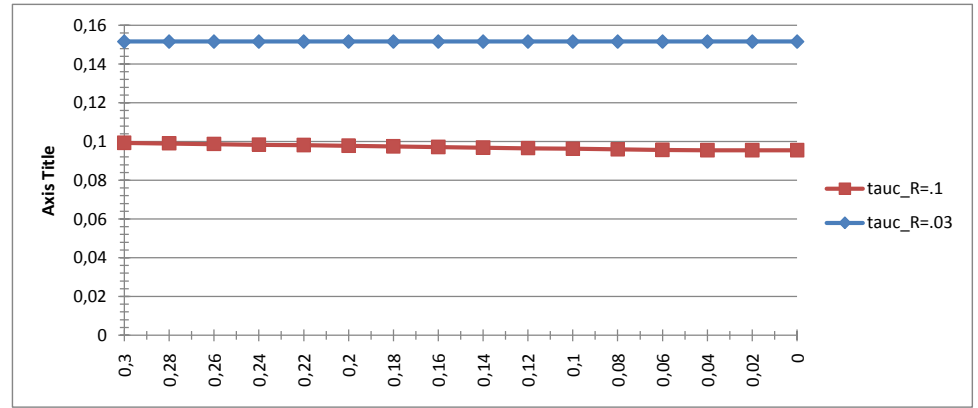
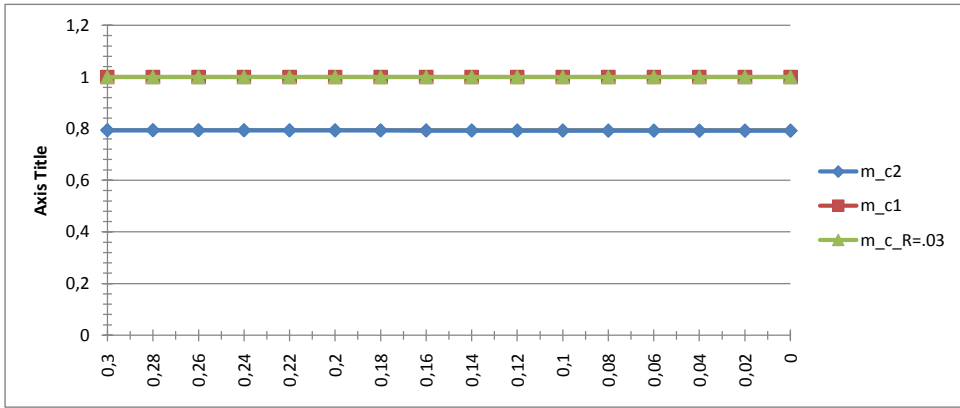
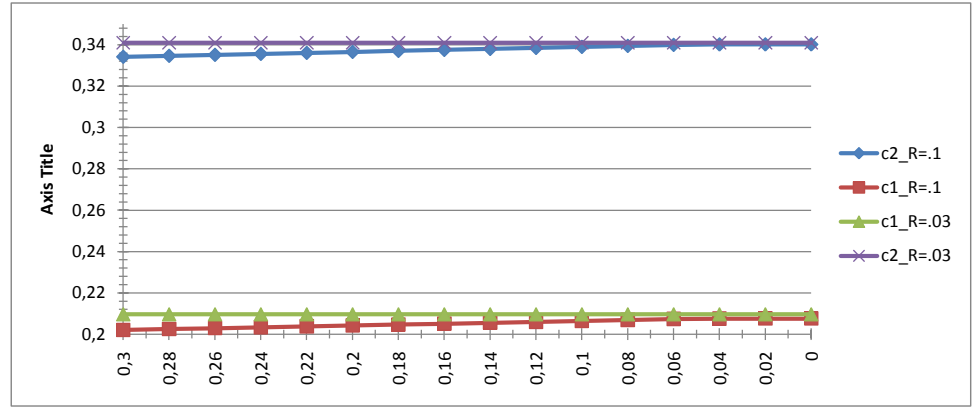
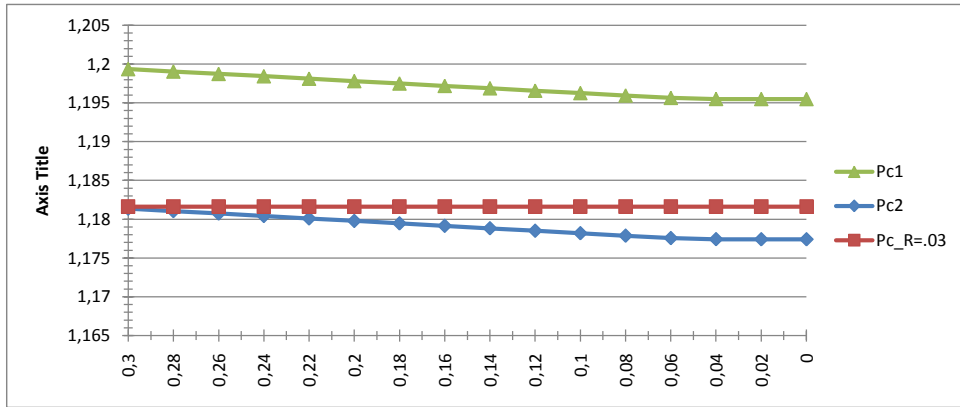
**Result 11:** Efficiency at home depends more on inequality abroad than on inequality at home. The opposite occurs with equity.

Figure 4: How important is the second country distribution and  $R=1$   
 (the difference in endowment is in the horizontal axis)



**Result 12:** The gain on efficiency and on equity of the decline of inflation is higher the more unequal is the foreign country.

Figure 5: The first country has a constant distribution of wealth and two different nom. int. rates  $R=0.1$  and  $R=.03$   
 (the difference in endowment of the second country is in the horizontal axis)







# Conclusions

- Inequality is relevant to evaluate policy changes.
- In open economies inequality abroad is more relevant than inequality in the country.