INFLATION AND INEQUALITY*

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1. INTRODUCTION

Across developed countries the prolonged decline in the average inflation rate is perhaps the most widespread, large and sustained economic policy regime change. When comparing the average inflation rate in the 80’s and in the last decade for most of those economies we find an average decline of around 10 percent points. This decline is described as a very positive monetary policy change, the main reason being the gain in efficiency which is associated with the regime change. However, whether this gain can be reinforced through a significative effect on equity is an open issue.

There is some empirical evidence that there is a strong positive correlation between average inflation and measures of income inequality in the post-war period (see Albanesi (2007)). Easterly and Fisher (2001) present indirect evidence on the distributional effects of inflation. Using household pooling data on 38 countries they find that the poor are more likely to be concerned with inflation than the rich. It seems that low income households perceive inflation as more costly.

It is important however to understand what can cause such a relation, and how it is connected with more empirical cross-section evidence on portfolio holdings and payments patterns. This is the objective of this article.

Heterogeneity of households is reflected on different consumption and hours of work choices, but for the present question the main fact is that it is also reflected in wealth composition and transaction patterns. Erosa and Ventura (2002) survey some facts for households in the U.S.. First, high income individuals use cash, and cash plus checks, for a smaller fraction of their transactions than low income individuals. Second, the fraction of household wealth held in liquid assets decreases with income and wealth. And third, a nontrivial fraction of households do not own a checking account and/or do not use credit cards to perform transactions.

The evaluation of welfare costs of policy changes with heterogeneous agents is in general a quite difficult task. In this article I will use as a first approach to that answer the method developed in Correia (1999). This method can be applied in a first stage where it is still feasible to compute the equilibrium prices of the economy as if agents are identical, and allows for determining the qualitative effect on equity of the decline of inflation, for any given distribution of households. The use of the method implies that, although the economy is populated by heterogeneous agents, preferences and markets are such that equilibrium prices do not depend on the specific distribution of agents’ characteristics. Unfortu-
nately when I try to apply this method for the monetary model those constraints are not consistent with
the cross section evidence just described above. Thus I begin by developing a model economy where
the method can be applied but, although agents display the observed cross section characteristics on
consumption and labor, is not able to replicate the cross section evidence on wealth composition and
transaction patterns. The gain is to have a tractable fist step to get some intuition on the mechanisms
through which inflation affects different agents differently. Then I will extend the model to accomplish
replicating the cross section facts on payments patterns. The above method can no longer be applied
here, but we can add the intuition from studying the first economy to the novel features of the more
realistic one to try to answer the question raised in this article.

Agents' heterogeneity has its roots on differences in labor productivity and in the initial wealth held by
every agent. The effect of the policy change on equity depends on some well known and robust cross
country facts of the joint distribution of these characteristics. In particular wealth is more concentrated
than earnings and that these two characteristics are positively correlated in the population.

This article focus on a stationary economy meaning that, given constant policies, prices and alloca-
tions are constant over time. Therefore I abstract from capital, and labor is the only input in production.
Given stationarity the real interest rate is constant across policies and there is a one to one relation be-
tween changes in inflation and changes in the nominal interest rate. Monetary policy is therefore char-
acterized either by the nominal interest rate or the inflation rate, and these two prices will be used with
the same meaning.

Since inflation is a source of revenue for central banks (and eventually to governments) comparing pol-
icy regimes associated with different inflation rates while maintaining other taxes is not a complete ex-
cercise. Different revenues from the inflation tax should be compensated by an increase of alternative
tax rates. This article develops a revenue neutral exercise where the decline of the inflation tax is ac-
companied either with an increase of consumption (VAT) taxation or with an increase of labor income
taxation. As discussed below the answer to the question of the article also depends on which is the
alternative tax.

Therefore the question of the effect on equity of different inflation rates is equivalent to the comparison
of the distribution across households of the burden from inflation versus the distribution of the burden
of alternative taxes.

This burden distribution would imply the comparison of welfare distributions across different policies.

The hypothesis of stationarity as well as the type of preferences chosen imply that the comparison is
across income distribution, as explained below.

2. THE MODEL

The monetary economy in analysis is populated by agents that decide over consumption and leisure
as well as over the means of payment. Households hold money because it is an alternative means of
payment to costly credit. Credit services are produced by a transaction technology that uses labor as
As discussed below, whether this technology has constant returns to scale or not is determinant for the ability of the model to replicate cross section facts, and will have an important role on the evaluation of the distributional effects of different inflation regimes.

The economy is well described by a monetary general equilibrium model where the credit technology is \( s = l(m, C) \), where \( s \) is time used on transactions paid with credit, and \( m \) and \( C \) represent, respectively, real balances and consumption. There is no physical capital and the production technology of the consumption good is linear in labor with a unitary coefficient. The government must finance a constant exogenous government expenditures, and collects revenues from the inflation tax and from either a tax on labor income or a tax on consumption expenditures. There is a set of households indexed by \( i \) and differentiated by their labor productivity and their initial financial wealth in real terms, represented respectively by \( E_i \) and \( A_{i0} \).

Stationarity allows us to concentrate in momentary preferences. I choose an utility function linear in consumption

\[

\nu_i = C_i - \xi N_i^e, \xi > 0, \psi > 1

\]

The stationary budget constraint is given by the following expression

\[

(1 + \tau_c)C_i + \omega l(m_i, C_i) + Rm_i = wE_i N_j + \beta A_{i0},

\]

where \( \tau_c \) represents the tax on consumption expenditures, \( w \) the wage net of taxes, \( R \) the nominal interest rate and \( N_j \) total hours of work.

The choice of real money demand is such that the cost of an additional unity of money, \( R \), should equalize the benefit in terms of reduction of transaction costs, measured by net wage times the decline in hours necessary for transactions with credit, which is given by \( w m_i (m_i, C_i) \).

### 2.1. First stage - constant returns to scale in transactions

When the technology of transactions is constant returns to scale, CRS, we can say that for a given ratio of money to consumption, \( m_i/C_i \), the marginal and average labor productivity on transactions do not depend on the level of consumption. As an example let us suppose that \( l(m_i, C_i) = k \left( 1 - \frac{m_i}{C_i} \right) \). In this case the optimal choice of money, \( R = w m_i (m_i, C_i) \) is given by

\[

\frac{m_i}{C_i} = \left( 1 - \frac{R}{2\omega w} \right) \leq 1 \quad (= 1 \text{ for } R = 0)

\]

This expression has the basic money demand characteristics, namely that money demand increases with the amount of transactions and declines with the opportunity cost of money, the nominal interest rate. We can state that:

\[\text{(1) See Correia (1999) to justify this type of preferences.}\]
Result 1: When transaction technologies are CRS, $m_i/C_i$ is the same across households. Rich and poor agents hold money as a constant to transactions.

In this case we can rewrite the budget constraint as

$$P_c C_i = wE N_j + \beta A_0$$ (3)

where $P_c = (1 + \tau_c) + wk\left(1 - \frac{m_i}{C_i}\right)^2 + R \frac{m_i}{C_i}$

Note that in this case the effective price of consumption, $P_c$, includes the direct tax on consumption and the indirect cost due to payments. This one depends on the opportunity cost of holding cash, $R$, on the cost of labor used in credit, $w$ as well as on the transactions technology. Given that this effective price of consumption is identical across households the budget constraint, (3), can be used, and there is still a representative agent that represents the economy.²

Given optimal decisions of every agent, its indirect utility can be written as

$$v_i = \frac{\left[\frac{\theta E_j / P_c}{\varphi - 1} \left(1 - \frac{1}{\varphi}\right) + \beta A_0 / P_c\right]}{\left(\chi \varphi \right) / (\varphi - 1)}$$ (4)

The representative agent of this economy, $i = r$, is characterized by $E_r = 1$ and $A_0 = 0$. When welfare is computed as the utility of the representative agent, or corresponds to the efficiency level of the economy, it is well known, see Correia and Teles (1996), that:

Result 2: (Friedman Rule) In a second best environment, to maximize the utility of the representative agent governments should abstain from taxing money, i.e., the government should follow the Friedman rule and set the nominal interest rate to zero. Government expenditures should be financed with consumptions taxes and/or labor income taxes. Using (4), as well as the characteristics of the representative agent, we can write the utility of the representative agent as $v_r = \frac{\left[w / P_c\right]}{\left(\chi \varphi \right) / (\varphi - 1)} \left(1 - \frac{1}{\varphi}\right)$. Because to decline the inflation rate increases the utility of the representative agent, it is immediate to conclude that the decline of inflation, compensated either with an increase in the tax on labor income or in the tax on consumption, leads to an increase of the net real effective wage, $w / P_c$.

As was said before, in this first stage of the analysis, given that CRS transactions technologies allow for Gorman aggregation, we can use a simple method to rank policies by their effects on inequality.³ The simplicity of the methodology allows for the development of economic intuition on the channels through which policy changes affect equity. The conditions are rather strong for the case under study. As just stated in result 1, they are obtained at the cost of imposing a degenerate distribution in the money to consumption ratio across households. Only policy measures that yield an equilibrium in

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² We say that the economy is amenable to Gorman aggregation.

³ This methodology was developed in Correia (1999).
which all agents face the same prices can be discussed. This rules out for example, some regressive
taxes which I will show are very important for the case of this article.

It also implies some restrictions on the multivariate distribution of characteristics across agents, but I
will not take this as a cost since the class of characteristics for which the methodology is valid covers
the most relevant cases of heterogeneity characterization used in general equilibrium aggregate mod-
els, namely the heterogeneity in private wealth or the heterogeneity in labor efficiency.

A short description of equity evaluation

The assumption of Gorman aggregation is equivalent to assuming indirect utility functions which can
be represented by
$$\nu_i = \alpha(p) F(E_i) + \gamma(p) \lambda_i,$$
where $p$ is the vector of equilibrium prices faced by every household.

I have shown in (4) that
$$\frac{\nu_i^2}{\nu_j^2} > \frac{\nu^j}{\nu_j} \text{ for } i > j$$
for $i > j$. When by the policy change this ratio increases, it means that the poor household is less distant
from the richer one, that is, their economic situation is more equal than before. When this is true for ev-
ery two agents then we say that the policy change leads to a more equal society, or that inequality
declined.

Therefore the question is to understand how policy changes alter equilibrium prices, and then whether
that change in policy increase relative welfare if
$$\frac{\nu_i^2}{\nu_j^2} > \frac{\nu^j}{\nu_j} \text{ for } i > j$$
(5)

The intuition for this condition is quite simple: suppose we compare any two households in the econ-
omy, agent $i$ and agent $j$, where the first is poor (meaning that has a lower welfare, or income$^4$).

Using 4 let me begin by analyzing the easier case where agents are identical in labor productivity
$E_i = E_j$. In this case we can write the relative welfare between agent $i$ and $j$:

$$\frac{\nu_i}{\nu_j} = \frac{\gamma(p) + A_{ij}}{\gamma(p) + A_{jj}}$$

where
$$\gamma(p) = \frac{p_i[w/E_i]}{\beta(x^p)} \left[ 1 - \frac{1}{\phi} \right] = \frac{P^{-1}}{(x^p)^{\phi-1}} \left[ 1 - \frac{1}{\phi} \right] \tag{6}$$

As $A_{ij} < A_{jj}$, $\frac{\nu_i}{\nu_j} < 1$ and the change in policy increase relative welfare if $\gamma(p)$ increases.

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$^4$ Since utility is given by
$$\frac{[w/E_i]}{\beta(x^p)^{\phi-1}} = \left[ 1 - \frac{1}{\phi} \right] + \beta \lambda_i / \phi,$$

it can be read as a measure of income.
Compensating inflation with a VAT tax

When the decline of inflation (a lower $R$) is compensated by an increase of the VAT tax (or the tax on consumption) to maintain tax revenues, the net wage, $w$, is not affected by the change of policy. This results from the gross wage being equal to a constant marginal labor productivity and from taxes on labor income being not affected by the policy change. Then using result 2, which states that the net effective wage, $w_{Pc}$, increases with the decline of inflation, it is immediate to conclude that the change in policy just affects $P_c$. The reason why in this case the lower inflation tax is efficient is that it declines the effective consumption price. As $m_{C_i} < 1$, the base of the consumption tax is higher than the base of the inflation tax. This means that although the tax on consumption increases it increases by less than the decline of the nominal interest rate. Other way to understand this result is to see that in the limit, when the nominal interest rate is zero and credit is not used as payment, the inflation tax is equivalent to the consumption tax. But when households decide to use credit for a share of payments, it is because at the existing interest rate the cost of transactions is lower. Again the decline in $R$ implies a positive income effect, that to be compensated implies an smaller increase in $\tau_c$. We can write $\gamma(p)$ as the second expression in 6 and since $\varphi > 1$, a decline on $P_c$ increases $\gamma(p)$.

We can summarize this in:

**Result 3:** A decline in inflation compensated by an increase in the consumption tax rate improves welfare distribution, when $E_{ij} = E_{ij}^5$.

Note that the robustness of this result, that the decrease of inflation compensated with a consumption tax reduces inequality, is not obvious even in this very simple set-up without the help of the mathematical analysis. Since we know that the main effect of the change of policy is the decline of the effective price of consumption what we can immediately guarantee is that richer agents with positive levels of initial wealth would gain by two reasons: first because the value of initial wealth in terms of consumption is higher, $\beta \Lambda_0 / P_c$; and second because the net real effective wage increases. Therefore households with non-negative wealth, as the representative agent, increase welfare given the proposed change of policy. The same cannot be said for agents that have negative initial wealth. As with richer agents they benefit from the the higher net effective wage, but since they are debtors, and the effective value of debt increases with the decline of the effective price, it would not be clear, just by analyzing the expression for their utility, why the first effects would always dominate this last one, and the poor is better off given the policy change. Note however this is always true, without any other channel in addition to the ones described, because:

**Result 4:** A decline in inflation compensated by an increase in the consumption tax by result 3 improves equity, and leads to an increase in $V_{ij}$ for every $i$, $i < r$. Given result 2 the welfare of the representative agent, $v_i$, increases and therefore $V_{ij}$ also increases for every $i$. Therefore the proposed policy
increases welfare for every household in this economy, leads to a Pareto movement, but the poor, the debtor, increases more than the richer, the creditor.

This result is fundamental since is the one from where the intuition of the rest of this article is developed.

Compensating inflation with a labor income tax

Instead of using the tax on consumption to compensate for the decline in revenues coming from the inflation tax, I analyze now the effects on equity of increasing the tax on labor income. As before, this change of policy is efficient, meaning that using result 2 we still have as a result that the net effective wage increases. But since now the tax on labor is higher, the net wage, \( w \), declines. This tells us that \( P_c \) declines more then \( w \). Again we should use the expression (6), to understand the effect on relative welfare. And we can state that:

**Result 5**: A decline in inflation compensated by an increase in the labor income tax has an ambiguous effect on equity.

As \( P_c \) declines and \( w / P_c \) increases the effect on \( \gamma(p) = \frac{P_{cw} / P_c}{(1 - \varphi)} \) is not a general one. To understand this difference relatively to the former result we can think that for the representative agent the tax on labor income is identical to the tax on consumption when the interest rate is zero. However, a household with positive wealth would prefer the tax on labor and the opposite occurs for the household with negative wealth. Therefore the change from a consumption tax to a labor income tax with zero interest rate would increase inequality. As we already concluded that the change of inflation to a consumption tax improves equity we can understand why the change to a tax on labor income has an effect on inequality that is parameter and distribution dependent.

2.2. Economies of scale

After analyzing the case where transactions technology is constant returns to scale, let us correct for the cross section evidence on payment patters. As before the stationary budget constraint can be written as:

\[
(1 + \tau_c)C_i + wL(m_i, C_i) + Rm_i = wE_N + \beta A_{00}.
\]

Let us assume that the transactions technology \( I(m_i, C_i) \) is no more homogeneous of degree one, and that it can be given, for example, by:

\[
I(m_i, C_i) = k \left[ 1 - \left( \frac{m_i}{C_i} \right) \right]^2 C_i + \left[ 1 - \left( \frac{m_i}{C_i} \right) \right]^N.
\]
where the main difference is the inclusion of a cost that does not depend on the total amount of transactions but uniquely on the share of transactions paid with credit. It is a fixed cost for a given share. When this technology is used to compute whether payments should be done with cash or credit we obtain that:

$$\left(\frac{m_i}{C_i}\right) = 1 - \frac{R}{2wk} + \frac{\bar{N}}{2kC_i}$$

It is immediate to conclude that for $\bar{N} > 0$ the larger is $C_i$ the smaller is the share of transactions realized with cash. That is:

**Result 6**: When transaction technologies are increasing returns to scale, $\frac{m_i}{C_i}$ is no more constant across households. Rich agents hold a lower share of cash to transactions than poor agents.

This money demand replicates exactly the facts that we quote in the beginning of this article. Agents differ on $m/C$ depending on the total volume of transactions. There is a household for which $C_i = \frac{w\bar{N}}{R}$ that does not pay with credit. There is a group for which $C_i < \frac{w\bar{N}}{R}$ that use just cash for payments and therefore

1) $m_i = C_i, i < s.$

The other subset of the population for which $C_i > \frac{w\bar{N}}{R}$ decide to use both cash and credit for payments. However they decide to use more credit the higher is the transactions level, that is the richer they are, and therefore the higher the wealth, the lower its cash to wealth ratio. For this group money demand is given by

2) $m_j = 1 - \frac{R}{2wk} + \frac{\bar{N}}{2kC_j}, j > s.$

Then we can write the budget constraint for every household as

$$P_{0}C_i + w\left(1 - \frac{m_i}{C_i}\right)\bar{N} = wE_i + \beta A_0,$$

The effective price of consumption is now specific to each household and given by

$$P_{0} = \left(1 + \tau_e\right)R\left(\frac{m_i}{C_i}\right) + wk\left(1 - \frac{m_i}{C_i}\right)^2$$

In addition we can observe that the heterogeneity of this price comes uniquely due to the share of payments done with cash, which as stated in result 6 is now different across agents.

In addition it is straightforward to compute that

$$\frac{\partial}{\partial \frac{m_i}{C_i}} P = R - 2wk\left(1 - \frac{m_i}{C_i}\right) = \frac{w\bar{N}}{C_i} > 0$$

which implies the following result:
**Result 7:** With economies of scale in the transactions technology there is a non degenerate distribution of $m_C$ across households. Poor agents ($i$) consume less and have a higher share of money. Having a zero, or small use of credit, leads to a higher effective price of consumption.

The existence of inflation with this type of technology is an additional source of inequality.

Since the main objective of this article is to understand the connection between inflation and inequality this result is quite important. It explains that, when the monetary model economy is able to replicate payments facts, the mere existence of inflation is a source of inequality. The existence of fixed costs in the use of credit implies that the effective price of consumption is higher for those agents that do not have an advantage in using credit. And for those that use it, the richer they are the lower is the effective price of consumption.

Now our question is what happens when inflation declines. It is easy to see that with this new channel, introduced through the increasing returns on transactions and which is reflected in different effective prices of consumption across agents, inequality is affected by the change of inflation.

We can see that the relative price of consumption across agents depends on the inflation level. Inflation, directly and through $m/C$, affects the relative effective price of consumption:

$$\frac{d\ P}{dR} > 0$$

The price for the poorer household is higher than for the richer, i.e., the relative price $\frac{P_i}{P_j}$ for $i < j$ is greater than one. When inflation increases both households face a higher price but because the richer households have higher advantage for substituting cash by credit the price faced by the richer households increases less than that faced by poorer households. Then we can say that:

**Result 8:** With economies of scale in the transactions technology, inflation acts like a regressive tax on consumption. It is as if the tax rate on consumption increases more for poorer than for richer households.

Inflation is thus not just an additional source of inequality but the increase of inflation is regressive. As I am analyzing the effects of the decline of the inflation tax I can say that, if the rest of the analysis would be maintained, the decline of inflation would work as a progressive policy. But through the additional channel now discussed, the decline in inflation would reduce inequality.

As mentioned in the beginning the problem with this more realistic transactions technology is that in this monetary economy it is no longer possible to aggregate households decisions and to compute equilibrium prices that do not depend explicitly on the underlying distribution. This can be easily seen since I claim that a necessary condition for this to be true is that prices faced by different agents should be identical, and we just showed that this is not the case with increasing returns since the effective price of consumption is specific to every household.
An alternative to pursue this work would be the construction, calibration and numerical computation of the equilibrium in this non-aggregable heterogeneous agent model. The results would be always conditional on the specific calibration, either of the parameters that command the aggregate behavior or of the proposed joint distribution of characteristics across households. Instead I decided to use some quantitative results taken from a similar model in the literature. Erosa and Ventura (2002) use an heterogeneous agent model with several alternatives, some of which are similar to the model described in this article. In their examples, aggregate results, and therefore equilibrium prices, behave qualitatively in the same way in the heterogeneous agent model when compared with a representative agent model.

They also show that when the decline of inflation is accompanied by an increase of the labor tax the welfare of the poor agent increases by more than the one of the rich agent. Using the definitions in this article this means that inequality is reduced. Since this is the case where I show that the results are not robust, it helps to state that in a carefully calibrated model forces that lead to the decline in inequality will dominate those that increase it.

3. CONCLUSIONS

There is a strong connection between inflation and inequality, even when the change of inflation, and the associated inflation tax, is not coupled with a decline of government expenditures. When the lost revenues from taxing money are substituted by revenues from other taxes, the specific tax chosen can affect the distributional effects of the lower level of inflation.

Given the fundamental roots of heterogeneity, which were taken to be differences in labor productivity and initial wealth, and given the higher concentration of wealth when compared with earnings, the increase in the labor income tax is worse for inequality than the increase in the consumption tax. Therefore the best alternative to help the reduction of inequality when inflation is reduced is the increase of the tax on consumption or a VAT tax. The tax on cash, when compared with this tax on consumption is worse for inequality for two reasons: first, just by increasing a common consumption price hurts the poor more; and second, when this price differs across households, penalizing the poorer, the increase of inflation increases this difference. The inflation tax is a tax that is worse for inequality than the linear tax on consumption, even when does not create different consumption prices across households, and in more realistic frameworks it is even worse given its regressive characteristics.

Therefore the decline in inflation, in addition to being able to increase the aggregate welfare, is equity improving. This means that agents in the bottom of the welfare distribution have a high probability of improving welfare due to the decline of inflation.
REFERENCES


