Currency Substitution and the Regressivity of Inflationary Taxation

by

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1 Introduction

The Austral and Cavallo plans implemented in Argentina in 1985 and 1991, respectively, point to a drastic change in the perception of proper economic policy. In both cases, stabilization programs that stressed the need for fiscal adjustment and monetary restraint were seen as the only way out of Argentina's history of high inflation. What makes both experiences so remarkable is that in both cases, they were implemented with clear electoral purposes in mind. Three months after the Austral plan and six after the Cavallo plan were launched, general elections for the legislative assembly took place.[1]

Table 1 summarizes some of the main developments of economic policy relevance for Argentina, between January 1990 and the elections in October. As can be immediately seen from a quick browsing of this table, the government chose a strategy of strict fiscal austerity, regardless of the degree of confrontation that this implied with labor unions or other sectors of the economy. Eventually, the rate of inflation was strikingly reduced and the government had an uncontested electoral success in October.

The question this paper tries to answer is why a policy that emphasizes the need of fiscal austerity and hardships would be politically acceptable and, indeed, politically attractive. The answer that we suggest to explain this seeming paradox is simple. The inflation tax is far more regressive than is generally understood. This regressivity arises from a process of financial adaptation to which richer agents in the economy have easier access.

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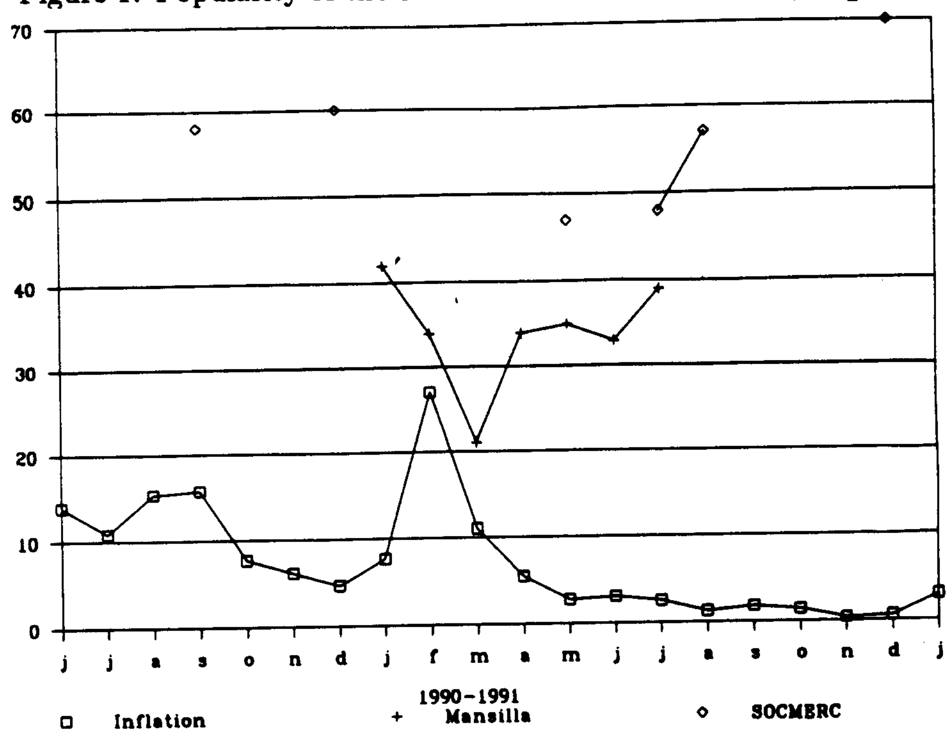
[1]In September 1991 provincial governments were also contested.

Table 1: Economic Developments in Argentina during 1990.

Jan. 27	Run on the exchange rate. The dollar jumps 100 % in a few days.
Jan 28	Cavallo sworn as Finance Minister.
Feb. 3	Increase in VAT. Increase in gas taxes.
Feb. 5	Increase in most public sector tariffs. January inflation is 7.7 % (CPI).
Feb. 11	Strike by Ferrocarriles Argentinos workers starts.
Feb. 13	100 fired from Ferrocarriles.
Feb. 17	300 fired from Ferrocarriles.
Feb. 20	Firings in Ferrocarriles reach 600.
March 1	Government takes control of La Fraternidad, the railroad union.
March 1	Trade liberalization announced.
March 3	Ferrocarriles closed until privatization.
March 10	Teachers on strike. February inflation is 27 % (CPI).
March 11	Government threatens massive firings from Ferrocarriles.
March 17	Disturbances in a protest by teachers and railroad workers. Strike starts to weaken.
March 20	Cavallo sends a project to fix the exchange rate to Congress. Stock markets boom. Interest rates collapse.
March 22	List of firms closed for tax evasion is published.
March 28	Strike by Ferrocarriles workers ends. March inflation is 11 % (CPI).
April 3	Additional list of 1,200 tax evaders is made public.
April 15	Sweeping privatization program is announced. Rosario-Bahía Blanca railroad is sold.
April 21	3,600 fired from ACINDAR.
April 24	2,500 public employees fired in Catamarca.
May 9	BANADE occupied by employees. Government threatens to fire 1,200. Inflation in April reduced to 5.5 % (CPI), 1.1 % (WPI).
May 26	Project for payment of "aguinaldo" in installments.
May 30	Increase in pensions conditional on new taxes is announced.
June 7	Pensionists protest. They are dispersed by the police.
June 13	Cavallo declares "I have to explain to society the meaning of having a **budget constraint**".
July 15	Drug trafficking charges are pressed against high government officials, including the President's sister-in-law.
August 4	Inflation in July down to 2.6 % (CPI) and 0.4 % (WPI). Labor market deregulation announced.
August 11	Ruling party strikes surprising success in first-round elections.
August 25	Stock market hits volume record.
October 5	Inflation for August falls to 1.8 % (CPI).
October 13	3,100 fired from SOMISA.
October	Ruling Party succeeds in next two election rounds. Wins in 14 out of 21 contested provinces.

Source: De Pablo (1991) and La Nación, several issues.

Figure 1: Popularity of the President and Inflation rates, Argentina



Source: Cesar Mansilla & Asoc. and SOCMERC, Indicadores de Coyuntura, FIEL, Bs. As.

Financial adaptation, i.e., an improvement in the savings or transactions technology that creates convenient alternatives to money, is a well known phenomenon in high-inflation economies. (See, for example, Dornbusch, Sturzenegger, and Wolf, 1990.) There are many ways to evade the inflation tax, from using credit cards, checkable interest-bearing accounts, or simply through "dollarization", ie. the use of foreign currency. This paper explores the reasons why wealthier individuals have preferential access to these technologies. We concentrate on the transactions technology. However, the poor also usually have a higher fraction of their savings in non-indexed assets or fixed-interest rate deposits, which make them even more vulnerable to an outburst of high inflation.

The above reasons combined make the inflation tax extremely regressive. Therefore, stabilization programs become very attractive to a vast majority of the population. This can explain the electoral successes of the two previously mentioned episodes in Argentina in spite of tough rhetoric and drastic measures described above.

A crude but enlightening way to test the popularity of stabilization programs is to follow the degree of popularity of the President before and after the stabilization program. Figure 1 shows the degree of popularity of President Menem as the stabilization program of 1991 evolved. As can be immediately seen, the popularity of the President is strongly negatively correlated with the rate of inflation.

While financial adaptation does induce strong regressivity in the inflation tax, it does not follow that financial adaptation should be restricted. One way or the other, financial adaptation will take place. Latin American countries have tried to stop the flight from domestic money and from the domestic credit and capital markets using all kind of restrictions, but have only succeeded in causing a proliferation of black markets or capital flight. Resources can always be diverted to other countries, and transactions can always become dollarized, independent of any government restriction. Therefore, the lesson to be learned is that the inflation tax should be avoided because it generates an extremely regressive taxation system.

The outline of the paper is as follows. Section 2 develops the basic model for the case in which financial adaptation, or the use of a second currency, is costless. Section 3 introduces a constraint or cost for currency substitution. More specifically we assume that there is a fixed cost of substituting into the alternative currency. We show that under this assumption, only the richest agents in the economy will engage in currency substitution. Finally, in Section 4, we show how this affects the regressivity of the inflation tax. Section 5 contains concluding remarks.

2 The model

The model in this section is a standard version of a money-in-the-utility function framework with two currencies. This setup has been extensively used in the literature to discuss the implications of inflationary policy on the balance of payments, current account, and real exchange rates. The purpose of this paper is not to discuss new findings on the above issues but to explain how costs of switching from one currency to the other can generate different impacts of the inflation tax on different individuals. The incidence of the inflation tax depends crucially on the availability of alternative means of transactions, and these depend, in turn, on the costs of improving the savings or transactions technology.

The process of financial adaptation in the presence of high inflation may take several paths. It may show up as a shift into foreign assets or shifts into interest-bearing domestic assets, goods, investments, or real estate. Here we concentrate not on those assets used for savings purposes, but on those used for transactions. In this area, high inflation quickly generates changes. The use of credit cards, of interest-bearing checkable accounts, and eventually, of foreign currency all increase substantially as inflation increases. In this paper, we concentrate on this last channel and therefore talk of "currency substitution" rather than of "financial adaptation".[2]

The model we use is a simplified version of that in Calvo (1985). The representative agent's maximization problem is to maximize intertemporal utility, or

$$Max \int_0^\infty V(u(c), l(m, f))e^{-\delta t}dt, \tag{1}$$

where c is consumption, m and f represent the amount of domestic and foreign currency holdings (measured in terms of the commodity), respectively, and δ is the discount factor. Following Calvo (1985) we impose some structure on the functions $V(.,.)$, $u(.,.)$ and $l(.,.)$. We assume that V is weakly separable in both subutilities, u and l. More restrictively, we assume that both V and l are linear homogeneous and that $\sigma_{ul} < \sigma_{mf}$, where σ represents

[2]The money-in-the-utility function framework captures more of the role of money as a transactions medium rather than as a store of value, hence, we use the interpretation in the text.

an elasticity of substitution.[3] The second condition states that agents find it easier to substitute between both monetary assets than between goods and money. In general, we expect this to be the case in high inflation economies. These conditions are not strictly necessary but are sufficient to generate the reasonable predictions that increases in the rate of growth of money will induce a real depreciation and an accumulation of foreign assets, as people switch out of domestic money and into the foreign currency. We use these assumptions in this paper for simplicity.

The dynamic budget constraint faced by an agent is

$$c + \dot{m} + \pi m + \dot{f} = e + x, \tag{2}$$

where π is the inflation rate of domestic currency and x represents a transfer received from the government. In each period he can either consume goods or accumulate real balances of both types. e is his endowment of the commodity. Foreign assets do not pay any real return and therefore correspond to the notion of using "dollars" for transaction purposes. In addition we have that

$$\dot{m}/m = \mu - \pi, \tag{3}$$

where μ is the rate of growth of the stock of domestic money. In equilibrium it will turn out that

$$x = \mu m, \tag{4}$$

or that agents receive back their inflation tax as a transfer. Equations (2), (3) and (4) imply that the accumulation of foreign assets will only take place through a trade surplus.

Finally we have an additional constraint for the state variable, the stock of total assets, a, of

$$a = m + f. \tag{5}$$

Solving the maximization of (1) subject to (2) and (5) and assuming an interior solution gives the first-order conditions

$$\begin{aligned} V_c &= \lambda, & (6)\\ V_m - \lambda\pi - \mu &= 0, & (7)\\ V_f - \mu &= 0, & (8)\\ -\dot{\lambda} + \delta\lambda &= \mu, & (9)\\ \lim_{t\to\infty} a_t \lambda_t e^{-\delta t} &= 0. & (10) \end{aligned}$$

These conditions plus the budget constraint, (2), plus the two previous equilibrium conditions, (3) and (4), characterize the solution to this dynamic problem.

[3] Many of our proofs require only the assumption of homotheticity, which is less restrictive than the linear homogeneity assumed by Calvo.

The dynamics of the above system are properly described in Calvo (1985). We concentrate here on the steady-state solution. From the first order conditions and the equilibrium conditions, we can immediately see that the steady state is characterized by the following conditions:

$$e = c, \tag{11}$$
$$\frac{V_m}{V_c} = \frac{V_l l_m}{V_u u_c} = \delta + \mu = \delta + \pi, \tag{12}$$
$$\frac{V_f}{V_c} = \frac{V_l l_f}{V_u u_c} = \delta. \tag{13}$$

Equation (11) states that in the steady state, consumption equals production. The country does not experience any trade surplus, so, there is no accumulation of foreign currency. Equation (12) shows that in the steady state, the ratio of the marginal utility of domestic currency relative to that of the numeraire equals the nominal interest rate. Finally, equation (13) states the condition for optimal holdings of foreign currency, its marginal utility relative to that of consumption must equal the real interest rate.

In this economy, foreign currency is measured in terms of commodities; that is, relative PPP holds with the rate of depreciation corresponding to the domestic inflation rate.

To understand the stationary steady state, suppose there is an increase in the rate of money creation. This will imply a steady-state increase in the marginal utility of domestic money, i.e., a fall in the holdings of domestic monetary balances relative to foreign assets. Calvo (1985) has shown that under the assumptions made on V, u, and l, for (13) to hold, there must be an increase in the holdings of foreign assets. The transition is achieved through a downward jump in the level of consumption that generates an accumulation of foreign assets along the convergence path. Eventually the level of consumption returns to its steady state level e. (See Calvo (1985) for further details.) Notice that if the ratio of liquidity to consumption services remained constant, the complementarity of both currencies would induce a fall in the holdings of foreign currency. The increase in the inflation rate decreases the total consumption of liquidity services, increasing the ratio $\frac{V_l}{V_u}$ sufficiently, that for (13) to hold, then, an increase in foreign assets is required.

What we want to stress from the steady state solution is that the conditions characterizing this solution allow for a direct computation of the demand for each currency. Notice that V_c is equal to the marginal utility of income. Therefore, equations (12) and (13) are equivalent to those arising from the maximization of a static problem in which the prices of domestic and foreign money equal $\pi + \delta$ and δ, respectively.

The corresponding demands for both currencies will depend on the form of the utility function assumed for V and, in particular, for l. l denotes the utility of using the two currencies. What should this utility function look like? There are two alternatives that capture the nature of substitutability between both currencies. One is the "love of variety" function. In this framework, the agent chooses from a menu of alternatives but when faced with equal prices, chooses to spread his spending evenly among all the alternatives. This corresponds to an economy in which even though people use dollars for some transactions, they still prefer to use domestic currency for some purchases. A CES utility function is the most standard representation of this utility. The other alternative is the "ideal variety" function. In this case, the agent has a preferred variety. Alternative varieties substitute imperfectly for the preferred one, and the agent chooses that which gives the lowest quality-adjusted price (where quality denotes the compensation required to account for the fact that one variety is preferred to the other). Here, if the agent switches to the foreign currency, he will not demand any domestic currency at all. In the demand for money setup, it is not clear if any currency should be preferred per-se. The ideal-variety function behaves similarly to a love-of-variety function in which the elasticity of substitution approaches infinity. See Helpman and Krugman (1986).

For the sake of illustrating the results, let's assume that V is Cobb-Douglas with exponent α on the consumption of goods and that l is CES with an elasticity of substitution equal to θ.[4] Given this parametrization of the utility function, in the steady state the demands for currencies equal

$$m = \left(\frac{\delta + \pi}{P}\right)^{-\theta} (1-\alpha)\frac{y}{2P}, \tag{14}$$

and

$$f = \left(\frac{\delta}{P}\right)^{-\theta} (1-\alpha)\frac{y}{2P}, \tag{15}$$

where P is the price index for liquidity services corresponding to the CES utility function assumed. In particular,

$$P = \left(\frac{1}{2}[(\delta+\pi)^{1-\theta} + \delta^{1-\theta}]\right)^{\frac{1}{1-\theta}}. \tag{16}$$

In steady state, the demand for each money depends on the relative price of the two currencies and the amount of income devoted to liquidity services. If currency prices are equal, the agent will consume half of the amount devoted to liquidity services in each currency.

If the demand is of the ideal-variety form, then maintaining the Cobb-Douglas assumption for the overall utility, the demands for currencies equal

$$m = 0, \tag{17}$$

and

$$f = \frac{(1-\alpha)y}{\delta}. \tag{18}$$

3 The extended model

In this section we try to tackle the issue of different access to the financial sector or different access to currency substitution possibilities. The extended model assumes that there is

[4]Notice that the condition $\sigma_{ul} < \sigma_{mf}$ implies that θ has to be strictly greater than one.

a fixed cost of using the foreign financial asset, f. This, of course, does not correspond entirely to reality, as we know that there are also positive marginal costs. Some institutional arrangements, such as the checkable interest-bearing accounts in Brazil, carry a small transaction fee for each check. What is true, however, is that the fixed cost is paramount, in terms of learning about new transactions procedures, in walking to the store to exchange domestic currency for dollars, or bearing the costs of setting up bank accounts or getting a credit card.

Faced with a fixed cost for using the foreign currency, the agent must decide if he is going to pay it and avoid the inflation tax on some of his monetary balances or if he is going to use only domestic currency. His decision will depend on many factors. Of course, the inflation rate for domestic money will be important. Income will also be critical. High-income agents will use foreign currency; low income agents will not.

Consider an agent who can choose between both currencies, m and f, but pays a fix cost, k, if he decides to use foreign currency at all.[5] We can easily compute the indirect utility of two portfolios, one holding only domestic currency, one holding both. The agent will choose the portfolio that gives him the highest utility. Each individual agent solves a problem identical to that in Section 2, in which he takes the inflation rate as given. In order not to distort the currency choice we assume that each agent receives an identical transfer independent of his monetary holdings. In steady state individual consumption will be constant but not equal to each individual's endowment.

We consider the case in which V, u, and l are all homothetic functions. Recall that for a homothetic utility function, the indirect utility function equals the level of income times a corresponding price index for the commodities considered, or

$$\Omega(\nu_u, \nu_l, y) = \nu_y(\nu_u, \nu_l)y, \tag{19}$$

where ν_y, ν_u and ν_l represent the price levels for overall income, goods consumption, and liquidity services respectively. Ω denotes the indirect utility function associated with the steady-state analog of problem (1). The demand shares for, or the relative income spent on, goods and liquidity depend on relative prices. The corresponding price levels are derived from the subutility maximization problem for goods and liquidity services. Since there is only one consumption commodity, the price level equals the price of that commodity, which, since it is the numeraire, equals 1. Therefore, we have that $\nu_u = 1$. For liquidity services, the exact representation of the price level will depend on the form of the utility function chosen but will be related to the price of both currencies; so, $\nu_l = \nu_l(\pi + \delta, \delta)$ and $\nu_y = \nu_y(1, \pi + \delta, \delta)$.

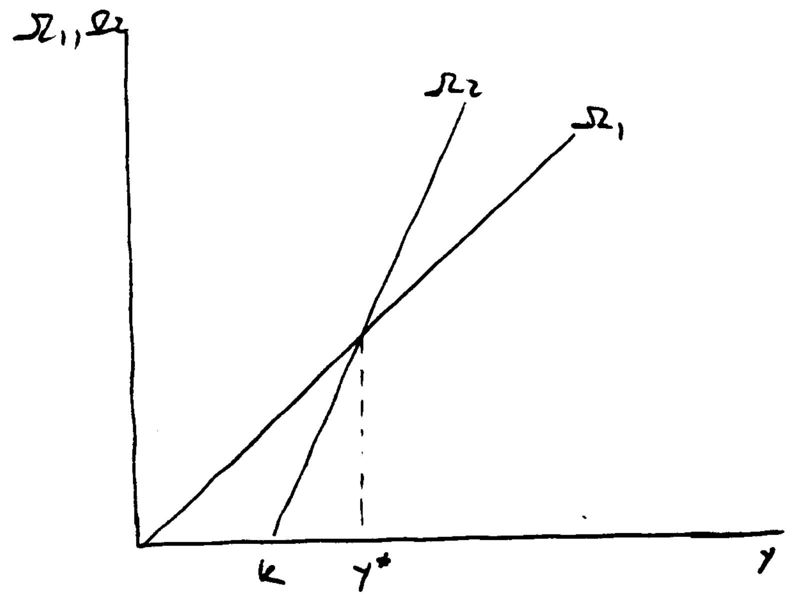
Now, consider the agent's decision whether or not to use financial adaptation. If he decides not to use financial adaptation, his indirect utility function equals

$$\Omega_1 = \nu_y(1, \pi + \delta, \infty)y. \tag{20}$$

The relevant income level is y, and the price level does not go to infinity given the assumptions made on the elasticity of substitution between both currencies (see equation

[5]Notice that as stated here, this fixed cost is paid every period. If it were paid only once, the incentive to switch would be much bigger, but the argument would be the same.

Figure 2: The Portfolio Choice



(16) for $\theta > 1$).[6] If the agent decides to use financial adaptation, his indirect utility function is

$$\Omega_2 = \nu_y(1, \pi + \delta, \delta)(y - k), \tag{21}$$

where the relevant income level is now $y - k$ because the fixed cost of financial adaptation has to be discounted. Figure 2 shows both indirect utility functions.

Given the homotheticity of the utility function, both indirect utility functions are linear in y. The slope of the indirect utility function in the case in which only domestic currency is used is smaller than that for the case in which both currencies are used because the real price index is higher under the assumption that inflation is positive; that is, the marginal utility of income has to be greater or equal if the agent has the option of holding some foreign currency in addition to holding domestic money. Together with linearity, this generates a unique intersection point in the positive quadrant that determines the critical level of income that differentiates the two groups of agents, y^*. For income levels below y^*, the agent doesn't find it worthwhile to pay the fixed cost in order to use the foreign currency ($\Omega_1 > \Omega_2$). Only when his level of purchases is big enough does it justify using the foreign currency. The intuition is fairly straightforward. In order to pay the fixed cost, the agent has to have enough purchasing power to be able to spread this cost over a sufficiently large holding of foreign assets.

[6]In what follows we attach subscript 1 to all equations which correspond to the case of no currency substitution.

Notice two other implications of equations (20) and (21). First, the critical level of income depends on the inflation rate, π. As the inflation rate increases, it becomes more and more convenient to shift to the foreign currency, and y^* shifts to the left. This is represented by a downward rotation of both indirect utility functions in Figure 2; but where Ω_2 shifts more than Ω_1. Secondly, notice that if the inflation rate is zero, domestic currency dominates the foreign currency, and nobody uses the foreign currency at any level of income. This dominance usually not present in currency substitution models clearly hinges on the fixed cost of using foreign currency.

The fact that richer agents use more financial adaptation has been obtained in other setups. For example, both Prescott (1987) and Sturzenegger (1991), used a cash-in-advance model in which commodities are differentiated in the sense that they differ in the degree of indivisibility. Agents have to decide which currency to use for each commodity. Sturzenegger used a continuum of foreign denominations, while Prescott assumed a banking technology with a fixed cost. Either setup generates the implication that there will be a cutoff commodity bundle such that all expenditures above this value (or goods that are bought in units bigger than that of the cutoff commodity) become "dollarized" or transacted with the inflation-proof technology. If agents have different incomes, the richest will have a consumption pattern biased towards goods with comparative advantages in the inflation proof transactions technology. In the model of this paper, the consumption setup is identical for all commodities. Nevertheless, the cost of currency substitution generates the same result that the negative effects of inflation are stronger for those groups with lower incomes.

4 The incidence of the inflation tax

Section 3 gave us a classification of agents based on their money holdings that relied only on homotheticity of the utility function. The purpose of this section is to evaluate the implications of this characterization on the incidence of the inflation tax. To do so, we must compare the inflation rates paid by both groups. We need to know what percentage of income does each group, those who use financial adaptation and those who don't, pay as inflation tax.

To compute these tax rates we need to compute individual money demands.[7] To do so, we first discuss at length a special case, and then prove a general proposition which holds for any homothetic utility function.

Consider initially the case in which the overall utility is Cobb-Douglas in its two arguments, goods and liquidity consumption. This has the advantage of fixing the income shares spent on both subutilities. We allow for the two cases, ie. the love-for-variety utility function and the ideal-variety utility. The demands for the domestic currency are

$$m_2 = \left(\frac{\delta + \pi}{P}\right)^{-\theta} \frac{(1-\alpha)(y-k)}{2P}, \tag{22}$$

[7] Aggregate money demand does not exist, as it depends on the distribution of income. We have assumed that the rate of inflation is exogenous, so this feature does not generate complications when evaluating individual demands.

and $m_2 = 0$ for the two cases, respectively. For those who don't use the foreign asset, the demand for domestic currency equals

$$m_1 = (1-\alpha)\frac{y}{\delta + \pi}. \tag{23}$$

The differences in the demand functions in (22) and (23) reflect two different effects. One is the price effect that corresponds to the first term in m_2. This price effect captures the substitution away from domestic currency due to the higher relative price of domestic currency generated by a positive inflation rate. The second effect is the income effect. While the use of financial adaptation entails a cost, k, it allows for a lower price level, P. Of course, above y^*, income for those who use financial adaptation are larger. Notice that, in (22), if the prices of the two currencies are equal (i.e. $\pi = 0$) still money demand falls by half.

The inflation tax as a proportion of income is readily computed as $\pi m/y$. To show that this setup induces regressivity of the inflation tax at all levels of income, we prove the following proposition.

Proposition 1. For the utility function that gives the demands for money as in (22) and (23), the inflation tax represents a higher fraction of income for those who have not substituted away from domestic currency at all income levels.

Proof. We first compute $\pi m/y$ for both cases, ie., when people substitute away from domestic currency and when they do not. For those who demand only domestic currency, we can use (23) to obtain the inflation tax rate

$$\Pi_1 = \frac{\pi m_1}{y} = \frac{(1-\alpha)\pi}{\pi + \delta}. \tag{24}$$

For those who have substituted away from domestic currency, we get that for the ideal variety utility the inflation tax equals zero ($\Pi_2 = 0$), so the proposition is true trivially. For the love-of-variety utility function, we obtain the inflation tax rate

$$\Pi_3 = \frac{\pi m_2}{y} = \left(\frac{\pi + \delta}{P}\right)^{-\theta} \frac{1}{2P} \frac{(y-k)(1-\alpha)\pi}{y}. \tag{25}$$

Now compare equations (24) and (25). To see that the former rate is bigger, or that

$$\frac{1}{\pi + \delta} > \left(\frac{\pi + \delta}{P}\right)^{-\theta} \frac{1}{2P} \frac{y-k}{y}, \tag{26}$$

multiply both sides of (26) by $\pi + \delta$ and realize that all the factors on the right-hand side are smaller than one. Therefore showing that $\Pi_1 > \Pi_3$. □

To illustrate the importance of the inflation tax, we present the results of some computations on the differential effect of the inflation tax on both groups. Using (24) and (25), we obtained the values in Table 2. We assumed that $\delta = .05$, $\alpha = .1$, $\theta = 2$ and $k/y = .05$. The discount factor is standard, while the value of α implies that people spend 10 % of their income in liquidity services. Finally we assume an elasticity of substitution between

Table 2: The Incidence of the Inflation Tax.

π	Π_1	Π_2	Π_3
0.00	0.00	0.00	0.00
5.00	5.00	0.00	1.50
10.00	6.67	0.00	1.50
50.00	9.09	0.00	0.72
100.00	9.52	0.00	0.41
∞	10.00	0.00	0.00

Numbers are in percents.

both money services equal to 2 and that the costs of financial adaptation equal 5 % of total income. These computations do not pretend to represent actual quantities, only to describe the possibilities of the model.

As can be observed, there is a drastic difference in the incidence of the inflation tax for both groups. This difference widens as the rate of inflation increases. While those agents who remain in domestic currency end up losing all the resources spent for liquidity purposes, those who are able to substitute away eventually pay nothing.[8]

While the above illustrates the different impact of the inflation tax, the previous formulae are still incomplete. Agents who substitute to foreign currency have to pay the fixed cost of financial adaptation, k. Therefore, for them, the relevant cost should be $\pi m/y + k/y$, and not only the inflation tax as considered above. To prove that the rich are proportionally less worse off than the poor at all levels of income, taking into account the costs in terms of the inflation tax, financial adaptation, and the distortion of the liquidity consumption choice faced by the individual, the following proposition shows that those who have substituted away from domestic currency are willing to sacrifice a smaller fraction of income to face a situation without inflation than those who haven't.

Proposition 2. Assume that V, u, and l be homothetic functions. Then, the fraction of income that agents are willing to give up in order to avoid the inflation tax is smaller for those who have substituted away from domestic currency.

Proof. To compute how much income the agent is willing to give up to face a different set of prices, we use the indirect compensation function[9]

$$\mu(p; q, y) = e(p, \nu(q, y)), \tag{27}$$

where μ gives the value of income needed at prices p (without inflation) to obtain the level of utility $\nu(q, y)$ (with inflation and income y.). The cost of inflation considered here is given then by: $(y - \mu)/\mu$.

For those who have substituted away from domestic currency, we can use the fact that

[8]Recall that, by the assumption on the elasticities of substitution, we restrict the elasticity of substitution between both monies to be greater than one.

[9]For a review, see Varian (1984).

$e(p,\nu(p,y)) = y$ and realize that if they pay the fixed cost agents will face the no-inflation relative price vector. Therefore, their indirect compensation function will be

$$\mu_2(p;q,y) = e(p,\nu(q,y)) = e(p;\nu(p,y-k)) = y-k. \tag{28}$$

The cost of inflation for the high income group therefore equals

$$\frac{y-(y-k)}{y-k} = \frac{k}{y-k}, \tag{29}$$

which is declining in y.

To compute the indirect compensation function for the low income group we use the homotheticity property, which implies that $\mu(p;q,y) = e(p,\nu(q,y)) = h(p)\nu(q,y)$, to get

$$\mu_1(p;q,y) = e(p,\nu(q,y)) = h(p)\nu(q,y) = \frac{h(p)}{h(q)}y. \tag{30}$$

Notice that the price indices are invariant to the level of income, so the cost of inflation for the poor is constant and equal to

$$\frac{y-\frac{h(p)}{h(q)}y}{\frac{h(p)}{h(q)}y} = \frac{h(q)-h(p)}{h(p)}. \tag{31}$$

Finally, notice that at y^*, the point at which both indirect utility functions are equal, we have that

$$\mu_1(p;q,y^*) = e_1(p,\nu_1) = e(p;\nu) = e_2(p,\nu_2) = \mu_2(p;q,y^*), \tag{32}$$

that is, at that point, both groups pay the same proportion of income as inflation tax. Using the fact that for the low income group, the cost of inflation is constant as a fraction of income and that it is declining for those who substitute out of domestic currency completes the proof. □.

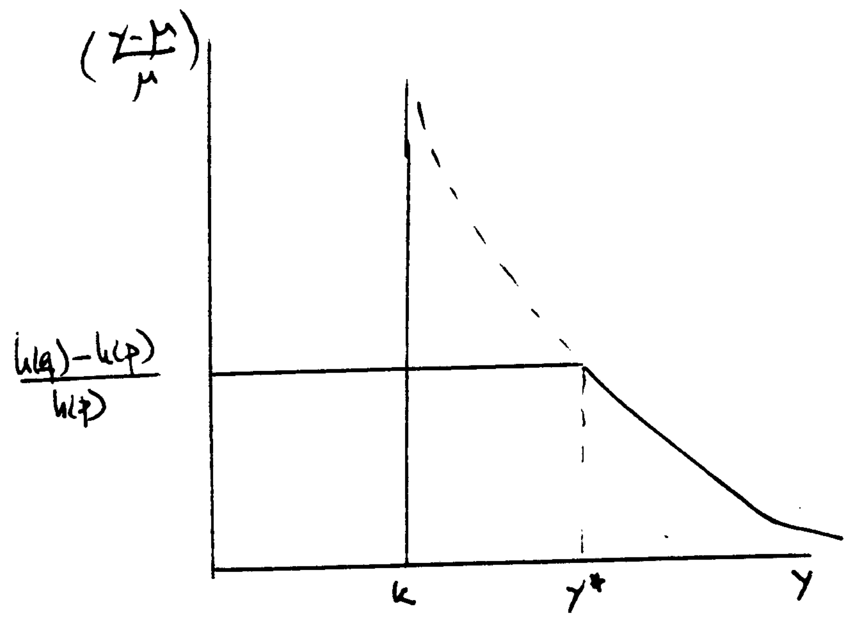
Figure 2 gives a graphical interpretation of proposition 2. While those who use only domestic currency have a constant cost of inflation, this cost is declining for those which have substituted into foreign currency. At income level y^* the two costs are equal. All those who have substituted currency perceive a lower cost of inflation.

Proposition 2 shows that the inflation tax is regressive overall, ie., that those who substitute away from domestic currency are willing to give up a smaller fraction of their income in order not to have to face the inflation tax. The indirect compensation function is the appropriate metric because it takes into account the distortions in the overall pattern of consumption that occur because of changes in the inflation rate.

5 Conclusions

This paper uses a simple story to obtain a strong message. Inflation taxation is more regressive than is usually thought. The traditional analyses of the income distribution

Figure 3: The Costs of Inflation.



effects of inflation concentrated on the fact that the income elasticity of money demand is smaller than one or that there are "economies of scale" in the use of money. This paper sidesteps this issue, not because we think it is not relevant but because we want to stress another channel through which inflation affects income distribution. Currency substitution takes place in high inflation economies, and rich people have preferential access to this technology. In our setup, this preferential access was induced by a fixed cost of currency substitution, which made this technology profitable only for sufficiently high levels of income. Once this effect is taken into account, we see that agents with higher incomes use less money and therefore pay a smaller fraction of the inflation tax.

In the analysis, we assumed that the rate of inflation is exogenous. If the government tries to finance a given amount of resources through inflationary financing, as some agents engage in currency substitution the equilibrium rate of inflation for the economy will increase. This only strengthens the implications of this paper, as the tax charged on those who remain in domestic currency will increase. In general, it also happens that financial adaptation takes place only slowly, as if there were adjustment costs. This increases the rate and regressiveness of inflation tax through time. This may be behind the reason why the rate of inflation has to increase substantially before a political consensus arises for stabilization.[10]

An additional cost not considered in this paper is the seigniorage issue discussed in Fisher (1982). As people switch to the foreign currency the economy as a whole runs a current account surplus in order to purchase the new money stock. This represents a net

[10]See Labán and Sturzenegger (1991) for a political economy model that takes this point into account.

loss for the economy which is not taken into account at the individual level.

Financial adaptation introduces additional regressivity to the inflation tax, increases the rate of inflation and induces seigniorage losses. However, the lesson to learn from this paper is not that financial adaptation should be disrupted or restrained. The importance of a having a developed financial sector, for an efficient allocation of savings, for example, has been repeatedly stressed in the literature. If governments try to restrain the process of financial adaptation, it nevertheless takes place through informal channels or the black market. The lesson is that the inflation tax is much more regressive than the usual analysis has portrayed and that therefore governments that care for the lower income groups should restrain from using it.

Stability has become a major political asset. This paper contributes to understanding why.

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