

**THE ACCIDENTAL TAX:
INFLATION AND THE FINANCIAL SECTOR**

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1. Introduction

Although first and foremost a monetary phenomenon, inflation has wider implications for macroeconomic stability, competitiveness and contracting, notably by virtue of the fact that many contracts, especially wage contracts, are fixed in terms of money. But it is two particular features of inflation that concern us here (and their interaction), namely its potential to ease the government's budget constraint and the impact on financial sector performance.

We argue that inflation is nowadays often an “accidental tax”, with surprisingly little use of direct monetary financing of the government. It has two contrasting impacts on the financial sector. On the one hand, by increasing the risk and cost of payments and maintaining liquid transactions balances, it increases the demand for certain financial services, swelling the value-added and profitability of banks. On the other hand, the interaction of inflation with a non-indexed tax system often results in an effective rate of taxation on financial intermediation which is super-sensitive to the inflation rate. The high and volatile effective tax rates are associated with wide intermediation margins and a reduced scale of intermediation.

Socially, both effects are costly distortions: even if banking activity and profits are increased by the additional demand for efficient payments services, this is a socially costly diversion of resources from more productive activities. The costs of tax-inflation interactions can be reduced by avoiding particular tax designs, including taxes on gross interest receipts, off-market interest ceilings and unremunerated reserve requirements.

This paper is organized as follows. Section 2 reviews the underlying theory of inflation as a tax, asking whether it could form a part of the optimal set of taxes, especially bearing in mind its impact on the financial system. Section 3 examines the mechanics of how inflation generates revenue for the government, uncovering evidence suggesting that, in most countries recently, most of the fiscal benefit flows through the profits of the central bank, rather than in the form of a direct flow of financing. Section 4 presents the empirical evidence of the impact of inflation on banking activity and profits, showing that, while the financial system shrinks with inflation (markets apparently more than banking) it tends to be associated with a boost to bank profitability and value added. Section 5 shows how highly sensitive the effective rate of other taxes (especially those on

¹ Thanks to Klaus Schmidt-Hebbel for helpful suggestions.

interest) can be to inflation, and proposes a measure of that sensitivity. Section 6 offers some remarks on incidence. Section 7 concludes.

2. Could inflation be a good tax – even for the financial sector?

Genuine tax or analytical construct?

If inflation is always and everywhere a monetary phenomenon, the inflation tax too is inherently a monetary phenomenon. But, as with the causes of inflation itself, it is often necessary to look behind the money creation in order to understand the processes that create and sustain the conditions for monetary expansion. Rather than being the consequence of a measured policy decision to impose an “inflation tax”, inflation is more often the result of quite different policy dynamics. For example it may result from monetary accommodation of a wage bargaining process, or of an exchange rate depreciation caused by non-monetary factors.

To some extent, the concept of inflation tax is an analytical construct rather than a recognized and managed source of revenue for the state. It is clear enough that inflation and the associated money creation can represent a transfer of resources to the state, but measuring the resources so transferred, or even identifying the tax base, is a matter of analysis on which authors differ. No government budget contains a line entitled “inflation tax” or “seigniorage”. That is not to say that the implicit revenue comes as a surprise at the end of the year – estimates of the revenue and expenditure of the various channels through which inflation will have its effect on the budget will normally be taken into account in budgetary forecasts. Thus, only if the inflation is unexpected will there be surprises.

It is the increased demand for holdings of nominal base money associated with the inflation that will create the conditions for the government’s budget to profit from its monopoly pricing of base money.

It is not even the case that inflation will always be associated with a net gain to the budget. Existing conventions and contracts may greatly erode, or even reverse, the gains. Thus, as was famously pointed out by Tanzi (1977), if government wage rates are indexed, or quickly adjust to changing price levels, while tax receipts, struck in nominal terms, arrive at the Exchequer in arrears, an engineered expansion in the money supply may not provide enough resources to cover the additional net outlays that are required because of the change in prices.

Few governments, then, set out consciously to exploit the inflation tax. If there is monetary financing of the budget, it is seen as a financing, rather than as a tax device, albeit one that is likely to have the politically costly side-effect of inflation. Nevertheless, once they are benefiting from the implicit revenue of a steady rate of inflation, they will quickly feel the loss of this revenue from a stabilization, as was pointed out in respect of some potential ERM and EMU members (cf. Grilli, 1989a, b, Repullo, 1991).

Should inflation tax be used?

Some have argued that perhaps governments *should* consciously exploit the inflation tax. Of course, Bailey and Friedman argued in an essentially partial equilibrium steady-state context that the optimal rate of inflation tax was zero, to be achieved (absent any way of paying interest on currency notes) by a steady proportionate contraction in the money supply and the associated deflation. But, as pointed out by Phelps, undistorting taxes are not generally available, so that, in order to finance socially desirable government expenditure, the optimal set of taxes might easily include the inflation tax. An unresolved debate has raged since over this issue. Among theorists, the question has been whether the inflation tax is one of those taxes which (following Diamond and Mirrlees) should optimally be omitted from the set of taxes in preference to taxes that can achieve the desired impact on consumption without distorting production structures. An increasingly refined literature has pinpointed the assumptions necessary (in a frictionless economy) to sustain the original Friedman proposition in terms of whether the role of money is essentially reducible to that of an intermediate good.²

If higher inflation induces less reliance on money balances in household portfolios, channeling more of savings instead into capital formation, more rapid growth could be the result. This proposition, advanced long ago by Tobin and retaining theoretical support in some models³ of endogenous growth, remains controversial and rather heterodox. Certainly, empirical studies cited below show a negative cross-country correlation between inflation and growth.

The existence of non-trivial collection costs for formal taxes may provide another rationale for use of the inflation tax, and some authors have gone so far as to suggest that the presence of currency substitution may in this respect be harmful in that it limits the scope for using the inflation tax for such reasons (Sibert and Liu, 1998).⁴

The base of the inflation tax includes not only currency, but also unremunerated or partly remunerated required banking reserves. It is hardly disputed nowadays that the primary rationale for sizable unremunerated reserves is fiscal (even if some techniques of monetary stabilization employ requires reserves, little if any fiscal penalty is needed to ensure their effectiveness in this role).⁵ Noting that bank depositors are more prosperous than those whose liquid assets are wholly in the form of currency notes, some scholars have argued that the major political economy motivation for using partially remunerated reserve requirements instead of relying on seigniorage from currency only is to

² For instance Chari et al. (1996) show that, whether the role of money is characterized in terms of “cash or credit in advance of payment” or in terms of “money in the utility function”, the optimality of a zero inflation tax depends on homotheticity and separability properties of the relevant utility functions. Essentially, the assumptions required are those that relegate the role of money to being an intermediate good in the production of utility. Cf. Correia and Teles (1997).

³ Cf. Alogoskoufis and van der Ploeg, 1994, which presents conditions under which inflationary financing of an increase in government spending will be better than tax-financing for growth.

⁴ The existence of an otherwise untaxed underground economy could be another justification, though perhaps not a strong one (Nicolini, 1998)

⁵ According to Goodfriend and Hargreaves (1983), even in the US revenue was the original motive for introducing reserve requirements.

discriminate between income groups. In these models, partly remunerated reserve requirement will be preferred (to unremunerated) by a government supported by the rich (cf. Espinosa-Vega, 1995; Espinosa-Vega and Russell, 1999, 2001; see also Chang, 1994). As to the distinct question of whether reserve requirements or a tax on deposit interest is a preferable steady-state way of raising government revenue, the majority view among theoreticians, since Freeman (1987) and Brock (1989), has been that the two are equivalent, though some authors argue that deposit tax is preferable, to the extent that it allows the banks to make more use of any special abilities to earn higher returns on loanable funds, thereby being more able to transfer the needed fiscal resources to the government (Espinosa-Vega and Yip, 2000, but see Mourmouras and Russell, 1992).⁶

Some have taken this reasoning to imply that the rate of inflation tax, if optimally chosen, should be correlated with other rates of tax (the tax smoothing argument).⁷ While the tax smoothing argument may seem plausible in theory, the difficulty in practice of controlling inflationary psychology and expectations means that a given target for the rate of inflation tax may not be as easily hit as with other taxes.

Without doubt, recourse to monetary financing is often much easier and quicker than adjusting tax rates and schedules in order to raise additional revenue.⁸ Therefore, on a time-series basis, after taking account of adjustment costs, we would expect optimally chosen inflation financing to be correlated, not with other tax rates, but with unanticipated fluctuations in spending or in the government deficit (the residual financing argument). This does appear to be the case, but in a systematic way only for high inflation countries (Fischer et al. 2002, cf. Boyd et al. 2001).⁹

Response of the financial system to inflation

The monetary and financial system does not remain passive in response to inflation. Countless studies document the substitution away from non-interest-bearing monetary assets in favor of interest-bearing or indexed assets, or to those denominated in foreign currencies, or to non-monetary assets. It is this substitution that has the most important impact on the performance and functioning of the financial system. On the one hand, the volume of funds that it is able to mobilize and intermediate may shrink. On the other hand, its capacity to provide the instruments to insulate economic agents from the effects of high or volatile inflation is an important aspect of its social contribution.

⁶ Or, looking at it from another perspective, the deposit tax equals a reserve requirement *plus* an open market operation (Bacchetta and Caminal, 1994)

⁷ The positive correlation between seigniorage and conventional taxes predicted, for example by Trehan and Walsh (1990), is based on the idea that the shocks come from spending. But other patterns of shock are possible: Click (2000) shows empirically how interaction between exogenous shocks to any of debt, seigniorage or taxation feed through to the others contemporaneously and over time. See also Mankiw (1987), Poterba and Rotemberg (1990).

⁸ This is especially the case where the efficiency of the tax system is underdeveloped – a consequence perhaps of a polarized society where each side is reluctant to improve the permanent arrangements for tax collection in case the other side misuses the revenue (cf. Cukierman et al, 1992, who provide some evidence that reliance on seigniorage is higher in politically polarized societies).

⁹ The volatility of inflation tax revenues or, more specifically, the degree of unpredictable fluctuation, does appear to be similar to that of deficits (Calvo and Guidotti, 1993)

The average rate, the variability and the predictability of inflation are three key elements contributing to the impact of the inflation tax. These in turn are linked with the rate of monetary expansion, but not in a neat or mechanical way. Over the long-term, the rate of inflation can be expected to equal the rate of base money growth less the rate of growth in the real economy and some allowance for technical change in the demand for base money. In practice, this relation is only a good predictor only at high rates of money growth (and it is very good for hyperinflation). This means that there is a disconnect between the rate of tax as measured by the opportunity cost of holding interest-free base money (which will be related to the expected inflation rate), and the flow of financing to the budget from money creation (Honohan, 1996).

Costs of inflation

What are the social costs of the inflation tax and how big are they? This broad and much discussed question takes us beyond the sphere of the financial sector (Cukierman, 1984, Feldstein, 1999). Broad, reduced form calculations have compared how growth rates vary with inflation across countries (e.g. Sarel, 1996, Bruno and Easterly, 1998, Fischer et al., 2002, Khan and Senhadji, 2000). But such calculations do not consider the channels of effect and what aspects of the financial system may be involved. The early study by Bailey adopted a simple approach, by measuring the lost consumer surplus under an estimated demand for money function. Several more specific channels of affect have been studied theoretically, including the considerations that, in the face of steady inflation, agents will over-economize on the holding of transactions balances (Cooley and Hansen, 1991)¹⁰ and that they will hold too few precautionary balances, resulting in unneeded fluctuations in consumption (Imrohorglu and Prescott, 1991).¹¹

It is often noted that, as agents will adjust only the expected part of inflation, and to the variability of the inflationary process, an unexpected inflation is, to some extent, like a lump-sum tax. However, it could contribute to the market's future allowance (risk-premium) for surprises entailing a long-lasting deadweight-loss effect which could even be larger than if each period's inflation were fully anticipated in advance.

¹⁰ For Cooley and Hansen's calibration, the welfare costs of this over-economizing on transactions balances is less than the saving made by being able to reduce income tax rates.

¹¹ Using a calibrated model of precautionary balances, Imrohorglu and Prescott deduce that the key impact of inflation or other financial sector taxes is their impact on the real rate of return on deposits as it is this that influences the degree to which agents will over-economize on precautionary balances. A tax that lowers the real rate of return by 5 percentage points is estimated to be equivalent to a loss of about 0.5 per cent of average consumption. The model is subject to the criticism that precautionary savings may in the real world alternatively be held in other forms not be subject to inflation tax. Interestingly, despite fully simulating the stochastic dynamic programming problem of the household, this model does not predict any adverse effect of variations in inflation: only the mean effect on rate of return matters.

3. *How Does the Government Get Hold of the Inflation Tax Revenues?*

In simple textbook models, the role of money creation in influencing the government's budget constraint is typically expressed in terms of a balance sheet identity which has to be satisfied at all times, such as:

$$G - T = B - (1 + r)B_{-1} + M - M_{-1}, \quad (1)$$

where G and T represent spending and taxation, B is the stock of bonds (perpetuities), r the rate of interest paid on the bonds and M the stock of base money. This is all fine and perfectly consistent, but do the implicit institutional arrangements correspond to reality? Curiously, this question does not appear to figure very prominently in the theoretical literature, though it is important in empirical analyses, especially for particular countries (cf. Anand and Wijnbergen, 1989, Fry et al., 1996, Goff and Toma, 1993; see also Drazen, 1985, Honohan, 1991, Robinson and Stella, 1993).

Almost all countries now have an articulated accounting system which clearly distinguishes the central bank from the government. An increase in the central bank's monetary liabilities (currency and the deposits placed, mainly by banks and other financial institutions – what we know as the money base) need not have as its counterpart an increase in central bank credit to the government. (Below we look at the empirical facts on this).

If the central bank does not “lend” newly created money to the government, is there still seigniorage, and if so how does the government receive the seigniorage? The short answer to this is that the seigniorage does exist, and comes through the assets that are acquired by the central bank in return for issuing money base. These are either foreign exchange, claims on the banking system, or claims on other sectors of the domestic economy.

But these assets in turn are not usually handed over to the government to be liquidated in aid of the budget.¹² Instead they are typically held on the central bank's balance sheet, where they earn interest until redeemed, and that interest accrues to the benefit of the central bank's income statement. Most central banks are either owned by the government, or if they are not nevertheless the government is usually entitled to the bulk of the profits of the central bank in due course. In this case it is through the distribution of the central bank's profits that the government's budget finally receives the seigniorage in cash form.

Other demands on the revenues of the central bank can intervene with the results that some of the seigniorage never reaches the government's budget. For one thing, the operational expenses of the central bank will often be paid out of its interest revenues; also, the central bank may undertake lending or similar activities at below-market interest

¹² Sometimes, as with the UK's Exchange Equalization Account, the foreign exchange received may be transferred to the ownership of the government.

rates.¹³ Such schemes are, in effect, off-budget subsidies: although they reduce the flow of seigniorage to the budget, they do relieve the budget from alternative spending programs that would have been required to achieve the same goals as the subsidized lending by the central bank. Improved transparency and fiscal control argue against such hidden subsidies paid for out of seigniorage before it is transferred to the government, but they do continue to be observed, though less than before.

The often delayed and opaque nature of the link between monetary expansion and the budget in regimes where relatively little of the base money liabilities of the central bank are backed by its lending to government contrasts sharply with the consolidated budget identity of equation (1). An expansion in non-interest-bearing base money that is fully backed by an increase in foreign bills, for example, will yield only the interest rate in the first year, and there may even be a further delay in transmitting this to the government, depending on the accounting and dividend procedures of the central bank.¹⁴

Dividend and accounting policies of central banks are changeable and often rather opaque, but we can observe the balance sheet structures to detect which central banks back their base money liabilities with net claims on the government, which with net foreign assets and which with other net claims on domestic sectors. We may term the institutional arrangements where it is mostly government backing (corresponding to Equation 1) as “Mode I”, and where it is mostly foreign exchange as “Mode II”.

An analysis along these lines was carried out for 153 central banks using data in *International Financial Statistics*¹⁵ A caveat needs to be entered in regard to this data inasmuch as the stated composition of assets reported by central banks to *IFS* could differ from the effective composition after account is taken of swaps and other derivative activities.¹⁶ Strikingly, we find that the mean (and median) percentage foreign exchange backing of base money in the world’s central banks (in 2000) was more than 100 per cent (Table 1). Far from the picture implied by Equation (1) which implicitly allocates all of the annual increase in base money to advances to government, the overall picture is of a predominance of Mode II type institutional arrangements. Clearly there is also a wide

¹³ Discount window lending by the Deutsche Bundesbank was, until recently, a prominent example. The below-market interest rates charged on this reflected the very low remuneration on banks’ deposits with the Bundesbank.

¹⁴ The process is seen in sharp outline in the European Monetary Union as different member central banks are faced with the question of how to account for unredeemed legacy currency notes. One approach is to recognize that some of these notes are “dead” (lost, destroyed) and as such will never be presented. Of course making an assumption on these lines gives an accounting windfall to the central bank. Should this windfall be transferred as a special dividend to the government, or would that be inflationary?

¹⁵ The analysis requires considerable regrouping of categories in *IFS* as the breakdown of the accounts of the monetary authority are presented in widely differing ways for different countries.

¹⁶ I am indebted to Klaus Schmidt-Hebbel for stressing this point. This could be especially relevant where a central bank wishes to conceal the true scale of its support to the market. Certainly some central banks have been found in several celebrated instances in the past to have undertaken future commitments of one sort or another which had the effect of reducing their usable foreign exchange reserves. And some central bank lending to local banks will have supported onlending to government. It seems less likely that much *direct* lending to government has been concealed in such ways, and it is this direct lending which our data purports to measure.

variation from country to country, with some countries relying very heavily on net credit to government as the main backing for base money. The calculations were also carried out for 1998 and 1999 and for the change from 1998 to 2000. While the mean foreign exchange backing was lower in those years, it was still very high.

Analysis of the change shows even greater reliance on foreign exchange backing at the margin in 1998-2000. Of the 130 countries which increased money base between 1998 and 2000, 80, or 38% fully backed all of the new money base with foreign exchange; all but 20 had at least 25 per cent foreign exchange cover at the margin. Far from routinely adding to the government's indebtedness to the central bank, in well over half of the countries (72 cases) central bank credit to government actually declined, and in only 30 cases did such credit increase by as much as half of the increase in the money base.

Table 1: *Backing of the money base by foreign exchange or claims on government*

		Year:	2000	Change 1998-2000
<i>Proportion backed by:</i>			%	%
(i) Foreign exchange	lower quartile		45.0	28.8
	median		100.4	115.5
	upper quartile		154.5	237.2
(ii) Government	lower quartile		-12.8	-70.4
	median		11.7	-1.1
	upper quartile		53.8	63.7
(iii) Government less central bank capital	lower quartile		-1.6	-13.0
	median		21.3	14.1
	upper quartile		60.7	71.4
Currency share in money base	lower quartile		42.3	30.8
	median		56.7	54.8
	upper quartile		72.9	81.2

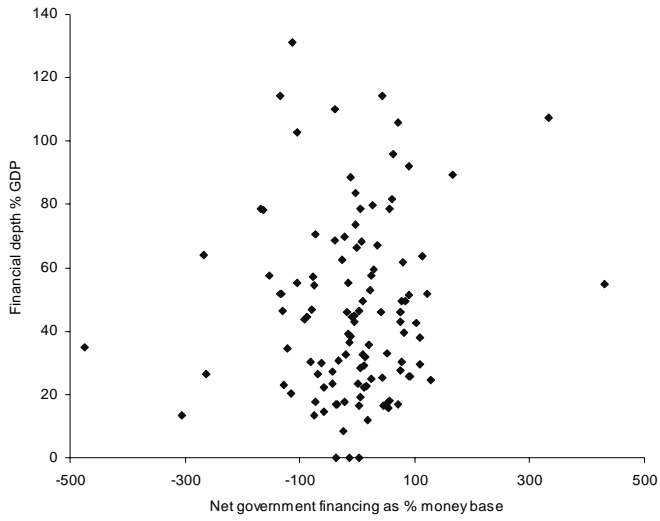
Note: Based on calculations for 153 countries of the end-2000 level (and for 130 countries of the 1998-2000 change) in money base as a percentage of the end-2000 level (and the 1998-2000 change) in (i) foreign exchange reserves, (ii) net claims on government, (iii) net claims on government less central bank capital. Also currency as a percentage of the money base. Source: Author's calculations from *International Financial Statistics*.

An alternative calculation (row (iii) in Table 1) nets out the capitalization (and other items) of the central bank on the grounds that an increase in net credit to the government which is funded by an increase in central bank capitalization does not represent monetary financing. The results of the calculation are qualitatively similar and indicate even less of a link between monetary financing of the government and increases in base money.

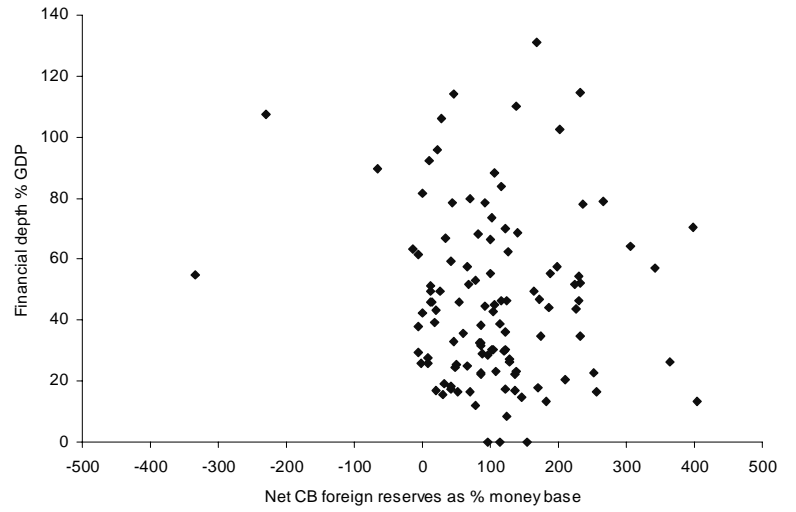
If this analysis reveals that the timing and mechanisms of budgetary finance through money creation and the inflation tax are most commonly closer to Mode II than Mode I and as such quite different from the textbook model, it is natural to ask whether there is a clear statistical link between inflation and the institutional mode of seigniorage transmission; or between monetary depth and the institutional mode, in each case measuring the mode by the degree to which money base increase is backed by foreign exchange or by net credit to government. Figures 1(a-d) (from cbaccsort.xls) show the relevant

scatterplots. Because of the wide range of values for the explanatory variable, no strong relationship is evident. Regression analysis confirms the theoretically plausible negative correlation between inflation and the degree of foreign backing (and a positive correlation with net government credit), but the finding is not statistically significant, even after excluding the largest outliers.

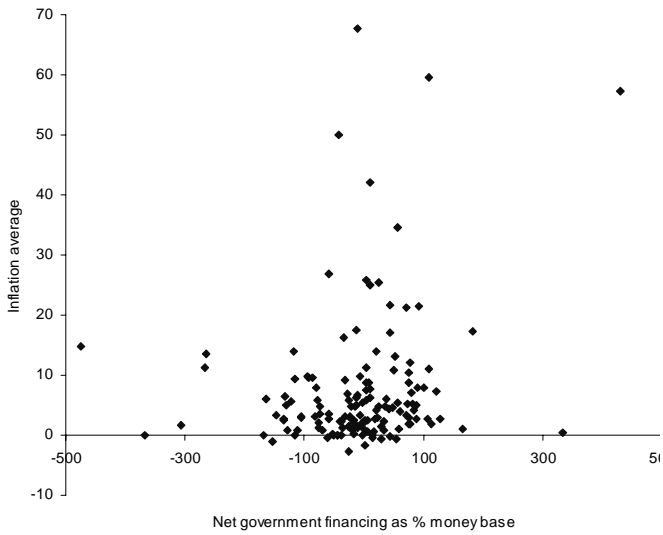
Monetary financing and financial depth
(10 outliers removed)



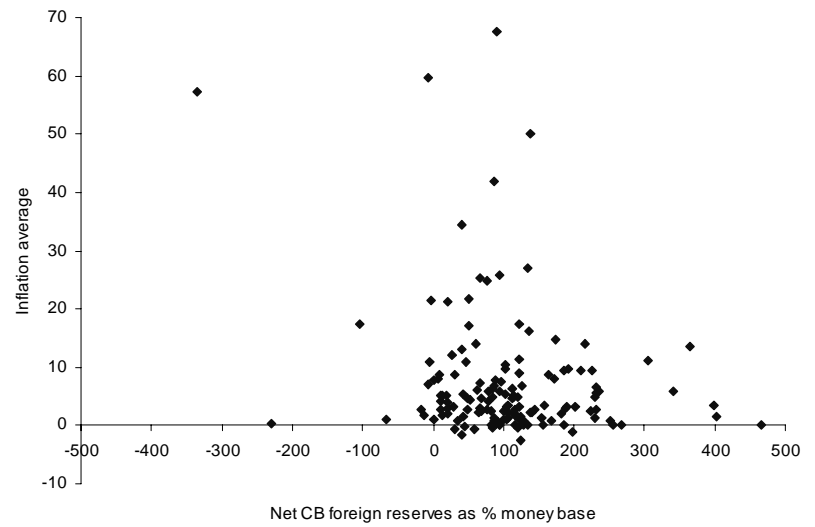
Foreign backing and financial depth
(10 outliers removed)



Monetary financing and inflation
(9 outliers removed)



Foreign backing and inflation
(9 outliers removed)



4. The impact of inflation on the financial sector

How does inflation affect the scale and profitability of financial intermediation and real rates of return? In addition to reviewing some cross-country evidence from the literature, this section contributes some new empirical evidence on these issues. Inflation is found to be positively associated with profitability and especially with the value-added of the banking system. But the balance-sheet size of the banking system shrinks with inflation, though the effect may be smaller at higher rates of inflation. Stock market liquidity also diminishes with inflation, apparently to a greater extent. The Fisherian link between inflation and nominal interest rates – only weakly evident in the cross-country data at low rates of inflation – is clear at higher rates.

Since the rate of inflation is endogenous to macroeconomic policies and financial sector structures, it would be unwise to assert too strongly that the relationships detected are causal ones. Furthermore the impact of inflation on financial sector magnitudes is highly dependent on administrative, legal and tax characteristics for which we have no good statistical controls. Therefore the statistical associations which we observe should be regarded as indicative of general tendencies rather than immutable laws.

Bank profitability

First to the impact of inflation on bank profitability? This question was addressed by the major studies of Demirgüç-Kunt and Huizinga (1999) and Claessens, Demirgüç-Kunt and Huizinga (2000). Although exploring the role of inflation was not the main focus of these papers, the authors concluded that the impact of inflation on profitability, while not very significant, is positive. Looking again at this issue with more recent data confirms and reinforces their finding. In addition, we find that inflation has a stronger and more consistent positive association with the value-added of the banking system.

The above-mentioned authors used data from the income statements of about 3000 banks in eighty countries, 1988-95. They examined a large range of potential determinants, both bank-specific and country-specific, of bank profitability. The bank-specific determinants included equity capitalization (which not surprisingly increases the ratio of before tax profits to total assets),¹⁷ the average tax rate paid (estimated to pass-through 100 per cent to before tax profits) and a dummy for foreign ownership (helps a bank's profitability by as much as 50 basis points in low income countries, hinders it in large). A bank with high overhead costs as a share of total assets does not, on average, recover these fully, though the point estimate suggests that the shortfall is very slight.¹⁸ The other bank-specific explanatory variables represent the shares in total assets represented by loans and non-interest earning assets respectively and of deposits in total liabilities. Relative to the excluded balance sheet categories, a heavy reliance on non-interest earning assets hits the bottom line, especially in rich countries; access to sources of

¹⁷ But the effect is small: about 5 basis points in additional profit for each percentage point of total assets backed by equity; seemingly implying a marginal rate of return on equity of just 5 per cent.

¹⁸ For a country with a per capita GDP of \$1000, for example all but about 3-5 per cent of overhead costs are recovered on average; for a country ten times richer, though, the estimated recovery rate is much lower: in rich countries high overheads means lower profits.

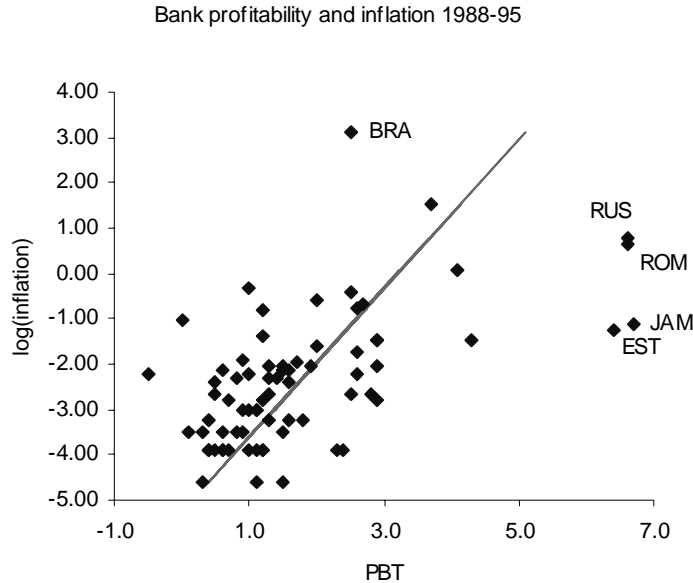


Figure 2: *Bank profitability and inflation 1988-95*

funding other than deposits boosts profitability. Loans contribute to profits somewhat more than the excluded category.

These are the only bank-specific variables used in the D-H analysis, but they are augmented by a series of macro, tax and institutional variables. It is here that the effect of inflation is measured. In fact, inflation is nowhere significant at the 10 per cent level, but the coefficient is positive, its size implying that a 10 per cent rate of inflation boosts bank profitability by about 10 basis points of total assets. The significant macro variables in these regressions are per capita income and the real wholesale interest rate, both of which are estimated to add to profits.¹⁹ GDP growth is not significant.

D-H include the economy-wide average reserve holdings as a proxy measure for this form of quasi-taxation.²⁰ Interestingly, average reserve holdings (as a share of total assets) in poorer countries sharply reduce before-tax profits, whereas they increase them in richer countries. One would expect that unremunerated reserve requirements might have an especially severe impact where inflation is high, but this was not tested by the authors.

If we are to focus on the overall impact of inflation, it needs to be borne in mind both that inflation may be jointly determined with some of the other variables included in the

¹⁹ Though per capita income becomes wholly insignificant if an institutional dummy measuring the quality of contract enforcement in the economy (BERI) is included. Another factor included is bank concentration, which could well influence the banking system's ability to capture some of the inflation tax (cf. Baltensperger and Jordan, 1997).

²⁰ This contrasts with the approach of Saunders and Schumacher (2000) who instead use each bank's non-interest earning assets as an approximation to required reserves. Evidently both are imperfect proxies. Overall reserves include non-compulsory reserves, and on the other hand in some countries some compulsory reserves are interest-earning even if at an off-market rate.

regression (notably the real interest rate). Also, the wide variation of inflation rates (and in particular the inclusion of Brazil which in the sample period reached 2300 per cent inflation) and the use of country dummies may mask a genuine impact of inflation on bank profitability. This prompts us to revisit the data and look a little more closely at inflation effects (though without retaining the micro aspects). With cross-sectional data covering some 70 countries, then, it seems appropriate to pursue a loose specification search to try to assess the scale and robustness of any link between inflation and average profitability.

As shown in figure 2, a bivariate scatterplot of the country-average values of the two variables suggests a positive relationship. This is confirmed by regression analysis on these averaged figures (Table 2). The reported regressions use log inflation instead of the level and include all of the other cross-country variables that were significant in the D-H study, namely per capita GDP, real interest rates and the level of reserves. Even including all of these variables, inflation remains highly significant when the equation is estimated in log form or, if Brazil is excluded, even in level form.²¹

Examining further, we uncover the interesting fact that inflation strongly interacts with reserve holdings, but not to reduce profits, instead to increase them! Rather than the reserve holdings being involuntary, in countries with high reserve holdings and high inflation the banks are likely finding ample remuneration at least on their marginal reserve holdings. A look at some of the high-profit countries in the scatter shows Russia and Romania to be prominent, no doubt pointing to special features of these Transition economies' systems in the early 1990s.²²

²¹ Equations 1-5 in Table 2 display the cross-country correlation of return on assets (profit before tax) with inflation in the 1988-95 period. Using the significant macro indicators of DH (1999), Equation 1 finds (as they did) an insignificant, though positive, coefficient on the rate of inflation. Brazil is an outlier in the inflation data however, and removing it (Equation 2) uncovers a strong and significant positive relationship. Actually, a more plausible functional form is to use the log-inflation, (as the impact of a one percentage point change in inflation is unlikely to be the same at high inflation rates). Substituting this results in the income per capita income variable becoming insignificant (Equations 3, 4). Inflation is significant with this functional form even if Brazil is included (Equation 5).

²² Equations 6 and 7 of Table 2 explore the tax variables examined in DH, again using country averages. Dropping Brazil again allows inflation to become significant. The significance of the reserve holdings is amplified if interacted with inflation (Equation 8) – a result which appears to be driven at least partly by the high reported profitability of Russian and Romanian banks.

Table 2: *Inflation and bank profitability 1988-95*
 Dependent variable is *Profit before tax as % total assets (country average)*

	1		2		3		4	
			<i>Exclude Brazil</i>		<i>log form</i>			
	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)
<i>c</i>	2.262	(9.6)	1.941	(8.4)	3.518	(11.8)	3.544	(12.1)
<i>Inflation</i>	0.066	(1.1)	-0.972	(3.9)	0.685	(5.0)	0.727	(6.9)
<i>GDP per capx10⁻⁴</i>	-0.863	(3.5)	-0.689	(3.0)	-0.122	(0.5)		
<i>Real interest</i>	0.001	(0.1)	0.001	(0.1)				
Countries	all		not Brazil		not Brazil		not Brazil	
Functional form	level		level		log		log	
Method/no. obs	OLS	67	OLS	66	OLS	72	OLS	72
RSQ/DW	0.188	1.46	0.338	1.82	0.409	1.91	0.741	1.76

Note: Equation 1 includes the same variables as in Demirgüç-Kunt-Huizinga's equation 1.

Table 2 (Continued): *Inflation and bank profitability 1988-95*
 Dependent variable is *Profit before tax as % total assets (country average)*

	5		6		7		8	
					<i>Exclude Brazil</i>			
	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)
<i>c</i>	3.217	(11.8)	1.748	(3.2)	1.475	(3.1)	2.657	(6.9)
<i>Inflation</i>	0.609	(6.2)	-0.074	(1.2)	0.976	(4.2)	0.526	(5.1)
<i>GDP per capx10⁻⁴</i>			-0.503	(0.7)	-0.384	(0.6)		
<i>Real interest</i>			0.000	(0.0)	0.002	(0.1)		
<i>Reserve reqts</i>			3.165	(1.6)	2.986	(1.8)	2.152	(1.8)
<i>Res. reqts x GDP/cap</i>			-2.780	(0.6)	-2.070	(0.5)		
<i>Tax rate</i>			-0.364	(0.4)	-0.643	(0.7)		
<i>Tax rate x GDP/cap</i>			0.016	(0.1)	0.191	(0.1)		
Countries	all		all		not Brazil		not Brazil	
Functional form	log		level		level		log	
Method/no. obs	OLS	73	OLS	55	OLS	54	OLS	58
RSQ/DW	0.355	1.92	0.265	0.86	0.409	1.91	0.560	1.77

Note: Equation 6 includes the same variables as in Demirgüç-Kunt-Huizinga's equation 2.

Table 3: *Inflation and bank profitability 1995-99*
 Dependent variable is % Return on assets (country average)
 except 3 & 4: Value added as % total assets

Dependent var	1		2		3		4	
	ROA		ROA		VA		VA	
	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)
<i>c</i>	0.529	(2.6)	0.212	(0.4)	2.422	(6.8)	2.23	(5.9)
<i>Inflation</i>	0.410	(4.1)	0.513	(2.9)	1.462	(8.3)	1.65	(7.4)
<i>GDP per capx10⁻⁴</i>			-0.065	(0.4)				
<i>Real interest</i>			0.023	(1.1)				
<i>Res Reqt x inflation x 10³</i>							-0.510	(1.4)
Countries	all		all		all		all	
Functional form	log		log		log		log	
Method/no. obs	OLS	71	OLS	67	OLS	71	OLS	71
RSQ/DW	0.194	2.23	0.217	2.23	0.501	2.25	0.514	2.30

Table 3 (continued): *Inflation and bank profitability 1995-99*
 Dependent variable is % Return on assets (country average)

	5		6		7		8	
	Estimate	(t-stat)	Estimate	Estimate	Estimate	(t-stat)	Estimate	(t-stat)
<i>c</i>	-0.590	(1.6)	0.269	(0.9)			-0.328	(1.1)
<i>Inflation</i>	0.092	(0.7)	0.251	(2.8)			0.287	(1.5)
<i>Overheads</i>	0.151	(1.6)					0.085	(1.1)
<i>Concentration</i>	1.638	(3.5)	1.535	(3.3)			1.456	(3.8)
Countries	all		all				Not MDA, THA ^b	
Functional form			log				log	
Method/no. obs	OLS	54	OLS	53			OLS	52
RSQ/DW	0.360	1.00	0.310	0.923			0.409	1.35

^bMoldova and Thailand

Bank profitability and inflation, 1995-99

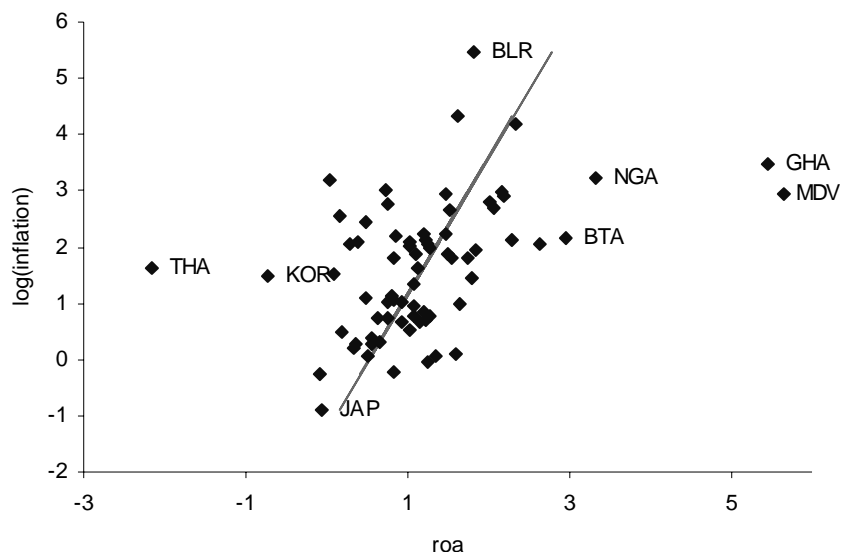


Figure 3: *Bank profitability and inflation, 1995-99*

For the second half of the 1990s we can look at a similar scatterplot of average country banking profits (measured here by the rate of return on assets) against log-inflation (Figure 3). The same approach to equation specification is adopted. Once more a clear upward-sloping relation appears in the simple regression (Table 3, Equation 1), in this case, a ten percentage point increase in inflation from the sample median of 6 per cent per annum to 16 per cent is associated on average with an increase in return on assets of 0.4 percentage points – compared with a median value of 1.1 per cent.²³ The relationship appears strongly significant, and survives the addition of per capita income and real interest rates (neither of which are significant in this later data set: Table 3, Equation 2). Once again the pattern of outliers (more than three standard errors away) is interesting: Moldova with high measured profitability and inflation; Thailand with very low profitability (reflecting the crisis of 1997-8) and moderate inflation. These outliers do not, however, strongly influence the simple regression with log-inflation. And here the link with reserve ratios no longer applies.

²³ This impact is somewhat smaller than obtained in Table 2: Equations 4 or 5 in the earlier period; but in line with Equation 8. Thanks to Luc Laeven for assembling and making available the 1995-99 data, which is used in a forthcoming paper by Demirgüç-Kunt, Laeven and Levine.

As a control against under-specification, we also checked to see whether some of the other variables employed by D-H but not significant for the earlier period remain insignificant here. The only one which is consistently significant is the bank concentration ratio, as shown in Table 3, Equations 5, 6 and 8. It should be borne in mind that this variable is available only for about three quarters of the countries. Overheads as a share of total assets is only marginally significant, but when included tends to reduce the significance of inflation (Equation 5). However, removing the main outliers Moldova and Thailand, this effect is diminished. Overall then, inflation does seem to be positively associated with bank profitability in the more recent period also.

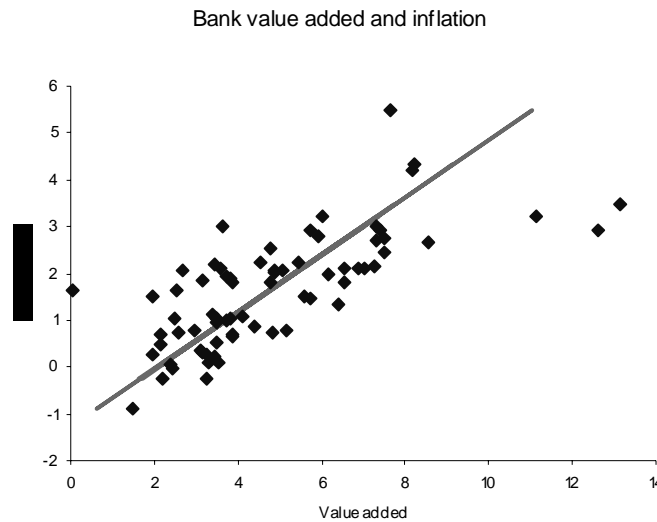


Figure 4: *Bank value added and inflation*

We conclude that although the link is far from mechanical, in both the early and the late 1990s higher inflation has tended to yield substantially greater profit opportunities in at least some countries.

Banking value added

Widening the focus to include all of the value-added of the banking system reinforces the message that inflation tends to offer possibilities for the financial sector to generate more value-added per unit of total assets. Figure 4 shows that the simple correlation between value-added²⁴ and inflation is even stronger than with just profits. Once again inflation is the major variable of those discussed above which remains significant in the analysis under different specifications.²⁵

A number of alternative specifications parallel to those discussed above for profitability were explored with value-added as the major explanatory variable. The cross-product of

²⁴ Measures as return on assets plus overheads as a percentage of assets.

²⁵ This is in line with the theoretical predictions of Aiyagari et al (1998) who emphasize the function of the banking system in supplying transactions services in times of inflation.

reserve holdings and inflation (also mentioned above for bank profitability) proved to be the most consistently significant variable in the specifications that included a lot of explanatory variables. Removing the least significant variables one-by-one however, left the (log of the) inflation rate as the only significant variable, with a very high t-statistic of over 8 (Table 3: Equation 3). The significance of the cross product term between reserves and inflation progressively weakens as other explanatory variables are removed, to the point where it is no longer significant when included only with inflation (Table 3: Equation 4).

Finding a strong relation between value added and inflation should not be any surprise. Banks offer liquidity and transactions services which may be more highly valued in a period of high inflation or in countries where inflation is often high. But also, these profitability and value-added figures are calculated as a share of total assets, and these, as is well-known, are prone to shrink in real terms in inflationary times.

Bank asset size

What then, of the impact of inflation on the overall balance sheet size of the financial sector and its major components? Here the picture is unambiguous. As clearly documented by Boyd et al. (2001) inflation reduces both the size of the banking sector and measures of stock market activity (value traded and turnover). According to their estimates, however, beyond an inflation rate of 15 per cent or so, the financial sector does not shrink any further. It appears that inflation has done “all the damage it can” by the time it reaches 15 per cent.

Actually, the suggestion that “all the damage has been done by 15 per cent” requires close scrutiny in the present context of the inflation tax.²⁶ For one thing, it may seem to flies in the face of a long-held view that reliance on the inflation tax is limited by substitution away from money, and that there is a maximal rate of inflation tax.²⁷ (Inflation Laffer curve). The idea of an inflation tax Laffer-curve can be made consistent with the finding that the size of the financial sector does not shrink much as inflation increases beyond 15 per cent if at high rates of inflation the sector switches to reliance on interest-bearing instruments structured in such a way as to insulate the participants from fluctuations in inflation. Indeed, the same authors, as well as Barnes et al., find that nominal financial asset yields tend to be much more strongly correlated (across countries) with inflation at high rates of inflation (again they use the 15 per cent cut-off).

Stock market activity

Measures of stock market activity also decline with inflation according to the estimates presented by Boyd et al. Once again they identify a slowing of the decline around 15 per cent inflation, though here the cutoff is much less distinct and may reasonably be

²⁶ It should be noted that the alternative harmonic functional form for inflation, which embodies a more gradually slowing influence of inflation on financial sector size, actually fits the data better than the threshold regression emphasized by Boyd et al.

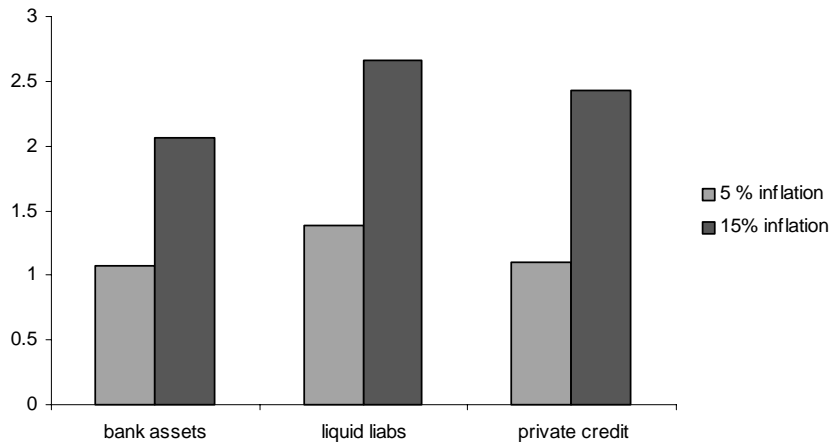
²⁷ Estimates by Bali and Thurston, 2000, Easterly et al., 1996, Kiguel and Neumeyer, 1995 and others of the rate of inflation which maximizes the inflation tax tend to be much higher than 15 per cent.

questioned.²⁸ As both components are hit by inflation it is important to know which of the two declines by more. For instance, if we take the ratio of bank assets to market capitalization, does this decline with inflation or not? Somewhat surprisingly, the data and estimates assembled by Boyd et al. strongly suggest that the bank-to-market ratio tends to increase with inflation, at least if we use market capitalization or value-traded as our market indicators (Figure 5).²⁹ That the effect of inflation on the stock market would be greater than on banking is particularly surprising when one considers that stocks are commonly considered a hedge against inflation (though a most imperfect one as the evidence shows). It seems likely that here especially we are observing a common path effect, with weak macro-policy conditions resulting both in high average inflation and in weak stock market development. In other words that the endogeneity of inflation is especially problematic for the interpretation of this empirical finding.

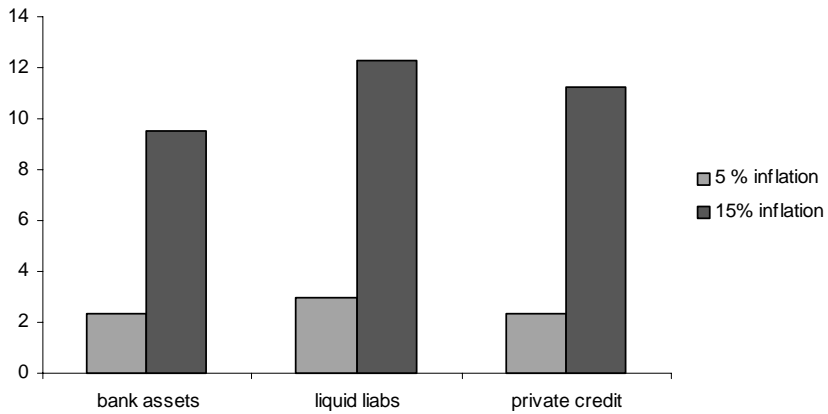
²⁸ Actually, the piecewise linear regressions estimated by Boyd et al for market size and activity have significant discontinuities at the imposed break-point. Thus we prefer to rely on the harmonic regressions they report, or simply on the interquartile differences in the data sorted by inflation.

²⁹ There is some ambiguity here, depending on which estimates are used. Figure yy is based on simple interquartile differences. Using the regression results suggests that market capitalization does not decline as fast, but that turnover declines more quickly. We prefer to use the interquartile differences as the regression estimates risk being extrapolated beyond the range where they can be regarded as trustworthy.

Bank-to-market ratios and inflation
(a) using market capitalization



(b) using value traded



(c) using turnover

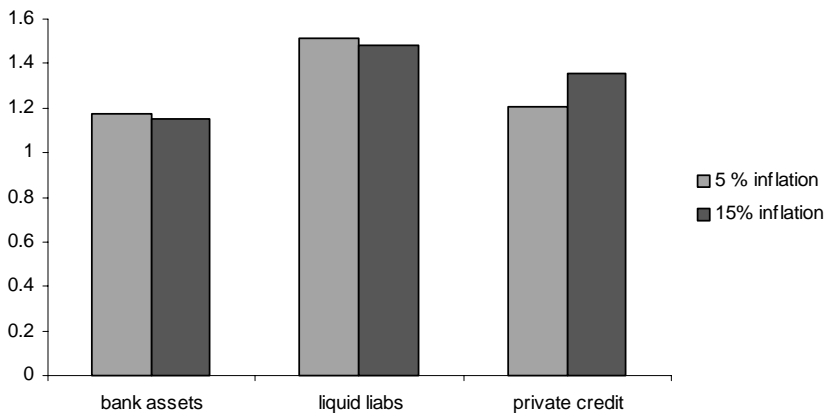


Figure 5: *How bank-to market ratios change with inflation.*

Note: Shows the ratio of various measures of the size of the banking system relative to the size or activity of the stock market. Source: Based on data in Boyd et al., 2001, using the interquartile gradient for each component. (boyd.xls)

5. Interactions between inflation and the rest of a non-indexed tax system.

We now add in considerations relating to the interaction between inflation and the remainder of the explicit and implicit tax system. We show that certain types of tax affecting the financial system have effective rates that are highly sensitive to the rate of inflation. A simple index which can be used to measure this sensitivity is proposed. We conclude that low values of the sensitivity index are desirable especially in countries that have proved susceptible to episodes of inflation.

Feldstein (1983, 1999) has been to the fore with the observation that the interaction between inflation and a non-indexed tax system can have sizable and unexpected effects even in a country with single digit inflation. As inflation increases, the double distortions of inflation and taxation can be multiplicative rather than additive, with severe consequences.

The effects are mainly through

(a) the fact that nominal interest is treated as and income (or an expense) without any adjustment for inflation. Thus it receives a tax charge that depends on the inflation premium that may be built into the interest rate. Alternatively, we might say that the capital gain on nominal liabilities due to inflation is not chargeable to income tax.

(b) the fact that depreciation allowances are calculated according to historical cost and not to a realistic replacement cost in line with rising prices.

A further effect of taxation in the case where the tax schedule is a progressive one (with lower rates of tax imposed on lower values of the base) is that, if the thresholds of the progression are not indexed to the price level, rising prices will push the average rate of tax on any real sum higher.

The behavioral effects of a non-indexed tax system include that:

- The real after-tax rate of return to investors in real projects is generally lower (this is because effect (b) usually and on average outweighs (a)). Accordingly investment in productive activity is penalized at the expense of investment in land, consumer durables and other assets not yielding a taxable nominal return, such as gold.
- There may be a shift in the relative advantage of bond and equity finance, even though, for the individual tax-paying shareholder, the fact that bond interest is tax deductible for the corporation may be offset by the fact that it is taxable as shareholder's income.
- Judging monetary policy is complicated: in an inflationary environment, a given gross-of-tax nominal rate of interest may look to be high enough not to be judged

expansionary. But for the investing company, the deductibility of nominal interest payments may mean that the net-of-tax real interest rate is very low or negative, and that the stance of monetary policy is not tight enough to dampen spending.

Feldstein notes an important distinction between steady inflation and changes in inflation. Comparing two different steady rates of inflation, one expects equity prices to rise faster in the higher inflation environment. But when inflation jumps from one steady rate to a higher one, equilibrium price-earnings ratios are damaged by the higher effective tax rate to which they are subject. Accordingly, equity prices will fall at first, before beginning to increase at the faster rate.

But what of the influence on the financial services industry? Clearly, the effects can be significant here too. Some of the same considerations arise, but the relative importance is altered, and in addition there are some new considerations. For one thing, the financial services industry is obviously affected by shifts in the relative reliance on different financing instruments. Thus, while the impact of inflation on demand and supply conditions for other industries will be chiefly affected through whatever overall impact there is on the economy at large, inflation will have a first-order or direct influence on the demand for different financial services. The impact of inflation on the scale and activity of financial services firms needs to be considered alongside the effect on their tax-inclusive cost structures.

The degree to which the interaction between inflation and non-indexed taxes means that the effective tax rate on financial institutions varies with inflation varies as between different non-indexed taxes. We may distinguish between

- (i) tax burdens that increase, but not in proportion to the rate of inflation (first order non-indexation);
- (ii) an increase in the effective tax rate that is approximately proportional to the rate of inflation (“second-order non-indexation” or “supersensitivity”); and
- (iii) an even greater (third-order) sensitivity to inflation

First-order non-indexation is associated, for example with a simple failure to index the thresholds (e.g. the tax-free allowance and the point at which a higher rate of tax applies) in a progressive tax on non-interest income. In this case a rise in prices has the effect of pushing more of the tax base into the higher rate of taxation. But to the extent that the rates of taxation are fixed, there is a ceiling on the rate of taxation regardless of the rate of inflation or of the degree to which adjustment of the nominal thresholds lags inflation.

When it comes to taxes on interest income, however, supersensitivity can often arise implying a potentially very volatile inflation rate. Where this arises will obviously depend on the precise specification of the taxes and quasi-taxes involved. We cannot hope to model every possible tax structure and will confine ourselves to some simple canonical cases.

If we think of a financial intermediary as adding value to investable funds by repackaging them for users of funds, thereby increasing both the risk-return profile and liquidity of the provider and cost and availability of funds for the users, then it is relative to that value-added that the impact of taxation can best be measured.

The three forms in which non-indexed taxes arise most frequently for financial intermediaries are taxes on nominal interest income, nominal interest ceilings and unremunerated reserve requirements.

One way of looking at the role of inflation in increasing the burden of these taxes is to express the tax taken as a percentage of the real interest income that would otherwise be involved.

Thus, a fixed rate of taxation t on nominal interest income, a reserve requirement at a fixed percentage θ of deposits remunerated at rate r^a , or a fixed nominal interest ceiling \bar{r} , all represent forms of non-indexed taxation. Their effective rate varies with inflation. All three have higher effective rates as inflation increases. But the degree of variation differs as between the three taxes. As will be shown below, the effective rate for the first two rises rapidly but less than in proportion to inflation (Figures 6-8); the effective tax rate corresponding to the interest ceiling increases more than in proportion to the inflation rate – a doubling of inflation more than doubles the effective rate of tax. As such, we may describe the interest ceiling as a third-degree non-indexed inflation-supersensitive tax.

These assertions are now substantiated under the familiar assumption that the nominal wholesale interest rate equals a fixed real interest rate ρ plus the expected inflation rate π .³⁰

Fixed tax rate on nominal interest income

Then if the nominal deposit interest rate r^d equals the nominal wholesale rate less a provision μ^d for deposit-related services, the nominal interest income per dollar deposited will be:

$$r^d = \rho + \pi - \mu^d,$$

whereas the real interest income will be $\rho - \mu^d$. Thus the tax collected expressed as a share of the pre-tax real interest income is:

$$z = t \frac{\rho + \pi - \mu^d}{\rho - \mu^d}.$$

The elasticity of the rate of tax with respect to π is:

³⁰ Actually, this Fisher relationship is itself quite controversial in the tax context. A partial equilibrium argument can be made to the effect that the nominal interest rate may increase *more* than one-for-one with the rate of inflation because of the need to compensate savers for the fact that nominal interest income is fully chargeable to personal income tax. On the other hand, as has been stressed by Feldstein, the ability of borrowers to pay interest, and hence their demand for funds, may be reduced in times of inflation by other aspects of non-indexation of the tax system (notably lack of indexation of depreciation allowances). Empirically there is no strong evidence of such a tax effect, at least for industrial countries where (because of the greater effectiveness of income tax collection) one would expect the effect to be strongest.

$$\eta = \frac{\pi}{\rho + \pi - \mu^d}$$

It is easily seen that $\eta < 1$ if $\rho > \mu^d$ and that $\eta \rightarrow 1$ as $\pi \rightarrow \infty$. Thus the tax on interest income is supersensitive and non-indexed of the second degree.³¹

Reserve requirement

For the reserve requirement, the nominal opportunity cost of the funds raised in deposits is the nominal wholesale interest rate $r^m = \rho + \pi$. Instead of receiving this amount, the bank receives only the reserve remuneration rate r^r on a fraction θ of the funds raised.³² Thus the implicit tax can be written as $\theta(r^m - r^r)$, which, expressed as a share of the real opportunity cost of the funds is:

$$z = \theta \frac{\rho + \pi - r^r}{\rho}$$

The elasticity of this tax rate with respect to the rate of inflation π is:

$$\eta = \frac{\pi}{\rho + \pi - r^r}.$$

For $\pi = 0$, $\eta = 0$; and $\eta \rightarrow 1$ as $\pi \rightarrow \infty$.

Tax through interest ceiling.

In this case the basic assumption is that the uncontrolled interest rate on lending r^a exceeds the wholesale rate by a fixed provision μ^a for credit appraisal and loan-losses. By controlling the lending interest rate at \bar{r} , the government is providing an implicit transfer (tax from lender, subsidy to borrower) per dollar lent of $r^a - \bar{r}$, if this is nonnegative. Expressed as a share of what would be the share of the pre-tax real interest income, the implicit tax rate can be written:

$$z = \max \left\{ \frac{\rho + \pi + \mu^a - \bar{r}}{\rho + \mu^a}, 0 \right\},$$

and the elasticity of this tax rate with respect to π is:

$$z = \max \left\{ \frac{\pi}{\rho + \pi + \mu^a - \bar{r}}, 0 \right\}.$$

In this case, for $\bar{r} > r^a$, $\eta > 1$ and $\eta \rightarrow 1$ as $\pi \rightarrow \infty$. This is a supersensitive tax with non-indexation of order three, given that the elasticity of the effective tax rate with respect to inflation remains greater than one – much greater over a certain range of values of inflation.

³¹ An alternative, suggested by Klaus Schmidt-Hebbel, would be to specify these expressions in terms of the inflation factor $\pi/(1+\pi)$, which has the advantage of being bounded by unity and its limiting elasticity with respect to π is zero.

³² Many authors have made the simplifying assumption that all reserve holdings of banks are unremunerated but this is far from being the case. In many countries the central bank remunerates excess reserves (those in excess of the compulsory requirement), in some even the required reserves are remunerated (cf. Fry et al. 1996)

These patterns are illustrated in Figures 6-8 for particular parameter values: $\rho = 0.05$; $t = 0.25$; $\mu^d = 0.01$; $\mu^a = 0.03$; $\theta = 0.25$; $\bar{r} = 0.1$; $r^r = 0.03$. It can be seen clearly from these plots that the effective rate of taxation expressed as a percentage of the real rate of return (or opportunity cost) of the funds involved can quickly exceed 100%. Indeed for the parameters chosen, which are not unrealistic, this point is passed for quite modest inflation rates in the range 10-12%.

Where the providers of funds to the intermediary are also taxed on the nominal interest received, without deduction for tax already paid by the intermediary, the burden is increased once again. This typically just increases the *rate* of tax without much altering the *elasticity* substantially. If the depositor has the alternative of receiving non-intermediated interest income that is not taxed, it may be more appropriate to see the base of the double tax as being simply the intermediation margin. For the numerical example used in Figure 6, a double interest tax (already representing a very high rate of tax on the intermediation margin even at zero inflation) also increases rapidly, and, though its elasticity with respect to the inflation rate is lower, this also converges to unity.

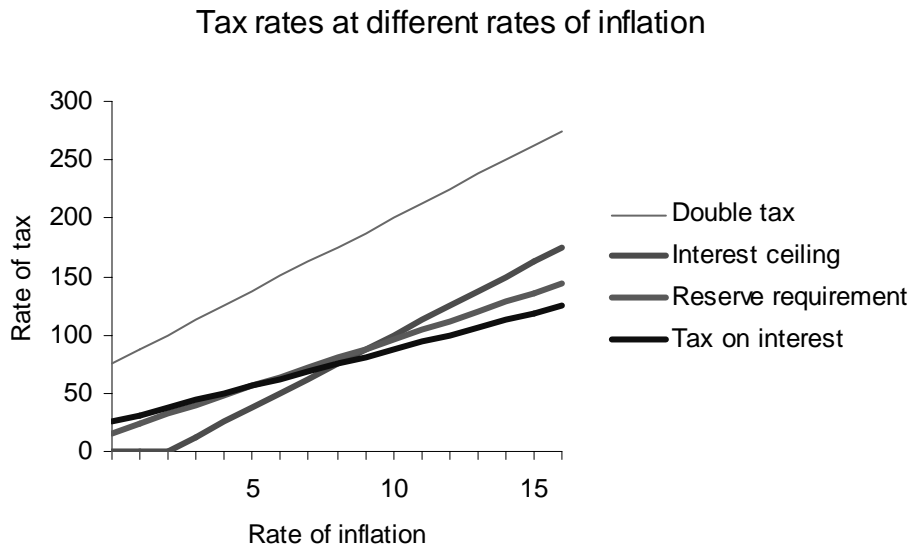


Figure 6

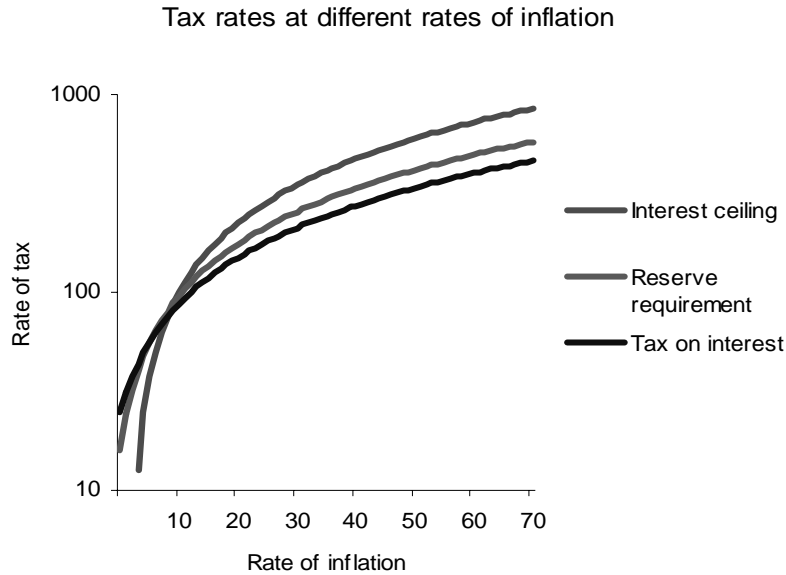


Figure 7

The calculations suggest summary ways of quantifying the degree of non-indexation of the various financial sector taxes with respect to inflation. The increase in the effective rate of tax as inflation goes from zero to ten per cent could be one measure, which we can call the tax's *inflation gradient*, and the *limiting elasticity* of the effective tax rate with respect to inflation as inflation becomes very large could be the other. All taxes in a perfectly indexed tax system would have a zero gradient and zero limiting elasticity.

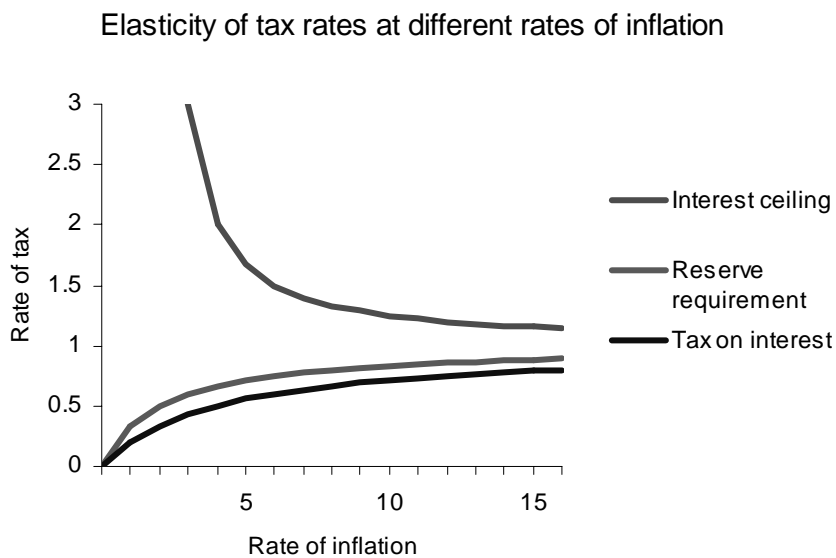


Figure 8

The three interest taxes discussed have, for the parameters shown, gradients of 63, 80 and 100 per cent respectively. The double taxation (expressed as a percentage of intermediation margin) has a gradient of 125 per cent. All have limiting elasticities of 1. The gradients are obviously high – a value of 100 implies that inflation fluctuating between zero and ten percent results in an effective tax rate which fluctuates by 100 per cent of the base. The limiting elasticity of 1 implies that the tax rate is unlimited as inflation grows – actually any limiting elasticity greater than zero has the same implication (and even if the limiting elasticity is zero, still the effective tax rate might increase without limit, though more slowly as inflation increases). The chaotic conditions caused by an unlimited rate of inflation tax as hyperinflation kicks in strongly suggests that any economy prone to surges of high inflation should ensure that its tax system have a limiting elasticity with respect to inflation no greater than zero.

Optimal degree of supersensitivity

Supersensitivity implies a high variation of effective tax rates where inflation is variable. Could this be good? It seems unlikely from the point of view of a stable and healthy development of human and organizational capital in the financial services industry. If monetary financing is primarily used in response to unanticipated deficits (the residual financing argument), then an induced volatility in the tax pressure on financial intermediation can hardly be a desired side-effect. Equally, if fluctuations in inflation tax are seen as optimally programmed in line with fluctuations in the burden of other taxes (tax smoothing arguments) an induced amplification of some of those other taxes seems equally unlikely to be optimal (after all, such arguments imply that inflation tax may optimally take up some of the pressure when other taxes are also high and as such causing distortions; increasing a tax that exacerbates the distortions of existing taxes is not helpful in that context). Above all it can probably be taken for granted that the governments do not anticipate the indirect impact on financial intermediation which we are considering here.

Thus even if setting zero as the optimal value of the gradient may be asking for a lot, a figure near 20 per cent might be an a realistic policy ceiling.

6. Incidence of inflation tax interactions

Absent behavioral responses, the increase in the tax take will fall on the legal person liable to pay. In the case of the reserve requirement tax, for example, the shareholders of the bank will bear the entire burden. However, especially with such high effective tax rates, the assumption of no behavioral response is hopelessly unrealistic.

For banks, it may be assumed that the main burden of the tax will be divided between depositors, borrowers and bank shareholders. There could also be a burden on employees and suppliers of the banks though, in a reasonably full employment context with smooth adjustment of the labor market, they would only be affected to the extent that they had sector-specific human capital deployed in the industry.

Whatever behavioral assumptions are made, and whatever about the consequential distribution of the incidence, it is clear that sizable behavioral responses can be expected to supersensitive taxes at high inflation. Naturally, the effects will be larger the closer the un-taxed substitutes. Thus in particular the extent to which dollarization has developed ready on-shore alternatives to local currency banking products will be an important factor in the scale of the behavioral response (and the revenue impact of a particular supersensitive tax). Also crucial is whether there are untaxed near-bank NBFIs competing with the taxed banking sector. Offshore finance, non-depository onshore finance and informal finance are also obviously important substitutes for banking, though to a lesser extent.

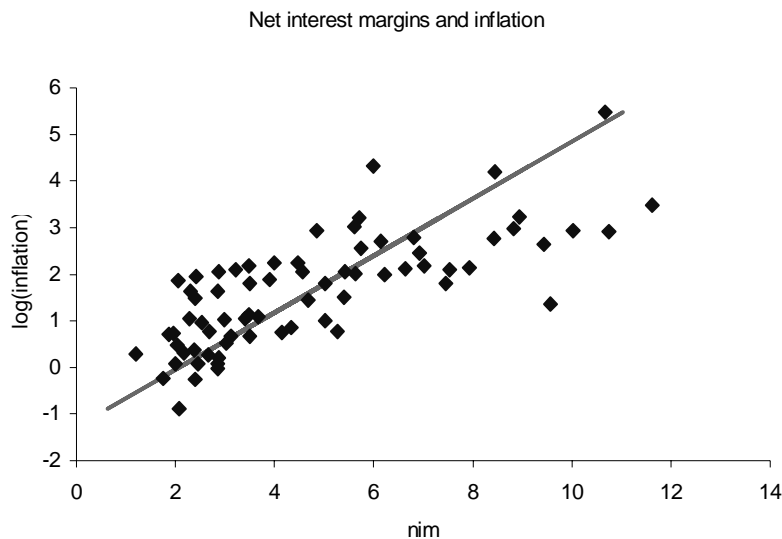


Figure 9

If inflation merely passed through to all nominal interest rates on banking assets and liabilities on a one-for-one basis, then there would be no impact on net interest margins and no inflation tax at all. The interaction with the tax system is likely the major reason why instead we observe a clear sizable impact of inflation on bank net interest margins

expressed as a share of total assets (Figure 9, Table 4). Here, as with the other tables, a selection only of the most significant results are shown. (Thus for example, we do not report a regression including *both* inflation and the interaction of inflation with reserve requirements as they are not both significant when included together).³³

Table 4: *Inflation and net interest margins 1995-99*
Dependent variable is *Net interest margin of banks % of total assets (country average)*

	1		2		3		4	
	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)
<i>c</i>	1.105	(2.4)	3.658	(4.0)	-0.000	(0.0)	0.008	(0.0)
<i>Inflation</i>	0.011	(2.3)	0.011	(2.7)	0.418	(2.7)	0.101	(2.5)
<i>Inflation</i> ² $\times 10^3$							-1.932	(2.8)
<i>Inflation</i> ³ $\times 10^6$							6.630	(2.9)
<i>log (GNP/Cap)</i>	-0.426	(3.1)	-0.360	(4.1)				
<i>Return on assets</i>			0.456	(3.7)	0.570	(4.4)	0.559	(4.4)
<i>Overheads</i>	1.099	(11.2)	0.950	(11.1)	0.937	(8.7)	0.970	(9.1)
<i>Res. reqt. x inflation</i>								
Countries	all		all		all		all	
Functional form	level		level		log			
Method/no. obs	OLS	68	OLS	68	OLS	71	OLS	68
RSQ/DW	0.813	2.07	0.872	2.23	0.845	2.22	0.864	2.09

Table 4 (Continued): *Inflation and net interest margins 1995-99*
Dependent variable is *Net interest margin of banks % of total assets (country average)*

	5		6		7	
	Estimate	(t-stat)	Estimate	(t-stat)	Estimate	(t-stat)
<i>c</i>	4.716	(4.9)	5.573	(3.1)	2.076	(5.9)
<i>Inflation</i>			1.324	(5.6)	1.637	(9.4)
<i>log (GNP/Cap)</i>	-0.463	(5.0)	-0.351	(2.0)		
<i>Return on assets</i>						
<i>Overheads</i>	1.055	(11.9)				
<i>Res. reqt. x inflation x 10³</i>	0.473	(2.5)				
Countries	all		all		all	
Functional form			log		log	
Method/no. obs	OLS	68	OLS	68	OLS	71
RSQ/DW	0.844	2.05	0.587	2.42	0.563	2.35

³³ Of course, even an indexed system, such as that of Chile, unremunerated reserve requirements would be expected to affect margins (cf. Basch and Fuentes, 2000).

The point estimate in the simplest of the regression equations reported in Table yy suggest that a doubling of inflation (say from 5 to 10 per cent, or from 10 to 20 per cent) can widen the net interest margin by 115 basis points. Considering that the median net interest margin in the seventy countries used was just over 400 basis points, we can see that this a sizable effect. Not all of this need be through a tax effect – for instance it is easy to think of reasons why the average risk of a bank’s portfolio would increase with inflation, but it does indicate the potential magnitudes involved.

Even if the tax interaction with inflation can be passed through to the intermediary’s customers through the net interest margin, this contributes to the reduced scale of intermediation and the resulting fluctuations in real intermediation activity discourage the development of specialized human capital in loan appraisal skills.

7. Concluding remarks

The fiscal authorities are rarely set-up to consider, in an explicit way, the impact of inflation on the budget or the interactions between an imperfectly indexed formal tax system and the rate of inflation.

Understanding the fiscal impact of inflation and how it impacts the financial system is important for developing good policies. Nowadays, fewer and fewer governments rely on printing money: the fiscal benefits of inflation come in more indirect forms.

Although it shrinks the financial system, inflation can be associated with increased profitability of banks. Yet, because interest forms the bulk of their gross revenue, the distortions caused by the interaction between inflation and other non-indexed taxes can be particularly severe for banks and other financial intermediaries.

Our proposed measures of nonindexation (the tax gradient and the limiting elasticity) can help summarize some of the most potentially damaging aspects of tax-inflation interaction. Improving the indexation of the tax system so far as the computation of interest is concerned would reduce the sensitivity of effective tax rates on intermediation.

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