

Federal Reserve Bank of Minneapolis
Research Department Staff Report 134

February 1991

A DISCUSSION OF COOLEY AND HANSEN'S
"WELFARE COSTS OF MODERATE INFLATIONS"

Randall Wright

Federal Reserve Bank of Minneapolis
and University of Pennsylvania

ABSTRACT

This is a note on the analysis of inflation and taxation in Cooley and Hansen's cash-in-advance economy described in their paper "The Welfare Costs of Moderate Inflation." Basic issues concerning the costs and consequences of inflation are considered, their results are assessed, and some directions for extensions are suggested.

This discussion was prepared for the Federal Reserve Bank of Cleveland's Conference on Price Stability in November of 1990.

The views expressed herein are those of the author and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

In "The Welfare Costs of Moderate Inflation," Thomas Cooley and Gary Hansen (1990) raise important issues and present some interesting results from experiments in an economic model with money and taxes. The model is a fully articulated, dynamic, general equilibrium structure, in which money is introduced via a cash-in-advance constraint that assumes some goods must be purchased with money while others need not be. This is important, in principle, because it allows for a degree of substitution away from the use of money when the cost of holding money (inflation) increases. This analysis constitutes a significant extension of Cooley and Hansen's 1989 paper, in which they assumed that all goods were subject to the cash-in-advance constraint and also neglected taxes on capital and labor income. The authors' 1990 analysis provides precise quantitative predictions concerning the effects of changes in inflation on several observable variables and also on economic welfare. Before discussing the model or the results in any detail, I want to review some of the general questions raised by Cooley and Hansen.¹

The first question (one that the authors say they don't address even though they do) is, Why do governments choose to inflate? The answer most of us were taught in economics courses not so long ago concerns the Phillips curve trade-off: some inflation is a good thing because it leads to lower unemployment. According to Cooley and Hansen, "this justification for tolerating inflation has long since been abandoned by economists and policymakers because both theory and experience showed it to be false" (p. 1). Clearly they are overstating the position. Although this

¹ Some of these issues are discussed in more detail in a recent essay by Rao Aiyagari (1990).

traditional Keynesian reasoning has become passé in all but a few academic institutions, it is still the bread and butter of both the popular media and your garden-variety policymaker. Nevertheless, the authors' basic point is well-taken: a serious inquiry into the costs and consequences of inflation today must rise above these Phillips curve-style arguments.

This leaves us with another answer to the question of why governments choose to inflate, and it is the answer implicitly adopted by Cooley and Hansen: inflation is the consequence of monetary expansion, which is a way to pay for all of the stuff that governments need or want to buy. Inflation as a revenue source is the exclusive focus of the Cooley-Hansen study, and I think this is a virtue of their paper. The public finance aspect of inflation is an intellectually honest and policy-relevant issue that needs to be analyzed. One may suspect that the revenue potential of inflationary finance is not very big, and that the benefit of using monetary expansion as a tax instrument is not worth very much. This may even lead one to believe that a policy of zero inflation would be close to efficient. But this conclusion is not obviously justified without an explicit model such as the one provided by Cooley and Hansen. And in the context of this model the results are somewhat surprising, as I will discuss below.

The second question that I would like to address is, What are the costs of inflation to private individuals? We can dispense with the effects of bracket creep, nominal depreciation allowances, and so on, as costs not of inflation *per se*, but of particular tax policies. Indexation is possible, and with indexed taxes these effects are, for all intents and purposes, nil. Similarly, we can quickly dispense with menu costs. Given the rapidity and efficiency with which prices can be changed, actual menu costs are trivial, at least for moderate inflations. Finally, we can dispense with the

venerable notion that high inflation implies that relative prices are more difficult to forecast. It does not. Signal extraction problems can be just as difficult in times of zero average inflation as in times of 10% average inflation, and that's that.

What is left is the one salient cost of inflation: it reduces the rate of return on holding nominal assets and, in particular, money or other media of exchange that do not bear interest.² Given that these assets are held, inflation is nothing more nor less than a tax on them. As with any tax, it tends to encourage avoidance behavior, but by the definition of a monetary economy, money and other such assets are not abandoned and therefore this tax is not avoided entirely. The taxation of money holdings does cause individuals to engage in activities they would otherwise consider inefficient, such as making more trips to the bank, and does cause them to

² At least since Hicks' (1935) classic essay, one of the central questions in monetary economics has been, Why do individuals choose to hold these nominal assets in the presence of alternative stores of value that dominate them in rate of return? Everyone seems to agree that it has to do with their role as media of exchange. Although modern monetary economics has made substantial progress in formally modeling the medium of exchange function of assets (at least, in my opinion), Cooley and Hansen do not address this question; in their model agents do not *choose* to hold nominal assets at all, but are *forced* to by the cash-in-advance constraint. Hence, Cooley and Hansen's model cannot address most of the issues that monetary economists find interesting, such as why their economy uses media of exchange at all, which objects come to play this role, how severe would the cost of using a particular money have to become before agents switch to something else, could more than one fiat currency circulate simultaneously, and so on. Nevertheless, the model implies, or at least assumes, that some fiat money is valued in equilibrium and thereby allows them to study the effects of taxation via inflation.

substitute away from activities that require money. The former effect is not captured in the Cooley-Hansen model, but the latter is, by the assumption that there are two types of consumption goods (that enter the representative agent's utility function as less-than-perfect substitutes) only one of which is subject to the cash-in-advance constraint.

Hence, the model is well-designed to measure one realistic and relevant impact of inflation on the private sector at the same time that it captures the relevant aspect of inflation to the public sector. Inflation is a tax on the activities that use money. As a tax, inflation does have some desirable properties: It is relatively easy to administer.³ It is also relatively easy to vary in response to economic conditions. And in spite of to the effect that inflation is regressive, it does hit hardest some groups that we may want to target. As a tax on activities that use money, inflation is a tax on illegal or underground activities that some people think we should attempt to discourage. Furthermore, a surprisingly small percentage of U.S. dollars are held by U.S. residents (see Aiyagari 1990 for a discussion and some references). To the extent that foreigners therefore bear much of the burden of the inflation tax, it may serve domestic interests well.

All of the above suggests that Cooley and Hansen are on the right track with their model. The key questions, then, include the following: How

³ It obviously does cost something to keep the printing presses up and running, to oversee the banking system, and so on. But the resource costs associated with raising other forms of revenue should not be forgotten. Individuals spend a considerable amount of time keeping records, filling out forms, and carrying out other activities associated with the income tax, all of which entail a loss in real output (to say nothing of utility).

important is inflation as a revenue source? What is the welfare loss associated with the inflation tax? What would be the net change in welfare of eliminating inflation and replacing the lost revenue with increases in other taxes? Cooley and Hansen have given us a framework that provides precise quantitative answers to these and other questions, at least for moderate inflations.⁴

I will now focus on the specific question of what is the welfare gain of going from 10% to zero inflation, where this gain is computed as the amount of consumption the representative agent would be willing to forgo in order to have such a policy implemented. As a point of reference, note that although this figure is not reported in their 1989 American Economic Review article, the welfare gain in that model may be deduced from what is reported, and the result is .28% of GNP per quarter.

Recall that the AER model has all goods subject to the cash-in-advance constraint and has no other taxes. The effect of incorporating both cash and credit goods into the model, but not including other taxes, can be computed from the numbers in the current paper to be 0.27% of GNP per quarter. This number is less than Cooley and Hansen's AER number because when only some of the goods are subject to a cash-in-advance constraint, inflation hurts less. The change is small, because the way they calibrate their model implies that most of the goods in the economy are cash goods,

⁴ For large inflations, Cooley and Hansen's neglect of the possibility of engaging in activities such as more frequent trips to the bank is a serious drawback. This is simply another way of saying that the behavior described by the cash-in-advance constraint is not generally invariant to changes in the cost of using money, and that for large changes in this cost, this is likely to be important.

based on an interpretation of the transactions data that includes purchases from checking accounts as cash purchases.⁵ In any case, the effect of adding other taxes to the two types of goods can also be computed from the numbers in the current paper. The answer is 0.78%, which is considerably higher than the other numbers although still less than 1% of GNP.

Note that the above figures are *not* based on a constant revenue comparison; they measure the amount of consumption agents would be willing to give up to have inflation reduced from 10% to zero with no change in other taxes. One way to compute a number that is more interesting is as follows. With 10% inflation, Cooley and Hansen report the welfare cost of all government tax collection is 17.66%; with zero inflation and the labor income tax adjusted to keep revenue the same, this cost increases to 18.91%. The welfare gain to moving instantly from a steady state of 10% inflation to stable prices is approximately the difference, -1.25%. In other words, the representative agent would be willing to pay 1.25% of GNP to keep inflation at 10%.⁶ Although the inflation tax may not raise much revenue, replacing this amount of revenue by another tax results in a net welfare loss. At least based on this model, then, there seems to be no case for moving to zero inflation.

⁵ This is not obviously valid given that checking accounts pay interest, and recalibrating the model by assuming that only currency purchases represent cash-in-advance constrained goods would yield a smaller fraction of such goods in the model and therefore a further reduction in the cost of inflation.

⁶ Taking into account the dynamic transition between steady states results in a revision to about -1%, but the point is this number is still negative.

Clearly, the robustness of these calculations needs to be addressed. One thing I have already mentioned concerns the way the model is calibrated in terms of the fraction of goods that are subject to the cash-in-advance constraint. I am uncomfortable with this fraction being 0.84, which seems far too high based on casual empiricism. It is the estimate implied by their money demand regressions, although those results will almost certainly depend on the time period used. It is also the number implied by their (perhaps questionable) interpretation of the data on transactions, although this too will depend on the year being considered, which is 1984 in their data set. Furthermore, given that transactions are measured as of 1984, shouldn't the inflation rate be calibrated to its actual value around this time and not to its postwar average? It would be worth knowing how sensitive the results are to parameter values that depend on each of these numbers.⁷

Finally, I want to raise some issues concerning functional forms. The instantaneous utility function of the representative agent in the model can be written in a generalized way as

$$u(C,h) = \log(C) + v(h),$$

where h denotes hours of employment and C is a composite consumption good

⁷ With continuing developments in transactions technologies, the cost of inflation may end up being quite small for some individuals, although not for those who do not have access to some financial instruments, or for those whose activities require the use of currency. An ambitious project would be to incorporate income or wealth heterogeneity into the model and try to measure the redistributive impact of inflation.

described by

$$C = \left[\alpha c_1^\varepsilon + (1-\alpha) c_2^\varepsilon \right]^{1/\varepsilon}$$

where c_1 is the good subject to cash-in-advance, c_2 is the other good, and ε is a parameter less than 1 such that $1/(1-\varepsilon)$ is the elasticity of substitution between the two goods.⁸ Cooley and Hansen are implicitly assuming $\varepsilon = 0$, so that $C = c_1^\alpha c_2^{1-\alpha}$ and

$$u = \alpha \log(c_1) + (1-\alpha) \log(c_2) + v(h).$$

I would like to know how sensitive the results are to the value of the parameter ε . This parameter may well matter, since the elasticity of substitution between cash goods and credit goods is given by $1/(1-\varepsilon)$. Intuitively, all of the revenue and welfare cost calculations should be sensitive to this elasticity, although I will not attempt here to offer any conjectures as to how the results would be affected. One approach is to try to calibrate both α and ε from the data. But even if this were to imply a point estimate of $\varepsilon = 0$, it would still be useful to present some sensitivity analysis with respect to this elasticity, as I don't think anyone would have a relatively high degree of confidence in such a point

⁸ There is good reason to adopt this specification: with no uncertainty, it is the only one that allows us to match the growth observations on the productivity and hours worked (see King, Plosser and Rebello, 1987). The paper also assumes $v(h)$ is linear, which amounts to assuming indivisible labor, but the authors suggest they will be experimenting with different forms for the disutility of labor function in the future.

estimate. None of this is meant to suggest the Cooley-Hansen results are without interest or that they are flawed in any way. It would simply be useful to know how much they depend on parameter values about which we have less-than-perfect information.

These authors have developed a useful approach to an important problem. The answer they provide to one question is also a bit surprising: there is no case for reducing inflation if the revenue loss has to be made up by increases in the income tax. How robust is this or any other prediction of the model? Time will tell, and I look forward to continued work in this research program.

List of Citations

Aiyagari, S. Rao. "Deflating the Case for Zero Inflation." Federal Reserve Bank of Minneapolis Quarterly Review 14 (Summer 1990) 2-11.

Cooley, Thomas F. and Gary Hansen. "The Inflation Tax in a Real Business Cycle Model." American Economic Review 79 (1989) 733-748.

————— . "The Welfare Costs of Moderate Inflation." Paper presented at the Federal Reserve Bank of Cleveland's Conference on Price Stability, November 1990.

Hicks, John. "A Suggestion for Simplifying the Theory of Money." *Economica* 2 (1935) 1-19.

King, Robert, Charles Plosser, and Sergio Rebello. "Production, Growth and Business Cycles: Technical Appendix." Manuscript. University of Rochester, 1987.