Understanding the Inflation Tax

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Abstract

The inflation tax is the most non-transparent of all taxes in that the way in which the tax is paid is not well understood and the amount of real revenue (or purchasing power) obtained by the government is difficult to calculate. Moreover, this revenue is generally disguised by the fact that the government injects newly-created money into the economy by purchasing bonds not goods. In addition, inflation tax revenue varies with the rate of money creation, and it is not necessarily the case that revenues will increase when the rate of money growth increases. Finally, when real output is growing simultaneously with the money supply, government revenue from money creation takes two forms. The first derives from the inflation tax on money holdings carried over from the previous period, and the second derives from the ability of the government to purchase some of the increase in production each year.

Introduction

All taxes transfer purchasing power from the general public to the government. In addition, almost all taxes are transparent in the sense that the manner in which purchasing power is transferred is obvious to all. Income and social security taxes, for example, are withheld from the paychecks of wage earners and turned over to the government. Corporations write checks to cover taxes on profits. Personal and real property owners write checks every year to local governments. Taxes on estates are paid to the government before distributions can be made to beneficiaries. General sales and excise taxes are paid at the point of sale. The sole exception to this rule is the inflation tax. The way in which the government gains purchasing power is not obvious given that most governments inject newly-created money into the economy via open market purchases of bonds, not goods. Even less obvious is the manner in which the public pays the inflation tax. The standard explanation is that the inflation resulting from money creation reduces the real value of money held by the public. However, during a pure inflation real money holdings are constant because the price level and the money supply increase at the same rate. Consequently, real money holdings don't actually fall. So how does the public pay the inflation tax? This paper addresses these, and closely-related, issues.

I. Government Revenue from Money Creation

Let z represent the gross rate of nominal money creation by the government. That is,

$$M_t = z \cdot M_{t-1}. \qquad (1)$$

The *nominal* revenue from money creation is:

$$M_t - M_{t-1} = M_t - (1/z) \cdot M_t = (1 - 1/z) \cdot M_t. \qquad (2)$$

It follows directly that the *real* revenue from money creation is[1]:

$$g_t = (M_t - M_{t-1})/P_t = (1 - 1/z)\cdot(M_t/P_t). \quad (3)$$

The interpretation of g_t is that it represents the number of goods that the government could purchase with its newly-created money if the government chose to buy goods rather than bonds.[2] Revenue from inflation, or money creation, follows the standard formula for all taxes, namely:

$$\text{Tax revenue} = (\text{tax rate})\bullet(\text{tax base}). \quad (4)$$

In equation 3, the tax revenue is g_t, the tax rate is $(1 - 1/z)$, and the tax base is M_t/P_t.[3]

Thus, real government revenue from inflation equals a fraction of real money holdings. It is not true, as often supposed, that the government can purchase all of the goods in the economy with its newly-created money. The government's take is limited to the amount of real money balances held.[4] Looked at from the opposite point of view, the most that money-holders can lose in any one period to the inflation tax is M/P, the amount of real money balances held during the period.

For example, suppose that only one good is produced in the economy. Suppose further that z = 1.25, M_{t-1} = \$100, and P_{t-1} = \$1/good. It follows that:

$$M_{t-1} = \$100 \rightarrow M_t = \$125$$
$$P_{t-1} = \$1/\text{good} \rightarrow P_t = \$1.25/\text{good}$$
$$\Rightarrow M_{t-1}/P_{t-1} = M_t/P_t = \$100/(\$1/\text{good}) = \$125/(\$1.25/\text{good}) = 100 \text{ goods}.$$

Government revenue from money creation (that is, the number of goods the government can purchase with the newly-created money) is:

$$g_t = (1 - 1/1.25)\cdot\$100 \text{ goods} = (.2)\cdot\$100 \text{ goods} = 20 \text{ goods}.$$

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[1] This general setup follows that of Champ, Freeman, and Haslag (2011).

[2] There is a very important assumption implicit in this formulation in that the real money supply is determined by dividing by P_t, not P_{t-1}. This means that the price paid for the goods reflects the increase in the money supply during period t. In turn, this implies that the increase in the money supply was fully anticipated by the public. In addition, the z in this formula technically refers to the inflation rate, not the rate of money growth. When output is constant, as assumed here, these two rates are the same. However, when real output is rising money growth exceeds inflation. In this case it will be necessary to substitute the gross rate of inflation for z. This is, after all, an inflation tax and not a money growth tax.

[3] One of the enduring lessons of economics is that when you tax something or some activity, you will get less of that thing or activity. That is, the tax base falls as the tax rate rises. This is the basis for the so-called Laffer Curve, which illustrates that repeated increases in the tax rate eventually cause the tax base to shrink so much that overall tax revenues fall. We will see that revenue from the inflation tax is also subject to the Laffer Curve because the tax base (M/P) shrinks as z, and therefore (1 - 1/z), increases.

[4] The government's take is limited by the assumption that the increase in the money supply is fully anticipated. The price level increases by the same percentage as the money supply, and this limits the purchasing power of the newly-created money.

Alternatively, the government creates \$25 in new money and uses this to purchase goods costing \$1.25/good. The number of goods that can be purchased is, therefore, \$25/(\$1.25/good) = 20 goods. Thus, in this example the government can obtain (real) revenue equal to 20% of the entire stock of real money balances that the public chooses to hold. And since the public chooses to hold real balances equal to 100 goods, the government's revenue is 20 goods.[5]

II. What if the Government Buys Bonds, Not Goods?

In practice, newly-created money is injected into the economy via open market operations. That is, the government, or, more properly, its central bank, purchases securities on the open market and pays with a check drawn on itself.[6] The check is deposited in the banking system, thus adding to the existing stock of money. This represents a swap of new money for bonds, not new money for goods. So how does the government obtain goods given that it no longer possesses the newly-created money? The answer to this question lies in an understanding of the government budget constraint (GBC). According to the GBC, government expenditures must identically equal government revenues. Put somewhat differently, every dollar that the government spends must come from somewhere. Since there are two types of expenditures: government purchases of goods (G) and government transfer payments (TR), and three sources of revenue: taxes (T), bond sales (BS), and money creation (MC), it follows that the GBC is written as:

$$G + TR \equiv T + BS + MC \qquad (5)$$

If the government were to purchase goods with newly-created money, the corresponding changes in the GBC would be:

$$G\uparrow + TR \equiv T + BS + MC\uparrow$$

But this isn't what happens. Instead, the government purchases securities, usually government bonds, with the newly-created money. The corresponding changes in the GBC are as follows:

$$G + TR \equiv T + BS\downarrow + MC\uparrow$$

This requires some explanation since, officially, the Treasury still counts these bonds as part of the outstanding debt. So why does BS fall? The answer is that the central bank now owns these bonds and, since it has no need for the revenue generated by these bonds, it returns all coupon payments and payments of face value at maturity to the Treasury.[7] Thus, while bonds purchased by the central bank continue to be debt in an accounting sense, they are no longer debt in an economic sense.[8] We call this *monetized* debt, meaning debt previously held in private sector

[5] We are assuming, for simplicity, that the government creates 100% of the new money. In reality, an increase in high-powered money by the government permits banks to create even more money via the deposit expansion process. Thus, some of the inflation tax revenue is, in practice, shared with commercial banks.
[6] These securities are generally government bonds, but they could be securities of any type.
[7] See Appelbaum (2013).
[8] It is for this reason that it is appropriate to exclude debt purchased by the central bank from measures of total debt outstanding. Some analysts exclude, in addition, debt held by the Social Security and Medicare systems in their trust funds—in effect arguing that *all* publically held debt should excluded. See, for example, Eisner (1993). This isn't correct, however, because payments on these bonds are needed to finance benefits to seniors. The Social

asset portfolios that has been replaced with newly-created money. It follows that, since an open market purchase extinguishes government debt in an economic sense, an open market purchase effectively reduces the amount of government debt outstanding. That is what is meant by BS↓.

Suppose, now, that the government finances purchases of goods by selling bonds. Using the GBC, this shows up as:

$$G\uparrow + TR \equiv T + BS\uparrow + MC$$

Suppose, furthermore, that the debt sold to finance these purchases of goods is immediately monetized by the Fed. The combined result of these two actions is as follows:

$$\begin{aligned} & G\uparrow + TR \equiv T + BS\uparrow + MC \\ + \; & \underline{G + TR \equiv T + BS\downarrow + MC\uparrow} \\ = \; & G\uparrow + TR \equiv T + BS + MC\uparrow \end{aligned}$$

That is, the overall effect is exactly the same as if the government had purchased goods with the newly-created money. The fact that the government actually purchased bonds is irrelevant.

III. How Do Money Holders Pay the Inflation Tax?

In one version of the story, inflation reduces the real value of money held by the public, and this constitutes the inflation tax. Continuing with the previous numerical example, the money-holding public carries over \$100 in nominal money balances from period t – 1 (i.e., M_{t-1} = \$100). Because z = 1.25 and P_{t-1} = \$1/good, the price level rises to \$1.25/good in period t. This reduces the real value of money holdings inherited from period t – 1 from \$100/(\$1/good) = 100 goods to \$100/(\$1.25/good) = 80 goods. Thus, the public experiences a loss of purchasing power equal to 20 goods, which is exactly equal to the government's gain in purchasing power. The number is correct, so how does this story get it wrong? There are two problems with this explanation. First, what happens when the rate of money creation equals the rate of growth of real output so that no inflation occurs? Clearly there would be a transfer of purchasing power in this case in that the government would be bidding goods away from the public with its newly-created money. And this transfer would occur even though there is no inflation and, therefore, no reduction in real money holdings (i.e., no inflation tax). This point is addressed in a later section. Second, if this story is pushed to its logical conclusion the constantly rising price level causes real money balances to approach zero asymptotically. But we know this doesn't happen. What does happen is that in a pure inflation (output constant) inflation equals money growth. Real money balances don't fall. So how is the public paying an inflation tax?

Let's suppose that the public consists of one representative agent who consumes, earns income, and holds money. Initially, this agent has annual disposable income of \$1,000 and nominal money holdings of \$100. In addition, z = 1 (i.e., M is constant) and P is constant at \$1/good. In this situation, the agent could spend all of his/her income on goods in each year and still end up with real money balances equal to 100 goods. Suppose instead that z = 1.25 so that P rises to

Security and Medicare systems have no intention of returning payments on the bonds that they hold. It follows that debt held in the Social Security and Medicare trust funds is debt in an economic sense in addition to being debt in an accounting sense.

\$1.25 (in one period). What does this agent have to do in order to end the period with real money balances equal to 100 goods?[9] The answer is that the agent must accumulate additional nominal money holdings of \$25, implying that he/she can spend only \$975 of his/her income on goods during the period. The remaining \$25 of income must be left in a checkable deposit to support transactions during the period. In order to accumulate this \$25 of additional nominal money balances our agent must sacrifice the purchase of \$25/(\$1.25/good) = 20 goods, exactly the amount gained by the government. Moreover, our agent must repeat this process in every future period, sacrificing the purchase of 20 goods in each period. Thus, the way that the public "pays" the inflation tax is through the diversion of income into checkable deposits (or similar balances) sufficient to keep nominal money holdings rising with the price level. This diversion of income into nominal money holdings requires a reduction in the purchase of goods. And these goods that are left unpurchased by the public are precisely the goods that are purchased by the government with its newly-created money.

IV. Why Do We Call This the Inflation Tax?

To begin with, the process of money creation by the government results in a transfer of purchasing power from the public to the government, just like any tax. Therefore, calling it a tax is seems reasonable notwithstanding that the manner in which resources are transferred is less than transparent.[10] The collection of the tax by the government should probably be referred to as government revenue from money creation. The fact that this money creation may, or may not, result in inflation is an incidental consequence having nothing in particular to do with the collection of the tax. For the public, however, the resulting inflation is of paramount importance since this is what necessitates the diversion of income into money holdings and the consequent loss of purchasing power. From the public's point of view, this would certainly seem to be an "inflation" tax.

V. What If the Rate of Money Growth Changes?

Suppose that $z = 1$ initially, and that the economy is a general equilibrium at natural output. Both the money supply and the price level are constant. In period t, the government announces that, starting in period t + 1, the rate of money growth will increase to $z = 1.25$. If people want to make any adjustments in anticipation of the higher rate of money growth, they should do it in period t. Two things will happen in period t. One, expected inflation will rise to π^e = 25%/year. Two, the price level will rise in period t, and this increase in P is not caused by the actual increase in M starting next period. It is, instead, caused by the expectation of a growing money supply. The effect of a rising money supply won't be felt until period t + 1. Everything that happens in period t is an expectations effect.

All of this happens because π^e is a shift variable in the IS curve in the IS/LM-AD/AS model.[11] The rise in π^e shifts the IS and AD curves to the right. Excess demand in the market for goods

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[9] The assumption here, for simplicity of exposition, is that the agent chooses to hold real money balances equal to 100 goods for both $z = 1$ and $z = 1.25$. This would not normally be the case. The higher is z the smaller the amount of real money balances that the public will choose to hold. Incorporating this effect would not change the example in any significant way other than to make it more difficult to understand.

[10] This is simply the nature of the inflation tax and not the result of any effort by the government to obfuscate.

[11] See Blanchard and Johnson (2013) for a detailed explanation of this modification of the IS curve in the presence of nonzero expected inflation. The standard, or base, IS/LM-AD/AS model doesn't incorporate this effect because it is normally assumed that π^e is constant at 0%/year.

drives up P, thus shifting the LM curve to the left until general equilibrium is restored at natural output, a higher nominal interest rate[12], and a higher price level. These are the adjustments that the public makes in anticipation of the inflation starting tomorrow. The first adjustment, a higher nominal interest rate, makes perfect sense. Lenders are trying to preserve the purchasing power of the money they lend out. This is, of course, the well-known Fisher Effect. The second adjustment, a higher price level, has an explanation that is less obvious. Recall equation 4, which states that the revenue from a tax, any tax, equals the tax rate times the tax base. The tax base is the thing, or activity, being taxed. If the rate of taxation is increased, the public will react by reducing the tax base, thus reducing their exposure to the tax. This means that total tax revenue can rise or fall. Initially, revenue rises. Eventually, however, if the tax rate continues to increase the tax base will fall so much that total revenue falls. This is the basis for what is widely known as the Laffer Curve.[13] In the case of inflation, the thing being taxed consists of the real money holdings of the public. It is natural that the public will wish to reduce their exposure to the tax in future periods by holding smaller real money balances. This is precisely analogous to purchasing less gasoline when the gasoline tax rises or working less when the income tax rate increases. But the public has no way to reduce its nominal money holdings, aside from burning currency. Consequently, if M/P is to fall, it must be the result of a rise in P, and this is exactly what happens. Real money balances fall in period t because the public wants to reduce its exposure to the inflation tax starting in period t + 1.

Starting, then, at z = 1, there is no money creation, no government revenue from inflation, and no inflation tax on the real money balances held by the public. As the government raises z, the tax rate (1 – 1/z) also rises, and M/P falls due to the rise in π^e that accompanies each increase in z. The government claims an increasingly large percentage of a shrinking tax base. Initially, government revenue rises, but eventually it falls due to the decline in M/P. It is interesting to speculate that hyperinflations may be the result of governments failing to understand the relationship between z and inflation tax revenue. Almost surely, the hyperinflations in Germany in 1921-24 and Hungary in 1945-46 put those economies on the downward-sloping segments of their respective Laffer Curves for inflation tax revenue.[14] Yet, those governments continued to increase the rate of money growth when the revenue increasing course of action would have been to reduce z. The non-transparency of the inflation tax probably contributed significantly to these disastrous policy decisions.

VI. What If There Is Money Creation and Economic Growth, But No Inflation?

We know, from the so-called Equation of Exchange, that:

$$M_t \cdot V_t \equiv P_t \cdot Y_t. \quad (6)$$

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[12] The real interest rate is, of course, unchanged.
[13] See, for example, Laffer (2004). This relationship is named for economist Arthur Laffer who, according to the account of Jude Wanninski, first drew the curve for Wanninski, Donald Rumsfeld, and Dick Cheney on a napkin in a New York restaurant. For a discussion of the Laffer Curve as applied specifically to variations in the rate of money growth, see Champ, Freeman, and Haslag (2011).
[14] See Bomberger and Makinin (1983) for an interesting discussion of the Hungarian hyperinflation and subsequent stabilization.

V is the velocity of money, and Y is real output. The velocity of money is the number of times, on average, that a dollar is spent during the year for the purchase of goods.

The percentage change version of this equation is:

$$\%\Delta M + \%\Delta V \equiv \%\Delta P + \%\Delta Y \tag{7}$$

It follows directly that the rate of inflation (%ΔP), can be expressed as:

$$\%\Delta P \equiv \%\Delta M + \%\Delta V - \%\Delta Y \tag{8}$$

If we assume that V is constant, then:

$$\%\Delta P = \%\Delta M - \%\Delta Y \tag{9}$$

Equation 9 is an equality, not an identity, because it doesn't hold when velocity is changing. Suppose that both M and Y are growing at 2%/year (z = 1.02). There is no inflation in this case because the supply of money and the demand for money are increasing at the same rate.[15] There is no inflation tax in this case, for the simple reason that there is no inflation. That said, the government is clearly deriving revenue from money creation because the government is spending, either directly or indirectly, its newly-created money on goods.

How much revenue is the government deriving? It is tempting to conclude that the government must be purchasing 100% of the new production (e.g., 8 goods in period t) each year because the money supply is growing at the same rate as output. But this is correct only in the special case in which V = 1. This can be illustrated with a simple numerical example. Suppose that:

$M_{t-1} = \$100 \rightarrow M_t = \$102$
$Y_{t-1} = 400$ goods/year $\rightarrow Y_t = 408$ goods/year
$P_{t-1} = \$1$/good $\rightarrow P_t = \$1$/good
$V_{t-1} = 4$/year $\rightarrow V_t = 4$/year

Because each dollar is spent on goods, on average, 4 times per year, the government only has to create an additional $2 to accommodate an increase in output of 8 goods. It follows directly that the government can purchase only $\Delta M_t/P_t = \$2/(\$1/\text{good}) = 2$ goods in period t. The government bids these goods away from the public using its newly-created money. This is the government's revenue from money creation. There is no inflation tax, however, so the public sees no need to reduce its holdings of real money balances. To the contrary, real money balances are increasing at 2%/year. This is because the public requires 2% more money every year to carry out the transactions associated with the increase in output.[16] So the government's revenue from money creation equals 25% of all new production. It is no coincidence that 1/V = .25.

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[15] The assumption here is that the demand for nominal money balances is homogenous of degree 1 with respect to real output.

[16] In all subsequent years, this 2% increase in output in period t will accrue entirely to the public because the government derives its money creation revenue from the *new* production in each year. So the demand for money rises by 2% because the public knows that it will need this money to purchase the entirety of this year's increase in output (not just 75% of it) in all future years.

More generally, we have seen that the government's revenue from money creation at a rate equal to the rate of growth of output equals $\Delta M_t/P_t$. Solving the Equation of Exchange for M/P and taking first differences (P and V constant) yields:

$$g_t = \Delta Mt/P_t = \Delta Y_t/V_t = (8 \text{ goods/year})/(4/\text{year}) = 2 \text{ goods.} \quad (10)$$

If V had been 8, the government's revenue from money creation would have been only (8 goods/year)/(8/year) = 1 good. The government would have been able to purchase only 1/8 = .125 (or 12.5%) of the new output in period t.

VII. Revenue from Money Creation in Excess of Output Growth

Let's combine the results from sections I and VI, and assume that real output is rising (at 2%/year) and that the money supply is growing at a rate that exceeds the rate of output growth. If we want inflation to be 25%/year, as in section I, we must set z = 1.27, not z = 1.25, to account for the 2%/year growth in output. Money growth adjusted for output growth (which equals the gross inflation rate) is z* = 1.25. We now have two sources of revenue from money creation. The first source is the inflation tax imposed on the real money balances carried over from period t – 1. The second source is the government's share of the increase in output in period t purchased with some of the newly-created money. Total revenue from money creation in this case is:

$$g_t = (1 - 1/z^*)\cdot(M_{t-1}/P_{t-1}) + \Delta(M_t/P_t).^{17} \quad (11)$$

The first term in equation 11 is the inflation tax revenue, and the second term is the government's share of the new output produced in period t. Combining our two numerical examples, we have:

$M_{t-1} = \$100 \rightarrow M_t = \$127$
$Y_{t-1} = 400$ goods/year $\rightarrow Y_t = 408$ goods/year
$P_{t-1} = \$1$/good $\rightarrow P_t = \$1.25$/good
$M_{t-1}/P_{t-1} = 100$ goods $\rightarrow M_t/P_t = 101.6$ goods $\Rightarrow \Delta(M_t/P_t) = 1.6$ goods.

Government revenue from money creation in this case is:

$$g_t = (1 - 1/1.25)\cdot(100 \text{ goods}) + 1.6 \text{ goods} = 20 \text{ goods} + 1.6 \text{ goods} = 21.6 \text{ goods.}$$

This is easily verified. The government creates \$27 in new money in period t which it uses to purchase goods costing \$1.25/good. Therefore, the number of goods that the government can buy with its newly-created money is \$27/(\$1.25/good) = 21.6 goods. It is curious that the government's share of new output is 1.6 goods, not 2 goods as was the case in which money growth equaled output growth. The reason for this reduction is that the higher price level reduces the real value of all money created by the government, including the money used to

[17] We are assuming here that the inflation resulting from the government's choice of z = 1.27 has been going on long enough to be fully anticipated by the public. Therefore, real money balances held in period t – 1 already reflect π^e = 25%/year.

purchase some of the new output. Prices are now 20% higher (as a percentage of P_t), so it should not be surprising that (new) output purchased with the same amount of money as before is 20% lower.

VIII. Conclusion

Government revenue from money creation derives from an inflation tax on nominal money balances carried over from the previous period and from the fact that some part of the new production each year can be purchased with newly-created money. These two components of government revenue are separate and logically distinct in that either one could exist without the other. This revenue, which accrues in the form of purchasing power over goods, is largely disguised by the fact that governments generally inject newly-created money into the economy by buying bonds, not goods. It can be shown, however, that this is effectively equivalent to financing the purchase of goods with new money. Finally, government revenue from money creation and inflation varies systematically with the rate of money growth. Specifically, as the rate of money creation increases total revenue first rises but eventually falls. Put somewhat differently, the inflation tax is subject to the Laffer curve. It is interesting to speculate that this may be the cause of hyperinflations if government officials fail to understand this relationship due to the non-transparent nature of the inflation tax.

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