ANTICIPATED INFLATION AND ECONOMIC WELFARE

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I. INTRODUCTION

It was once believed that a fully anticipated inflation has no effect upon the allocation of resources. While this proposition was reiterated as late as 1949 by Lerner, it met with an objection by Friedman. If holders of money receive no interest on their deposits (or if the rate of interest on money is fixed) then the expectation of inflation—by leading to a higher nominal rate of interest on other (earning) assets—will widen the spread between the rate of interest on money and that on other assets and hence increase the incentive to “economize” on money. People will be driven to reallocate their resources—for example, to take more trips to the bank—in an inefficient way.

Friedman’s argument was later formalized by Bailey, who proposed to measure the “cost” of inflation (per unit time) by the area under the demand curve for real-money balances (displayed as a function of the nominal rate of interest) between the initial and the new level of real-money holdings, the new equilibrium level being smaller than the initial as a consequence of the rise in the equilibrium nominal rate of interest. Bailey joined Friedman in condemning inflation in view of this cost.

There the matter lay until Robert A. Mundell demonstrated, in the context of the Metzler flexible-wage-price model, that the expectation of inflation does not raise the nominal rate of interest on earning assets by the full amount of the expected rate of inflation. Rather, as the nominal interest rate rises and people seek to reduce their money holdings, prices move to a higher equilibrium level, reducing the real value of these holdings.

1 I should like to acknowledge helpful discussions with William C. Brainard and Paul A. Samuelson on the subject of this paper. Ronald Bodkin and Harry G. Johnson suggested several improvements of earlier drafts.


and thus stimulating greater saving at given levels of the real rate of interest and real income (the “Pigou effect”). The increased desire to save reduces the equilibrium real rate of interest and thereby prevents the nominal rate of interest from rising above its initial level by the full amount of the expected rate of inflation.

By implication the cost of inflation in Mundell’s model cannot be measured as Bailey proposed because ceteris are not paribus: the real rate of interest has fallen. Mundell concludes that the expectation of inflation confers “benefits” or “evils” depending apparently upon whether the rise of saving and investment associated with the fall of the real interest rate is good or bad. The upshot is that the welfare analysis of inflation appears to lack definite conclusions.

Nevertheless, definite welfare conclusions can be drawn. It will be shown in this paper that Mundell’s analysis refers only to an exogenous expectation of inflation to which the government makes no fiscal or monetary response. Using a Metzler-like model having fiscal and monetary controls over consumption and investment demand, I show that whether the real interest rate falls or rises when inflation becomes expected depends entirely upon the government’s use of these fiscal and monetary controls. Should the expectation of inflation be induced by inflationary government policies the real rate of interest still need not fall: the government has the latitude to induce inflationary expectations by (fiscal) means which raise the real rate of interest, or by (monetary) means which reduce the real rate of interest. Thus, the expectation of inflation, even when that expectation is induced and sustained by the government, will depress the real rate of interest, as Mundell concluded, only if the government desires that to happen.

Since there is no necessary connection between the expected rate of inflation and the real rate of interest, it can be shown that, as Friedman and Bailey argued, the expectation of inflation in excess of a certain rate (which may be negative) has an unambiguously ill effect upon “feasible welfare” provided the government finds it infeasible to pay interest on money at a suitable rate. But it will also be shown that the expectation of inflation need have no effect upon welfare if the government is able to pay the appropriate rate of interest on money.

Finally, I reconcile my results with William S. Vickrey’s well-known argument that in some circumstances an anticipated inflation would be desirable.\(^6\)

A summary of my principal results concludes the paper.

II. CONSEQUENCES OF THE EXPECTATION OF INFLATION WITHOUT GOVERNMENT ACTION

I postulate that wages and prices are perfectly flexible, that the economy is able in each period to achieve a full-employment equilibrium, and that the supply of labor is perfectly inelastic so that equilibrium employment is fixed and independent of the other variables.

I treat the banking system as a unit, henceforth referred to as “the bank.” I suppose that the economy divides its wealth between only two assets, non-interest-bearing “money” and equity “shares” (claims upon capital goods). Initially I suppose that the government owns no shares. Hence the equilibrium real value of the privately held shares, \(E\), in any period equals the real value of the economy’s capital after the investment of

the current period.\footnote{I have in mind a model in which the capital stock changes by discrete amounts in every period, or planting season, as it were.} Real private wealth is therefore \( W = E + M/\rho \), where \( M \) is the amount of money held and \( \rho \) is the price level.

I further suppose that there is no uncertainty concerning the prospective rise of the price level and the prospective real rate of return on shares. There is thus no speculative demand for money or shares; the motive for holding money is entirely the transaction demand, and, as Baumol and Tobin have shown, this demand will be well defined and interest elastic.

The demand for real money holdings is taken to be a function of the nominal rate of interest, \( i \) (this is the prospective nominal yield on shares), and the aggregate volume of planned transactions during the period. Presumably, the greater the yield on shares, the smaller is the amount of money that people are willing to hold, relative to transactions. Since currently planned transactions depend mainly upon the volume of current production and the latter is a datum if resources are fully employed, production can be suppressed from the demand function, which can be written \( M = \rho L(i) \), \( L_i < 0 \).

The supply of money, which is determined by the fiscal and monetary authorities, I initially take as given, hence \( M = M_0 \).

The market in which these two assets (money and shares) are traded for one another will be in equilibrium—a "portfolio" equilibrium—when the price level and prospective nominal yield on shares equate the demand and supply of money:

\[
\frac{M_0}{P} = L(i) \tag{1}
\]

Now if \( \rho \), the expected relative rate of price inflation, is zero, then the nominal rate of interest, \( i \), and the real rate of interest, \( r \), are equal. Therefore, the \( LM \) curve labeled \( \rho = 0 \) in Figure 1 is the locus of pairs of the real (as well as the nominal) interest rate and real-money holdings that satisfy the equilibrium requirement of equation (1) when there is a zero rate of expected inflation.

The amount of capital invested, \( I \), in any period is equal to private saving (unconsumed production), \( S \), plus public saving (the government budgetary surplus). The latter is simply net taxes \( T \), since government expenditures are omitted. Hence \( I = S + T \). All taxes are assumed to be lump sum.

Private saving is assumed to depend on the real rate of interest (the real prospective yield on shares), real private wealth, and taxes. Real pretax income is suppressed since it is assumed constant. Hence \( S = S(r, W, T) \). It is further supposed that an increase of wealth will decrease desired private saving, \( S_w < 0 \); that a rise of taxes reduces saving but by less than the amount of the tax, \(-1 < S_T < 0 \) and that an increase of the real return on shares will not decrease saving (if it decreases at all) by as much as it decreases investment, \( S_r > I_r \). Public saving is initially assumed constant: \( T = T_o \).

The prospective real rate of return on investment (shares) is assumed to be inversely related to the volume of investment, which gives us the relation \( I = I(r) \), \( I_r < 0 \).

Equilibrium of the whole system requires in addition to equation (1) that the real rate of interest and real wealth be such as to equate the corresponding level of investment to the corresponding level of saving:
\[ I(r) = S \left( r, E \frac{M}{\rho}, T_o \right) + T_o. \] (2)

The \textit{IS} curve in Figure 1 is the locus of pairs of the real interest rate and real money holdings that satisfy this equilibrium requirement. The slope of the curve is positive because a rise of the real interest rate reduces investment and so requires an increase of the real value of money holdings (inducing a decline of desired saving) in order to maintain equality of desired saving and investment.

The expectation of a rising price level raises the nominal yield of shares at each real rate of interest (real yield on shares); this decreases the quantity of real money balances demanded, increases the quantity of shares (hence capital) demanded, and thereby causes the price level to be bid higher. To the extent that the result-

\[ r = i - \rho. \] (3)

If no inflation or deflation is expected, then the intersection at \( O \) of this \textit{IS} curve with the \textit{LM} curve for \( \rho = 0 \) determines the equilibrium nominal and real interest rate, \( i_o = r_o \), and the equilibrium real value of money holdings, \( M_o/\rho_o \) (that is, the equilibrium price level, \( p_o \)).

In general, however, the expected nominal rate will exceed the real rate (to a first approximation) by the expected relative rate of change of the price level between this period and the next. Letting \( \rho \) denote the expected rate of inflation we have

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\( LM \) curve for \( \rho = \rho_1 \) will lie below the \( LM \) curve for \( \rho = 0 \) by the amount \( \rho_1 \); because \( \rho > 0 \), it takes a lower \( r \) to keep \( L(i) = L(r + \rho) \) constant at any specified \( M'/p \). The new equilibrium is at \( T \) where the real interest rate is \( r_1 \) and the real value of the money supply is \( M_0/p_1 \). The point \( R \) indicates the new nominal interest rate \( i_1 = r_1 + \rho_1 \).  

III. CONSEQUENCES FOR POLICY OPPORTUNITIES OF THE EXPECTATION OF INFLATION

The foregoing results, obtained by Mundell, describe the effects of a spontaneous change of the expected rate of price change, with the government making no response to the change of expectations or being itself responsible for the change of expectations.

The monetary and fiscal authorities need not, however, acquiesce to the new equilibrium shown above. Investment and the real interest rate could be restored to their "original" levels by open-market sales of securities by the central bank or by a tax reduction; alternatively the authorities could restore real money holdings and the nominal interest rate to their original levels by the opposite steps; or the authorities could bring about some different equilibrium lying either between or outside these two possible equilibria.

Should the government induce the expectation of inflation by the way it employs one of its two tools (say, taxes), it still needs not accept the particular change of equilibrium shown above; the government's other tool (say, open-market purchases) gives it latitude in choosing what the new real interest rate and investment level shall be.

I now analyze the separate effects of these two government tools and go on to deduce the consequences for policy opportunities of the expectation (spontaneous or induced) of inflation.

TAX POLICY

A change of taxes changes by an equal amount the algebraic budgetary surplus (which may be positive or negative) of the government. Since there are just two assets, money and shares, any change of the surplus must be "financed" by an equal and opposite change of the money supply.

A change of taxes has three points of impact upon the model: A change of \( T \) has an "income effect" upon consumption demand, hence available total saving, as shown in the right-hand side of equation (2); a change of \( T \) changes \( M \) and thus has an "asset effect" (or a "Lerner effect") upon private saving, again as shown in equation (2); and finally, a change of \( M \) has monetary effects through equation (1).

Consider first the impacts of the change of \( M \), holding \( T \) constant. \( M \) appears in equations (1) and (2) only as a ratio to \( p \); in other words, it is only the real value of money holdings, not their nominal size, that affects behavior. Therefore, if there existed initially an equilibrium with real money balances \( M_0/p_0 \), then, when the reduction of the algebraic surplus increases the money supply from \( M_0 \) to \( M' \), there must exist a new equilibrium with the same \( r \), \( E \), and so on but with a price level, \( p' \), that makes the real value of money holdings the same as initially. Moreover, since for every given \( M \) there is a unique equilibrium, \( p' \) must be the only possible equilibrium price level. It follows that
the new equilibrium, holding $T$ fixed, does not differ from the original equilibrium, except for equiproportionate changes in $M$ and $\rho$, since only a change of $M/\rho$ can change the behavior of the economy.

Hence, taking as given the expected rate of inflation, any effects of the tax cut are due solely to its "income effect" upon consumption demand. This is a well-known story: The tax cut stimulates consumption and hence requires a reduction of real balances (to stimulate private saving) if any given real rate of interest is to continue to satisfy the investment-saving equality in expression (2). Hence the $IS$ curve shifts to the left. The $LM$ curve remains fixed.

Therefore, given the rate of expected inflation, a tax reduction results in a higher rate of interest (both real and nominal so as to satisfy equation [3]) and therefore a smaller level of real-money holdings and a smaller level of investment. It follows that, by suitable tax policy (shifts of $IS$) the government can bring about an equilibrium anywhere on the given $LM$ curve.

**MONETARY ACTIONS**

In the present model, monetary actions are confined to open-market operations—the exchange of money (the bank's liabilities) for shares.

Open-market transactions can be viewed as having two impacts: the impact of the change in $E$, interpreted now as privately held shares (total shares issued less the bank's holdings), and the impact of the equal and opposite change of $M$. A change of $M$, keeping the bank's holdings of shares constant, has no effect on the interest rate (real or nominal, given $\rho$) nor any other real magnitude, only an effect upon the price level, which must change in the same proportion as $M$. Any "real" effect of open-market operations must therefore arise from the impact of the change in privately held shares. Indeed, as Metzler explained, open-market purchases of shares have the same effect as a capital levy payable only in shares.

A reduction of privately held shares (due to an open-market purchase) evidently has no effect upon the demand for real money holdings at any given interest rate since that demand is based upon transactions needs. But the loss of securities does increase the quantity of real money holdings needed at any interest rate to produce the private wealth total that will equate desired saving to investment. Hence the $IS$ curve shifts to the right. Since $M/\rho$ must increase by the amount of the decrease of $E$, the shift at any real interest rate is equal to the amount of shares purchased. Hence the intersection of the $IS$ curve with the $LM$ curve moves downward and rightward along $LM$.

An open-market purchase therefore results in a lower rate of interest (nominal and real), therefore in greater real money holdings (as well as greater nominal holdings), and in a greater rate

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9 Because $T$, which is held constant, signifies net government receipts, its constancy implies that the government reduces taxes by the amount of the earnings from the shares purchased by the bank. The Metzler model implies that tax reduction has no effect upon consumption demand if it is matched by equal loss (to the private sector) of interest earnings due to a reduction of privately held shares, given total real wealth and the rate of interest. Mundell and Froot have pointed out that this implies that the tax reduction must not be offered as a reduction on property-tax rates or corporate-tax rates; otherwise it will be "capitalized" by the market and hence raise the market value of property (shares). A stronger point should be made: Only if the tax reduction is considered transitory rather than permanent will the tax reduction fail to be "capitalized" to some degree and hence fail to stimulate consumption demand.
of investment. In these respects it is similar to a tax increase.

Note that both open-market action and tax variation work by shifting the IS curve and leave unchanged the LM curve, given the expected rate of inflation. The government can employ either a tax reduction or an open-market sale to raise the real rate of interest; it can employ either a tax increase or an open-market purchase to reduce the real rate of interest. Note, however, that these actions have different price effects. A tax reduction raises the price level; in fact, since \( M/p \) falls, \( p \) must rise proportionately more than \( M \). An open-market sale, while also reducing \( M/p \), reduces the price level; since \( M/p \) falls by an amount less than \( (1/p_0)\Delta M \), the amount of money withdrawn by the bank, \( p_0 \), must fall.

It is immediately clear that if the expected rate of inflation is completely exogenous, the government can use either the fiscal or the monetary tool to raise or lower the real interest rate. Any point on the LM curve for \( \rho = \rho_1 \) can be chosen by the government. Mundell's result that the real interest rate must fall assumes the absence of any government response to the shift of the LM curve.

The conclusion is no different if the expectation of inflation is induced by inflationary government actions rather than exogenous. Just as the government can maintain a stationary price level by fiscal-monetary policies that produce either a high or a low real rate of interest, the government can also engineer a rising price trend combined with a high or low real rate of interest.

Suppose (without loss of generality) that to induce a certain expected rate of inflation the government desires to raise the price level a certain amount (above) what the price level would be if the government took no action. To raise the price level, the government must either reduce taxes or engage in open-market purchases. The former action shifts the IS curve to the left while the latter shifts it to the right. Hence the tax reduction will accomplish the desired inflation with a higher real rate of interest than will the open-market purchase. But the difference between these two resulting real interest rates does not exhaust the range of choice. If the government should desire a higher real rate than would result from tax reduction alone, it should engage in open-market sales (which reduce the price level) together with additional tax reductions (to keep the price level constant at the desired level) until the real rate of interest reaches the desired level. In short, the government can choose among the points on the LM curve that prevails in an anticipated inflation as easily and in just the same way as it chooses among the points on the (different) LM curve that prevails under stationary price expectations.

Thus the government can choose what kind of inflation to have: an inflation with high saving and a low real rate of interest—brought about by open-market purchases—or an inflation with low saving and a high real rate of interest—brought about by low taxes.  

10 Note that a permanent change of tax rates has an effect upon the path of the price level from period to period that a once-for-all change in the supply of money due to an open-market transaction does not have. If the government sets the tax level so as to run a deficit \( (T < 0) \) then, since the money supply will be increasing over time while the real value of money holdings will be constant from period to period (if the IS and LM curve remain the same over time) the price level will be increasing over time in proportion to the changing money supply. The monetary authority can cause inflation—through continual increases of the money supply—only if it engages in fresh open-market purchases each period. A permanent change of taxes causes a
proposition is the analogue for a flexible price model of the familiar proposition for inflexible price models that the government, by its use of fiscal and monetary controls, can control both the level of employment and the rate of interest; in a flexible price model, it is the rate of inflation and the (real or nominal) rate of interest which can be independently controlled.

I conclude that the expectation of inflation—even when that expectation is deliberately induced and sustained by the government—will depress the real rate of interest, as Mundell maintained, only if the government allows that to happen.

The pairs of values of the real interest rate and real money holdings which the government may feasibly bring about by taxation and open-market operations are represented by the LM curve; this curve constitutes the "opportunity locus" for these policy instruments. The effect of anticipated inflation upon "feasible welfare"—the maximum welfare attainable through tax and open-market policies under the given monetary arrangements and institutions—depends therefore only upon the resulting downward shift of this opportunity locus in relation to community preferences. I now proceed to analyze the welfare effects of anticipated inflation.

IV. CONSEQUENCES FOR FEASIBLE WELFARE OF ANTICIPATED INFLATION

In the present model, welfare can be considered a function of the amount of time spent economizing on money holdings and the investment-consumption mix (that is, the degree to which the economy's investment approximates to the "optimum" level).

Clearly, the economy can invest so much of its output as to leave too little available for present consumption; or it can invest so little as to leave too little income available for consumption in the future. Therefore welfare depends upon the level of investment, given the present capital stock, employment, and time spent in husbanding money holdings.

Given time spent in production and the amounts of output invested and consumed respectively, welfare will depend upon the amount of time left for leisure. The greater the number of deposits and withdrawals at the bank made by individuals in order to keep a greater share of wealth in the forms of earning assets (shares), the smaller is the amount of time left for leisure; hence, given the public's distaste for this activity, the greater the number of these trips to the bank, the smaller will be the community's welfare.

The twofold dependence of welfare upon investment and leisure can be expressed in terms of the real interest rate and real money holdings on our simplifying—but not crucial—supposition that the community is determined to devote a fixed amount of time to production. On this supposition, the amount of output invested is an inverse function of the real rate of interest. Therefore, given employment and given time spent economizing on money (hence given leisure), welfare can be represented as a function of the real rate of interest: As the real rate is decreased (investment increased) welfare first increases and then eventually decreases when investment becomes excessive. Thus, there is an optimal real rate of interest, say \( r^* \), corresponding to the optimal rate of investment.

Also, the amount of time spent in economizing on money instead of spent
in leisure can be represented as a function of real money holdings, since the greater equilibrium real money holdings, the smaller must be the nominal rate of interest, and therefore the smaller the incentive to economize on money. Therefore, given employment and given the real rate of interest (hence investment), welfare can be represented as a function of the real value of money holdings: As real money holdings are increased (the nominal interest rate decreased) welfare increases until the nominal rate of interest has fallen to a point near zero where the incentive to economize on money is nil. When the incentive to economize on money is nil, meaning that all transactions balances are held in the form of money, I shall say that there is "full liquidity." Assuming that it costs the government nothing to increase real balances (at least in the neighborhood of full liquidity), the optimal level of liquidity is at full liquidity. I denote this liquidity optimum \( m^* \). It is represented in Figure 2 by the quantity of real balances demanded when \( \rho = 0 \) and \( r = 0 \) (that is, when the nominal interest rate is zero).

The optimal real rate of interest, \( r^* \), may not be as small as the nominal interest rate required to produce full liquidity. Suppose that it is not. Then the optimum is at point \( (r^*, m^*) \) which lies above the \( LM \) curve for \( \rho = 0 \). Any point \( (r, M/P) \) different from this optimum entails a below-optimal level of welfare.

Suppose now that \( \rho = \rho_e = 0 \) and that the government is committed to sustaining the expectation of a stationary price level by keeping the price level stationary. Then the \( LM \) curve for \( \rho_e \) is the opportunity locus of points from which the government must be content to choose if it is committed to sustain stationary price expectations. Let \( (r_o, m_o) \) be the best point on this opportunity locus. Then the government, if it seeks the greatest level of welfare feasible, will choose those fiscal and monetary actions (among all actions which keep the price level stationary) that cause the \( IS \) curve to intersect the \( LM \) curve at this point. Trivially, this point is inferior to \( (r^*, m^*) \).

Suppose now that the community expects rising prices \( (\rho = \rho_1 > 0) \) and that the authorities commit themselves
to sustaining this expectation. Then the new LM curve for \(\rho_1\) becomes the locus of policy opportunities. This locus is clearly inferior to the previous locus, for any real interest rate that can be achieved on the first locus can be achieved (if at all) on the second locus only at a smaller level of liquidity—with a greater short fall of liquidity from optimal liquidity. Hence \((r^{**}, m^{**})\), the best feasible equilibrium on the \(\rho_1\) locus, is inferior to \((r^*, m_*^)\). The expectation of inflation reduces feasible welfare below that attainable when a stationary price trend is expected.11

We have finally arrived at a familiar proposition: Anticipated inflation is unambiguously bad. From this proposition it is sometimes concluded that, should the expectation of inflation develop, anti-inflationary measures ought to be introduced in order to induce the expectation of "stable prices." I shall make three remarks on this conclusion.

First, should the government rely solely upon monetary tightening to curb the price trend (in the hope that people will thereby learn not to expect inflation) while sticking to the same fiscal course, it is possible that the cure will be worse than the disease. Surrender of the equilibrium at \((r^{**}, m^{**})\) in favor of tighter money will, until the community revise its price expectations, place the economy higher up on the LM curve: Real money holdings will fall below \(m_*^\) and, while the real interest rate will rise above \(r^{**}\), the net effect of this alternation is to place society in a worse position since the former position was the best feasible on the LM curve.

Similarly, should the government rely solely upon fiscal tightening (an increased surplus) to arrest the price rise, then (given an unchanged course of action by the monetary authority) the equilibrium at \((r^{**}, m^{**})\) will give way to one with a lower real rate of interest and, despite greater real money holdings, welfare will here also fall below the feasible level—until the desired effect upon the LM locus finally develops.

The lesson of this, of course, is that monetary and fiscal policies must be used jointly to bring about a moderation of the price trend together with maintenance of feasible welfare. We require both monetary and fiscal tightening—open-market sales (which lower the price level and raise the nominal interest rate) and an increase of the surplus (which lowers and slows the price level while reducing the nominal interest rate) in such proportions that the real rate of interest remains at \(r^{**}\) until the LM curve begins to shift rightward. In this way the economy can be guided along some optimal expansion path from \((r^{**}, m^{**})\) to \((r^*, m_*^)\).

Our second remark is that there is nothing optimal in this model about stationary price expectations. The same logic as demands the elimination of inflation in favor of price stability also demands the abandonment of price stationarity in favor of an appropriate rate of price deflation. The optimal expansion path does not end at \((r^*, m_*)\) but continues over to \((r^*, m^*)\), the grand optimum. To realize any point on this stretch of the expansion path it is necessary to bring about a certain rate of expected deflation, that is, a certain value of \(\rho < 0\).

What rate of expected deflation is necessary to bring about equilibrium at the optimum \((r^*, m^*)\)? Here there is "full liquidity." Hence the spread be-

11 Another proof that \((r^*, m_*)\) is better than \((r^{**}, m^{**})\) is the following: The first locus permits \((r^{**}, \hat{m})\) where \(\hat{m} > m^{**}\) and this is better than \((r^{**}, m^{**})\). If \((r^*, m_*)\) is preferred to \((r^{**}, \hat{m})\), it must also be better than \((r^{**}, m^{**})\). It is not possible, however, to measure how much better it is. Only if \(r^{**} = r^*\) could we make use of Bailey's measure of the welfare cost of the inflation.
tween the nominal (and real) yields of money and shares must be approximately zero. Since the nominal yield on money is zero, the nominal rate of interest, therefore, must be approximately equal to zero.\footnote{It is not necessary to drive the nominal interest rate all the way to zero in order to eliminate the incentive to switch transactions balances in and out of money. Provided even one such transaction has a finite duration the LM curve will possess a vertical slope close to the horizontal axis (that is, for very small nominal interest rates).} This means that the expected rate of deflation must approximate the real rate of interest \( r^* \), the real rate that is optimal when there is full liquidity. In short \( \rho \approx -r^* \) is required to cause the \( LM \) curve to pass through the point \( (r^*, m^*) \).

In this optimal equilibrium there is no incentive to exchange money for shares in order to economize on money. Transactions balances consist only of money; there would be no purpose in increasing liquidity if that were possible. Moreover, the investment level is chosen solely with regard to intertemporal consumption preferences rather than with regard also to the consequences for liquidity of the implicit nominal rate of interest. By manipulating \( \rho \) the government would be able to break the link between the nominal interest rate (liquidity) and the real rate of interest (investment) and therefore achieve simultaneously both full liquidity and the investment optimum.

This route to the optimum seems rather awkward, however. It might be argued that the process of teaching the community to expect deflation is uncertain and slow at best. The deflationary method of attaining the grand optimum depends upon a tendency of the community to extrapolate recent price trends into the future. But it is conceivable that price expectations are "adaptive" in too stabilizing a fashion—that, the expected price level next period is a positively weighted average of the current and each past price level so that the expectation of a price fall could not be induced by the policy act of making prices fall.

Fortunately there is another method of attaining the optimum, one suggested by Friedman and others,\footnote{See, for example, Milton Friedman, \textit{A Program for Monetary Stability} (New York: Fordham University Press, 1960).} and this is the subject of my third remark. I supposed from the start that money bore no interest. This placed money at a greater disadvantage relative to shares when the nominal interest rate (yield on shares) rose. Planned deflation, which people will eventually anticipate, is a device for making non-interest-bearing money bear a positive real rate of return. If \( \rho \approx -r = -r^* \), both money and shares will bear approximately the same real (and the same nominal) rate of return. The trouble with any expected price trend that is less deflationary—especially any inflationary trend—is that it creates an excessive spread between the nominal (and hence also the real) rates of return on money and shares; clearly it is on this spread between the nominal interest rate on shares and that on money (until now supposed to be zero) that the demand for real money holdings depends. The greater this spread, the greater will be the community’s socially inefficient efforts to economize on money.

Suppose now that the government pays interest (in money) to holders of money. Let \( \mu \) denote the (own) rate of interest on money. The spread between the nominal rates of interest on shares and money is now \( i - \mu = r + \rho + \mu \). Therefore the real money demand function is

\[
\frac{M}{\rho} = L(r + \rho - \mu). \tag{1'}
\]

Money is no longer at a potential disadvantage relative to shares. If \( \mu > 0 \),
money has an inherent attraction beyond its utility in making transactions. If \( \rho \) should rise, the government can prevent the effect of that rise upon the \( LM \) curve, hence its effect upon real money balances and the real interest rate, by raising \( \mu \) by an equal amount. Indeed, in a laissez-faire banking system in which it is legal to pay interest on deposits, the advent of inflationary expectations would presumably lead profit-maximizing banks to raise the interest rates they pay to depositors enough to maintain the spread between the yields on money and shares and thus maintain their deposits and earnings in real terms. This seems a significant qualification to the usual welfare analysis of inflation and to the analysis by Mundell: Such analysis has little relevance to economies in which the rate of interest on a large portion of the money supply fluctuates with other yields so as to keep most interest differentials roughly invariant to the expected rate of inflation.\(^{14}\)

More importantly, the government can now achieve the optimum through control of \( \mu \) rather than by efforts to control \( \rho \). It can narrow the spread between the nominal (or real) rate of interest on money and that on money by raising the own rate of interest on money rather than by attempting to lower the expected nominal rate of interest on money (the real rate plus the expected rate of change of prices). Taxation and open-market operations can be used to bring about the desired price level and the desired real rate of interest on money while the bank raises their own rate of interest on money toward the nominal rate of interest on money, reducing the spread sufficiently to eliminate the incentive to economize on money.

By this method, then, the government can achieve the optimum without having to attempt to influence the rate of expected change of the price level. The economy is not restricted to maximizing the welfare level that is feasible under any given rate of expected algebraic inflation. The economy's full potential welfare can be achieved through the device of paying interest on money.

My analysis has led to the conclusion that anticipated inflation and even insufficient deflation is bad unless its ill effects are neutralized by the payment of a suitable interest rate on money. But there is a qualification: I analyzed only the case in which the optimum point \((r^*, \, m^*)\) lay above the \( LM \) curve for \( \rho = 0 \); we supposed, in other words, that \( r^* \) was so high that if \( \rho = 0 \) and \( \mu = 0 \) then, when \( r = r^* \), the cost of holding money, \( i - \mu = r + \rho - \mu = r^* \), would have been too high to permit full liquidity. It was for this reason that we required either a positive \( \mu \) or a negative \( \rho \) to realize both the optimal \( r \) and an \( i - \mu \) small enough to induce full liquidity.

But it is possible that the optimum point lies on the \( LM \) curve for \( \rho = 0 \), that is, somewhere on the vertical stretch of \( LM \) where \( M/p = m^* \). The meaning of this case is that \( r^* \) is so small that, when \( \rho = 0 \), \( \mu = 0 \), the cost of holding money, \( i - \mu = r + \rho - \mu = r^* \), is small enough to insure full liquidity.

In this second case there is no need to introduce a negative \( \rho \) or positive \( \mu \) to shift the \( LM \) curve upward; that curve already intersects the optimum point. Hence, to realize the optimum, it suffices to adopt a fiscal-monetary policy that is neither inflationary nor deflationary (in order to keep \( \rho \) equal to zero) and that causes the \( IS \) curve to intersect the \( LM \) curve for \( \rho = 0 \) at the point \((r^*, \, m^*)\). There is no need here for deflation or interest on money.

Further, just as a stationary price

\(^{14}\) For a fuller discussion of the significance of bank interest payments see Vickrey, pp. 112-13.
trend is consistent with optimality in this case without need for interest on money, a moderate rate of anticipated inflation may be harmless. While a positive \( \rho \) will produce an \( LM \) curve below that for \( \rho = 0 \), this new \( LM \) curve will still intersect the optimum point if \( \rho \) and \( r^* \) are small enough. This is because the \( LM \) curve for \( \rho = 0 \) is vertical for some distance over the point \( M/\rho = m^* \) (meaning that there is a finite range of smaller nominal interest rates consistent with full liquidity). Hence an \( LM \) curve slightly below that for \( \rho = 0 \) will also have a vertical stretch over the point \( M/\rho = m^* \); the two curves will coincide near the horizontal axis and hence may coincide at the optimum point if the latter is close to the horizontal axis.

Our conclusion, therefore, is that anticipated inflation above a certain critical rate is bad unless offset by the payment of interest on money. The critical rate may be negative (deflation required in the absence of interest on money), or it may be positive. The critical rate is negative if and only if the optimal real interest rate is sufficiently high that equality of the nominal interest rate with that real rate (implying \( \rho = 0 \)) would prevent full liquidity; that is, if and only if the optimum point \( (r^*, m^*) \) lies above the \( LM \) curve for \( \rho = 0 \).

The reader may feel that in fact the optimum point lies well above the \( LM \) curve for \( \rho = 0 \), that is, that \( r^* \) is so high that we require for full liquidity either anticipated deflation or interest on money. But this is less certain if we recognize that there may be a speculative as well as a transaction demand for money.

Suppose there is a speculative demand for money. Optimal liquidity occurs when the cost of holding money \( (i - \mu) \) is small enough to induce full liquidity—to cause all individuals to hold all their transactions balances in the form of money. Let \( m^* \) denote the level of real money holdings when the cost of holding money is just small enough to induce full liquidity. A “difficulty” in this case, and it is not a real one, is that if the cost of holding money is reduced further there may be a larger speculative demand (the transactions demand is already satiated) so that the level of real money holdings corresponding to this reduced cost of holding money may be larger than \( m^* \). Hence there may be a whole range of values of real money holdings, \( M/\rho > m^* \), all of which correspond to equilibria of full liquidity. This is illustrated in Figure 3 (see Sec. V), where, rather than a single optimum point, there is an “optimum line”: Any point on the horizontal line stretching rightward from the point \( (r^*, m^*) \) is a point of optimal investment and full liquidity.

The important difference which a speculative demand makes pertains to the position of \( (r^*, m^*) \) relative to the \( LM \) curve for \( \rho = 0 \). When there is only a transaction demand for money, \( m^* \) is equal to the value of \( M/\rho \) at which the \( LM \) curve reaches the horizontal axis; hence the point \( (r^*, m^*) \) is either on the \( LM \) curve (if \( r^* \) is very small) or above the \( LM \) curve. But when there is a speculative demand for money as well, then full liquidity—all transactions balances held in the form of money—can occur without there also occurring liquidity saturation—the demand for money equal to total wealth. In other words, the value of \( M/\rho \) at which the cost of holding money is just small enough to produce full liquidity may be smaller than the value of \( M/\rho \) corresponding to liquidity saturation. Hence \( m^* \) need not be the horizontal intercept of the \( LM \) curve for \( \rho = 0 \); rather, \( m^* \) may be to the left of this intercept. As a consequence, if \( r^* \) is rather small, the point \( (r^*, m^*) \) may be
below the $LM$ curve for $\rho = 0$ (this is shown in Fig. 3). There are, therefore, three cases to be considered.

If the point $(r^*, m^*)$ lies above the $LM$ curve for $\rho = 0$ then either anticipated deflation or positive interest on money is needed to shift up the $LM$ curve so that it will intersect $(r^*, m^*)$ or any other point on the optimum line.

If the $LM$ curve for $\rho = 0$ passes through $(r^*, m^*)$ then, to realize optimal investment and liquidity, it suffices to adopt a fiscal-monetary policy that is neither inflationary nor deflationary (in order to keep $\rho$ equal to zero) and that causes the $IS$ curve to intersect the $LM$ curve for $\rho = 0$ at the point $(r^*, m^*)$.

If the point $(r^*, m^*)$ lies below the $LM$ curve for $\rho = 0$ then the optimum line must stretch rightward from that point, reaching the $LM$ curve at some $M/\rho > m^*$, $r = r^*$. As has been explained, this point is also an optimum. Hence, for an optimum it suffices to adopt a non-inflationary, non-deflationary, fiscal-monetary policy that makes the $IS$ curve intersect the $LM$ curve at this point, where $r = r^*$.

In the latter two cases, therefore, neither deflation nor interest on money is required for an optimum. Further, in the last case, a moderate rate of anticipated inflation is harmless. In that case there is a range of anticipated inflation rates which, while they produce $LM$ curves below the one for $\rho = 0$, still allow the $LM$ curve to pass through or above $(r^*, m^*)$, and hence still allow an optimum to be achieved without payment of interest on money.

I am not sure which is the empirically relevant case. But I can say that the presence of a speculative demand for money increases the likelihood that the last case is the relevant one, hence increasing the likelihood that optimal investment and liquidity can be achieved without deflation or interest on money and can be achieved even with a moderate rate of inflation (without paying interest on money).

I have concluded that anticipated inflation, at least if it is excessive, reduces feasible welfare if no interest is paid on money. But what of Vickrey’s well-known argument that anticipated inflation may be desirable? I append a final section in which our respective analyses are reconciled. The analysis below differs from that above in that I now suppose, with Vickrey, that the bank is restrained from buying the quantity of shares it would like to buy.

V. THE ANALYSIS UNDER A MONETARY RESTRAINT

Vickrey supposes that there is a speculative demand for money. Further, he supposes that, when $\rho = 0$, there is some rate of interest, say $\bar{\xi}$, such that at any $i < \bar{\xi}$, everyone expects a negative yield on shares (including the capital loss). Hence the $LM$ curve exhibits a so-called liquidity trap as shown in Figure 3. At any interest rate below a critical level, everyone is happy to sell all his shares; the demand for real money is equal to real total wealth; liquidity preference is “absolute.”

However, such a phenomenon in no way impairs the power of the monetary authority to bid for shares and hence to drive down the nominal rate of interest to any desired level short of zero. At the kink in the $LM$ curve, shareholders will have sold all their remaining shares to the bank; thereafter, the price offered by the bank for new shares determines the equilibrium rate of interest.

Yet, in Vickrey’s model, the bank is unable to establish a “low” real rate of interest, if that should be desired. The reason is that the monetary authority is supposed to be unable to purchase the
total stock of private shares. If, for example, all open-market operations in private claims were illegal (and no other debt such as government bonds existed for purchase or sale) then, should fiscal policy be committed to price stationariness (or to any other price trend) there would be just one possible equilibrium real rate of interest—where the IS curve corresponding to the required fiscal policy intersects the associated LM curve. In Figure 3, \( r^* \) denotes the lowest \( r^* \) and \( M/p \geq m^* \); \( r^* \) is lower than \( r^0 \). All points on this optimum line are points of full liquidity.

In this situation, the government seems unable to drive the real interest rate to the optimal level. But Vickrey proposes a solution through inflation. He would have the government contrive a program of announced inflation in order to shift the LM curve downward on the belief that a lower real rate of interest would then be feasible.

How is this inflation to be generated? The bank can cause a rising price trend only by repeated open-market purchases from period to period. But this route is evidently closed by Vickrey's assumption of a restraint on bank holdings of shares. The only apparent alternative is fiscal policy.

To raise the price level and hence to induce the expectation of inflation by means of taxation the government must,

\footnote{If a level trend of prices is considered a sine qua non, a high [nominal] interest rate also implies a high real rate of interest which in turn may discourage . . . capital formation to an undesirable extent\textsuperscript{1} (ibid., p. 98).}
on the usual stability condition, reduce taxes (increase the deficit). This shifts the IS curve in Figure 3 to the left for reasons explained earlier. The LM curve will shift downward by the amount of the expected rate of inflation that the new price trend induces. But notice that, as Figure 3 illustrates, the resulting real rate of interest, \( r^* \), is not necessarily lower than \( r^0 \). If and only if the downward shift of LM exceeds the upward shift of IS will the real rate fall. Thus there is no guaranty that this fiscal effort to achieve a lower real rate of interest will be successful.

In Figure 3 I have drawn the curve FF, which is the locus of points of intersection of every “lowest IS curve,” each one corresponding to some rate of anticipated inflation, with the LM curve that corresponds to the same rate of anticipated inflation. This curve is the boundary of the policy opportunity set: Through monetary tightening it will be possible to achieve any point on or above this frontier; but the constraint on monetary ease makes it impossible to achieve any point below FF.

I have demonstrated that the government may be unable to reduce the real interest rate through fiscally induced inflation. The government’s only tool for sustaining inflation, namely, the deficit, may raise the real rate of interest on balance (and reduce liquidity in addition) and therefore reduce welfare. This is the result where FF is downward-sloping as it may be in the left-hand range; it is the result shown in the diagram. But FF may be upward-sloping—the LM shift predominating—in which case Vickrey’s result occurs; the diagram shows FF to be upward-sloping to the right, where LM is very flat, as Vickrey supposed.

Even if the real rate does fall (FF upward-sloping in the relevant range), however, there is no necessity that welfare will thereby be increased, since liquidity also falls. If the new and smaller liquidity level still exceeds or equals full liquidity—so that all transactions balances are held only in the form of money—liquidity reduction is of no consequence for welfare; then, since the real rate was originally above the optimum level by assumption, welfare will be increased if the reduction of the real rate is of the “right” magnitude. But if the new liquidity level is less than “full,” the reduction of liquidity accompanying the fall of the real interest rate may reduce welfare. In any case it is always possible to go so far along FF that welfare begins to fall. Somewhere on the FF boundary there may be constrained optimum. (This is the case in Fig. 3 where the unconstrained optimum lies below FF.) The real interest rate associated with this constrained optimum may or may not be lower than \( r^0 \); the lowest real rate consistent with non-inflationary fiscal policy, so that a fall of the real rate below \( r^0 \) may or may not increase welfare.

To summarize: Inflation through fiscal means does not insure an increase of welfare in this case. A fiscally induced inflation may fail to reduce the real rate, may reduce welfare even if it succeeds, and cannot—if the restraint on the monetary authority is sufficiently binding—make feasible the optimum.

To assure feasibility of the optimum or even a desirable reduction of the real rate of interest the government needs a third tool. A negative own rate of interest on money—a tax on money holding—is such a tool.

Suppose the government maximizes monetary ease subject to the restraint on the bank. Let the government choose that fiscal policy consistent with price stability, so that \( \rho = 0 \). The resulting IS curve—the “lowest IS” for \( \rho = 0 \)—may, as in Figure 3, lie to the right of the
point \( (r^*, m^*) \) and hence intersect the optimum line connected to that point. If this IS curve lies to the left, let the government choose a sufficiently tighter fiscal policy to shift the IS curve to the right so as to intersect somewhere with the optimum line. In either case the LM curve that corresponds to the IS curve chosen will intersect the IS curve somewhere on \( FF \). By hypothesis, \( FF \) lies everywhere above the optimum line. The problem therefore is to make the LM curve intersect the chosen IS curve where the latter intersects the optimum line. This can be achieved by levying a tax on money. Let \( \mu \) continue to denote the own rate of interest on money; then \(-\mu\) is the tax rate on money. Just as the introduction of a positive own rate on money shifts the LM curve (corresponding to a given \( \rho \)) upward by the amount \( \mu \), the introduction of a tax on money will shift the LM curve downward by the absolute value of \( \mu \). Hence it is only necessary to set the tax rate on money so as to shift the LM curve down from its intersection with the chosen IS at \( FF \) to an intersection with IS at the point where the chosen IS curve intersects the optimum line.

Hence, by establishing a negative own rate of interest on money and by adopting a sufficiently tight fiscal policy, the government can secure full liquidity and the optimal real rate of interest. Given the third tool of negative interest on money, the “price” of the monetary restraint, if binding, is only that a deflationary fiscal policy may be required to bring down the real rate of interest. In the present model there are no welfare effects of deflation, given that optimal levels of investment and liquidity are achieved; in particular, full employment is assumed to result whatever the price trend.

VI. CONCLUSIONS

If fiscal and monetary policies are effective and unconstrained, there is no necessary connection between the rate of anticipated inflation and the real rate of interest (hence investment and growth). The government can engineer a high-investment or a low-investment inflation in the same way that it can engineer high or low investment and keep the price level stationary.

If the government has unconstrained power to buy and sell claims on wealth (shares, in our model) and has the power to pay interest on money, considerations of investment and liquidity offer no basis for choosing among anticipated price trends: The desired levels of investment and liquidity can be achieved with any anticipated price trend. But if the government cannot pay interest on money, anticipated inflation in excess of some critical rate (which may be negative) will prevent attainment of the optimum; attainment of the desired levels of investment and liquidity may require a deflationary mix of fiscal and monetary policies.

If, in addition to being unable to pay interest on money, the government faces a constraint on the quantity of private wealth it can monetize, the optimum may not be attainable; in that case, attainment of a constrained optimum (the best feasible investment-liquidity combination) may require a rising anticipated price trend, as Vickrey argued, or a falling anticipated price trend. But if the government can tax money holdings (thus making the own rate of interest on money negative) it can achieve the optimum whether or not there is a constraint on open-market operations; however, if this constraint is binding, attainment of the optimum by means of fiscal policy and the taxation of money holdings may entail a falling price level.