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Recovering Effectiveness of Monetary Policy under a Deflationary Environment

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Introduction

In the last decade several countries have adopted a strategy for the conduction of a monetary policy based on central bank independence and inflation targeting. Generally speaking, the results suggest success in controlling inflation in several emerging and industrialized economies. Nonetheless, under this new environment, a new problem emerges: the risk of deflation.

The main problem, as shown by the Japanese experience, is that falling prices may lock countries into a spiral of economic decline. The core of the idea is: once consumers expect falling prices, they decide to postpone purchases, implying a decrease in demand and a consequent fall in prices by producers, threatening the start of a spiral of fall in output and demand. Furthermore, based on the results presented by a profit maximizing behavior, both prices and output are influenced by expected future prices.

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Contrary to the idea above, Atkeson and Kehoe (2004) through a panel data set of inflation and real output growth which considers 17 countries and 100 years, concluded that "deflation is not closely related to depression". Notwithstanding, recently, several empirical analysis are in opposition to this result. Cargill and Parker (2004) using annual data from 1955 to 2002 for Japan and from 1929 to 2002 for the United States, show that deflation has reduced consumption. In the same direction, Guerrero and Parker (2006), using panel data analysis based on two different data sets (one historical for 15 countries, and another one for the period after the Second World War with 94 countries) verified that deflation has a statistically significant negative effect on economic growth.

It is possible to identify two opposite visions with respect to this subject. In accordance with conventional approach, an economy with perfect flexible prices and wages represents a basic condition to assure the natural rate of unemployment in the long run. For example, Romer (1993), based on the Pigou effect, believe that a fall in prices implies an increase in consumers wealth bringing an increase in consumption that neutralizes the negative effects on output due to a fall in prices. Contrary to this idea, Keynes was not that enthusiastic about this "automatic stabilizer". According to him, the "cheapness which is due to increased efficiency and skill in the arts of production is indeed a benefit. But cheapness which means the ruin of the producer is one of greatest economic disasters which can possibly occur." (Keynes, 1972, p. 136).

When an economy plunges into a persistent deflation, the use of monetary policy may be considered inadequate because the successive fall in the nominal interest rate aiming at neutralizing the deflationary expectations has a limit. As a consequence, the liquidity trap problem may be understood as a situation in which monetary policy loses its capacity to influence the economy. Considering Fisher's equation when the nominal interest rate is zero or near zero, expected inflation will tend to equal a negative real interest rate. Thus, the case known as "liquidity trap" implies a situation with persistent deflation and deflation expectations. As pointed out by Svensson (1999, p. 197): "Since monetary policy may be ineffective on

its own, fiscal policy, both with regard to a fiscal expansion and to nominal public debt management, is likely to have an important role in escaping from a liquidity trap."

Recent theoretical studies are usually concerned with discussing the concepts of liquidity trap and with how economic policy recommendations which are capable of restoring monetary policy effectiveness are made. This point is directly related with the contemporaneous debate about government interventions among New Classical (real) equilibrium business cycle theorists, the New Keynesian economics and New Neoclassical Synthesis theorists.[1] New Classical (real) equilibrium business cycle theorists emphasize the importance of intertemporal optimization and rational expectations, exploring the role of productivity shocks in models where economic policies have relatively little effect on employment and output. Keynesian economists stress the role of monopolistic competition, markups, and costly price adjustment in models where economic policies are central to macroeconomic fluctuations and work as the main instrument for economic recoveries. The New Neoclassical Synthesis melds Classical with Keynesian ideas through models that involve the systematic application of intertemporal optimization and rational expectations to consumption, investment, pricing and output decisions from a Keynesian perspective (Goodfriend and King, 1997; King, 2000; Goodfriend, 2004).

From the developments of the New Neoclassical Synthesis there are new dynamic microeconomic foundations for macroeconomics. Hence, the present paper attempts to contribute within this new theoretical framework, analyzing the role and effectiveness of economic policies (particularly focused on fiscal policy) in an environment where the economy faces a liquidity trap and deflation expectations.[2]

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[1] For an analysis of the debate among several existing macroeconomics schools of thought concerning the importance and effectiveness of government interventions, see Snowdon and Vane (2005).

[2] Although this paper considers agents' behavior (firms and consumers) the link with Keynesian analysis is made by means of the effects of economic policies on public expectations.

The analysis presented in this paper takes into consideration two perceptions concerning the conduction of monetary policy in a context of "traps". The first one, the deflation trap, regards the deflationary process as a consequence of agents' expectations about future prices. The second one corresponds to the liquidity trap, which results in the lack of effectiveness of monetary policy in the promotion of economic recovery. The main concern is how agents react to expectations for the prices and the expectations concerning the implemented economic policies; and how these reactions may carry the economy into a recession/recovery path, considering a context of liquidity trap and deflation trap.

The remainder of this paper is organized in the following way. The second section briefly presents the liquidity trap problem; the third one, based on Romer (1996), presents the behavior of economic agents; in the fourth section, the model embodies the liquidity preference behavior; the fifth one presents the analysis concerning aggregate demand; the sixth section analyses the dynamics and the implications of the model, and the last section concludes.

Two perceptions of the liquidity preference problem

The analysis presented in this paper considers two perceptions concerning the conduction of monetary policy in a context of *traps*. The first one, the deflation trap, regards the deflationary process as a consequence of agents' expectations about future prices. The second one corresponds to the liquidity trap, which results in the lack of effectiveness of monetary policy to promote economic recovery.[3] With regard to the liquidity trap, and due to the fact that the approaches shown by Krugman (1998) and Kregel (2000) are relevant for the development of this work, these analyses are stressed.

According to the Hicksian approach, the liquidity trap and then the lack of effectiveness of monetary policy are related to the shape of the LM

[3] For an analysis on developments concerning the liquidity trap concepts, see Boianovsky (2004).

curve (which represents the equilibrium of the monetary market). The fact that the LM curve is horizontal shows the weakness of monetary policy. The idea is that an attempt to raise the money supply will not succeed. In brief, the demand for money becomes extremely (infinitely) elastic with respect to the interest rate.

Another approach for the liquidity trap problem, where the role of credibility matters, is offered by Krugman (1998). Based on the "rules rather than discretion" literature, there is a difficulty in finding a commitment technology which assures a second-best result. In this view the liquidity trap problem may emerge due to a constraint imposed by the conduction of monetary policy in the search for credibility by central banks. Therefore, the success of monetary policy in counteracting the liquidity trap depends on the low level of monetary authorities' credibility in order to ensure the commitment to price stability.[4] Kregel (2000) stresses that the liquidity trap occurs because the central bank is unable to make agents (with rational expectations) believe that it is possible to keep an expansionist monetary policy that is able to pledge a high inflation rate in the long term. Thus, the lack of credibility is not related to the inflationary/deflationary policy, but to the difficulty of managing a credible interest rate policy.

According to the Keynesian view, the liquidity trap problem emerges when the interest rate (expected by investors) is increased above the current interest rate; however this increase is not sufficient to reduce the preference for holding money. Hence, the liquidity trap depends on the expectations about future prices of bonds as well as the volatility of return rates. Considering a highly volatile environment, the use of the interest rate to affect the demand for money becomes less efficient. As Kregel notes (2000, p. 55):

> […] even if investors have perfect confidence in the central bank's ability to increase the rate of inflation, the existence of a zero bid rate means that there is a zero probability of a further fall in short rates, making the expected value of the change in short rates positive. As long as there is a uniform market expectation that interest rates would rise by more

[4] Krugman's argument is based on the idea developed by Fisher (1930) regarding the intertemporal choices of the agents.

than the square of themselves, the expectation is that long rates will rise by more than this and the failure of the economy to respond to monetary policy will remain (although the actual existence of a liquidity trap could only be confirmed if the Central Bank did attempt to influence long rates).

Therefore, in a situation of lack of credibility with agents presenting high liquidity preference, the monetary policy is incapable of changing agents' expectations in relation to a fall in prices. Given the difficulty of managing monetary policy under this environment, fiscal policy is asked to assume the responsibility for disassembling the trap.

Some Post Keynesians (like Kregel, 2000) believe that the open market policy represents a sufficient and a capable strategy to promote the recovery of the economy. Nevertheless, according to Sicsú (2001) this approach neglects the expectational dynamics. When the lessons extracted from the concepts of reputation, credibility and efficiency are embodied into the framework, there is an improvement in the analysis. The results become different and much more interesting because the liquidity preference function may also shift when monetary authorities announce their intentions.

In order to find the empirical link between deflation and recession, and how monetary and fiscal policies should be conducted in a liquidity trap (or a near zero nominal interest rate) situation, some authors have focused their attention on the most recent case observed since the great depression –the Japanese case. Although some economists as Krugman (1998 and 2000) and Svensson (2003) defend the idea that Japan experienced a liquidity trap situation, other authors like Hetzel (2003) argue that there is no evidence for a liquidity trap in Japan. Notwithstanding, what really matters is the fact that the Bank of Japan faced real difficulties in helping the economy to escape from a situation where: i) the nominal interest rate was almost zero, ii) the price movements (deflation) did not response to monetary actions, but did react mostly to the inflation expectations, and iii) the effects of expected deflation could be considered one of the main causes for a decline in consumption and, consequently, in output, when nominal interest rate comes closer to its lower bound.

The following sections consider the use of fiscal policy as a strategy to eliminate the liquidity trap problem. It is important to note that the model is an attempt to fill a gap in how micro decisions are affected in a context of liquidity and deflation traps based on a Keynesian perspective.

Producer behavior

The following assumptions show how a fall in autonomous aggregate demand creates a fall in the general price level which in turn deepens the initial recession, thus: i) economic agents maximize utility and profits; ii) markets for products are monopolistically competitive and markets for factors are perfectly competitive; iii) prices are perfectly flexible, and iv) the liquidity preference behavior is a response to the agent's expectations regarding prices and uncertainty about future business.

The model considers a representative producer of a typical good (j) that uses an amount of individual work (L_j) and capital (K_j) for its production (Q_j).[5] Hence, the individual's production function is

$$Q_j = K_j + L_j \qquad [1]$$

where K_j is a positive constant.[6]

It is assumed that the individual can buy goods or bonds. According to the model, the individual considers (when deciding what and how many of it to buy) expectations for the aggregate price level. Individual's purchasing parity is divided between goods and bonds. In this sense, α (where $0 < \alpha < 1$) is a parameter of speculation that defines the amount of real income (P_jQ_j/P) that is used in consumption, otherwise $(1 - \alpha)$ is applied in short-term government bonds. Therefore, an individual's consumption is

[5] Since a monopolistically competitive market for products is assumed, the use of a representative producer model does not mean that it represents a one-commodity world.

[6] The assumption about capital being constant is justified by the microeconomic concept of short term, in which at least one of the factors is held constant.

$$C_j = \alpha \frac{(P_j Q_j)}{C} \quad [2]$$

where P_jQ_j is the revenue.

Since deflation expectation postpones the consumption of goods, because the individual hopes to buy at lower prices in the future, the parameter of speculation depends on expectations for future prices (P^e),

$$\alpha = \omega + \phi P^e \quad [3]$$

where ω is a positive constant and $\phi > 0$.

The relation between α and the expected price is important. It clarifies that households decide how much to consume and how much to save based on the exogenous parameter ω and on the possibility of speculating regarding the variations in the price of the consumption good (P^e). In other words, if the individual expects a fall in price, part of current consumption is postponed, consequently he holds more money and the parameter of speculation is reduced.

Utility depends positively on consumption (constant marginal utility) and negatively on the amount of work (increasing marginal disutility), thus

$$U_j = \left\{\alpha \frac{P_j(K_j + L_j)}{P}\right\} - \frac{1}{\gamma} L_j^{\gamma}, \text{ with } \gamma > 1 \quad [4]$$

The agent chooses L_j to maximize utility taking P_j and P as given. The first-order condition is

$$L_j^* = \left(\alpha \frac{P_j}{P}\right)^{\frac{1}{\gamma - 1}} \quad [5]$$

$$Q_j^* = K_j + \left(\alpha \frac{P_j}{P}\right)^{\frac{1}{\gamma - 1}} \quad [6]$$

According to equations above, the individual's labor supply (L_j^*) and the amount of output (Q_j^*) that maximizes utility are increasing due to the relative price and to the parameter of speculation.

However, the amount produced by the firm is not exclusively determined by the amount of labor supplied and capital, it is also determined by the expected demand. To understand how prices and the amount of output are affected by expectations and thus the liquidity preference behavior, the following developments concerning the firm behavior are presented.

The model assumes that the firm maximizes profits and produces based on its expectations in a market of monopolistic competition. Moreover, the expected general price index (P^e) is considered when nominal wages (W) are determined by a barter process between labor unions and firms ($\partial W/\partial P^e>0$). In addition, unions give relevant weight to the maintenance of real wage. Hence, $\partial^2 W/\partial(P^e)^2 = 0$.

Since agents compare the current price of the good with the expected general price index, the demand for a specific good is a function of the ratio between these prices, as well as of income (Y),

$$Q_j^d = \left(\alpha \frac{P_j}{P^e}\right)^{-\eta} Y \qquad [7]$$

where η is the price-elasticity of demand parameter.

Considering that the firm follows the profit maximization rule, its goal becomes

$$Max.\ \Omega = Max.\ P_j Q_j - W L_j \qquad [8]$$

Substituting [7] and [1] in [8], the profit maximization is in relation to Q_j. Thus, [8] becomes:

$$Max\ \Omega = Max\left(\frac{(P^e)^{\eta} Y}{Q_j}\right)^{\frac{1}{\eta}} Q_j - W(Q_j - K_j) \qquad [8a]$$

Therefore, the amount that the firm will produce is:

$$Q_j = \left[\frac{\left(1 - \frac{1}{\eta}\right) P^e Y^{\frac{1}{\eta}}}{Q_j} \right]^{\eta} \qquad [9]$$

The equation above denotes that when expectations for the price index increase (decrease), the amount produced also increases (decreases). Furthermore, the impact of expectations on future prices has an influence on nominal wages and on the firm's output.

In order to understand the behavior of the general price index and the path of the economy in the analysis, it must be stressed how expectations may affect the profit maximizing price determined by the firm. Substituting equation [9] in equation [7] and solving for the price determined by the firm, the result shows that the price follows the demand and the costs of the firm, expressed, respectively, by the elasticity parameter and by wages, as equation [10] shows:

$$P_{jt}^{*} = \left[\frac{W_t}{\left(1 - \frac{1}{\eta}\right)} \right] \qquad [10]$$

As the firm uses capital and labor factors to produce its good and follows the profit maximization rule to determine the amount of goods produced, the equilibrium is a result of the solution found for the profit maximization problem put together with the solution for the utility maximization problem. Therefore, from [6] and [9], equation [11] represents this equilibrium,

$$K_j + \left(\alpha \frac{P_j}{P}\right)^{\frac{1}{\gamma - 1}} = \left[\frac{\left(1 - \frac{1}{\eta}\right) P^e Y^{\frac{1}{\eta}}}{W} \right]^{\eta} \qquad [11]$$

Assuming symmetric information among producers, each producer considers that $P_j = P$. Consequently, the aggregate real income can be written as:

$$Y = \left(K_j + \alpha^{\frac{1}{\gamma-1}}\right)\left[\frac{W}{\left(1-\frac{1}{\eta}\right)P^e}\right]^{\eta} \qquad [12]$$

Which in turn, in a dynamic form, is given by

$$\dot{Y} = \left[\frac{W}{\left(1-\frac{1}{\eta}\right)P^e}\right]^{\eta-1}\left[\dot{\alpha}\left(\frac{1}{\gamma-1}\right)\alpha^{\frac{\alpha-\gamma}{\gamma-1}}\frac{W}{\left(1-\frac{1}{\eta}\right)P^e} + \left(K_j + \alpha^{\frac{1}{\gamma-1}}\right)\eta\left(\frac{\dot{W}P^e - W\dot{P}^e}{\left(1-\frac{1}{\eta}\right)(P^e)^2}\right)\right] \qquad [13]$$

Assuming that the labor unions have the ability to keep real wages constant, *i.e*, $\dot{W}/W = \dot{P}^e/P^e$, then $\dot{W}P^e = W\dot{P}^e$. Therefore, the equation above can be reduced to:

$$\dot{Y} = \left[\frac{W}{\left(1-\frac{1}{\eta}\right)P^e}\right]^{\eta-1}\left[\dot{\alpha}\left(\frac{1}{\gamma-1}\right)\alpha^{\frac{\alpha-\gamma}{\gamma-1}}\frac{W}{\left(1-\frac{1}{\eta}\right)P^e}\right] \qquad [13a]$$

In order to simplify, non-dynamic terms will be expressed as h,

$$\left[\frac{W}{\left(1-\frac{1}{\eta}\right)P^e}\right]^{\eta-1}\left[\left(\frac{1}{\gamma-1}\right)\alpha^{\frac{\alpha-\gamma}{\gamma-1}}\frac{W}{\left(1-\frac{1}{\eta}\right)P^e}\right] = h$$

then, equation [13a] can be written as

$$\dot{Y} = h\dot{\alpha} \qquad [14]$$

Therefore, equation [14] shows that output is directly affected by price expectations. In other words, it reveals that in the case of deflationary expectations, aggregate real income will decrease in time.

Liquidity preference

The objective of this section is to analyze the effect of liquidity preference on the spiral of deflation-unemployment taking into account agents' expectations. The justification is that an increase in liquidity preference, due to a fall in aggregate demand, causes another reduction in demand, creating a spiral of deflation-unemployment which in turn deepens the initiated recession. In this sense, the model begins with the equilibrium in the money market:

$$\frac{M^S}{P} = M^D \qquad [15]$$

where: M^S is the nominal money supply; which it is considered constant, $M^S = \bar{M}$, and M^D is the real money demand.

In this model, the money demand is divided into two motives: transactions (M_T^D) and speculative (M_S^D):

$$M^D = M_T^D + M_S^D \qquad [16]$$

Transaction motive for holding money is a function of: the consumption spending (C), the investment spending (I), general price index (P), and the government expenditures on goods and services (G):

$$M_T^D = f_1(C, I, P, G) \qquad [17]$$

where: $\partial f_1/\partial C > 0$, $\partial f_1/\partial I > 0$, $\partial f_1/\partial P > 0$ and $\partial f_1/\partial G > 0$.

Government spending is divided into current spending and capital spending:

$$G = G_c + G_k \qquad [18]$$

Equation [18] follows the idea in Keynes concerning the active fiscal policy. In this view, government should prepare two fiscal budgets, one for

ordinary activities of the public administration (which according to Keynes should always be on balance) and the other for government discretionary spending. Capital spending or the discretionary budget may be considered as the available fiscal lever whose capacity is to push the economy to a more prosperous situation through aggregate demand. This budget would cover investment activities that could be accelerated or decelerated based on the general conditions of the business cycle. What really matters is how much is spent and not the deficit, a well-implemented leading action in this manner may have the power to influence private agents' expectations concerning future business, thus reducing uncertainty. Capital spending is the result of investment projects that government implements when it deems necessary.

Therefore, the function which represents the transaction motive for holding money can be expressed as:

$$M_T^D = a_1 C + a_2 I + a_3 P + a_4 G \qquad [17a]$$

with $a_1, a_2, a_4 > 0$ and $a_3 = 1$.

The minimal transaction demand for money ($M_{T\min}^D$) is given by the autonomous consumption ($\overline{C}$) and the current government spending (G_c):

$$M_{T\min}^D = \overline{C} + G_c \qquad [17b]$$

The model assumes that speculative motive for holding money is a function of price expectations (P^e), uncertainty (Ψ),[7] and real interest rate (r). The

[7] Uncertainty is associated with the expected profitability of the investment projects and it follows two perspectives. The first one, uncertainty is defined "as a situation in which knowledge, due to paucity of evidence, is incomplete and unreliable as a guide to conduct. Uncertainty then implies the absence of a fully reliable probability distribution. In its strongest sense, uncertainty implies indeterminacy of the future, as the future is yet to be created by people's decision." (Dequech, 1999b, pp. 67-68); the second one, fundamental uncertainty "refers to situations in which at least some essential information about future events cannot be known at the moment of decision because this information does not exist and cannot be inferred from any existing data set." (Dequech, 1999a, pp. 415-416) Indeed, fundamental uncertainty does not need to imply complete ignorance regarding all aspects of the future, although it does concern relevant events for the decision making process.

justification for the relation between speculative demand for money and real interest rate is a result of the comparison between the effects of bonds' returns combined to the price expectations and the expected profitability of current investment decisions. This motive for holding money depends on agents' ability to form expectations regarding real and financial returns, which in turn implies that both are determined by future changes in prices. Therefore, the speculative demand will increase if the general price index is expected to fall implying a speculative behavior (part of consumption is postponed). In other words, if a fall in prices is expected, the coherent behavior is one of holding money because it allows profitable business in the future. It is important to highlight that there is no guarantee for good business for everyone in the future (there may be a lack of desired goods). Therefore, uncertainty is linked to future business as much as it is to future prices, thus,

$$M_S^D = f_2(\Psi, P^e, r) \qquad [18]$$

$$M_S^D = b_1\Psi - b_2P^e - b_3r \qquad [18a]$$

with $b_1, b_2, b_3 > 0$.

Since a fall in the nominal interest rate is proportional to a fall in prices, there will be no incentive to change the portfolios because $\dot{r} = \dot{i} - \dot{P} = 0$. Although the nominal supply of money is controlled by the monetary authority, when the general price index falls, real money balances increase, which in turn reduces the nominal interest rate, keeping the real interest rate constant. This assumption is useful because it neutralizes the consequent impacts caused by the real interest rate upon investment decisions. Hence, the negative effects on investments, in a deflationary environment, are eliminated under the hypothesis that the real interest rate is constant. If this is not considered, and the nominal interest rate is constant, a deflationary environment will imply an increase in the attractiveness for bonds and it will be another impulse pushing the economy towards a recession with deflation.

Indeed, when the economy is in a liquidity trap situation with deflation and the nominal interest rate has reached a limit –and if this limit is zero,

i.e, a constant nominal interest rate– the real interest rate will be no longer kept constant. In this case, investments will be negatively affected. It does not matter whether agents allocate their resources in bonds or money. Resources are not slipping away to the productive scope, and thus a case where monetary policy has lost its effectiveness has been created.

In this model the Keynes effect (the decrease in nominal wages as a mechanism for investment incentives) does not work. The Keynes effect may be described in the following sense: it is expected that an economy with involuntary unemployment leads to a fall in nominal wages and, consequently, in prices. This result would imply a reduction in transaction motive for holding money even if the supply of money is constant. As a consequence, real money balances would increase thus decreasing the real interest rate and fomenting investment. However, a deflationary environment with or without liquidity trap will not work. With respect to the latter (without), the assumption of a constant real interest rate guarantees that the effect does not work, *i.e*, as the real interest rate does not change, there is no incentive to change investments. With respect to the former (with) the nominal interest rate has already reached a minimum limit. Notwithstanding, the real interest rate is increasing thus implying a negative effect on investments. Moreover, the classical quantitative theory will not work given the agents' expectations and the liquidity preference behavior.

Aggregate demand

Considering a closed economy with government, the aggregate demand can be expressed by the following equation in real terms:

$$DA = C + I + G \qquad [19]$$

Aggregate consumption is explained by an autonomous parameter (the autonomous consumption, C_0) and by the available income that is given by the difference between income (Y) and the sum of taxes (T), and the present value of public bonds, $B(1 + i)$, thus:

$$C = C_0 + C_1[Y - T + B(1 + i)] \quad [20]$$

where, $0 < C_1 < 1$.

In this analysis the fact that the government is concerned with the budget equilibrium is considered. Thus, the present value of public bonds is equivalent to the tax charge.[8] Therefore, equation [20] can be reduced to

$$C = C_0 + C_1 Y \quad [20a]$$

It is important to note that the propensity to consume plays a double role in the model. Through the supply side (α –parameter of speculation– in equation [3]) an increase in price expectations is associated with an increase in the agent's utility (equation [4]) and an increase in optimum labor supply (equation [5]), and thus, with an increase in the output (equation [6]). On the side of demand, the effect of an increase in price expectations also increases the propensity to consume and consequently provokes an increase in aggregate consumption, which in turn, implies an expansion in aggregate demand compatible with that observed in aggregate supply.

As the real interest rate is fixed in the model, only uncertainty (Ψ) and the expected level of prices (P^e) are capable of affecting the investment. Uncertainty, in this case, is associated with the expected profitability of investment projects. Besides, when entrepreneurs expect a fall in prices, there is a tendency to postpone investments, increasing the liquidity preference. Therefore,

$$I = f_3(\Psi, P^e) \quad [21]$$

where, $\partial f_4/\partial \Psi < 0$ and $\partial f_4/\partial P^e > 0$.

Taking into consideration equation [18a], aggregate investment may be written as:

[8] Since fiscal policy is important for the economic recovery through government capital spending (G_k), the funding of government deficits is made by the issue of bonds, which leads the government to raise tax avoiding deficits acceleration.

$$I = I_0 - \lambda(b_1\Psi - b_2P^e) \quad [22]$$

where, I_0 is a positive constant.

Based on equation [22] and assuming that the real interest rate is constant, it is possible to establish a functional relation between the above equation and the speculative demand for money (equation [18a]). In both cases, uncertainty and price expectations play an important role. In the case of investment, an increase in uncertainty contributes to a reduction in that investment. On the other hand, expectations that prices are increasing imply an increase in investment. The relation of the speculative demand for money and investment occurs due to the effect caused by the transactional demand for money. When uncertainty increases (decreases) and/or price expectations decrease (increase), the speculative demand tends to increase (decrease), thus, there is a decrease (increase) in transactional demand, which in turn implies a decrease (increase) in investment.

Substituting [20a] and [22] in [19], and considering that equilibrium is given by ($Y = DA$), one finds:

$$Y = \left[\frac{1}{1 - C_1}\right](C_0 + I_0 + G - \lambda b_1\Psi + \lambda b_2P^e) \quad [23]$$

Furthermore, considering $\left[\frac{1}{1 - C_1}\right] = \beta$; $\lambda b_1 = \varphi$; $\lambda b_2 = \mu$; then [23] becomes:

$$Y = \beta(C_0 + I_0 + G - \varphi\Psi + \mu P^e) \quad [23a]$$

Deriving equation [23a] in relation to time, the equation reached is the one that describes the dynamics of output,

$$\dot{Y} = \beta\dot{G} - \beta\varphi\dot{\Psi} + \beta\mu\dot{P}^e \quad [24]$$

Although uncertainty (Ψ) is defined independently of P^e, both variables move in opposite directions: for instance, when P^e falls, the agents postpone

their purchases, reducing aggregate demand. If aggregate demand gets lower and lower, future business becomes more uncertain, causing an increase in Ψ. Thus, both contribute to the decrease in the level of output. In fact, there is a link between the movements of these variables that could justify a functional dependence between them allowing the introduction of only one in the argument; thus, Ψ can be omitted in order to simplify equation [24] without damaging the analysis. In this manner, equation [24] may be written as,

$$\dot{Y} = \beta\dot{G} + \beta\mu\dot{P}^e \qquad [25]$$

The lack of variation in government spending ($\dot{G} = 0$) and a fall in income (due to a fall in autonomous investment, for instance) imply a decrease in consumption, which in turn create expectations of falling prices and an increase in uncertainty (this result increases the speculative motive for holding money, as equation [18a] states). On the other hand, the fall in prices implies a decrease in the transaction motive for holding money which reinforces the increase in the speculative motive for holding money thus decreasing investments, implying, as a consequence, a fall in the level of the output. A fall in autonomous investment, for instance, starts a process of continuous falling in the level of output.

The speculative motive for holding money has a fundamental role for the determination of output. It is important to make clear that the liquidity preference is not only revealed by the amount of money held, but also by extreme liquidity assets held by economic agents. In this way, the speculative motive for holding money may be understood as a *mix* of money and high liquidity assets that the agents keep.[9] According to this, it is important to emphasize two distinct situations concerning the liquidity preference:

Case 1: $lim\ Y_t = C + I + G$ (reduced liquidity preference)
$M_S^D \rightarrow 0$

[9] An example of this case is the M2 aggregate.

Case 2: $lim\ Y_t = \bar{C} + G_c$ (increased liquidity preference)
$M_S^D \rightarrow \theta$

where: $\theta = (M^S/P) - M_{T\min}^D$.

These cases represent, respectively, the ceiling and the floor for the output level of the economy. Case 2 shows that the greater part of money demanded is due to the speculative motive rather than to the transaction motive. As a consequence, output will be at the lowest level because the money demanded, according to the transaction motive, will be the minimum to still keep the economy working.

Equilibrium and implications

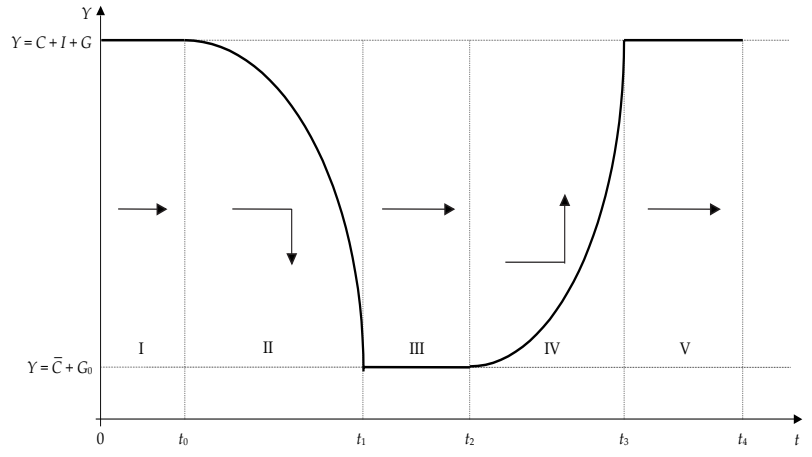
Based on equations [14] and [25], the dynamic for the parameter of speculation is given by,

$$\dot{\alpha} = \frac{\beta}{h}(\dot{G} + \mu\dot{P}^e) \qquad [26]$$

The equation above plays a crucial role in the dynamics of output. Figure 1 describes, in phase I, the path of output when the speculative motive for holding money tends to zero (the limit case 1). Phase II will start if, for instance, autonomous investment falls, implying a continuous fall (at an increasing rate) in output until the limit indicated by case 2 is reached. The path described by phase II starts with an autonomous decline of aggregate demand, implying a reduction in the general price index and the consequent reversion of agents' expectations, whose reaction is the postponement of consumption decisions. Since the parameter of speculation is a function of expected aggregate price level, the consequence is a decrease in transaction motive for holding money by the same amount that speculative motive increases. Thus, there is an increase in liquidity preference. In summary, phase II represents a period with a spiral of deflation-unemployment.

In the absence of any change in autonomous spending, the economy would leave phase II and it would enter phase III (depression case), which is a phase with full liquidity preference indicated by the case 2 limit. Since in economic depression an increase in autonomous investment due to high uncertainty is not expected, then phase IV will start only if the government makes an expansionist fiscal policy. This political decision (denoted by G) starts a process of recovery of the output that will increase continuously (at an increasing rate) until the limit indicated by case 1 is reached, causing the output to enter phase V. The justification for this is that G is a component of aggregate demand, *i.e.*, when G increases there is a tendency for the general price index to increase, thus causing in its turn an expectation that prices will increase reducing liquidity preference (an increase in the speculative parameter). In phase IV, the transaction motive for holding money would increase by the same amount that precautionary motive would decrease, implying a decrease in liquidity preference. Contrary to phase II, phase IV represents a spiral of inflation-employment. Phase V is equivalent to phase I and shows path of the output after phase IV is finished.

FIGURE **1**
Output phases



Based on equations [27] and [28] below, for each of the phases described by the figure above, the analysis about the output-path is made.

$$P_t^e = P_{t-1} + \tau(Y_t - Y_{t-1}) \quad [27]$$

$$P_t = P_{t-1} + \rho(Y_t - Y_{t-1}) \quad [28]$$

Theorem 1. When the economy is in phases I and V (which represent reduced liquidity preference), and also in phase III (which denotes increased liquidity preference) there is no variation in output.

Proof: Considering equations [27] and [28], when the following differences ($Y_{t0} - Y_0$, $Y_{t2} - Y_{t1}$ and $Y_{t4} - Y_{t3}$, which represent phases I, III and IV respectively) are equal to zero and $\dot{G} = 0$, thus $P_{t0} = P_0$, $P_{t1} = P_{t2}$ and $P_{t3} = P_{t4}$, implies $\dot{P}^e = 0$. Therefore, according to equations [14] and [26] it is found that $\dot{Y} = 0$ is valid for the intervals $(0, t_0)$, (t_1, t_2) and (t_3, t_4).

Theorem 2. A fall in autonomous aggregate demand implies an increase in liquidity preference which in turn promotes a decrease in output (phase II).

Proof: Given $\dot{G} = 0$ and considering an autonomous aggregate demand reduction, where, $Y_t < Y_{t-1}$ or $Y_t - Y_{t-1} < 0$, it is shown that $P_t^e < P_{t-1}$, $\forall t$ between t_0 and t_1, implying $\dot{P}^e < 0$ and, thus, by equations [14] and [26] that $\dot{Y}|_{t0,\,t1} < 0$. Therefore, $\dot{Y}$ is a decreasing function for the (t_0, t_1) interval.

Since it is assumed that agents' expectations regarding a fall in prices are increasing, equation [26] allows that:

$$\frac{\beta}{h}(\ddot{G} + \mu\ddot{P}^e) < 0$$

since $\dot{G} = 0, \Rightarrow \ddot{Y}|_{t0,\,t1} < 0$.

Hence, $\ddot{Y}$ is a function whose concavity is turned down in this phase.

Theorem 3. The use of an expansionist fiscal policy promotes a decrease in liquidity preference which in turn implies an increase in output (phase IV).

Proof: Using equation [25], which represents the composition of output at a given moment, it is possible to observe that an increase in government spending, *ceteris paribus*, implies an increase in output for the next moment. Thus, an increase in government capital spending is capable of creating an expectation for rising prices which will continue as time passes. This observation allows the use of equation [26] to explain the path of output in phase IV. Considering that in t–1 the government implemented a positive variation on spending, then: $\Delta G > 0 \Rightarrow Y_t > Y_{t-1}$. Therefore, analogous to the demonstration for phase II, it is observed that $P_t^e > P_{t-1}$, $\forall t \Rightarrow \dot{P}^e > 0$. As a consequence, $\dot{Y}|_{t2,\, t3} > 0$, thus $\dot{Y}$ is an increasing function in the interval (t_2, t_3).

Likewise, it is admitted that due to an increase in government spending, and thus an increase in output, the economic agents expect that prices will continue to increase. Hence, equation [26] implies that,

$$\frac{\beta}{h}(\ddot{G} + \mu\ddot{P}^e) > 0$$

since $\dot{G} = 0 \Rightarrow \ddot{Y}|_{t0,\, t1} > 0$.

Therefore $\ddot{Y}$ is a function whose concavity is turned up in this phase.

Concluding remarks

The analysis here presented considers agents taking current decisions based on expectations about future events. Hence, when an autonomous decrease in aggregate demand (capable of promoting both reductions in prices and deflationary expectations) happens, economic agents will coherently wait for lower prices in the future and then meet profitable business. Liquidity preference, in this manner, may be explained: i) by the possibility of taking advantage of future negotiations (because agents expect lower prices in the future) and ii) by a situation of liquidity trap with deflation expectations (implying real interest rates each time lower) which discourage the preference for illiquid assets.

The proposed solution for the problem is based on the Keynesian theory. As emphasized by Fazzari, Ferri and Greenberg (1998, p. 527):

> The defining feature of Keynesian economics is that fluctuations in aggregate demand directly affect aggregate employment and output. […] the best way to understand the macroeconomic implications of aggregate demand is to study how changes in aggregate spending directly alter the environment faced by agents who make production and employment decisions.

The findings denote that both decisions (consumption and production) are influenced by expectations and liquidity preference behavior. Expected future prices affect consumption decisions by the speculative parameter due to the effect of the amount produced by the firm and its price. The main result of the model, presented in this article, suggests that waiting for the consequence of the Pigou effect in an economy characterized by flexible prices and flexible wages with liquidity preference of the economic agents is disastrous. This situation is observed by the recessive process in phase II and the locking of the economy in depression (phase III). It is important to note that the government does not need to wait the economy to reach at phase III for adopting an expansionist fiscal policy. Therefore, the results show, according to the Keynesian view, that fiscal policy is an important instrument for stabilizing economies.

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