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Inconsistency of Policies and Oil Shocks: Dynamics According to the Monetary Regime

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Abstract

The main goal of this paper is to analyze the inconsistency between monetary and fiscal policy for an oil economy. In particular, we study the dynamics caused by a permanent oil revenue reduction when fiscal corrections are not implemented and the respective intermediate monetary policy variable is maintained at its original level. We examine the effects of a permanent oil shock under two alternative monetary regimes. These regimes are, according to the election of the intermediate variable, a monetary rule and the exchange rate anchor. For the purposes of our study, we assume a small open economy for which oil constitutes an important source of public revenue. Also, we assume perfect capital mobility, perfect foresight, full employment, and flexible prices. The inconsistency arises with a permanent reduction in oil revenues. In this paper, we offer the following two contributions. First, we show that, under any of the previous monetary regimes, keeping policies at pre-shock levels generates an unstable growth of government indebtedness. This unstable growth causes both the abandonment of the monetary regime and higher future inflation rates. Second, we demonstrate that delaying the implementation of an adjustment program causes increasing inflationary and indebtedness costs.

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1. Introduction

This work analyzes the macroeconomic dynamics originated by the inconsistency between monetary policy and fiscal policy in an economy where oil constitutes an important source of public income. In particular, we study the dynamics generated by a permanent reduction of oil revenue when the required fiscal corrections are not implemented and the central bank maintains the trajectory of its intermediate variable at levels that are compatible with pre-shock oil revenue. The monetary strategies that we included, according to the election of the intermediate variable, are the monetary rule and the exchange rate anchor. We simplify the analysis by using a simple neoclassic model with full employment and flexible prices for a small open economy with capital mobility. This simplification is made to focus on the effect of inconsistent policies on the dynamics of inflation, debt, and real money balances.

Zavarce (1998) studies the case of the exchange rate as an intermediate variable and considers the implementation of capital account controls in an oil economy. He shows that keeping the exchange rule at pre-shock levels in order to maintain a stable rate of inflation, leads to unstable growth of public debt that in turn produces a speculative attack as explained by Krugman (1979).

Our study draws heavily on the work of Auernheimer (1987). He studies the failure of stabilization programs based on exchange rate or monetary anchors considering the key role of the consolidated budgetary restriction of government with the central bank on the process of formation of expectations. Basically, the results that we obtain for the case of an oil economy are variations of the results from Auernheimer (1987). In a small open economy populated with agents with perfect foresight, obtaining an inflation rate smaller than that required to maintain a stable level of national debt, by adopting an exchange rate rule or a monetary rule, can be achieved only temporarily and at a greater rate of future inflation. This result shows that some *unpleasant monetarist arithmetic* characterizes the dynamics generated by inconsistent stabilization programs for a small open economy, as in Sargent and Wallace (1981) and the later works of Liviatan (1984) and Drazen (1985). This result is also present in the case that we examine. Regardless of the monetary regime, fiscal and monetary strategies that are not adjusted after oil shocks bring unstable growth of government net debt. This situation causes the abandonment of the intermediate monetary policy variable resulting in an inflation rate higher than the forecasted one.

We examine the effects of a permanent reduction of oil revenue under unchanged levels of the intermediate monetary policy variable. We study the dynamics of the country's net debt, real money balances, inflation and the price level. Two main conclusions emerge from our study. First, keeping policies at the pre-shock levels to generate a stable inflation rate leads to unstable growth of the indebted position of the public sector that produces both the abandonment of the monetary regime and higher future inflation rates, regardless of the monetary policy regime. Second, delaying necessary changes of the intermediate monetary policy variable causes increasing indebtedness and higher costs of inflation in order to stabilize the debt dynamic.

This paper is organized as follows. Section 2 describes the model and the closings according to the election of the intermediate variable. Section 3 examines the dynamics of the exchange rate and monetary aggregates as intermediate monetary policy variables. Section 4 concludes and offers suggestions for further research.

2. The model

Assume a small open economy that is inhabited by a continuum of identical private agents. Population is normalized to the $[0, 1]$ interval. Time is continuous and all the individuals live forever and have perfect foresight.

There are two types of goods. A constant flow of oil that emerges from the ground, denoted by X_g , is property of the government. Oil, X_g , is not consumed within the economy but is traded with the rest of the world, without restrictions, at a price P_g . Also, private agents produce a constant flow of good y , which also is internationally traded without restrictions at a constant price P_y . For simplicity, P_y is normalized to one. Because of the effects of arbitrage, the exchange rate E equals the price level P , and the rate of inflation \boldsymbol{p} equals the rate of depreciation \dot{E}/E .

For simplicity we assume that the government is a net debtor with a real debt stock b at any time. Private agents are net creditors. They save in real non-monetary financial assets, a , and in real monetary balances, m . The total of the country's net debt, $b-a$, is represented by Ω .

Both private agents and the government can lend and borrow without restrictions in the international financial market at the same interest rate r . However, this interest rate r is subject to the country-risk level that positively depends on Ω , the country's total net debt. Thus, in spite of being a small open economy, the aggregate economy faces a variable real interest rate. However, given the competitive character of the economy, private agents consider that the interest rate is exogenously given when they allocate their disposable income into their portfolio of assets. Thus, private agents tend to excessively borrow because they ignore the effects of their portfolio decisions on the real interest rate.

Following Auernheimer (1987) and Garcia-Saltos (1998), we assume that the real interest rate depends positively on total level of net debt and on the exogenous world interest rate r^* , which is assumed constant. Thus,

$$r = r(r^*, \Omega), \text{ where } r_1 > 0 \text{ and } r_2 > 0. \quad (1)$$

The government spends g , receives income from selling X_g , charges a lump-sum tax T , and pays interests on its debt br . The fiscal deficit, including these payments of interests, is financed by borrowing \dot{b} and the use of seignorage \dot{M}/P . Consequently, the government budget constraint *cum* the central bank can be written as

$$g - T - X_g \frac{P_g}{P_y} \frac{EP_y}{P} + br = b + \frac{\dot{M}}{P}. \quad (2)$$

Equation (2) indicates that the amount of income resulting from oil sales depends upon both the terms of trade P_g/P_y and the real exchange rate EP_g/P_y . To simplify matters, we assume that all private production is freely traded with the rest of the world. Thus we ignore the effect of the real exchange rate on oil revenues in terms of domestic goods. The dynamics of seignorage is given by

$$\frac{\dot{M}}{P} = \dot{m} + m\mathbf{p} = m\mathbf{m}. \quad (3)$$

Equation (3) contains the dynamics of real money balances. Using (3) and (2), we have that the dynamic of government debt is given by

$$\dot{b} = d + br(r^*, \Omega) - m\mathbf{m}. \quad (4)$$

Where d represent the primary deficit. That is $d = g - T - X_g \frac{P_g}{P_y} \frac{EP_y}{P}$.

As usual, households obtain utility from consumption (c) and real money balances (m). We assume an instantaneous utility function that is additively separable in c and m . That is, $U(c, m) = u(c) + v(m)$. Both $u(c)$ and $v(m)$ are strictly concave, twice differentiable, and satisfy the usual Inada conditions. Also, we assume a constant rate of time preference, ρ .

Every period, individuals decide how to allocate their disposable income between consumption and assets accumulation, for a given level of private wealth constituted by monetary assets (m) and non-monetary assets (a). The problem of the representative individual is to maximize the present value of utility. That is,

$$\max_{\{c(t), m(t)\}} \int_0^{\infty} [u(c) + v(m)] e^{-rt} dt \quad (5)$$

subject to

$$\dot{w} = y + wr - c - T - m(r + \mathbf{p}), \quad (6)$$

$$w \equiv a + m, \quad (7)$$

$$a(0) = a_0, \quad (8)$$

and

$$\lim_{t \rightarrow \infty} w e^{-rt} = 0. \quad (9)$$

Note that condition (9) rules out the possibility of unlimited wealth accumulation. Appendix 1 contains a detailed solution for the representative individual's maximization problem.

Aggregating across individuals, and considering the assumption of an additively separable utility function, the first order conditions for maximization are reduced to

$$\dot{c} = \frac{u'}{u} \left[\mathbf{r} - r(r^*, \Omega) \right] \quad (10)$$

and

$$v'(m) = u'(c) \left[r(r^*, \Omega) + \mathbf{p} \right]. \quad (11)$$

From equation (11), we derive the money demand function, which plays a fundamental role in our analysis. Thus, assuming that the money market clears instantaneously, we have

$$m = l(c, i), \quad (12)$$

where i is the nominal interest rate defined as $i \equiv r + \mathbf{p}$ and $l_1 > 0$ and $l_2 < 0$.

In addition, by using equations (2), (3), and (6), we obtain the following expression that shows the country's balance of payments identity,

$$\dot{\Omega} = (c + g - y - X_g P_g) + \Omega r(r^*, \Omega). \quad (13)$$

Note that the right hand side of (6) constitutes the current account deficit whereas the first term in parenthesis shows the trade balance deficit. Thus, current account deficits increase the aggregate of the country's net debt.

The solution to the overall aggregate system is obtained as follows. First, equations (10) and (13) determine consumption and the aggregate of the country's net debt. Second, the behavior of inflation, the rate of monetary expansion, and the rate of growth of real money balances are obtained from equations (3) and (11), considering both the monetary regime and maximum level of sustainable debt. Third, the path of government debt is obtained from equation (4) after determining the path of π , the rate of monetary expansion, and the rate of growth of real money balances.

In the three following subsections, we describe completely the behavior of the economy. In these sub-sections, we examine the dynamics of consumption and the country's net debt and explain the existence of a maximum level of sustainable debt. In addition, we define inconsistency of policies and study the behavior of key monetary variables under each of the two alternative regimes that are considered.

2.1 Dynamic of consumption and the country's net debt

We derive the paths of consumption and the country's net debt from equations (10) and (13). Assuming that the equilibrium paths of government expenditure, taxes, and oil revenues are given, we have¹

$$r\left(r^*, \tilde{\Omega}\right) = \mathbf{r}, \quad (14)$$

$$\tilde{c} = y + X_g P_g - \tilde{\Omega} \mathbf{r} - g. \quad (15)$$

As shown by both the appendix and figure 1, the behavior of the non-oil sector is characterized by a saddle path for c and Ω . The behavior of the economy outside the long-run equilibrium and on the path can be understood by analyzing the effects of an unanticipated increase in the country's net debt caused by an exogenous increase in government debt. When, the country's net debt increases, the country risk increases causing an increase in the real interest rate charged to both the government and private agents. A real interest rate greater than the rate of time preference, causes a decrease in present consumption that allows a higher net accumulation of assets in the future. This greater net accumulation of assets in the future leads to increasing future consumption levels as shown by trajectory 2 in figure 1. As the private sector accumulates assets and the real interest rate decreases, the consumption growth rate decreases until the system reaches point 1 again.

2.2 Inconsistent policies, limit for the inflationary tax, and solvency

The trajectory of b that satisfies equation (4) must satisfy the Non-Ponzi game condition given by

$$\lim_{t \rightarrow \infty} e^{\int_0^t r(r^*, \Omega) dz} b(t) = 0 \quad (16)$$

In equilibrium, equation (14) is satisfied. Consequently, by integrating equation (4) and using (16), we obtain the long-run debt level is equal to

$$\tilde{b} = \frac{\mathbf{m}\tilde{m} - d}{\mathbf{r}} = \frac{\mathbf{p}\tilde{m} - d}{\mathbf{r}} \quad (17)$$

¹ A tilde (~) over a variable denotes the equilibrium value for that variable.

where \tilde{m} and \tilde{b} represent the equilibrium levels of real money balances and government net debt, respectively. Equation (17) establishes that the long-run debt level is equal to the present value of the government surpluses including revenue from the inflationary tax $\mathbf{p}m$ that equals the level of seigniorage in equilibrium. Therefore, fiscal solvency exists if the trajectory of b that satisfies equation (4) also satisfies equation (17) with a finite value of long-run debt that satisfies equation (17) too. After defining fiscal solvency, we can define inconsistent policies. The mix of fiscal and monetary policy is inconsistent if the government net debt grows without limits given a monetary strategy that determines both the inflationary tax π and the exogenous components of the primary fiscal deficit.

Note that a permanent increase in the primary deficit that increases government net debt without limits is inconsistent with the monetary strategy. This is because it is impossible to finance the fiscal deficit and the interests on the debt, $d + br$, with inflationary tax income in the long run. A government indebtedness crisis emerges when a maximum level of debt constraints the explosive trajectory of b .

How can the indebtedness crisis be solved?

Assuming that the instantaneous utility function $u + v$ allows for a maximum level of inflationary tax income², the central bank abandons the monetary strategy by changing or redefining the intermediate variable when \bar{b} reaches a maximum level \bar{b} so that the maximum level of inflationary tax income satisfies equation (17). The following expression shows this situation formally:

$$b(\bar{r}) = \max b = \frac{1}{\mathbf{r}} [\max_p (\mathbf{p}l(\bar{c}, \mathbf{p} + \mathbf{r})) - d]. \quad (18)$$

At the time when the central bank modifies the monetary strategy, government debt is stabilized at $\max b$. The rate of monetary expansion equals the inflation rate that maximizes the inflationary tax collections, that is commonly called Cagan's revenue-maximizing inflation rate. In this manner, adjusting the inflation tax solves the indebtedness crisis.

3. Inconsistency of policies

For our analysis of the outcome of inconsistent policies, we assume that in a neighborhood of the initial equilibrium the inflation rate is lower than Cagan's revenue-maximizing inflation rate. Later in this section, we will see that a permanent reduction in oil revenues causes a

² In general, the class of utility functions that has a Cagan maximum level of revenues are of type

$$v = \frac{m^{1-s}}{1-s} \text{ donde } \mathbf{s} = -v'' \frac{m}{v'} \in [0,1] \text{ o } v = (\mathbf{a} - \mathbf{b} \ln m) m$$

reduction in the demand for money. This reduction in the money demand can be produced by two different sets of circumstances. First, the reduction can be due to a fall in consumption and a discrete decrease in real money balances via capital flight or foreign exchange sales by the central bank. That is, a discrete fall in b when the exchange rate is the intermediate variable. Second, the money demand reduction can be due to a decrease in consumption and a jump in the price level when the exchange rate is flexible and M is continuous. Since in both of the previous cases, seigniorage $m\mathbf{m}$ falls, government debt increases without limits to finance the after-shock fiscal deficit level. This unlimited government debt growth makes the monetary program inconsistent with the fiscal stance. Under these circumstances, we say that the monetary and fiscal policies are incompatible and that coordinating them is not feasible.

Finally, note that each monetary policy regime is constituted by a particular set of equations that determines the dynamics of the relevant monetary variables. In the next section, we study the inconsistency of policies under two alternative monetary regimes: the exchange rate rule and a monetary rule.

3.1 Inconsistency of policies under the exchange rate rule

Under this monetary regime, the exchange rate is the variable controlled by the monetary authority. The central bank announces at $t = 0$ that it will intervene in the exchange market to maintain a continuous path of the exchange rate, such as

$$E(t) = E(0)e^{pt}. \quad (19)$$

Note that p is the rate of devaluation of the exchange rate that is equal to the inflation rate in this model. Remember that because of the effects of arbitrage in the market for goods, the exchange rate equals the price level and the inflation rate equals the rate of devaluation. Also, remember that under the exchange rate rule, the behavior of the nominal money stock is endogenous. Notice that for a given rate of devaluation, the commitment to keep a continuous path of the exchange rate prevents the monetary authority from implementing once-and-for-all devaluation or any other discretionary exchange rate adjustments. Devaluations may eliminate the problem of inconsistent policies since they may reduce the level of government indebtedness. Auernheimer (1987) argues that the implementation of the exchange rule is vulnerable to credibility/reputation problems, as explained by the literature on *time inconsistency*.

The behavior of inflation, real money balances, and government debt

In aggregation, real money balances are piecewise continuous since both consumption and the real interest rate are piecewise continuous. Thus, the equations describing the behavior of inflation, real money balances, and government debt are the following:

$$\mathbf{p} = \frac{\dot{E}}{E}, \quad (20)$$

$$\dot{v}(m) = u'(c) \left[r(r^*, \Omega) + p \right], \quad (21)$$

$$\dot{m} = 0, \quad (22)$$

$$\dot{b} = d + br(r^*, \Omega) - pm \quad (23)$$

The effects of a permanent oil revenue reduction

Let us assume that the system is initially in steady state equilibrium where $r = \mathbf{r}$, $\mathbf{m}_0 = \mathbf{p}_0$, all the state variables are in equilibrium, and the level of government net debt satisfies equation (17). Assume now that oil revenues fall permanently and, at that time, the monetary authority announces that the exchange rule will be maintained at the pre-shock level and that discrete changes in the level of the exchange rate will not be allowed. These results are shown in Figure 3. At the time of the shock, consumption falls from c_0 to c_1 . At the new equilibrium, the country's net debt level remains unchanged. This is because the reduction of consumption produces an increase in the amount of assets held by private individuals, that matches the increase in government indebtedness. In addition, expression (12) shows that the fall in consumption causes a discrete reduction in the demand for real money balances, which, in turn, affects the money market equilibrium at $t=0$. This new level of real money balances will remain unchanged as long as the central bank does not abandon the exchange rule.

If continuity prevails, the disequilibrium in the monetary market will be restored via loss of international reserves. The loss of international reserves causes an equilibrating contraction of the monetary base as shown in Graph 3, panel 3. Also, panel 6 of the same graph shows that this loss of international reserves generates a discrete jump in government net debt from b_0 to b_1 . Panel 6 also shows that if fiscal corrections necessary to face the permanent oil revenue reduction are not implemented, government net debt increases without limits and does not converge to an equilibrium path.

In addition to the permanent fall in oil revenues, there are two other elements that cause these unlimited increasing levels of government debt. One, the reduction in real money balances decreases inflationary tax income for any given inflation rate. Two, the higher level of government debt produces higher debt-service payments.

Public sector indebtedness is limited by the government repayment capacity. This capacity is determined by the present value of fiscal surpluses that included income from seigniorage. In our model, this indebtedness limit is determined by equation (18), whereas equation (4) determines the path of government debt. Panel 6 from Graph 3 illustrates the path of government debt for the period during which the central bank maintains the exchange rule. This is the period between t_0 and t_3 , where t_3 is the time when the speculative attack occurs and the central bank abandons the exchange rules and switches to a monetary rule. Note that both the path of government debt and the indebtedness limit determine t_3 .

At t_3 , the central bank adopts a monetary rule that satisfies $\mathbf{m} = \arg \max_p \mathbf{pl}(\tilde{c}, \mathbf{p} + r(r^*, \tilde{\Omega}))$ and avoids further increases in government indebtedness by fixing government debt at $\max \mathbf{b}$ for every $t \geq t_3$. In addition, note that the exchange rate does not jump at time t_3 since agents have perfect foresight. Consequently, the price level does not jump either. If the exchange rate jumped, individuals would obtain unlimited gains because of the perfect capital mobility assumption. Therefore, there is a sudden loss of foreign reserves when the crisis occurs. The magnitude of this loss of foreign reserves is high enough to stabilize government debt at its maximum sustainable level in line with the higher inflationary tax income. This is also shown in panel 6.

As in Krugman (1979), a speculative attack leads to the abandonment of the fixed exchange rate regime. Also, it is important to highlight the possibility that an autonomous decrease in money demand due to changes in consumer preferences might be another source of policy inconsistency, as noted by Auernheimer (1987). Furthermore, a decrease in money demand, may cause a sudden speculative attack that changes the distribution of assets between government and private causing, in turn, a balance of payments crisis.

3.2 Inconsistency of policies under a monetary rule

Under this monetary regime, a monetary aggregate is the variable controlled by the monetary authority. The central bank announces at $t = 0$ that it will allow the exchange rate to float and intervene in the exchange market to maintain a continuous path of monetary aggregate, such as

$$M(t) = M(0) e^{\mathbf{m}t}, \quad (24)$$

where \mathbf{m} is the constant rate of monetary expansion.

Under a monetary rule, both the exchange rate and the price level are not determined by the devaluation rate. Now, the exchange rate and, consequently, the price level are endogenously determined by the money market equilibrium.

Also, note that for a given rate of monetary expansion the commitment to keep a continuous path of the monetary aggregate prevents the monetary authority from implementing open market operations to change the level of the monetary aggregate. As before, the possibility of inconsistent policies may be ruled out by an open market operation that simultaneously decreases both the level of the monetary aggregate and government indebtedness. This operation produces capital gains that are not transferred to private agents via a price level reduction. Instead, the government appropriates these capital gains through accumulation of assets. This means, as in the case of the exchange rate rule, that a monetary rule is also vulnerable to the time inconsistency problem if the commitment of the monetary authority is not perfectly credible.

The behavior of inflation, real money balances, and government debt

Since inflation is endogenous under a monetary rule, the path of real money balances is obtained by substituting equation (11) in equation (3). Thus, the equations describing the behavior of real money balances, inflation, and government debt are

$$\mathbf{p} = \frac{v'(m)}{u'(c)} - r, \quad (25)$$

$$\dot{m} = m \left[\mathbf{m} + r - \frac{v'(m)}{u'(c)} \right], \quad (26)$$

and

$$\dot{b} = d + br - \mathbf{m}m, \quad (27)$$

As demonstrated in the appendix and illustrated in Graph 2, the system equilibrium, in this case, is a unstable node.

In equilibrium, $\dot{m} = 0$ and $\dot{b} = 0$. Thus by combining equations (4) and (26), we obtain

$$b = \frac{1}{r} \left[\left(\frac{v'(m)m}{u'(c)} - mr \right) - d \right], \quad (28)$$

which is the equation that defines the locus of points containing the long run equilibrium combinations of m and b for a given rate of monetary expansion, as shown in Graph 2. Equation (28) is called function h . The term within parentheses on the right hand side of (28) is the inflationary tax revenue expressed in terms of real money balances. Note that function h has a local maximum in the (m, b) space. This maximum indicates the level of real money balances that maximizes inflationary tax revenue for a given inflation rate, as expressed by equation (18).³

The effects of a permanent oil revenue reduction

The following analysis of the effects of a permanent oil revenue reduction follows Drazen (1984). As in the previous case, we start from a long-run equilibrium position where $r = \mathbf{r}$, $\mathbf{p} = \mathbf{p}_0$, all the state variables are in equilibrium, and the level of government net debt satisfies equation (17). We assume that the monetary authority has announced and implemented a constant rate of monetary expansion, \mathbf{m} with the credible commitment of no discrete changes in the money supply.

³ Remember that in the long run equilibrium $r = \rho$ and v'/u' is the nominal interest rate.

Now, we assume that oil revenue falls permanently at t_0 and the central bank reacts by announcing that the monetary rule will be maintained at the pre-shock level and that discrete changes in the monetary aggregate will not be allowed. As the result of the permanent oil revenue reduction, private consumption decreases at the time of the shock and the country's net debt level remains unchanged at the new equilibrium as in the case of the exchange rate rule. The decrease in consumption causes a decrease in the demand for real money balances, as before. This lesser money demand and the permanent increase of the fiscal deficit level generate the expectation that the central bank will adopt a higher rate of monetary expansion to restore fiscal equilibrium, after government debt reaches $max\ b$. This expectation of a higher money supply growth rate contributes further to the reduction of the real money balances. Consequently, both the path of m and d are shifted. The path of real money balances shifts to the left while the path of government net debt shifts to the right. These shifts lead the economy to a point such as 1 in panel 1 of Graph 4. At the time of the shock, real money balances jump to point 3 that is on a path that will take them, within a finite period, to point 4. At point 4, b reaches its maximum sustainable level, $max\ b$, and the rate of monetary expansion increases to \bar{m} , as it is illustrated by the leftward shift experienced by the demarcation curve \bar{m} . The initial decrease of real money balances is offset by a discrete increase in both the exchange rate and the price level. Panel 1 of Graph 4 shows this adjustment process.

In sum, if fiscal corrections necessary to face the permanent oil revenue reduction are not implemented, government net debt grows until it reaches its maximum sustainable level $max\ b$. In turn, real money balances fall continuously until they reach the level that maximizes inflationary tax revenue. Equation (25) shows that inflation increases until the time in which the central bank abandons the monetary rule. This behavior of inflation differs from the one that we obtained under the exchange rate rule. Also, it is important to note that the path of inflation becomes unstable, during the adjustment period, only under the monetary rule.

5. Concluding Remarks

Following Auernheimer (1987), we provide a simple neoclassical dynamic model as the starting point to analyze the inconsistency between monetary and fiscal policy for an oil economy. We assume the existence of identical private agents with rational expectations in small open economy, for which oil constitutes a significant source of public income. Also, we assume perfect capital mobility, full employment, and flexible prices. Within this theoretical framework, we examine the dynamics caused by a permanent oil revenue reduction when fiscal corrections are not implemented and the respective intermediate monetary policy variable is maintained at its original level.

In particular, we examine the effects of a permanent oil shock under two alternative monetary regimes. These regimes are, according to the election of the intermediate variable, the exchange rate rule and a monetary rule. Policy inconsistency arises when government net debt grows without limits, given a monetary strategy that determines both the inflationary tax and the exogenous components of the fiscal deficit.

Two important conclusions emerge from our work. First, keeping policies at the level previous to the permanent decrease in oil revenue generates an unstable growth of government indebtedness, under any of the monetary regimes that were examined. This unstable growth causes both the abandonment of the monetary regime and higher future inflation rates. Second, maintaining the monetary regime after the oil shock in order to stabilize the path of debt causes increasing inflationary and indebtedness costs.

Intuitively, the adverse oil shock implies greater discounted values of future fiscal deficits. Consequently, private agents forecast that the government will use higher seigniorage to meet future higher fiscal deficit levels. At some later point, the central bank would modify the monetary strategy by either replacing the intermediate variable or redefining it to a level consistent with a greater fiscal deficit. Thus, the ultimate results are higher inflation, a greater level of public indebtedness, and higher debt-service expenses.

These previous results do not consider the rationale that might explain why the central bank maintains the monetary regime after an adverse oil shock. On this topic, Auernheimer (1987) suggests that the central bank could overestimate the government's ability to restore the equilibrium deficit. Also, he argues that monetary discipline could either motivate or force the government to implement the necessary fiscal adjustments. Further research will analyze the reasons that motivate the central bank decision to maintain its monetary program after a permanent oil revenue reduction.

Another interesting opportunity for future research is to extend our analysis by including an inflation targeting monetary regime. We can use two alternative approaches for this task. We can either include the case of Taylor's rules or consider the case of an optimal rule explicitly derived from the monetary authority's maximization problem.

Appendix

In this appendix some of the technical derivations employed in the work are discussed.

1. First order conditions of the individual problem

In order to solve the problem of individual optimization we applied the maximum principle in terms of the current value of the Hamiltonian:

$$H = u(c) + v(m) + \mathbf{l} \dot{w} \quad (\text{A1})$$

The conditions of first order are

$$H_c = u'(c) - \mathbf{l} = 0 \quad (\text{A2})$$

$$H_m = v'(m) - \mathbf{l}(r + \mathbf{p}) = 0 \quad (\text{A3})$$

$$\dot{\mathbf{l}} = \mathbf{r}\mathbf{l} - H_w = \mathbf{l}(\mathbf{r} - r) \quad (\text{A4})$$

$$\lim_{t \rightarrow \infty} w u'(c) e^{-rt} = 0 \quad (\text{A5})$$

to which we added the restriction (3b) in the text. Differentiating (A2) with respect to time and replacing in (A4) we obtain the equation (7a) in the text. Also, replacing (A2) in (A3) we obtain the equation (7b).

2. Dynamics of c and W

Linearizing (6) and (7a) in the neighborhood of an initial equilibrium, we have:

$$\begin{bmatrix} \dot{\Omega} \\ \dot{c} \end{bmatrix} = J \begin{bmatrix} \Omega - \tilde{\Omega} \\ c - \tilde{c} \end{bmatrix} \quad (\text{A6})$$

$$J = \begin{bmatrix} \partial(\Omega r)/\Omega & 1 \\ -r_2 u' / u'' & 0 \end{bmatrix}_{(\tilde{\Omega}, \tilde{c})} \quad (\text{0.1})$$

where J is the Jacobian.

Because $(\text{Tr}J)^2 - 4\det J > 0$ and $\text{Tr}J > 0$ by hypothesis, dynamics exhibits a saddle path, which, given to the initial conditions of the state variables and the characteristics of the problem, determines a unique rational expectations solution.

2. Dynamics of m y b

Linearizing (4) y (17) in the neighborhood of a long term initial equilibrium we have:

$$\begin{bmatrix} \dot{m} \\ \dot{b} \end{bmatrix} = J \begin{bmatrix} m - \tilde{m} \\ b - \tilde{b} \end{bmatrix} \quad (\text{A7})$$

where

$$J = \begin{bmatrix} -mv'(m)/u'(c) & 0 \\ -\mathbf{m} & r \end{bmatrix}_{(\tilde{m}, \tilde{b})}$$

Because $\det J > 0$, $(\text{Tr}J)^2 > 0$, y $(\text{Tr}J)^2 - 4\det J > 0$ by hypothesis, this equilibrium is an unstable node. In this case, we have an unique rational expectation equilibrium as in Drezen (1984).

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FIGURA 1

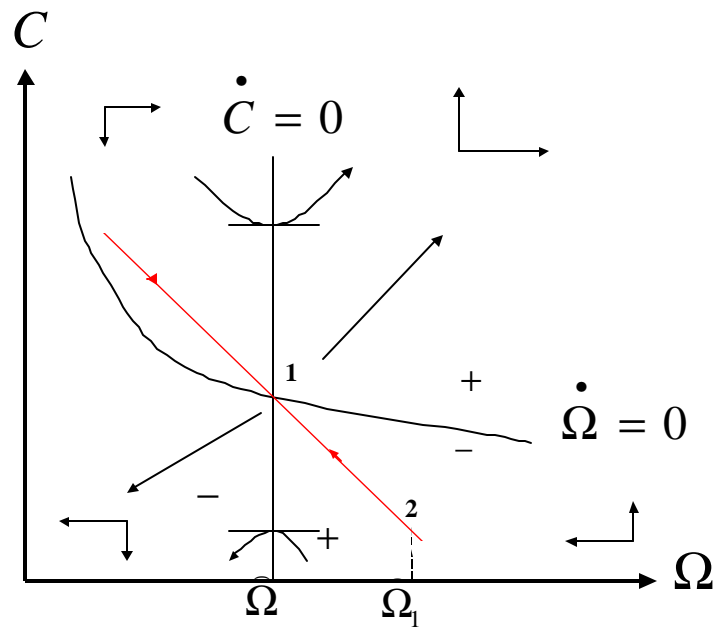
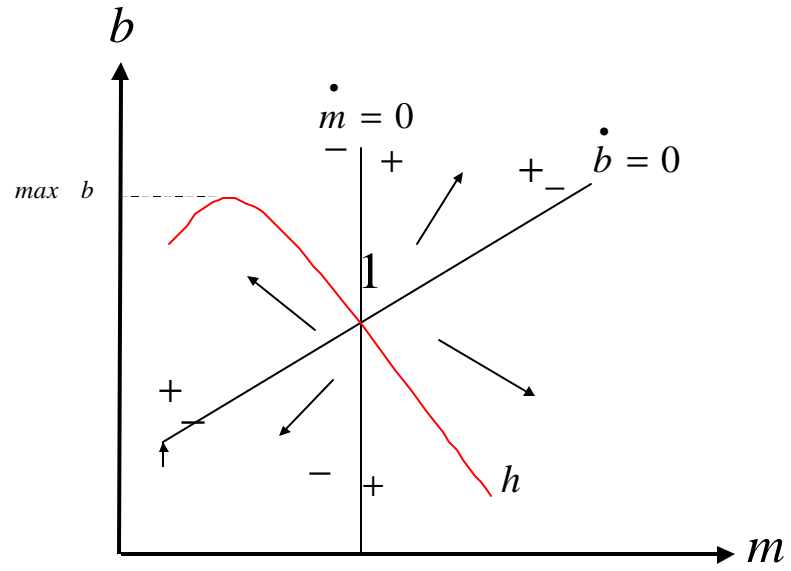


FIGURA 2



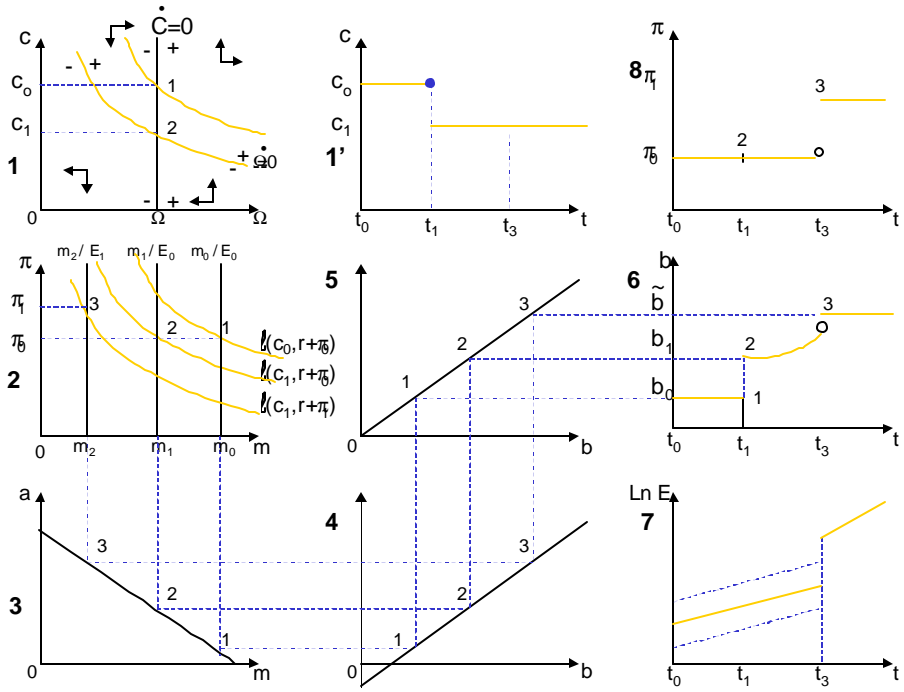


FIGURA 4

