Explaining the Fiscal Theory of Price Level Determination and Its Empirical Plausibility for Taiwan

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Keywords: Fiscal theory of the price level, Fiscal dominant, Ricardian and non-Ricardian policy regimes, Impulse response function

JEL classification: C32, E31, E52

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ABSTRACT

This paper illustrates the propositions of the fiscal theory of the price level (FTPL) using a simple dynamic framework. The FTPL argues that in a Ricardian policy regime, the price level is determined by the monetary variables. In a non-Ricardian policy regime, the government’s solvency constraint provides an additional restriction that helps pin down the price level. This paper begins with the main propositions of the FTPL. These include the price level determinacy under an interest rate rule, the observational equivalence between the Ricardian and the non-Ricardian policy regime, the ineffectiveness of monetary policy on price control under specific fiscal rule, and the tight money paradox by which an aggressive interest rate rule can lead to explosive inflation. We then discuss the critiques of the theory, such as the fragility of the theory and the over-determination of price level. The last part examines whether Taiwan is in a Ricardian or a non-Ricardian policy regime.
Explaining the Fiscal Theory of Price Level Determination (Tai-kuang Ho)

1. INTRODUCTION

This paper comprises of two parts. The first part explains the fiscal theory of the price level (FTPL) using a simple and easily understandable general dynamic model. We discuss the proposals of the theory and its important implications. The second part examines its empirical plausibility using Taiwan’s fiscal and monetary data.

Pioneering works on the FTPL include Leeper (1991), Woodford (1994, 1995) and Sims (1994, 1998). Economists have long noticed the need for coordination between fiscal and monetary policies. Failure of this policy coordination can endanger price stability. This is best seen from the government’s present value budget constraint. Given a process for government expenditure, the process for taxation and money stock cannot be chosen independently if the government’s budget constraint is to be satisfied (Sargent, 1987). In other words, if the fiscal authority pursues an unsustainable fiscal policy, the monetary authority is forced to issue money to satisfy the government’s budget constraint. This will affect the price level stability. Note that in this conventional scenario, fiscal policy has no direct effect on price stability. Ultimately, it is still the growth of money that determines the price level.

What is new about the fiscal theory of the price level? The FTPL is new in two respects. First, it asserts that the government’s budget constraint is an equilibrium condition that needs to be satisfied only in equilibrium. This changes the dimension of the coordination problem. Second, it asserts that fiscal policy has direct effect on price stability rather than through the creation of money.

The FTPL has important policy implications. In the conventional theory, the demand for liquidity matters for price determination. In the FTPL, it is the outstanding government liabilities and the present value of primary surplus plus seigniorage that matter. In the FTPL, monetary policy, to have effects on the price level, has to work through seigniorage and the government’s budget constraint. This implies that for countries in which seigniorage accounts for only a small part of the total revenues, the central bank would lose control of the price level (Canzoneri et al., 2001a).

The recent rapidly growing public debt in Taiwan has aroused attention on the effects of government debt on price stability. Assessing in which policy regime we live is important because it determines what policy tools are really effective in affecting price stability. If fiscal and monetary policies coordinate in a way such that fiscal policy
becomes the dominant determinant of price level as the FTPL predicts, then to achieve price stability, the government of Taiwan should have control over its public debt and deficits rather than monetary aggregate. Our empirical analysis finds little evidence supportive of FTPL in the case of Taiwan.

The rest of the paper is organized as follows: Section 2 describes the model. In section 3, we use the model to demonstrate the propositions of FTPL. Critiques on the FTPL are demonstrated in section 4 using the same analytical framework. Section 5 provides an empirical study on Taiwan. The last section concludes.

2. THE MODEL

We use a simple dynamic model to illustrate the main propositions of the fiscal theory of the price level. The analytical framework presented here is extremely simple and excludes capital accumulation and holding of assets other than government bonds. Such simplification is intended to make the argument as transparent as possible. The model consists of a representative private agent and a government sector. It is deterministic with discrete time indexed by $t$ with $1 \leq t < \infty$. To make the expression consistent, we denote nominal variables by capital letters and real variables by small letters throughout the text.

2.1 The household

The single representative infinite-lived household has preferences over consumption and real balances given by

$$
\sum_{t=0}^{\infty} \beta^t u \left( c_t, \frac{M_{t+1}}{P_t} \right),
$$

where $\beta$ is a constant discount factor, $c_t$ denotes consumption, $M_t$ denotes money balances at the beginning of period $t$, $P_t$ is price level, and $M_{t+1}/P_t$ denotes real money balances. This money-in-the-utility-function approach stands as a proxy for the transaction-facilitating role of money. Note that we have end-of-period money stock
$M_{t+1}/P_t$ instead of beginning-of-period money stock $M_t/P_t$ in the utility function. The use of end-of-period money stock in the utility function gives it a cash-in-arrears flavor.\(^2\) To make the arguments as transparent as possible, we assume that preferences are separable and given by\(^3\)

$$u \left( c_t, \frac{M_{t+1}}{P_t} \right) = \frac{1}{1-\sigma} c_t^{1-\sigma} + \phi \frac{1}{1-\eta} \left( \frac{M_{t+1}}{P_t} \right)^{1-\eta}, \quad (2)$$

where coefficients $\sigma, \phi, \eta > 0$. The household has an endowment of $y_t$ in each period. It pays lump-sum taxes in the amount $\tau_t$. Let $B_{t+1}$ denote bond holdings purchased in period $t$ and $R_{t+1}$ denote the one-period nominal interest rate in period $t$. We assume that the holdings of government bonds must be non-negative. In other words, the household cannot borrow from the government. The household’s budget constraint is expressed as\(^4\)

$$y_tP_t + M_t + B_t = c_tP_t + \tau_tP_t + M_{t+1} + \frac{B_{t+1}}{1 + R_{t+1}}. \quad (3)$$

Household chooses $c_t, M_{t+1},$ and $B_{t+1}$ to maximize its lifetime utility (1), subject to the budget constraint (3). The first-order conditions of the household’s optimization problem are

$$c_t^{-\sigma} = \lambda_tP_t, \quad (4)$$

\(^2\) Notice that this cash-in-arrears approach is crucial to the indeterminacy of price level under a nominal interest rate peg. The model would have a cash-in-advance constraint if we use the beginning-of-period money stock in the utility function. Most advocates of the FTPL employ a cash-in-arrears framework. Buiter (1998) shows that the cash-in-arrears specification renders the price level indeterminate under a fixed interest rate rule and the FTPL provides an additional constraint to pin down the price level. In contrast, price level is determinate under a cash-in-advance specification and the FTPL makes the price level become over-identified. We will illustrate these arguments subsequently. Here we adopt the cash-in-arrears approach of Woodford (1995) and Sims (1994) simply to be loyal to the FTPL flavor.

\(^3\) McCallum (2001) and Buiter (2002) employ a similar utility function.

\(^4\) With the preferences specified as in (2), the household will have positive quantities of consumption and real balances. Therefore, the constraint can be written as equality.
\[ \lambda_t = \frac{\phi}{P_t} \left( \frac{M_{t+1}}{P_t} \right)^{-\eta} + \beta \lambda_{t+1} \]  
\[ (\frac{\lambda_t}{\lambda_{t+1}}) = \beta (1 + R_{t+1}) \]  

where \( \lambda \) is the Lagrange multiplier to the household’s budget constraint.

We obtain the consumption Euler equation by combining (4) and (6)

\[ \left( \frac{c_t}{c_{t+1}} \right)^{-\sigma} = \frac{\beta(1 + R_{t+1})}{P_{t+1}/P_t} = \beta(1 + r_{t+1}), \]  

with \( 1 + r_{t+1} \equiv (1 + R_{t+1})/(P_{t+1}/P_t) \) denoting the real interest rate. The Euler equation has the conventional meaning that the household maximizes its lifetime utility by equaling the present value of marginal utilities of subsequent periods. The money demand function is obtained by combining (4), (5) and (6)

\[ \left( \frac{M_{t+1}}{P_t} \right)^{\eta} = \phi \left( \frac{1 + R_{t+1}}{R_{t+1}} \right) c_t^\sigma. \]

The demand for real balances is proportional to the consumption and varies inversely with the nominal interest rate.

2.2 The government

The government is made up of the consolidated fiscal and monetary authorities. It faces the following intertemporal budget constraint

\[ g_t P_t + M_t + B_t = \tau_t P_t + M_{t+1} + \frac{B_{t+1}}{1 + R_{t+1}}, \]  

where \( g_t \) denotes government expenditures, \( \tau_t \) denotes tax revenues, and \( B_{t+1} \) is the number of government bonds issued in period \( t \) at the discount \( 1/(1+R_{t+1}) \). The nominal value of the government’s financial liabilities is defined as the sum of outstanding stock of government bonds and base money \( W_t \equiv B_t + M_t \). The government’s budget
constraint can be expressed in terms of nominal liabilities

$$W_t = \frac{1}{1 + R_{t+1}}W_{t+1} + (\tau_t - g_t)P_t + \frac{R_{t+1}}{1 + R_{t+1}}M_{t+1}. \quad (10)$$

The solvency constraint prohibits the government from engaging in a Ponzi game, which means that the government finances the principle and interest on liabilities coming due entirely out of newly issued liabilities. The solvency constraint is obtained by iterating (10) forward, that is

$$W_t = \sum_{l=0}^\infty \prod_{j=1}^l \left( \frac{1}{1 + R_{t+j}} \right) \left[ (\tau_{t+l} - g_{t+l})P_{t+l} + \frac{R_{t+l+1}}{1 + R_{t+l+1}}M_{t+l+1} \right], \quad (11)$$

or equivalently $^5$

$$\lim_{T \to \infty} \prod_{j=1}^T \left( \frac{1}{1 + R_{t+j}} \right) W_{t+T} = 0. \quad (12)$$

Equation (12) is usually named the transversality condition.

2.3 Market clearing

The goods market clears in each period so that $^6$

$$y_t = c_t + g_t.$$

For simplicity, we assume that output and government expenditures are constant

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$^5$ We use notation convention that $\Pi_{j=n}^{n-1}[1/(1 + R_{t+j})] \equiv 1.$

$^6$ Market clearing requires in addition that money supply equals money demand, and bonds supply equals bonds demand. Since we have implicitly assumed that these conditions are satisfied when discussing the household and government behaviors, we do not introduce these conditions here.
in this simple economy, that is \(^7\)

\[ y_t = \overline{y} \quad \text{and} \quad g_t = \overline{g}. \]

We summarize the equilibrium conditions as follows

\[ c_t = \overline{c} = \overline{y} - \overline{g}, \quad (13) \]

\[ \beta (1 + r_{t+1}) = 1, \quad (14) \]

\[ \left( \frac{M_{t+1}}{P_t} \right)^\eta = \phi \left( \frac{1 + R_{t+1}}{R_{t+1}} \right)^{\overline{\sigma}}, \quad (15) \]

\[ W_t = \sum_{l=0}^{\infty} \prod_{j=1}^{l} \left( \frac{1}{1 + R_{t+j}} \right) \left[ (\tau_{t+l} - \overline{y}) P_{t+l} + \frac{R_{t+l+1}}{1 + R_{t+l+1}} M_{t+l+1} \right]. \quad (16) \]

3. PROPOSITIONS OF THE FTPL

Conditions (13), (14), (15) and (16) determine the equilibrium of the model. Condition (13) shows that household has constant consumption over time. Condition (14) implies that the real interest rate \( r_{t+1} \) is constant and equals \( (1 - \beta) / \beta \). Suppose the government adopts a fixed interest rate rule by keeping the nominal interest rate constant at the value \( R \). The stock of money becomes endogenous under a fixed interest rate, that is, the government has to supply as much money stock as necessary to satisfy the household’s demand for money. Since the real interest rate is constant, a fixed interest rate rule also implies a constant inflation rate \( \pi_{t+1} \) that equals \( \beta (1 + R) - 1 \).\(^8\) An im-

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\(^7\) The assumptions of constant output and government expenditures are not crucial for our conclusion. As will be shown below, what is important for the theory is whether the government adjusts its primary surplus (equivalently to adjust its tax when the expenditures are fixed) to satisfy the solvency constraint. The assumption of constancy is only for easy exposition.

\(^8\) We obtain \( P_{t+1}/P_t \) by using the fact that \( \beta (1 + r_{t+1}) = \beta (1 + R)/(P_{t+1}/P_t) = 1 \). Inflation rate \( \pi_{t+1} \) is defined as \((P_{t+1}/P_t) - 1 \).
portant feature of the model is that real balances are determined from condition (15), but the price level $P_t$ and the money supply $M_{t+1}$ are indeterminate. In other words, the real balances will be the same even if we multiply the nominal variables (both price level and money stock) by the same proportion. Such price level indeterminacy is a common feature in dynamic models with a fixed interest rate rule.

The FTPL starts from the problem of price level indeterminacy under fixed interest rate rule and promises to solve it. The FTPL shares the same interpretation as the conventional view with respect to conditions (13), (14) and (15). What makes the FTPL unconventional is its interpretation of condition (16). According to the conventional view, the government’s budget constraint is an identity that has to be satisfied ex post for all possible realization of the variables. In economic modeling, endogenizing the tax policy is a preferred way to ensure that the budget constraint is always satisfied (Canzoneri et al., 2001a). The government budget therefore does not provide an additional condition to constrain the solution of the variables. In contrast, the FTPL treats (16) as an equilibrium condition that is satisfied only in equilibrium. That is, the government’s solvency constraint provides an additional restriction that helps pin down the price level. Following the terminology of the FTPL, a Ricardian policy regime is a monetary/fiscal policy regime in which the government’s solvency constraint holds for all admissible sequences of the variables entering the government’s budget constraint. A non-Ricardian policy regime is a monetary/fiscal policy regime in which the government’s solvency constraint holds only in equilibrium (Buiter, 2002). The FTPL is similar to the natural law in a non-Ricardian world.

To illustrate how the government’s solvency constraint (16) helps pin down the price level in a non-Ricardian policy regime, we rewrite the government’s solvency constraint in real terms

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9 Or called nominal indeterminate following the terminology of McCallum (2001).

10 A monetary/fiscal policy regime specifies the sequence of public spending, lump-sum taxes, money stock (or nominal interest rate), and stock of government bonds.

11 The names of the regimes derive from the fact that government bonds are net wealth in a non-Ricardian regime. Canzoneri et al. (2001a) call a Ricardian regime money dominant and a non-Ricardian regime fiscal dominant. They use this terminology on the basis that monetary policy serves as the nominal anchor in the Ricardian regime, while fiscal policy plays that role in a non-Ricardian regime.
\[ \frac{W_t}{P_t} = \sum_{t=0}^{\infty} \prod_{j=1}^{t} \left( \frac{1}{1 + r_{t+j}} \right) \left[ (\tau_{t+l} - \bar{g}) + \frac{R_{t+l+1}}{1 + R_{t+l+1}} \frac{M_{t+l+1}}{P_{t+l}} \right]. \] 

Given the sequence of public spending and fixed interest rate \( \{\tau_t; R_t = R\} \), the right hand side of (17) is determinate since real interest rate is determined from (14) and real money balances are determined from (15). Since nominal government liabilities \( W_t \) on the left-hand side of (17) are given, therefore \( P_t \) has to adjust to satisfy the solvency constraint. We arrive at the first proposition of the FTPL.

**Proposition 1**  Price level is determinate under an interest rate rule. The price level is determined by the government’s solvency constraint. In other words, the price level adjusts to make the government financial liabilities in real terms equal the sum of the present value of primary surplus\(^{12}\) and the present value of the interest cost the government saves when it issues money rather than bonds.

Proposition 1 implies that in a Ricardian policy regime, the government adjusts its tax revenues or expenditures to satisfy the intertemporal budget constraint for all possible realizations of price level. In a non-Ricardian policy regime, the government commits to an exogenous path of fiscal policy.\(^{13}\) Government solvency constraint is achieved by the unexpected jumping of price level. For both positive and normative purposes, it is necessary to ask how plausible the FTPL is and how empirically relevant the non-Ricardian policy regime is. However, the Ricardian and non-Ricardian regimes are not distinguishable by a direct examination of time series data. This is because conditions (13) to (16), which determine the routes of the variables, hold for both the Ricardian and non-Ricardian regimes in equilibrium. The equilibrium values are what the economic data record. We arrive at the second proposition of FTPL.\(^{14}\)

\(^{12}\) Primary surplus is defined as \( \tau_t - \bar{g} \).

\(^{13}\) A common feature of non-Ricardian regime is that primary surpluses are not actively adjusted to guarantee solvency constraint. To simplify, we can think of these surpluses being determined by an exogenous process, even though fiscal policy need not be exogenous in a non-Ricardian regime (Canzoneri et al., 2001b).

\(^{14}\) This does not mean that there is no way to distinguish between the Ricardian and non-Ricardian policy regimes. See the discussion below.
Proposition 2  A simple examination of the time series data will not help to answer the empirical plausibility of the FTPL.

The FTPL would not be disturbing if it merely provides an additional restriction to pin down the price level. The theory has important implication for the coordination of monetary and fiscal policy. According to the conventional view, monetary authorities are solely responsible for price stability. Fiscal policies can threaten price stability only when monetary authorities are forced to monetarize the fiscal deficits, and thus influence money supply. Therefore, making the monetary authorities independent and committed to their own mandate is the best way to ensure price stability. The FTPL challenges this view. Suppose the monetary authorities commit to a fixed interest rate rule. The second item of the right hand side of (17) is determined since both \( \frac{R_{t+1}}{1 + R_{t+1}} \) and \( \frac{M_{t+1}}{P_{t+1}} \) are functions of nominal interest rate \( R \). This alone, however, is not the ultimate determinant of price level, which depends also on how fiscal policies decide on the present value of primary surplus. If the fiscal authorities reduce the present value of primary surplus, even though the interest rate and real money balances are unchanged, the price level will have to jump to satisfy the government’s solvency constraint. This implies that regardless of how independent and how tough the monetary authorities are, fiscal policies alone can influence price stability. To ensure price stability, monetary authorities should do more than just ensuring their own house is in order. They should also take care that the fiscal authorities adopt an appropriate policy (Christiano and Fitzgerald, 2000).

It can be shown that under some specific fiscal rules, the monetary authorities may totally lose their control over the price stability. Suppose the government follows a fiscal rule, which specifies the lump-sum taxes according to \( \tau_t P_t = \tau P_t + M_t - M_{t+1} \). We know from (9) that the government can finance its deficits either by issuing bonds or by printing money. The fiscal rule specified above means that tax revenues and hence primary surpluses are determined exogenously. In addition, the fiscal authority adjusts tax revenues to fully offset the revenues from seigniorage. The government’s budget constraint (9) can be rearranged as \( B_t = B_{t+1}/(1 + R_{t+1}) + (\tau - \bar{\gamma}) P_t \) and the solvency constraint now becomes
\[
\frac{B_t}{P_t} = \sum_{t=0}^{\infty} \prod_{j=1}^{T} \left( \frac{1}{1 + r_{t+j}} \right) (\tau - \bar{g}) \quad \text{or equivalently}
\]
\[
\lim_{T \to \infty} \prod_{j=1}^{T} \left( \frac{1}{1 + r_{t+j}} \right) \frac{B_{t+T}}{P_{t+T}} = 0. \quad (18)
\]

Note that none of the monetary variables, either money stock or nominal interest rate, enters into the government’s solvency constraint. The price level is determined by the predetermined value of government bonds and the present value of primary surplus. The price level is independent of the monetary policy.

**Proposition 3** For certain fiscal rules, the equilibrium price level sequence is dependent solely upon the fiscal policy and independent of the monetary variables.

The FTPL goes further to challenge the conventional view on the conduct of monetary policy. Policy discussions on interest rate rule suggest that inflation can be more effectively controlled with an interest rate rule that responds aggressively to inflation rate. That is, the central bank should raise the nominal interest rate higher than the (expected) inflation rate to make the real interest rate increase. This is because a response coefficient less than one would make self-fulfilling inflation possible and cause multiple equilibria. The interest rate rule is generally specified as

\[
R_{t+1} = \gamma_0 + \gamma_1 \pi_t = \gamma_0 + \gamma_1 \left( \frac{P_t}{P_{t-1}} - 1 \right). \quad (19)
\]

Taylor (1993) had argued that coefficient \( \gamma_1 \) should be around 1.5. An empirical estimate of Taylor rule using U.S. data suggests that \( \gamma_1 \) is greater than one in periods during which inflation was more successfully controlled.\(^{15}\) The FTPL, however, implies that such an aggressive interest rate rule will lead to explosive inflation in a non-Ricardian policy regime. This conclusion is called the *tight money paradox* of the FTPL. To see this, substitute the interest rate rule (19) into the definition of real interest rate \( 1 + r_{t+1} = (1 + R_{t+1})/(P_{t+1}/P_t) \), we obtain the following expression for

\(^{15}\) The Volker and Greenspan FED, see Clarida et al. (1999).
the inflation rate

\[ \pi_{t+1} = \beta \gamma_1 \pi_t + \beta (1 + \gamma_0) - 1. \]  \hspace{1cm} (20)

The inflation rate follows a first-order difference equation and will explode over time if \( \beta \gamma_1 > 1 \). Therefore, an aggressive interest rate rule with \( \beta \gamma_1 > 1 \) induces price instability, unless the initial inflation rate \( \pi_1 \) happens to be \( [\beta (1 + \gamma_0) - 1]/(1 - \beta \gamma_1) \) and the inflation rate remains constant thereafter.

**Proposition 4**  An aggressive interest rate rule can lead to explosive inflation in a non-Ricardian policy regime.

The FTPL also provides a way of thinking how the price level is determined in a world where the efficiency of the transactions mechanism is enhanced to the point that money becomes redundant (Woodford, 1995). This is important because financial innovation in recent years involves more and more private creation of substitutes for government-issued money and thus causes policy concern. The answer is obvious from equation (18), which shows that price level can be pinned down, even without reference to government-provided money. The price level is determined by the government’s fiscal decisions.

**Proposition 5**  There is price-level determinacy in a world where fiat money does not exist. Fiscal policy alone can determine the price level.

The above discussion has focused on a closed economy. The implications of the fiscal theory of the price level for an open economy are not straightforward, as Dupor (2000), Daniel (2001), Bergin (2000) and Canzoneri et al. (2001b) have made clear.

In a closed economy, the amount of prices left undetermined by an interest rate peg equals the number of restrictions imposed by the solvency constraint, supposing the fiscal/monetary policy is non-Ricardian. In an open economy, as Bergin (2000) has pointed out, the sum of the household intertemporal budget constraints must equal the sum of the government budget constraints due to accounting identity. That is,
the solvency constraint in an open economy is an aggregate condition that applies no matter how many governments are involved and thus provides only an additional restriction to fix one price level. Therefore in an \( n \)-country open economy model under an interest rate peg, \((n - 1)\), prices are left undetermined even if the FTPL applies.

There are several ways to avoid this indeterminacy problem when interest rates are the central bank’s policy instruments. The simplest one is making one price level given as in the case of a small open economy with an exchange rate peg. Then, in a non-Ricardian regime, one price level is determined by the solvency constraint and the other price level is determined by the purchasing power parity. Another extreme case is a monetary union in which the single price level can be determined under a non-Ricardian regime by the aggregate solvency constraint in a way similar to a model of closed economy. Here we restrict our discussion to the implication of FTPL for a small open economy with a fixed exchange rate regime.\(^{16}\)

Canzoneri et al. (2001b) show that a fixed exchange rate regime is not compatible with a non-Ricardian regime. Moving from a closed economy to an open economy will add into the model two additional conditions: the purchasing power parity and the interest rate parity.\(^{17}\) Under a fixed exchange rate regime, the former condition implies that domestic price level is also fixed, while the latter condition implies that domestic interest rate is equal to foreign interest rate. Since price jump is not possible, and central bank’s interest rate policy is dictated by foreign interest rate, the only way to satisfy the government budget constraint is through fiscal adjustments. In other words, fiscal policy becomes endogenous in the sense that fiscal authorities must help assure fiscal solvency at a given price level that is consistent with the purchasing power parity. So the fiscal/monetary regime must be Ricardian.

To be formal, consider the purchasing power parity \( P = eP^* \). Assume that foreign price level \( P^* \) is equal to one. It follows \( P = e \). Substitute into equation (17) we have

\(^{16}\) We discuss only this case since Taiwan is a small open economy that has been maintaining a stable currency peg to the U.S. dollar.

\(^{17}\) These two conditions can also be obtained from the necessary condition for optimization in a two-country model, as is shown in Dupor (2000).
where \( \tau_{t+1} - \bar{g} \) is primary surplus and \( \left[ R_{t+1}/(1 + R_{t+1}) \right] (M_{t+1}/P_{t+1}) \) represents seigniorage. Note that nominal liabilities \( W_t \) are predetermined at the beginning of the period. In a non-Ricardian regime, the sequence of primary surplus does not automatically guarantee fiscal solvency. The sequence of central bank transfers is presumed to achieve this work. But to maintain a currency peg, the central bank must subject its interest rate policy to foreign interest rate, so that the transfers are actually determined independently of the government solvency constraint. That means that in a non-Ricardian regime, it is impossible to peg the exchange rate and assure solvency constraint simultaneously.

**Proposition 6**  A currency peg requires a Ricardian fiscal/monetary regime.

So far these are the important propositions of the FTPL. The following section discusses the critiques of the FTPL.

### 4. Critiques Of FTPL

#### 4.1 The FTPL is fragile

The FTPL assumes that the government follows an exogenous path of fiscal policy. Will the argument of FTPL remain valid if we slightly relax this assumption? Canzoneri et al. (2001a) point out that the fiscal theory of the price level is fragile, in the sense that allowing some sensibility in the primary surplus to real government liabilities causes the FTPL to collapse.\(^{18}\) Suppose the government adjusts its primary surplus in response to the level of outstanding liabilities. This small deviation from

\(^{18}\) The original intention of Canzoneri et al. (2001a) is to demonstrate that the Ricardian regime is not a rare and special case as the advocates of the FTPL claim. On the contrary, the Ricardian regime is a more plausible and prevailing one. They do this by showing that a wide class of fiscal policy rules leads to a Ricardian regime. These rules have the common features that primary surplus responds to the level of government liabilities, even when the requisite fiscal response may be arbitrarily small and infrequent.
the non-Ricardian policy is plausible and realistic since it means that the government adjusts the fiscal policy to bring the liabilities under control. We express this policy rule as $\tau - g = \varepsilon (B_t/P_t)$, where $0 < \varepsilon \leq 1$. Recall that satisfying the government solvency constraint is equivalent to satisfying the transversality condition expressed by (18). This transversality condition holds for any price level because under such a policy rule

$$\lim_{T \to \infty} \prod_{j=1}^{T} \left( \frac{1}{1 + r_{t+j}} \right) \frac{B_{t+T}}{P_{t+T}} = \lim_{T \to \infty} (1 - \varepsilon)^T \frac{B_1}{P_1} = 0. \quad (22)$$

In other words, a realistic deviation from the non-Ricardian policy changes the whole policy regime into a Ricardian one. The fiscal theory of the price level is no longer able to pin down the price level and the analysis turns into a Ricardian one.$^{19}$

4.2 The FTPL is at maximum a theory of initial price level

Buiter (1998) argues that what the FTPL actually determines is the initial price level, not the whole spectrum of the price sequence. In fact, the inflation rate is constant and equals $\beta(1 + R) - 1$ under a fixed interest rate rule. The FTPL is not able to influence the evolution of price sequence. What it can do is merely to pin down the initial price level, and let the subsequent prices evolve according to the constant inflation rate.

To see this, rearrange the government’s budget constraint as follows

$$\frac{B_{t+1}}{P_{t+1}} = (1 + r_{t+1}) \frac{B_t}{P_t} - (1 + r_{t+1})(\tau - g). \quad (23)$$

With exogenous sequences of government expenditures and taxes, the government’s solvency constraint will generally be violated. The government’s liabilities $B_t/P_t$ tend to explode because $(1 + r_{t+1})$ is greater than one. One possibility to sat-

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$^{19}$ Christiano and Fitzgerald (2000) show an example in which the fiscal policy is exogenous at a low level of debt, but the fiscal policy adjusts to bring the debt back into line when the debt exceeds some upper bound. They argue that such a policy rule is realistic and reflects the U.S. experiences in the 1980s and 1990s and the Maastricht treaty that sets a limit on the real debts of the member countries in the EMU. Such small deviation from the non-Ricardian assumption makes the FTPL collapse.
isfy the solvency constraint is to have an initial non-zero stock of government bonds, whose real value can be equated to the present value of primary surpluses through an appropriate assignment of the initial price level (Buiter, 1998).20

This is illustrated in the above figure. Beginning from \((B/P)^A\), the government liabilities will explode toward infinity. On the other hand, beginning from \((B/P)^B\), the government liabilities will converge to the negative area, which violates the restriction that government bonds must be positive. The only non-explosive equilibrium is \((B/P)^*\). To prevent the government liabilities from exploding, we need to select the value of \(B_1/P_1\) to induce the government liabilities to remain constant at that value. That is,

\[
\frac{B_1}{P_1} = \sum_{l=1}^{\infty} \prod_{j=2}^{l} \left( \frac{1}{1 + r_j} \right) (\bar{\tau} - \bar{\gamma}) = \frac{1}{1 - \beta} (\bar{\tau} - \bar{\gamma}).
\] (24)

Since the nominal value of government bonds \(B_t\) is predetermined, the initial price level \(P_t\) is thus determined from the government’s solvency constraint.21 This initial price level is the first element of an equilibrium price sequence that keeps the

---


21 This is why Buiter (1998) calls it “the pure fiscal theory of the initial price level”.
real value of government’s liabilities $B_t/P_t$ constant (Buiter, 1998).

### 4.3 The FTPL is over-determined

We have deduced the main propositions of the FTPL using a cash-in-arrears approach. Proposition 1 suggests that price level is indeterminate under a fixed interest rate, and the government’s solvency constraint provides an additional restriction to pin down the price level. What would happen if we adopt a cash-in-advance approach?

Under a cash-in-advance approach, it is the beginning-of-period real balances that enter into the utility function. The household’s utility function becomes

$$u \left( c_t, \frac{M_t}{P_t} \right) = \frac{1}{1-\sigma} c_t^{1-\sigma} + \phi \frac{1}{1-\eta} \left( \frac{M_t}{P_t} \right)^{1-\eta}. \quad (25)$$

The equilibrium conditions now turn out to be

$$c_t = \bar{c} = \bar{y} - \bar{g}, \quad (26)$$

$$\beta(1 + r_{t+1}) = 1, \quad (27)$$

$$\left( \frac{M_t}{P_t} \right)^{\eta} = \phi \left( \frac{1}{R_t} \right)^{\bar{c}^\sigma}, \quad (28)$$

$$W_t = \sum_{l=0}^{\infty} \prod_{j=1}^{l} \left( \frac{1}{1 + R_{t+j}} \right) \left[ (\tau_{t+l} - \bar{\eta}) P_{t+l} + \frac{R_{t+l+1} M_{t+l+1}}{1 + R_{t+l+1}} \right]. \quad (29)$$

Conditions (26), (27) and (29) are the same as the equilibrium conditions under a cash-in-arrears approach. The only but important modification is (28), the money demand function. Now there is price-level determinacy under a fixed interest rate rule because for a predetermined money stock $M_t$ and nominal interest rate $R_t$, the price level is uniquely determined from condition (28). The price level will be over-determined if we impose the government’s budget constraint as an additional condition for price level determination. One can imagine that the price level determined from the money demand equation will generally differ from the price level determined from the
solvency constraint. The two prices will coincide only by accident. It is not clear how the FTPL might deal with this problem.

5. Empirical Plausibility Of FTPL

5.1 Testing the FTPL

We mentioned before that a Ricardian regime and a non-Ricardian regime are observational equivalence, and there is no straightforward method to test the FTPL.

A conventional single-equation approach does not work because a positive correlation between primary surplus and debt level can be reconciled with both the Ricardian and non-Ricardian regime. To make it clear, suppose we regress the government’s budget surplus on the previous period’s outstanding debt, and suppose the estimated coefficient is positive. This can imply that government adjusts its primary surplus in response to the level of liabilities. We have shown in section 4.1 that a positive response of primary surplus to the debt level implies that the government’s budget constraint is always satisfied. This suggests that the finding that government surplus responds to the level of debt constitutes evidence in favor of a Ricardian regime. However, a positive response of primary surplus to public debt can be reconciled with the FTPL in which current outstanding debt is simply forecasting future surpluses. Therefore, the single-equation approach is not sufficient for testing the FTPL.22

Canzoneri et al. (2001a) rely on the response of government debt to primary surplus to distinguish between the two policy regimes. Their approach is to estimate the response of government debt to primary surplus and try to find out which regime gives more plausible explanation to these patterns. Specifically, they estimate a VAR model that includes primary surplus and level of government liabilities (both expressed in terms of nominal GDP) as variables and focus on a set of impulse response functions. Suppose the impulse response of liabilities to an innovation in primary surplus is negative and significant. The Ricardian regime gives a simple and straightforward

---

22 An example of the single-equation approach is Bohn (1998).
explanation that the government pays off some of the debt with primary surplus, and therefore the level of debt falls in the subsequent period. The non-Ricardian regime can also explain this pattern of impulse response, however with the property that primary surplus has strong and negative autocorrelation in the long run. That is, there has to be negative correlation in the surplus process at longer horizons, and the eventual decreases in surplus must be strong enough to make the present value of surpluses fall. Our empirical test follows Canzoneri et al. (2001a).

5.2 Empirical plausibility of FTPL for Taiwan’s economy

We assess in this section the empirical plausibility of the Ricardian regime by examining annual data on Taiwan’s surpluses and liabilities during 1970–2001.

The theory implies that ability of monetary authority to maintain price stability, through nominal interest rate management, is severely undermined if the fiscal authority lacks of sufficient discipline to satisfy its intertemporal budget constraint. Before testing the FTPL, we need to convince ourselves that the central bank of Taiwan has been using the interest rate to manage its monetary policy. Even though the central bank of Taiwan has been announcing an official target for annual money growth since 1992, it is commonly perceived that interest rates remain the policy instrument of the central bank. Shen and Hakes (1995), for instance, use the discount rate as the central bank of Taiwan’s policy instrument. Studies conducted by the central bank staff also conclude that short-term interest rates, rather than monetary base, can better reflect the stance of central bank policy. In the most recent press release issued on 30th September 2004, the central bank of Taiwan decided to raise the discount rate by 0.25%, based on the considerations of rising inflation expectation and narrowing output gap. The press release mentioned no single word regarding the central bank’s official money growth target. We think that this evidence is enough to convince us the central bank of Taiwan conducts its monetary policy through interest rate management.


24 Formally, we could employ the VAR-based approach suggested by Bernanke and Mihov (1998) to identify an appropriate indicator of central bank’s policy. This, however, would make the text somehow
Figure 1 presents the three key series in our analysis. Surplus/GDP is net revenues of general government (plus central bank transfers) minus net expenditures of general government, divided by nominal GDP. Debt/GDP is calculated by dividing outstanding public bonds and foreign debt of central government by nominal GDP. Liabilities/GDP is calculated as the sum of debt and money base, divided by nominal GDP. We take the data from the *Yearbook of Financial Statistics of the Republic of China*.

![Graph showing Surplus/GDP, Debt/GDP, and Liabilities/GDP over the years 1970 to 2001.](image)

**Notes:** Scale for Surplus/GDP is on the left. Scale for Debt/GDP and Liabilities/GDP is on the right.

**Figure 1 Fiscal Data, Taiwan, 1970–2001**

Figure 2 illustrates the negative correlation between surplus/GDP and liabilities/GDP in the Taiwan data. Regressing the former series on the latter series yields a coefficient $-0.50$ at one percent significance level. We obtain a similar result if we use one period lag of the latter series instead. The negative correlation simply implies that government deficits have led to the accumulation of government liabilities.
We follow the method of Canzoneri et al. (2001a) to distinguish between Ricardian and non-Ricardian regimes. Consider how a positive innovation in surplus influences the next period’s liabilities. In a Ricardian regime, the surplus pays off part of the debt and the next period’s liabilities fall. In a non-Ricardian regime, there are two possibilities. Consider first that an innovation in surplus is not correlated with future surpluses on the right hand side of (17). In this case, the next periods’ liabilities will not be affected by the innovation in surplus. Next suppose an innovation in surplus is positively correlated with future surpluses. In this case, the next periods’ liabilities will rise. Therefore, impulse response functions from a VAR in surplus and liabilities would help differentiate between Ricardian and non-Ricardian regimes. If the next period’s liabilities fall following a positive innovation surplus, then we have a Ricardian regime. If not, we have a non-Ricardian regime. Note that a negative response can be reconciled with a non-Ricardian regime, supposing there is negative correlation in the surplus process at longer horizons and the correlation is strong enough to lower the present value of surpluses. What mechanism would generate a sequence of surpluses with the required properties? Cochrane (1998) shows that a negative correla-
tion between the innovations in cyclical and long-term components of the surplus can induce the eventually negative autocorrelation in surpluses. The negative correlation between the cyclical and long-term components of the surplus also implies that the fiscal authority adopts a pro-cyclical fiscal policy.

We begin with a VAR in surplus/GDP and liabilities/GDP. Our focus is on the responses of both variables to surplus/GDP shocks. Figure 3 and Figure 4 present the impulse response function of the VAR computed for both orderings of the variables. Surplus/GDP comes first in the first ordering. This is consistent with a non-Ricardian regime because it allows innovation in surplus/GDP to have a contemporaneous effect on liabilities/GDP. The second ordering, in which liabilities/GDP comes first, is consistent with a Ricardian regime because it does not allow surplus/GDP shocks to have a contemporaneous effect on liabilities/GDP. Both LR test statistics and information criteria lead us to include one lag and a constant. The dashed lines represent the two standard deviation bands obtained by the Monte Carlo method.

The response of the liabilities/GDP in period \( t + 1 \) to surplus/GDP shocks in period \( t \) is negative and significant for four years in the first ordering. This negative response would arise in a Ricardian regime. However, the negative response could also arise in a non-Ricardian regime if a positive surplus/GDP innovation is associated with sufficiently lower future surpluses and thus reduce the right-hand side value of equation (17). Is this the case for Taiwan? Table 1 represents the autocorrelation and the Q-statistics for surplus/GDP. It shows that the correlation coefficients first become negative only after a lag of 13 years. In absolute terms, the coefficients are smaller than their positive counterparts. To be concrete, assume an annual interest rate of 3%. Then the cumulative effect of a surplus/GDP innovation up to 30 years is roughly 1.65. That is, liabilities/GDP should rise, rather than fall, following a surplus/GDP innovation supposing the non-Ricardian assumption is correct. Therefore, the negative response of liabilities/GDP in the first ordering is supportive of a Ricardian regime, not a non-Ricardian regime.

Figure 4 plots the impulse response of the second ordering. Here the ordering presumes a Ricardian regime and we expect a negative response of liabilities/GDP to surplus/GDP shocks. Figure 4, however, is not very informative because the response
Response of SURPLUS/GDP to SURPLUS/GDP

Response of LIABILITIES/GDP to SURPLUS/GDP

Notes: VAR is estimated with one lag and a constant over the sample 1970–2001. Response standard errors computed by Monte Carlo method. Ordering: Surplus/GDP, Liabilities/GDP.

Figure 3 VAR in Surplus/GDP and Liabilities/GDP Ordering
Explaining the Fiscal Theory of Price Level Determination (T'ai-kuang Ho)

Response of SURPLUS/GDP to SURPLUS/GDP

Response of LIABILITIES/GDP to SURPLUS/GDP

Notes: VAR is estimated with one lag and a constant over the sample 1970–2001.
Response standard errors computed by Monte Carlo method.
Ordering: Liabilities/GDP, Surplus/GDP.

Figure 4 VAR in Liabilities/GDP and Surplus/GDP Ordering
<table>
<thead>
<tr>
<th>Period</th>
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<th>Partial Correlation</th>
<th>Q-statistics</th>
<th>P-value</th>
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of liabilities/GDP to surplus/GDP is almost zero, and the response is neither significant nor negative.

5.3 Extensions and robustness

5.3.1 First extension

In the first extension, we use real revenues and real expenditures instead of net revenues and net expenditures. Real revenues are defined as net revenues minus non-real revenues, which include proceeds from issuance of public debts, receipts from loans for economic construction, and surplus of previous fiscal year. Real expenditures are defined as net expenditures minus principal payments.

The VAR has a constant and one lag. Figure 5 shows the impulse response to an innovation in surplus/GDP. The top panel places surplus/GDP in the first ordering, while the bottom panel places liabilities/GDP in the first ordering. In the first ordering, the response of liabilities/GDP to a shock in surplus/GDP is negative and significant for the first three years following the shock. We see in Table 2 that the correlation coefficients of surplus/GDP first become negative only after a lag of 13 years, and the cumulative effect of a surplus/GDP innovation up to 30 years is roughly 1.82, so the negative response of liabilities/GDP in the first ordering is supportive of a Ricardian regime, not a non-Ricardian regime. In the second ordering, response of liabilities/GDP to surplus/GDP is never significant. Again, the basic results are robust to different definitions of primary surplus.

5.3.2 Second extension

In this second extension, we want to examine the robustness of the impulse response functions over different sample periods. In the preceding analysis, we implicitly assume that there are no regime changes in the data. However, it is commonly perceived that Taiwan’s budget deficits have soared after 1989 due to factors such as land procurement and adverse public choice. One might wonder if fiscal regime has changed after 1989. Here we simply re-estimate the VAR for only the period 1970–1988.

Figure 6 is the scatter graph for surplus/GDP and liabilities/GDP for the period 1970-1988. The figure is obviously different from Figure 2 and indicates a positive
correlation between surplus/GDP and liabilities/GDP. Regressing the former on the latter yields a coefficient of 0.6 and p-value 0.04. However, the coefficient becomes insignificant if we use one-year-lag value of liabilities/GDP instead. Based on this prima facie evidence, it is hard to conclude that the fiscal regime before 1989 was different in the sense that fiscal policy during 1970–1988 took corrective actions when the public debt accumulated.

We estimate a VAR in surplus/GDP and liabilities/GDP, with a constant and one lag. Figure 7 presents the impulse response of surplus/GDP to liabilities/GDP for both orderings. Impulse responses of liabilities/GDP to shocks in surplus/GDP are not significantly different from zero in both orderings. Table 3 indicates that the autocor-
Table 2  Autocorrelations and Partial Correlations of Surplus/GDP, Using Real Revenues and Real Expenditures

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relation of surplus/GDP becomes significantly negative after a lag of 4 years, but the cumulative effect of a surplus/GDP innovation up to 10 years is positive and equals 0.99. Even though less clear-cut, the overall evidence is still supportive of a Ricardian regime.

5.3.3 Third extension

In a non-Ricardian regime, a positive innovation in surplus/GDP would induce an increase in the real value of government liabilities. Since the nominal value of outstanding liabilities is given, this increment in real value of liabilities is achieved through nominal income reduction. In other words, the FTPL implies that in a non-Ricardian regime, nominal income moves to satisfy the present value constraint. We test this prediction in this third extension.

We estimate a VAR in the log of nominal liabilities, the surplus/GDP, and the log of nominal GDP. This is the ordering consistent with a non-Ricardian regime. The VAR has a lag and a constant. Figure 8 represents the impulse response functions. Again, the evidence is in favor of a Ricardian regime. The bottom panel shows that the
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Notes: VAR is estimated with one lag and a constant over 1970–1988.
Response standard errors computed by Monte Carlo method.
Top panel ordering: Surplus/GDP, Liabilities/GDP.
Bottom panel ordering: Liabilities/GDP, Surplus/GDP.

Figure 7 VAR in Surplus/GDP and Liabilities/GDP, for Shorter Period 1970–1988

Table 3 Autocorrelations and Partial Correlations of Surplus/GDP, for Shorter Period 1970–1988

<table>
<thead>
<tr>
<th>Period</th>
<th>Autocorrelation</th>
<th>Partial Correlation</th>
<th>Q-statistics</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.521</td>
<td>0.521</td>
<td>6.014</td>
<td>0.014</td>
</tr>
<tr>
<td>2</td>
<td>0.229</td>
<td>−0.058</td>
<td>7.243</td>
<td>0.027</td>
</tr>
<tr>
<td>3</td>
<td>0.045</td>
<td>−0.070</td>
<td>7.293</td>
<td>0.063</td>
</tr>
<tr>
<td>4</td>
<td>−0.157</td>
<td>−0.195</td>
<td>7.953</td>
<td>0.093</td>
</tr>
<tr>
<td>5</td>
<td>−0.254</td>
<td>−0.109</td>
<td>9.790</td>
<td>0.081</td>
</tr>
<tr>
<td>6</td>
<td>−0.256</td>
<td>−0.061</td>
<td>11.795</td>
<td>0.067</td>
</tr>
<tr>
<td>7</td>
<td>−0.219</td>
<td>−0.052</td>
<td>13.396</td>
<td>0.063</td>
</tr>
<tr>
<td>8</td>
<td>−0.053</td>
<td>0.109</td>
<td>13.496</td>
<td>0.096</td>
</tr>
<tr>
<td>9</td>
<td>0.015</td>
<td>−0.043</td>
<td>13.505</td>
<td>0.141</td>
</tr>
<tr>
<td>10</td>
<td>0.017</td>
<td>−0.069</td>
<td>13.517</td>
<td>0.196</td>
</tr>
</tbody>
</table>

Figure 8 VAR in LN (Liabilities), Surplus/GDP, and LN (GDP)
responses of nominal GDP to surplus/GDP shocks are significant and positive for the first two years. The response predicted by the FTPL is not supported by the data. The finding could be reconciled with a non-Ricardian regime. However, as we have shown in Table 1, the negative correlation of surplus/GDP is not strong enough to cause the present value of primary surpluses to fall, and thus to induce a rise in nominal GDP in response to the innovation in order to reduce the real value of liabilities.

To sum up, our empirical analysis indicates the plausibility of a Ricardian policy regime for Taiwan. Moreover, we do not find evidence of a regime change after 1989.

6. CONCLUSION

In this paper we employ a simple framework to demonstrate the propositions of the fiscal theory of the price level. We also discuss several critiques on the theory. Using the VAR-based approach suggested by Canzoneri et al. (2001a), we find evidence supporting the Ricardian regime in case of Taiwan. This is consistent with the fact that Taiwan has been maintaining a stable currency peg to the U.S. dollar, and it is known that a currency peg requires the fiscal discipline of a Ricardian regime.

This paper focuses on a model of closed economy and discusses only the case of a small open economy with fixed exchange rate. Other implications of the FTPL for an open economy, such as price level determinacy and fiscal policy coordination in a monetary union, are not mentioned. A further restriction of this paper is that the empirical test of the FTPL is based on a model of closed economy. For an economy like Taiwan with a large percentage of GDP contributed by foreign trade, this might lead to biased results and conclusions. I leave these questions for future research.
REFERENCES


Explaining the Fiscal Theory of Price Level Determination (Tai-kuang Ho)

均衡物價的財政理論與台灣的實證結果

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關鍵詞: 均衡物價的財政理論, 財政政策主導, 李嘉圖體制與非李嘉圖體制, 衝擊反應函數
JEL 分類代號: C32, E31, E52
摘 要

本文以一个简单的动态模型，来解说均衡物价的财政理论(fiscal theory of the price level, FTPL)。该理论宣称在李嘉图体制下，物价是由货币政策所决定。在非李嘉图体制下，物价则是由政府预算限制所决定。本文首先介绍FTPL的主要论点：固定利率法则之下物价的确定性；李嘉图与非李嘉图体制在时间序列观察上的等同；在特定财政法则下货币政策丧失对物价的影响；泰勒法则无法稳定通货膨胀等。接着讨论对理论的批评。最后则实证台湾是处于李嘉图或是非李嘉图体制。