A FISCAL PERSPECTIVE ON THE GOVERNMENT DEBT SUSTAINABILITY AND EMPIRICAL ANALYSIS FOR JAPAN

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Abstract

The sustainability of the growing Japanese government debt is a concern for many but the financial market seems to be neglecting such concern. Its growing debt level and subdued general price level are not easy to explain from the fiscal theory of the price level (FTPL) either and Japan has been a "puzzle". This dissertation shows that the FTPL can explain the Japanese experience if the Fiscal Investment and Loan Program (FILP) is included in the scope of the government and loans in the government debt. It further analyzes the potential negative consequence of monetary independence under the fiscal dominance.

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I would like to dedicate this dissertation to my late father, Dr. Takeshi Takeda.

I Introduction

I.1 The growth of the Japanese government debt

Japan's fiscal position has been a concern for many policy makers and economists around the world. As Hoshi and Ito (2012, p.3) summarize, "[m]any academic papers written in the last decade have concluded that the current Japanese government deficits and debts are not sustainable." In terms of market value, 911 trillion yen of Japanese Government Bonds (JGBs), 157 trillion yen Treasury Discount Bills (TBs), and 163 trillion yen of loans are outstanding as of March, 2014. Of the loans, 56 trillion yen is borrowed by the central government and 107 trillion yen is borrowed by the Fiscal Investment and Loan Program (FILP) agencies. Figure I-1 shows how this large amount of debt has grown over the past 25 years. JGB is mostly held by domestic investors[1] and this fact is typically quoted as a reason for JGB market's stability. However, as Hoshi and Ito (2012, p.14) discuss, "Japanese government debt will soon exceed private sector financial assets" possibly within 10 years. Still the JGB market is quite calm and nominal interest rates are extremely low.

In the context of the fiscal theory of the price level (FTPL), an increase in the nominal value of the government debt should be accompanied by either one or the combination of an increase in the general price level and an increase in the present value of future government surpluses. The price level did not rise and the government surplus as casually observed in the primary balance was generally negative (or deficit) over the past 25 years except for a very brief period around 1990.

[1] As of March 2014, 8.4% of JGBs and TBs are held by foreigners.

The surprisingly stable JGB market and the subdued price level despite the growing debt level and the continuing primary balance deficit are the two sides of the same "puzzle". The government debt price should fall when there is too much of them in the market and there is no clear sign of future decrease in volume through budget surpluses. The general price level should rise when the nominal value of the government debt increases without corresponding increase in the present value of future surpluses. Both theories imply an economy with higher price level with lower real values for the government debts.

This dissertation attempts to provide a new measurement of the government debt and the derived surpluses to bridge the gap between the theory and the data to solve these puzzles. A casual observation of JGBs leads to an impression that the Japanese government debt burden has kept increasing for 25 years and accelerated from 2001. However, the government borrows funds from the private sector not only in the form of bonds and bills but also in the form of loans, most of which has been used to finance the Fiscal Investment and Loan Program (FILP) financial agencies. If such loans are included in the definition of the government debt, one can see that the market value of debt did not increase during the first several years of 2000s and it only started to increase again after the global financial crisis in 2008. Figure I-1 suggests that fiscal consolidation in Japan led by Prime Ministers Koizumi and Abe was successful in stabilizing Japan's fiscal condition. The trend continued on throughout the Liberal Democratic Party (LDP) rule until 2009 under Prime Ministers Fukuda and Aso. The Japanese government debt started to grow again when the Democratic Party of Japan (DPJ) came into power in 2009 right after the global financial crisis, even before the 2011 earthquake. This dissertation suggests that fiscal dominance exists in Japan if one properly accounts for the FILP financial agencies

as a part of the government and if the implied surplus is used as a measure of surplus in the government sector. The existence of fiscal dominance indicates a possibility of fiscal inflation in Japan beyond the control of the BoJ.

I.2 Fiscal inflation

Generally speaking, a government deficit during an economic downturn has been believed to be offset by surpluses during an economic boom time but this story does not hold any more for two reasons. Firstly, the government's fiscal deficit is not only coming from a cyclical economic movement but more and more from the changing demography and the subsequent increase in the current and the future social security expenses. This makes it difficult for the fiscal authority to adjust its policy variables to satisfy the fiscal equation with the price level set by the monetary equation. Secondly, the monetary authority has started to execute fiscal policies. For example, both the Federal Reserve (Fed) and the BoJ have been aggressively purchasing medium to long term government bonds and other financial assets such as non-government fixed income securities and private company's equity stakes for the case of the BoJ. These activities are not a monetary policy action but a fiscal one which involves government transfers to the private sector, albeit temporary. There is a possibility that those purchased assets could lose their value and impair the central banks' balance sheets, which must be restored by capital injection from the fiscal authority.

The policy coordination between the fiscal and the monetary authorities which Sargent and Wallace (1981) describe is characterized as a "game of chicken" by some authors such as Canzoneri, Cumby, and Diba (2011). If the fiscal authority keeps increasing its debt

and the debt balance hits the fiscal limit, which is the maximum level of debt that can be sustained by the future fiscal surpluses, and the monetary authority takes no action, the government debt would default due to the shortage of financial resources. Thus, either the fiscal authority controls the debt level under the fiscal limit or the monetary authority creates more seigniorage revenue by printing more money. That is, either the fiscal or the monetary authority must "blink" in order to save the government debt from defaulting. When the monetary authority "blinks", the increased liquidity would drive the price level higher in accordance with the quantity equation. This is the "unpleasant monetarist arithmetic."

As Leeper and Walker (2012) and others clarify, Sargent and Wallace (1981) treat the real debt case. When the government borrows in the real debts, there is no way for the government to redeem the debts except for raising real revenue in one way or another, including the real seigniorage revenue. However, if the debts are nominal, a temporary inequality in the fiscal equation can be restored to equality by a change in the price level. This restoration mechanism, however, implies that there exists another channel from the fiscal policy to a change in the price level other than the "unpleasant arithmetic" path. If the nominal debt value increases or the expected real present value of the future surpluses decreases, the price level should increase. This is fiscal inflation.[2]

One potential unpleasant outcome is a "run" as Cochrane (2011a) discusses. This is

[2]It may appear contrarian to discuss inflation when most advanced economies are experiencing either disinflation or deflation. However, signs or government's "intent" of fiscal inflation is apparent. For example, Prime Minster Abe announced his second, or revised, version of the "Three Arrows", which sets the target nominal GDP of 600 trillion yen in 2020. Nominal GDP in 2014 was 487.6 trillion yen and IMF forecasts 499.8 trillion yen for 2015 (IMF, 2015) . Therefore, the economy has to grow at more than 3.5% per year when both IMF and most economists forecast Japan's real growth potential to be less than 1%. The government appears to be trying to generate inflation of more than 2.5% average, where the BoJ has continuously failed to generate modest 2.0% inflation target.

the situation in which the government is perceived to have more debts, both money and bonds together, held by the private sector than it can collect in the future in the form of taxes.

I.3 Fiscal and monetary policy coordination

In Japan, it is becoming increasingly difficult for the government to control or reduce the social security expenditure because of the increasing median voter age.[3] The fiscal authority does not have the freedom to adjust its future surpluses to satisfy the fiscal equation based on the monetary determined price level. Rather, it is more natural to assume that the price is set by the fiscal equation and the monetary policy must follow.

There is a well known identification challenge for fiscal and monetary dominance. While the two are different, the outcome economic time series will be identical. As Cochrane (1999) shows for the US and Chapter IV of this dissertation does for Japan, the economic time series for the two countries can be explained by the fiscal theory framework. It is, therefore, prudent to consider what both monetary and fiscal frameworks say about a price level and inflation because they have different channels for the determination of the price level and the controlling mechanism for inflation. In particular, it is worth considering the effect of the "independence" of central banks. What if the fiscal policy moves exogenously for political reasons and the monetary policy does not cooperate or follow because of "independence"?

[3] Katagiri, Konishi, and Ueda (2014) use the FTPL concept in the overlapping generation (OLG) model. Their analysis assumes a series of short lived governments, each of which stays in power just for one period and explicitly shows the impact of population aging on the price level. Katagiri et al. (2014) conclude that the price level will go down if the aging is the result of increasing survival rate while it will go up if it is caused by decreasing birth rate.

In the fiscal framework, or the Regime F introduced in Chapter V.2 of this dissertation, the monetary authority must follow a certain policy to contain the debt from exploding. The risk is that what is asked for the central bank appears very similar to what the central banks have learned not to do, which is the monetization of the government debt. The central banks have gained independence from the fiscal authority so that they are not forced to monetize the government debt because the consensus is that this independence is the best approach for the price stability. However, this logic holds only under the monetary framework for the price level. That is, it assumes that the monetary policy is determining the price level and the fiscal policy is controlling the nominal debt balance.

In the case of Japan, the fiscal policy appears to be dominant as the fiscal authority is not willing to control the fiscal deficit and the overall debt position, while the monetary authority is holding the nominal interest rates low primarily to stimulate the economy but also to keep the debt servicing under control. It appears that the BoJ has blinked in the analogy of a chicken game. Furthermore, if the rates start to rise for any reasons, the BoJ must keep them low for its current policy to take hold. As Krugman (1998) says, a central bank must "credibly promise to be irresponsible" for its policy to be effective.

Both fiscal and monetary authorities are taking fiscal actions now. The key message of Leeper and Walker (2012) is that the fiscal policy can undermine monetary control of inflation. In other words, the monetary authority cannot control inflation when the fiscal authority does not cooperate. Even when a certain level of cooperation is assumed, Leeper and Walker (2012) show some interesting implications when a fiscal limit exists. For example, an aggressive tax policy can amplify the effects of transfer shock on debt, contrary to a general perception. Similarly, hawkish monetary policy may amplify the

volatility of expected inflation as Chapter V.2 shows, again, contrary to general beliefs. This dissertation explicitly shows the consequence of the monetary authority's independence misperception when there is lack of coordination between the fiscal and monetary authorities. Lack of cooperation results in inflation which is more volatile and lower than the Regime F.[4]

[4]Sims (2013) makes an interesting observation on the US and European economies with respect to their common difficulty in assuring effective partnership between fiscal and monetary authorities. He claims "it is not hard to imagine Congress blaming the Fed for the painful decisions it faces and in the process casting doubt on its commitment to recapitalize the Fed" for the US and "if the capital called for were substantial, and the call came in the wake of ECB policy actions that were politically unpopular in some countries, the provision of capital might not be automatic" for Europe. (Sims, 2013, p.567)

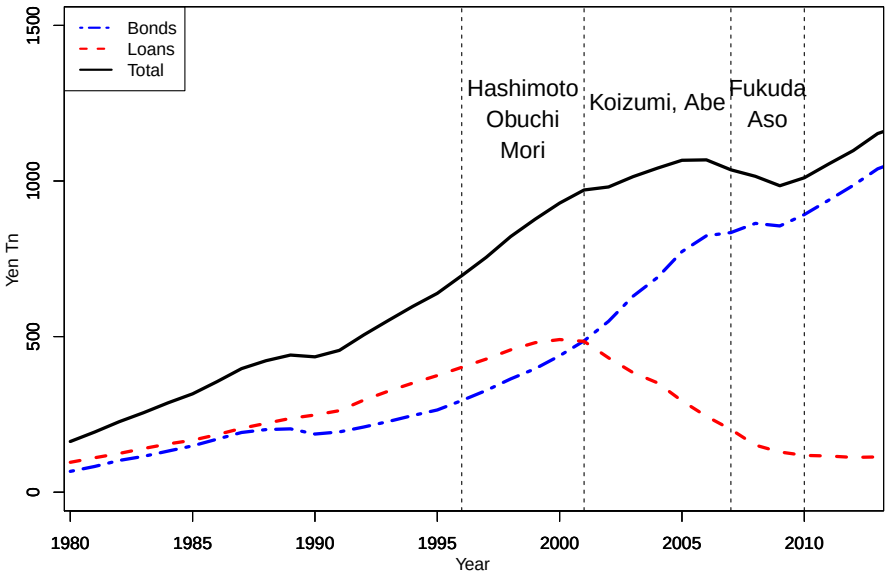

Figure I-1. History of Japanese debt (market value): A casual observation of bonds leads to an impression of fast growing debt but the total debt level has not materially changed sine 2001 during the era of Koizumi, Abe, Fukuda, and Aso if loans are included. The data source for figures in this dissertation is discussed in Chapter IV.2.

II Review of the fiscal theory of the price level

In this chapter, I summarize the theoretical outline of the fiscal theory of the price level, its applicability to Japan, and its implication on a path for the fiscal policy to affect the price level. I also briefly review the literature on the Japanese debt sustainability and the Fiscal Investment and Loan Program.

II.1 The FTPL and fiscal inflation

The FTPL has been developed since 1991 by Leeper (1991); Leeper and Walker (2012), Sims (1994, 2013), Cochrane (1999, 2001, 2005, 2009), and Woodford (1999) among others.

There are two approaches for the determination of the price level, monetary and fiscal, expressed by the following two equations as extensively used by Cochrane (2005, 2011b).[5]

$$M_t V_t = P_t y_t \tag{1}$$

$$\frac{B_t + M_t}{P_t} = \mathrm{E}_t \int_{\tau=0}^{\infty} \frac{\Lambda_{t+\tau}}{\Lambda_t} s_{t+\tau} d\tau \tag{2}$$

M_t is the monetary base, V_t is the 'velocity' including the money multiplier, P_t is the general price level, y_t is the output, B_t is the nominal value of the government debt portfolio, $\Lambda_{t+\tau}/\Lambda_t$ is the stochastic discount factor from t to $t+\tau$, and $s_{t+\tau}$ is the real primary government surplus including seignorage at $t+\tau$. (1) represents the quantity theory of money

[5]Most description of the fiscal theory framework is taken from Cochrane (1999, 2001, 2005, 2011b) and Woodford (1999). For the derivation of (2) in a discrete form, please also see Chapter V.2.

(the monetary equation) and (2) is the fiscal equation.

If one assumes a constant velocity $V_t = V$, the monetary equation (1) determines the general price level P_t from the policy variable M_t once the output y_t is set. Then the government, or the fiscal authority, has to adopt the surplus path $s_{t+\tau}$ which satisfies the fiscal equation (2) for given B_t and M_t. In this case, the monetary framework dominates the fiscal framework and it is called monetary dominance, also known as the Ricardian regime. The price level is set by the quantity theory.

On the other hand, if the fiscal authority sets the future surplus path $s_{t+\tau}$ independently from the output level or simply assuming it is exogenously given, the fiscal equation (2) determines the price level P_t for given B_t and M_t. In this case, the fiscal equation dominates and the monetary authority must choose M_t that satisfies the monetary equation (1). This is the fiscal dominance, also known as the non-Ricardian regime. In the non-Ricardian policy regime, (2) does not hold for all price levels but there may be a unique P_t which makes (2) balanced for any exogenously given sequence of $s_{t+\tau}$. This is the fiscal theory of the price level.[6] Note that B_t and M_t are interchangeable in (2). That is, open market operations by a central bank in which nominal government bonds are exchanged with money at the fair market price have no immediate impact on the left hand side of (2) and, thus, on P_t under the fiscal dominance.

Sargent and Wallace (1981) show there are two sources for the ceiling for the amount of publicly held interest-bearing government debts, which are "an upper limit on the real stock of government bonds relative to the size of the economy" and "the interest rate the government must pay on bonds." Under the monetary dominance, the monetary authority

[6]Some critics, most notably Buiter (2001, 2002) argue that (2) is not an equilibrium condition but a constraint that must be satisfied even off equlibrium.

sets its monetary policy and, thus, determines the seigniorage revenue. The fiscal authority must operate under the revenue constraints thus defined by the combination of the seigniorage and other forms of revenues. The monetary authority can control inflation under this paradigm. On the other hand, if the fiscal policy dominates, the fiscal authority dictates to the monetary authority how much seigniorage revenue it must provide and, thus, the monetary authority's capability to control inflation is limited.

Under the fiscal dominance, decrease in the expected future government surpluses (the right hand side of (2)) or increase in the nominal value of government debt and money (the numerator on the left hand side of (2)) will cause the general price level (the denominator on the left hand side of (2)) to rise, and this is called fiscal inflation. Cochrane (2009) offers an illustrative description of fiscal inflation. He starts by asking why fiat money has any value at all. Fiat money "has value because the government accepts dollars, and only dollars, in payment of taxes" in the US (Cochrane, 2011a, p.69). Therefore, if people believe there is more money than the government can absorb in the future in the form of taxes, "people collectively try to get rid of the extra cash." People would need to buy goods and services in order to get rid of money and this will drive the prices higher. This is the fiscal inflation. Note that monetary policy of exchanging government bonds with money cannot control this inflation because it only exchanges B_t and M_t in the numerator of the left hand side of (2).

II.2 The FTPL's extension to multi-period and application to the government debt sustainability debate

Most literature uses one period debts and is with or without money. Cochrane (1999, 2001, 2011b) extends the model to use long term debts and shows the FTPL is consistent with the history of surpluses and debts of the United States. Cochrane (2001) explores the impact of term structure on the price level evolution against exogenous shock to surpluses. He shows that any surprise shock to the government surplus can be absorbed by the nominal value change of the government debt portfolio when it contains long term debts. Since any shock to the surplus would affect the general price level immediately in a one-period debt model, this is a significant extension of the framework.

Cochrane (2011b, p.7) expands (2) with respect to B_t as follows:

$$B_t = \int_{j=0}^{\infty} Q_t^{(j)} B_t^{(j)} dj = \int_{j=0}^{\infty} \mathrm{E}_t \left(\frac{\Lambda_{t+j} P_t}{\Lambda_t P_{t+j}} \right) B_t^{(j)} dj, \tag{3}$$

where $B_t^{(j)}$ denotes the nominal notional amount of j year debt at time t and $Q_t^{(j)}$ denotes its nominal market value at time t. Combining (2) and (3), one obtains

$$\frac{M_t}{P_t} + \int_{j=0}^{\infty} \mathrm{E}_t \left(\frac{\Lambda_{t+j}}{\Lambda_t P_{t+j}} \right) B_t^{(j)} dj = \mathrm{E}_t \int_{\tau=0}^{\infty} \frac{\Lambda_{t+\tau}}{\Lambda_t} s_{t+\tau} d\tau. \tag{4}$$

Therefore, "[b]y buying and selling debt at date t and later, after $\mathrm{E}_t\, s_{t+\tau}$ is revealed, the government can achieve any sequence of $\mathrm{E}_t \left(1/P_{t+j} \right)$, consistent with this equation, without making any changes in surpluses. The more long-term debt outstanding – the greater $B_t^{(j)}$ relative to $B_t^{(0)}$ – the better the trade off" (Cochrane, 2011b, p.7).

In the Japanese context, a longer term structure of government bonds dampens the impact of future surplus changes on the current price levels. Japan Ministry of Finance (MoF) has been extending the average duration of JGBs both to take advantage of the low interest rate environment and to minimize refunding risks while the BoJ is buying longer term JGBs, effectively shortening the government debt portfolio duration held by the private sector.

II.3 Similarities and dissimilarities between the monetary and the fiscal frameworks

The two equations (1) and (2) reveal similarities and dissimilarities between the monetary and fiscal frameworks. In terms of similarities, both equations imply a higher price level with an increase in the amount of money. For the dissimilarities, there are a couple worth noting. First, because the money and the bonds are treated equally in the fiscal equation, the central bank's open market operations have no impact on the price level in the fiscal framework, quite contrary to what is believed in the monetary framework. Second, the monetary equation implies a negative relationship between the price level and the real output while the fiscal equation implies a negative relationship between the price level and the future real surpluses of the government. These two implications are consistent assuming a positive relationship between the real output and the government's real surpluses.

As Sargent and Wallace (1981)'s argument shows some linkage between the monetary and fiscal frameworks, there are theoretical similarities and dissimilarities. For example, McCallum and Nelson (2006) show that the both frameworks present similar

consequences of government macroeconomic policies when the monetary authority is using an interest rate target, rather than the monetary base target. Chapter III discusses this point in more detail.

II.4 Empirical analyses on Japan

The policy discussion in Japan has revolved around the monetary side and there have not been many studies from the fiscal perspective. Doi (2000) follows Cochrane (1999) and Woodford (1999) and concludes that, based on data from 1955 to 1997, the monetary policy in Japan was passive during this period, the fiscal policy was active, and the FTPL cannot be neglected in order to explain price levels in Japan (Doi, 2000). However, there has not been much research since then.

While being pioneering, Doi's analysis has some room for improvement in order to be applied to the current environment. For example, Doi focuses on the central government and uses the government bonds as the proxy for the government obligation but Japanese government used to borrow a large amount in the form of loans until 2000 through the FILP as discussed earlier. Another area is the nominal yield of the government debts. Doi (2000) uses the average issuing yield of JGBs but it is more appropriate to use the average yield of all outstanding bonds. Finally, he uses the primary balance as the surplus instead of the implied surplus derived by the change in the privately held government debt values. This is not much of an issue for his sample period from 1955 to 1997 and for the limited scope of the central government but, as I shall show shortly, the primary balance is not a good proxy for the overall government surplus in Japan.

This dissertation extends the current discussion on Japanese debt sustainability by re-

scoping the government debt and by adding a fiscal theory perspective. Further it extends the existing FTPL literature on Japan in two ways. First, it uses the surplus implied by the change in the privately held government debt, which enables the analysis to cover the broadly defined government including the FILP agencies. Second, it uses both bonds and loans as the government debt and the weighted average yield of outstanding debt as the nominal yield on the government debt portfolio. These two extensions provide a better vantage point to analyze and solve the Japan puzzle for the FTPL.

II.5 Fiscal perspectives on the fiscal and monetary policy coordination

The paper by Leeper and Walker (2012) is titled "Perceptions and Misperceptions of Fiscal Inflation" because there is a general tendency to connect "fiscal inflation" with the type of inflation mechanism Sargent and Wallace (1981) describe and disregards it. This is a misperception of fiscal inflation. Sargent and Wallace (1981)'s "unpleasant arithmetics" assumes real debts and shows the indirect path from the debt growth to inflation. When the real debt to GDP grows too high, the household stops purchasing the government debts unless a larger real backing is provided. This can be done by the central bank's generating seigniorage revenue by printing an increasing amount of fiat money. This channel is often disregarded as unlikely mostly because seigniorage is a very small portion of government revenues in most industrialized countries. Another "perception" of fiscal inflation, i.e., a path from the fiscal policy to inflation, is given by the fiscal theory. Seigniorage revenue may or may not exist in the future surplus stream and it does not make any difference in the relationship just explained.

As Leeper and Walker (2012) discuss, there is a common understanding that central

banks have learned that too rapid money growth generates inflation and the independence of the central bank from the fiscal authority ensures that the latter cannot require the former to provide any specific seigniorage revenue or debt monetization in general. That is, it is commonly believed that the independent central banks today can achieve its policy objective, which is the price stability. Leeper and Walker (2012) show how ineffective the monetary policy can become in controlling inflation when the fiscal side does not cooperate. In fact, the monetary policy must aim to contain the debt balance by keeping the nominal interest rates very low when the fiscal authority does not control the debt balance by maintaining sufficient surpluses. By extending the study of Leeper and Walker (2012), this dissertation explicitly shows how the lack of understanding of the underlying price setting mechanisms by the two authorities can lead to an undesired outcome.

II.6 The sustainability of Japanese government debt

The sustainability of Japanese government debt situation has been extensively discussed among economists and various reports have also been published by international organizations such as IMF. IMF (2011) suggests the slow growth and policy missteps as the root cause of the Japanese fiscal imbalances and also mentions that "market sentiment toward sovereigns with unsustainably large fiscal imbalances can shift abruptly, with adverse effects on debt dynamics." It also refers to the high corporate savings and declining household savings due to demographic change and stagnating wages. Although the private saving remains high, the composition has changed. Hoshi and Ito (2012) claim that the private saving supporting the government fiscal imbalances has a ceiling and summarizes literature in this field all pointing at the dire situation of the Japanese government

debt position. Doi, Ihori, and Mitsui (2006) discuss the sustainability of the Japanese government debt situation by focusing on the JGB market and suggests that "[t]he fiscal authority has an incentive to default when the amount of debt outstanding is more than a certain level." It also touches on the "non-Keynesian effects", where several countries have experienced growth in private demand under tight fiscal policy.

Additionally, credit rating agencies such as Standard and Poor's and Moody's have continuously downgraded the Japanese sovereign rating. Standard and Poor's lowered the sovereign rating of Japan to AA- in January 2011 claiming that the Japanese government would not achieve a primary balance before 2020 unless a significant fiscal consolidation program is implemented (S&P, 2011). Standard and Poor's changed the credit outlook of Japan from stable to negative in April 2011 reflecting the increased fiscal difficulty incurred by the Great Tohoku Earthquake in March 2011. More recently, Moody's downgraded the Government of Japan's debt rating from Aa3 to A1 with a stable outlook in December 2014 (Moody's, 2014). The agency cites as the reason both the increased uncertainty of achieving debt reduction goals and the uncertainty over the effectiveness of the growth strategy, which is the "Third Arrow" of Abenomics.

II.7 The Fiscal Investment and Loan Program (FILP) of Japan

Information on the FILP can be obtained in the official FILP report published by the Japan Ministry of Finance. Doi and Hoshi (2002) examine the financial health of the FILP agencies by studying the financial conditions of the FILP recepients and concludes that "many are de facto insolvent" (Doi & Hoshi, 2002, p.1). Iwamoto (2002) states, following Doi and Hoshi (2002), "[t]he already created loss is unavoidable. What is important for

the current decision making is how not to produce a further welfare loss in the future FILP programs."

Tomita (2000) summarizes the need and the purpose of the FILP reform. He states that the FILP was a policy tool to mitigate failures of financial markets in its inability to provide long term risk money but a new concern has emerged about the "political failures" that the FILP may have not kept up with the socio-economic changes and that it may "have placed a burden on future generations". Iwamoto (2002) similarly concludes that the FILP needs to be changed to fit "the well-developed market economy".

Watarase (2007) studies the FILP from the perspective of the flow of funds and concludes that the "private to public" flow has not changed despite the FILP reform because private financial institutions still make a large amount of JGB investments. He also points out that Postal Savings, Postal Insurance, and Public Pensions were forced to purchase JGBs between 2001 and 2007 as a means of smoothing the transition of financing mechanism for the FILP agencies from loans to JGBs.

III Theoretical debate on the FTPL

The FTPL is an unorthodox theory in many economists' eyes and has provoked many discussions, some of which I summarize in this chapter. The discussions are mainly around the interpretation of the fiscal equation, the restriction on the right hand side of the fiscal equation, types of government debt, and existence of money. Lastly I discuss where the fiscal and the monetary frameworks diverge and where they do not.

III.1 Interpretation of the fiscal equation

Buiter (2001) claims that "if default is ruled out, budget constraints ... must be satisfied for all admissible values of the economy-wide endogenous variables" and that this is "an economic misspecification" of the FTPL. Bassetto (2002) also says that the difference in interpretation of the government budget constraint "has spurred the major controversy".

Cochrane argues that the fiscal equation is an equilibrium condition. Cochrane (2005) uses an example of currency reform where a government doubles the nominal debt and monetary base without changing the future surplus stream and argues that the price level must double in the new equilibrium.

Bassetto (2002) agrees with Cochrane because the fiscal equation's equality is violated "[f]or prices that are out of equilibrium". Rather, he considers the government's ability to sell and the households' willingness to buy the "right" amount of debt as the true constraint.

III.2 Restriction on the right hand side of the fiscal equation

It is clear that in (2) that the right hand side value must be positive in order for the equation to hold because all the variables on the left hand side must be positive by definition. Buiter (2001) calls this an arbitrary constraint imposed by the FTPL on a pricing kernel for government bonds.

Bassetto (2002) argues that "in any game in which lending is voluntary, it is impossible for the government to unconditionally adhere to a target level of taxes that falls short of spending." Cochrane (2005) extensively uses the term "transversality condition" to imply a similar restriction that the outstanding debt must converge to zero but Bassetto (2002) argues that "the transversality condition plays no special role in our analysis" because "it is impossible to unconditionally commit to a sequence of taxes and government spending that involves a primary deficit even in a single period." For him, the most important condition to be met is for the households to be "willing to lend the 'right' amount of resources," which requires the government's commitment to generate future surpluses even for a single period deficit.

Bassetto (2002) discusses "the possibility that the private sector may force the government to adjust its budget plans by not purchasing its debt." The households' unwillingness to purchase the government debt could lead to a debt crisis and the government would need to commit to increasing surpluses without an offsetting move in the future. That is, the government would be forced to increase the value of the right hand side of the fiscal equation (2). Cochrane (2011a) extensively discusses a very similar situation as a potential "run on the dollar", which could happen if the households "become convinced

that our government will end up printing money to cover intractable deficits".

What Bassetto and Cochrane discuss as a debt crisis or a run is the potential consequences for the variables' going out of the "restricted domain of existence" described by Buiter. That is, the fiscal equation as an equilibrium condition drives up the price level when the right hand side value decreases toward zero and would not be able to determine any price level once the right hand side value reaches zero. The right hand side value decreases not only because of the decline in the expected future surpluses but also because of a higher discount rate applied to calculated the expected present value. This dissertation discusses this issue in Chapter V.1.

III.3 Debt types

Cochrane (2005) considers nominal debts equivalent to corporate equities. When a company issues equity stocks, it is obliged to pay dividends from the future profit streams which should not be directly affected by the fact of equity issuance. The company does not have to pay more dividend. Instead, it only needs to pay the same amount of total dividend to more stock holders. On the other hand, if a company borrows money in notes, loans, or any other form of debts, the company has to generate resources to pay back the debt. In the case of a government, a nominal debt is similar to corporate equities because the government only needs to print money to pay back what it borrows. However, on the other hand, a real debt for a government is similar to corporate debts because the government needs to generate real resources to pay back.

Buiter (2001) calls it another arbitrary constraint of the FTPL on the government debt composition. He argues that "there is no FTPL if there is only index-linked government

debt or if all government debt is foreign currency denominated." Bassetto (2002) concludes that "when government debt is denominated in a unit of account rather than in real terms, the fiscal policy can be used to select the value of the unit of account" and this is, in a sense, in agreement with Buiter's argument.[7]

The channel from a fiscal action to a possible inflation is what is discussed by Sargent and Wallace (1981). When the government's real debt amount increases without accompanying future real surplus increases, the government needs to raise real income somewhere and such income source is typically the seigniorage income. The government will print more money and the general price level is expected to rise due to the increase in money stock.

When there's no nominal debt of the government, what would the FTPL tell? As money is treated equivalently in the FTPL framework, it means that the real value of money must be equal to the expected present value of future government surpluses.

III.4 Prices with no money

An extreme case of the FTPL is a cashless economy and the general price level can still be determined by the ratio of the nominal value of the debt and the money to the expected present value of future government surpluses.

Buiter (2001) argues that the FTPL is "[a] theory capable of pricing phlogiston, something that does not exist except as a name" and calls it "an intellectual bridge too far".

Rogers (2006) accepts the fiscal equation as an equilibrium condition but argues that

[7] Bassetto (2002) claims that he only needs "the government commitment to exchange maturing bonds and money at par ... in reproducing the results I obtained here." This is exactly what is assumed in the model used in this dissertation.

"Cochrane is forced to change the concept of money, and along with it the concept of the price level." Citing Patinkin, he argues that there are two kind of prices:

> The abstract unit of account for purposes of record keeping but which had no physical existence – we could follow Buiter and call it phlogiston – and fiat money that acts as the physical medium of exchange. (Rogers, 2006, p.17)

Following Patinkin, he calls those two prices "accounting prices and money or absolute prices" and employs the general price level definition proposed by Patinkin, $p = \sum_{j=1}^{n-1} w_j p_j$, where the n^{th} good is the fiat money. He concludes that the FTPL "does not determine the price level as defined in monetary Walrasian general equilibrium models or as measured by the GDP deflator or CPI" (Rogers, 2006, p.22).

While there are some misunderstanding of the FTPL,[8] Rogers' argument around the concept of a 'price' is an interesting one. The general price level is in fact defined in many macro and micro economics text books along Patinkin's definition. In the FTPL, however, the general price level is determined first by the ratio of the nominal market value of the government debt to the expected present value of the government's future real surpluses without any information on the prices of goods. This introduces an interesting issue: Patinkin's equation must hold but there is no clear and explicit guarantee that the general price level calculated by Patinkin's equation and that by the fiscal equation would be the same.

All prices in the cashless extremity of the FTPL are in fact abstract units called an accounting price. This may look odd in the traditional cash based economy but may in-

[8] Particularly on page 21 of Rogers (2006), where he discusses the mathematical identity between stock and bonds and the absence of nominal interest rates in the FTPL.

stead appear natural in the future with further financial innovation. Money is becoming an abstract unit, most of which we only see in our banking or security brokerage statements. From that sense, the purchasing power of households need not be measured by or backed by money. It may as well be backed by other credible assets such as government bonds stored in the households' banking or security brokerage accounts. Cochrane (2001) argues that "fiscal price level determination is immune to financial innovation" because "agents can create and trade claims to government debt or banknotes with no effect on a fiscally-determined price level."

III.5 The FTPL with money stock or interest rate target monetary rules

McCallum and Nelson (2006) analyze the similarities and the differences between the monetarist framework and the FTPL. They argue that there is no difference between the two frameworks "on how excess [nominal aggregate] demand pressures are transmitted to the inflation rate."[9] Rather, the difference is "on what factors trigger expansion of nominal aggregate demand" and "the FTPL can be thought of as an attempt to provide a model that can generate explosive behavior of velocity."

The FTPL typically does not employ "any nonstandard specification of money demand" and money and prices generally move together. "Arbitrary divergence between money and prices can then only occur in equilibria that produce explosive behavior of the nominal interest rate". The monetarist and the FTPL results drastically differ in the monetary rules with constant or exogenous money stock while there is no practical difference between the two in the monetary rules with target interest rate as "[m]oney and prices do

[9] As Chapter II.1 shows, both monetary and fiscal equations indicate a higher price level with an increase in money, *ceteris paribus*.

not diverge in equilibria" (McCallum & Nelson, 2006).

With the constant money stock rule, the money demand function can be written as

$$m - p_t = \gamma + \alpha(\mathrm{E}_t\, p_{t+1} - p_t), \quad \alpha < 0,$$

which can be solved for p_t, with a conjectured solution $p_t = \phi_0 + \phi_1 p_{t-1}$. Since m and γ are constants, one can show $0 = \alpha{\phi_1}^2 + (1-\alpha)\phi_1 = \alpha\phi_1\{\phi_1 - (1-\alpha)/\alpha\}$. The traditional solusion is $\phi_1 = 0$ but FTPL exponents "emphasize instead $\phi_1 = (\alpha - 1)/\alpha > 1$" (McCallum & Nelson, 2006, pp.8–9). Obviously p_t explodes in the FTPL solution while stays constant in the monetarist framework. Buiter (2001) also argues "[i]f, with a constant nominal money stock, the price level were to start off below its steady-state value, it would decline towards zero. The stock of real money balances would go to infinity".

One might argue that it is natural for the FTPL with money stock rules to generate unstable equilibria because money stock is only a subset of the government debt. Focusing on and trying to control a portion of the overall government debt may have unstable consequences. For example, the central bank's open market operation to control the quantity of money will inevitably affect the nominal interest rates, which will in turn unintentionally affect the level of inflation.

On the other hand, with the monetary policy with interest rate rules, there is no practical difference in the solutions and money growth and inflation move together even in the FTPL. In this regard, "the FTPL can be regarded as an account of how excessive monetary expansion comes about, not as an alternative to the monetary explanation of inflation" (McCallum & Nelson, 2006, pp.10–11).

McCallum and Nelson (2006) review the monetary-fiscal interaction from the monetarists' perspective and argues:

> Monetarists have observed that in peacetime practice, the more likely conditions for deficits to trigger money creation occur if the central bank pegs or stabilizes the nominal interest rate, thereby offsetting pressure on the nominal interest rate that arises from deficits. (McCallum & Nelson, 2006, pp.12–13).

If the central bank tries to stabilize the interest rate while the fiscal authority expands its debt base, the central bank will be forced to execute indirect monetization, which will consequently increase the monetary base. Thus, under the interest rate rule, the monetarist and the FTPL solutions do not practically differ. That is, the channels may be different but the starting point (debt increase) and the end point (inflation) are the same.

III.6 Summary of theoretical debates

I summarize the theoretical debates on the FTPL discussed in this chapter as the following.

First, most economists view the fiscal equation as an equilibrium condition, rather than a constraint.

Second, the fact that the right hand side of the fiscal equation has to be positive in order for the price determinacy under the fiscal dominance is viewed as an arbitrary constraint by some economists but viewed as a boundary beyond which a debt crisis would occur by Bassetto and a "run" would occur by Cochrane.

Third, the FTPL's ability to determine the general price level even in the absence of money is viewed as an anomaly by some economists but many seem to accept the concept

of a price measured in the unit of account. However, there is an interesting challenge to connect the prices of all individual goods and the general price level.

Fourth, the government debt types matter as the FTPL requires the existence of either nominal bonds or money for price determinacy. Some view this again as an arbitrary constraint imposed by the FTPL.

Fifth, the monetarist framework and the fiscal framework are not dissimilar when the monetary rules target at interest rate while they are dissimilar when the monetary rules target at exogenous or fixed money stock.

IV Empirical analyses

In this chapter, I show that the Japanese historical experience is explainable by the FTPL and, thus, it is not a "puzzle" if the FILP and the loans are properly accounted for. There were implied surpluses, instead of deficits as the primary balance history shows, during the first decade of the 21st century when the FILP is included in the scope of the government and the loans are included in the definition of government debt. Therefore, it is reasonable to expect a steady price level and a calm government debt market. However, the same explanation is not possible if the FILP and the loans are excluded from the analysis, which shows the history of implied surplus very similar to that of the primary balance and, therefore, suggests a higher inflation and a troubled debt market.

IV.1 Definition of surplus, debts, and the government

In order to shed some light on the fiscal conditions in Japan, it is beneficial to revisit the definitions of surpluses and debts and the scope of the government of Japan. I use implied (or economic) surpluses derived from the change in values of debts including both bonds and loans. I also consider the FILP agencies as a part of the government of Japan.

IV.1(a) Scope of the government and its debts

Most researches including Doi (2000) use the central government as the definition of government in their analyses. On the other hand, Hoshi and Ito (2012, pp.4–5) suggest the following three different definitions of government debts, which implies multiple definitions for the scope of the government as well.

1. JGB (including the FILP bonds), long term borrowings, TB, and explicit government guarantees.
2. JGB (excluding the FILP bonds) and local government bonds.
3. JGB (excluding the FILP bonds), TB, explicit government guarantees, and liabilities in the social security funds.

The first is used for reports to IMF while the third is used for National Income Accounting.

This research defines the government as the combination of the central government, the BoJ, and the Fiscal Investment and Loan Program (FILP) agencies. The FTPL treats central banks as a part of the government because it focuses on the public sector's debts to the private sector and the monetary base is a part of what the government owes to the private sector.[10] All kinds of borrowed money such as bonds, bills, and loans are included in debts. On the other hand, government sponsored pension assets and liabilities and other implicit, or hidden, debt of the government are excluded from definition of debt in this analysis. An important and interesting characteristic of pension liabilities is that it is a real debt, instead of a nominal debt, in most advanced countries. That is, the liability is adjusted according to the general price level in order to maintain the purchasing power of pensioners. This calls for a special treatment in the FTPL framework and I regard the pension as a part of government's recurring social security expenditure. Implicit government guarantees are a contingent liability of the government and it should also be regarded as a part of government's recurring expenditure in this analysis for simplicity.

[10]Thus, the total value of the government debt does not change when the BoJ conducts monetary operations by buying or selling JGBs in the market. Please refer to Cochrane (1999, 2001, 2005, 2011b) for more detailed discussion on this point.

IV.1(b) Treatment of the FILP in this dissertation

This dissertation includes the FILP in the scope of the government for three reasons. First, the FILP is too big to be ignored. As Figure IV-1 shows, the amount of funds that go through the FILP is comparable to the central government. Second, the FILP agencies' investments are made as an integral part of fiscal policies to support the creation of future tax base, just like ordinary spending by the general account. As MoF (2014) says, the FILP is a tool of fiscal policy and its plan is annually submitted to the Japanese Diet for deliberations and resolutions.[11] Third, the FILP agencies are closely linked with various special accounts of Japanese government budget.

One might argue that some FILP agencies make investments and not just expend the funds and therefore the FILP should be treated differently from the central government. In other words, there is an argument that the FILP liabilities are backed by the FILP's investments. However, the FILP financial agencies are making those investments for policy reasons rather than for economic return reason and Doi and Hoshi (2002) claim that many of the FILP agencies' investments are insolvent and that they are supported by taxpayers. In addition, a government spends money with an intention to collect the money with some "interest" to cover its cost of debts. That is, a government cannot run perpetual deficits. If, and when, people come to believe that the government will not earn enough surpluses in the future, they realize there will be more government's debts in the market than they need to pay the taxes in the future and they will try to get rid of them, causing a "run" on the government (Cochrane, 2011a). From this perspective, all government's

[11] This is also evidenced by the most recent stimulus package announced by the Japanese government on January 9, 2015, where the government announced 3.1 trillion yen of additional spending from the general account accompanied by 0.1 trillion yen increase in the FILP.

spending must be considered backed by future tax income in a stable economy. Then, there is not much difference between the central government's activities and those of the FILP agencies.

IV.1(c) The FILP reform in 2001

The FILP was set up to provide financial support to long term infrastructure investments and other areas where private investment was not sufficient. Funds from Postal Saving, Postal Insurance, and Public Pension were deposited at the Trust Fund Bureau (TFB) of MoF, which in turn lent those funds to the FILP agencies.[12] The FILP agencies also borrow funds directly from the private financial institutions.

The Japanese government was quite "big" because of the FILP agencies and their associated special account budgets. Further, the FILP has become obsolete as Iwamoto (2002) says "[a] system that worked very well in a postwar reconstruction period stumbled in recent times. The system has to be changed so that it fits the well-developed market economy."

The Liberal Democratic Party (LDP) recovered the premiership back from the coalition of "anti-LDP" parties in 1996. The FILP reform discussion was started and Outline for Fundamental Reform of the Fiscal Investment and Loan Program was published in November 1997[13] and a detailed blueprint was announced in August 1999.[14] Legislation to abolish the Trust Fund Bureau was passed in May 2000 to be effective from April

[12]Postal Insurance also made direct loans to the FILP agencies. Doi and Hoshi (2002, p.39) has a detailed visual description of the flow of funds.

[13]Please see www.mof.go.jp/english/about_mof/councils/fund_operation/e1a028.htm

[14]"Zaisei toyushi no bapponteki kaikaku ni kakaru giron no seiri" in https://www.mof.go.jp/about_mof/councils/unyosin/report/1a1503.htm

2001.[15] At the same time, the direct flow of fund from the public pension to the FILP was stopped by the legislation in 1999.

Mr. Koizumi became the prime minister in April 2001 and carried through the reform. His main focus was to privatize Postal Saving and Postal Insurance so that they invest their customers' funds just like other financial service providers. The abolishment of TFB was meant to require the FILP agencies to secure their own fundings but this part of reform was not fully executed as the FILP agencies now finance themselves mostly by issuing the FILP bonds under full guarantee of the government, which are perfectly fungible with regular JGBs. Therefore, the amount of JGB issuance grew substantially from 2001 to compensate for the decline of the loan channel.[16] Figure IV-2 shows how this switch from loans to bonds took place and the total funding decreased. Postal Saving and Postal Insurance, together with Public Pension, are significant investors of JGBs. Thus, the funds are still flowing from Postal Saving, Postal Insurance, and Public Pension to the FILP agencies but now in the form of bonds rather than loans. That is, the flow of funds from the private sector to the FILP agencies was only transformed from loans to bonds and, thus, the total amount of fund flowing to the FILP has not declined so much as the portion of fund in the form of loans has.

IV.1(d) Implied (or economic) surplus

The government collects money in one way or another, mostly by tax, and spends it to provide necessary pubic services. The inflow and outflow of money must be balanced

[15] For the more graphical but official description of the FILP reform in English, please see www.mof.go.jp/english/filp/filp_report/zaito2011/pdf/p07-1.pdf

[16] There is a little amount of bonds issued by the FILP agencies with their own credit but the majority of the funding is done through the FILP bonds.

in the long run but there is a surplus or a deficit in each year. One way to measure those surpluses is the sign and the magnitude of the primary balance. I use the implied surplus following Cochrane (1999) based on an accounting identity in which the change in borrowing must be equal to the surplus. For example, if a company borrows 100 in year t at an interest rate of 10% per period and has only notional 90 debt outstanding at $t+1$, the debt should have grown to 110 with the accrued interest but is in fact 90 and this reduction of 20 in debt must come from somewhere, which I call the surplus.[17]

The accounting identity holds also in real terms and Cochrane (1999) writes

$$s_{t+1} = v_t r_{t+1} - v_{t+1}, \tag{5}$$

where s_{t+1} denotes the real surplus for the period from t to $t+1$, v_t the outstanding real value of debt[18] at time t, r_{t+1} the real interest rate on the debt from t to $t+1$. That is, v grows from v_t to $v_t r_{t+1}$ with the real interest rate r_{t+1} and the difference between this value and the actual real value of debt v_{t+1} at time $t+1$ is the surplus s_{t+1} from t to $t+1$. This implied (or economic) surplus s_t is used throughout this dissertation.

IV.2 Data and variables

I analyze the period from 1981 to 2014 based on three sources of data; Flow of Funds report from the BoJ[19], SNA(System of National Accounts of Japan) from Cabinet Office[20],

[17] What if the market value of the debt comes down from year t to $t+1$? It still means there is less to be returned to the creditors and I consider it as a surplus generated by a proper debt management, or by a pure luck.

[18] The debt values are netted within the government before surpluses are calculated.

[19] www.stat-search.boj.or.jp/index_en.html

[20] www.esri.cao.go.jp/en/sna/menu.html

both based on 93SNA, and information on the websites of MoF.

IV.2(a) Flow of Funds report

The report is compiled and published by the BoJ on the market value basis wherever possible and the numbers for the Japanese fiscal year end (March) are used for all entries. The data taken from the Flow of Funds report are: bonds, discount bills, loans, the FILP fund, financial assets, and the monetary base. For further description and the complete listing of data series, please refer to Appendix A.

IV.2(b) National Accounts of Japan

Cabinet Office of the government reports these figures on a quarterly basis. Two annual series are taken: H21 Series which covers from March 1981 to March 2010 and H24 Series which covers from March 1995. H24 Series is used where possible and H21 Series is simply rescaled in March 1995 and used for 1981 to 1994. The data taken from the National Accounts of Japan are: deflator (GDP deflator, 100 in the calendar year 2005), consumption (annual nominal consumption for both public and private sectors), and the primary balance (reported in SNA as net government lending after adjustment for interest payments).

IV.2(c) MoF websites

The weighted average outstanding nominal yields of JGBs are obtained from the MoF website.[21] This weighted average is calculated only for JGBs and excludes discount secu-

[21] www.mof.go.jp/jgbs/reference/appendix/zandaka05.htm

rities (TBs). TB yields are obtained from another page using the 1 year point on the yield curve.[22]

IV.2(d) Variables

The following variables are constructed from the above data following Cochrane (1999). More detailed discussion on the variables are in Appendix B.

v_t: Real value of government debts held by the private sector, constructed from the Flow of Funds report on the basis of market values. Values are converted to real numbers by the GDP deflator.

π_t: Inflation π_t is defined by the *ex-post* change of GDP deflator from time $t-1$ to t. I.e., $\pi_t = P_t/P_{t-1}$.

r_t: Real return of government debt portfolio from $t-1$ to t calculated from the weighted average nominal yield of the government's total debt portfolio and the inflation. The inflation from $t-1$ to t (π_t) is then subtracted from this weighted average rate to produce r_t.

sc_t: Surplus implied by the change in the government debt value and the interest rate, as expressed in (5), is divided by consumption for normalization following Cochrane (1999, p.361).

vc_t: Privately held government debt value is divided by consumption for normalization.

dc_t: Real growth of consumption from $t-1$ to t.

[22] www.mof.go.jp/jgbs/reference/interest_rate/data/jgbcm_all.csv

Further, vc_t and dc_t are log linearized around their steady states (sample means) but sc_t is a simple deviation from the sample mean as the value can be negative.

Figure IV-3 shows the history of weighted averaged rates used in the analysis for the case including loans. Nominal rates were high in the 1980s and continued to drop while real rates did not fall as much because of deflation. The sudden drop in real rates toward the end of 1980s is a result of spiking inflation.

IV.3 Implied surpluses

IV.3(a) Graphical analysis

Figure IV-4 compares the primary balance reported in SNA to the implied surplus s_t in (5). s_t, including the FILP and the loans, fluctuates more than the primary balance but the overall fit seems reasonable. The correlation between the two series is 0.78 before year 2000 and 0.91 thereafter. It is important to note that the implied surplus is mostly positive during the first decade of this century, which is consistent with flat or slightly decreasing trend of total debts presented in Figure I-1. The series excluding the FILP and the loans is much closer to the primary balance in terms of the level but the correlation after the FILP reform drops to 0.46. Additionally, it should be noted that the fluctuation of the implied surpluses is larger than that of the primary balance, which appears intuitive because the implied surplus is more inclusive.

Figure IV-5 summarizes the evolution of implied real surplus, real debt value, and the weighted average real interest rate of government debt portfolio. The figure looks very similar to Figure 8 in Cochrane (1999, p.364) as the surplus and the debt growth

correlate negatively. Real interest rates were high in 1980s and 1990s with a sudden drop in late 1980s due to high inflation during the peak of the economic bubble. Real debt value was growing fast in 1980s and 1990s due to both high interest rates and negative surplus (deficit). Interest rates kept falling and the real debt value was stable during the first decade of this century due to lower interest rate and surplus including the FILP. The Global Financial Crisis in 2008 and the Great Tohoku Earthquake in 2011 brought the Japanese government again into deficit and the real value of government debt has shown a rapid growth since 2009.

IV.3(b) Correlation analysis

The next task is to analyze the observed relationship among the surplus, the real value of the government debts, and the real return on the debts.

The fiscal framework views the identity (5) as the following.

$$r_{t+1} = \frac{s_{t+1}}{v_t} + \frac{v_{t+1}}{v_t} \tag{6}$$

The future surpluses determine the real value of the government debts in the FTPL. Thus, (6) determines the real return of the privately held government debts with the information on the future surpluses, which in turn determines the inflation from the nominal yield so that the Fischer equation holds. This relationship suggests positive correlations between r_{t+1} and s_{t+1}/v_t and between r_{t+1} and v_{t+1}/v_t (Cochrane, 1999, p.366).

On the other hand, the monetary framework views the same identity (5) differently. In the monetary framework, the price level is given by (1) and this will derive the real

value of the government debt v_{t+1} from its nominal value. Then the government adjusts the value of surplus s_{t+1} to satisfy the identity shown in (5). Thus, (5) is also interpreted as the derivation equation for s_{t+1}. Cochrane rewrites (5) as

$$\frac{s_{t+1}}{v_t} = r_{t+1} - \frac{v_{t+1}}{v_t}. \tag{7}$$

From the monetary perspective, this equation shows how the surplus as a fraction of debt value is determined by the difference between the real rate of return on the privately held government debts and the growth rate of such debts (Cochrane, 1999, p.364), both of which are determined outside of this equation by the price level P_t set by (1).

Regarding (7), it is expected that s_{t+1}/v_t has a negative correlation with v_{t+1}/v_t. On the other hand r_{t+1} should have a positive correlation with v_{t+1}/v_t as v_t should grow at r_{t+1} assuming balanced government budget. Therefore, s_{t+1}/v_t and r_{t+1} should have a weaker negative correlation. (Cochrane, 1999, p.365)

Table IV-1 shows the results for Japan, which have the same characteristics as Cochrane's results reproduced in Table E-1. The Japanese data also seem to support a backward-looking, or a monetary, perspective. Cochrane (1999) shows that this "puzzle" can be solved by a simple VAR analysis for the U.S. case and the same method can also explain the historical time series for Japan if the FILP and the loans are included in the definition of government and its debt.

IV.4 VAR analysis

IV.4(a) Explaining the correlations with a simple VAR

I normalize the variables with consumption following Cochrane (1999) and rewrite (5) as:

$$\frac{v_t}{c_t} = \frac{1}{r_{t+1}} \frac{c_{t+1}}{c_t} \left(\frac{s_{t+1}}{c_{t+1}} + \frac{v_{t+1}}{c_{t+1}} \right)$$

and define:

$$\beta \equiv \mathrm{E}\left[\frac{c_{t+1}}{c_t r_{t+1}} \right].$$

Using the log linearized variables[23] and solving forward, one can derive:

$$vc_t = \mathrm{E}_t \sum_{j=1}^{\infty} \beta^j sc_{t+j}. \tag{8}$$

The surplus is modeled exogenously as the sum of a long term trend component z_t and a cyclical component a_t as the following:

$$sc_t = z_t + a_t, \tag{9}$$

$$\begin{bmatrix} z_t \\ a_t \end{bmatrix} = \begin{bmatrix} \eta_z & 0 \\ 0 & \eta_a \end{bmatrix} \begin{bmatrix} z_{t-1} \\ a_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{zt} \\ \varepsilon_{at} \end{bmatrix} = P \begin{bmatrix} z_{t-1} \\ a_{t-1} \end{bmatrix} + \varepsilon_t.$$

That is, both the long term trend and the short term cyclical components are modeled as AR(1) and there is no other shock element in the surplus. Cochrane views the long

[23] As discussed in IV.2(d), vc_t and dc_t are log linearized while sc_t is a deviation from the sample mean.

term component as driven by policies such as tax and spending. Note that η_z is expected to be close to 1, i.e., z_t should be a persistent process.

Using (9) into (8), Cochrane (1999) writes

$$\begin{bmatrix} sc_t \\ vc_t \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ \frac{\beta\eta_z}{1-\beta\eta_z} & \frac{\beta\eta_a}{1-\beta\eta_a} \end{bmatrix} \begin{bmatrix} z_t \\ a_t \end{bmatrix} = B \begin{bmatrix} z_t \\ a_t \end{bmatrix} \tag{10}$$

and form a simple VAR, represented as

$$\begin{bmatrix} sc_t \\ vc_t \end{bmatrix} = A \begin{bmatrix} sc_{t-1} \\ vc_{t-1} \end{bmatrix} + \delta_t. \tag{11}$$

It is straightforward to show from (9), (10), and (11):

$$A = BPB^{-1} = \begin{bmatrix} \beta\eta_z\eta_a & \beta^{-1}(1-\beta\eta_z)(1-\beta\eta_a) \\ -\beta\eta_z\eta_a & \eta_z + \eta_a - \beta\eta_z\eta_a \end{bmatrix}. \tag{12}$$

There is a structural restriction that (2, 1) element of A, a_{21}, must be negative of (1, 1) element, a_{11}, as Cochrane (1999) mentions and (12) means a_{12} must be positive.

Using the Japanese data including both the FILP and the loans, I obtain point estimations as[24]

$$\begin{bmatrix} \widehat{sc_t} \\ vc_t \end{bmatrix} = \begin{bmatrix} 0.501^{***} & 0.018 \\ -0.558^{***} & 0.990^{***} \end{bmatrix} \begin{bmatrix} sc_{t-1} \\ vc_{t-1} \end{bmatrix} \tag{13}$$

and, using the sample mean,

$$\hat{\beta} = 0.9896.$$

[24] *** indicates the estimate is statistically significant at 1%. t-statistc for the (1, 2) element is 0.95. The result of VAR analyses with and without the FILP are shown in Table E-4 and Table E-6.

Taking the average of the two absolute values for a_{11} and a_{21}, I rewrite:[25]

$$\widehat{A} = \begin{bmatrix} 0.529 & 0.018 \\ -0.529 & 0.990 \end{bmatrix}. \tag{14}$$

From (12), (14), and $\hat{\beta} = 0.9896$, I obtain[26]

$$\widehat{P} = \begin{bmatrix} \widehat{\eta_z} & 0 \\ 0 & \widehat{\eta_a} \end{bmatrix} = \begin{bmatrix} 0.964 & 0 \\ 0 & 0.555 \end{bmatrix} \tag{15}$$

and also the correlation between the innovations ε_{zt} and ε_{za} of -0.60. The estimated values for η_z and η_z and their correlation support the similar data interpretation for Japan as what Cochrane (1999) provides for the U.S. data. That is, the exogenous surplus process with long and short components and a negative correlation between those two components[27] can explain the correlation pattern from the fiscal perspective although the pattern appears more consistent with the backward looking framework of the monetary story.

IV.4(b) Comparison of different analysis scopes

Note, however, that this explanation does not seem plausible when the analysis does not include the FILP and the loans. For the treatment of the FILP and the loans, there can

[25]Cochrane sets a_{21} as the negative of a_{11} for further calculation. Mathematically, $a_{11} < \left(\frac{1}{\sqrt{\beta}} - \sqrt{\frac{1}{\beta} - a_{22}}\right)^2$ has to hold in order for A to be properly determined. This condition would not be satisfied in Cochrane (1999) if the average of the two absolute values were used for a_{11}. Otherwise, it is more natural to use the average given the similar statistical significances of $\widehat{a_{11}}$ and $\widehat{a_{21}}$.

[26]a_{12} is not used for derivation of η_z and η_a but for checking reasonableness. a_{12} calculated from the estimated η_z and η_a into (12) is 0.021, compared with 0.018 in (14).

[27]The negative correlation between the long and the short components of the exogenous surplus process means that the government is reacting to a short term business cycle. Please see Cochrane (1999, pp.368–370).

be four possible combinations: two by two choices whether to include or exclude the FILP and the loans. The analysis results are summarized in Table IV-2. Of the four possible combinations, I discuss the two most plausible combinations: "Both In" and "Both Out".[28]

It is clear that the "both in" case where both the FILP and the loans are included in the analysis is more consistent with the fiscal story than the "both out" case where both the FILP and the loans are excluded. $\widehat{a_{12}}$ is positive in "Both In" but negative in "Both Out". The signs and the relative size for η_z and η_a look appropriate in both cases but η_a is over 1 in "Both Out". Most importantly, the correlation between the innovation of the two surplus components is negative as expected in "Both In" but positive in "Both Out".[29]

IV.4(c) Inflation model

Cochrane (1999) expands the simple VAR discussed above by including dc_t and r_t in addition to vc_t and sc_t but Woodford (1999) argues that r_t is determined by

$$\tilde{r}_t = \rho(vc_t + sc_t) + dc_t - vc_{t-1}, \tag{16}$$

[28] Since the FILP agencies used to rely on funding through loans until the FILP restructuring, there is not much sense in looking at the cases where the FILP is included but the loans are not. Similarly, the majority of the loan funding was used to finance the FILP agencies and, therefore, the case in which the FILP is excluded but the loans are included is not insightful.

[29] Additionally, the implied surplus appears to track the primary balance during the periods both before and after the FILP restructuring in "Both In" whereas the correlation drops materially after the FILP restructuring in "Both Out". There is no theoretical requirement for the implied surpluses and the primary balance to be highly correlated but a high correlation would be a natural assumption.

which is a log-linearized government accounting identity derived from (5) and that a VAR model

$$x_t = \begin{bmatrix} vc_t & sc_t & dc_t \end{bmatrix}' = Ax_{t-1} + \varepsilon_t \tag{17}$$

can describe a complete model of the evolution of those four series, i.e., vc_t, sc_t, dc_t, and $\tilde{r}_t$ together with (16). Thus he writes:

$$\mathrm{E}_{t-1}\,\tilde{r}_t = \xi' x_{t-1} \tag{18}$$

He then introduces the monetary policy

$$R_t = \phi_p \pi_t + z_t = \phi_p \pi_t + \alpha' x_t \tag{19}$$

and an equilibrium condition

$$\mathrm{E}_t\,\tilde{r}_{t+1} = R_t - \mathrm{E}_t\,\pi_{t+1}. \tag{20}$$

(18), (19), and (20) give:

$$\mathrm{E}_t\,\pi_{t+1} = \phi_p \pi_t + \gamma' x_t = \phi_p \pi_t + (\alpha - \xi)' x_t, \tag{21}$$

and his point estimation for the US is

$$\mathrm{E}_t\,\pi_{t+1} = 0.677\pi_t - 0.027vc_t + 0.088sc_t + 0.524dc_t. \tag{22}$$

Doi (2000), using the Japanese data from 1955 to 1997, obtains

$$\mathrm{E}_t \pi_{t+1} = 0.533\pi_t - 0.014vc_t - 0.448sc_t + 0.005dc_t. \tag{23}$$

My estimation for Japan from the VAR model is[30]

$$\mathrm{E}_t \pi_{t+1} = 0.541^{***}\pi_t - 0.001vc_t + 0.014sc_t + 0.424^{***}dc_t. \tag{24}$$

This last estimate for Japan (24) looks similar to Woodford's US estimate (22) compared to Doi's Japan estimate (23) in that the coefficient for sc_{t-1} is positive. Woodford's result in (22) and my result in (24) are intuitively understandable because a higher government surplus and a higher growth both lead to higher expectation of inflation.

Since the point estimates for Japan are from Table E-9:[31]

$$\gamma = \begin{bmatrix} -0.001 & 0.014 & 0.424 \end{bmatrix}'$$
$$\xi = \begin{bmatrix} -0.02 & 0.20 & 0.64 \end{bmatrix}',$$

one can write

$$z_t = \alpha' x_t = (\gamma_{JP} + \xi_{JP})' x_t \approx \xi' x_t + 0.424dc_t = \mathrm{E}_t \tilde{r}_{t+1} + 0.424dc_t$$

[30] *** indicates the estimate is statistically significant at 1%.

[31] ξ is calculated by $\xi' = \begin{bmatrix} \rho & \rho & 1 \end{bmatrix}' A - \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}'$ where ρ is estimated by $\hat{\beta}$ as shown in (13) and A is estimated from Table E-9.

or

$$R_t = 0.541\pi_t + \mathrm{E}_t\,\tilde{r}_{t+1} + 0.424dc_t. \tag{25}$$

(25) is consistent with the argument made by Woodford (1999, p.406): for a given level of current inflation rate, the BoJ will adjust its policy rate higher when the expected real rate or the growth is higher.[32]

IV.5 Chapter conclusion

The FTPL can explain the Japan experience from 1980 to 2014 if the FILP is included in the definition of government and the debt definition includes loans as well as bonds. The data is consistent with the fiscal story assuming an exogenous surplus series consisting of a long term and a short term component with a negative correlation in between. The monetary policy rate appears to be positively affected by both the expected inflation and the economic growth, which is intuitive.

[32]I impose no restriction regarding the zero nominal interest rate boundary in the analysis because the nominal rates used in this analysis are not the over night or other short term interest rates and instead the weighted average coupon rates of JGBs, which were well above zero during the analysis period.

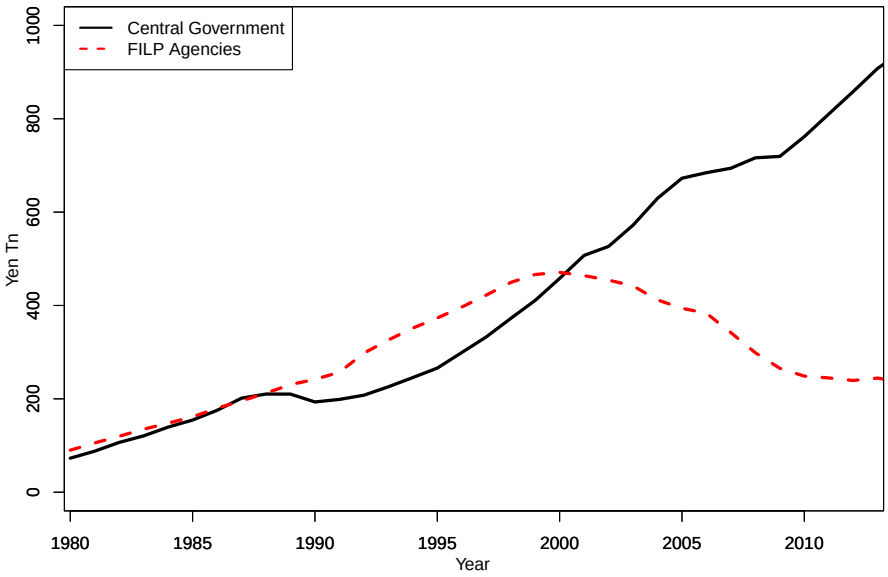

Figure IV-1. Debt comparison between the central government and the FILP agencies: The outstanding debt value of the FILP agencies was the same or more than the debt value of the central government until the FILP reform of 2001.

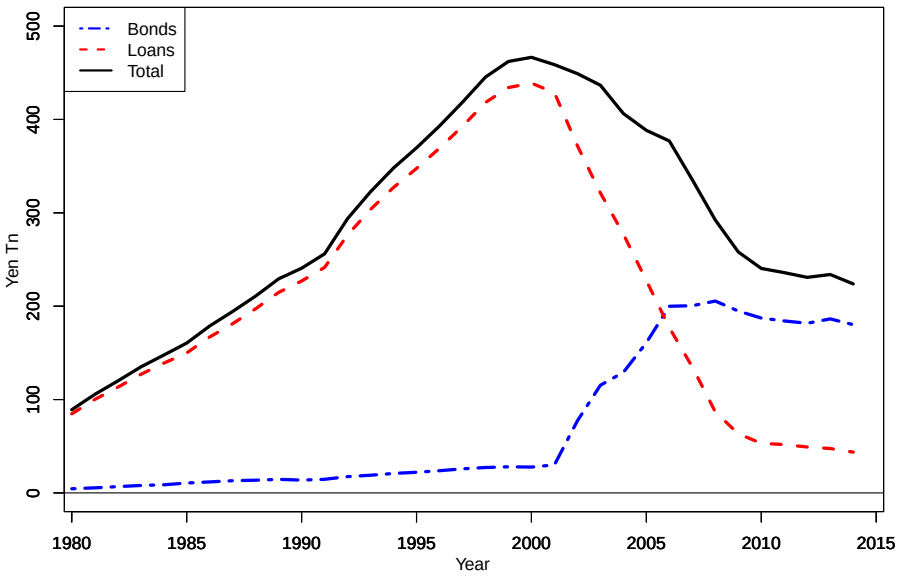

Figure IV-2. Evolution of funding for the FILP financial agencies: the FILP agencies used to fund almost entirely by loans through Trust Fund Bureau and direct loans from Postal Insurance but shifted their main funding channel to the FILP bonds since 2000.

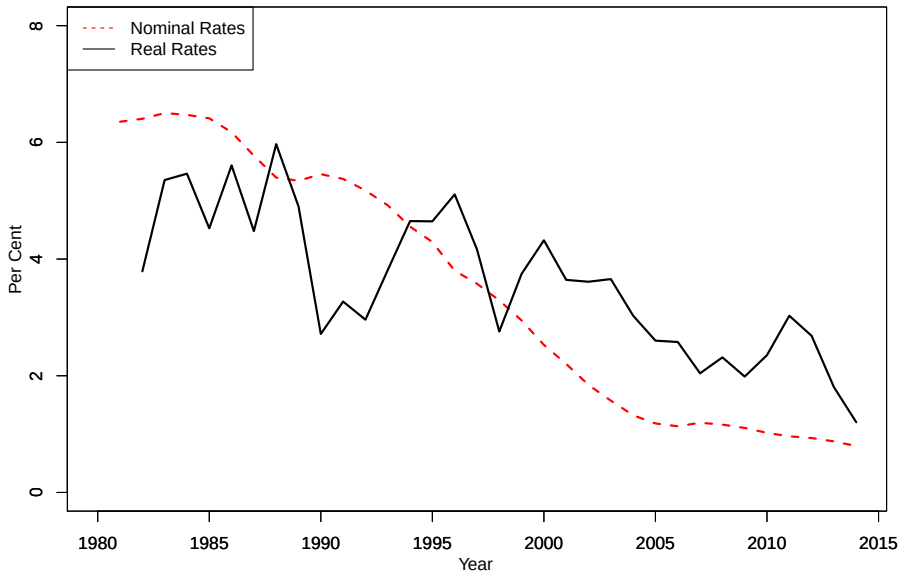

Figure IV-3. Nominal and real rates: Weighted average rates of outstanding bonds, bills and monetary base kept declining throughout the analysis period. The real rate suddenly dropped around 1990 because of the bubble inflation.

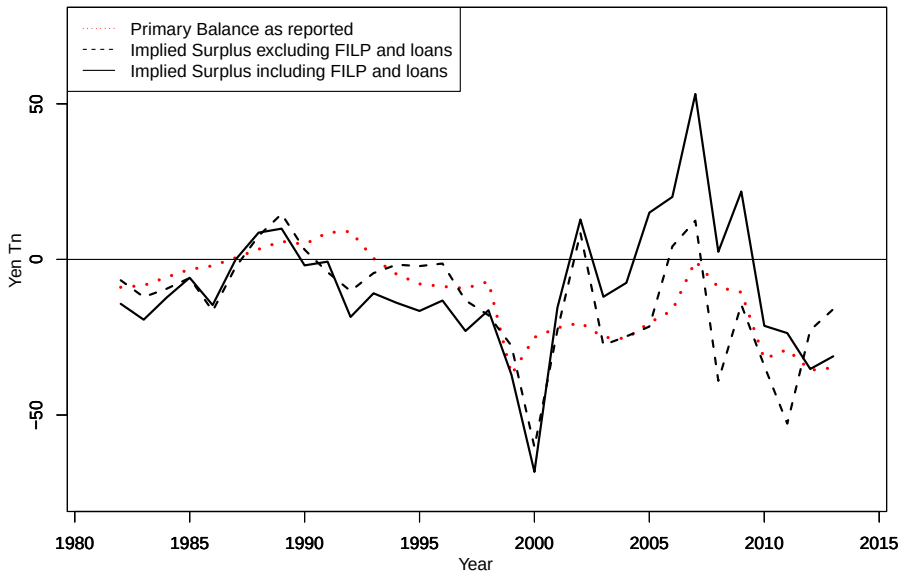

Figure IV-4. Surplus comparison: Implied surplus from the change in debt values has wider variation than SNA reported Primary Balance because it is more inclusive but the innovation patterns are similar. Implied surpluses show clear surplus, rather than deficit, in the first several years in this century when the FILP and the loans are included.

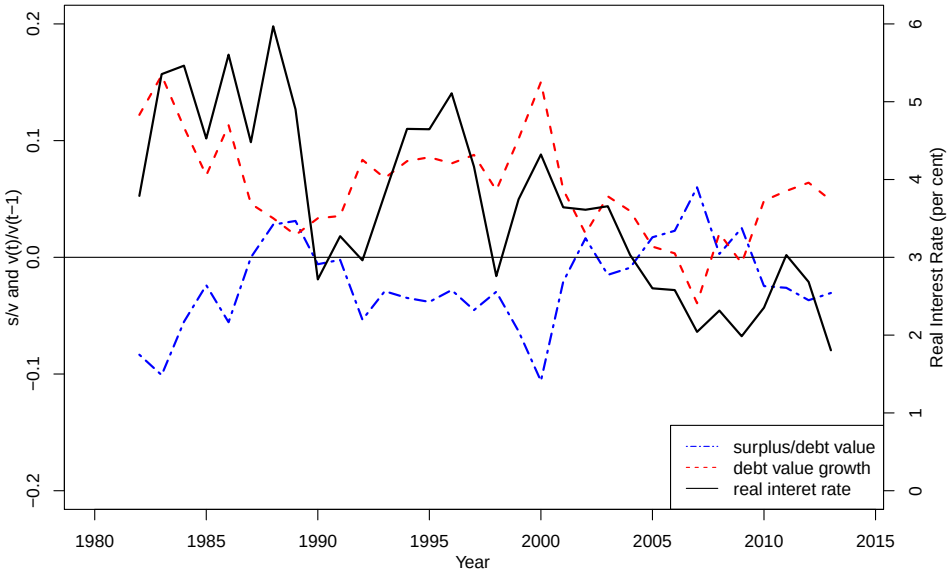

Figure IV-5. Surplus, debt value, and interest rate: Real value of debts was growing fast in 1980s and 1990s with high interest rates and slightly negative surplus. Debt value is more influenced by surplus with declining interest rates from 2000

Table IV-1. Correlations in Japan data

	r_{t+1}	v_{t+1}/v_t	s_{t+1}/v_t
r_{t+1}	1.00	0.58	-0.35
v_{t+1}/v_t		1.00	-0.97
s_{t+1}/v_t			1.00

Table IV-2. Comparison for four possible combinations

	Loan In	Loan Out
	"Both In"	
FILP In	$\eta_z = 0.964, \eta_a = 0.555$	$\eta_z = 1.005, \eta_a = 0.650$
	$\rho_{za} = -0.60, \widehat{a_{12}} = 0.018$	$\rho_{za} = -0.63, \widehat{a_{12}} = -0.005$
	$\rho_1 = 0.78, \rho_2 = 0.91$	$\rho_1 = 0.72, \rho_2 = -0.02$
		"Both Out"
FILP Out	$\eta_z = 1.006, \eta_a = 0.441$	$\eta_z = 1.012, \eta_a = 0.396$
	$\rho_{za} = -0.39, \widehat{a_{12}} = -0.004$	$\rho_{za} = 0.32, \widehat{a_{12}} = -0.011$
	$\rho_1 = 0.82, \rho_2 = 0.79$	$\rho_1 = 0.71, \rho_2 = 0.46$

Notes: η_a and η_z are persistence of the long and short processes in (9).
ρ_{za} is the correlation between the two innovation in (9).
$\widehat{a_{12}}$ is the estimated a_{12} element in (11).
ρ_1 and ρ_2 are the correlations between the primary balance and the implied surplus before and after the FILP reform.

V Fiscal inflation

In this chapter, I discuss two implications of the FTPL framework on the fiscal and monetary policy. I first show the importance of the discount rate applied to the right hand side of the fiscal equation. This discount rate can be viewed as an indicator for the households' confidence in the fiscal authority with respect to its commitment to and capability of fiscal discipline. For countries with current fiscal deficits like Japan, higher discount rates can trigger an extreme scenario of a "run". I then show that, under the fiscal dominance, not only a traditional open market operation by the central bank loses effectiveness, a monetary policy driven by monetary perspectives to control inflation by adjusting the policy rate may result in slower convergence to the steady state and more volatile paths toward convergence.

V.1 The RHS of the fiscal equation and the mechanism for fiscal inflation

The FTPL claims that the real value of all government debts (LHS) must equal to the expected present value of the government's real future surpluses (RHS) in the fiscal equation (2). The discount factor β is exogenously given in the analysis in Chapter IV, and the monetary policy and the debt management policy control the general price levels. On the other hand, for a given set of the monetary and the debt management policy variables, the choice of β will affect the price level by changing the RHS value.[33] If β is low, i.e., when the discount rate $1/\beta - 1$ is high, the RHS value is low and the general price level P_t is high for a given set of the policy variables. For countries with current primary deficits, the RHS value may turn negative depending on the discount rate. For those economies,

[33]This chapter is inspired by a discussion with Professor Miwa of Osaka Gakuin University.

it is critical to understand not only when and how deficits turn to surpluses but also the discount rate with which the surpluses are brought to the present value.

This discount rate is used by the households to discount the future real utilities to the present. For an economy where this discount rate is high, the households do not put much weight on far future and this may be interpreted as the households' uncertainty regarding the future state of the economy.[34] The discount rate should be high if the households do not believe the government's will to control its fiscal conditions or if the market questions the government's commitment to control its primary balance and to honor its debt obligations. A higher discount rate implies the lower expected present value on the RHS. This will cause less appetite for government's debts and increase the aggregate demand, pushing prices higher, which will bring the LHS lower to match the RHS.

If an economy is running and expected to run surpluses, a higher discount rate only means a lower RHS value and a higher price level. However, the RHS will turn negative beyond a certain discount rate when there are fiscal deficits in the near future. The price level will continue to rise as the discount rate rises and eventually diverges because there is no price level that can satisfy the fiscal equation (31) with negative RHS as B_t cannot be negative.

The Japanese government announced its forecast of future primary balances as Table V-1 in February, 2015.[35] Using this forecast for both nominal deficit figures and deflators and assuming the primary balance returns to positive 10 trillion yen in 2015 yen after 2024, the RHS of the fiscal equation, i.e., the present value of future real surpluses, is

[34] There are other factors such as time preference included in this discount factor.

[35] Please see Appendix C for the numbers excluding the reconstruction related expenses and revenues, which are often used for political debates.

calculated with varying real discount rate.

Assumptions used for the simulation are as the following and shown in Table V-2. The real deficit is assumed at the constant value of 15 trillion yen in real term (in 2015 yen) until 2023 in line with the government forecast. Then, the primary balance improves by 5 trillion in real term for 4 consecutive years until it reaches 5 trillion yen surplus in 2027 and then it stays at the same surplus level thereafter. The time horizon is set at 50 years as a reasonable time frame for policy analyses. Figure V-1 shows the result of this simulation.

The present value is, of course, a decreasing function of the discount rate and the value turns negative beyond a certain level of the discount rate. This threshold level depends on the assumed pattern of fiscal recovery but there always is a real discount rate above which the RHS of the fiscal equation turns negative so long as the government is currently running a fiscal deficit. Additionally this threshold rate declines as the size and the expected duration of current primary deficits increase.

Figure V-1 shows that the RHS value declines to about one half when the real discount rate moves from zero to 0.5%. When the RHS declines by the order of one half and the nominal value of the money and the government debts does not change, the fiscal equation claims that the general price level must double. Of course, the nominal value of the outstanding government debts should decline on the left hand side of the fiscal equation but if there is not enough long term government debts outstanding, the nominal value of the government debts cannot change much. Therefore, the real discount rate for the future surpluses does matter. Cochrane argues that it depends on the private demand

for the government debts.[36] He touches on the quantity of the outstanding government debts as a factor for the discount rates. That is, the real discount rate should increase if the government issues more debts. Moreover, one can argue that the discount rate should increase when the market becomes less assured that the government will pay back its debts just as the perceived credit risk affects the credit spread. The riskier the issuer is, the higher the discount rate should be.[37]

V.2 Monetary and fiscal regimes

This section discusses the possibility of harmful consequences of independent monetary policy under the fiscal dominance, drawing on Leeper and Walker (2012).

V.2(a) General framework

Households maximize

$$\mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t u(c_t), \quad 0 < \beta < 1 \tag{26}$$

subject to the flow constraint

$$c_t + \frac{B_t}{P_t} + \tau_t = y + z_t + \frac{R_{t-1} B_{t-1}}{P_t} \qquad \forall t \geq 1, \tag{27}$$

[36] For example, please see Cochrane (2011b, p.11).

[37] As Figure V-1 shows, the RHS value is still positive with the discount rate below 1%. A rational expectation model to explain the endogenously determined discount rate, but this analysis seems to suggest that it is still "rational" for the households to believe the positiveness of the RHS and, therefore, the solvency of the government.

where β is the real discount factor, $u(\cdot)$ is the utility function, c_t is the real consumption, B_t is the nominal value of government debt, P_t is the general price level, τ_t is the tax, y is the constant perishable endowment, z_t is the government transfer, and R_t is the nominal interest rate.

The government also faces the flow constraint:

$$\frac{B_t}{P_t} + \tau_t = z_t + \frac{R_{t-1}B_{t-1}}{P_t} \qquad \forall t \geq 1 \tag{28}$$

and there is a market clearing condition:

$$c_t = y \qquad \forall t \geq 0. \tag{29}$$

The Euler equation for this optimization is:

$$\frac{1}{R_t} = \beta \, \mathrm{E}_t \left[\frac{P_t}{P_{t+1}} \right]. \tag{30}$$

From the government flow constraint (28) and the Euler equation (30),

$$\frac{R_{t-1}B_{t-1}}{P_t} = \frac{B_t}{P_t} + \tau_t - z_t = \beta \, \mathrm{E}_t \left[\frac{R_t B_t}{P_{t+1}} \right] + \tau_t - z_t.$$

Solving forward,

$$\begin{aligned}\frac{R_{t-1}B_{t-1}}{P_t} &= \lim_{n\to\infty}\left\{\beta^n \mathrm{E}_t\left[\frac{R_{t+n}B_{t+n}}{P_{t+n+1}}\right] + \mathrm{E}_t\sum_{j=0}^{n}\beta^j(\tau_{t+j}-z_{t+j})\right\}\\ &= \mathrm{E}_t\sum_{j=0}^{n}\beta^j(\tau_{t+j}-z_{t+j})\end{aligned}$$

with the transversality condition:[38]

$$\lim_{n\to\infty}\left\{\beta^n \mathrm{E}_t\left[\frac{R_{t+n}B_{t+n}}{P_{t+n}}\right]\right\} = 0.$$

Therefore, the inter-temporal constraint for the government is:

$$\frac{B_t}{P_t} = \frac{R_{t-1}B_{t-1}}{P_t} - (\tau_t - z_t) = \mathrm{E}_t\sum_{j=1}^{\infty}\beta^j\left(\tau_{t+j}-z_{t+j}\right). \tag{31}$$

I from time to time refer to (31) as the fiscal equation in this chapter.

V.2(b) Regime M

In the Regime M, an active monetary policy is defined as:

$$\frac{1}{R_t} = \frac{1}{R^*} + \alpha\left(\frac{P_{t-1}}{P_t} - \frac{1}{\pi^*}\right), \quad \alpha > 1/\beta, \tag{32}$$

where π^* is the inflation target and $R^* = \pi^*/\beta$ is the steady state nominal interest rate, obtained by replacing R_t and P_{t+1}/P_t by R^* and π^*, respectively in (30). α indicates the "toughness" of the monetary policy on inflation control. I.e., the policy rate R_t is adjusted

[38] See, for example, Cochrane (2005, pp.508–509).

more to react to any deviation of inflation from its target when α is large. In the other extreme, the policy rate is set independently from deviation of inflation at R^* when α is zero.

Fiscal policy adjusts tax in response to B_t:

$$\tau_t = \tau^* + \gamma\left(\frac{B_{t-1}}{P_{t-1}} - b^*\right), \quad \gamma > r = 1/\beta - 1, \tag{33}$$

where b^* is the real debt target, τ^* is the steady state tax level, and $r = 1/\beta - 1$ is the net real interest rate.

The government transfer is assumed exogenous and follows the process:

$$z_t = (1-\rho)z^* + \rho z_{t-1} + \varepsilon_t, \quad 0 < \rho < 1, \tag{34}$$

where z^* is the steady state transfers and $\mathrm{E}_t\, \varepsilon_{t+1} = 0$ for $\forall t > 0$.

From (30) and (32),

$$\mathrm{E}_t\left[\frac{P_t}{P_{t+1}} - \frac{1}{\pi^*}\right] = \frac{\alpha}{\beta}\left(\frac{P_{t-1}}{P_t} - \frac{1}{\pi^*}\right). \tag{35}$$

Since $\alpha/\beta > 1$, the unique bounded solution is:

$$\pi_t = \pi^*, \tag{36}$$

which implies that the inflation is always on its target.[39]

[39]There are a range of explosive unbound solutions as well as Leeper and Walker (2012, p.9) discusses.

V.2(c) Regime F

Political factors may prevent taxes from rising as needed to stabilize debts. Or, monetary authority's focus shifts from price stability to output stability or financial market stability after a crisis, where the monetary authority may be only weakly adjusting the nominal interest rate. Leeper and Walker (2012) assume $R_t^{-1} = R^{*\,-1} \geq 1$, that is, the nominal interest rate is set independently of inflation; $\tau_t = \tau^* > 0$, that is, taxes are set independently of debt level; and $\alpha = 0$ and $\gamma = 0$. They call this framework the Regime F, i.e., the fiscal dominance, for simplicity.

Then

$$\mathrm{E}_t\left(\frac{P_t}{P_{t+1}}\right) = \frac{1}{\beta R^*} = \frac{1}{\pi^*}. \tag{37}$$

That is, the expected inflation is anchored on the inflation target.

However, by imposing the tax rule on (31), one obtains

$$\frac{B_t}{P_t} = \frac{\beta}{1-\beta}\tau^* - \mathrm{E}_t \sum_{j=1}^{\infty} \beta^j z_{t+j}. \tag{38}$$

With the flow constraint (28),

$$P_t = \frac{R^* B_{t-1}}{\frac{1}{1-\beta}\tau^* - \mathrm{E}_t \sum_{j=0}^{\infty} \beta^j z_{t+j}}. \tag{39}$$

Rewrite (34) as, by letting $e_t = z_t - z^*$,

$$e_t = \rho e_{t-1} + \varepsilon_t. \tag{40}$$

Assuming $\mathrm{E}_t[\varepsilon_{t+j}] = 0$ for all $j > 0$, $\mathrm{E}_t[e_{t+j}] = \rho^j e_t$. Then,

$$\begin{aligned}
\mathrm{E}_t \sum_{j=0}^{\infty} \beta^j z_{t+j} &= \sum_{j=0}^{\infty} \beta^j \, \mathrm{E}_t \, e_{t+j} + z^* \sum_{j=0}^{\infty} \beta^j \\
&= \sum_{j=0}^{\infty} (\beta\rho)^j e_t + z^* \sum_{j=0}^{\infty} \beta^j \\
&= \frac{e_t}{1-\beta\rho} + \frac{z^*}{1-\beta}. \qquad (41)
\end{aligned}$$

By combining (39) and (41), and defining $\eta = \frac{1-\beta}{1-\beta\rho}$, $s^* = \tau^* - z^*$, and $\phi_t = \frac{B_t}{B_{t-1}}$ as the growth rate of government debts' nominal value,

$$\begin{aligned}
\pi_t &= \frac{P_t}{P_{t-1}} \\
&= \frac{R^* B_{t-1}}{\frac{1}{1-\beta}\tau^* - \mathrm{E}_t \sum_{j=0}^{\infty} \beta^j z_{t+j}} \frac{\frac{1}{1-\beta}\tau^* - \mathrm{E}_{t-1} \sum_{j=0}^{\infty} \beta^j z_{t-1+j}}{R^* B_{t-2}} \\
&= \frac{B_{t-1}}{B_{t-2}} \frac{\eta e_{t-1} + s^*}{\eta e_t + s^*} = \phi_{t-1} \frac{\eta e_{t-1} + s^*}{\eta e_t + s^*}, \qquad (42)
\end{aligned}$$

In the steady state, assuming $e_t = e_{t-1} = 0$, the inflation rate π_t equals the debt growth rate ϕ_{t-1}. Therefore, in the Regime F, the monetary policy sets the expected inflation by choosing R^* while the fiscal policy determines the realized inflation by setting τ^* and, more importantly, ϕ.

Leeper and Walker (2012) interpret this result as the following. First, an increase of z_t is financed by an increase of B_t with no offsetting current or expected tax τ. This makes households feel wealthier and shift up their consumption path. Then, the price starts to rise and continues to do so until the wealth effect from increased transfer z_t dissipates.

This is why B_t/P_t in (38) does not change with z_t but it does with future z_{t+j}. If the future transfer is expected to change, then the households feel wealthier even though z_t and B_t do not change and P_t will rise. In this case, B_t/P_t decreases.

Cochrane (1999) argues that the future increase in z_{t+j} reduces the real backing of the government debt and the real value of government debt must fall. The only way for households to get rid of the government debt is to convert it to goods, which increases the aggregate demand and then the general price level. Note that in (39) a higher R^* raises P_t. That is, the monetary authority loses traditional control of inflation.

From (38) and (41), the real debt value can be written as:

$$b_t = \frac{B_t}{P_t} = \frac{\beta}{1-\beta}\tau^* - \mathrm{E}_t \sum_{j=1}^{\infty} \beta^j z_{t+j} = \frac{\beta}{1-\beta}(\tau^* - z^*) - \frac{\beta\rho}{1-\beta\rho} e_t. \tag{43}$$

(43) means that a higher $e_t = z_t - z^*$ decreases the current real value of the debt because $0 < \beta < 1$ and $0 < \rho < 1$. Note that a current positive deviation of government transfer is a predictor of positive deviations in the future as (41) shows and, thus, implying weaker real backing for the current debt.

V.2(d) Consequence of the lack of coordination (Regime LoC)

Based on the two regime framework of Leeper and Walker (2012) introduced above, I would like to explicitly show how a lack of coordination between the fiscal and the monetary authorities can bring about an unexpectedly unstable outcome.

In the Regime M, the monetary authority is expected to execute an active monetary policy (32) in line with the Taylor rule to control the inflation and the fiscal authority

adjusts tax level (33) to keep the real debt level at its target level. The tax level must be aggressively set to counter the deviation of real debt balance from its target as the condition $\gamma > 1/\beta - 1$ shows. The combination of these two policies achieve stable inflation and the real debt level.

In the Regime F, the monetary authority sets its policy interest rate at an arbitrary level, independent from inflation. Further, the fiscal authority is assumed to set its tax level independently from the real debt level, perhaps driven by political reasons. In this case, (39) shows that the price level is set by the combination of the monetary policy R^* and the fiscal policy τ^* in a controversial way. That is, the higher the policy interest rate R^* is, the higher the price level will be. This is because the higher R^* will increase the nominal wealth of households and it will in turn drive up the aggregate demand. In this regime, the monetary authority must cooperate with the fiscal authority by keeping R^* low so that the real debt does not explode.

As Leeper and Walker (2012) point out, there appear to be more countries operating in the Regime F, albeit partially. That is, the tax level is not set aggressively enough to control the real debt balance. Japan looks terrible but IMF (2009) shows that in fact there are other countries that look even worse.[40] Assuming the fiscal dominance, in which the fiscal authority is not fully capable of controlling its real debt level, the monetary authority must accommodate the fiscal policy by maintaining the policy rate low, which is completely counter-intuitive for central bankers: when the price level starts to rise with an increase in government deficit under the fiscal dominance, the monetary framework calls for a higher policy rate to control the money demand .

[40]Japan has been aging fast and its fiscal condition looks bad now but the other countries are surely following.

Assume that the fiscal authority follows the tax rule under the Regime F, which is to set τ^* at an arbitrary level, and that the monetary authority follows the Taylor rule (32) under the Regime M. That is,

$$\begin{aligned} \tau_t &= \tau^* > 0 \\ R_t^{-1} &= R^{*-1} + \alpha\left(\frac{P_{t-1}}{P_t} - \pi^{*-1}\right) \end{aligned} \tag{44}$$

and (39) changes because now the monetary authority follows the Taylor rule:

$$\begin{aligned} P_t &= \frac{R_{t-1}B_{t-1}}{\frac{1}{1-\beta}\tau^* - \mathrm{E}_t\sum_{j=0}^{\infty}\beta^j z_{t+j}} \\ &= k_t R_{t-1}B_{t-1}, \end{aligned} \tag{45}$$

where

$$\begin{aligned} \frac{1}{k_t} &= \frac{1}{1-\beta}\tau^* - \mathrm{E}_t\sum_{j=0}^{\infty}\beta^j z_{t+j} \\ &= \frac{\tau^*}{1-\beta} - \frac{e_t}{1-\beta\rho} - \frac{z^*}{1-\beta} \\ &= \frac{s^*}{1-\beta} - \frac{e_t}{1-\beta\rho}, \end{aligned}$$

and defining $s^* = \tau^* - z^*$.

Then, for given $\{P_{t-1}, R_{t-1}, B_{t-1}\}$, the following law of motion can be defined for inno-

vation e_t, by combining (28), (44), and (45),

$$\begin{cases} s_t = \tau^* - z_t = s^* - e_t \\ k_t = \left(\dfrac{s^*}{1-\beta} - \dfrac{e_t}{1-\beta\rho} \right)^{-1} \\ P_t = k_t R_{t-1} B_{t-1} \\ R_t = \left(\dfrac{1}{R^*} + \alpha \left(\dfrac{P_{t-1}}{P_t} - \dfrac{1}{\pi^*} \right) \right)^{-1} \\ B_t = R_{t-1} B_{t-1} - P_t s_t. \end{cases} \tag{46}$$

To observe the overall characteristics of the model, I first present a deterministic simulation where $e_t = 0$ for all t. Assuming the initial values of $\{P_0, R_0, B_0\} = \{1.01, 1.03, 1\}$, $\beta = 0.99$, i.e., the initial policy rate of 3%, $R^* = 1.015$, i.e., the target policy rate of 1.5%, and $s^* = 0.01$, the simulated paths for the inflation rates are shown in Figure V-2. α is assumed 0.9 for the hawkish case and 0.5 for the dovish case.

As Figure V-2 shows, the dovish monetary policy with a smaller α makes the inflation to converge faster, which is quite a counter intuitive result. A central banker would think a hawkish monetary policy, which is represented by a higher α, should bring the economy to the steady state faster than a dovish policy. However, this analysis shows that a more dovish policy brings the economy faster back to the steady state. This is because the nominal bond amount determines the price level under the fiscal dominance and the bond amount is positively affected by a change in policy rate. While the positive fiscal surplus decreases the outstanding bond amount, the higher policy rate which the monetary authority sets somewhat cancels this effect from the fiscal surplus.

Assume now that the transfer z_t follows the process specified in (34). In order to see

the effect of α on the volatility of the economy, I present the simulated inflation paths with the initial value of $\{P_0, R_0, B_0\} = \{1.01, 1.015, 1\}$, i.e., the policy rate starts from its target rate. All other parameters are assumed the same as in the deterministic case.

Figure V-3 shows the simulated inflation rates assuming $\rho = 0.01$, $\sigma_\varepsilon = 0.0015$, and the target surplus $s^* = 0.01$. Because of the continuous innovation in the government transfer z_t, the bond amount fluctuates around its steady state causing deviation of inflation rates also from its steady state. When the price level moves because of the volatility in fiscal balance, the move is amplified with the action taken by the monetary authority. The convergence back to the steady state is slower with a higher α as in the deterministic case. Thus, the hawkish case generates larger deviation from the steady state and slower convergence compared to the dovish case.

V.3 Stability of Regime LoC

In the Regime F, the fiscal authority accepts drifting real value of debts following the innovation in the transfer z_t, whereas the monetary authority does nothing but keeping the policy rate low and stable. Therefore the inflation rate is primarily determined by the growth rate of nominal debt. In the Regime M, the monetary authority is adjusting its policy rate to control the inflation and the fiscal authority is adjusting its tax rate to control the real value of debts.

In the Regime LoC, the fiscal authority behaves as it does in the Regime F by not adjusting its tax τ to control the real debt level, whereas the monetary authority as it does in the Regime M by adjusting the policy rate to control the inflation. In other words, both the fiscal and monetary authority are trying to control the inflation.

An important question arises: after a period of the Regime LoC, is there any incentive on either the fiscal or the monetary authority to change its policy to accommodate the other? For the fiscal authority, this accommodation means that it starts controlling the real debt of value by changing the tax τ_t in response to the exogenous innovation in the transfer z_t. It appears that this change will not voluntarily happen since the change implies an adoption of a new target, the real value of debt, by imposing a higher tax in response to an increase in transfer. A strong political will is required.

Similarly, for the monetary policy to accommodate the fiscal authority and move from the Regime LoC to the Regime F, it must drop its "mission" of price level control through traditional monetary policy by simply keeping its policy rate low so that the fiscal authority can control the inflation rate. Again, this is unlikely to happen, particularly in the context of increased independence of the central banks from the government in major advanced economies.

In contrast, the regime F or M will be more likely. The fiscal authority has an incentive to move from the Regime M to the Regime LoC by stopping to adjust the tax to counter the innovation in the transfer. The monetary authority has an incentive to move from the Regime F to the Regime LoC by starting to adjust its policy rate to control inflation. These deviations are driven by the need for, and the lack of, a strong political will for the fiscal authority to stay in the Regime M and by the independent mission of fighting inflation for the monetary authority

V.4 Game theoretic discussion

I present here a simple 2 by 2 game theoretic representation of the stability discussion in Chapter V.3. I shall show that the game has a single Nash equilibrium, the Regime LoC, but there is a possibility of turning the Regime M and F to Nash equilibria of the same game by introducing some cooperation between the two authorities. I further discuss the difference of this game from the game of chicken in Sargent and Wallace (1981) and the indeterminacy problem raised by Leeper (1991) when both the fiscal and the monetary authorities take aggressive policies.

V.4(a) Current model

The players are the fiscal authority (FA) and the monetary authority (MA). FA has two strategies: to control the real debt level by adjusting the tax level according to the policy rule shown in (33) called Tough and to arbitrarily choose the tax level called Loose. MA also has two strategies: to keep the policy rate stable at its steady state labeled SSIR and to follow the Taylor rule shown in (32) called Taylor. The outcomes are labeled ND (not discussed in this dissertation[41]), M (the Regime M), F (the Regime F), and LoC (the Regime LoC) as shown in Table V-3.

Different ”scores” are assigned to outcomes in order to calculate utilities. There are three axes, ”Debt Control”, ”Price Control”, and ”Short Term Politics”, and FA and MA respectively apply different ”weights” to those scores to calculate utilities for the outcomes. In Table V-4, the columns with headers ND, M, F, LoC indicate the scores and the

[41]This outcome is another case of lack of coordination but not discussed in this dissertation because the outcome is neither a Nash equilibrium nor socially efficient in the model discussed here.

columns with headers FA and MA indicate the weights the players use to calculate their utilities.

Table V-5 shows the calculated utilities based on this methodology. For example, Outcome ND has Debt Control score of 10, Price Control score of 1, and Short Term Politics score of 0. MA applies 2, 5, and 1 on those axes to calculate its utilities. Thus, the Outcome ND has the utility of 25 for MA.

This representation numerically shows the discussion in V.3.[42] From the outcome M, FA has an incentive to change its strategy from Tough to Loose, resulting in LoC. Similarly, from the outcome F, MA has an incentive to unilaterally change its strategy from SSIR to Taylor, resulting again in LoC. From the outcome ND, both MA and FA have incentives to deviate while neither player has an incentive to unilaterally deviate from the outcome LoC and, therefore, LoC is the Nash equilibrium.

If the social utility is defined as the sum of utilities for the two players, the outcomes F and M have higher social utilities than the Nash equilibrium LoC and it is preferable to achieve these outcome from the social perspective. However, this game is not a prisoners' dilemma (PD) because (Tough, SSIR) is not socially efficient although Loose and Taylor are the dominant strategies for FA and MA, respectively, as in a PD. Therefore, simply repeating this game cannot produce socially efficient outcomes of F or M.

In a PD, two prisoners can either cooperate (C) or defect (D). (C, C) is the socially efficient outcome but (C, D) or (D, C) produces a disastrous outcome for the player who chooses C and, therefore, both players have an incentive to play D. In fact, D is the dom-

[42]The analysis below does not heavily depend on the specification of these numbers; there is no qualitative change as long as (i) Loose and Taylor are dominant strategies for each party and (ii) the joint payoffs in LoC (Loose, Taylor) is smaller than those in the regimes F (Loose, SSIR) and M (Though, Taylor). A strategy is dominant for a player if the strategy results better outcome regardless of the opponent's strategy.

inant strategy for each player although (D, D) is the socially worst outcome. It is known that, for an infinitely repeated PD with a large enough discount factor applied to payoffs, a trigger strategy in which each player continues to play C until the counterpart plays D, and plays D forever once someone deviates, is a subgame perfect Nash equilibrium (SPNE). In order for this type of long term punishment scheme to work, the socially efficient outcome must entail a larger payoff than one-shot equilibrium payoff for every player. Otherwise, some player necessarily has and incentive not to follow the socially efficient outcome, which makes the trigger strategy fail to be a credible punishment scheme. This is indeed the case in the game discussed here: MA's (FA's) payoff under the Regime F (M) is lower than that under LoC.

One possibility to induce those socially preferred outcomes is to include the other player's utility as part of a player's utility. For example, if FA and MA change their utility functions to the sum of utilities shown in Table V-5 and one half of the each other's utility, one obtains the utilities shown in Table V-6. For each player, its own "bottom up" utility is the most important but it may be able to include the other's utility as "colleague" arms of the government.

The game represented in Table V-6 has two Nash equilibria, F and M. The challenges to achieve these outcomes are as previously discussed: for the monetary authority to sacrifice some of its independence to accommodate the need of the fiscal authority and for the fiscal authority to resist its temptation to please voters' short term demands.[43]

[43]There is a different kind of trigger strategy from what is discussed earlier, which makes the Regime M and F subgame perfect Nash equilibria. If the fiscal authority plays Loose and Tough alternating each year and the monetary authority plays SSIR and Taylor, the outcomes are switching between the Regime F (Loose, SSIR) or the Regime M (Tough, Taylor). If one party deviates from this strategy, the parties switch to Loose and Taylor and the Regime LoC will result. That is, socially efficient outcomes, the regimes M and F, can be sustained without modifying the outcomes but it requires rotating coordination between the two authorities.

V.4(b) Conditions for payoffs and comparison with the game of chicken and the indeterminacy case

The values used in Table V-4 and, therefore, in Table V-5 appear arbitrary but there are conditions that must be met as described as the following.

Using the notation in Table V-7, the conditions are:

$$\begin{cases} m_{i1} < m_{i2} \quad for\ i = 1, 2 \\ f_{1j} < f_{2j} \quad for\ j = 1, 2 \\ f_{22} + m_{22} < f_{12} + m_{12} \\ f_{22} + m_{22} < f_{21} + m_{21} \\ f_{11} + m_{11} < f_{22} + m_{22} \end{cases} \tag{47}$$

(47) guarantees that "Taylor" and "Loose" are dominant strategies for MA and FA, respectively, and that LoC is socially suboptimal.

The game between the fiscal and the monetary authorities described in Sargent and Wallace (1981) is viewed as the game of chicken because there would be a disaster if the fiscal authority expands and the monetary authority does not print enough money to generate seigniorage. The Regime LoC shares the same uncoordinated nature as the model presented by Sargent and Wallace (1981) but the former can be desirable because it does deliver convergence to the steady state although at a lower speed and this convergence is possible because of the existence of fiscal surplus in the future. That is, the Regime LoC would not be stable if the government is continuously running deficits, in which case the game would look more like the game of chicken.

In the model presented by Leeper (1991), money exists and the monetary authority controls the seigniorage revenue. The transversality condition of his model has both the fiscal surpluses and the monetary seigniorage and this gives more freedom to the fiscal authority. In the model presented here, again, the fiscal authority is maintaining a positive surplus target s^* and this milder and more realistic assumption makes the regime LoC stable.

V.5 Chapter conclusion

Under the fiscal dominance where the fiscal equation determines the price level, the discount factor applied to the expected government future surpluses plays an important role, particularly if the government is currently running fiscal deficits like Japan. The right hand side of the fiscal equation must be positive for price determinacy. It can be guaranteed for any discount rate if all the future surpluses are positive but not if there are expected deficits, especially if the deficits are expected in the near future. Further, the general price level moves in accordance with the change in the nominal bond value under the fiscal dominance. If the fiscal authority acts as if in the Regime F and the monetary as if in the Regime M, the resulting uncoordinated Regime LoC may produce a more volatile and lengthy path to the steady state, despite the efforts by the monetary authority. The reason why the Regime LoC is still not a disastrous scenario as implied by the game of chicken in Sargent and Wallace (1981) or not indeterminate as in Leeper (1991) is that the fiscal authority in this model behaves not completely irrationally. That is, the fiscal authority still maintains a positive surplus target.

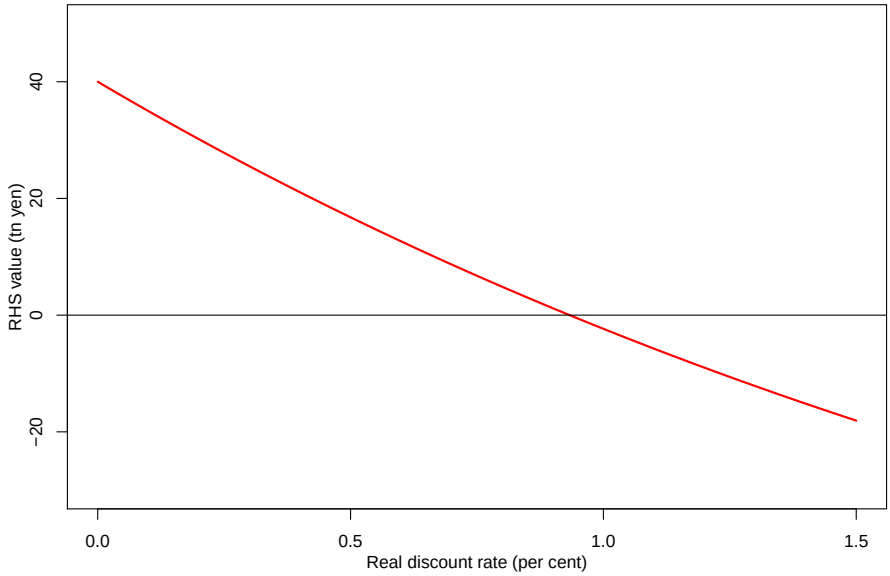

Figure V-1. Real deficit of 15 trillion yen is assumed for 2015 through 2023 and then the primary balance improves by 5 trillion in real term for 4 consecutive years until it reaches 5 trillion yen surplus in 2027 and then it stays at the same surplus level thereafter. The RHS value is a decreasing function of the discount rate. There is a possibility of the RHS turning negative if there is a current primary deficit.

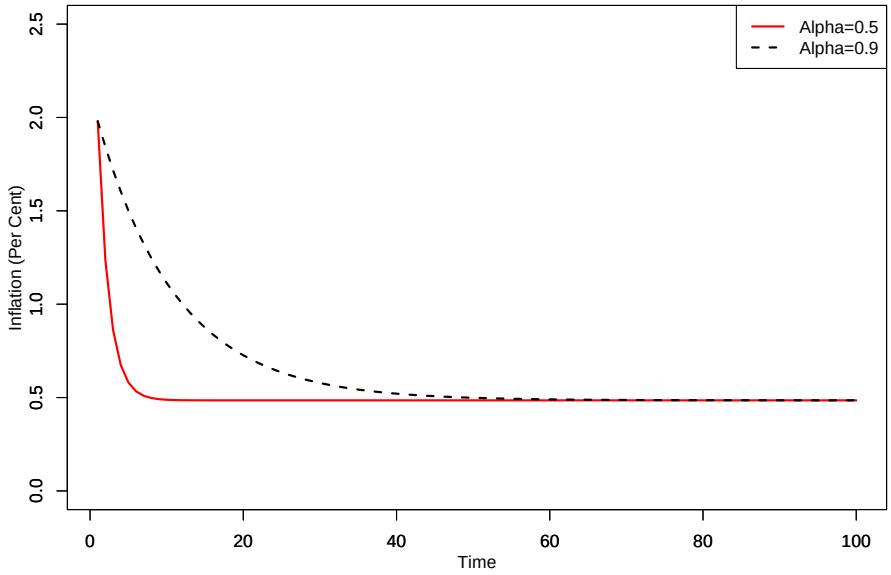

Figure V-2. Inflation converges to its steady state slower with a more hawkish, i.e., a larger α.

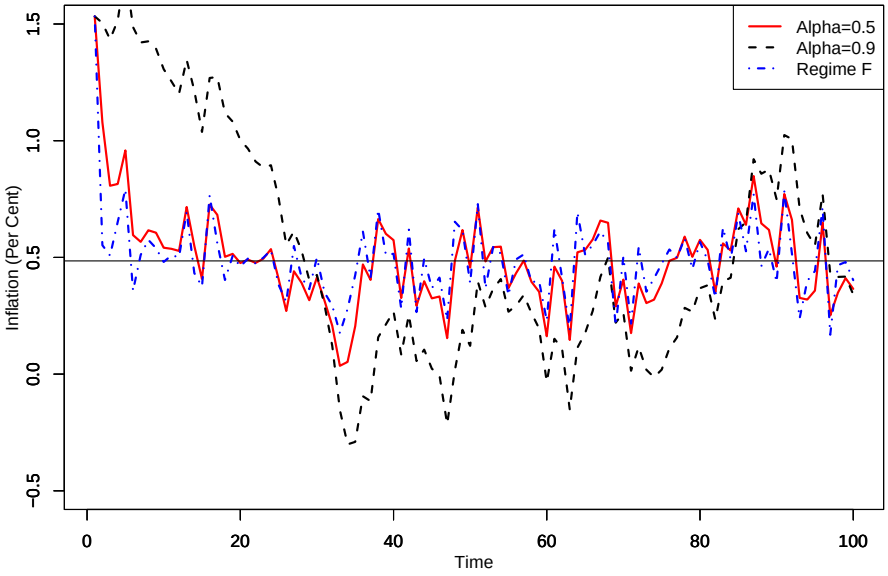

Figure V-3. The hawkish monetary policy tends to amplify the volatility of inflation and to make the convergence back to the steady state slower. Regime F simulation result is shown for comparison.

Table V-1. Primary balance forecast by Cabinet Office

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
Primary Balance (tn yen)	-16.4	-16.0	-16.8	-15.7	-16	-16.4	-16.7	-17.6	-18.4
National Gov.	-19.5	-17.9	-17.7	-16.6	-16.7	-16.8	-16.9	-17.4	-17.6
Municipalities	3.1	1.9	0.8	1	0.7	0.4	0.2	-0.2	-0.8
Deflator (% chng)		0.4	1.4	0.5	0.5	0.5	0.5	0.5	0.5

Notes: Announced by Cabinet Office on February 12, 2015
Reconstruction related expenses and revenues are included.

Table V-2. Primary balance used in simulation

Year	2015 – 23	2024	2025	2026	2027 – 64
Assumption (tn yen)	-15.0	-10.0	-5.0	0.0	5.0

Table V-3. Basic Framework

FA \MA	SSIR	Taylor
Tough	ND	M
Loose	F	LoC

Table V-4. Scores and weights

Goals \Outcome and Player	ND	M	F	LoC	FA	MA
Debt Control	10	5	1	0	2	2
Price Control	1	10	2	5	1	5
Short Term Politics	0	0	10	4	5	1

Table V-5. Simple Payoffs

FA \MA	SSIR	Taylor
Tough	21, 25	20, 60
Loose	54, 22	25, 29

Table V-6. Cooperative Payoffs

FA \MA	SSIR	Taylor
Tough	34, 36	50, 70
Loose	65, 49	40, 42

Table V-7. Cooperative Payoffs

FA \MA	SSIR	Taylor
Tough	f_{11}, m_{11}	f_{12}, m_{12}
Loose	f_{21}, m_{21}	f_{22}, m_{22}

VI Discussions and conclusion

VI.1 A brief summary of the thesis

In the first decade of 2000s, the Japanese government's total debt was quite stable considering the FILP and it even decreased in some years. This is a result of the FILP reform. The reform changed the flow path of the FILP funds from loans to bonds and imposed stricter control over the FILP agencies' activities and the total size of the program has decreased.

During this period, the FILP agencies received more funds back from the private sector than they provided such funds. Thus, the Japanese experience can be consistent with the fiscal theory of the price level even though the price level did not increase or the JGB prices did not fall as the growth of nominal JGB value suggested. The analysis in this dissertation suggests that the FTPL deserves a proper attention by economists and policy makers in such a debt heavy country as Japan, once the scope of the government is appropriately accounted for.

This dissertation reviews in Chapter V.2 the two paths for the fiscal inflation in addition to Sargent and Wallace (1981)'s unpleasant arithmetics. The first path is shown in the Regime F, where the fiscal authority stops committing itself to accommodating the monetary policy by changing either the tax or the transfer to control the nominal debt level. This is the main path of inflation for the fiscal theory of the price level. I additionally showed that the lack of coordination between the fiscal and the monetary authorities may make the path to a steady state much longer and more volatile particularly when the monetary authority takes a traditional hawkish policy. This case is discussed as the Regime LoC.

Note that the volatile interest rates would affect all yen denominated securities regardless of the issuer.

There is yet another path in which a fiscal inflation can occur and that is the change in the discount rate for the future government surpluses. A higher discount rate applied to the right hand side of the fiscal equation requires an increase in the general price level. Chapter V.1 discusses the particular danger for countries with current fiscal deficits.

While the reform of social welfare is intensely discussed in Japan, the policy makers are not able to make drastic actions because of the Japanese political landscape. Elections are increasingly focused around the control of social security benefits and it appears that the conditions for the median voter theorem are generally satisfied.[44] This suggests the importance of where the median voter stands in the demographic spectrum. The Japanese population is aging. Additionally, the low voting rate among the younger generations is increasing the median voter's age even when the population is not aging.[45]

When the fiscal inflation starts, the inflation is mainly set by the growth rate of the nominal debt value including both bonds and money. Traditional monetary policy through open market operations cannot affect this aggregate amount because they only involve fair value exchanges of bonds and money.[46] If the monetary authority tries to counter fiscal inflation by adjusting its policy rates, it will generate more volatility in inflation as discussed in Chapter V.2.

[44] A single-dimensional policy space along the social security benefit payouts and a single-peaked preference.

[45] The median voter's age increased from 56.05 years in 2010 General Election to 58.50 years in 2014 General Election as Appendix D shows. According to the median voter theorem, the policy by the elected politicians must be increasingly pro-elders for the issue of social security benefits. This makes it even more difficult for the fiscal authority to properly control the future surpluses because the social security is one of the biggest and fastest growing item in the Japanese government budget.

[46] Please see Appendix **??** for further discussion.

VI.2 Possibility of a "run"

It is worth understanding the FTPL's distinct implication of the growing debt situation. Most academic literature and market reports express the Japanese debt concern as potential incapability of the government to refinance the maturing debt. Thus, a fiscal consolidation is called for before the government runs out of its capability to borrow.

The concern is expressed somewhat differently from the fiscal theory. As Cochrane (2011a) portraits, the concern from the FTPL perspective is a potential "run" on the government. He writes (Cochrane, 2011a, p.56):

> If people become convinced that our government will end up printing money to cover intractable deficits, they will see inflation in the future and so will try to get rid of dollars today – driving up the prices of goods, services, and eventually wages across the entire country. This will amount to a "run" on the dollar.

This is an extreme case of fiscal inflation discussed in this dissertation. This will lead not only to the collapse of the JGB market but also to depreciation of Japanese yen against everything, including goods and foreign currencies. Mathematically, this "run" can be interpreted as the case in which the RHS of the fiscal equation (31) turns negative and there is no price level that can equate the LHS and the RHS of (31). As one can observe in Figure V-1, the RHS can turn negative very easily when the magnitude and the duration of the current primary deficit is material. When the RHS turns negative, i.e., the government becomes insolvent, there is no price level to equate the two sides of the fiscal equation no matter how long the maturity of the government debts is.

As Cochrane (2005), Leeper and Walker (2012), and others repeatedly argue, there is a fundamental difference whether a government debt is nominal or real. Future government surpluses can support almost any amount of nominal debt by adjusting the general price level but there is a clear ceiling for sustainable real debts. However, this distinction is not always fully appreciated. It may be because the proportion of outstanding real government bonds in the total government debt is still very small. The oldest issuer of the real government bond is the UK and its proportion is about 25%. The US has about 5% of its government debt issued in real term. Japan has less than 0.1% of its debt in the real term and this fact should support the argument for the Japanese government debt sustainability.

VI.3 Independence of the Bank of Japan as a potential risk

Independence of central banks has become known as a key to keep the inflation rate low. As Alesina and Summers (1993, p.151) summarize, "Delegating monetary policy to an agent whose preferences are more inflation averse than are society's preference serves as a commitment device that permits sustaining a lower rate of inflation than would otherwise be possible." Now that the majority of industrial countries have very low inflation rate and the concern of deflation is more profound, it is unclear whether an independent central bank is an advantage or a disadvantage to achieve the desired level of inflation.

Prime Minister Abe is aiming to revive the economy and achieve both nominal and real growth with a mild inflation rate of around 2%. The Bank of Japan is keeping its policy rate low and maintaining its aggressive quantitative easing policy and trying to persuade the market that it will keep the rates low for long enough a time. Both proponents and opponents of quantitative easing or reflationary policies in general consider a key is

for the central bank to become credibly irresponsible. For example, Krugman (1998) says that "monetary policy will in fact be effective if the central bank can credibly promise to be irresponsible, to seek a higher future price level." Under the framework discussed in this dissertation, this is equivalent for the central bank to stay in the Regime F. However, the discussion in Chapter V.2 shows the instability of the Regime F, which implies the difficulty of this policy.

VI.4 Scope of the government

The definition of government can include municipalities or government affiliated corporations but this dissertation defines the government as the central government, the BoJ, and the FILP agencies as discussed in Chapter IV. Since the government administrative reform initiative started in 1996 under Prime Minister Hashimoto, the FILP has been the most challenging area to simplify and Prime Minister Koizumi was the first one to effectively address the issue by limiting the flow of funds into the FILP agencies through the postal reform. This reform had an impact on the growth of the JGB and, thus, this dissertation includes the FILP in its scope of the government.

The government subsidies to the private sector can be made in many ways including explicit subsidies, public infrastructure spending, and long term funding to projects through the FILP agencies. Much of the Japanese public spending has been done through the last channel. As discussed in Chapter IV, the government gives subsidies and makes public spending with the expectation to recover its investment in the future in the form of taxes. The government can similarly make public investments through the FILP agencies to power plants and airports and highways with the expectation to recover those invest-

ments in the form of privatization, i.e., the sale of investments though the capital markets, or through taxes.

VI.5 Assumptions made in this dissertation for data

Interest rates data used in the analysis of this dissertation are weighted average nominal coupon rate of outstanding nominal bonds. While the coupon rate and the prevailing market interest rate should stay close to each other over the long run, the former should always be lagging the latter because new bonds' coupon rates are set in line with the prevailing market rates. This lag is not considered in the analysis.

One difficulty in obtaining the appropriate interest rate for the netted government debt portfolio as it is needed for the FTPL empirical analysis is the insufficient information on the intra-government bond holding. The total amount is disclosed but not by individual bond issue numbers, which makes it impossible to obtain the net portfolio's true picture.

Another limitation with respect to the data is the nominal value of loans. The Flow of Funds data from the Bank of Japan is by the market value on the best effort basis. The price for a loan is not generally available in the financial markets and this fact should create some distortion in the data I use in the analysis.

With respect to the scope of the government assets and liabilities, there are two areas that should be considered further in future research. These are the government sponsored pension and the government's hidden liabilities such as implicit guarantees. With respect to the former, there are two obvious challenges. First, the nature of the government pension liability is not very clear. It appears similar to a defined benefit plan but the benefit, the contribution, and the timing of benefit payment are all changed by the decision of the

government. It is a government liability but very different from a well defined debts such as loans and bonds.

Second, the pension benefit amount is linked to the general price level and this fact makes it a real liability rather than a nominal liability. From this perspective, it may make sense for the pension liability to stay on the right hand side of the fiscal equation as it implicitly does in the analysis of this dissertation.

The other limitation with respect to the scope of the government, the hidden liabilities, is even more difficult to model for the similar two reasons cited for the government sponsored pension. First, the government can decide what guarantee to make unless it is explicitly documented. Cochrane (2011a) argues that "[t]he government clearly considers the big banks too important to fail, and will assume their debts should they get into trouble again" but the government can be "picky" which banks to save and which ones to let down. A lot depends on the political landscape at the time of event occurrence. Second, the liability size is again unknown even in the case of clearly documented explicit guarantees.[47] It is even more ambiguous for implicit guarantees.

VI.6 Conclusion

This dissertation shows that the FTPL can reasonably explain the debt and price experience in Japan and claims that the implication of fiscal theory on the Japanese debt situation deserves attention. The risk of the current debt situation in Japan from the fiscal perspective is not just a potential JGB market collapse but a "run" on all kinds of Japanese

[47] Consider a case of debt guarantee. If the obligor defaults, the guarantor needs to make the payment in full but usually recovers a large portion from the original obligor. Therefore, the realized liability is almost always smaller than the maximum face amount of the guarantee.

government debts, including money. If this kind of a "run" or its milder version of fiscal inflation materializes, there is not much that the BoJ can do to control because the market will refuse to hold the Japanese yen currency as well as JGB. While the total debt level since 2000 was rather stable until the Global Financial Crisis and the Tohoku Great Earthquake, the debt value started to increase since then and it accelerated under Governer Kuroda's BoJ. There is a risk of a "run on yen" if the debt continues to grow but it would be unpredictable as Cochrane (2011a) warns.

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A Detailed description of the data taken from the BoJ Flow of Funds report and the list data series used in this dissertation

Description

Bonds Japanese central government issues Japanese Government Bonds (JGBs) and the FILP Fund issues the FILP Bonds, which are completely fungible with and undistinguishable from JGBs. Additionally, the FILP agencies issue bonds with their own credit (the FILP Agency Bonds). All three types of bonds' outstanding market values are reported. Intra-government holdings are net out to calculate the bonds held by the private sector.

Discount Bills Japanese central government issues Treasury Discount Bills (TBs) with up to 1 year maturity for short term financing. These securities are often purchased by various entities to temporarily park investment or operational funds. The market value is reported in Flow of Funds reports and intra-government holdings are netted out.

Loans Central government borrows money from private financial institutions and special financial institutions such as Postal Saving, Postal Insurance, and Public Pension. The FILP agencies borrow money from private financial institutions. Those amounts are reported at market value wherever possible. Bank of Japan provides loans to private financial institutions and this loan value is subtracted from the total value.

The FILP Fund Money flows through the FILP Special Account. Funds from Postal Saving, Postal Insurance and Public Pension are deposited into the fund, which is

then distributed to the FILP agencies for public finance purpose. It is a liability account for the FILP agencies but an asset for the central government. The net liability is calculated by subtracting the latter from the former. The numbers are reported at the notional value, rather than the market value.

Financial Assets Market value of foreign securities held by the government for foreign exchange reserves[48] and private sector securities held by the BoJ are reported at the market value.

Monetary Base Cash in circulation and reserves held at the BoJ.

Data series

JGB/TB

On the liability side,

FF'FOF_FFYS421L311 Liabilities/ -Central government securities and FILP bonds/ Central government/ Stock

FF'FOF_FFYS421L310 Liabilities/ -Treasury discount bills/ Central government/Stock

FF'FOF_FFYS180L311 Liabilities/ -Central government securities and FILP bonds/ Public financial institutions/Stock

FF'FOF_FFYS180L313 Liabilities/ -Public corporation securities/ Public financial institutions/ Stock

On the asset (contra) side,

FF'FOF_FFYS421A311 Assets/ -Central government securities and FILP bonds/ Central government/ Stock

FF'FOF_FFYS421A310 Assets/ -Treasury discount bills/ Central government/ Stock

FF'FOF_FFYS110A311 Assets/ -Central government securities and FILP bonds/ Central bank/ Stock

FF'FOF_FFYS110A310 Assets/ -Treasury discount bills/ Central bank/ Stock

[48] In Japan, foreign reserves are entirely managed and held by MoF instead of the BoJ. The BoJ simply executes transactions on behalf of MoF.

FF'FOF_FFYS180A311 Assets/ -Central government securities and FILP bonds/ Public financial institutions/ Stock

FF'FOF_FFYS180A310 Assets/ -Treasury discount bills/ Public financial institutions/ Stock

Loans and the FILP Funds

On the liability side,

FF'FOF_FFYS421L200 Liabilities/ Loans/ Central government/ StockLiabilities/ Loans/ Public financial institutions/ Stock

FF'FOF_FFYS180L190 Liabilities/ -Public corporation securities/ Public financial institutions/ Stock

FF'FOF_FFYS180L240 Liabilities/ -Loans by private financial institutions/ Public financial institutions/ Stock

FF'FOF_FFYS180L260 Liabilities/ -Loans by private financial institutions/ Public financial institutions/ Stock

On the asset (contra) side,

FF'FOF_FFYS421A190 Assets/ Deposits with the Fiscal Loan Fund/ Central government/Stock

FF'FOF_FFYS421A260 Liabilities/ -Loans by private financial institutions/ Public financial institutions/ Stock

FF'FOF_FFYS110A210 Assets/ -Bank of Japan loans/ Central bank/ Stock

FF'FOF_FFYS180A190 Assets/ Deposits with the Fiscal Loan Fund/ Public financial institutions/ Stock

Financial Assets

FF'FOF_FFYS421A540 Assets/ -Industrial securities/ Central bank/ Stock

FF'FOF_FFYS421A550 Assets/ Other external claims and debts/ Central government/ Stock

FF'FOF_FFYS110A315 Assets/ -Industrial securities/ Central bank/ Stock

FF'FOF_FFYS110A317 Assets/ -Commercial paper/ Central bank/ Stock

FF'FOF_FFYS110A318 Assets/ -Investment trust beneficiary certificates/ Central bank/ Stock

FF'FOF_FFYS110A320 Assets/ -Structured-financing instruments/ Central bank/ Stock

FF'FOF_FFYS110A330 Assets/ Shares and other equities/ Central bank/ Stock

Monetary Base

FF'FOF_FFYS110L110 Liabilities/ -Currency/ Central bank/ Stock

FF'FOF_FFYS110L120 Liabilities/ -Deposits with the Bank of Japan/ Central bank/ Stock

B Additional discussion on variables

Here are further clarifying discussions on the variables described in Chapter IV.2.

v_t: In order to derive the privately held debt value, government debt value held by the government agencies including the BoJ is subtracted from the total liability value of the central government and the FILP agencies. Further, the foreign securities held by the government as a foreign reserve and the private securities held by the BoJ are subtracted from the liabilities as those securities are financial assets usable by the government to pay down its debts. Other assets, either held directly by the central government or by the FILP agencies, are not accounted for in this research.

As discussed in IV.1(b), this dissertation treats the private investments on the FILP balance sheets not as assets deductible from the liabilities. On the asset side of the government's balance sheet, there are non-financial assets such as roads and ports and other infrastructures. Those assets are created as the result of public spending with the purpose to increase the future tax base and not to sell for cash. Since the FILP agencies invest in private projects and entities for public policy purpose, the intent is similarly not to sell those investments for capital gains but to increase and improve the public infrastructure for the overall growth of the economy. There may be opportunities from time to time for the FILP agencies to sell the investments for cash just as the

central government has been able to sell its stake in JR, NTT, and JT, for example, but the original intent is not to sell.

r_t: In order to calculate the overall nominal portfolio yield of the government debt, this dissertation calculates the weighted average between TBs and JGBs assuming zero interest rate for the monetary base and further assumes that the loans have the same weighted average nominal yield as JGBs.

MoF websites' JGB weighted average yield and 1 year JGB yield are averaged with the market value weight of JGBs and TBs. This weighted average yield is also assumed for the government loans. The monetary base is assumed to have zero interest rate and the overall weighted average nominal rate of the government debt portfolio (JGBs, TBs, loans, and monetary base) is calculated.

It is preferable to use the weighted average of nominal yield to maturity of government's total debt portfolio held by the private sector. In this analysis, the weighted average nominal coupon rate is used for simplicity because it is difficult to obtain the debt issue number for each of the intra-government holding of the JGB and the interest rates on the loans are unknown.

sc_t: The division by consumption "scale[s] variables with growth, producing plausibly stationary series" while avoiding "business-cycle output variation in the surplus measure" which division by output may incur. (Cochrane, 1999, p.361)

C Cabinet Office surplus forecast

The figures shown in Table C-1 are the ones usually used for policy discussion. Although Table V-1 shows the true and entire picture of the fiscal condition, Table C-1, which shows the forecast excluding the impact from 2011 Earthquake, is often used for consistency in political discussions.

Table C-1. Primary balance forecast by Cabinet Office

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
Primary Balance (tn yen)	-16.4	-15.4	-15.1	-12	-10.7	-9.4	-7.2	-6.3	-4.9
National Gov.	-19.5	-17.4	-16.5	-14.6	-14.3	-13.9	-13.3	-13	-12.1
Municipalities	3.1	2	1.4	2.6	3.6	4.5	6.1	6.7	7.2
Deflator (% chng)		1.2	2.2	1.3	1.4	1.4	1.4	1.3	1.3

Notes: Announced by Cabinet Office on February 12, 2015
Reconstruction related expenses and revenues are excluded.

D Aging "Median Voter" in Japan

Table D-1 shows the voting rate of each age category at the recent two General Elections for the lower house of the Japanese Diet.[49] 2010 General Election attracted much interest across the age groups and the voting rates were high. Voting rates dropped in 2014 but the decline was more significant in the lower age groups.

In Table D-2, voting rate for each age group is calculated by taking a weighted average of appropriate data from Table D-1. The voting rate for "18-34" is calculated from 20s and 30s data using 1:0.5 ratio. Similarly, "35-59" uses 30s, 40s, and 50s data with 0.5:1:1 weight. For "60-", 60s and 70s+ are equally weighted. Voting rate weighted population is calculated by multiplying population percentage by voting rate and shown in their respective ratio. Based on this calculation, in 2010 General Election, 43.56% of the votes came from 60 years old and above and this ratio went up to 47.69% in 2014 General Election although the population is not assumed to be aging. The change is entirely due to the fact that the voting rate has declined more for the young generations than the elders and the actual aging of the population amplify this change calculated here.

Assuming the population is uniformly distributed within each age group, the median voter's age can be easily calculated. It is 56.05 years for 2010 General Election and 58.50 years for 2014 General Election. Even though the population aging is not assumed, the median voter's age increased by almost 2.5 years and is approaching 60 years.

[49] Source is Ministry of Internal Affairs and Communications.

Table D-1. Voting rate per age group

Ages	20s	30s	40s	50s	60s	70s+
2010 GE	49.45	63.87	72.63	79.69	84.15	71.06
2014 GE	32.58	42.09	49.98	60.07	68.28	59.46

Table D-2. Voting rate weighted population

Age Group	18 - 34	35 - 59	60 -
Population (%) [50]	17.5	33.5	34.0
Voting rate (%)			
2010 GE	54.26	73.70	77.61
2014 GE	35.75	52.44	63.87
Voting rate weighted population (%)			
2010 GE	15.68	40.76	43.56
2014 GE	13.74	38.58	47.69

[50] Source is National Institute of Population and Social Security Research. Ratios are slightly different year by year and the figures used here are approximation.

E Additional Tables

Table E-1. Correlations in US data, reproduced from Cochrane (1999, p.365)

	r_{t+1}	v_{t+1}/v_t	s_{t+1}/v_t
r_{t+1}	1.00	0.70	-0.16
v_{t+1}/v_t		1.00	-0.82
s_{t+1}/v_t			1.00

Table E-2. Reproduction from Cochrane (1999)

	Right-hand variable			
Left-hand variable	$\ln\left(\frac{v}{c}\right)_{t-1}$	$\left(\frac{1}{vc}\frac{s}{c}\right)_{t-1}$	$\ln r_{t-1}$	$\ln\frac{c_{t-1}}{c_{t-2}}$
$\ln\left(\frac{v}{c}\right)_t$	0.96	-0.73	0.18	-2.31
	(21)	(-3.1)	(0.6)	(-3.7)
$\left(\frac{1}{vc}\frac{s}{c}\right)_t$	0.07	0.46	-0.19	1.23
	(2.9)	(3.9)	(-1.4)	(4.0)
$\ln r_t$	0.05	-0.23	0.13	-0.46
	(1.3)	(-1.3)	(0.7)	(-1.0)
$\ln\frac{c_t}{c_{t-1}}$	0.00	0.00	0.06	0.37
	(0.0)	(0.0)	(0.8)	(2.2)

Notes: Reproduced from Cochrane (1999, p.378)
t-statistics in parentheses
vc is 0.43.

Table E-3. Simple VAR analysis: Including the FILP and the loans

	sc_t	vc_t
sc_{t-1}	0.501***	−0.558***
	(0.156)	(0.175)
vc_{t-1}	0.018	0.990***
	(0.019)	(0.021)
Constant	−0.045	0.049
	(0.035)	(0.040)
R^2	0.293	0.987
Adjusted R^2	0.244	0.986
F Statistic (df = 2; 29)	6.005***	1,099.544***
Notes:	***Significant at the 1 percent level.	
	**Significant at the 5 percent level.	
	*Significant at the 10 percent level.	

Table E-4. Simple VAR analysis: Including the FILP but excluding the loans

	sc_t	vc_t
sc_{t-1}	0.587***	−0.712***
	(0.169)	(0.180)
vc_{t-1}	−0.005	1.005***
	(0.014)	(0.015)
Constant	−0.018	0.017
	(0.016)	(0.017)
R^2	0.372	0.995
Adjusted R^2	0.329	0.995
F Statistic (df = 2; 29)	8.597***	3,003.440***
Notes:	***Significant at the 1 percent level.	
	**Significant at the 5 percent level.	
	*Significant at the 10 percent level.	

Table E-5. Simple VAR analysis: Excluding the FILP but including the loans

	sc_t	vc_t
sc_{t-1}	0.413**	−0.469**
	(0.177)	(0.189)
vc_{t-1}	−0.004	1.006***
	(0.022)	(0.023)
Constant	−0.018	0.021
	(0.023)	(0.025)
R^2	0.179	0.987
Adjusted R^2	0.122	0.986
F Statistic (df = 2; 30)	3.159*	1,077.584***

Notes: ***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table E-6. Simple VAR analysis: Excluding the FILP and the loans

	sc_t	vc_t
sc_{t-1}	0.348**	−0.449**
	(0.184)	(0.201)
vc_{t-1}	−0.011	1.010***
	(0.020)	(0.021)
Constant	−0.018	0.021
	(0.023)	(0.025)
R^2	0.156	0.989
Adjusted R^2	0.098	0.989
F Statistic (df = 2; 30)	2.684*	1,340.467***

Notes: ***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table E-7. Reproduction from Woodford (1999)

	vc_t	sc_t	dc_t	π_t
π_{t-1}				0.677
				(0.231)
vc_{t-1}	1.000	0.067	0.007	−0.027
	(0.041)	(0.022)	(0.011)	(0.026)
sc_{t-1}	−0.634	0.455	−0.041	0.088
	(0.198)	(0.109)	(0.052)	(0.066)
dc_{t-1}	−2.508	1.662	0.355	0.524
	(0.641)	(0.352)	(0.169)	(0.275)

Notes: Reproduced from Woodford (1999, p.404)
Numbers in parentheses show s.e.

Table E-8. Reproduction from Doi (2000)

	vc_t	sc_t	dc_t	π_t
π_{t-1}				0.533
				(4.346)
vc_{t-1}	0.898	−0.001	−0.018	−0.014
	(16.641)	(−0.240)	(−3.189)	(−1.321)
sc_{t-1}	−1.453	0.963	0.107	−0.448
	(−2.510)	(19.469)	(1.739)	(−2.861)
dc_{t-1}	−2.918	−0.122	0.411	0.005
	(−2.067)	(−1.012)	(2.727)	(0.020)

Notes: Reproduced from Doi (2000, p.209)
Numbers in parentheses show t-values

Table E-9. Woodford specification VAR analysis including the FILP and the loans

	vc_t	sc_t	dc_t	π_t
π_{t-1}				0.541***
				(0.195)
vc_{t-1}	0.928***	0.091**	−0.032***	−0.001
	(0.024)	(0.043)	(0.011)	(0.012)
sc_{t-1}	−0.338***	0.522***	0.018	0.014
	(0.085)	(0.149)	(0.037)	(0.017)
dc_{t-1}	−1.313***	1.844**	0.110	0.424***
	(0.453)	(0.796)	(0.196)	(0.108)
Constant	0.031***	0.000	−0.001	−0.001
	(0.005)	(0.009)	(0.002)	(0.001)
R^2	0.991	0.413	0.453	0.848
Adjusted R^2	0.990	0.347	0.393	0.825
F Statistic	1,021.370***	6.321***	7.464***	36.361***

Notes: ***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table E-10. Woodford specification VAR analysis excluding the FILP and the loans

	vc_t	sc_t	dc_t	π_t
π_{t-1}				0.569^{***}
				(0.144)
vc_{t-1}	0.932^{***}	0.019	-0.015^{**}	−0.001
	(0.028)	(0.025)	(0.007)	(0.006)
sc_{t-1}	-0.494^{***}	0.299^{*}	0.044	0.014
	(0.196)	(0.174)	(0.052)	(0.023)
dc_{t-1}	-1.919^{**}	1.573^{**}	0.208	0.430^{***}
	(0.732)	(0.649)	(0.193)	(0.090)
Constant	0.045^{***}	−0.001	−0.001	−0.001
	(0.009)	(0.008)	(0.002)	(0.001)
R^2	0.989	0.315	0.407	0.847
Adjusted R^2	0.988	0.239	0.341	0.823
F Statistic	798.252^{***}	4.137^{**}	6.178^{***}	35.874^{***}

Notes: ***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.