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Financing Fiscal Support under Alternative Policy Frameworks

Zico Dasgupta

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Zico Dasgupta[1]

Azim Premji University, Bengaluru, India

Abstract: This paper perceives fiscal support as a policy instrument and examines alternative policy frameworks that can simultaneously stabilize labour income, output and debt-GDP ratio. The need to stabilize labour income over and above output follows from the possibility of income growth rate of labour falling below output growth rate. This paper points out the limitations of sound finance regime in meeting these targets and proposes an alternative policy framework which is termed as Debt-Neutral Functional Finance with Fiscal Support (DNFS). The DNFS framework highlights the role of development financial institutions and the need for a floor level of corporate tax-GDP ratio.

[1] The author can be reached at zico.dasgupta@apu.edu.in

1. Introduction

Macroeconomic policy frameworks in different countries in the recent period have aimed at stabilizing output growth rate and the debt-GDP ratio. The policy assignment rules have adhered to the New Consensus macroeconomic framework, where monetary policy aims at maintaining output stability for inflation-targeting (Fontana and Palecio-Vera, 2007) and fiscal policy is assigned to maintain stable debt-GDP ratio (Fullwiler, 2007 and Ryoo and Skott, 2017). The ability of New Consensus framework to stabilize output and debt-GDP ratio has been questioned at least on two grounds[2].

The first limitation involves the possibility of instability following the New Consensus assignment rule when the existing debt-GDP ratio happens to be above a threshold level (Mason and Jayadev, 2018). Since the sufficient condition for dynamic stability can be found only at relatively low levels of debt ratio, there exists no a priori reason why the Consensus framework would necessarily attain the two targets.

The second limitation emerges when the Central bank's policy rate can no longer act as the instrument of stabilizing output. Such possibility may arise at least in three cases. The first case involves the zero low bound, which indicate the ineffectiveness of monetary policy in meeting output target at negative interest rate (Leão, 2013 and Bianchi and Melosi, 2017). The second case emerges if the monetary transmission mechanism is broken with policy rate being ineffective to change the market interest rate. The emergence of covid-19 crisis has been argued to have particularly weakened the transmission mechanism in different countries (Wei and Han, 2021). The third case involves the possible constraint of setting domestic interest rate above foreign interest rates in order to avoid capital outflow (Arestis and Sawyer, 2006). Indicating positive currency risk premia, Hassan and

[2] The Post-Keynesian critique of New Consensus Models has comprised a wide range of issues including the instability of NAIRU, the endogeneity of NAIRU and the shape of the Philips Curve, the detailed discussion of which goes beyond the scope of this paper. For a detailed analysis, see Arestis and Sawyer (2004), Setterfield (2005), Palecio-Vera (2005), Lavoie (2006) and Kriesler and Lavoie (2007).

Zhang (2020) found that interest rates were higher in countries which had higher currency risk. Such limitations may restrict the consensus framework from attaining its two targets.

This paper attempts to highlight an additional limitation of consensus assignment: its limitation to compensate income growth rate of labour even when it manages to stabilize output growth rate. If the level of labour income is defined as the wage bill, then the income growth rate of labour in a laisse-faire economy would be given by the sum of employment growth rate and the growth rate of real wages. Since employment growth rate is the difference between output growth rate and labour productivity growth rate, the income growth rate of labour would be determined by the output growth rate and the growth gap between labour productivity and real wage rate. In the short run or medium run, it is only by fluke that the productivity-wage growth gap would be zero and income growth rate of labour would be equal to the output growth rate. One of the central features of the globalization period has been the fall in the income share of labour (ILO, 2015), indicating a positive productivity-wage growth gap for the period as a whole.

By implication, changes in institutional framework or structural feature of an economy that reduce growth rate of real wages at a given level of productivity growth rate, would also lead to a reduction in income growth rate of labour at a given output growth rate. The emergence of COVID-19 crisis has opened up the possibility of widening productivity-wage gap as the pandemic has been found to be associated with wage cuts and sharp reduction in growth rate of real wages in bulk of the countries for which data was available (ILO, 2020).

Over and above undertaking demand management policies, this paper makes the case for providing fiscal support to compensate labour income. It points out the limitation of consensus framework in compensating labour income under alternative settings. Firstly, even when stability condition is guaranteed and policy rate is used as an instrument to stabilize output, consensus assignment is shown to be ineffective in the midst of adverse changes in productivity-wage gap. Secondly, when the policy rate does not act as policy instrument and market interest rate is given exogenously, consensus framework is argued to provide pro-cyclical fiscal policy. Adverse changes in demand and productivity-wage gap is shown to adversely affect output growth rate and income growth rate of labour to an extent which is even greater than the case without policy rule. Thirdly, if consensus framework is modified to the extent of including the target of compensating labour income, while assuming away the problem of interest rate exogeneity, the assignment rule is found to exhibit dynamic instability above a threshold level of debt-GDP ratio as in Mason and Jayadev (2018).

This paper proposes an alternative policy framework within which the three targets of stabilizing output growth rate, income growth rate of labour and debt-GDP ratio can be met simultaneously. This policy framework has been termed as Debt-Neutral Functional Finance with Fiscal Support (DNFS). There are two variants of DNFS framework that has been analyzed. The first variant presumes corporate tax-multiplier to be zero and uses it as a policy instrument. This variant is called the tax-financed DNFS. The second variant presumes a non-zero tax multiplier and uses the lending rate of the Development Financial Institution (DFI) as a policy instrument. This variant is called the DFI-financed DNFS and it operates by setting a floor value to the corporate tax-ratio. The rest of the paper is organized as follows.

Section 2 provides the baseline model without any policy rule. The objective of this section is to examine the impact of the exogenous changes in demand and productivity-wage gap on output growth rate, income growth rate of labour and debt-GDP ratio in the absence of any policy rule. Section 3 sets out the targets and assignment rules of alternative policy frameworks and policy regimes. Section 4 analyzes the dynamics of different policy frameworks of sound finance regime. Section 5 analyzes the dynamics of two variants of DNFS framework. Section 6 provides some concluding remarks.

2. Baseline Model

This section provides a medium-run baseline growth model assuming expenditures, taxes and interest rates to be exogenously given. In contrast to the notion of “long run”, there are at least two distinguishing features of this model by which the analysis can be interpreted as “medium run”. Firstly, output growth rate can diverge from natural growth rate in this model. Secondly, the growth gap between labour productivity and real wage rate can be positive during this period.

For the sake of simplicity, the economy is assumed to be closed. The binding constraint is assumed to be aggregate demand. In order to focus on specific questions, the model assumes away the possibility of Harrodian instability as in Ryoo and Skott (2017) as well as different forms of instabilities that may arise due change in income distribution as pointed out by Stockhammer (2004) and Hein (2006). The consumption propensity out of profit income and interest income are assumed to be zero[3]. Interest income does not play any role in the model. Thus the deposit rates of banks are assumed to be zero for the sake of simplicity. The lending rate of banks is positive. The technological output capital ratio is assumed to be exogenously given.

Similar to many medium-run post-Keynesian models, the investment decisions are affected by 'animal spirits' and aggregate demand. Government expenditures affect aggregate demand through purchases of goods and services of firms. The fiscal support is perceived as a transfer income to labour and hence analytically distinct from government spending on goods and services. The baseline model has at least two Kaleckian features. Firstly, consumption propensity of workers is greater than that of capitalists such that reduction in income share of labour reduces consumption demand. Secondly, it is set within an under- consumptionist framework where investment decisions are not affected by profit share.

In contrast to many post-Keynesian models, however, the capacity utilization rate and technological output- capital ratio are not explicitly modelled here. This method is adopted as a convenient strategy for estimating the relevant parameters of the model in countries where time-series data for aggregate capital stock and capacity utilization rate is not directly available.

[3] Allowing for positive consumption propensity out of profit income does not affect essential results of the baseline model as long as it is lower than consumption propensity of the workers. The consumption propensity out of interest income is not relevant to this model since the issue of dynamic instability as in Hein (2006) is assumed away.

2.1 Basic Equations

The level of output is determined by aggregate demand through equation (1), where ‘I’, ‘C’ and ‘E’ denote private investments, consumption expenditure and current government expenditures on the purchase of goods and services.

$$Y = C + I + E \qquad (1)$$

The consumption expenditure is a positive function of an autonomous component ‘A’ and labour income ‘Y_L’, ‘b’ is the marginal propensity to consume.

$$C = A + bY_L \qquad (2)$$

where $0 < b < 1$

The labour income is perceived as a sum of wage bill and a fiscal support ‘N’. The fiscal support is defined as income transfer to labour from government. In the absence of any fiscal support, labour income equals wage is bill or the product of real wage rate ‘w_r’ and employment ‘L’.

$$Y_L = w_r L + N \qquad (3)$$

The level of nominal wage rate and output per worker is assumed to be exogenously given. The prices are formed through a mark-up over unit labour cost through equation (4), where ‘w’ is the nominal wage rate, ‘v’ is the given output-worker ratio, ‘k’ is the mark-up and p is the price.

$$\frac{w}{v} k = p \qquad (4)$$

where k>1

Deriving the level of real wage rate from equation (4) as a ratio between nominal wage rate and price and taking its growth form, the growth rate of real wage rate can be written as equation (5). The growth rate of output per worker is denoted as the labour productivity growth rate ‘m’. The relationship described by equation (5) indicates that the growth rate of real wage rate depends on the growth rate of labour productivity net of growth rate of mark-up. The distinguishing feature of this model is the presence of positive productivity-wage growth gap in the medium run, indicating a positive growth rate of mark-up in this case.

$$\widehat{w_r} = m - \hat{k} \qquad (5)$$

where

$\hat{v} = m > 0;\ \hat{k} > 0$

The growth rate in the mark-up is assumed to be proportional to labour productivity growth rate as described in equation (6). The parameter 'φ' can be called the *elasticity of mark-up* and indicates the responsiveness of mark-up due to change in labour productivity. The phenomenon of positive mark-up growth rate would be reflected by a positive elasticity of mark-up. The maximum value that the parameter may attain is 1, in which case growth rate of mark-up is equal to growth rate of labour productivity. In the closed economy framework, the growth gap between labour productivity and real wage would be equal to the growth rate of mark-up, i.e. $\varphi m = m - \widehat{w_r}$.

The level of elasticity of mark-up in the short and medium run can be perceived to depend on existing socio-political bargaining strength between capital and labour and structural feature of the economy. The globalization period can be perceived to bring about long term changes in institutions and economic structure by which capital's bargaining strength increased. Such long term changes are reflected here through the assumption that capitalists in the short run and medium run are always successful to increase their mark-up when growth rate of labour productivity is positive. The mark-up elasticity is assumed to be sticky with respect to fluctuations in output.

$$\hat{k} = \varphi m \qquad (6)$$

where

$0 < \varphi \leq 1$

It can be noted, that equation (6) can be made more realistic by adding another term for output growth rate such that growth rate of mark-up depends on both changes in demand as well as mark-up elasticity. Nonetheless, inclusion of this term would not change the essential results of the model and for the sake of simplicity, it is excluded from the model. The emphasis of equation (6) is on the presence of the positive parameter φ and *not* on the absence of the term for output growth rate. Along with positive labour productivity growth rate, it is this positive and exogenously given mark-up elasticity that is particularly distinct from conflict-inflation models as in Rowthorn (1977) and Hein and Stockhammer (2009).

By implication, from equations (5) and (6), the growth rate of real wage rate would be determined by exogenously given labour productivity growth rate and mark-up elasticity as described in equation (6a). For any given values of the RHS in equation (6a), growth rate of nominal wage rate and inflation rate adjust in a manner such that the LHS remain unchanged. The LHS of the equation only change when either mark-up elasticity changes or the labour productivity growth rate changes. Throughout the paper, 'm' is assumed to be fixed.

In the extreme case when $\varphi = 1$, the growth rate of real wage rate is zero since the entire change in labour productivity is absorbed by proportional change in the mark-up. When $0 < \varphi < 1$, the change in real wage rate is less than proportional to changes in labour productivity. In both the cases, labour productivity growth rate is greater than the real wage rate growth rate. Rise in mark-up elasticity at given level of productivity growth rate indicates reduction in growth rate of real wage rate.

$$\widehat{w_r} = (1 - \varphi)m \qquad (6a)$$

For the sake of comparability of policy implications in terms of output, labour income and debt, what would be relevant for the paper is the manner in which alternative policy frameworks *perceive* the inflation rate to behave and not how the inflation rate *actually* behaves over time. Given the sharp differences in the manner in which Philips curve equations are viewed within New-Keynesian and Post-Keynesian approaches, the paper takes a middle path. Equation (6) sets out a perceived behavior in inflation rate within alternative policy frameworks, that is neither inconsistent with New-Keynesian approach nor with the post-Keynesian approach[4]. The middle path is taken to

[4] Equation (6b) is similar to the one that was used in Lavoie (2006) to compare Post-Keynesian amended model with the New Keynesian models in Allsopp and Vines (2000) and (Taylor, 2000).

indicate that the essential results of the paper do not necessarily follow from the difference in the perceived behavior of the inflation rate within alternative policy frameworks[5].

$$\frac{d\pi^p}{dt} = \sigma(g - g_n) \qquad (6b)$$

where

$\sigma > 0$

Equation (6b) indicates that rate of change in perceived inflation rate ($\frac{d\pi^p}{dt}$) is positively affected by the gap between output growth rate (g) and the natural growth rate (g_n). Thus, $g = g_n$ provides a necessary and sufficient condition for $\frac{d\pi^p}{dt} = 0$.

By definition, the employment growth rate is the difference between output growth rate and the labour productivity growth rate. This relationship is described in equation (7), where ‘g’ denotes output growth rate.

$$\hat{L} = g - m \qquad (7)$$

The growth rate of labour income can be derived from equation (3) as equation (8a), where ‘n_s’ denotes the historically given share of fiscal support in labour income and (1-n_s) denotes the share of wage bill in labour income. Plugging equations (5a) and (7) in (8a), the income growth rate of labour can be described as equation (8b). At any given share of fiscal support in labour income and exogenously given labour productivity growth rate, the growth rate of labour income is positively affected by the growth rate of output and fiscal support and negatively affected by mark-up elasticity.

$$g_L = (1 - n_s)\left(\widehat{w_r} + \hat{L}\right) + n_s\hat{n} \qquad (8a)$$

$$= (1 - n_s)g - (1 - n_s)\varphi m + n_s\hat{n} \qquad (8b)$$

[5] Depending on the nature of price expectations and the sensitivity of inflation rate to output gap, the actual inflation rate may be different or similar to the perceived inflation rate as described in equation (6b).

where

$$n_s = \frac{N}{Y_L}; 1 - n_s = \frac{w_r L}{Y_L}$$

$$0 \leq n_s < 1$$

Similar to different post-Keynesian models, investments depend on expectations and various autonomous components of demand. Instead of describing the relation between investment rate and capacity utilization rate, however, here the investment function is written in growth form as equation (9). The growth rate of investment expenditure is positively affected by the present level of aggregate demand since the latter acts as a proxy for growth rate of profits. Changes in market interest rate 'r' is assumed to have adverse impact on investments by hardening financial constraint. The corporate tax-GDP ratio is defined here as a ratio between a lump sum value of corporate tax (T_π^o) and the given level of output. The baseline model includes the possibility of corporate tax ratio exerting a negative impact on corporate investments by adversely affecting animal spirits. The coefficient 'a_3' is assumed to be either zero or positive, such that investment growth rate either remains unchanged or gets adversely affected by higher corporate taxes. The parameter 'a_1' is an autonomous component of investment and reflects expected growth rate of sales.

$$\hat{I} = a_1 - a_2 r - a_3 t_\pi + a_4 g \qquad (9)$$

where

$a_1 > 0;\ a_2 > 0;\ a_3 \geq 0;\ a_4 > 0$

$t_\pi = \frac{T_\pi^o}{Y}$

Converting level values into growth form from equations (1) and (2), the output growth rate would be given by equation (10). The parameters c_0, c_1, c_2 and c_3 respectively denote the given shares of investment, autonomous component of consumption, labour income and government expenditures in output.

$$g = c_0 \hat{I} + c_1 \hat{A} + b c_2 g_L + c_3 \hat{e} \qquad (10)$$

where

$$c_0 = \frac{I}{Y} > 0;\ c_1 = \frac{A}{Y} > 0;\ c_2 = \frac{Y_L}{Y} > 0;\ c_3 = \frac{E}{Y} > 0$$

Since growth rate in aggregate expenditures would be affected by output growth rate through consumption and investment channel, while growth rate in expenditures affects output growth rate, stability condition would be provided when change in expenditure growth rate due to change in output growth rate is less than unity. This stability condition is given by condition (C.1). To make the analysis meaningful, condition (C.1) is assumed to hold throughout this paper.

$$c_0 a_4 + b c_2 (1 - n_s) < 1 \qquad (C.1)$$

Plugging in the value of income growth rate of labour and investment growth rate from equations (8b) and (9), the medium run equilibrium growth rate in the baseline model would be given by equation (11). The equilibrium output growth rate is positively affected by government expenditures and fiscal support. The interest rate has unambiguously adverse impact on equilibrium output growth rate[6]. The impact of corporate tax ratio on output growth rate is either zero or negative. Since actual output growth rate is determined autonomous components of demand, it can diverge from natural growth rate in the medium run in the baseline model.

$$g^* = c_4 - c_5 r - c_6 t_\pi + c_7 \hat{e} + c_8 \hat{n} \qquad (11)$$

where

$$c_4 = \frac{c_0 a_1 + c_1 \hat{A} - b c_2 \varphi (1 - n_s) m}{1 - c_0 a_4 - b c_2 (1 - n_s)}$$

$$c_5 = \frac{c_0 a_2}{1 - c_0 a_4 - b c_2 (1 - n_s)} > 0$$

$$c_6 = \frac{c_0 a_3}{1 - c_0 a_4 - b c_2 (1 - n_s)} \geq 0$$

[6] It can be noted that unlike the New-Keynesian models as in Gali (2008, Chapter 2) where interest rate affects output through the consumption channel, here it affects output through the investment channel.

$$c_7 = \frac{c_3}{1 - c_0 a_4 - b c_2 (1 - n_s)} > 0$$

$$c_8 = \frac{b c_2 n_s}{1 - c_0 a_4 - b c_2 (1 - n_s)} > 0$$

The natural growth rate is defined as the sum of labour productivity growth rate and labour supply growth rate. This relationship is given by equation (12), where 'q' is the exogenously given labour supply growth rate.

$$g_n = m + q \qquad (12)$$

The fiscal deficit ratio is defined as the ratio between level of fiscal deficit and the historically given output level, whereas the level of debt-GDP ratio is defined as a ratio between initial level of debt stock and output. Since deficit ratio is total expenditures net of revenue and corporate taxes are the only form of taxes considered in the model[7], the deficit ratio is given equation (13).

$$\frac{F}{Y} = \frac{E + N - T_\pi^o}{Y} + r\lambda \qquad (13)$$

The rate of change in debt-GDP ratio is given by equation (14). In contrast to Domar (1944) and Pasinetti (1998), the output growth rate in equation (14) would be affected by the fiscal policy of the government. Though the proposition of this positive relation is similar to (Leão, 2013), here different forms of government expenditures would affect output growth rate differently.

$$\dot{\lambda} = \frac{F}{Y} - \lambda g \qquad (14)$$

where

$$\dot{\lambda} = \frac{d\lambda}{dt}$$

[7] The exclusion of other taxes is entirely for the sake of simplicity. Except for changing the steady state level values, inclusion of other taxes in the model as in Ryoo and Skott (2013) would not change the essential results of the model.

Plugging equations (13) in (14) and writing the present values as products of initial values and growth factor, the rate of change in debt-GDP ratio can be written as equation (15).

$$\dot{\lambda} = n_s c_2 + c_3 - \lambda c_4 + (c_3 - \lambda c_7)\hat{e} + (n_s c_2 - \lambda c_8)\hat{n} - (1 - \lambda c_6)t_\pi + (1 + c_5)\lambda r \qquad (15)$$

The relation between interest rate and the rate of change in debt-GDP ratio is unambiguously positive since $c_5>0$ and $\lambda>0$. But the impact of expenditures and corporate taxes on the rate of change in debt ratio would depend on the sign of their respective coefficients. To reflect the assumption of debt ratio getting positively affected by expenditures and negatively by taxes, further restrictions on the coefficients are needed. Restrictions (R1) and (R2) guarantee such relationship by ensuring $(c_3 - \lambda c_7) > 0$, $(n_s c_2 - \lambda c_8) > 0$ and $(1 - \lambda c_6) > 0$. Condition (C1) will be necessarily satisfied when restriction (R1) is satisfied[8].

$$a_4 < \frac{1 - \lambda b - b c_2 (1 - n_s)}{c_0} \qquad (R1)$$

$$a_3 \leq \frac{b}{c_0} \qquad (R2)$$

The 2 restrictions (R1) and (R2) reflect the assumption that responsiveness of output growth rate with respect to government expenditures (a_4) and corporate taxes (a_3) lie below a threshold level. In the presence of these restrictions $\frac{\partial \dot{\lambda}}{\partial \hat{e}} > 0, \frac{\partial \dot{\lambda}}{\partial \hat{n}} > 0$ and $\frac{\partial \dot{\lambda}}{\partial t_\pi} < 0$.

2.2 Comparative Statics

The central objective of this paper is to analyze the impact of exogenous changes in aggregate demand and income distribution under different policy regimes. The changes in aggregate demand and income distribution are respectively analyzed in terms of exogenous changes in the autonomous component of investment 'a_1' and the elasticity mark-up 'φ'. In the baseline comparative statics, the impact of these changes are analyzed by assuming exogenously given interest rates, expenditures and taxes.

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[8] See Appendix 1

The impact of these exogenous changes on output growth rate are given by equations (16) and (17). The partial derivative with respect to autonomous changes in investment is positive in equation (16), indicating the usual post-Keynesian conclusion that adverse shocks in investments leads to a fall in output growth rate. The partial derivative of output growth rate with respect to changes in mark-up elasticity is negative in equation (17), reflecting the under-consumptionist proposition of adverse impact of fall in growth in real wage rate.

$$\frac{\partial g}{\partial a_1} = \frac{c_0}{1 - bc_2(1 - n_s)} > 0 \qquad (16)$$

$$\frac{\partial g}{\partial \varphi} = -\frac{bc_2 m(1 - n_s)}{1 - bc_2(1 - n_s)} < 0 \qquad (17)$$

The effect of changes in autonomous investments and mark-up elasticity on income growth rate of labour is similar, since labour income is positively affected by output through the employment channel. The partial derivatives are described in equations (18) and (19).

$$\frac{\partial g_L}{\partial a_1} = \frac{c_0(1 - n_s)}{1 - bc_2(1 - n_s)} > 0 \qquad (18)$$

$$\frac{\partial g_L}{\partial \varphi} = -(1 - n_s)\left[\frac{bc_2 m(1 - n_s)}{1 - bc_2(1 - n_s)} + m\right] < 0 \qquad (19)$$

Equations (20) and (21) show the impact of these exogenous shocks on rate of change in debt-GDP ratio. The partial derivative with respect to autonomous component of investment is negative in equation (20), whereas the partial derivative with respect to mark-up elasticity is positive in (21). Since rate of change in debt-GDP ratio would be negatively related to output growth rate at any given growth rate of debt stock, fall in investment and higher mark-up elasticity would increase the rate of change in debt-ratio.

$$\frac{\partial \dot{\lambda}}{\partial a_1} = -\frac{c_0 \lambda}{1 - bc_2(1 - n_s)} < 0 \qquad (20)$$

$$\frac{\partial \dot{\lambda}}{\partial \varphi} = \lambda \frac{bc_2 m(1-n_s)}{1-bc_2(1-n_s)} > 0 \qquad (21)$$

The baseline model described the impact of exogenous shocks on output growth rate, income growth rate of labour and the debt-GDP ratio in the absence of any policy targets and policy rule. The next section describes different policy rules that aim to stabilize these variables.

3. Alternative Policy Frameworks

Stabilization policies may involve at least 3 distinct policy targets-stabilization of output growth rate, stabilization of debt-GDP ratio and stabilization of income growth rate of labour. The three policy targets can be described as targets (T1) - (T3). Attaining target (T1) implies $\frac{d\pi^p}{dt} = 0$ in equation (6b). While targets (T1) and (T2) are frequently used in different policy frameworks, the need for target (T3) comes from the positive and exogenous mark-up elasticity. The targeted income growth rate of labour is set here at natural growth rate for the sake of exposition[9].

$$g = g_n \qquad (T1)$$

$$\dot{\lambda} = 0 \qquad (T2)$$

$$g_L = g_n \qquad (T3)$$

Throughout the paper, a distinction is made between *policy regimes* and *policy frameworks*. Depending on whether fiscal policy instruments are used for attaining target (T1), the policy regimes are broadly classified into sound finance or functional finance regimes. Sound finance is defined as a regime where fiscal instruments are not used for output stabilization. In contrast, functional finance regimes include policy rules that necessarily use fiscal instrument for stabilizing output. Depending on the number of policy targets, each policy regime is further categorized into three distinct policy frameworks.

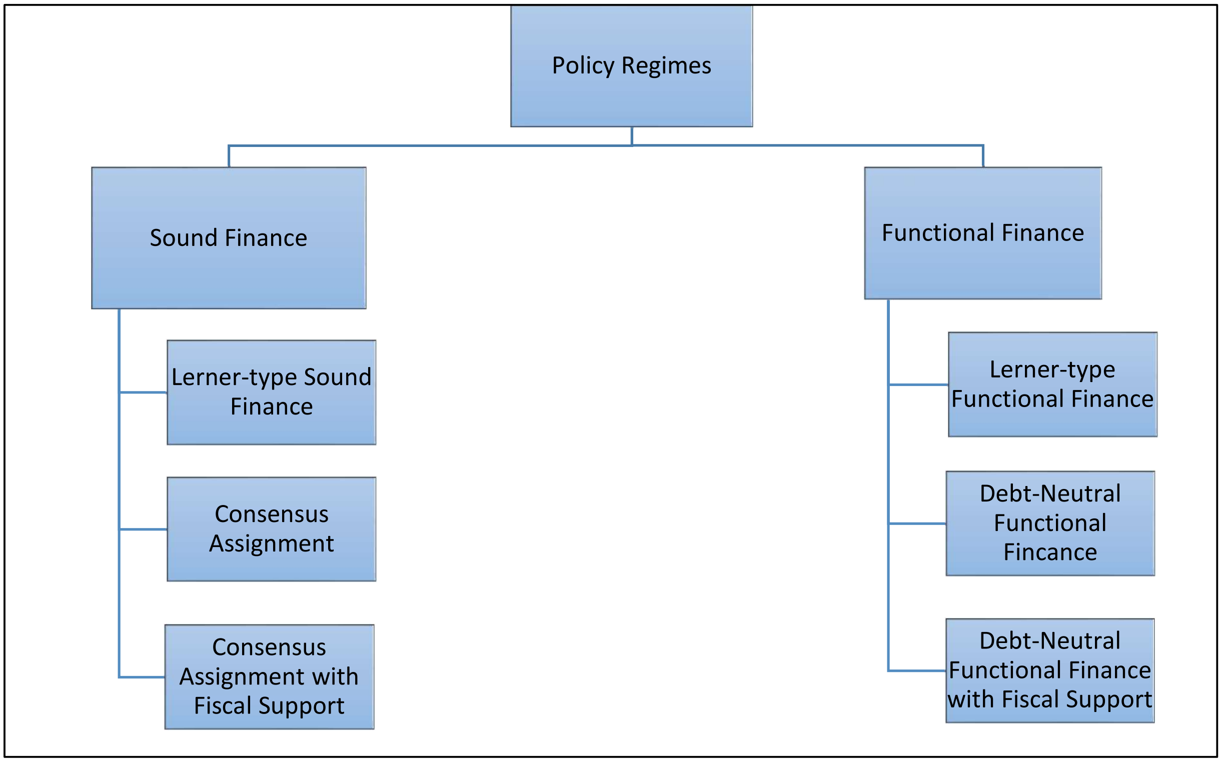
[9] It can be noted that depending on the level of targeted labour income with respect to a given historic value, there can be different values of targeted growth rate of labour income other than the natural growth rate.

The sound finance regime can be classified into 3 different policy frameworks: (i) Lerner-type sound finance, (ii) Consensus assignment and what we term as (iii) consensus assignment with fiscal support. Similar to how Lerner (1943) perceived sound finance, the Lerner-type sound finance framework has 1 policy target (T2) of stabilizing debt-GDP ratio. The consensus assignment has 2 policy targets (T1) and (T2) as it attempts to stabilize both debt ratio as well as the output growth rate. The consensus assignment with fiscal support is perceived as a thought experiment and includes all 3 policy targets (T1)-(T3) including stabilization of income growth rate of labour.

Similarly, the functional finance regime can be classified into (i) Lerner-type functional finance, (ii) debt-neutral functional finance, and what is termed as (iii) debt-neutral functional finance with fiscal support (DNFS) framework. Similar to Lerner's definition of functional finance, Lerner-type functional finance has 1 policy target (T1) of stabilizing output growth rate and the debt dynamics evolves endogenously as in Davidson (2010) and Arestis and Sawyer (2010). The notion of debt-neutral functional finance is similar to Mason and Jayadev and has 2 policy targets (T1) and (T2). The DNFS policy framework is perceived to comprise all 3 policy targets (T1-T3) including stabilization of labour income. The broad classification of different policy frameworks is shown in figure 1.

The specific *regime* that a country follows may depend on political-economic factors as pointed out by Kalecki (1943), whereas the choice of *policy framework* may depend on the number of policy targets that can be attained under given set of institutions. The number of policy targets that can be met depend on the number of available policy instruments as well as the stability condition of the policy framework. Rigidity in interest rate reduces the number of policy instruments, whereas dynamic instability emerging from assignment rules makes a policy framework logically untenable as multiple targets become mutually contradictory.

Figure 1: Different Policy Frameworks under Alternative Policy Regimes



The central objective of this paper is to examine the effectiveness of different policy frameworks in mitigating exogenous shocks in demand and mark-up elasticity in the midst of these possible constraints. Since most countries follow different variants of sound finance regime, the role of all possible policy frameworks under sound finance regime is analyzed in details. For the functional finance regime, the paper focuses on the DNFS framework. The policy instruments used for the DNFS framework precludes the use of market interest rate as an instrument due to the possibility of interest rate rigidity. Thus market interest rate is assumed to be exogenously given. Instead of using fiscal balance as one single instrument, both these variants use taxes and expenditures as separate policy instruments.

3.1 The Sound Finance Regime

The common feature of all variants of sound finance regime is the use of fiscal instruments in meeting target (T2). For the sake of comparability across alternative policy frameworks, expenditure growth rate is perceived as the assigned instrument for attaining target (T2) in all the variants.

The desired expenditure growth rate is defined as that expenditure growth rate at which debt-GDP ratio is stabilized. Thus, desired expenditure growth rate is expressed as equation (22), where desired expenditure growth rate is the level of expenditure growth rate at which $\frac{d\lambda}{dt} = 0$.

$$\hat{e}_d = \hat{e}|_{\frac{d\lambda}{dt}=0} \qquad (22)$$

Putting $\frac{d\lambda}{dt} = 0$ in equation (15),

$$\hat{e}|_{\frac{d\lambda}{dt}=0} = -\frac{n_s c_2 + c_3 - \lambda c_4}{c_3 - \lambda c_7} - \frac{\lambda(1 + c_5)}{c_3 - \lambda c_7} r + \frac{(1 - \lambda c_6)}{c_3 - \lambda c_7} t_\pi - \frac{(n_s c_2 - \lambda c_8)}{c_3 - \lambda c_7} \hat{n} \qquad (23)$$

Thus, from equations (22) and (23), the desired expenditure growth rate is given by equation (24).

$$\hat{e}_d = -\frac{n_s c_2 + c_3 - \lambda c_4}{c_3 - \lambda c_7} - \frac{\lambda(1 + c_5)}{c_3 - \lambda c_7} r + \frac{(1 - \lambda c_6)}{c_3 - \lambda c_7} t_\pi - \frac{(n_s c_2 - \lambda c_8)}{c_3 - \lambda c_7} \hat{n} \qquad (24)$$

The *consensus assignment* attains the targets (T1) and (T2) by respectively using the policy instruments of interest rate and expenditure growth rate. The assignment rules are given equations (25) and (26), where θ_1 and θ_2 are positive parameters reflecting the respective speed of adjustment in the two instruments. Equation (25) is the monetary policy rule which indicates that the interest rate would be reduced when output growth rate is lower than natural growth rate and increased in the opposite case. Equation (26) indicates that expenditure growth rate would be reduced when it is greater than the desired level and increased otherwise. Interest rate and expenditure growth rate would remain unchanged when output growth rate equal natural growth rate and desired expenditure equal actual expenditure growth rate.

$$\dot{r} = \theta_1(g - g_n) \qquad (25)$$

$$\dot{\hat{e}} = \theta_2(\hat{e}_d - \hat{e}) \qquad (26)$$

where

$$\dot{\hat{e}} = \frac{d\hat{e}}{dt}\,; \dot{r} = \frac{dr}{dt}$$

$$\theta_1 > 0;\ \theta_2 > 0$$

The *Lerner-type sound finance* would be characterized exclusively by equation (26) since it has only one policy target (T2). The exclusion of target (T1) can be either by choice or due to constraints posed by interest rate rigidity. The exclusion of equation (25) due to interest rate rigidity transforms an otherwise Consensus assignment rule into a specific variant of Lerner-type sound finance framework. The specific case where a policy framework operates like Lerner-type sound finance on account of interest rate exogeneity is termed in the paper as *consensus assignment with exogenous interest rate (CAEI)* framework.

The *Consensus assignment with fiscal support* (CAFS) is perceived to be a policy framework which has an additional assignment rule as equation (27) over and above equations (25) and (26). The growth rate of fiscal support is the instrument through which target (T3) is attained. The speed of adjustment is assumed to be instantaneous for the sake of convenience. This policy framework is introduced as a thought experiment to examine whether target (T3) can be attained within an otherwise consensus assignment without making the targets (T1)-(T3) mutually contradictory. The necessary condition for this policy framework to operate is interest rate acting as a policy instrument. This assumption is maintained to bring out more clearly the constraints posed by dynamic instability.

$$\dot{\hat{n}} = g_n - g_L \qquad (27)$$

where

$$\dot{\hat{n}} = \frac{d\hat{n}}{dt}$$

3.2 The 2 variants of DNFS framework

There are 2 variants of DNFS policy framework which are discussed, both of which are argued to provide sufficient conditions for meeting the three targets (T1)-(T3). The first variant presumes that corporate tax has no adverse impact on corporate investments, in which case corporate tax coefficient in the investment function would be zero, i.e. $a_3 = 0$. The second variant allows for negative tax coefficient ($a_3 > 0$) and introduces the role of development financial institutions. Both the variants use equation (27) as an assignment rule. Expenditure growth rate is used as policy instrument in both these variants to stabilize output growth rate. In terms of assignment rule, the central difference between the 2 frameworks is the manner in which debt-GDP ratio is stabilized.

The specificity of the first variant is the use of corporate tax-GDP ratio as a policy instrument to stabilize debt-GDP ratio. If desired level is defined as that level of corporate tax ratio at which debt-GDP ratio is stabilized, then desired level of corporate tax ratio can be defined by equation (28).

$$t_\pi^d = t_\pi|_{\frac{d\lambda}{dt}=0} \qquad (28)$$

Putting $\frac{d\lambda}{dt} = 0$ and $a_3 = 0$ in equation (15),

$$t_\pi^d = n_s c_2 + c_3 - \lambda c_4 + (c_3 - \lambda c_7)\hat{e} + (n_s c_2 - \lambda c_8)\hat{n} + (1 + \lambda c_5)r \qquad (29)$$

Targets (T1) and (T2) are attained by respectively using the policy instruments of expenditure growth rate and corporate tax rate. The assignment rules are given by equations (30) and (31), where θ_3 and θ_4 are positive parameters reflecting the respective speeds of adjustments. Equation (30) indicates that corporate tax ratio would be increased when the actual corporate tax ratio is less than the desired level and vice versa. Equation (31) indicates that expenditure growth rate would be increased when it is less than the natural growth rate and vice versa. The two instruments attain equilibrium values when output growth rate equal natural growth rate and desired level equals actual corporate tax ratios.

$$\frac{dt_\pi}{dt} = \theta_3(t_\pi^d - t_\pi) \quad (30)$$

$$\frac{d\hat{e}}{dt} = \theta_4(g_n - g) \quad (31)$$

Where

$\theta_3 > 0;\ \theta_4 > 0$

Table 1: Balance Sheet Matrix with Development Financial Institutions

	Workers	Firms	Government	Commercial Bank	DFI	Total
Fixed Capital		+pK				+pK
Deposit	$+D_H$		$+D_G$	$-D_H$	$-D_G$	0
Loans		$-L_F$	$-L_G$	$+L_F$	$+L_G$	0
-Net Worth	$-N_H$	$-N_F$	$-N_G$	$-N_B$	$-N_V$	-pK
Sum	0	0	0	0	0	0

The second variant of DNFS framework is perceived under an alternative institutional setting where development financial institution (DFI) plays a key role. There are three key features of such an institutional setting. Firstly, the DFI is assumed to be owned by a government agency such that it can be used as a policy tool. Despite government ownership, the DFI is perceived to operate as an independent entity and DFI profits are not transferred to other government agencies. Secondly, the DFI is perceived to lend only to the government and maintain deposits exclusively of government agencies. The interest rate of the DFI remains delinked from the market rate of interest. Thirdly, the government borrows exclusively from the DFI at interest rate 'r_V'. Though interest income can be earned out of deposits maintained at the DFI, it plays no substantial role in the present analysis. Thus deposit rate of the DFI is assumed to be zero for the sake of simplicity. The institutional setting perceived for this policy framework can be summarized by the balance sheet matrix in table 1:

For the sake of simplicity, the role of high powered money and central bank is assumed away. The assets are denotes as '+' and liabilities are denoted as '-'. Difference between asset and liabilities equals net worth, such that the vertical sum for an economic unit is zero. Since asset of an economic unit is liability of the other, net financial wealth of the system as a whole is zero. Deposits of commercial banks are only held by household, whereas deposits of DFI are exclusive held by the government. Loans issued by the commercial bank ($+L_F$) is its asset, whereas it is exclusively held by the firms as liabilities ($-L_F$). Similarly, loans issued by the DFI is its asset ($+L_G$), which is exclusive held by the government as liabilities ($-L_G$). By implication, the lending rate of the DFI affects government's debt equation without changing the market interest rate whatsoever.

The desired level of DFI lending rate is defined as the rate at which debt-GDP ratio is stabilized. It is expressed as equation (32).

$$r_v^d = r_v|_{\frac{d\lambda}{dt}=0} \qquad (32)$$

Putting $\frac{d\lambda}{dt} = 0$ in equation (15), the desired lending rate is given by equation (33).

$$r_v^d = -\frac{n_s c_2 + c_3 - \lambda c_4}{\lambda} - c_5 r + \left(\frac{1 - c_6 \lambda}{\lambda}\right) t_\pi - \left(\frac{c_3 - \lambda c_7}{\lambda}\right) \hat{e} - \left(\frac{n_s c_2 - \lambda c_8}{\lambda}\right) \hat{n} \qquad (33)$$

The DFI lending rate is used as a policy instrument for debt-stabilization and its rate of change is given by equation (32), where θ_5 indicates the speed of adjustment. The lending rate is increased if it is below the desired level and increased in the opposite case.

$$\frac{dr_v}{dt} = \theta_5 \left(r_v^d - r_v\right) \qquad (34)$$

Where

$\theta_5 > 0$

The sufficient condition for DFI lending rate to act as the policy instrument is that it remains above a minimum level r_v^{min}. This minimum level of lending rate can be perceived either as a zero lower bound or as an interest rate that ensures minimum level of earnings for continuing banking operations. The corporate tax ratio would be used as a policy instrument that guarantees the fulfillment of this condition. The policy framework perceives corporate tax ratio to be maintained at a minimum level, the value of which would be subsequently determined from the model.

4. Stabilization Policies under Sound Finance Regime

This section analyzes the role of stabilization policies of different policy frameworks under sound finance regime. The impact of exogenous changes in autonomous investment and mark-up elasticity is analyzed within 3 policy frameworks- (i) Consensus Assignment, (ii) Consensus Assignment with exogenous interest rate and (iii) Consensus Assignment with Fiscal Support.

4.1 Consensus Assignment

The steady state values for expenditure growth rate and interest rate would be attained when targets (T1) and (T2) are met with $g = g_n$ and $\hat{e}_d = \hat{e}$ and in terms of equations (25) and (26), $\dot{r} = 0$ and $\dot{\hat{e}} = 0$. Solving for the steady state values at $g = g_n$ and $\hat{e}_d = \hat{e}$, the equilibrium level of expenditure growth rate and interest rate can be derived respectively as equations (35) and (36). Equation (35) provides the value of expenditure growth rate at which $\dot{\lambda} = 0$.

$$\hat{e}_1^* = -\frac{\lambda c_4}{K_4} + \frac{K_1 \lambda (1 + c_5)}{K_4} + \frac{(K_3 - K_2) c_5}{K_4} \qquad (35)$$

$$r_1^* = \frac{c_3 c_4}{K_4} - \frac{K_1}{K_4} c_3 + \frac{c_7}{K_4} (\lambda K_1 + K_3 - K_2) \qquad (36)$$

where

$K_1 = c_6 t_\pi - c_8 \hat{n} + m + q$

$K_2 = n_s c_2 + c_3 > 0$

$K_3 = (1 - \lambda c_6) t_\pi - (n_s c_2 - \lambda c_8) \hat{n}$

$K_4 = c_3c_5 + \lambda c_7 > 0$

Plugging in the steady state values of $\hat{e}_1^*$ and r_1^* in equation (11), the medium run steady value of output growth rate would be given by equation (37). Plugging in the value of steady state output growth rate in equation (8b), income growth rate of labour would be given by equation (38).

$$g_1^{**} = c_4 - c_5r^* - c_6t_\pi + c_7\hat{e}^* + c_8\hat{n} = g_n \qquad (37)$$

$$g_{L1}^{**} = (1-n_s)g_n - (1-n_s)\varphi m + n_s\hat{n} \qquad (38)$$

The central feature of equation (38) is the role of positive mark-up elasticity. In the absence of fiscal support, i.e. $n_s = 0$ and $\hat{n} = 0$, steady state income growth rate of labour is necessarily below natural growth rate as described by equation (38a). Since fiscal support is exogenously given, it can take any value and it is only by fluke that its growth rate would be such that income growth rate of labour is equal to the natural growth rate. By implication, income growth rate of labour would be lower than steady state output growth rate when the growth rate of fiscal support is relatively small.

$$g_{L1}^{**} = g_n - \varphi m \qquad (38a)$$

The Jacobian of the 2 equation system (25) and (26) is given by equation (39). The trace and the determinant of the Jacobian are respectively given by equations (40) and (41). Since the parameters θ_1, θ_2 and c_5 are positive, the trace is negative. With restriction (R1), $c_3 - \lambda c_7 > 0$ and $|J| > 0$. Thus, by the restriction (R1) of the model, stability condition would be guaranteed.

$$J_1 = \begin{bmatrix} -\theta_1c_5 & \theta_1c_7 \\ -\frac{\theta_2\lambda(1+c_5)}{c_3-\lambda c_7} & -\theta_2 \end{bmatrix} \qquad (39)$$

$$trJ_1 = -\theta_1c_5 - \theta_2 < 0 \qquad (40)$$

$$|J| = \theta_1\theta_2\left\{c_5 + \frac{\lambda(1+c_5)}{c_3-\lambda c_7}\right\} > 0 \qquad (41)$$

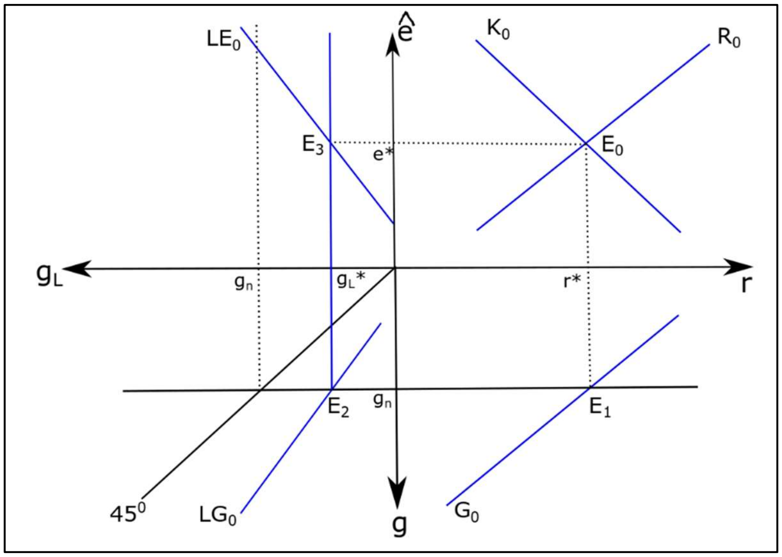
The manner in which the equilibrium values are determined can be described in figure 2. The four quadrants provide the relationship between expenditure growth rate, interest rate, output growth rate and income growth rate of labour.

The isocline for $\dot{\hat{e}} = 0$ is mapped in quadrant 1 and given by the negatively sloped line K_0. The slope of the K_0 isocline is negative because $\frac{\partial \hat{e}}{\partial r}\Big|_{\frac{d\hat{e}}{dt}=0} = -\frac{\lambda(1+c_5)}{c_3-\lambda c_7} < 0$. The isocline for $\dot{r} = 0$ indicates the monetary policy rule and is given by the positively sloped line R_0 in quadrant 1. The slope of the R_0 isocline is positive because $\frac{\partial \hat{e}}{\partial r}\Big|_{\frac{dr}{dt}=0} = \frac{c_5}{c_7} > 0$.

The negative relation between output growth rate and interest rate in equation (11) is mapped in quadrant 4 and reflected by the line G_0. The slope of the line G_0 is given by $\frac{\partial g^*}{\partial r} = -c_5 < 0$. Quadrant 3 maps the positive relation between output growth rate and income growth rate of labour in equation (8b) through the positively sloped straight line LG_0. In the $g - g_L$ space, the slope would be given by $\frac{\partial g}{\partial g_L} = \frac{1}{(1-n_s)} \geq 1$. The intercept term of LG_0 would be given by $\varphi m - \frac{n_s}{1-n_s}\hat{n}$. For the purpose of exposition, the growth rate and initial value of fiscal support is assumed to be small such that the intercept term is positive. Due to steep slope and positive intercept term, LG_0 does not intersect the 45 degree line. Quadrant 4 shows the relationship between expenditure growth rate and income growth rate of labour through the positively sloped line LE_0. The expenditure growth rate positively affects income growth rate of labour by affecting output growth rate. The slope of LG_0 is given by $\frac{\partial g_L}{\partial \hat{e}} = c_7(1-n_s) > 0$.

The 2 isoclines in quadrant 1 intersect at E_0 to produce the equilibrium values of expenditure growth rate and interest rate $\hat{e}^*$ and r^*. The unique equilibrium value of interest rate $r = r^*$ cuts the G0 line in quadrant 4 at E_1 where $g = g_n$. The steady state output growth rate cuts the LG_0 line at E2 to determine the equilibrium level of income growth rate of labour g_L^* such that it is less than g_n. The equilibrium income growth rate of labour is a value independent of expenditure growth rate and drawn as a vertical line in quadrant 2. The intersection point between the vertical g_L^* line and positively sloped LE_0 line is at E3. Since equilibrium income growth rate of labour is determined at equilibrium expenditure growth rate, the intersection point is consistent with the equilibrium value $\hat{e}^*$.

Figure 2: Steady State Equilibrium in Consensus Assignment



The impact of exogenous change in autonomous component of investment on steady state output growth rate is zero as the policy instruments meet target (T1) while meeting (T2). With output growth rate being stabilized at natural growth rate, income growth rate of labour is also stabilized. Accordingly, the partial derivatives with respect to output growth rate and income growth rate of labour are zero and respectively given by equations (42) and (43). Thus, given the model restrictions, shocks in autonomous components of investments would be fully compensated within consensus assignment framework.

$$\frac{\partial g_1^{**}}{\partial a_1} = \overbrace{\left[\frac{c_0}{1 - bc_2(1 - n_s)}\right]}^{>0} \overbrace{\left(1 - \frac{c_5 c_3}{K_4} - \frac{\lambda c_7}{K_4}\right)}^{=0} = 0 \qquad (42)$$

$$\frac{\partial g_{L1}^{**}}{\partial a_1} = (1 - n_s) \overbrace{\frac{\partial g^{**}}{\partial a_1}}^{=0} = 0 \qquad (43)$$

The impact on equilibrium interest rate and expenditure growth rate is given by equations (44) and (45). The positive partial derivative in equation (45) indicates that lower investment would require reduction in interest rate in order to keep output growth rate at natural growth rate. The negative partial derivative in equation (45) reflects that reduction in interest rate following reduction in investments created fiscal space for the rise in expenditure growth rate.

$$\frac{\partial r_1^*}{\partial a_1} = \frac{c_3}{K_4}\left[\frac{c_0}{1 - bc_2(1 - n_s)}\right] > 0 \qquad (44)$$

$$\frac{\partial \hat{e}_1^*}{\partial a_1} = -\frac{\lambda}{K_4}\left[\frac{c_0}{1 - bc_2(1 - n_s)}\right] < 0 \qquad (45)$$

The impact of exogenous change in mark-up elasticity on output growth rate and income growth rate of labour is respectively given by equations (46) and (47). Similar to the case in changes autonomous component of investment, the partial derivative is zero. But in contrast to the previous case, the partial derivative in equation (47) is negative, indicating higher mark-up elasticity leads to fall in income growth rate of labour. Thus, adverse shocks in income growth rate of labour due to higher mark-up elasticity is not compensated in the given policy framework despite output growth rate getting stabilized.

$$\frac{\partial g_1^{**}}{\partial \varphi} = -\overbrace{\frac{bc_2 m(1 - n_s)}{1 - bc_2(1 - n_s)}}^{<0}\overbrace{\left(1 - \frac{c_5 c_3}{K_4} - \frac{\lambda c_7}{K_4}\right)}^{=0} = 0 \qquad (46)$$

$$\frac{\partial g_{L1}^{**}}{\partial \varphi} = (1 - n_s)\frac{\overbrace{\partial g^{**}}^{=0}}{\partial \varphi} - \overbrace{(1 - n_s)m}^{>0} < 0 \qquad (47)$$

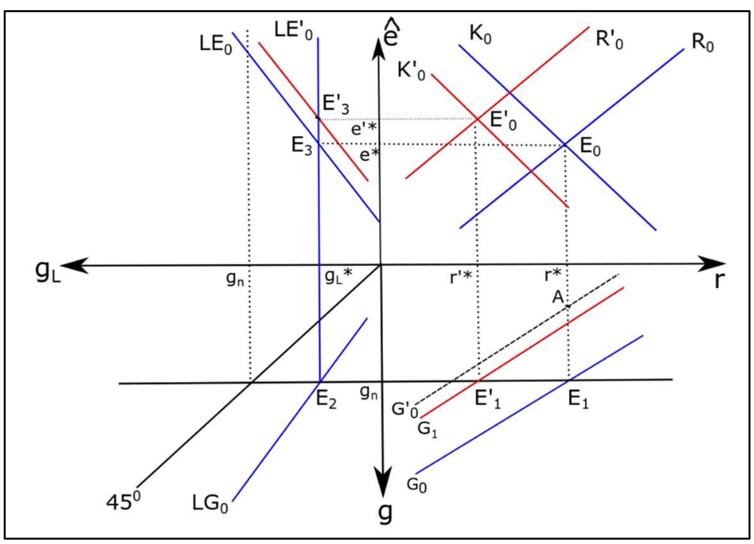
The impact on equilibrium interest rate and expenditure growth rate is given by equations (48) and (49). The partial derivative for interest rate is negative, which indicates higher mark-up elasticity requires reduction in interest rate in order to keep output growth rate at natural growth rate. Partial derivative for equation (49) is positive, which indicates lower interest rate following rise in mark-up elasticity would create fiscal space to increase expenditure growth rate.

$$\frac{\partial r_1^*}{\partial \varphi} = \frac{c_3}{K_4}\left[-\frac{bc_2 m(1 - n_s)}{1 - bc_2(1 - n_s)}\right] < 0 \qquad (48)$$

$$\frac{\partial \hat{e}_1^*}{\partial \varphi} = -\frac{\lambda}{K_4}\left[-\frac{bc_2 m(1 - n_s)}{1 - bc_2(1 - n_s)}\right] > 0 \qquad (49)$$

The central feature of consensus assignment in the midst of higher mark-up elasticity is the impact on income growth rate of labour. Higher mark up elasticity has adverse impact on income growth rate of labour through 2 distinct routes. Firstly, it reduces output growth rate at given growth gap between labour productivity and real wage rate and secondly, it reduces growth rate of real wage rate at given output growth rate and productivity growth rate. While the 2 policy instruments mitigate the first adverse impact by stabilizing the output growth rate at natural growth rate, there exists no instrument to compensate the second adverse impact. While figure 3 describes the impact of fall in autonomous component of investment, figure 4 shows the impact of higher mark-up elasticity.

Figure 3: Impact of Fall in Autonomous Component of Investment in Consensus Assignment



At any initial level of interest rate and expenditure growth rate, fall in investments would lead to a downward shift in the growth line from G_0 to G'_0 in quadrant 4 of figure 3 indicating lower output growth rate. The movement from E_1 to A indicates this change and its extent would be given by equation (16) of baseline model. Due to monetary policy rule, the interest rate would be reduced at any given expenditure growth rate leading to a leftward shift of R_0 to R_0' in quadrant 1. Due to debt-stabilization target, expenditure growth rate would be reduced at any given interest rate. This will lead to a downward shift of K_0 to K'_0 in quadrant 1. With interest rate and expenditure growth rate affecting each other through growth equation and debt- stability equation, the final equilibrium would be at E'$_0$ with lower equilibrium interest rate and higher expenditure growth rate. Higher expenditure growth rate leads to an upward shift in growth line from G'$_0$ to G_1. The output growth rate settles at the new equilibrium E_1' where it is again equal to natural growth rate at interest rate r'*. The LG_0 line remains unchanged since neither the slope nor the intercept term changes on account of changes in autonomous investment. LE_0 line shift downward to LE_0', which indicates that the sustaining the same equilibrium income growth rate of labour now requires greater expenditure growth rate.

Figure 4: Impact of Higher Mark-up Elasticity

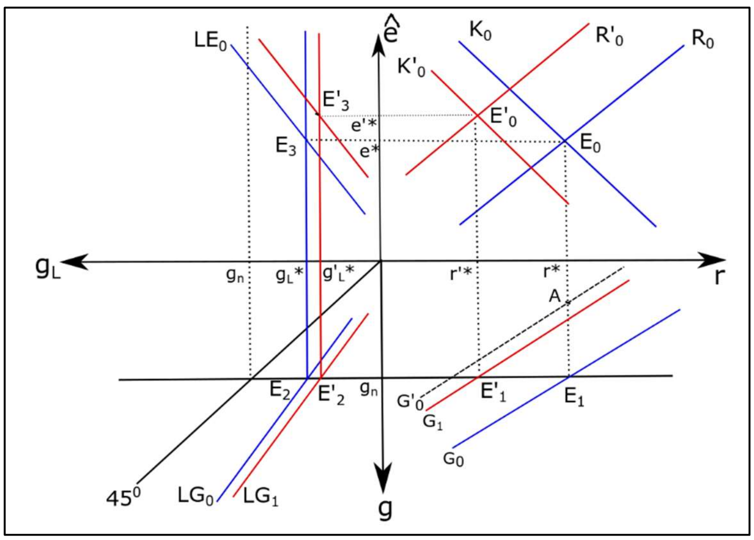


Figure 4 shows the impact of higher mark-up elasticity. At the given interest rate and expenditure growth rate, the extent of decline in output growth rate would be given by equation (17). While the changes in quadrant 1 and 4 would be similar to figure 3, the central difference in figure 4 is the shift of the labour income line from LG_0 to LG_1 in quadrant 3 as equilibrium point shifts from E_2 to E'$_2$. In terms of equation (38), this indicates the fall in income growth rate of labour at a given output growth rate due to higher mark-up elasticity. Reduction in equilibrium growth rate of labour income from g_L to g'_L leads to a shift in the vertical line in quadrant 2 as equilibrium position moves from E_3 to E'$_3$.

4.2 Consensus Assignment with Exogenous Interest Rate (CAEI)

In the midst of interest rate exogeneity, consensus assignment would transform to a Lerner-type sound finance framework. At any given interest rate, the steady state value of expenditure growth rate would be attained when $\hat{e}_d = \hat{e}$ and can be described by equation (35a). Equation (35a) provides the value of expenditure growth rate at which $\dot{\lambda} = 0$.

$$\hat{e}_2^* = -\frac{n_s c_2 + c_3 - \lambda c_4}{c_3 - \lambda c_7} - \frac{\lambda(1 + c_5)}{c_3 - \lambda c_7} r + \frac{(1 - \lambda c_6)}{c_3 - \lambda c_7} t_\pi - \frac{(n_s c_2 - \lambda c_8)}{c_3 - \lambda c_7} \hat{n} \qquad (35a)$$

The steady state value of output growth rate can be derived by plugging in the steady state value of $\hat{e}_2^*$ in equation (15) and can be described as equation (37a). Since equilibrium expenditure growth rate exclusively meets target (T2), there exists no a priori reason that output growth rate equals natural growth rate. The equilibrium income growth rate of labour is derived in a similar way as equation (38) and expressed as equation (38a).

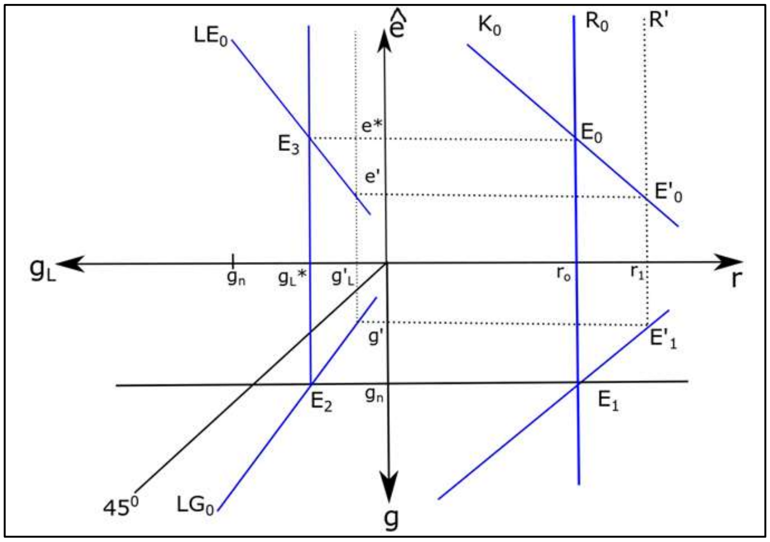
$$g_2^{**} = c_4 - c_5 r - c_6 t_\pi + c_7 \hat{e}_2^* + c_8 \hat{n} \qquad (37a)$$

$$g_{L2}^{**} = (1 - n_s) g_2^{**} - (1 - n_s)\varphi m + n_s \hat{n} \qquad (38a)$$

The stabilization condition can be examined by taking a partial derivative of equation (26) w.r.t $\hat{e}$. Since $\frac{\partial \dot{\hat{e}}}{\partial \hat{e}} = -\theta_2 < 0$, the stability condition would be fulfilled.

The determination of steady state values is shown in figure 5. The specificity of exogenous interest rate lies in the vertical R_0 line in quadrant 1 since interest rate is given exogenous to expenditure growth rate. It is only by fluke, that the exogenous interest rate is at r_0 where it cuts G_0 at E_1 and equilibrium level of expenditure growth rate is associated with natural growth rate. At any interest r_1 which is greater than r_0, output growth rate would be less than natural growth rate. By implication, the income growth rate would be lower as compared to the level at natural growth rate.

Figure 5: Steady State Equilibrium under Consensus Assignment with Exogenous Interest Rate



The impact of fall in autonomous component of investment on output growth rate and income growth rate of labour are respectively given by the equations (50) and (51). The two equations are derived by differentiating equations (37a) and (38a) w.r.t 'a_1'.

$$\frac{\partial g_2^{**}}{\partial a_1} = \left(\frac{c_0}{1 - bc_2(1 - n_s)}\right)\overbrace{\left(1 + \frac{c_7\lambda}{c_3 - \lambda c_7}\right)}^{>1} > 0 \qquad (50)$$

$$\frac{\partial g_{L2}^{**}}{\partial a_1} = \left\{\frac{c_0(1 - n_s)}{1 - bc_2(1 - n_s)}\right\}\overbrace{\left(1 + \frac{c_7\lambda}{c_3 - \lambda c_7}\right)}^{>1} > 0 \qquad (51)$$

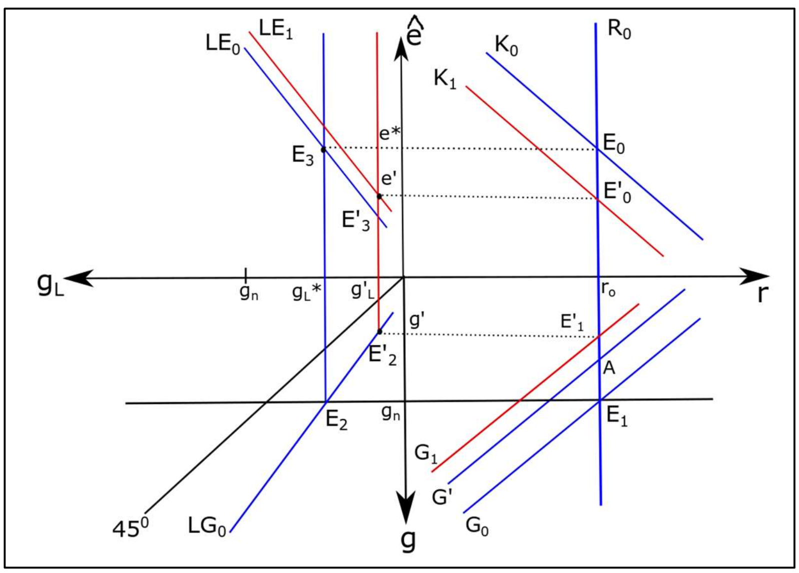
In contrast to equations (42) and (43) of the consensus assignment framework, here both the partial derivatives are positive. As compared to equations (18) and (19) of the baseline model without fiscal rules, the magnitude of change in output and labour income growth rate is greater since the second terms of equations (50) and (51) are greater than 1.

Differentiating equation (35a) w.r.t 'a_1', the impact on equilibrium expenditure growth rate is derived as equation (52). In contrast to equation (45) of the consensus assignment, here the partial derivative is positive.

$$\frac{\partial \hat{e}_2^*}{\partial a_1} = \left(\frac{\lambda}{c_3 - \lambda c_7}\right)\left(\frac{c_0}{1 - bc_2(1 - n_s)}\right) > 0 \qquad (52)$$

The specificity of consensus assignment under exogenous interest rate follows from the pro-cyclical nature of expenditure growth rate which is reflected by the positive sign of the partial derivative in equation (52). While expenditure growth rate remains unchanged in the absence of fiscal rules (baseline model) and increases for consensus assignment, here a reduction in investment will lead to reduction in expenditure growth rate leading to further fall in output growth rate. This mechanism is shown in figure 6 where the output growth rate is initially at natural growth rate.

Figure 6: Impact of Fall in Autonomous Component of Investment under Exogenous Interest Rate



The fall in investments leads to a fall in output growth rate at given expenditure growth rate and interest rate, reflected by the downward shift of the growth line from G_0 to G'. Similar to consensus assignment, the equilibrium position moves from E_1 to A. Due to pro-cyclical fiscal policy, expenditure growth rate falls leading to a downward shift of expenditure isocline from K_0 to K_1. The fall in expenditures leads to further decline in output growth rate, as growth line shifts further downward from G' to G_1. The final equilibrium position is at E'_1 where output growth rate falls to g'. The income growth rate of labour falls to g'_L due to reduction in output growth rate and the equilibrium position in quadrant 3 moves from E_2 to E'_2. The downward shift of LE_0 to LE_1 in quadrant 2 reflects the impact of lower output growth rate at given expenditure growth rate. Reduction in expenditure growth rate would involve a movement along the LE_1 line till the equilibrium position moves to E'_3.

The impact of higher mark-up elasticity on output growth rate and income growth rate of labour are derived as equations (53) and (54) respectively by differentiating equations (37a) and (38a) w.r.t 'φ'. Both the partial derivatives are negative.

$$\frac{\partial g_2^{**}}{\partial \varphi} = -\left\{\frac{bc_2 m(1-n_s)}{1-bc_2(1-n_s)}\right\}\overbrace{\left(1+\frac{c_7\lambda}{c_3-\lambda c_7}\right)}^{>1} < 0 \qquad (53)$$

$$\frac{\partial g_{L2}^{**}}{\partial \varphi} = -(1-n_s)\left[\left\{\frac{bc_2 m(1-n_s)}{1-bc_2(1-n_s)}\right\}\overbrace{\left(1+\frac{c_7\lambda}{c_3-\lambda c_7}\right)}^{>1} + m\right] < 0 \qquad (54)$$

In contrast to the consensus assignment where the adverse impact of higher mark-up elasticity on output growth rate would be compensated by policy rules, under exogenous interest rate the output growth rate would fall. The magnitude of fall is greater as compared to the baseline model since the second term of RHS in equation (53) is greater than 1. The magnitude of fall in income growth rate of labour in equation (54) would be greater as compared to equation (19) of baseline model and equation (47) of consensus assignment since $\left(1+\frac{c_7\lambda}{c_3-\lambda c_7}\right) > 1$ and $\left\{\frac{bc_2 m(1-n_s)}{1-bc_2(1-n_s)}\right\}\left(1+\frac{c_7\lambda}{c_3-\lambda c_7}\right) > 0$. The greater impact of mark-up elasticity on output growth rate in this case is again due to presence of pro-cyclical fiscal policy.

The impact of mark-up elasticity on expenditure growth rate is derived as equation (55) by differentiating equation (35a) w.r.t 'φ'. The partial derivative is negative, which indicates that higher mark-up elasticity will lead to lower expenditure growth rate.

$$\frac{\partial \hat{e}_2^{*}}{\partial \varphi} = -\left(\frac{\lambda}{c_3-\lambda c_7}\right)\left\{\frac{bc_2 m(1-n_s)}{1-bc_2(1-n_s)}\right\} < 0 \qquad (55)$$

4.3 Consensus Assignment with Fiscal Support (CAFS)

The steady state values for expenditure growth rate, interest rate and growth rate of fiscal support would be attained when targets (T1) - (T3) are met with $g = g_n$, $\hat{e}_d = \hat{e}$ and $g_L = g_n$ and in terms of equations (25), (26) and (27), $\dot{r} = 0$, $\dot{\hat{e}} = 0$ and $\dot{\hat{n}} = 0$. Solving for the steady state values at $g = g_n$, $\hat{e}_d = \hat{e}$ and $g_L = g_n$ the equilibrium level of expenditure growth rate, interest rate and growth rate of fiscal support can be derived respectively as equations (56) - (58). Equation (56) provides the value of expenditure growth rate at which $\dot{\lambda} = 0$.

$$\hat{e}_3^* = -\frac{\lambda c_4}{K_4} + \frac{K_5 \lambda (1 + c_5)}{K_4} + \frac{(K_6 - K_2) c_5}{K_4} \tag{56}$$

$$r_3^* = \frac{c_3 c_4}{K_4} - \frac{K_5}{K_4}(c_3 - \lambda c_7) + \frac{c_7}{K_4}(K_6 - K_2) \tag{57}$$

$$\hat{n}^* = q + m\left[1 + \frac{(1 - n_s)\varphi}{n_s}\right] \tag{58}$$

where

$$K_5 = c_6 t_\pi + q(1 - c_8) + m\left[1 - c_8\left\{1 + \frac{(1 - n_s)\varphi}{n_s}\right\}\right]$$

$$K_2 = n_s c_2 + c_3$$

$$K_6 = (1 - \lambda c_6)t_\pi - (n_s c_2 - \lambda c_8)\left[q + m\left\{1 + \frac{(1 - n_s)\varphi}{n_s}\right\}\right]$$

$$K_4 = c_3 c_5 + \lambda c_7$$

While equilibrium expenditure growth rate and interest rate meet target (T1) and (T2) as in the consensus assignment, the specificity of this framework is the determination of fiscal support growth rate at a level that meets target (T3). At any given labour supply growth rate, productivity growth rate and initial values of fiscal support, the steady state value of $\hat{n}^*$ would depend on the mark-up elasticity. At steady state values, both output growth rate and income growth rate of labour is at natural growth rate as described in equations (37b) and (38b).

$$g_3^{**} = c_4 - c_5 r_3^* - c_6 t_\pi + c_7 \hat{e}_3^* + c_8 \hat{n}^* = g_n \tag{37b}$$

$$g_{L3}^{**} = (1-n_s)g_n - (1-n_s)\varphi m + n_s\hat{n}^* = g_n \qquad (38b)$$

The Jacobian of the equation system (25)-(27) would be given by equation (59):

$$J_2 = \begin{bmatrix} \frac{\partial \dot{r}}{\partial r} & \frac{\partial \dot{r}}{\partial \hat{e}} & \frac{\partial \dot{r}}{\partial \hat{n}} \\ \frac{\partial \dot{\hat{e}}}{\partial r} & \frac{\partial \dot{\hat{e}}}{\partial \hat{e}} & \frac{\partial \dot{\hat{e}}}{\partial \hat{n}} \\ \frac{\partial \dot{\hat{n}}}{\partial r} & \frac{\partial \dot{\hat{n}}}{\partial \hat{e}} & \frac{\partial \dot{\hat{n}}}{\partial \hat{n}} \end{bmatrix} = \begin{bmatrix} -\theta_1 c_5 & \theta_1 c_7 & \theta_1 c_8 \\ -\frac{\theta_2\lambda(1+c_5)}{c_3-\lambda c_7} & -\theta_2 & -\frac{\theta_2(n_s c_2 - \lambda c_8)}{c_3 - \lambda c_7} \\ (1-n_s)c_5 & -c_7(1-n_s) & -\{(1-n_s)c_8 + n_s\} \end{bmatrix} \qquad (59)$$

By Routh-Hurwitz Theorem, the system would be stable if and only if $\beta_1 > 0, \beta_3 > 0\ and\ \beta_4 > 0$, where $\beta_1 = -trJ$, $\beta_2 = M_{11} + M_{22} + M_{33}$, $\beta_3 = -|J_2|$ and $\beta_4 = \beta_1\beta_2 - \beta_3$. The principal minor of i[th] row and i[th] column of the Jacobian is denoted as M_{ii}, where i=1,2,3. The trace, determinant and principal minors are derived as equations (60) - (64).

$$trJ_2 = -\theta_1 c_5 - \theta_2 - \{(1-n_s)c_8 + n_s\} < 0 \qquad (60)$$

$$|J_2| = -\frac{n\theta_1\theta_2(\lambda c_7 + c_3 c_5)}{c_3 - \lambda c_7} < 0 \qquad (61)$$

$$M_{11} = \theta_2\left[(1-n_s)c_8 + n_s - \left(\frac{n_s c_2 - \lambda c_8}{c_3 - \lambda c_7}\right)(1-n_s)c_7\right] \qquad (62)$$

$$M_{22} = \theta_1 c_5 n_s > 0 \qquad (63)$$

$$M_{33} = \theta_1\theta_2\left\{1 + \frac{c_7(1+c_5)\lambda}{c_3 - \lambda c_7}\right\} > 0 \qquad (64)$$

Thus, $\beta_1 > 0$ and $\beta_3 > 0$. But, the sign of the square bracketed term of M_{11} is ambiguous. Thus, the sign of β_4 is ambiguous. $\beta_4 > 0$ if condition (C2) is fulfilled.

$$\lambda < \frac{\beta_1[c_3(M_{22} + A_1) + A_3] - A_5}{A_4 - \beta_1 A_2} \qquad (C2)$$

where

$$A_1 = \theta_2[(1-n_s)c_8 + n_s] + \theta_1\theta_2 > 0$$

$$A_2 = \theta_2 c_7[(1-n_s)c_8 + n_s] > 0$$

$A_3 = \theta_2 c_7 n_s c_2 (1 - n_s) > 0$

$A_4 = \theta_1 \theta_2 c_7 n_s > 0$

$A_5 = \theta_1 \theta_2 n_s c_3 c_5 \geq 0$

Thus the stability condition of the system would depend on the initial values of debt-GDP ratio. It is only when the initial debt-GDP ratio is below a threshold level as given by the RHS of condition (C2), that the stability condition would be fulfilled. Despite adding restrictions in the model which resolved the stability problem of consensus assignment, the possibility of dynamic instability emerges in the three target case of sound finance regime.

5. Stabilization Policies under DNFS Framework

This section analyzes the dynamics of two variants DNFS framework- tax-financed and DFI-financed DNFS. At the steady state values, both policy frameworks would stabilize the debt-GDP ratio and keep the output growth rate and income growth rate of labour at natural growth rate. The central objective of this section would be to analyze the stability condition and the comparative dynamics.

5.1 Tax Financed DNFS Framework

The steady state values for growth rate of fiscal support, corporate tax ratio and expenditure growth rate would be attained when $g_L = g_n$ and $t_\pi = t_\pi^d$ and $g = g_n$ in equations (27), (30) and (31) respectively. Solving for the steady state values from equations (8b), (11), (12), (27), (29), (30 and (31), the equilibrium level of expenditure growth rate, corporate tax ratio and growth rate of fiscal support can be derived respectively as equations (65), (66) and (58a).

$$\hat{e}_4^* = K_7 - \frac{c_4}{c_7} - \frac{c_8}{c_7}\left[q + m\left\{1 + \frac{(1 - n_s)\varphi}{n_s}\right\}\right] \qquad (65)$$

$$t_\pi^* = K_8 + (c_3 - \lambda c_7)K_7 \ - \frac{c_3 c_4}{c_7} + \left(n_s c_2 - \frac{c_3 c_8}{c_7}\right)\left[q + m\left\{1 + \frac{(1 - n_s)\varphi}{n_s}\right\}\right] \qquad (66)$$

$$\hat{n}_4^* = q + m\left\{1 + \frac{(1 - n_s)\varphi}{n_s}\right\} \qquad (58a)$$

where

$$K_7 = \frac{c_5 r + m + q}{c_7} > 0$$

$$K_8 = n_s c_2 - c_3 + \lambda(1 + c_5)r$$

The steady state values of 3 policy instruments ensure that targets (T1) -(T3) are met. The steady state value of $\hat{n}^*$ is equal to the one derived in the case of consensus assignment with fiscal support. At steady state values, both output growth rate and income growth rate of labour is at natural growth rate as described in equations (37c) and (38c).

$$g_4^{**} = c_4 - c_5 r - c_6 t_\pi^* + c_7 \hat{e}_4^* + c_8 \hat{n}_4^* = g_n \qquad (37c)$$

$$g_{L4}^{**} = (1 - n_s)g_n - (1 - n_s)\varphi m + n_s \hat{n}_4^* = g_n \qquad (38c)$$

5.1.1 Stability Conditions

The Jacobian of the equation system (27), (30) and (31) would be given by equation (67):

$$J_3 = \begin{bmatrix} \frac{\partial \dot{t}_\pi^d}{\partial t_\pi} & \frac{\partial \dot{t}_\pi^d}{\partial \hat{e}} & \frac{\partial \dot{t}_\pi^d}{\partial \hat{n}} \\ \frac{\partial \dot{\hat{e}}}{\partial t_\pi} & \frac{\partial \dot{\hat{e}}}{\partial \hat{e}} & \frac{\partial \dot{\hat{e}}}{\partial \hat{n}} \\ \frac{\partial \dot{\hat{n}}}{\partial t_\pi} & \frac{\partial \dot{\hat{n}}}{\partial \hat{e}} & \frac{\partial \dot{\hat{n}}}{\partial \hat{n}} \end{bmatrix} = \begin{bmatrix} -\theta_3 & \theta_3(c_3 - \lambda c_7) & \theta_3(n_s c_2 - \lambda c_8) \\ 0 & -\theta_4 c_7 & -\theta_4 c_8 \\ 0 & -c_7(1 - n_s) & -\{(1 - n_s)c_8 + n_s\} \end{bmatrix} \qquad (67)$$

If $\beta_1 = -trJ_3$, $\beta_2 = M_{11} + M_{22} + M_{33}$, $\beta_3 = -|J_3|$ and $\beta_4 = \beta_1\beta_2 - \beta_3$, then the stability condition of the system would be given by $\beta_1 > 0, \beta_3 > 0 \text{ and } \beta_4 > 0$. The values of β_1 and β_3 are respectively given by equations (68) and (69). Both the values are positive.

$$\beta_1 = -trJ_3 = \theta_3 + \theta_4 c_7 + \{(1 - n_s)c_8 + n_s\} > 0 \qquad (68)$$

$$\beta_3 = -|J_3| = \theta_3 M_{11} > 0 \qquad (69)$$

The values of the principal minors are given by equations (70) - (72). All the principal minors are positive.

$$M_{11} = \theta_4 c_7 \left[n_s + \frac{(1 - n_s)^2 c_8 \varphi}{1 + \varphi(1 - n_s)} \right] > 0 \qquad (70)$$

$$M_{22} = \theta_3\{(1 - n_s)c_8 + n_s\} > 0 \qquad (71)$$

$$M_{33} = \theta_3\theta_4 c_7 > 0 \qquad (72)$$

Using the definition of β_4 and the value of β_3 from equation (70), the value of β_4 is given by equation (73).

$$\beta_4 = M_{11}[\theta_4 c_7 + \{(1 - n_s)c_8 + n_s\}] + \beta_1(M_{22} + M_{33}) > 0 \qquad (73)$$

Thus the stability condition would be guaranteed in the tax-financed DNFS framework. We now examine the comparative dynamics of this policy framework.

5.1.2 Comparative Dynamics

Since the steady state values would be independent on demand components, changes in autonomous investment and mark-up elasticity would have no impact on g_4^{**} and g_{L4}^{**}. Thus, $\frac{\partial g_4^{**}}{\partial a_1} = \frac{\partial g_4^{**}}{\partial \varphi} = \frac{\partial g_{L4}^{**}}{\partial a_1} = \frac{\partial g_{L4}^{**}}{\partial \varphi} = 0$.

By differentiating equations (65), (66) and (58a) w.r.t 'a_1', the impact of change in autonomous investment on expenditure growth rate, corporate tax ratio and growth rate of fiscal support are derived as equations (74)- (76).

$$\frac{\partial \hat{e}_4^*}{\partial a_1} = -\frac{c_0}{c_7[1 - bc_2(1 - n_s)]} < 0 \qquad (74)$$

$$\frac{\partial t_\pi^*}{\partial a_1} = -\frac{c_0 c_3}{c_7[1 - bc_2(1 - n_s)]} < 0 \qquad (75)$$

$$\frac{\partial \hat{n}_4^*}{\partial a_1} = 0 \qquad (76)$$

The negative partial derivative in equation (74) indicates counter-cyclical fiscal policy where the expenditure growth rate would be increased in the midst of lower investments and reduced in the opposite case. The negative partial derivate in equation (75) indicates that lower investment leads to higher corporate tax ratio, because higher expenditures requires higher corporate taxes to stabilize debt-GDP ratio at a given level. Since growth rate of fiscal support is independent of demand side factors, its equilibrium value remains unaffected by changes in investment in equation (76).

By differentiating equations (65), (66) and (58a) w.r.t 'φ', the impact of change in autonomous investment on expenditure growth rate, corporate tax ratio and growth rate of fiscal support are derived as equations (77)- (79).

$$\frac{\partial \hat{e}_4^*}{\partial \varphi} = \frac{bc_2 m(1-n_s)}{c_7[1-bc_2(1-n_s)]} - \frac{c_8(1-n_s)m}{n_s c_7} \tag{77}$$

$$\frac{\partial t_\pi^*}{\partial \varphi} = \frac{c_3}{c_7}\left[\frac{bc_2 m(1-n_s)}{1-bc_2(1-n_s)}\right] + \left(n_s c_2 - \frac{c_3 c_8}{c_7}\right)\left\{\frac{(1-n_s)m}{n_s}\right\} \tag{78}$$

$$\frac{\partial \hat{n}_4^*}{\partial \varphi} = \frac{(1-n_s)m}{n_s} > 0 \tag{79}$$

While the first term of RHS in equation (77) is positive, the second term is negative. Thus, the sign of partial derivative in equation (77) is ambiguous. Similarly, sign of the bracketed term $\left(n_s c_2 - \frac{c_3 c_8}{c_7}\right)$ in equation (78) is ambiguous and so is the sign of the partial derivative. At any given set of initial values, the sign of the partial derivatives would depend on the sensitivity of output growth rate to changes in fiscal support (c_8) and expenditures (c_7). With equilibrium growth rate of fiscal support being dependent on the level of mark-up elasticity, the sign of partial derivative in equation (79) is unambiguously positive.

5.2 DFI Financed DNFS Framework

The steady state values for growth rate of fiscal support, DFI lending rate and expenditure growth rate would be attained when $g_L = g_n$ and $r_v = r_v^d$ and $g = g_n$ in equations (27), (34) and (31) respectively. Solving for the steady state values from equations (8b), (11), (12), (27), (33), (34) and (31), the equilibrium level of expenditure growth rate, DFI lending rate and growth rate of fiscal support can be derived respectively as equations (80), (81) and (58b).

$$\hat{e}_5^* = K_9 + \frac{c_6}{c_7} t_\pi - \frac{c_4}{c_7} - \frac{c_8}{c_7}\left[q + m\left\{1 + \frac{(1-n_s)\varphi}{n_s}\right\}\right] \tag{80}$$

$$r_v^* = K_{10} t_\pi - K_{12} + \frac{c_3}{c_7\lambda} c_4 + K_{11} + \left(\frac{c_3 c_8}{\lambda c_7} - \frac{n_s c_2}{\lambda}\right)\left[q + m\left\{1 + \frac{(1-n_s)\varphi}{n_s}\right\}\right] \tag{81}$$

$$\hat{n}_5^* = q + m\left\{1 + \frac{(1-n_s)\varphi}{n_s}\right\} \tag{58b}$$

where

$$K_9 = \frac{c_5 r + m + q}{c_7} > 0$$

$$K_{10} = \frac{1 - \lambda c_6}{\lambda} + \frac{c_6(c_3 - \lambda c_7)}{\lambda c_7} > 0$$

$$K_{11} = \frac{(c_3 - \lambda c_7)}{\lambda}\left(\frac{c_5 r + m + q}{c_7}\right) > 0$$

$$K_{12} = \frac{n_s c_2 + c_3 + \lambda c_5 r}{\lambda} > 0$$

The steady state value of growth rate of fiscal support in DFI-financed framework is equal to that of tax financed DNFS framework and Consensus Assignment with fiscal support. Target (T2) would always be met when the DFI lending rate is greater than a threshold level, say r_v^{min}, where the threshold value may reflect a zero lower bound or an interest rate that is required to earn minimum level of earnings for continuing banking operations.

Since equilibrium lending rate is positively affected by corporate tax ratio, equation (81) indicates that $r_v^* > r_v^{min}$ if $t_\pi > t_\pi^{min}$ where t_π^{min} is a minimum level of corporate tax ratio which needs to be maintained at any given level of r_v^{min}. Equation (82) describes the value of t_π^{min}. Though it is not used to meet the targets (T1) - (T3), but corporate tax ratio is perceived to be used here as a policy instrument to ensure a minimum lending rate.

$$t_\pi^{min} = \frac{r_v^{min} + K_{12} - K_{11}}{K_{10}} - \frac{c_3 c_4}{K_{10} c_7 \lambda} - \left(\frac{c_3 c_8}{K_{10} c_7 \lambda} - \frac{n_s c_2}{K_{10}\lambda}\right)\left[q + m\left\{1 + \frac{(1-n_s)\varphi}{n_s}\right\}\right] \tag{82}$$

At steady state values, both output growth rate and income growth rate of labour is at natural growth rate as described in equations (37d) and (38d).

$$g_5^{**} = c_4 - c_5 r - c_6 t_\pi^* + c_7 \hat{e}_5^* + c_8 \hat{n}_5^* = g_n \qquad (37d)$$

$$g_{L5}^{**} = (1 - n_s) g_n - (1 - n_s)\varphi m + n_s \hat{n}_5^* = g_n \qquad (38d)$$

5.2.1 Stability Conditions

The Jacobian of the differential equation system (27), (31) and (34) would be given by equation (83). The rule of delinking between market interest rate and DFI lending rate gets reflected by the two zeros that appear in the 2nd and 3rd row of column 1 of the Jacobian.

$$J_4 = \begin{bmatrix} \frac{\partial \dot{r}_v}{\partial r_v} & \frac{\partial \dot{r}_v}{\partial \hat{e}} & \frac{\partial \dot{r}_v}{\partial \hat{n}} \\ \frac{\partial \dot{\hat{e}}}{\partial r_v} & \frac{\partial \dot{\hat{e}}}{\partial \hat{e}} & \frac{\partial \dot{\hat{e}}}{\partial \hat{n}} \\ \frac{\partial \dot{\hat{n}}}{\partial r_v} & \frac{\partial \dot{\hat{n}}}{\partial \hat{e}} & \frac{\partial \dot{\hat{n}}}{\partial \hat{n}} \end{bmatrix} = \begin{bmatrix} -\theta_5 & -\theta_5\left(\frac{c_3 - \lambda c_7}{\lambda}\right) & -\theta_5\left(\frac{n_s c_2 - \lambda c_8}{\lambda}\right) \\ 0 & -\theta_4 c_7 & -\theta_4 c_8 \\ 0 & -c_7(1 - n_s) & -\{(1 - n_s)c_8 + n_s\} \end{bmatrix} \qquad (83)$$

The values of β_1 and β_3 are derived from the Jacobian as equations (68a) and (69a):

$$\beta_1 = -trJ_4 = \theta_5 + \theta_4 c_7 + \{(1 - n_s)c_8 + n_s\} > 0 \qquad (68a)$$

$$\beta_3 = -|J_4| = \theta_5 M_{11} > 0 \qquad (69a)$$

The values of the principal minors are given by equations (70a) - (72a). All the principal minors are positive.

$$M_{11} = \theta_4 c_7 \left[n_s + \frac{(1 - n_s)^2 c_8 \varphi}{1 + \varphi(1 - n_s)}\right] > 0 \qquad (70a)$$

$$M_{22} = \theta_5\{(1 - n_s)c_8 + n_s\} > 0 \qquad (71a)$$

$$M_{33} = \theta_4 \theta_5 c_7 > 0 \qquad (72a)$$

Using the definition of β_4 and the value of β_3 from equation (69a), the value of β_4 is given by equation (73a).

$$\beta_4 = M_{11}[\theta_4 c_7 + \{(1 - n_s)c_8 + n_s\}] + \beta_1(M_{22} + M_{33}) > 0 \qquad (73a)$$

Similar to the tax-financed case, the stability condition would be guaranteed in the DFI-financed DNFS framework. We now examine the comparative dynamics of this policy framework

5.2.2 Comparative Dynamics

Similar to the tax-financed case, the steady state values would be independent on demand components and thus changes in autonomous investment and mark-up elasticity would have no impact on g_5^{**} and g_{L5}^{**}. Thus, $\frac{\partial g_5^{**}}{\partial a_1} = \frac{\partial g_5^{**}}{\partial \varphi} = \frac{\partial g_{L5}^{**}}{\partial a_1} = \frac{\partial g_{L5}^{**}}{\partial \varphi} = 0$.

By differentiating equations (80), (81) and (58b) w.r.t 'a_1', the impact of change in autonomous investment on expenditure growth rate, corporate tax ratio and growth rate of fiscal support are derived as equations (84)- (86).

The steady state growth rate of fiscal support remains unaffected by changes in investments as reflected by equation (84). The sign of partial derivative in equation (85) is negative, indicating the role of counter cyclical fiscal policy. The sign of partial derivative is positive in equation (86), indicating the need for reduction in DFI lending rate to stabilize the debt-ratio.

$$\frac{\partial \hat{n}_5^*}{\partial a_1} = 0 \tag{84}$$

$$\frac{\partial \hat{e}_5^*}{\partial a_1} = -\frac{1}{c_7}\left[\frac{c_0}{1 - bc_2(1 - n_s)}\right] < 0 \tag{85}$$

$$\frac{\partial r_v^*}{\partial a_1} = \left[\frac{c_0}{1 - bc_2(1 - n_s)}\right]\left(\frac{c_3}{\lambda c_7}\right) > 0 \tag{86}$$

By differentiating equations (80), (81) and (58b) w.r.t 'ϕ', the impact of change in mark-up elasticity on expenditure growth rate, corporate tax ratio and growth rate of fiscal support are derived as equations (87)- (89).

The sign of partial derivative in equation (87) is unambiguously positive as higher mark-up elasticity requires a rise in the growth rate of fiscal support to keep income growth rate of labour at the natural growth rate. The sign of partial derivative in equation (88) is ambiguous. This is because higher mark-up elasticity has two opposite effects on steady state expenditure growth rate. Reduction in demand requires increasing the expenditure growth rate, whereas the rise in growth rate of fiscal support requires reducing expenditure growth rate in order to keep output growth rate at the natural growth rate. The first term of the RHS in equation (88) includes the former positive effect, whereas the second term of RHS includes the latter negative effect. The sign of the partial derivative would depend on the relative strength of these two terms. The sign of partial derivative in equation (89) is ambiguous. The ambiguous sign reflects the fact that direction of change in lending rate would depend on the direction of change in aggregate expenditure growth rate of the government including fiscal support and expenditure on goods and services.

$$\frac{\partial \hat{n}_5^*}{\partial \varphi} = \frac{(1-n_s)m}{n_s} > 0 \tag{87}$$

$$\frac{\partial \hat{e}_5^*}{\partial \varphi} = \frac{bc_2 m(1-n_s)}{c_7[1-bc_2(1-n_s)]} - \frac{c_8(1-n_s)m}{n_s c_7} \tag{88}$$

$$\frac{\partial r_v^*}{\partial \varphi} = \left[\frac{(1-n_s)m}{n_s}\right]\left(\frac{c_3 c_8}{\lambda c_7} - \frac{n_s c_2}{\lambda}\right) - \left\{\frac{bc_2 m(1-n_s)}{1-bc_2(1-n_s)}\right\}\left(\frac{c_3}{\lambda c_7}\right) \tag{89}$$

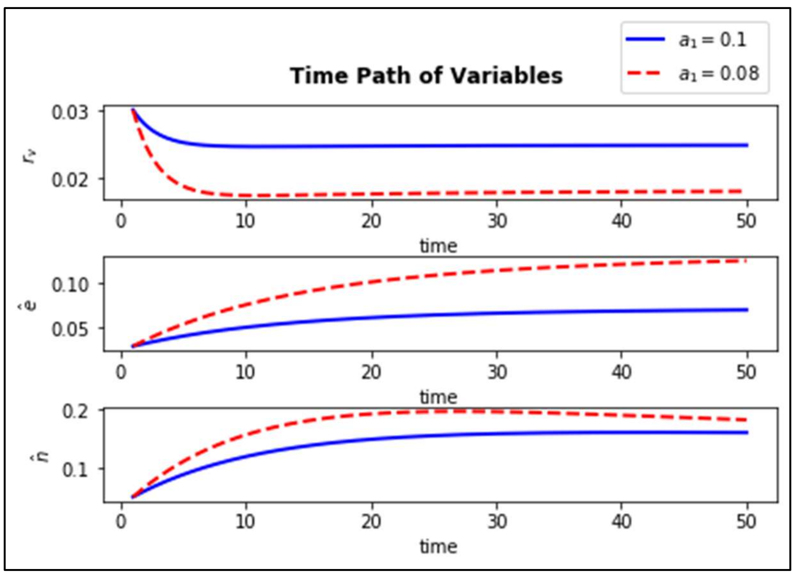
5.2.3 Numerical Example of DFI-Financed DNFS

The impact of lower investment and higher mark-up elasticity on the three instruments are now described by assuming a set of values for the parameters. The values of all parameters used for this exercise are provided in table A.1 in the appendix.

Both the autonomous component of investment growth rate as well as the mark-up elasticity is assumed to be equal to 0.1, i.e. $a_1 = 0.1$ and $\varphi = 0.1$. The labour productivity growth rate and labour force growth rate are assumed to be given by m=0.05 and q=0.01 respectively, such that the natural growth rate $g_n = 0.06$. With the given mark-up elasticity and labour productivity growth rate, the growth gap between labour productivity and real wage rate is $\varphi m = 0.005$. The initial value of DFI lending rate, expenditure growth rate and growth rate of fiscal support are assumed to be $r_v = 0.03$, $\hat{e} = 0.03$ and $\hat{n} = 0.05$. The minimum threshold value of lending rate is assumed to be 0. The initial debt-GDP ratio is assumed to be at a high level at $\lambda = 0.9$. In the absence of any policy rule, the output growth rate and income growth rate of labour would be respectively given by $g = 0.053$ and $g_L = 0.048$. The debt-GDP ratio would be unstable as the rate of change in debt ratio would be given by $\frac{d\lambda}{dt} = 0.005$.

In the presence of DFI-financed DNFS policy framework, the 3 instruments adjust in a manner such that the debt-GDP ratio stabilizes while the output growth rate and income growth rate of labour settles at the natural growth rate. The steady state value of DFI lending rate, growth rate of expenditure and growth rate of fiscal support would be $r_v^* = 0.025$, $\hat{e}^* = 0.072$ and $\hat{n}^* = 0.155$. The blue lines in figure 7 show the time path of these 3 variable as they converge to the steady state values from the initial values.

Figure 7: Impact of Lower Investment in DFI-Financed DNFS Framework

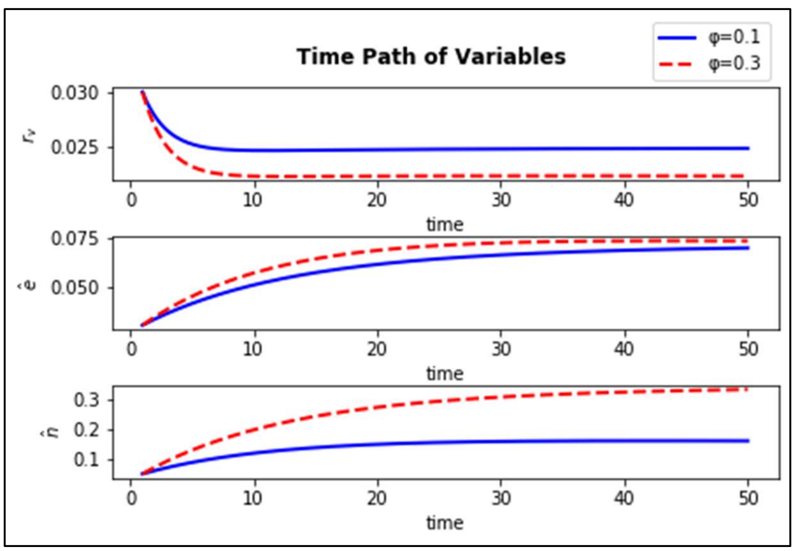


The impact of lower investment is shown through a reduction in the autonomous componment of investment from $a_1 = 0.1$ to $a_1 = 0.08$. In the absence of any policy rule, rate of change in debt-ratio would be higher with $\frac{d\lambda}{dt} = 0.011$. The output growth rate and income growth rate of labour would be lower as compared to the initial value with $g = 0.046$ and $g_L = 0.041$. In the presence of the policy rule, the 3 instruments would adjust in a way such that $g = g_L = g_n = 0.06$. The steady state equilibrium value of the three instruments would be $r_v^* = 0.018$, $\hat{e}^* = 0.132$ and $\hat{n}^* = 0.155$. Starting from the initial positions, the red dotted line in figure 7 shows the adjustment process of the 3 instruments after a fall in autonomous investment growth rate. The expenditure growth rate settles at higher value whereas the

DFI lending rate settles at a lower value. Despite an initial rise in growth rate of fiscal support, the latter falls back to the initial value as the equilibrium value $\hat{n}^*$does not change due to lower investments.

Starting from the initial values, the impact of higher mark-up elasticity is shown through a rise in 'φ' from $\varphi = 0.1$ to $\varphi = 0.3$. The growth gap between labour productivity and real wage rate would increase to $\varphi m = 0.015$. In the absence of any policy rule, rate of change in debt-ratio would be higher with $\frac{d\lambda}{dt} = 0.007$. The output growth rate and income growth rate of labour would be lower as compared to the initial value with $g = 0.051$ and $g_L = 0.036$. What can be noted, that here the fall in the income growth rate of labour is greater and the fall in output growth rate is lower as compared to the case of fall in investments. The steady state values of the three instruments would be given by $r_v^* = 0.022$, $\hat{e}^* = 0.072$ and $\hat{n}^* = 0.345$.The time path of three instruments are shown in figure 8. The blue lines indicate the timep ath for the initial values and the red dotted line indicates the time path of thevariables when mark-up elasticity increases.

Figure 8: Impact of Higher Mark-up Elasticity in DFI-Financed DNFS Framework



In contrast to the case of fall in investments, here the steady state values are attained by increasing the growth rate of fiscal support. The rise in the expenditure growth rate is marginal and at the three decimel point, the change in steady state value is zero. Though the extent is smaller, but the DFI lending rate falls similar to the previous case.

6. Concluding Remarks

The primary objective of the paper was to examine appropriate policy frameworks under which the 3 targets can be attained simultaneously- maintaining income growth rate of labour at natural growth rate, stabilizing output growth rate and stabilizing the debt-GDP ratio The effectiveness of different policy frameworks was examined in terms of their ability to meet the 3 targets in the midst of adverse changes in investments and mark-up elasticity. There were broadly 3 distinct limitations of consensus framework that were pointed out in the present context- (i) lack of adequate number of policy targets, (ii) lack of adequate number of policy instruments and (iii) possibility of dynamic instability. In the backdrop of these limitations, an alternative policy framework was examined that was termed as the DNFS framework.

There were two variants of DNFS framework that was analyzed: tax-financed and DFI-financed. Both the variants meet the three targets, display dynamic stability and operate at any given level of market interest rate. Being used as an instrument to stabilize debt-ratio, steady state equilibrium would be associated with a unique equilibrium value of corporate tax-ratio in tax-financed DNFS framework. The DFI financed framework perceived the lending rate of DFI as the policy instrument for debt-stabilization and used the floor level of corporate tax ratio to maintain a minimum level of lending rate. This framework highlights the role of banking policy in macroeconomic policy frameworks over and above fiscal and monetary policy. The analysis can be relevant in the present policy debates during covid-19 crisis in two distinct ways.

Firstly, the pandemic has been simultaneously associated with decline in aggregate demand and in many instances, fall in the income share of labour. The recovery strategy in many countries, however, has mostly aimed at increasing output at the pre-pandemic level. This paper highlights the need for compensating labour income and increasing fiscal support over and above undertaking demand management policies. Secondly, with sharp decline in output growth rate, drastic rise in debt-GDP ratio and interest rate exogeneity, different countries have de-facto confronted a trade-off between continuing with high level of fiscal stimulus and maintaining a stable debt-GDP ratio. The policy dilemma essentially involves a choice between switching to Lerner- type functional finance and adhering to what was described as the CAEI policy framework. This paper attempted to contribute to the functional finance literature by proposing an alternative policy framework that simultaneously meets the three targets despite exogeneity in market interest rate.

This is not to ignore the possibility of institutional constraints in implementing the DNFS framework. There are at least three institutional constraints that may emerge. The first institutional constraint is similar to Kalecki's observations and would be confronted by any functional finance regime-namely, the political opposition to high levels economic activity through government expenditures since the latter undermines the social legitimacy of capitalist class. The second constraint can be similar to the one discussed by Rowthorn and can emerge if capitalists respond to higher taxes by increasing mark-up. Though actual inflation rate has not been modeled in the paper, but if remain unchecked, such changes in mark-up may trigger accelerating inflation. The third constrain can emerge in an open economy setting, if capital flows depend on the difference between domestic and foreign corporate tax ratio. If switching to DNFS framework involves a rise in domestic tax ratio, then the possibility of outflow of foreign investments cannot be assumed away.

Relaxing these constraints may require institutional changes both at domestic as well international sphere, such as increasing the role of State Owned Enterprises, greater control over capital flows and setting a global floor value of corporate tax ratio. The objective of the paper was to indicate that for any plausible values of the structural parameters, there exist policy rules that can meet the three targets when the institutional constraints get adequately relaxed.

References

Allsop, C., & Vines, D. (2000). The Assessment:Macroeconomic Policy. *Oxford Review of Economic Policy, 16*(4), 1-32.

Arestis, P. a. (2010). The Return of Fiscal Policy. *Journal of Post Keynesian Economics, 32*(3), 327-46.

Arestis, P., & Sawyer, M. (2004). Monetary policy when money is endogenous: going beyond the 'New Consensus'. In *in: Lavoie, M., Seccareccia, M. (eds.), Central Banking in the Modern World: Alternative Perspectives.* Cheltenham: Edward Elgar.

Arestis, P., & Sawyer, M. (2006). The nature and the role of monetary policy when money is endogenous. *Cambridge Journal of Economics, 30*, 847-860.

Davidson, P. (2010). Making Dollars and Sense of the U.S. Government Debt. *Journal of Post Keynesian Economics, 32*(4), 661-665.

Domar, E. (1944). The "Burden of the Debt" and the National Income. *The American Economic Review, 34*(4), 798-827.

Fontana, G. P.-V. (2007). Are long-run price stability and short-run output stabilization all that monetary policy can aim for? *Metroeconomica, 58*, 269-298.

Fullwiler, S. (2007). Interest rates and fiscal sustainability. *Journal of Economic Issues, 41*(4), 1003-1042.

Gali, J. (2008). *Monetary Policy, Inflation and the Business Cycle: An Introduction to the New-Keynesian Framework.* Princeton and Oxford: Princeton University Press.

Hassan, T., & Zhang, T. (2017). The Economics of Currency Risk. *National Bureau of Economic Research, Working Paper 27847*.

Hein, E. (2006). Interest, debt and capital accumulation - a Kaleckian approach. *International Review of Applied Economics, 20*(3), 337-352.

Hein, E., & Stockhammer, E. (2009). A Post Keynesian Alternative to the New Consensus Model. In *in Fontana,G. & Setterfield,M. (eds) Macroeconomic Theory and Macroeconomic Pedagogy: An Introduction* (pp. 273-294). Springer.

ILO. (2015). *The Labour Share in G20 Economies.* Geneva: ILO.

ILO. (2020). *Global Wage Report 2020–21. Wages and minimum wages in the time of COVID-19.* Geneva: ILO.

Kalecki, M. (1943). Political Aspects of Full Employment. *Political Quarterly, 14*(4), 322-31.

Kriesler, P., & Lavoie, M. (2007). The New Consensus on Monetary Policy and its Post-Keynesian Critique. *Review of Political Economy, 19*(3), 387-404.

Leao, P. (2013). The effect of government spending on the Debt-to-GDP ratio: some Keynesian arithmetic. *Metroeconomica, 64*(3), 448-465.

Lerner, A. (1943). Functional finance and the federal debt. *Social Research, 10*(1), 38-51.

Mason, J., & Jayadev, A. (2018). A comparison of monetary and fiscal policy interaction under ‘sound’ and ‘functional’ finance regimes. *Metroeconomica, 69*(2), 488-508.

Palacio-Vera, A. (2005). The modern view of macroeconomics: Some critical reflections. *Cambridge Journal of Economics, 29*(5), 747-767.

Pasinetti, L. (1998). The myth (or folly) of the 3% deficit/GDP Maastricht ‘parameter’. *Cambridge Journal of Economics, 22*(1), 103-116.

Ryoo, S. S. (2013). Public debt and full employment in a stock-flow consistent model of a corporate economy. *Journal of Post Keynesian Economics, 35*(4), 511-27.

Ryoo, S., & Skott, P. (2017). Fiscal and monetary policy rules in an unstable economy. *Metroeconomica, 68*(3), 500-548.

Setterfield, M. (2005). Central bank behaviour and the stability of macroeconomic equilibrium: a critical examination of the ‘New Consensus’. In *in Arestis, P., Baddeley, M & McCombie,J. (Eds) The New Monetary Policy:Implications and Relevance* (pp. 23-49). Cheltenham, UK • Northampton, MA, USA: Edward Elgar.

Stockhammer, E. (2004). Is there an equilibrium rate of unemployment in the long run? *Review of Political Economy, 16*(1), 59-77.

Taylor, J. (2000). Teaching modern macroeconomics at the principles level. *American Economic Review, 90*(2), 90-94.

Wei, X., & Han, L. (2021). The impact of COVID-19 pandemic on transmission of monetary policy to financial markets. *International Review of Financial Analysis, 74*, 1-11.

Appendix

Appendix 1

Since $c_7 = \frac{c_3}{1-c_0 a_4 - bc_2(1-n_s)}$ and $c_8 = \frac{bc_2 n_s}{1-c_0 a_4 - bc_2(1-n_s)}$, $(c_3 - \lambda c_7) > 0$ and $(n_s c_2 - \lambda c_8) > 0$ if

$$a_4 < \frac{1 - \lambda b - bc_2(1-n_s)}{c_0} \qquad (R1)$$

Since $c_6 = \frac{c_0 a_3}{1-c_0 a_4 - bc_2(1-n_s)}$, $(1 - \lambda c_6) > 0$ if

$$\lambda\left(a_3 - \frac{b}{c_0}\right) + a_4 < \frac{1 - \lambda b - bc_2(1-n_s)}{c_0} \qquad (A1)$$

The second term of the LHS is less than the RHS by restriction (R1). The sufficient condition for (A1) would be provided if restriction (R2) holds:

$$a_3 - \frac{b}{c_0} \leq 0 \qquad (R2)$$

Appendix 2

Table A.1: Initial Values for the Simulation in Figure 7 and Figure 8.

Description of Parameters	Parameters	Initial Values
Initial Investment-GDP ratio	c_0	0.3
Share of Autonomous Consumption Expenditure in GDP	c_1	0.4
Income share of Labour in GDP	c_2	0.25
Share of Government Spending on Goods and Services in GDP	c_3	0.1
Autonomous Component of Investment Growth rate	a_1	0.1
Investment sensitivity to Change in market interest rate	a_2	0.05
Investment sensitivity to Change in tax ratio	a_3	0.5
Investment sensitivity to Change in GDP growth rate	a_4	0.05
Share of Fiscal Support in Labour Income	n_s	0.05
Mark-up Elasticity	φ	0.1
Growth rate of Labour Productivity	m	0.05
Growth Rate of Labour Force	q	0.01
Growth rate of autonomous component of Consumption	$\hat{A}$	0.06
Corporate tax-GDP ratio	t_π	0.09
Market Interest Rate	r	0.04
DFI Lending Rate	r_v	0.03
Initial Growth Rate government spending on Goods and Services	$\hat{e}$	0.03
Initial Growth rate of Fiscal Support	$\hat{n}$	0.05
Initial Debt-GDP Ratio	λ	0.9

Speed of Adjustment for Expenditure Growth Rate	θ_4	0.5
Speed of Adjustment of DFI Lending Rate	θ_5	0.5