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# MMT and Policy Assignment in an Open Economy Context: Simplicity is Useful, Oversimplification Not So Much.

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## Abstract

Modern Monetary Theory (MMT) has recently received significant attention in academic and policy circles. Critics question the sustainability of MMT-prescribed approaches to fiscal and monetary policy, especially over extended periods of time, in the presence of international financial markets, and for developing country governments that borrow in foreign currency. I formalize some of these arguments using a dynamic, open economy, Tobin-Markowitz portfolio balance environment that takes into account: (1) the role of expectations in the foreign exchange market and the feedback mechanisms between these and the exchange rate and inflation, and (2) interactions between the current account, debt accumulation, and the goods market. I show that continuous monetary accommodation of fiscal policy by a consolidated authority that targets low interest rates is likely to generate instability and make it hard to maintain full employment with stable inflation. Importantly, this is true even in the absence of rational forward-looking expectations or sovereign foreign indebtedness.

**JEL classification:** E12, E31, E42, E52, E61, F32.

**Keywords:** Modern Monetary Theory, expectations, endogenous money, balance of payments, fiscal and monetary policy.

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# 1 Introduction

Modern Monetary Theory (MMT) has made somewhat of a splash in recent policy debates. The absence of formal mathematical models makes it much harder to pin down the core arguments. The unifying theme appears to be that a country that has monetary sovereignty (i.e., its own floating exchange rate and the ability of the government to issue liabilities that are all denominated in domestic currency, i.e., no foreign-currency denominated government bonds) cannot be forced to default on its debt. This tenet seems rather uncontroversial if one defines default narrowly enough. Thus, according to MMT, there is no such thing as a government budget constraint except for in the limited sense that inflation poses one. While the absence of formal modeling makes it harder to pin down key details, and various scholars may emphasize different aspects, other key MMT doctrines or tenets appear to include: (1) a state monopoly on the issuance of base money, (2) a consolidated fiscal and monetary authority,<sup>1</sup> (3) the endogeneity of money, i.e., the banking system can elastically adjust the supply of money in response to changes in demand, (4) that inflation is *not* a monetary phenomenon and is caused by either excess demand or rising costs and distributional conflict; there is no direct link between outside money growth and inflation, (5) constraints on employment and output originate from the demand side; the supply side adjusts elastically in response to demand. Crucially, debt does not weigh negatively on potential or actual output. These features give the MMT framework a strong Keynesian flavor.<sup>2</sup>

From these tenets follow some of the widely-known policy recommendations such as: (1) fiscal policy (spending and taxation) should be used to control inflation which appears only once demand exceeds the level required to achieve full employment, (2) countries should have floating exchange rates (monetary sovereignty), (3) an important function of the consolidated fiscal and monetary authority should be to target a low (if not zero) interest rate.

This paper analyzes MMT in an open economy context and finds that it does not provide a satisfactory framework for policy analysis or design. I employ the Tobin-Markowitz portfolio balance approach to an open economy with a flexible exchange rate to analyze interactions between goods and asset markets. While a few other critiques of the MMT approach have considered open economy considerations, I do so in a more systematic manner by introducing portfolio- and expectations-related considerations in a model that assumes that the fiscal/monetary authorities can accommodate any level of spending while keeping the short term interest rate fixed.<sup>3</sup> These are crucial aspects in a world of global capital markets.

I find that, at a basic (and perhaps obvious) level, the theory suffers from

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<sup>1</sup>In fact, the use of a consolidated fiscal constraint in formal models goes back all the way to Blinder and Solow (1973).

<sup>2</sup>As Palley (2013) notes, “the macroeconomics of MMT is a primitive version of neo-Keynesian stock flow consistent ISLM analysis.”

<sup>3</sup>Thus there is no crowding out of domestic consumption or investment by fiscal spending through the interest rate channel.

an insufficient instruments problem. An authority that tries to target both full employment and low inflation will need another instrument in addition to fiscal policy. Once one introduces the role of expectations and foreign debt, other complications arise that render the system likely unstable. Small deviations from the steady state can then lead to self-fulfilling exchange rate depreciations, increasing inflation, and exploding foreign debt. This happens even though the country is sovereign in an MMT sense (i.e., it has a flexible exchange rate and no sovereign debt in foreign currency terms). An awareness of economic history over the last century makes it clear that such considerations have more than merely theoretical significance.

The next section briefly lays out the background and provides a brief overview of existing literature. Section 3 spells out the accounting details, proceeds to develop the contours of the framework employed, and analyzes the nature of the short-run/instantaneous equilibrium. Section 4 analyzes the dynamic stability properties of instrument assignment to targets under the simplest version of the MMT framework. Sections 5 and 6 introduce the role of expectations and the current account, respectively. Finally, Section 7 concludes.

## 2 Background and Literature

Before I turn to the formal analysis, it may be useful to briefly visit some background literature. The MMT analysis has emerged from a Post Keynesian backdrop and proponents often link their thoughts back to Knapp, Keynes, and Lerner. From this older literature they derive a number of hypotheses and tenets that challenge orthodox macroeconomics. Most importantly, perhaps, they challenge the idea that a government needs to borrow or tax in order to finance its spending. Instead, the consolidated monetary and fiscal authority of a monetarily sovereign country can always monetize fiscal deficits without losing control over inflation or facing a sovereign debt default. For example, to quote one leading proponent, “Taxes aren’t important because they help the government pay the bills. They are important because they help to prevent government spending from creating an inflation problem. [Kelton (2020)].<sup>4</sup> Or, “[i]n other words, the main problem with excessive spending by the state is inflation, not risk of default and solvency.” Thus, as long as the economy is operating at less than full employment of resources, the government should “maximize efficiency and minimize Okun losses,” by spending up to full employment,” Mitchell (2020)[p.8]. Wray (2014) [p. 10]. Moreover the monetary accommodation of deficits does not pose an inflationary risk. Inflation rather appears as an issue only when fiscal spending overheats the economy so that demand exceeds the potential supply at full employment [Kelton (2020)].

Thus “the most important conclusion emerging from this [MMT] framework is that the issuer of a currency faces no financial constraints. Put simply, a country that issues its own currency ... can never become insolvent in its own

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<sup>4</sup>It is important to note here that, according to Wray (2015), “MMTers fear inflation too. Indeed, price stability has always been one of the two key missions [of the MMT approach].”

currency. It can make all payments as they come due” (Mitchell and Watts (2019), p. 13). As a result, “for most governments, there is no default risk on government debt.” (Mitchell and Watts (2019), p. 15).

A few advocates have pointed out that borrowing helps adjudicate the desirable mix of instruments for policy communication. For example, “First, government spending is facilitated by central banks typing in numbers to bank accounts ... There is no spending out of taxes or bond sales.” The elaborate accounting and institutional processes, which make it look as though government revenue and/or debt sales fund spending, are voluntary arrangements with no real financial consequence. They are designed to impose political discipline on government spending [Mitchell (2020)]. Wray (2014)[p. 31] points to Lerner’s second principle according to which state should sell bonds only if “it is desirable that the public should have less money and more government bonds.”

The source of inflation, depending on which MMT scholar one reads, is either rising costs (cost-push inflation) or excess demand. In the latter case, the Phillips curve, however, is quite flat, at least until the point that full employment is attained.<sup>5</sup> In the former case, a major source of increasing costs could be rising conflicting claims over the share of national income. For instance, Mitchell and Watts (2019)[p. 255] note that, “Conflict theory situates the problem of inflation as being intrinsic to the power relations between workers and capital (class conflict), which are mediated by government within a capitalist system.” This focus on inconsistent distributional claims echoes the structuralist literature that emerged mainly from Latin America in the 1960s and 70s but can also be found in other strands of Post Keynesian literature.

Given that the consolidated authority targets short term interest rates, some MMT proponents advocate near zero interest rates [Wray (1998), Mosler and Forstater (2005)]. Since policy can maintain this low interest rate, there is no crowding out. Moreover, since monetary policy is not to be used to control inflation, the low interest rate target should not change in response to it. Indeed, as is well known, at this low interest rate money and short-term bonds become close substitutes so that monetary policy becomes ineffective even in the more orthodox frameworks that analyze liquidity traps. MMT enthusiasts simply advocate for making this state of affairs permanent.

The recent public visibility of MMT has, not surprisingly, led to a series of responses by Post Keynesian and more orthodox economists. For example, some have criticized MMT for introducing nothing novel/non-trivial to established macroeconomics [Palley (2013), Buiter and Mann (2019)], or even as being based on an outdated understanding of economics [Drumetz and Pfister (2021)]. Others have complained about the absence of formal mathematical models. Others have found the MMT explanation for inflation to be either too simplistic, or lacking significant explanatory power and its aggregate demand management recommendations lacking sufficient instruments [Edwards (2019), Drumetz and Pfister (2021), Palley (2013)]. Still others have criticized MMT for ignoring the role of inflation and exchange rate expectations, neglecting po-

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<sup>5</sup>See Palley (2019) for a discussion of this seemingly threshold model of inflation.

litical economic realities, downplaying opportunity costs and intergenerational distributional issues, and for paying little attention to aspects such as currency competition that narrow available policy options [Drumetz and Pfister (2021), Buiter and Mann (2019), Mankiw (2020)].

Some of these critiques center around developing country experiences with monetization of fiscal deficits. Presenting a detailed analysis of 4 countries, each of which had a sovereign currency, Edwards (2019), for instance, notes that “[A]lmost every one of the Latin American experiments with central bank-financed expansions took place under populist regimes and all of them ended badly” with “runaway inflation, huge currency devaluations, and precipitous real wage declines.”

While most of the critical literature cited above returns the favor by not utilizing formal models to structure their evaluation, there are exceptions. Bossone (2020) employs the IS-LM framework to demonstrate that, barring special circumstances such as high credibility in international financial markets and the status of reserve currency issuer, an open economy that pursues MMT-advocated policies will either experience unsustainable monetary expansion or high interest rates that are inconsistent with the domestic policy target of full employment.

Carnevali and Deleidi (2020) address open economy issues in a 2-country stock-flow consistent open economy model. Numerical simulations – the model cannot be analytically solved – show the presence of a trade-off. Greater government spending creates trade deficits. The resulting exchange rate depreciation and higher wages both raise inflation. Thus there is a trade off between inflation and employment. As the authors recognize, however, MMT advocates will counter with the argument that, with internationally integrated financial markets, the value of the exchange rate, at least in the short-run, is determined by financial flows rather than by the trade balance.

The present paper contributes to the literature by analyzing the robustness over time of MMT prescriptions using the building blocks of exchange rate behavior, inflation, and the goods market that are largely consistent with implicit or explicit MMT thinking. The goods market framework is Keynesian in nature and the exchange rate is flexible and determined in the asset markets (rather than by the trade balance). Inflation is cost push in nature and driven by distributional conflict. The consolidated monetary and fiscal authority targets a low interest rate and accommodates money demand changes due to government spending or other sources. As noted by Buiter and Mann (2019) and Palley (2013), the consolidation of policy authorities is not a novel contribution by the MMT school. Blinder and Solow (1973) and Tobin and Buiter (1974) are examples of previous contributions that analyze accommodative policy by a consolidated authority. However, unlike the present paper, these works assume that the monetary authorities hold the stock of base money constant in the short run. This is in conflict with the MMT assumption of interest rate targeting with endogenous money supply responses. Moreover, these papers do not incorporate conflicting claims over distribution, which is often seen by MMT advocates as a major source of inflation, and plays an important role in the analysis presented here.

Other formal models in the Post Keynesian tradition such as those by Bossone (2020) and Carnevali and Deleidi (2020) discussed earlier incorporate MMT ideas. Unlike the present paper, the financial account in Bossone (2020) is a flow one and wealth is not explicitly defined in terms of domestic and foreign assets. Thus one cannot keep track of the evolution of financial assets and the interaction between these and the exchange rate. Carnevali and Deleidi (2020) too do not incorporate financial market portfolio issues. Thus, they do not have exchange rate expectations or feedback between different markets. As mentioned earlier, the exchange rate in their model is determined by the trade deficit, even in the short run. The model cannot be solved analytically.

My paper is an attempt to fill some of these gaps in the literature by explicitly introducing, in an analytically tractable framework, the evolution of exchange rate expectations, exchange rate determination in the asset markets, dynamic interactions between different markets in the short run and over time, and conflicting claims inflation. The interactions of these ingredients generate dynamic instability that cannot be ignored in a policy environment.

### 3 The Nature of the Problem: Some Basic Accounting

I develop, in the following sections, a framework to analyze impact/short-run effects and dynamics over time of exogenous shocks. The aim is to analyze the stability properties of MMT policy assignment. In order to do this, I incorporate: (1) open economy considerations, (2) the role of exchange rate expectations, (3) conflicting claims, (4) interactions between stocks and flows, (5) the role of private international indebtedness. To satisfy the MMT definition of monetary sovereignty, I assume throughout a flexible exchange rate, and no foreign currency borrowing by the government. Indeed, with the exception of section 6, I assume a positive international investment position, i.e., the country is a net creditor in foreign currency terms.

Let's start with the asset markets. Table 1 provides a list of the variable symbols and their definitions.

There are three financial assets, held by domestic citizens: money ( $M$ ), domestic bonds ( $B$ ), and foreign-issued bonds denominated in foreign currency ( $F$ ), of which the private and consolidated government sector holdings are represented by  $F_P$  and  $F_G$ . When deflated by the domestic price level  $P$ , these assets add up to privately held domestic wealth,  $W_P$ . All bonds are variable price short-term ones so that their capital values are independent of the interest rates. Domestic bonds are held only by domestic citizens while foreign bonds are held both domestically but also (mainly) internationally. Recalling that one country's net liability is another's net asset, we can write the following identity.

$$F_P + F_G + F^* = 0 \tag{1}$$

where  $F^*$  denotes the foreign currency bonds held by the rest of the world. With

Table 1: Variable dictionary

Symbol	Variable definition
$M, B, F$	Nominal stocks of money, domestic currency bonds, and foreign currency bonds
$F_P, F_G, F^*$	Foreign currency bonds held by the private sector, the consolidated fiscal/monetary authority, and the rest of the world, respectively
$W_P, W_G$	Wealth held by the private sector and consolidated authority in real terms
$P$	The price of the domestic good
$x$	The risk premium on domestic assets
$i, i^*$	Domestic and international short term nominal interest rates.
$r, r^*$	Domestic and international real interest rates.
$Y, \bar{Y}$	Real domestic national output (income) and full employment level of output
$E, E^e$	Actual and expected nominal exchange rates
$e^e$	Expected exchange rate depreciation
$\pi, \pi^*$	Domestic and foreign goods' inflation
$G, T$	Government spending and tax revenues
$\Gamma$	Taxes net of income transfers and interest payments to the private sector
$V, V^e, \tau$	Actual and expected nominal wage and the mark-up factor
$v, \bar{v}$	Actual and target real wage
$\Omega$	$\equiv [(1 + \tau)\bar{v}]^{\frac{1}{\beta}}$ . Used to simplify notation.
$Q$	Real exchange rate
$TB$	Trade balance
$L$	Total employment
$\alpha, \beta, \gamma, \phi$	Parameters

a perfectly flexible exchange rate  $F_G$  is likely to be quite small and relatively stable in practice and I, therefore, ignore it (so that  $F_G = 0$ ).

Portfolio choice can be thought of occurring in two steps. In the first step, investors decide how much foreign currency risk to take on. Put differently, they decide the composition of their portfolio between domestic and foreign assets based on the risk premium. In the second step, they choose the composition of the domestic currency share of the portfolio between liquid money and bonds. The holdings of bonds are positive functions of total private wealth.

The standard money market equilibrium condition, after using  $i$  and  $Y$  to denote the domestic nominal interest rate and real national income, can be defined in the standard manner as follows:

$$\frac{M}{P} = L(i, Y); L_i < 0, L_Y > 0 \quad (2)$$

where the left and right hand sides represent real money supply and demand, respectively. Since money is assumed to be used for transactions purposes only, real wealth does not make an appearance as an argument. Using  $x$ ,  $e^e$ , and  $i^*$  to denote the expected risk premium on domestic bonds, expected exchange rate depreciation, and the foreign nominal interest rate, respectively, the equilibrium conditions for the domestic and foreign bonds markets can be expressed in the form of eqs. (4) and (5) below:

$$x = i - i^* - e^e \quad (3)$$

$$\frac{B}{P} = W_P - f(x, W_P) - L(i, Y) \quad (4)$$

$$\frac{EF_P}{P} = f(x, W_P); f_x < 0, f_W > 0 \quad (5)$$

As mentioned earlier, total private wealth is the sum of the holdings of the three assets. This variable, like the individual asset stocks, is pre-determined, and evolves gradually over time, although it is subject to instantaneous valuation changes due to nominal exchange rate ( $E$ ) movements.

$$W_P = \frac{M + B + EF_P}{P} \quad (6)$$

The corresponding government (consolidated fiscal and monetary authority) wealth definition is expressed by equation (7) (recall that  $F_G = 0$ ).

$$W_G = -\frac{M + B}{P} + \frac{EF_G}{P} = -\frac{M + B}{P} \quad (7)$$

Turning turn next to the goods market, let's start by defining real private income using the Hicks definition (i.e., the amount of consumption that leaves private real wealth unchanged).<sup>6</sup> Let's employ  $Y_P$  to represent real private

<sup>6</sup>Hicks's approach is preferable since it allows us to keep track of real variables while avoiding complications due to capita gains/losses which are of tangential interest here.

disposable income,  $r$  and  $r^*$  for domestic and foreign real interest rates,  $E$  and  $P$  for the nominal exchange rate and domestic price level,  $\pi$  for domestic inflation, and  $T$  for real taxes, respectively. Then real private income net of taxes can be expressed as follows:

$$Y_P = Y + r \frac{B}{P} + r^* \frac{EF_P}{P} - T - \pi \frac{M}{P}$$

Next, defining the real interest rates in the standard manner (where  $i$  and  $i^*$  are domestic and foreign nominal interest rates, while  $\pi^*$  – which is zero given that  $P^*$  is exogenously fixed – is foreign goods inflation),

$$r = i - \pi, r^* = i^* + e^e - \pi^*, e^e = \frac{E^e - E}{E}$$

allows us to re-define  $Y_P$  as:

$$Y_P = Y + r \frac{M + B}{P} + (i^* + e^e) \frac{EF_P}{P} - T - i \frac{M}{P}$$

or,

$$Y_P = Y + (i^* + e^e) \frac{EF_P}{P} - \Gamma \quad (8)$$

where  $\Gamma$  denotes taxes net of income transfers and interest payments to the private sector. Following Tobin and Buiter (1974), I simplify by assuming this quantity, rather than taxes only, to be a policy variable that is exogenously set. This simplification avoids having to keep track of domestic intra-sector interest payments.

Firms take expectations about the future into account while setting prices. Thus, the price of the domestically produced good is characterized by a constant mark-up over expected average variable costs (here, expected labor costs). Denoting the expected nominal wage by  $V^e$ , normalizing the constant marginal and average product of labor to unity, and denoting the mark-up factor by  $\tau$ ,

$$P = (1 + \tau)V^e \quad (9)$$

We will introduce conflicting claims inflation later. To lay the groundwork, suppose workers have a target real wage in terms of domestic and imported consumer goods. Suppose, further that a share  $\beta$  of consumption is spent on imported goods.<sup>7</sup> Then, the expected nominal wage can be specified as follows:

$$V^e = \bar{v} (E^e P^*)^\beta P^{1-\beta} = \bar{v} (E^e)^\beta P^{1-\beta} \quad (10)$$

The expected change in the exchange rate is defined in a standard manner with the adjustment in expectations specified to be gradual.

$$e^e = \alpha \left( \frac{E^e - E}{E} \right) = \alpha \left( \frac{E^e}{E} - 1 \right) \quad (11)$$

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<sup>7</sup>Think in terms of an underlying Cobb-Douglas utility function.

where  $\alpha$  is the speed of adjustment. This is similar to the standard regressive expectations specification except for that the long-run expected level of the exchange rate is not assumed to be uniquely defined by monetary conditions. Instead, more in line with MMT-inspired work, I assume that the long-run level itself evolves over time (more on this later).

Employing eqs. (9), (10), and (11), we can see how wage and exchange rate expectations interact. Suppose there is an expected rise in the exchange rate (i.e., depreciation). Then price-setters will expect the nominal wage to rise as workers try to defend their purchasing power. This will, in turn, lead price-setting firms to raise their prices.

Defining the real exchange rate  $Q$  in the standard manner, i.e. the price of foreign goods relative to domestic goods, and recalling that  $P^* = 1$ ,

$$Q = \frac{E}{P} \quad (12)$$

national income in real terms can be expressed as:

$$Y = A(Y_P, i - \pi^e, W_P, v) + G + TB(Q, Y, Y^*) \quad (13)$$

where  $A$  represents domestic absorption,  $G$  is government spending on goods and services,  $TB$  is the trade balance, which in turn is defined to be a function of the real exchange rate, national income, and foreign income, all specified in terms of the domestic price level. Note that I have ignored investment here and elsewhere, to keep things simple and focused. The first two arguments in the absorption function  $A(\cdot)$  are standard and do not require explanation. The third argument,  $W_P$ , or national wealth in real terms captures the wealth effect on consumption. The fourth argument comes from considerations that Post Keynesians emphasize and requires defining distributional terms. Let  $v$  denote the wage share of national income. Then,

$$v = 1 - \frac{PY - VL}{PY} = 1 - \frac{V}{P} = \frac{V}{(1 + \tau)V^e} \quad (14)$$

where the last equality uses the definition of  $P$  from equation (9). The presence of this as an argument reflects the standard – and empirically defensible – Post Keynesian assumption that workers save a smaller proportion of their income compared to owners of capital.

The signs of the relevant partial derivatives for equation (13) can be summarized as follows (where the subscript denotes the variable with respect to which the partial is expressed; e.g.,  $A_Y \equiv \partial A / \partial Y_P$ ):

$$A_Y, A_W, Av, TB_Q, TB_{Y^*} > 0, A_r, TB_Y < 0$$

Equations (1)-(14) constitute a system of 14 variables ( $Y, Y_P, P, M, B, E, e^e, x, F_P, W_P, W_G, v, V^e, Q$ ) in 14 eqs. As discussed earlier, with a fixed exchange rate,  $F_G$  is exogenous. The nominal wage, the expected exchange rate, and foreign asset positions are predetermined variables which evolve gradually over time. The Central Bank responds to any excess demand for money to keep

the interest rate constant (say, at a low level), so that the quantity of money supplied is endogenous. It is easy to demonstrate using eqs. (2), (4), (5), and (6) that one of these equations is superfluous. In other words, once two of the three asset equilibrium conditions are satisfied, the third is satisfied by Walras's Law. This leaves us with one endogenous variable too many. Assuming that the policy makers fix the supply of bonds, a simplification that is in line with the spirit of MMT analysis, renders the system fully determined.

For future reference, it would be useful to combine eqs. (9) and (14) to define a new variable,  $\Omega$  ( $\equiv [(1 + \tau)\bar{v}]^{\frac{1}{\beta}}$ ), so that:

$$P = [(1 + \tau)\bar{v}]^{\frac{1}{\beta}} E^e = \Omega E^e \quad (9')$$

and,

$$V^e = \frac{\Omega E^e}{1 + \tau} \quad (10')$$

The system can be consolidated so that it yields 3 equations in 3 variables ( $Y$ ,  $M$ , and  $E$ ). The goods market equilibrium condition can, after substituting from eqs. (6), (8), (9'), and (14) into equation (13), be expressed as:

$$\begin{aligned} Y = & A \left( Y + (i^* + e^e) \frac{EF_P}{\Omega E^e} - \Gamma, i - \pi^e, \frac{M + B + EF_P}{\Omega E^e}, \frac{V}{(1 + \tau)V^e} \right) \\ & + G + TB \left( \frac{E}{\Omega E^e}, Y, Y^* \right) \end{aligned} \quad (15)$$

Similarly substituting equation (9') into (2) yields:

$$\frac{M}{\Omega E^e} = L(i, Y) \quad (16)$$

And, finally, the foreign asset market clearing condition, i.e., equation (5) after substitution from eqs. (3), (6), and (9') becomes:

$$\frac{EF_P}{\Omega E^e} = f \left( i - i^* - e^e, \frac{M + B + EF_P}{\Omega E^e} \right) \quad (17)$$

The instantaneous (as opposed to longer- or medium-run) equilibria of our larger system is defined by eqs. (15)-(17). The endogenous variable ( $Y$ ,  $M$ ,  $E$ ) Jacobian determinant follows from these equations.

$$|J_1| = \frac{\Lambda}{P} \left[ (1 - f_W) \frac{F_P}{P} - \alpha f_x \frac{E^e}{E^2} \right] - \frac{L_Y}{P} \left\{ \frac{TB_Q + [A_W + A_Y (r^* - \alpha \frac{E^e}{E^2})] F_P}{P} + \alpha f_x \right\} \quad (18)$$

where  $\Lambda$  ( $\equiv 1 - A_Y - TB_Y$ )  $> 0$  is the standard Keynesian goods market stability condition, and based on equation (11),  $\partial e^e / \partial E = -\alpha / E^2$  ( $< 0$ ). Also, with

the exception of section 6, where I explore the implications of net private foreign indebtedness, I assume that  $F_P > 0$ .

The first term in the square parentheses on the right hand side of the Jacobian expression is unambiguously positive. The second term in the curly parentheses is ambiguously signed. However, as long as the economy, following MMT prescriptions, is under a regime of very low interest rates, bonds and liquid money should be close substitutes and the elasticity of transactions demand for money (i.e.,  $L_Y$ ) should be low (and, as in a liquidity trap, the elasticity of money demand with respect to the interest rate should be extremely high). The term associated with the curly brackets is, therefore, expected to be small in magnitude, which makes the determinant positively-signed. I will maintain this assumption about  $L_Y$  throughout the remainder of this paper and use it to determine the likely signs of expressions in the presence of ambiguity.<sup>8</sup>

We can now carry out some comparative static thought experiments to explore effects of changes in the relevant variables on the short-run equilibrium values of output, money stock, and the exchange rate. The exercises carried out here will help analyze the stability and comparative dynamic properties over (continuous) time in later sections.

### 3.1 An Increase in Government Spending

Suppose policy makers increase government spending while avoiding any changes in the interest rate through monetary accommodation. How does that affect our system in the short run? In mathematical terms,

$$\begin{aligned}\frac{dY}{dG} &= \frac{(1 - f_W) \frac{F_P}{P} - \alpha f_x \frac{E^e}{E^2}}{P |J_1|} > 0 \\ \frac{dM}{dG} &= L_Y \frac{(1 - f_W) \frac{F_P}{P} - \alpha f_x \frac{E^e}{E^2}}{|J_1|} > 0 \\ \frac{dE}{dG} &= L_Y \frac{f_W}{P |J_1|} > 0\end{aligned}$$

The new equilibrium values of  $Y$ ,  $M$ , and  $G$  are unambiguously higher. Why? It is clear from the basic set-up that output in our system is demand-led. An increase in government spending raises income and demand for money. The Central Bank accommodates the latter by raising the supply of liquid money. The resulting increased holdings of financial assets in private hands then leads to excess demand for foreign assets (via the wealth effect), and hence currency depreciation.

The depreciation caused by increased spending is not a typical result in models that incorporate financial account openness. An example would be the workhorse Mundell-Fleming model. This difference arises from the fact that policy makers in our MMT-motivated framework are keeping interest rates fixed

<sup>8</sup>See, for example, the sign for  $dE/di^*$  in section 3.3.

so that there are no capital inflows due to the higher domestic interest rates caused by increased fiscal spending in standard treatments. Instead, there are capital outflows due to the wealth effect of increased private asset holdings, part of which are directed towards foreign assets.

### 3.2 An increase in the nominal wage

Proponents of MMT appear to implicitly assume cost-based mark-up pricing but do not typically take into account the effects of distributional changes – for example, an increase in the mark-up rate – on prices. In other words, there is no explicit linkage between mark-ups, wages, and prices, at least up until the point of full employment. This, is an omission that needs to be rectified.

Let's, therefore, proceed by supposing, in line with standard Post Keynesian analysis, that the price is set as a constant mark-up over expected costs. We have, of course, already specified this earlier in equation (9). The thing to keep in mind is that the nominal wage is pre-determined at any point in time. Mathematically, the effects of an increase can be described as follows:

$$\begin{aligned}\frac{dY}{dV} &= \frac{A_v \left[ (1 - f_W) \frac{F_P}{P} - \alpha f_x \frac{E^e}{E^2} \right]}{P^2 |J_1|} > 0 \\ \frac{dM}{dV} &= L_Y \frac{A_v \left[ (1 - f_W) \frac{F_P}{P} - \alpha f_x \frac{E^e}{E^2} \right]}{P |J_1|} > 0 \\ \frac{dE}{dV} &= L_Y \frac{A_v f_W}{P^2 |J_1|} > 0\end{aligned}$$

Intuitively, a higher nominal wage (which also raises the real wage and the wage share) increases consumer spending and raises output as a result. Higher income translates into greater demand for money and hence increased money supply. The currency depreciates since increased wealth – in the form of increased money holdings – leads to excess demand for all assets, including foreign bonds. The end result, therefore, is an increase in all 3 variables.

### 3.3 An increase in the international interest rate

In sections 5 and 6, we will utilize a higher international interest rate as a thought device to examine the stability of the dynamic system. Here I lay the foundation for that analysis with the help of a comparative static exercise.

$$\begin{aligned}\frac{dY}{di^*} &= \frac{A_Y F_P \left[ (1 - f_W) \frac{E F_P}{P} - r^* f_x \right] - f_x (A_W F_P + T B_Q)}{P^2 |J_1|} > 0 \\ \frac{dM}{di^*} &= L_Y \frac{A_Y F_P \left[ (1 - f_W) \frac{E F_P}{P} - r^* f_x \right] - f_x (A_W F_P + T B_Q)}{P |J_1|} > 0\end{aligned}$$

$$\frac{dE}{di^*} = \frac{-\Lambda f_x + L_Y [A_W f_x + f_W A_Y \frac{E F_P}{P}]}{P |J_1|} > 0$$

A higher international interest rate translates into higher investment income from foreign currency denominated assets and an excess demand for foreign assets. The latter, along with the depreciation resulting from the latter, create an excess demand for goods, raising income and output.

To summarize our comparative static exercises for later reference, our three variables of interest can be expressed in terms of the state/pre-determined variables as follows:<sup>9</sup>

$$Y = Y(G, V, E^e; i^*); \quad Y_G, Y_V, Y_{i^*} > 0; \quad Y_{E^e} < 0 \quad (19)$$

$$M = M(G, V, E^e; i^*); \quad M_G, M_{E^e}, M_{i^*}, M_V > 0 \quad (20)$$

$$E = E(G, V, E^e; i^*); \quad E_G, E_V, E_{E^e}, E_{i^*} > 0 \quad (21)$$

## 4 Policy Mechanisms in the Simplest Version

We have laid the groundwork to set things in motion and analyze changes over time. To begin the dynamic analysis, let's start simple and assume static expectations, so that  $e^e$  is fixed. We will relax this assumption in the next section and see how this destabilizes the system. For now, consider an economy where the consolidated fiscal and monetary policy authority targets a full employment level of output,  $\bar{Y}$ , and stable inflation,  $\bar{\pi}$ . Wage earners have a target real wage  $\bar{v}$  that they measure in terms of a composite price level that includes both domestic and imported goods. Making use of equation (9), and consistent with equation (10), but now absent expectations, this index can be expressed simply in a Cobb-Douglas form:  $E^\beta [(1 + \tau)V]^{1-\beta}$ . The idea here is to incorporate distributional conflict-driven cost-push price increases which, as discussed in Section 2, MMT proponents tend to see as the main driver of inflation.

Suppose the consolidated authority employs fiscal policy to maintain full employment and the targeted inflation level ( $\bar{\pi}$ ).

$$\dot{G} = \phi(\bar{Y} - Y) + (\bar{\pi} - \pi)$$

$$\dot{V} = \psi \left[ \bar{v} - \frac{V}{E^\beta [(1 + \tau)V]^{1-\beta}} \right] = \psi \left[ \bar{v} - \left( \frac{V}{E} \right)^\beta \frac{1}{[(1 + \tau)^{1-\beta}]} \right]$$

It is immediately obvious that there is a mismatch between the number of policy instruments ( $G$ ) and targets ( $\bar{Y}$  and  $\bar{\pi}$ ). It is only by chance that both

<sup>9</sup>The signs for the partials with respect to  $E^e$  come from the analysis presented in section 5.1 but I provide them here to save space.

inflation and employment targets can be simultaneously met. Much of MMT literature has failed to deal with this issue, thanks to the threshold formulation of inflation (Palley (2019)).

Since there is a problem of insufficient instruments, let's reserve fiscal spending to target unemployment only. In the absence of any role for expectations, inflation will then simply follow the trajectory of labor costs.

$$\dot{P} = (1 + \tau)\dot{V} \quad (22)$$

so that,

$$\pi = \frac{\dot{V}}{V}$$

and the two-equation dynamic system is as follows:

$$\dot{G} = \phi(\bar{Y} - Y) \quad (23)$$

$$\dot{V} = \psi \left[ \bar{v} - \left( \frac{V}{E} \right)^\beta \frac{1}{(1 + \tau)^{1-\beta}} \right] \quad (24)$$

The system defined by eqs. (23) and (24) can be written more concisely after substitutions from eqs. (19) and (21).

$$\dot{G} = \dot{G}(G, V; i^*) \quad (25)$$

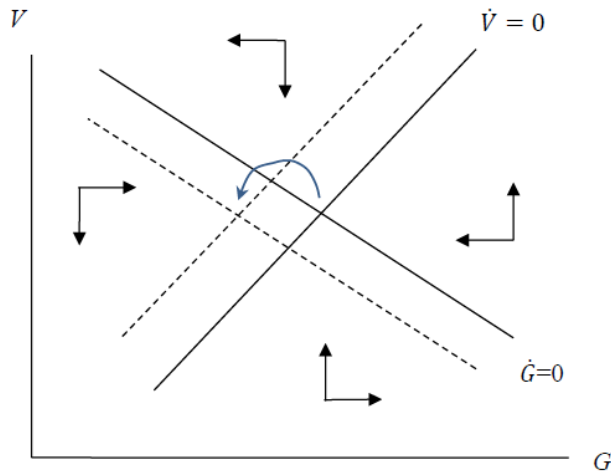
$$\dot{V} = \dot{V}(G, V; i^*) \quad (26)$$

with  $\dot{G}_G, \dot{G}_V, \dot{G}_{i^*}, \dot{V}_V < 0$  and  $\dot{V}_G, \dot{V}_{i^*} > 0$ .<sup>10</sup>

It is straightforward to show that the system is dynamically stable now that policy makers ignore inflation as a policy target. The trace is negative while the Jacobian determinant is positive. The presence of conflicting claims inflation does not destabilize the system. To understand why, suppose that the international interest rate rises, leading to currency depreciation and consequently domestic expansion. The government contracts spending in response while workers demand a higher nominal wage to compensate for the depreciation. Declining government spending dampens the initial depreciation (and real wage decline) as the government reduces the money supply in a process of (reverse) monetization. Thus, wage inflation is temporary as the economy settles into its new steady state. Government spending is lower in this new steady state. This process and the transitional dynamics involved are illustrated by Figure 4.

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<sup>10</sup>The Appendix provides detailed expression for these partials.



The dynamics of the model without expectations.

Inflation is transitory and the system is stable despite there being only one policy instrument available (i.e., fiscal policy). Implicitly this assumes that inflation can be controlled simply by letting distributional conflict play itself out so that, once wages are at the target level, the conflict disappears, as does inflation. There are no destabilizing feedback loops and we don't miss much by assuming a threshold model of inflation.

## 5 Taking Expectations Seriously

Financial markets play a huge role in determining exchange rates, which after all are asset prices that are influenced by expectations about the future. In this section we see that incorporating exchange rate expectations makes it unlikely that adjustments in fiscal policy will be able to stabilize the economy even in a simplified set-up. This conclusion does not require the incorporation of perfect foresight or rational expectations. In fact, as mentioned in Section 3, I assume here gradual expectation adjustment. Financial market participants form expectations about the long-run level of the exchange rate in each period. If the actual exchange rate deviates from this level, they expect that change to be gradually reversed over time. This expected long-run level is pre-determined in each period but slowly changes over time if it turns out to be inaccurate (i.e., there is partial error correction in each following period).

Before we can formally analyze the dynamic properties of the system, we need to lay the relevant groundwork by analyzing the immediate effects of a change in the expected exchange rate.

## 5.1 A higher *expected* exchange rate level

Suppose that, for some reason, the long-run expected level of the exchange rate rises. Since foreign debt dynamics are not the focus in this section, let's assume that the country is initially neither a net foreign debtor nor creditor (i.e.,  $F_P = 0$ ). The increase in the nominal wage that firms expect following an exogenous rise in  $E^e$  leads to an increase in the price of the domestic good, which lowers both domestic and foreign demand, and hence output. The rise in  $E^e$  also generates expectations of depreciation, which makes foreign assets more attractive leading to an actual depreciation through self-fulfilling expectations. Finally, the rise in the price level generates greater demand for money that the central bank accommodates by increasing the money supply. At the end of the day, income is lower while the other short-run adjusting variables have higher equilibrium values.

Mathematically, the comparative static results with respect to changes in  $G$ ,  $V$ , and  $i^*$  are identical to those presented in sections (3.1), (3.2), and (3.3), except for that now  $F_P = 0$ . The entirely new comparative static needed here is that for a change in the expected level of the exchange rate.

$$\frac{dY}{dE^e} = \frac{-\frac{TB_Q}{P} Bf_W + \alpha f_x \left( BA_W + A_v \frac{1-\beta}{E^\beta} \right) \frac{E^e}{E^2}}{PE^e |J'_1|} < 0$$

$$\frac{dM}{dE^e} = \frac{-\Lambda M \alpha f_x \frac{E^e}{E^2} + L_Y \left\{ \left[ \alpha f_x \frac{E^e}{E^2} \left( A_W W_P + A_v \frac{1-\beta}{E^\beta} \right) + f_W W_P TB_Q \right] + \frac{TB_Q \alpha f_x}{P} \frac{E^e}{E^2} (1 + \Omega) \right\}}{PE^e |J'_1|} > 0$$

$$\frac{dE}{dE^e} = \frac{-\Lambda \left( \alpha f_x \Omega \frac{E^e}{E^2} + \frac{Bf_W}{PE^e} \right) + L_Y \left[ A_W \Omega \alpha f_x \frac{E^e}{E^2} - \frac{TB_Q E + A_v \frac{1-\beta}{E^\beta} f_W}{PE^e} \right]}{P |J'_1|} > 0$$

where, with  $F_P = 0$ ,

$$|J'_1| = -\frac{\Lambda}{P} \alpha f_x - L_Y \left\{ \frac{\alpha f_x + TB_Q}{P} \right\} > 0 \quad (27)$$

We can now turn to the dynamics. For the reader's convenience, I restate the equations of motion of the variables of interest.

$$\dot{G} = \phi(\bar{Y} - Y) \quad (28)$$

$$\dot{V} = \psi \left[ \bar{v} - \left( \frac{V}{E} \right)^\beta \frac{1}{(1 + \tau)^{1-\beta}} \right] \quad (29)$$

The new equation below defines expectation evolution. As discussed earlier, investors have an expected exchange rate level in any given period. In standard

regressive (or rational) expectations approaches, one would specify a long-run level of the exchange rate which, given the monetary stance, all market participants would expect to hold over time. The actual exchange rate gravitates towards this long-run level as the system approaches a steady state. Such an approach will, however, be in tension with our MMT-inspired analysis where the money supply is continually changing so that any firm grounds for a long-run exchange rate level are absent. We, therefore, pursue a different approach.

Suppose investors in any given period have expectations about the future level of the exchange rate. If these expectations turn out to be inaccurate, there is gradual self-correction. Specifically, if the actual exchange rate deviates from that level, they update the level that they expect the actual exchange rate to move towards. For example, if an instantaneous devaluation raises the level of  $E$  relative to  $E^e$  investors expect a subsequent appreciation *but* to a higher level. This simple error-correction mechanism can be stated as follows:<sup>11</sup>

$$\dot{E}^e = (1 - \gamma)(E - E^e) \quad (30)$$

Again, given our set-up, goods price inflation simply follows actual and expected changes in costs/wages. The signs of the partials can be defined, again with the help of eqs. (19) - (21), as follows:<sup>12</sup>

$$\dot{G}_G, \dot{G}_V, \dot{G}_{i^*}, \dot{V}_V, \dot{E}_{E^e}^e < 0 \text{ and } \dot{G}_{E^e}, \dot{V}_G, \dot{V}_{i^*}, \dot{V}_{E^e}, \dot{E}_G^e, \dot{E}_V^e, \dot{E}_{i^*}^e > 0. \quad (31)$$

## 5.2 Dynamic Aspects

Analyzing the dynamic properties of the system is now obviously much more complicated, and the phase diagram for the  $3 \times 3$  system cannot be presented in two-dimensional space. I will proceed, as before, by establishing some mathematical properties before explaining the intuition underlying the results.

<sup>11</sup>A numerical example may be illustrative. Recall that the expected level of the exchange rate is pre-determined at any given point in time. Suppose the expected level for the next period is a weighted average of the expected and the actual levels in the current period.

$$E_{t+1}^e = \gamma E_t^e + (1 - \gamma)E_t \quad (A)$$

so that,

$$\dot{E}_t^e = (1 - \gamma)(E_t - E_t^e)$$

Recall also equation (11) and suppose initially  $\alpha = 0.1$ ,  $\gamma = 0.8$ ,  $\Omega = 1$ ,  $E_t^e = 100$ , and  $E_t = 100$ . Then initially  $e^e = 0$ ,  $E_{t+1}^e = 100$ , and  $\dot{E}_t^e = 0$ .

Now suppose that, due to an exogenous shock,  $E_t$  jumps up (depreciates) to 110. Then  $e^e = -1$ , i.e., the exchange rate is expected to appreciate in the next period. But to what level? The answer, given the value of  $\gamma$  (so that  $\dot{E}_t^e = 2$ ) is  $E_{t+1}^e = 102$ . That is, thanks to the jump depreciation, the exchange rate is expected to gradually start appreciating but towards a level higher than previously expected.

To put it more succinctly, the sub-system has three equations (eqs. (11), (30), and (A)) in 3 variables ( $e_t^e$ ,  $E_{t+1}^e$ ,  $\dot{E}_t^e$ ). Once  $E_t$  is determined in the financial markets, the three equation can be solved for these 3 unknowns.

<sup>12</sup>Again, the appendix provides detailed expressions for these partials.

Using  $\lambda$  to denote the eigenroot(s), the characteristic equation for the system (28)-(30) is given by:

$$\lambda^3 + A_1\lambda^2 + A_2\lambda + A_3 = 0$$

where,

$$A_1 = -(\dot{G}_G + \dot{V}_V + \dot{E}_{E^e}^e)$$

$$A_2 = \left[ \dot{G}_G \dot{V}_V - \dot{V}_{E^e} \dot{E}_V^e - \dot{G}_V \dot{V}_G \right] + \left[ (\dot{G}_G + \dot{V}_V) \dot{E}_{E^e}^e - \dot{G}_{E^e} \dot{E}_G^e \right]$$

$$A_3 = [(\dot{G}_G \dot{V}_{E^e} - \dot{G}_{E^e} \dot{V}_G) \dot{E}_V^e] + [(\dot{G}_V \dot{V}_G - \dot{G}_G \dot{V}_V)] \dot{E}_{E^e}^e + [(\dot{G}_{E^e} \dot{V}_V - \dot{G}_V \dot{V}_{E^e})] \dot{E}_G^e$$

The standard Routh-Hurwitz stability conditions require that, (1)  $A_1 > 0$ , (2)  $A_2 > 0$ , (3)  $A_3 > 0$ , and (4)  $A_1 A_2 - A_3 > 0$ .<sup>13</sup> As a reminder, the detailed expressions for the partials above (summarily presented in (31)), are provided in the appendix. Here I focus on the big picture.

Condition (1) is satisfied if  $\dot{G}_G + \dot{V}_V + \dot{E}_{E^e}^e > 0$ . This condition is unambiguously satisfied.

Turning to condition (2) the term in both sets of parentheses are ambiguously signed. On closer inspection, it is mainly the interactions between exchange rate expectations on the one hand and the labor and goods markets on the other that destabilize the system.<sup>14</sup> This is not surprising, of course, given that the absence of any role for expectations delivered a stable system in section (4).

Finally, turning to condition (3), the term in the first set of square parentheses is negative, that in the second is positive, while that in the third is ambiguously signed. Again, it is chiefly the interactions between the goods market, wages, and exchange rate expectations that causes the instability. Thus, without even considering condition (4), we can tell that the presence of exchange rate expectations makes it likely that the system is dynamically unstable.

What is the intuition underlying the likelihood of instability in the presence of exchange rate expectations? To understand this, consider again the consequences of an increase in the international interest rate. As in the case of Section 4, and as illustrated by Figure 4, the government initially shrinks spending in response to the increase in output beyond the full employment level, and the initial exchange rate depreciation leads to nominal wage rises as workers strive to preserve real purchasing power. The difference now is that the depreciation also affects exchange rate expectations (via equation (30)). Specifically, the initial depreciation means that the level of the exchange rate that is expected to prevail over time is now higher (even though it is lower than the actual exchange rate so that an appreciation that higher level is expected). This raises prices as firms build higher expected wage costs into their prices.

<sup>13</sup>Note that condition (2) is superfluous if the other conditions are satisfied.

<sup>14</sup>These interactions are captured by the partials  $\dot{G}_{E^e}$ ,  $\dot{E}_G^e$ ,  $\dot{V}_{E^e}$ , and  $\dot{E}_V^e$ .

Over time, a depreciating exchange rate gives a boost to demand and dampens the initial need for fiscal expansion. The interplay of rising wages, the resulting currency depreciation and rising levels of the expected exchange rate level, however, destabilize the system. Since inflation follows the trajectory of cost increases, it too rises further away from its steady state level. We have a potentially unstable loop of contractionary fiscal policy, depreciating currency, and rising inflation!

The likely instability of the system now means that controlling inflation has been re-introduced as a policy goal through the back door. Even though there is no explicit inflation target, evolving expectations and cost-push inflation require another instrument to stabilize the system. Harking back to Edwards (2019), countries with a history of currency crisis may be better able to appreciate the dilemma.<sup>15</sup>

## 6 Taking External Constraints Seriously

Speaking of currency crises, let's turn now to another aspect that is typically missing from MMT analysis. Economic processes in open economies involve important interactions between the exchange rate, the current account, foreign debt, and the rest of the economy. We now focus on this aspect. To do so, I simplify in another dimension by returning to the assumption of static expectations thus taking expectation evolution out of the analysis. Another change that I make is to focus on an economy that is a net debtor in international markets, i.e.,  $F_P < 0$ . As we will see, introducing debt considerations opens the door to a new source of instability. Notice that this does not violate the MMT definition of monetary sovereignty since it is the private sector rather than the consolidated authority that is a net foreign debtor. On a related note, one more simplification I make is in cases where the effect of real exchange rate changes on the trade balance and the value of foreign debt work in opposing directions, creating ambiguity. Since the focus on this section is on the impact of foreign indebtedness, I assume the latter effect to dominate in such cases.

Since expectations are now static, the specification of price-setting, as defined earlier by equation (9) can now be modified to:

$$P = (1 + \tau)V \quad (32)$$

and equation (10) becomes redundant. In other words, expectations about future wage increases now play no role in price formation.

Starting with the short-run instantaneous equilibria, notice that equation (18) from Section 3 now becomes (with  $e^{e'} = e^e = 0$ ):

$$|J_2| = \frac{\Lambda}{P^2} [(1 - f_W)F_P] - \frac{L_Y}{P^2} [(A_W + A_Y r^*) F_P + f_W T B_Q] \quad (33)$$

which, since  $F_P < 0$  is now negative if,  $L_Y$  as before, is considered to be small. The signs for equilibrium changes in comparative static values in response to

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<sup>15</sup>See Edwards (2019).

an increase in government spending are the same as in Section 3.1 except for the exchange rate which now appreciates (consistent with the Mundell-Fleming model). This is because, given the negative net international position, an appreciation is now required to remove excess demand for foreign assets created by the increase in the money stock and wealth.

$$\begin{aligned}\frac{dY}{dG} &= \frac{(1-f_W)F_P}{P^2|J_2|} > 0 \\ \frac{dM}{dG} &= L_Y \frac{(1-f_W)F_P}{P|J_2|} > 0 \\ \frac{dE}{dG} &= \frac{L_Y f_W}{P|J_2|} < 0\end{aligned}$$

The comparative statics of a rise in the nominal wage can now be expressed as:

$$\begin{aligned}\frac{dY}{dV} &= -\frac{(A_Y r^* + A_W)F_P + TB_Q}{P^2 V |J_2|} f_W B < 0 \\ \frac{dM}{dV} &= \frac{\Lambda M(1-f_W)F_P - L_Y(M+B)[(A_Y f_W r^* + A_W)F_P + f_W TB_Q]}{P V |J_2|} > 0 \\ \frac{dE}{dV} &= \frac{\Lambda[(1-f_W)E F_P - f_W B] - L_Y E [(A_W + A_Y r^* f_W)F_P + f_W TB_Q]}{P^2 V |J_2|} > 0\end{aligned}$$

Higher international interest rates have effects that can be captured mathematically as follows:

$$\begin{aligned}\frac{dY}{di^*} &= \frac{A_Y(1-f_W)\frac{E F_P^2}{P} - f_x[(A_W + A_Y r^*)\frac{F_P}{P} + TB_Q]}{P^2 |J_2|} \geq 0 \\ \frac{dM}{di^*} &= L_Y \frac{A_Y(1-f_W)\frac{E F_P^2}{P} - f_x[(A_W + A_Y r^*)F_P + TB_Q]}{P^2 |J_2|} \geq 0 \\ \frac{dE}{di^*} &= \frac{-\Lambda f_x + L_Y[A_W f_x + f_W A_Y \frac{E F_P}{P}]}{P |J_2|} < 0\end{aligned}$$

Finally, in order to study the dynamics of current account imbalances and foreign indebtedness in Section 6, we need to carry out a thought experiment involving an increase in  $F_P$  (i.e., a rise in foreign indebtedness; recall that, since the country is a net international debtor,  $F_P < 0$  in this section). Mathematically,

$$\begin{aligned}\frac{dY}{dF_P} &= -\frac{(1-f_W)(TB_Q)}{P^2|J_1|}E > 0 \\ \frac{dM}{dF_P} &= L_Y\frac{(1-f_W)F_P TB_Q}{P^2|J_2|}E > 0 \\ \frac{dE}{dF_P} &= \frac{-\Lambda(1-f_W) + L_Y[A_Y f_W r^* + A_W]}{P^2|J_2|}E > 0\end{aligned}$$

where again the signs assume that  $L_Y$  is small. Reduced foreign indebtedness raises private wealth and foreign investment income, thus raising spending and output as a result. Since only a fraction  $f_W$  of the increased wealth is directed to foreign assets, the excess (negative) supply of foreign assets created leads to a currency depreciation.

To summarize:

$$Y = Y(G, V, F_P; i^*); \quad Y_G, Y_{F_P} > 0, Y_V < 0, Y_{i^*} \geq 0 \quad (34)$$

$$M = M(G, V, F_P, E^e; i^*); \quad M_G, M_V, M_{F_P} > 0, M_{i^*} \geq 0 \quad (35)$$

$$E = E(G, V, F_P, E^e; i^*); \quad E_{F_P}, E_V > 0, E_G, E_{i^*} < 0 \quad (36)$$

## 6.1 Back to dynamic stability considerations

Again, the dynamic system involves 3 equations, the first two being the same as (28) and (29) in Section 5.

$$\dot{G} = \phi(\bar{Y} - Y) \quad (37)$$

$$\dot{V} = \psi \left[ \bar{V} - \left( \frac{V}{\bar{E}} \right)^\beta \frac{1}{(1+\tau)^{1-\beta}} \right] \quad (38)$$

In place of regressive expectations now, however, we incorporate the evolution of the financial account (i.e., foreign indebtedness) through the current account (investment income plus the trade balance).

$$\dot{F}_P = (i^* + e^e - \pi^*) \frac{EF_P}{P} + TB(Q, Y, Y^*) \quad (39)$$

Again, given our set-up, goods price inflation simply follows costs/wages. The signs of the partials can be defined, as before, with the help of eqs. (34) - (36), as follows:

$$\dot{G}_V, \dot{V}_F, \dot{F}_G, \dot{F}_V, \dot{F}_F > 0, \dot{F}_{i^*} \geq 0, \text{ and } \dot{G}_G, \dot{G}_F, \dot{V}_G, \dot{V}_V, \dot{V}_{i^*}, \dot{G}_{i^*} < 0. \quad (40)$$

Using  $\lambda$  to denote the eigenroot(s), the characteristic equation for the system (37)-(39) is given by:

$$\lambda^3 + C_1\lambda^2 + C_2\lambda + C_3 = 0$$

where,

$$C_1 = -(\dot{G}_G + \dot{V}_V + \dot{F}_F)$$

$$C_2 = \left[ \dot{G}_G\dot{V}_V - \dot{G}_F\dot{F}_G \right] + \left[ \dot{G}_V\dot{V}_G - \dot{V}_F\dot{F}_V + (\dot{G}_G + \dot{V}_V)\dot{F}_F \right]$$

$$C_3 = [(\dot{G}_G\dot{V}_F - \dot{G}_F\dot{V}_G)\dot{F}_V] + [(\dot{G}_V\dot{V}_G - \dot{G}_G\dot{V}_V)\dot{F}_F] + [(\dot{G}_F\dot{V}_V - \dot{G}_V\dot{V}_F)]\dot{F}_G$$

The standard Routh-Hurwitz stability conditions require that, (1)  $C_1 > 0$ , (2)  $C_2 > 0$ , (3)  $C_3 > 0$ , and (4)  $C_1C_2 - C_3 > 0$ . As a reminder, the detailed expressions for the partials above (and summarily presented in (40)) are provided in the appendix. Here I focus on the big picture.

Condition (1) is satisfied if  $\dot{G}_G + \dot{V}_V + \dot{F}_F > 0$ , i.e., if  $\left| \dot{G}_G + \dot{V}_V \right| > \dot{F}_F$ . Or, in other words, the destabilizing effect of net foreign debt on the domestic balance of payments via interest payments and the trade balance is not too strong.

Turning to condition (2) the term in the first set of square parentheses is positive while that in the second is negative. The condition, therefore, may or may not be satisfied. The interactions between the labor market on the one hand, and the goods market and the current account on the other are destabilizing.<sup>16</sup>

Finally, turning to condition (3), the terms in the first two sets of square parentheses are negative, while that in the third is ambiguously signed. Condition (3), in other words, is highly unlikely to be satisfied.

Thus, without even considering condition (4), we can tell that foreign indebtedness makes it likely that the system is dynamically unstable. The absence of any role for foreign debt delivered a stable system in section 4.

To understand the intuition underlying the instability, consider again an increase in the international interest rate. As in the case of Section 4, and as illustrated by Figure 4, the government initially shrinks spending in response to the increase in output beyond the full employment level. But now there is a nominal exchange rate *appreciation*. Moreover, the balance of payments turns negative so that the net foreign asset position starts deteriorating. The interactions between the labor market and the asset market now come into play. The appreciation leads to downward pressure on nominal wages and prices, which then magnifies the initial need to cut fiscal expenditures and increases real foreign indebtedness. At the same time, the decline in foreign indebtedness exerts further downward (appreciatory) pressure on the exchange rate while the

<sup>16</sup>These interactions are captured by the partials  $\dot{G}_V$ ,  $\dot{V}_G$ ,  $\dot{V}_F$ , and  $\dot{F}_V$ .

decline in fiscal spending strengthens the contractionary response of fiscal policy. We have a destabilizing feedback loop of declining nominal wages and prices, a deteriorating external position, and declining government spending.

## 7 Concluding Remarks

The analysis here has incorporated core tenets of MMT such as endogenous money, conflicting claims inflation, and flexible exchange rates to analyze the robustness of MMT prescriptions in a formal dynamic framework. In particular I investigate the dynamic stability properties of the framework assuming first that exchange rate expectations are endogenous and evolve over time, and then that the country (but not the sovereign) is a net foreign debtor. In either case, the system turns out likely to be unstable, so that an exogenous shock that moves the system from its initial steady state leads to outcomes such as exploding inflation/depreciation or foreign debt. MMT-prescribed instrument assignment is inadequate to the task of ensuring dynamic stability over time.

Obviously these results are of more than merely theoretical interest and are reminiscent of currency and debt crises episodes that have occurred in recent decades. Episodes of high inflation and collapsing money demand too are not hard to find if one looks back at recent history. The analysis here suggests that the preferred MMT assignment of policy instruments is likely to leave a country vulnerable to such outcomes even if the government issues debt in its own currency. Expectation management requires a separate policy instrument and partial central bank autonomy is useful, if only for this and no other reason. Of course incorporating inflation expectations, and the resulting impact on demand for money – aspects I ignored to keep things simple – would reinforce this message. A combination of economic history and traditional macroeconomic theory should serve to make us wary of sweeping ideas that ignore both.

## 8 Appendix:

The detailed mathematical expressions and signs for the partials in Section 4 follow from eqs. (19) – (21), (25), and (26):

$$\begin{aligned}\frac{\partial \dot{G}}{\partial G} &= -\phi \frac{(1-f_w) \frac{F_P}{P} - \alpha f_x \frac{E^c}{E^2}}{P|J_1|} < 0, \\ \frac{\partial \dot{G}}{\partial V} &= -\phi A_v \frac{(1-f_w) \frac{F_P}{P} - \alpha f_x \frac{E^c}{E^2}}{P^2|J_1|} < 0, \\ \frac{\partial \dot{G}}{\partial i^*} &= -\phi \frac{\left[ A_Y \frac{E F_P}{P} (1-f_w) - f_x (A_W + A_Y r^*) \right] F_P - f_x T B_Q}{P^2|J_1|} < 0, \\ \frac{\partial \dot{V}}{\partial G} &= \psi \beta \bar{v} \frac{L_Y f_w}{E P} > 0, \\ \frac{\partial \dot{V}}{\partial V} &= -\psi \beta \frac{\bar{v}}{V} \left( 1 - \frac{V}{E} \frac{\partial E}{\partial V} \right) < 0,\end{aligned}$$

where  $\frac{V}{E} \frac{\partial E}{\partial V} = \frac{A_Y L_Y f_w}{P^2|J_1|}$  is highly likely  $< 1$  given the assumption that  $L_Y$  is small.

$$\frac{\partial \dot{V}}{\partial i^*} = \psi \beta \frac{\bar{v}}{E} \frac{-f_x \Lambda + L_Y \left( f_x A_W + f_w A_Y \frac{E F_P}{P} \right)}{P|J_1|} > 0$$

The detailed expressions for the partials represented by equation (31) of section 5.1, are as follows:

$$\begin{aligned}
\frac{\partial \dot{G}}{\partial G} &= \phi \frac{\alpha f_x}{P|J'_1|} \frac{E^e}{E^2} < 0, \\
\frac{\partial \dot{G}}{\partial V} &= \phi A_v \frac{\alpha f_x}{P^2|J'_1|} \frac{E^e}{E^2} < 0, \\
\frac{\partial \dot{G}}{\partial E^e} &= \phi \frac{\frac{TBQ}{P} f_W B - \alpha f_x (A_W B + A_v \frac{1-\beta}{E^\beta}) \frac{E^e}{E^2}}{P^2 E^e |J'_1|} > 0, \\
\frac{\partial \dot{G}}{\partial i^*} &= -\phi \frac{f_x TBQ}{P^2 |J'_1|} < 0. \\
\frac{\partial \dot{V}}{\partial G} &= \psi \beta \frac{V^\beta}{(1+\tau)^{1-\beta} E^{1+\beta}} \frac{L_Y f_W}{P|J'_1|} > 0, \\
\frac{\partial \dot{V}}{\partial V} &= -\psi \beta \frac{\bar{v}}{V} \left(1 - \frac{V}{E} \frac{\partial E}{\partial V}\right) < 0,
\end{aligned}$$

where  $\frac{V}{E} \frac{\partial E}{\partial V} = \frac{A_v L_Y f_W}{P^2 |J'_1|}$  is highly likely  $< 1$  given the assumption that  $L_Y$  is small.

$$\begin{aligned}
\frac{\partial \dot{V}}{\partial E^e} &= \psi \beta \frac{V^\beta}{(1+\tau)^{1-\beta} E^{1+\beta}} \frac{-\Lambda \left(\alpha f_x \Omega \frac{E^e}{E^2} + \frac{B f_W}{P E^e}\right) + L_Y \left[A_W \Omega \alpha f_x \frac{E^e}{E^2} - \frac{TBQ E + A_v \frac{1-\beta}{E^\beta}}{P E^e} f_W\right]}{|J'_1|} > \\
0, \\
\frac{\partial \dot{V}}{\partial i^*} &= \psi \beta \frac{V^\beta}{(1+\tau)^{1-\beta} E^{1+\beta}} \frac{(-\Lambda + L_Y A_W) f_x}{P |J'_1|} > 0 \\
\frac{\partial \dot{E}^e}{\partial G} &= (1-\gamma) \frac{L_Y f_W}{P^2 |J'_1|} > 0, \quad \frac{\partial \dot{E}^e}{\partial V} = (1-\gamma) \frac{A_v L_Y f_W}{P^2 |J'_1|} > 0, \\
\frac{\partial \dot{E}^e}{\partial E^e} &= (1-\gamma) \left(\frac{\partial E}{\partial E^e} - 1\right) = (1-\gamma) \left\{ \frac{-\Lambda \left(\alpha f_x \Omega \frac{E^e}{E^2} + \frac{B f_W}{P E^e}\right) + L_Y \left[A_W \Omega \alpha f_x \Omega v - \frac{TBQ E + A_v \frac{1-\beta}{E^\beta}}{P E^e} f_W\right]}{|J'_1|} - 1 \right\} < \\
0, \\
\frac{\partial \dot{E}^e}{\partial i^*} &= (1-\gamma) \frac{(-\Lambda + L_Y A_W) f_x}{P |J'_1|} > 0.
\end{aligned}$$

The detailed expressions for the partials represented by equation (40) of section (6.1) are as follows:

$$\begin{aligned}
\frac{\partial \dot{G}}{\partial G} &= -\phi \frac{\partial Y}{\partial G} < 0, \\
\frac{\partial \dot{G}}{\partial V} &= -\phi \frac{\partial Y}{\partial V} < 0, \\
\frac{\partial \dot{G}}{\partial F_P} &= -\phi \frac{\partial Y}{\partial F_P} < 0 \\
\frac{\partial \dot{G}}{\partial i^*} &= -\phi \frac{\partial Y}{\partial i^*} < 0 \\
\frac{\partial \dot{V}}{\partial G} &= \psi \beta \frac{V}{P^{1-\beta} E^{1+\beta}} \frac{\partial E}{\partial G} < 0, \\
\frac{\partial \dot{V}}{\partial V} &= -\psi \beta \left(\frac{E}{P}\right)^{1-\beta} \left(1 - \frac{V}{E} \frac{\partial E}{\partial V}\right) < 0 \\
\frac{\partial \dot{V}}{\partial F_P} &= \psi \beta \frac{V}{P^{1-\beta} E^{1+\beta}} \frac{\partial E}{\partial F_P} > 0 \\
\frac{\partial \dot{V}}{\partial i^*} &= \psi \beta \frac{V}{P^{1-\beta} E^{1+\beta}} \frac{\partial E}{\partial i^*} < 0 \\
\frac{\partial \dot{F}_P}{\partial G} &= \left[\frac{r^* F_P + TBQ}{P}\right] \frac{\partial E}{\partial G} > 0 \\
\frac{\partial \dot{F}_P}{\partial V} &= -\frac{r^* (F_P + TBQ)}{P} \frac{E}{V} \left[1 - \frac{V}{E} \frac{\partial E}{\partial V}\right] > 0 \\
\frac{\partial \dot{F}_P}{\partial F_P} &= \frac{r^* E}{P} \left(1 + \frac{F_P}{E} \frac{\partial E}{\partial F_P}\right) + \frac{TBQ}{P} \frac{\partial E}{\partial F_P} > 0 \\
\frac{\partial \dot{F}_P}{\partial i^*} &= \frac{E F_P}{P} + \left(\frac{r^* F_P + TBQ}{P}\right) \frac{\partial E}{\partial i^*} \geq 0
\end{aligned}$$

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