Discussion of "Rule-of-Thumb Consumers and Labor Tax Cut Policy at the Zero Lower Bound"*

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1. Introduction

Lorant Kaszab shows that a labor tax reduction can stimulate the economy when it is at the zero lower bound (ZLB)—due to demand shocks. In sharp contrast, Christiano, Eichenbaum, and Rebelo (2011) and Eggertsson (2011) recommend a labor tax increase in similar economic conditions. Kaszab's argument merits great attention in the literature.

To put my discussion in context, let me start by pointing out that Eggertsson and Christiano, Eichenbaum, and Rebelo show that in a New Keynesian model, when the economy hits the ZLB, a labor tax increase stimulates the economy. In their papers, the key tax policy channel works through the real interest rate. I call this the *real interest rate channel*. Kaszab introduces an additional channel closer in spirit to the traditional Keynesian view. In his model, a subset of consumers determine consumption exclusively based on their current disposable income, thus a labor tax reduction stimulates their consumption. I call this channel the *disposable income channel*. In sharp contrast to Eggertsson and Christiano, Eichenbaum, and Rebelo, Kaszab shows that at the ZLB, a labor tax reduction is desirable. In Kaszab's model these two channels are present and they act in opposite directions.

In my discussion, I will focus first on how the real interest channel works in the Eggertsson-Christiano (EC) model, based on Christiano (2010), and how the disposable income channel works in the Kaszab model. Then, I will modify Kaszab's experiment to consider

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a far more persistent demand shock and quantify and discuss the relevance of both channels in the model. I conclude that the disposable income channel faces important challenges when the economy remains at the ZLB for a prolonged period of time. However, when the ZLB binds for short periods of time, it can be the dominant channel for fiscal policy. Finally, I will show that the interest rate channel increases its power in an accelerated fashion with the duration of the fiscal stimulus, but the same does not apply to the disposable income channel. I will discuss why and then conclude.

2. The Tax Policy Channels in the Eggertsson-Christiano Model versus the Kaszab Model

To discuss Kaszab's model, first let me take one step back and talk about the tax multiplier in the Eggertsson-Christiano model.

2.1 The Eggertsson-Christiano Model

The Eggertsson-Christiano model discussed in Christiano (2010) consists of six endogenous variables and six equations: (i) a Euler equation of consumption, equation (1); (ii) a New Keynesian Phillips curve for prices, (2); (iii) a New Keynesian Phillips curve for wages, (3); (iv) a monetary policy rule, (4); (v) a fiscal rule, (5); and (vi) the law of motion of real wages, (6).

$$H_t = H_{t+1} - \beta \left\{ dR_t - \frac{1}{\beta}\pi_{t+1} - r_t^* \right\} \tag{1}$$

$$\pi_t = \beta\pi_{t+1} + \kappa w_t \tag{2}$$

$$\pi_t^w = \beta\pi_{t+1}^w - \kappa^w \left\{ w_t - (1+\phi)H_t - \frac{1}{1-\tau}\tau_t \right\} \tag{3}$$

$$dR_t = \begin{cases} 1.5\pi_t & \text{outside ZLB} \\ -(1/\beta - 1) & \text{at ZLB} \end{cases} \tag{4}$$

$$\tau_t = \begin{cases} 0\% & \text{outside ZLB} \\ +10\% & \text{at ZLB} \end{cases} \tag{5}$$

$$w_t = w_{t-1} + \pi_t^w - \pi_t. \tag{6}$$

Additionally, the economy features two exogenous shocks: a demand shock that enters the Euler equation as a perturbation to the real interest rate (see equation (1)) and a tax shock that increases wages on the producer side and thus increases marginal cost (see equation (3)). The nomenclature is output, H; inflation, π; wage inflation, π^w; tax rate, τ; interest rate, dR; and real wage, w. The exogenous shocks are the demand shock, r^*, and the tax shock. The calibration is as follows: $\beta = 0.99, \tau = 0.3, \phi = 1, \kappa = \frac{(1-\xi^p)(1-\beta\xi^p)}{\xi^p}, \xi^p = 0.75, \kappa^w = \frac{(1-\xi^w)(1-\beta\xi^w)}{\xi^w}$, and $\xi^w = 0.75$.

The experiment buffets the economy with contractionary demand shocks ($r_t^* = -0.02$ for $t = 1, \ldots, T$) for ten quarters ($T = 10$). The lower demand brings inflation and the interest rate down to the point at which the interest rate hits the zero lower bound. Once the economy is at the ZLB, the labor tax policy is introduced for the same quarters for which the economy is at the ZLB state. In particular, the tax policy increases the labor tax by 10 percentage points (equation (5)).

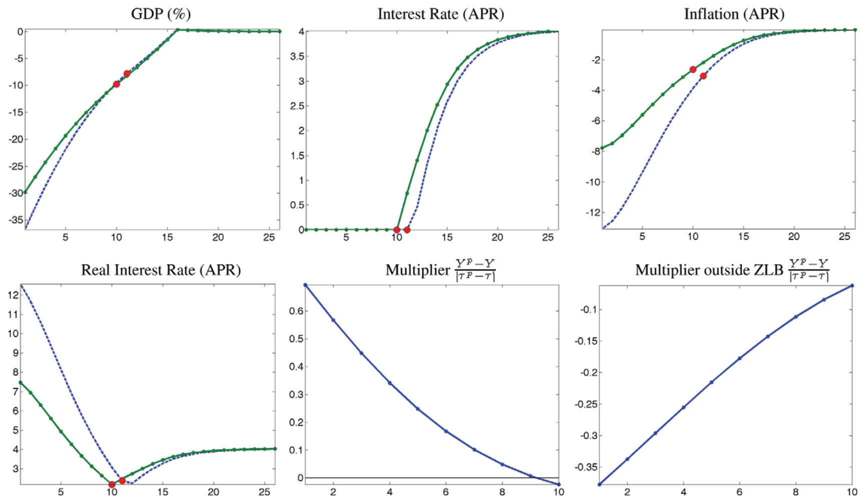
From the system of equations (1)–(6), note that the tax rate only enters in the Phillips curve for wages (6), so at the ZLB the tax policy affects consumption decisions through inflation and thus through the real interest rate.

Figure 1 shows the dynamics triggered by the EC experiment. The intuition for the outcome of the experiment is straightforward. At the ZLB, the tax rate hike lowers the deflation rate; thus this policy implies a lower real interest rate and a lower fall in output. The tax multiplier, calculated as the GDP with policy minus the GDP without policy and divided by the absolute change in the tax rate, is also shown in figure 1. The tax multiplier at the ZLB is positive and declines over time. Interestingly, the multiplier outside the ZLB state is negative; this is because outside the ZLB, the monetary authority can lower the real interest rate by lowering the policy rate; however, a tax increase is inflationary and makes the monetary policy less effective.

2.2 The Kaszab Model

As I mentioned before, the main contribution of the paper is to introduce an additional channel for fiscal policy into the model of Christiano, Eichenbaum, and Rebelo (2011) or that of Eggertsson

Figure 1. Simulated Eggertsson-Christiano Model



(2011). With that additional channel, Kaszab arrives at a sharply different policy recommendation.

The following summarizes the Kaszab model:

$$c_t^r = w_t + n_t - \frac{1}{1-\tau}\tau_t \tag{7}$$

$$c_t^o = c_{t+1}^o - \beta\{dR_t - \pi_{t+1} - r_t^*\} \tag{8}$$

$$\pi_t = \beta\pi_{t+1} + \kappa w_t \tag{9}$$

$$\pi_t^w = \beta\pi_{t+1}^w - \kappa^w \left\{ w_t - \left(1 + \frac{1}{\gamma^c}\right) n_t - \frac{1}{1-\tau}\tau_t \right\} \tag{10}$$

$$dR_t = \begin{cases} 1.5\pi_t & \text{outside ZLB} \\ -(1/\beta - 1) & \text{at ZLB} \end{cases} \tag{11}$$

$$\tau_t = \delta_1 \frac{Y}{WN} b_t - \tau w_t - \tau n_t + \begin{cases} 0\% & \text{outside ZLB} \\ -10\% & \text{at ZLB} \end{cases} \tag{12}$$

$$w_t = w_{t-1} + \pi_t^w - \pi_t. \tag{13}$$

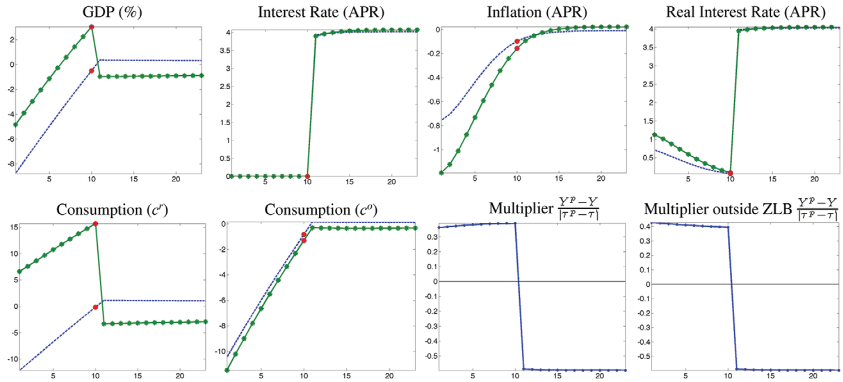
In addition to equations (7)–(13), the model also contains the law of motion of debt (15) and the equilibrium condition discussed below. The nomenclature is output and labor, n; inflation, π; wage inflation, π^w; tax rate, τ; interest rate, dR; real wage, w; Ricardian consumers, c^o; non-Ricardian consumers, c^r; and government debt, b. The exogenous shocks are the demand shock, r^*, and the tax shock. The calibration is as follows: $\beta = 0.99$, $\tau = 0.3$, $\kappa = \frac{(1-\xi^p)(1-\beta\xi^p)}{\xi^p}$, $\xi^p = 0.66$, $\kappa^w = \frac{(1-\xi^w)(1-\beta\xi^w)}{\xi^w}$, $\xi^w = 0.95$, $\gamma^c = 0.8$, $\delta_1 = 0.02$, and $\frac{WN}{Y} = 0.88$.

Equations (8)–(13) resemble the EC model. Those six equations are also present in the EC model, with small variations. Equation (8) is a Euler equation of consumption, equation (9) is a New Keynesian Phillips curve for prices, equation (10) is a New Keynesian Phillips curve for wages, equation (11) is a monetary policy rule, equation (12) is tax policy rule, and equation (13) is the law of motion of real wages. There are, however, two differences in the Kaszab model with respect to the EC model. The key difference is that the model also features a consumption decision equation (7) for non-Ricardian consumers. Equation (7) shows that those consumers determine their consumption based on their disposable income; thus, ceteris paribus a lower tax rate increases their consumption.

Note that, as in the EC model, the demand shock (r_t^*) only enters the Euler equation (8) and acts as a negative demand shock. However, in contrast to the EC model, the tax policy shock (τ_t) has two channels. First, as in the EC model, it factors into the Phillips curve of wages (equation (10)) and thus the model features a real interest rate channel precisely as in the EC model. However, the tax policy rate also enters in the consumption of the non-Ricardian consumer (equation (7)) and thus the model also features a disposable income channel. Note that these two channels act in opposite directions. As in the EC model, the real interest rate channel calls for a tax increase at the ZLB; however, the disposable income channel calls for a tax reduction.

Another small difference in the Kaszab model relative to the EC model is that the tax policy rate (12) is not purely exogenous. The tax policy reacts endogenously to government debt, wages and labor additionally to an exogenous component. Thus, to close the model we need two more equations: the law of motion of debt (15) discussed below and an equilibrium condition that relates total consumption

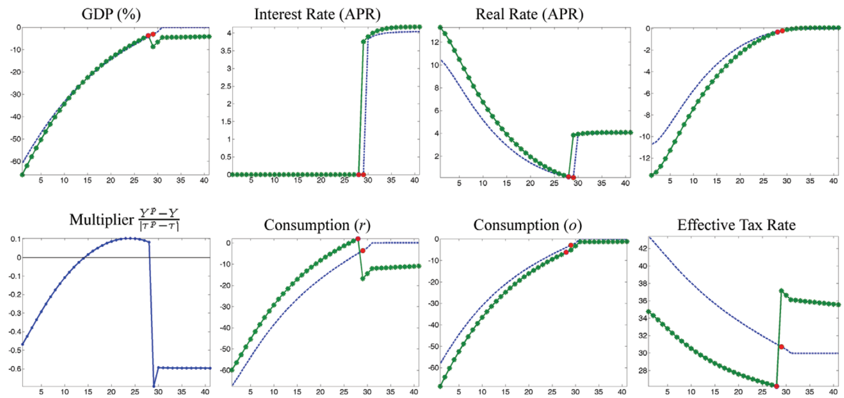
Figure 2. Simulated Kaszab Model



to total production $n_t = \gamma^c(\lambda c_t^r + (1 - \lambda)c_t^o)$, where λ is the fraction of non-Ricardian consumers and γ^c is the share of consumption in GDP. To be clear, the model contains nine variables in nine equations.

Figure 2 shows the dynamics of the model. As in the EC exercise, the economy receives a contractionary demand shock ($r_t^* = -0.02$) for ten quarters ($t = 1, \ldots, 10$); however, it is different from the EC exercise because the tax rule (12) *reduces* its exogenous component by 10 percent. Due to the real interest rate channel, a tax reduction makes the deflation worse and the real interest rate higher, so the consumption of the Ricardian consumers (c^o) is worse with than without policy. On the other hand, the disposable income channel makes the non-Ricardian consumption much higher (c^r). The additional consumption of the non-Ricardian consumer more than compensates for the lower consumption of the Ricardian consumer, and the net effect is higher GDP. As shown, the multiplier is positive at the ZLB; however, it becomes negative when the interest rate exits the ZLB state. The abrupt change in sign of the multiplier is a feature of the specific calibration chosen in my illustrative exercise; however, we can allow for habit in consumption and show a multiplier with a "soft landing." It is worth noting that in contrast to the EC model, the multiplier in the Kaszab model is positive at the ZLB and outside the ZLB. That is, the tax policy recommendation does not change at the ZLB.

Figure 3. The Tax Policy Channels in a Highly Persistent Shock: Baseline Model with Persistent Shock



3. The Tax Policy Channels in a Highly Persistent Shock

The United States hit the ZLB on the first quarter of 2009 and has remained at the ZLB until the last quarter of 2015. What happens in Kaszab's economy when the contractionary demand shock is persistent enough to keep the ZLB state for an extended period of time? I repeat the experiment with a demand shock ($r_t^* = -.02$ for $t = 1, \ldots, T$) that lasts for thirty quarters ($T = 30$) and during the ZLB state the fiscal policy (12) stays in place—that is, I only replace $T = 10$ for $T = 30$.

Figure 3 shows that in those circumstances, the multiplier is negative. As before, the consumption of the non-Ricardian consumer is higher than without policy, but in this case, the consumption of the Ricardian consumer is much lower, and thus total consumption is lower. That is, when the economy faces a highly persistent demand shock and the economy stays at the ZLB for a prolonged period of time, the real interest rate channel dominates the disposable income channel.

Before exploring further the dominance of the real interest rate channel in the presence of highly persistent demand shocks, let me discuss Kaszab's policy experiment itself.

3.1 Closing the Model

Figure 3 shows that, when the demand shock is highly persistent (thirty quarters), the policy rule (equation (12)) calls for an effective tax rate higher than the pre-shock rate. The reason for this is the tax rule responds positively to government debt and, in this scenario, the accumulation of debt is so high that the effective tax rate increases despite the reduction by 10 percent in the exogenous component of the policy rule.

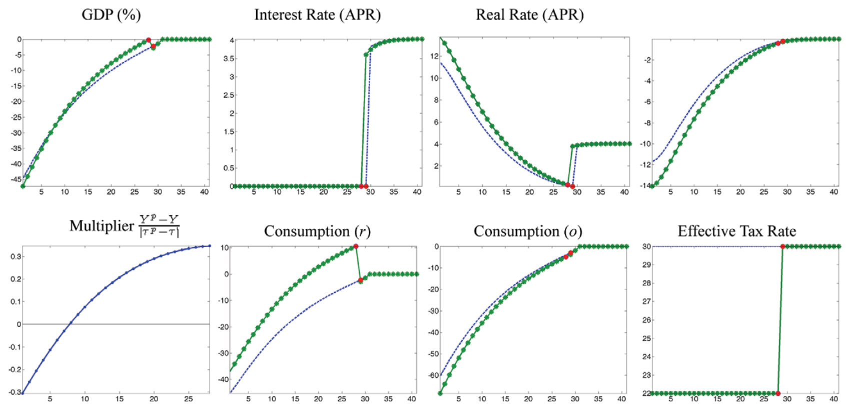
Kaszab motivates the use of the tax rule (equation (12) and reproduced below for convenience) based on the work of Leeper (1991). Leeper defines "active" and "passive" policies depending on their responsiveness to government debt; thus those policies inherently determine the existence and uniqueness of equilibria. To illustrate that point in a mechanical way, consider the tax policy rule and the law of motion of debt of the model shown below:

$$\tau_t = \delta_1 \frac{Y}{WN} b_t - \tau w_t - \tau n_t + \begin{cases} 0\% & \text{outside ZLB state} \\ -10\% & \text{at ZLB state} \end{cases} \tag{14}$$

$$b_t = -\tau \frac{WN}{Y} \left\{ w_t + n_t + \frac{1}{\tau}\tau_t \right\} + \frac{1}{\beta} b_{t-1} + \gamma^b dR_{t-1} - \gamma^b \frac{1}{\beta}\pi_t. \tag{15}$$

The law of motion of debt (equation (15)) contains a unit root because the coefficient of the autoregressive term equals the gross interest rate ($\frac{1}{\beta} = R > 1$). However, by adopting the tax rule (14), the coefficient δ_1 can be chosen so that after substituting the tax rule in the law of motion of debt, the resulting coefficient of the autoregressive term in the law of motion of debt is smaller than one. A similar issue arises naturally in *small open economies.* In those economies, the steady state of the model depends on the country's initial net foreign assets position, and thus foreign debt displays a unit root. Schmitt-Grohe and Uribe (2003) study the dynamic effects of alternative ways to deal with the unit root in small open economies. They compare the business-cycle dynamics of alternative ways to eliminate the unit root. Among those alternatives, they implement (i) an endogenous discount factor, (ii) a debt-elastic interest rate premium, (iii) convex portfolio adjustment costs, (iv) complete asset markets, and (v) a model without stationary-inducing features. They find that all versions of the model

Figure 4. The Tax Policy Channels in a Highly Persistent Shock: Purely Exogenous Tax with Persistent Shock



deliver very similar dynamics in terms of impulse responses and variances.

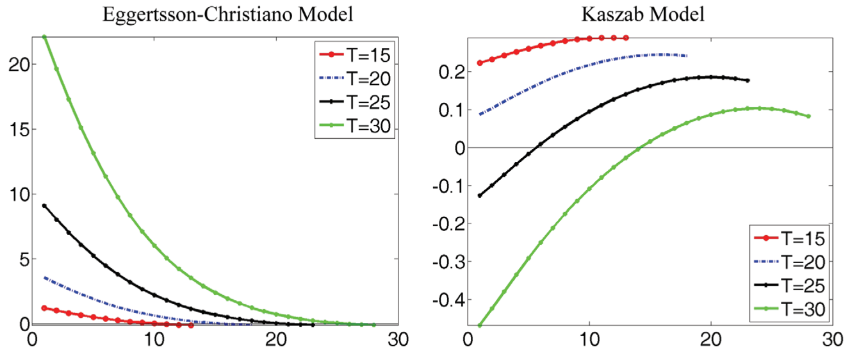
In light of the Schmitt-Grohe and Uribe (2003) results, it seems natural to consider the simplest tax policy rule in order to illustrate the role of the disposable income channel. Thus, as in the EC experiment, consider the tax rule

$$\tau_t = \begin{cases} 0\% & \text{outside ZLB state} \\ -8\% & \text{at ZLB state.} \end{cases} \tag{16}$$

Figure 4 shows the dynamic effects of the experiment described at the beginning of this section but with a purely exogenous tax rule (equation (16)).[1] The key result is that the resulting tax multiplier is negative on impact. As a matter of fact, consistent with Schmitt-Grohe and Uribe (2003), the dynamics under both tax rules (equations (14) and (16)) are very similar—except of course, for the dynamics of debt and the tax rate. However, the advantage of an exogenous tax rule is that the experiment is as transparent as possible.

[1] I choose a tax reduction of 8 percent as opposed to 10 percent to be consistent with the effective tax reduction in table 2.

Figure 5. The Tax Policy Channels in a Highly Persistent Shock: Robustness of CE and Kaszab Models to Shock Persistence



3.2 *Robustness of EC and Kaszab Models to Persistent Shocks*

How robust are the real interest rate and the disposable income channels? Figure 5 shows the multiplier in the EC model with demand shocks that last for fifteen, twenty, twenty-five, and thirty quarters. On impact, the multiplier grows in an accelerated fashion with the persistence of the shock in a range from around 1 to 4 to 9 to more than 20. The same panel also shows the multiplier in the Kaszab model under the same set of shocks. In sharp contrast, on impact, the multiplier decreases with the persistence of the demand shock.

Why is the real interest rate channel more powerful with persistent shocks and the disposable income channel is not? The answer is straightforward. The real interest rate channel works through the Phillips curve of the model (see equation (9)) and has a forward-looking nature, so current inflation will react to the full string of contemporaneous and future tax rates. Thus the initial effect on real interest rates is stronger when the tax policy stays in place for longer. On the other hand, the disposable income channel works through the consumption of the non-Ricardian consumer (see equation (7)), which only responds to the contemporaneous tax rate, and thus the initial effect is independent of the time duration of the policy rate.

4. Conclusions

Kaszab's model features two transmission channels for fiscal policy: the real interest rate channel and the disposable income channel. These channels act in opposite directions. For demand shocks of short enough duration, the disposable income channel dominates and a labor tax reduction is called for. The real interest rate channel, also featured in the model of Eggertsson (2011) and Christiano, Eichenbaum, and Rebelo (2011), is more powerful with persistent shocks because it works through the Phillips curve of the model, which has a forward-looking nature. Thus the initial impact compounds the longer duration of the fiscal policy and results in a stronger impact on the real interest rate. For persistent enough shocks, the Eggertsson-Christiano recommendation holds, i.e., a labor tax increase is called for in the Kaszab model as well. Finally, wage indexation is a feature regularly included in models to fit the data. Indexation moderates the forward-looking nature of the Phillips curve, and thus the inclusion of this feature in the model can reverse my conclusion on the effectiveness of the disposable income channel for persistent shocks.

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