Discussion of "Welfare Effects of Tax Policy in Open Economies: Stabilization and Cooperation"*

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1. Introduction

Jinill Kim and Sunghyun Kim explore the behavior of optimal tax rate rules in a one-sector stochastic growth or real business cycle (RBC) model, a small open-economy RBC model, and a two-country RBC model. The central question of the paper is whether optimized tax rate rules are procyclical or countercyclical across the three economies. The consensus is, according to Kim and Kim, that optimal tax rates are often countercyclical in closed economies, but in open economies less is known.

The models share several elements in common. The closed (domestic) economy generates supply-side Solow growth dynamics using a firm's production technology and capital accumulation by a household in response to an exogenous total factor productivity (TFP) shock, A_t, which evolves as a first-order autoregression, AR(1). The TFP shock represents aggregate risk against which the household and firm cannot insure. The household approximates a permanent income (PI) consumer and supplies capital and labor to the firm. The model also has a cost of adjustment in investment and a (domestic) government that raises revenue by placing proportional tax rates on consumption, $\tau_{C,t}$, labor income, $\tau_{L,t}$, and capital income, $\tau_{K,t}$, of the household. The small open economy issues international bonds, B_t, which creates adjustment costs that appear in household and government budget constraints. The two-country model includes a foreign twin of the domestic economy, which adds

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foreign bonds, B_t^*, adjustment costs, and a foreign TFP shock, A_t^*. Governments do not issue bonds in Kim and Kim's analysis. Instead, $\tau_{C,t}$, $\tau_{L,t}$, and $\tau_{K,t}$ raise revenue equal to fixed government spending plus the cost of adjusting B_t and household transfers. When tax revenue is not identical to a government's uses of resources, changes to household transfers close the government budget constraint.

Kim and Kim specify linear rules for $\tau_{C,t}$, $\tau_{L,t}$, and $\tau_{K,t}$. The linear tax rate rules are reaction functions written in deviations from steady-state TFP, $\overline{A}$,

$$\tau_{i,t} = \overline{\tau}_i + \eta_i \left[\ln A_t - \ln \overline{A}\right], \quad i = C,\ L,\ \text{and},\ K, \qquad (1)$$

where $\overline{\tau}_i$ is the average tax rate. A countercyclical tax rate is low (high); given A_t is small (large) relative to $\overline{A}$, which restricts the slope parameter, $\eta_i > 0$, in the tax rate rule (1). Exogeneity of TFP negates feedback from the fiscal policy instrument, $\tau_{i,t}$, to the "target," A_t. Hence, the household and firm predict $\mathbf{E}_t\tau_{i,t+j} = \overline{\tau}_i + \eta_i \left(\rho^j \ln A_t - \ln \overline{A}\right)$, where ρ is A_t's AR1 coefficient. These expectations also rely on a credible, time-consistent commitment by the government to the tax rate rule (1).

The tax rate rule (1) is optimized by searching for η_i that maximize household welfare conditional on calibrating $\overline{\tau}_i$ to G-7 sample means, where $i = C$, L, and, K. Household welfare is calculated by taking a second-order approximation of discounted expected lifetime household utility at optimal choices made by the household(s) and firm(s) around a steady state calibrated to sample G-7 data. Kim and Kim results are (i) optimal tax rate rules are countercyclical in the closed economy, (ii) B_t and $\left(B_t^*\right)$ reduce the role of countercyclical optimized consumption and capital income tax rate rules in the open-economy models, (iii) while the optimal labor income tax rate rule is countercyclical in the two-country model, (iv) the three optimal tax rate rules are countercyclical in the two-country model as costs of trading B_t and B_t^* or co-movement of A_t and A_t^* increase, and (v) across the three models, the optimized tax rate rules are countercyclical as TFP becomes more persistent.

2. Optimal Fiscal Policy and RBC Models

My comments address three aspects of Kim and Kim's interesting and timely paper. Sections 2.1, 2.2, and 2.3 analyze Kim and Kim's optimal fiscal policy results with respect to household expectations about its ability to insure against aggregate TFP risk; see Leeper and Nason (2008). Kim and Kim's tax rate rule (1) is discussed in section 2.4. Section 2.5 reviews problems of commitment and credibility that face fiscal policy because it can induce strategic behavior by private agents and policymakers.

2.1 The Closed Economy

Household choices yield the intratemporal labor market optimality condition

$$w_t = \left(\frac{1-\tau_{L,t}}{1+\tau_{C,t}}\right)\frac{\mathcal{U}'_{C,t}}{\mathcal{U}'_{\ell,t}}, \tag{2}$$

and the Euler equation for capital

$$\mathbf{E}_t\left\{\left[\left(1-\tau_{K,t+1}\right)r_{t+1}+\delta\tau_{K,t+1}+q_t\left(1-\delta\right)\gamma_{I,t+1}\right]\Gamma_{t+1}\right\}-q_t=0, \tag{3}$$

where $w_t, \mathcal{U}'_{C,t}, \mathcal{U}'_{\ell,t}$, r_t, δ, q_t, $\gamma_{I,t}$, and Γ_t are the real wage, marginal utility of consumption, marginal utility of leisure, rental rate of capital, depreciation rate of capital, Tobin's q, growth rate of investment $\left(I_t\right)$ scaled by its adjustment cost parameter ϕ, and the household's stochastic discount factor (SDF). Tobin's q is $q_t = \left(\frac{I_t}{\delta K_{t+1}}\right)^{\phi} > 1$, the scaled investment growth rate $\gamma_{I,t+1} \equiv \left(\frac{I_{t+1}}{I_t}\right)^{\phi}$, and the SDF is $\Gamma_{t+1} = \beta\left(\frac{1+\tau_{C,t}}{1+\tau_{C,t+1}}\right)\frac{\mathcal{U}'_{C,t+1}}{\mathcal{U}'_{C,t}}$, where β is the household's discount factor.

The optimality condition (2) harbors PI dynamics through which optimal rules for $\tau_{C,t}$ and $\tau_{L,t}$ contribute to stabilizing fluctuations in the RBC economy. The problem is that the household cannot insure against the aggregate risk of a poor realization of A_t. This is important for understanding Kim and Kim's results. Countercyclical $\tau_{C,t}$ and $\tau_{L,t}$ temporarily make leisure less (more) expensive compared with consumption in states in which it is most (less) valuable. The outcome is that optimal $\tau_{C,t}$ and $\tau_{L,t}$ produce fluctuations in PI around the steady state that co-move with A_t because it lacks a trend.

The Euler equation of capital (3) displays a tax wedge between pre- and after-tax r_{t+1}. The tax wedge consists of a unit of after-tax capital income, $1-\tau_{K,t+1}$, and capital consumption tax adjustment, $\delta\tau_{K,t+1}$. Since $\mathbf{E}_t\tau_{K,t+1}$ is known at date t, the Euler equation of capital (3) maps into

$$\begin{aligned}\mathbf{E}_t r_{t+1} = &\left[\frac{1}{1-\overline{\tau}_K-\eta_K\left(\rho\ln A_t-\ln\overline{A}\right)}\right]\frac{q_t}{\mathbf{E}_t\Gamma_{t+1}} \\ &-\frac{\delta\left[\overline{\tau}_K+\eta_K\left(\rho\ln A_t-\ln\overline{A}\right)\right]}{1-\overline{\tau}_K-\eta_K\left(\rho\ln A_t-\ln\overline{A}\right)}-\frac{\mathbf{Cov}_t\left(r_{t+1},\,\Gamma_{t+1}\right)}{\mathbf{E}_t\Gamma_{t+1}} \\ &-\left[\frac{\left(1-\delta\right)q_t}{1-\overline{\tau}_K-\eta_K\left(\rho\ln A_t-\ln\overline{A}\right)}\right] \\ &\times\left[\mathbf{E}_t\gamma_{I,t+1}+\frac{\mathbf{Cov}_t\left(\gamma_{I,t+1},\,\Gamma_{t+1}\right)}{\mathbf{E}_t\Gamma_{t+1}}\right], \end{aligned} \tag{4}$$

where Tobin's q and the conditional covariances, which are risk premiums on r_{t+1} and $\gamma_{I,t+1}$, are scaled by the riskless return, $1/\mathbf{E}_t\Gamma_{t+1}$. Since $\mathbf{Cov}_t\left(A_t,\,\Gamma_{t+1}\right)=0$, the risk premium on $\tau_{K,t+1}$ is eliminated from the expected rental rate of capital equation (4). This equation shows that a countercyclical rule for $\tau_{K,t+1}$ lowers (raises) $\mathbf{E}_t r_{t+1}$ as real activity contracts (expands). The household has incentives to increase investment and accumulate capital when consumption is most valuable, which provides output in the future to insure against states in which TFP is low.

2.2 The Small Open Economy

The small open economy has less need for optimal tax policy. The reason is that B_t, which the household carries from the end of date t into date $t+1$, gives the household another margin on which to insure against aggregate TFP risk. Combining the Euler equations of K_{t+1} and B_t yields the arbitrage condition

$$\begin{aligned}\mathbf{E}_t\Bigg\{\Bigg[&\left(1-\tau_{K,t+1}\right)r_{t+1}+\delta\tau_{K,t+1} \\ &+q_t\left[\left(1-\delta\right)\gamma_{I,t+1}-\frac{R_t}{1+\zeta B_t}\right]\Bigg]\Gamma_{t+1}\Bigg\}=0,\end{aligned} \tag{5}$$

where R_t and ζ are the exogenous world real interest rate and cost of adjusting B_t coefficient. The arbitrage condition (5) equates the expected after-tax gross rental rate of capital to post-depreciation $\gamma_{I,t+1}$ net of R_t deflated by the cost of adjusting B_t, $1 + \zeta B_t$, converted to the price of capital relative to consumption, q_t. The household uses B_t to absorb adverse TFP shocks and smooth consumption, which yields a small and positive η_C, $\eta_L = 0$, and $\eta_K < 0$. The procyclical optimal $\tau_{K,t}$ lowers $\mathbf{E}_t r_{t+1}$ in high-TFP states of the world, which is an incentive for the household to use resources borrowed from the rest of the world to increase investment. Since interest income on B_t is tax free, only the tax rate rule for $\tau_{K,t+1}$ directly affects household decisions for B_t in the arbitrage condition (5).

2.3 The Two-Country Model

Kim and Kim build a two-country model by twinning the domestic small open economy to create the foreign economy. Optimal tax policy in the domestic economy is conditional on A_t and A_t^* evolving as independent AR(1)s and the foreign government fixing its consumption, labor income, and capital income tax rates, τ_C^*, τ_L^*, and τ_K^*. The two-country model defines equilibrium in the international bond market to consist of an endogenous and positive R_t that sets net supply to zero, $B_t^* = -B_t$, where B_t^* is international bonds issued by the foreign economy at the end of date t.

Domestic and foreign households insure against TFP risk by trading B_t and B_t^*. Although A_t and A_t^* are idiosyncratic shocks in essence, which suggests that domestic and foreign households can pool TFP risk, perfect risk sharing is hard to obtain in the two-country model. The problem is that domestic and foreign households incur adjustment costs when issuing B_t and B_t^*. Adjustment costs place a wedge in the international risk-sharing condition

$$\frac{1}{\mathbf{E}_t \Gamma_{t+1}} = \left(\frac{1 - \zeta B_t}{1 + \zeta B_t} \right) \frac{1}{\mathbf{E}_t \Gamma_{t+1}^*}, \tag{6}$$

which depends on the optimality conditions for B_t and B_t^* and $B_t = -B_t^*$, where the price of non-state contingent B_t and B_t^* is $1/R_t$ at the end of date t. The wedge restricts the domestic economy to lend to (borrow from) the rest of the world, $B_t > (<)\ 0$, when its riskless rate is less (greater) than in the foreign economy $\frac{1}{\mathbf{E}_t\Gamma_t} < (>) \frac{1}{\mathbf{E}_t\Gamma_t^*}$, given $|B_t| < \zeta^{-1}$. Only when domestic and foreign riskless rates are equal, which implies $B_t = 0$, is international risk sharing complete in the two-country model.

Imperfect international risk sharing suggests that countercyclical optimal tax rate rules can improve household welfare in the two-country model. However, Kim and Kim report this is not always the case. Only a countercyclical optimal rule for $\tau_{L,t}$ raises domestic welfare, while the same holds for a procyclical optimal rule for $\tau_{K,t}$. The optimal rule for $\tau_{C,t}$ has little effect on domestic welfare.

The two-country model can yield optimal tax rate rules similar to the closed economy's. Kim and Kim engage larger costs of international bond adjustment and increased co-movement of A_t and A_t^* to show this. Since the wedge of the international risk-sharing condition (6) restricts the elasticity of B_t with respect to ζ to one, the former falls one-for-one (in percentage terms) as its adjustment costs rise. Given greater costs of insuring against TFP risk, countercyclical optimal rules for $\tau_{C,t}$, $\tau_{L,t}$, and $\tau_{K,t}$ begin to resemble ones produced in the small open-economy model.

Kim and Kim create co-movement in A_t and A_t^* in two ways. First, there is an off-diagonal element of the slope matrix of the bivariate AR(1), ν, that measures "spillover" in A_t and A_t^*. Second, Kim and Kim assume that the forecast innovations of A_t and A_t^*, ε_t and ε_t^*, are correlated. Given that ν and the covariance $\sigma_{\varepsilon,\varepsilon^*}$ are non-zero, the marginalized TFP processes are

$$\begin{aligned}&\left[1 - 2\rho\mathbf{L} + \left(\rho^2 - \nu^2\right)\mathbf{L}^2\right] \ln A_t \\ &\quad = \sqrt{\sigma_\varepsilon^2 - \frac{\sigma_{\varepsilon,\varepsilon^*}}{\sigma_\varepsilon^*}}(1 - \rho\mathbf{L})\varepsilon_t + \frac{\sigma_{\varepsilon,\varepsilon^*}}{\sigma_\varepsilon^*}\left[1 - \left(\rho - \nu\frac{\sigma_{\varepsilon^*}^2}{\sigma_{\varepsilon,\varepsilon^*}}\right)\mathbf{L}\right]\varepsilon_t^*, \quad (7)\end{aligned}$$

and

$$\begin{aligned}&\left[1 - 2\rho\mathbf{L} + \left(\rho^2 - \nu^2\right)\mathbf{L}^2\right] \ln A_t^* \\ &\quad = \nu\sqrt{\sigma_\varepsilon^2 - \frac{\sigma_{\varepsilon,\varepsilon^*}}{\sigma_\varepsilon^*}}\mathbf{L}\varepsilon_t + \sigma_{\varepsilon^*}\left[1 - \left(\rho - \nu\frac{\sigma_{\varepsilon,\varepsilon^*}}{\sigma_{\varepsilon^*}^2}\right)\mathbf{L}\right]\varepsilon_t^*, \quad (8)\end{aligned}$$

where σ_ε^2 and $\sigma_{\varepsilon^*}^2$ are the variances of ε_t and ε_t^*. For the lower triangular rotation of the Cholesky decomposition imposed on the bivariate AR(1) of domestic and foreign TFPs, the marginalized processes (7) and (8) show that the reduced forms of A_t and A_t^* are ARMA(2,1)s.

Spillover effects or correlation of ε_t and ε_t^* cause international risk sharing to break down in the two-country model. When ν $\left(\sigma_{\varepsilon,\varepsilon^*}\right) \neq 0$, ε_{t-1} $\left(\varepsilon_t^*\right)$ appears in the TFP processes (7) and (8), which generates co-movement in A_t and A_t^*. In either case, A_t and A_t^* are no longer idiosyncratic shocks against which domestic and foreign households can partially insure. The dearth of international risk sharing among these households is responsible for optimal countercyclical tax rules in $\tau_{C,t}$, $\tau_{L,t}$, and $\tau_{K,t}$ that are similar to ones produced by the closed-economy model.

2.4 Targets, Instruments, and Tax Rules

An early tradition in public finance holds that tax policy should be fair, equitable, and simple. For example, taxes should be easy to implement and understood by those paying for government. This seems true for a rational expectations household facing the tax rate rule (1) in the models Kim and Kim study.

The simplicity of the tax rate rule (1) provides other benefits to Kim and Kim's welfare analysis. As they note, an exogenous "target" in the tax rate rule makes the fiscal policy experiments straightforward to interpret because feedback from the policy instruments to TFP is ruled out. A lack of feedback also reduces the computational burden of searching for the parameters of the tax rate rule (1). This is a good place for Kim and Kim to begin studying optimal tax policy. Nonetheless, tying shifts in tax rates to a hidden, exogenous state variable is problematic if the goal is to inform policymakers about the tradeoffs across competing tax proposals.

One problem is that little consensus exists among economists about measuring TFP. An important strand of literature argues that measuring Solow residuals is biased by firm specialization with respect to the varieties of goods firms produce; see Devereux, Head, and Lapham (1996). This argument is extended to entry and exit of firms by, among others, Campbell (1998), Cook (2001), and Cavallari (2013). The tax rate rule (1) still has the potential to insure against TFP risk when it is left exogenous by model perturbations. Nonetheless, policymakers may have difficulties mapping Kim and Kim's results into practice because of the plethora of ways TFP measurement can be biased.

The robustness of Kim and Kim's results is also challenged by models in which TFP has an endogenous component. An example is the RBC model developed by Anzoategui et al. (2017). They have entrepreneurs creating new technologies. Part of TFP becomes endogenous when a new firm adopts a new technology, which pushes out existing firms. This maps actions by private agents into productivity spillovers that introduce feedback into tax rate rules, such as (1). The importance policymakers attach to tax proposals aimed at spurring growth suggests there is value in extending Kim and Kim's analysis to models that endogenize TFP with innovation and firm entry and exit.

Another issue is that the tax rate rule (1) differs from specifications often used in fiscal policy research. These tax rate rules include TFP and the government bond-output ratio; see, for example, Leeper, Plante, and Traum (2010). Fiscal policy targets the government bond-output ratio to stabilize it. Nonetheless, adding the government bond-output ratio to the tax rate rule (1) is, as Kim and Kim note, a non-trivial extension to their RBC models. The benefit is a wider audience for their study of optimal tax policy.

There are other benefits and costs associated with government bonds. A benefit is that lump-sum transfers to the households would no longer have to adjust to close the government's budget constraint. Instead, government bonds would serve this purpose, which is closer to actual practice. Kim and Kim also assume that domestic and foreign government budget constraints absorb household costs of adjusting international bond portfolios. Implicit is that B_t and B_t^* are near substitutes for domestic and foreign government bonds. One route is to treat these securities as perfect substitutes. By equating B_t and B_t^* with government bonds, fiscal policy has an instrument to alter the small open economy's arbitrage condition (5) or the international risk-sharing condition (6) of the two-country model.

The costs of adjusting B_t and B_t^* are economic primitives of the open-economy models that deserve better motivation. Kim and Kim choose a quadratic cost of adjustment because it renders stationary solutions of the open-economy models. Stationarity, although important, should not dominate this function's specification. Rather, the functional form should reflect its economic role. For example, alternative specifications recognize that R_t has world and country-specific components; see Nason and Rogers (2006) and Lubik (2007). If the country-specific component is the bond-output ratio, there is an interest rate spread on B_t and B_t^* that matches actual observation and depends on $\tau_{i,t}$ and $\tau_{i,t}^*$. This is another potential avenue for optimal tax policy to alter international risk-sharing conditions.

2.5 Optimal Tax Policy and Strategic Behavior

Kim and Kim use the two-country model to study strategic decision-making by domestic and foreign governments. Domestic and foreign tax rate rules are optimized under non-cooperative and cooperative game-theoretic regimes. A Nash equilibrium is employed in the non-cooperative game that has the domestic (foreign) policymaker selecting $\tau_{i,t}$ $\left(\tau_{i,t}^*\right)$ conditional on the expected best actions of the other policymaker. The cooperative regime delegates domestic and foreign tax policy to a social planner. The social planner maximizes domestic plus foreign household welfare by choosing parameters of $\tau_{i,t}$ and $\tau_{i,t}^*$. The Nash equilibrium gives results resembling the optimized rules of $\tau_{C,t}$, $\tau_{L,t}$, and $\tau_{K,t}$, given that $\tau_{C,t}^*$, $\tau_{L,t}^*$, and $\tau_{K,t}^*$ are fixed. The cooperative equilibrium relies on countercyclical optimized rules for $\tau_{C,t}$ and $\tau_{C,t}^*$ to improve welfare. The social planner insures against TFP risk by using these tax rates to alter $\frac{1}{\mathbf{E}_t\Gamma_t}$ and $\frac{1}{\mathbf{E}_t\Gamma_t^*}$ in the international risk-sharing condition (6).

Non-cooperative and cooperative equilibriums depend on credible commitments to optimized tax rate rules by domestic and foreign governments or the social planner. This assumption is often applied when studying Ramsey policy; for example, see Aiyagari et al. (2002). However, this is not Kim and Kim's goal. Ramsey policies require allocations to satisfy the competitive equilibrium, but Kim and Kim calibrate steady-state tax rates to sample data of the G-7 economies.

If Ramsey policies are not a goal, perhaps the assumption of complete and credible commitment to the tax rate rule (1) can be relaxed. Among others, Ortigueira (2006), Debortoli and Nunes (2010), Martin (2010), and Dennis and Kirsanova (2016) present useful research about optimal tax policy when it lacks credibility and commitment. These authors study optimal tax policy in deterministic (Ortigueira, Martin, and Debortoli and Nunes) and stochastic

(Dennis and Kirsanova) one-sector growth models under Markov-perfect equilibriums. This equilibrium concept grounds decisions on and only on the current state of the economy while at each date the actions of households, firms, and governments are consistent with a Nash equilibrium. When commitment is impossible, the character of optimal tax policy depends on assumptions about whether government decisions are made before the private sector makes decisions or at the same time (Ortigueira) and the available tax instruments (Martin). Debortoli and Nunes show that optimal tax policy under partial commitment (i.e., the government occasionally reoptimizes) is not informed by solutions relying on full or no commitment. Dennis and Kirsanova discuss the merits of three solution methods. The upshot is that questions remain to be answered about optimal tax policy.

3. Conclusions

Kim and Kim are engaged in ambitious research on which they have an excellent start. Future research should focus on the role fiscal policy has in improving risk sharing among private agents, endogenize TFP to generate feedback from it to tax instruments, include government debt, specify tax rate rules closer to the fiscal policy literature, alter the bond adjustment cost function, and allow for incomplete commitment. Another open question deserving an answer is why domestic and foreign governments assign tax policy to a social planner. Nonetheless, I expect that Kim and Kim's work has large value added, especially for policymakers as calls to change national tax systems become more prominent.

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