NOTES ON THE THEORY OF COUNTERCYCLICAL POLICIES

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1. Introduction

Economists generally believe that countercyclical fiscal policies have stabilizing effects that work through both automatic stabilizers and occasional discretionary actions [Duesenberry, Eckstein, and Fromm (1960), Hansen (1969), Blinder and Solow (1973), Baily (1978), Tobin (1980), Christiano (1984), Romer and Romer (1994), Chari and Kehoe (1999), Chatterjee (1999), Jones (2002), Romer (1999), Auerbach and Feenberg (2000), Cohen and Follette (2000), and Taylor (2000)]]. Analyses underlying this conventional wisdom focus on intratemporal margins: how employment and personal income respond to changes in current government expenditures and taxes. But in economic downturns, countercyclical policies increase government indebtedness, raising the costs of debt service. And these new expenditure commitments must be financed by some mix of higher taxes, lower spending, and higher money growth in the future. Expectations of how future policies adjust matter for asset returns, the current equilibrium, and the efficacy of countercyclical policies. It is even possible for responses to expected future policies to exacerbate and prolong recessions.

Countercyclical policies necessarily create dynamic links between monetary and fiscal policies. Although the ultimate response of the aggregate economy to countercyclical policies must include an intertemporal dimension, many analyses break this intertemporal link and place the response of future policies in the background.

We employ a general framework in which macro policies affect both intratemporal and intertemporal margins. This description specializes the general framework to present results that highlight the role of the intertemporal margin. Three new findings emerge:

• Through the intertemporal channel, countercyclical policies may be counterproductive by creating a business cycle when there would be no cycle in the absence of countercyclical policies.

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COUNTERCYCLICAL POLICIES

- Nontrivial fractions of variation in investment and velocity can be explained by variation in macro policies alone—without any nonpolicy sources of stochastic fluctuation.
- Persistence in key macro variables can arise solely from serial correlation in expectations of policy.

These findings are provocative. They do not necessarily contradict the view that on net countercyclical policies have been effective. But given the counterproductive effects stemming from intertemporal margins, if conventional wisdom is correct that countercyclical policies dampen the cycle, the intratemporal margin must be substantially more powerful than earlier studies have claimed.

2. A General Framework

This section describes a general equilibrium model of fiscal finance in the spirit of Chari, Jones, and Manuelli (1995). Like Sargent and Wallace (1981), we model only the fiscal financing role of monetary policy.

Gross output is produced using physical capital, $k$, human capital, $h$, and labor, $n$, with the constant returns to scale technology $f(k, hn)$. Output net of undepreciated capital, $y_t$, satisfies the accounting identity:

$$c_t + x_{kt} + x_{ht} + g_t = y_t,$$

where $x_k$ and $x_h$ are investment in physical and human capital, and $g$ is government purchases. The two capital stocks evolve according to

$$k_t = x_{kt} + d^k(k_{t-1}, h_{t-1}n_t),$$

$$h_t = x_{ht} + d^h(k_{t-1}, h_{t-1}n_t),$$

where $d(\cdot, \cdot)$ represents undepreciated capital. We shall consider two specializations of the depreciation functions.

There are two representative firms that rent factors of production from households and sell their outputs back to households. The goods producing firm rents $k$ at rental rate $r$ and hires effective labor $hn$ at wage rate $\omega$ to solve

$$\max_{k_{t-1}, h_{t-1}, n_t} D_Gt = f(k_{t-1}, h_{t-1}n_t) - r_t k_{t-1} - \omega_t h_{t-1}n_t.$$  \hspace{1cm} (4)

The transactions services producing firm hires labor $l$ at wage rate $w$ to solve

$$\max_{l_t} D_Tl = P_TlT(l_t) - w_l l_t,$$  \hspace{1cm} (5)
with $P_T$ the price of transactions services relative to consumption goods. Production functions are strictly concave and differentiable. Both firms behave competitively, taking all prices as given.

The representative household owns the firms and pays taxes on capital and labor income. It has disposable income

$$I_t = (1 - \tau^k_t)r_t k_{t-1} + (1 - \tau^n_t)\omega_t h_{t-1} n_t + D_{Gt} + w_l l_t + D_T + z_t,$$

where $z$ is lump-sum transfers from the government. The household’s expenditures on consumption and new capital goods at date $t$ must be financed with real money balances carried over from the previous period, $M_{t-1}/P_t$, or with transactions services, $T_t$, to satisfy the constraint

$$\frac{M_{t-1}}{P_t} + T_t(c_t + x_t) \geq c_t + x_t,$$

where $x_t = x_k t + x_h t$ is total investment in capital. Transactions services can be thought of as a clearinghouse, money market mutual funds, or credit cards and the labor supplied to that sector reflects resources used in producing the services. Those resources should not be construed as “labor supply” in the same sense that $n_t$ is.

The household consists of a worker-shopper pair. Each member of the household is endowed with a unit of time. The worker supplies $n_t$ units of time to the goods producing firm and the shopper supplies $l_t$ units of time to the transactions services producing firm; the two kinds of labor are not substitutable. The household solves

$$\max_{\{c_t, l_t, n_t, T_t, M_t, B_t, k_t, h_t\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U(c_t, 1 - l_t, 1 - n_t), \quad 0 < \beta < 1,$$

where $1 - n_t$ is leisure for the worker and $1 - l_t$ is leisure for the shopper, subject to (7), the budget constraint

$$c_t + k_t + h_t + \frac{M_t + B_t}{P_t} + P_T T_t \leq I_t + \frac{M_{t-1} + (1 + i_{t-1}) B_{t-1}}{P_t},$$

the evolution of the capital stocks, (2) and (3), and $0 \leq n_t, l_t \leq 1$. Future government policy is the sole source of uncertainty; the operator $E$ in (8) denotes equilibrium expectations of private agents over future policy. $B_t$ is purchases of nominal one-period government debt issued at $t$ and $i_t$ is the net nominal interest rate on debt issued at $t$ and due at $t+1$. The household starts with initial assets $k_{-1} > 0, h_{-1} > 0$, and $M_{-1} + (1 + i_{-1}) B_{-1} > 0$.

The government finances expenditures on goods, $g_t$, and transfer payments, $z_t$, by levying taxes, issuing new debt, and creating new money to satisfy the restraint:
\[ \tau^k_t r_t k_{t-1} + \tau^n_t \omega_t h_{t-1} n_t + \frac{M_t - M_{t-1}}{P_t} + \frac{B_t + (1 + i_{t-1})B_{t-1}}{P_t} = g_t + z_t. \] 

3. An Intertemporal Example

We illustrate the potential for countercyclical policies to be counterproductive by specializing the model to highlight the intertemporal implications of policy. Assume labor is supplied inelastically to goods production; normalize \( n_t \) to unity and set \( \tau^k_t = \tau^n_t = \tau_t \). Further assume the following functional forms:

\[ f(k_{t-1}, h_{t-1}) = k_{t-1}^{\sigma} h_{t-1}^{1-\sigma}, \quad 0 < \sigma < 1, \] 

\[ T(l_t) = 1 - (1 - l_t)^{\alpha}, \quad \alpha > 1, \] 

\[ U(c_t, 1 - l_t) = \log(c_t) + \gamma \log(1 - l_t), \quad \gamma > 0, \] 

\[ d^k(k_{t-1}, h_{t-1}) = \sigma (1 - \delta) f(k_{t-1}, h_{t-1}), \] 

\[ d^h(k_{t-1}, h_{t-1}) = (1 - \sigma) (1 - \delta) f(k_{t-1}, h_{t-1}). \]

With these functional forms the model admits an analytical solution. First we display the solution in the case of complete depreciation of capital stocks (\( \delta = 1 \)). Next, for the case of incomplete depreciation, we simulate perfect foresight time paths for a calibrated version of the model using U.S. data on policy variables.

There are no exogenous “shocks” to technology, preferences, or endowments. Realizations of current and expected policy variables are the sole source of variation.

3.1. Analytical Solution. Combining the Euler equations for physical and human capital yields a solution for the total capital stock:

\[ k_t + h_t = \left( 1 - \frac{1}{\eta_t} \right) (1 - s_t^q) f(k_{t-1}, h_{t-1}), \] 

where \( s_t^q \equiv g_t/y_t \) and

\[ \eta_t \equiv E_t \sum_{i=0}^{\infty} \beta^i d_i \left[ 1 - \beta \frac{\gamma}{\alpha} \frac{1 - \tau_{t+i+1}}{1 - s_{t+i+1}} \right], \quad d_i \equiv \prod_{j=0}^{i-1} \frac{1 - \tau_{t+j+1}}{1 - s_{t+j+1}}, \quad d_0 \equiv 1. \]

Solving the Euler equation for money yields
\[(1 - T_t) \left[ \frac{c_t + x_t}{c_t} - \frac{\gamma}{\alpha} \right] = \frac{\mu_t}{\rho_t}, \tag{18} \]

where \( \rho_t \equiv M_t/M_{t-1} \) and

\[\mu_t \equiv \beta \frac{\gamma}{\alpha} E_t \sum_{i=0}^{\infty} \beta^i d^\mu_i, \quad d^\mu_i \equiv \prod_{j=0}^{i-1} \frac{1}{\rho_{t+j+1}}, \quad d^\mu_0 \equiv 1. \tag{19} \]

We characterize the equilibrium in terms of policy expectations functions \((\mu_t, \eta_t)\), current government claims, \(s^g_t\), and initial assets, \((k_{t-1}, h_{t-1}, M_{t-1}, (1 + i_{t-1})B_{t-1})\). \((\mu_t, \eta_t)\), which summarize the information agents need to form rational expectations about the equilibrium of the economy, capture the portfolio balance effects of expected policies. \(\mu\) is the marginal value of real money balances and is ubiquitous in dynamic monetary models. \(\eta\) is a measure of the extent to which government expenditures are financed by taxing output, which affects the return on investment and generates substitution between real and nominal assets. Hence, \(\eta\) determines the division of wealth between real and nominal assets—or the choice between consumption and investment—while \(\mu\) determines the return on nominal assets.\(^1\)

Our results focus on two aspects of portfolio choice: investment and money demand. We express the choices in terms of their stationary counterparts—investment as a share of expenditures and velocity. Symmetry between the two capital stocks implies that in equilibrium \(h_t/k_t = (1 - \sigma)/\sigma\). Using this proportionality together with the solution (16) and the laws of motion for capital, we derive two investment ratios:

\[\frac{x_{kt}}{c_t + x_{kt}} = \frac{\sigma \left(1 - \frac{1}{\eta_t}\right)}{1 - (1 - \sigma) \left(1 - \frac{1}{\eta_t}\right)}. \tag{20} \]

and

\[\frac{x_t}{y_t} = \left(1 - \frac{1}{\eta_t}\right) \left(1 - s^g_t\right). \tag{21} \]

Expression (21) shows that the total impact of countercyclical fiscal policies consists of a direct effect, associated with fixed \(\eta\), and an amplification effect, due to induced changes in \(\eta\). Countercyclical policy raises \(s^g_t\) when the economy contracts. Hold expected policies fixed initially. Expansionary fiscal policy has a direct effect on investment, and the elasticity of that direct effect depends on \(\eta_t\), the index of expected policies being held fixed. Direct effects arise because an increase in \(s^g_t\) reduces current disposable income; how that reduction gets apportioned between consumption and

\(^1\)Gordon, Leeper, and Zha (1998) and Gordon and Leeper (2002) discuss \(\mu\) and \(\eta\) further.
investment depends on $\eta_t$. A lower value of $\eta$ reflects an expectation of either higher taxes or lower government spending. Lower $\eta$ raises the elasticity of equilibrium investment with respect to current government spending.

A second effect of countercyclical fiscal policies may arise. If higher $s^g_t$ induces agents to change their expectations of future tax rates or government spending shares, then the direct effects may get amplified. Suppose that debt-financed cyclical increases in spending create a recognition that future taxes must rise. This reduces $\eta_t$, amplifying the reduction in investment that higher $s^g_t$ entails.

Similarly, we derive two alternative expressions for velocity using the solution (18) together with (7) and other expressions:

$$v_{kt} \equiv \frac{c_t + x_{kt}}{M_t/P_t} = \frac{1}{\Delta_t} \left[ \sigma - (1 - \sigma) \left( 1 - \frac{1}{\eta_t} \right) \right],$$

and

$$v_{yt} \equiv \frac{y_t}{M_t/P_t} = \frac{1}{\Delta_t (1 - s^g_t)},$$

where

$$\Delta_t \equiv \frac{\mu_t}{\eta_t - \frac{1}{\alpha}}.$$  

Expected policies may increase velocity in two ways. First, higher expected money growth reduces the return on real balances (lower $\mu$) and induces substitution out of money into transactions services. Second, lower expected taxes or higher expected government spending (higher $\eta$) induces substitution out of nominal assets into real assets.

3.2. Equilibrium Expectations. Equilibrium requires that current and future policies satisfy the government’s budget constraint and that agents’ expectations of policy are consistent with equilibrium. This creates interactions among current and future policies, whose characterization is a novel feature of this project. We focus on circumstances in which the economy is in a stationary equilibrium in the future (dates $s > t$), but starts from some other position at date $t$. Assume future policies are constant:

$$\rho_{t+j} = \rho_F, \quad \tau_{t+j} = \tau_F, \quad s^g_{t+j} = s^g, \quad s^z_{t+j} = s^z, \quad j > 0,$$

where $s^z_t = z_t/y_t$.

The government budget constraint can be expressed entirely in terms of current and expected policies. In period $t$ the constraint is
Given expectations of policy embedded in $\Delta_t$ and initial government indebtedness as summarized by $(1+i_{t-1})B_{t-1}/M_{t-1}$, (26) reports equilibrium trade-offs among current policies.

We now derive equilibrium trade-offs among future policies given the state of government indebtedness. Shift the timing of (26) forward one period and assume future interest liabilities are correctly anticipated at $t$ by substituting the expression for equilibrium $i_t$. For simplicity, assume the bond-money ratio is constant at $(B/M)_F$ in the stationary equilibrium. Re-labeling variables dated $t+1$ with an "F" subscript and imposing equilibrium yields

$$\Delta_t = \frac{1}{1-s_F^q} \left[ (s_F^q + s_F^z - \tau_F) \right] \left[ \frac{1}{(B/M)_F - \frac{1}{\beta} (B/M)_t + \left( \frac{\rho_F^{-1}}{\rho_F} \right)} \right].$$

(27)

Given government indebtedness carried into the future, as summarized by $(B/M)_t$, (27) describes the trade-offs among future policies that are consistent with fixed $\Delta_t$ being an equilibrium.

Trade-offs between (26) and (27) determine the interactions between current policies and expectations of future policies. Any change in policy at $t$ that requires a change in $\Delta_t$ must be accompanied by a change in policy at date $F$ that is consistent with the new values of $\Delta_t$ and the new level of government liabilities, $(B/M)_t$.

3.3. Simulation. As a first step to link the theory with data, we use U.S. data on the policy variables $\{\tau_t, s_t^q, s_t^z, \rho_t\}$ together with a calibration of the model, to compute time series for $\{\mu_t, \eta_t\}$. Although countercyclical policies arise from both automatic stabilizers and discretionary policy changes, for present purposes nothing rests on the precise mechanism that produces the policies. In terms of current fiscal policies, countercyclical policy corresponds to lower than normal output bringing forth a lower than normal tax rate and higher than normal government spending shares. Monetary policy responds over the cycle to two factors. First, to accommodate the decline in money demand associated with an economic contraction, the Federal Reserve reduces money growth. Second, to counteract the downturn, the Fed reduces the nominal interest rate by increasing the growth of high-powered money. The net effect is procyclical money growth, which appears in statistical characterizations of the data [Cooley and Hansen (1995)].

Table 1 reports the time series facts. Correlations among cyclical components of output and policy suggest very strong countercyclical behavior, as the last column
indicates. Both components of spending, purchases and transfer payments, rise when output falls below trend and both components of revenues, direct taxes and seigniorage, fall with output. The resulting budget deficit is financed by debt expansion, so the debt-output ratio rises when output is low.

<table>
<thead>
<tr>
<th>Policy Variable</th>
<th>Correlation with Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>$s^g$</td>
<td>-.90</td>
</tr>
<tr>
<td>$s^z$</td>
<td>.82</td>
</tr>
<tr>
<td>$\tau$</td>
<td>.61</td>
</tr>
<tr>
<td>$\rho$</td>
<td>.47</td>
</tr>
<tr>
<td>$seigniorage/y$</td>
<td>.30</td>
</tr>
<tr>
<td>$B/P_y$</td>
<td>.19</td>
</tr>
</tbody>
</table>

$s^g = g/y$, $s^z = z/y$, $\rho_t = M_t/M_{t-1}$. Cyclical components derived from band-pass filtered data using Baxter and Kings’s (1999) algorithm to extract frequencies between 2 and 32 quarters with 3 years of padding.

Table 1. Correlations of Policy Variables with Output

To calibrate the quarterly model with partial depreciation of capital, we set $\beta = .99$ and $\sigma = .36$. With these settings, depreciation functions of the form (14) and (15) imply $\delta_k = \delta_h = \delta = .02663$ and $\gamma/\alpha = .01026$ in order to match the means of U.S. data on $x_k/(c + x_k)$ and $(c + x_k)/M/P$ when the constant policy functions $(\mu, \eta)$ are computed using time averages of U.S. policy variables from 1954:1-2000:2. The calibration implies a seigniorage-output ratio of .004, consistent with U.S. data, and transactions services as a share of output of .014. Diaz-Gimenez, Prescott, Fitzgerald, and Alvarez (1992) estimate the size of the U.S. financial intermediary sector at between 3 and 7 percent of GNP while Aiyagari, Braun, and Eckstein (1998) calculate the cost to commercial banks of providing demand deposits and credit cards to be between .5 and 1.1 percent of GNP. Our value of $P_T T/y$ seems reasonable.

We compute perfect foresight policy paths as a benchmark for specifying expectations. While this represents a limiting case in terms of how much information agents possess about policy realizations, it is agnostic about policy behavior by not assuming policy obeys time-invariant functions. Moreover, the $\{\mu_t, \eta_t\}$ sequences derived

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2In U.S. data, $x_k/(c + x_k) = .25$ and $(c + x_k)/M/P = 3.01$.

3Perfect foresight is a limiting case of the idea that agents have good information about tax rates and government spending some quarters into the future.
from realizations of U.S. policy variables reflect any dynamic interactions of the kind discussed in section 3.2 that are embedded in actual policy behavior. Perfect foresight provides a benchmark to be contrasted with econometric methods for estimating expectations. Applying perfect foresight to compute the functions $\{\mu_t, \eta_t\}$ over the sample $t = 1, 2, \ldots, T$ requires specifying expected values of policy variables beyond the sample. We assume policy realizations beyond the sample equal their means over the full sample.\(^4\) To avoid solving a system of non-linear equations at each date, we exploit recursive representations of $\{\mu_t, \eta_t\}$.

U.S. data on portfolio choices exhibits clear cyclical patterns. Figure 1 plots the cyclical components of investment share and velocity. Vertical lines mark NBER business cycle dates. Investment tends to peak just before business cycle peaks, while its troughs coincide with business cycle troughs. Velocity is also procyclical, though its peaks and troughs align less well with the business cycle.

Figure 2 shows the cyclical components of the model’s investment share and velocity. Both series exhibit cyclical behavior that coincides with the U.S. business cycle. Investment is strongly procyclical in the data and the model reproduces this cyclicity remarkably well. In many instances model investment reaches a cyclical peak or

\(^4\)The handling of post-sample expectations has little effect on the cyclical properties of the portfolio choices.
trough in precisely the same quarter that U.S. data does, though its volatility is less than in data. The model even produces investment booms that coincide with actual data (1965-1966, late 1972-early 1973, and 1984). Model velocity is weakly procyclical, falling in at least half the recessions. Rarely do its cyclical troughs coincide with those of U.S. velocity, although velocity’s general cyclical pattern does mimic actual data, especially in the past 30 years.

Table 2 compares summary statistics for our two investment shares and velocity measures from U.S. data and the model. The model explains 40% to 64% of variation in the level of the investment shares, and 17% to 30% at cyclical frequencies. It also accounts for 27% to 35% of the standard deviation of the level of velocity, and 50% to 71% at cyclical frequencies. Simulated data is highly persistent and its cyclical components are even more persistent than U.S. data.

These results are startling. All variation in the model stems from realizations of current and expected future macro policies. If policy variables were constant, simulated data would be constant. The cyclical pattern exhibited by simulated data arises from countercyclical policies. Evidently, those policies have counterproductive impacts on intertemporal margins.
### Table 2. Portfolio Choice Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Std. Dev. (log)</th>
<th>Serial Std. Dev. Serial Std. Correlation</th>
<th>Std. Dev. (%)</th>
<th>Serial Std. Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x_k/(c + x_k)$ (Data)</td>
<td>11.68</td>
<td>.970</td>
<td>4.25</td>
<td>.777</td>
</tr>
<tr>
<td>$x_k/(c + x_k)$ (Model)</td>
<td>4.63</td>
<td>.993</td>
<td>.74</td>
<td>.821</td>
</tr>
<tr>
<td>$x/y$ (Data)</td>
<td>11.09</td>
<td>.980</td>
<td>3.26</td>
<td>.775</td>
</tr>
<tr>
<td>$x/y$ (Model)</td>
<td>7.09</td>
<td>.995</td>
<td>.96</td>
<td>.820</td>
</tr>
<tr>
<td>$v_k$ (Data)</td>
<td>29.85</td>
<td>.999</td>
<td>1.78</td>
<td>.819</td>
</tr>
<tr>
<td>$v_k$ (Model)</td>
<td>10.30</td>
<td>.997</td>
<td>1.26</td>
<td>.892</td>
</tr>
<tr>
<td>$v_y$ (Data)</td>
<td>29.46</td>
<td>.998</td>
<td>2.57</td>
<td>.796</td>
</tr>
<tr>
<td>$v_y$ (Model)</td>
<td>8.01</td>
<td>.995</td>
<td>1.26</td>
<td>.900</td>
</tr>
</tbody>
</table>

$y$ denotes total output and is defined as $y = c + x + g$, where $x = x_k + x_h$.

For the production function $f(k, h) = k^\sigma h^{1-\sigma}$, $x_h = ((1 - \sigma)/\sigma)x_k$, so for U.S. data, $x_h$ is imputed from data on $x_k$ using this factor.

Velocity measures are $v_k = (c + x_k)/M/P$ and $v_y = y/M/P$.

### References


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