



Does fiscal policy matter for stock-bond return correlation?☆

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ABSTRACT

Switching between monetary and fiscal regimes is incorporated in a general-equilibrium model to explain three stylized facts: (1) a positive correlation of stock and bond returns in 1971–2001 and a negative correlation after 2001, (2) a negative correlation of consumption and inflation in 1971–2001 and a positive correlation after 2001, and (3) the coexistence of a positive bond risk premium and a negative correlation of stock and bond returns. While the technology shock drives the positive stock-bond and negative consumption-inflation correlations in the monetary regime, the investment shock drives the negative stock-bond and positive consumption-inflation correlations in the fiscal regime.

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1. Introduction

Empirical studies have documented the time-varying correlation between returns on the market portfolio of stocks and returns on long-term (5–10 years) nominal Treasury bonds (Baele et al., 2010; Baele and Holle, 2017; Campbell et al., 2017; Christiansen and Rinaldo, 2007; David and Veronesi, 2013; Guidolin and Timmermann, 2007). This correlation was positive before 2001 but turned negative afterwards (Panel A of Fig. 1). At the same time, the correlation between consumption

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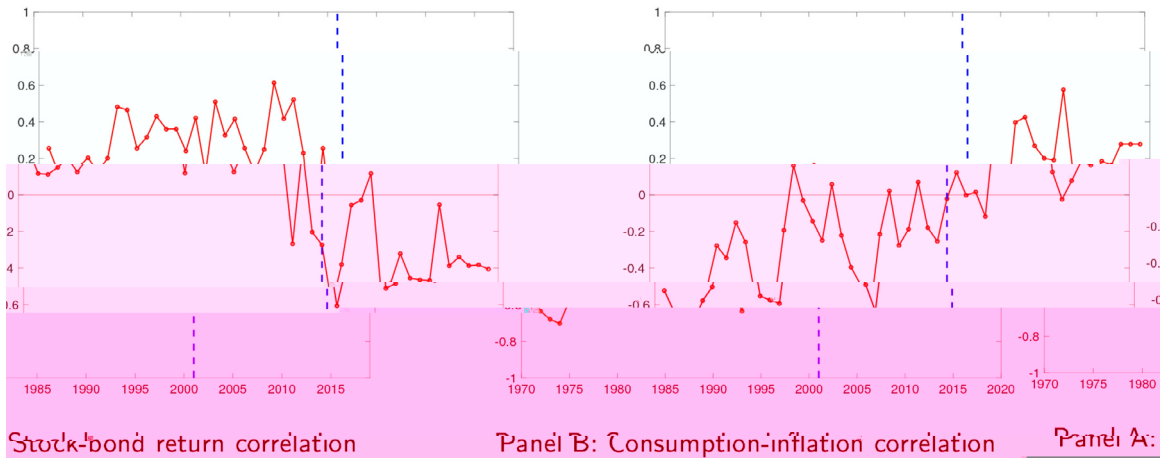


Fig. 1. Time-varying correlations—financial market and real economy *Notes:* Panel A reports the correlation between the value-weighted market return and the return on the 5-year (zero coupon) nominal Treasury bonds from 1971Q1 to 2018Q4 in annual frequency. The correlation is estimated based on daily returns for each year. Daily returns on the stock market index are obtained from Ken French's data library. Daily returns on the 5-year Treasury bonds ($r_b^{(5)}$) are computed with the daily yields provided by [Gürkaynak et al. \(2007\)](#). Panel B displays the correlation of real consumption growth and inflation (the consumption-inflation correlation). The correlation in year t is computed with the data within the 5-year period centering at t , i.e., $[t - 2, t + 2]$. Real consumption growth is based on quarterly total personal consumption expenditures, and inflation is based on the quarterly GDP deflator. Both data series are obtained from the Federal Reserve Bank of St. Louis. The details of the data are described in Online Appendix A.

growth and inflation also changed sign around 2001 from negative to positive (Panel B of [Fig. 1](#)).¹ Moreover, the risk premiums of long-term nominal Treasury bonds were positive before and after 2001 as shown in [Section 2](#).

Existing explanations for the sign change of stock-bond correlation around 2001 focus on the effects of monetary policy. [Song \(2017\)](#), for example, argues that monetary policy was more aggressive as inflation became procyclical, which led to a shift in the stock-bond correlation. [Campbell et al. \(2020\)](#) rely on the sign switch in the correlation between inflation and output gap, as well as a stronger reaction of monetary policy to output gap after 2001. In this paper, we provide an alternative explanation that emphasizes the role of a mix of monetary and fiscal policies identified by [Bianchi et al. \(2022\)](#) in accounting for sign changes of correlations observed in both the financial market and the real economy.² To this end, we develop a general equilibrium framework that incorporates switching between the monetary regime (the M regime) and the fiscal regime (the F regime). We model the M regime as a mix of active monetary policy and passive fiscal policy, and the F regime as a mix of active fiscal policy and passive monetary policy ([Bianchi and Ilut, 2017](#); [Bianchi and Melosi, 2017](#); [Leeper et al., 2017](#)).

Monetary policy is modeled as a simple Taylor rule, in which the short-term nominal interest rate reacts to inflation and output gap positively. The policy rate reacts to inflation more than one-for-one under active monetary policy, while less than one-for-one under passive monetary policy. Fiscal policy is modeled as a lump-sum tax rule that reacts to outstanding government debt and output ([Leeper, 1991](#)). Under passive fiscal policy, lump-sum taxes increase proportionately (in the present value) with government spending to satisfy the government budget constraint. Under active fiscal policy, the government budget constraint also holds, but taxes do not increase sufficiently to finance government spending; as a result, prices increase with government deficits to reduce the real debt burden. A switch from the M regime to the F regime took place in the early 2000s ([Bianchi et al., 2022](#)), around the same time when the consumption-inflation correlation and the stock-bond return correlation changed sign.

To assess how important a switch to the F regime is in explaining sign changes of these observed correlations, we study a general equilibrium model with four structural shocks: the technology shock defined as a shock to neutral technology (NT), the investment shock defined as a shock to the marginal efficiency of investment (MEI), the monetary policy (MP) shock, and the fiscal policy (FP) shock. In addition to the technology shock, [Justiniano et al. \(2010\)](#) show that the MEI shock as an investment shock contributes significantly to the business cycle fluctuation and economic growth. We calibrate the model to match moments of key macroeconomic and financial variables and show that technology and investment shocks, not monetary and fiscal policy shocks, are critical to yielding the following key results:

1. Both the positive stock-bond return correlation and the negative consumption-inflation correlation are driven by the technology shock under the M regime.

¹ Due to differences in data and methodology, the exact break dates of the stock-bond return correlation and consumption-inflation correlation identified by these cited papers range between 1999 to 2002.

² Our paper contributes to a growing body of literature studying the asset pricing implications of government policies in a general equilibrium framework. In addition to [Song \(2017\)](#) and [Campbell et al. \(2020\)](#), see [Van Binsbergen et al. \(2012\)](#), [Rudebusch and Swanson \(2012\)](#), [Dew-Becker \(2014\)](#), [Kung \(2015\)](#), and [Li and Palomino \(2014\)](#).

2. Both the negative stock-bond return correlation and the positive consumption-inflation correlation are driven by the investment shock under the F regime.
3. The negative stock-bond return correlation coincides with positive bond risk premiums under the F regime.

Since the seminal work of [Leeper \(1991\)](#), a growing literature has studied the joint behavior of monetary and fiscal authorities. We extend the standard New Keynesian model to incorporating this joint policy behavior as well as a recursive preference with habit formation to generate realistic risk premiums. We show that the mix of the M and F regimes is essential to account for the aforementioned correlation patterns and bond risk premiums. A positive technology shock, as a positive supply shock, causes both output and consumption to increase while driving down prices. The resulting consumption-inflation correlation becomes negative. The rise in consumption and the persistent fall in the short-run nominal interest rate as the monetary authority's reaction to falling inflation lead to higher stock prices and lower prices of long-term nominal Treasury bonds. As a result, the stock-bond return correlation is positive in response to the technology shock. Under the M regime, the interest rate falls more than inflation and thus the real interest rate falls as well. A fall in the real interest rate further stimulates output and consumption. Active monetary policy thus amplifies the effect of the technology shock and makes this shock a dominating force behind both the negative consumption-inflation correlation and the positive stock-bond return correlation. On the contrary, under the F regime, the nominal interest rate falls less than inflation due to passive monetary policy and as a result the real interest rate increases in response to a positive technology shock. Therefore, the stimulating effect of the technology shock is largely muted and the technology shock becomes unimportant for determining the correlations between consumption and inflation and between returns on long-term bonds.

In the F regime, the investment shock becomes the dominating force for generating the stock-bond return correlation and the consumption-inflation correlation. A positive investment shock makes the trade-off of investment into capital more efficient. In response to this positive shock, both output and investment increase but consumption decreases in the short run as an intertemporal substitution for higher consumption in the long run. The dominant effect of declining consumption in the short run causes the stock prices to fall. An increase in output leads to an increase in tax income and a decrease in government deficits. It follows from the government budget constraint that the price level must fall to make the real value of existing government debt higher. The falling price level leads to a reduction in the nominal interest rate according to the Taylor rule; as a result, bond prices rise. Under the F regime, therefore, the investment shock generates the negative stock-bond return correlation and the positive consumption-inflation correlation.

Table 1
Data Moments pre- and post-2001Q2.

	1971Q1-2001Q1	2001Q2-2018Q4
$\text{corr}(\Delta c_t, \pi_t)$	-0.44	0.27
$\text{corr}(r_{s,t}, r_{b,t}^{(5)})$	0.21	-0.37
$r_s - r$	6.59	6.67
$(r_s - r)$	16.14	14.54
$r_b^{(5)} - r$	1.87	2.03
$(r_b^{(5)} - r)$	6.98	4.58

Notes: The table reports the data moments in two subperiods: 1971Q1-2001Q1 and 2001Q2-2018Q4. Real consumption growth (Δc_t) is based on quarterly total personal consumption expenditures on nondurables and services, and inflation (π_t) is based on the quarterly GDP deflator. These data series are obtained from the Federal Reserve Bank of St. Louis. The stock-bond correlation is based on daily excess returns on the stock market index and the nominal 5-year Treasury bonds. Returns on the stock market index ($r_{s,t}$) and one-month Treasury bills (r_t), used as the risk-free rate, are obtained from Ken French's data library. Returns (annualized) on the 5-year Treasury bonds ($r_{b,t}^{(5)}$) are computed with the daily yields provided by [Gürkaynak et al. \(2007\)](#). The details of the data are described in Online Appendix A.

ratio (b_{t-1}) and the government expenditure-to-output ratio (g_{yt}):

$$\pi_t \sim \zeta_b b_{t-1} + \zeta_g g_{yt}, \quad (2.2)$$

where the coefficients ζ_b and ζ_g measure the corresponding responsiveness. Fiscal policy is passive if taxes respond strongly to the government debt with $\zeta_b > e^{r-\Delta y} - 1$, where r and Δy are the steady-state nominal interest rate and inflation.³ Fiscal policy is active if taxes do not respond strongly to the outstanding government debt ($\zeta_b \leq e^{r-\Delta y} - 1$). Whether fiscal policy is active does not depend on the level of government debt, but rather on how sensitive taxes are in response to the ratio of government debt to GDP. When fiscal policy is active, the price level must adjust so that the government budget constraint is satisfied. For example, prices would need to rise to reduce real government liabilities when the government's income (taxes plus new debt issuances) is insufficient to meet its spending and liabilities. Passive fiscal policy influences macroeconomic fluctuations by responding strongly to the level of outstanding government debt. Active fiscal policy, however, influences the price level directly, which in turn affects other macroeconomic variables.

[Campbell et al. \(2020\)](#) find that a structural break in the stock-bond return correlation and the output-inflation correlation occurred in 2001Q2. Around this time, the economy switched from the M to F regime according to the estimation by [Bianchi et al. \(2022\)](#).⁴ Table 1 presents key data moments in the two subperiods: 1971Q1-2001Q1 (the M regime) and 2001Q2-2018Q4 (the F regime). Specifically, the correlation between consumption growth rate (Δc_t) and inflation (π_t) is -0.44 for the first subperiod and 0.27 for the second subperiod; the correlation between (daily) returns on the stock market index ($r_{s,t}$) and returns on nominal (zero-coupon) Treasury bonds of 5-year maturity ($r_{b,t}^{(5)}$) is 0.21 for the first subperiod and -0.37 for the second subperiod; and the (annualized) average monthly excess returns on the 5-year Treasury bonds are 1.87% and 2.03% for the two subperiods. We summarize these key facts as follows.

1. The correlation between consumption growth and inflation was negative in the M regime and positive in the F regime.
2. The correlation between returns on stocks and nominal long-term Treasury bonds was positive in the M regime and negative in the F regime.
3. Nominal long-term Treasury bonds earned positive risk premiums in both the M and F regimes.

In the rest of the paper, we develop a general equilibrium model with a mix of monetary and fiscal policies to account for these facts.

³ Substituting the fiscal policy rule into the log-linearized government budget constraint represented by Eq. (3.7) in Section 3.5 leads to the debt dynamics as $\tilde{b}_t = [e^{r-\Delta y} - \zeta_b] \tilde{b}_{t-1}$ (other terms are omitted for illustration), where \tilde{b}_t is the log-linearized deviation from the steady state. The condition $\zeta_b > e^{r-\Delta y} - 1$ guarantees that debt is mean reverting and fiscal policy is passive in the sense that it ensures the debt stability to accommodate the behavior of the monetary authority. [Leeper \(1991\)](#) shows that when this condition is violated, the process of debt can be stabilized by passive monetary policy ($\alpha < 1$) to accommodate fiscal policy.

⁴ In earlier work, [Bianchi and Ilut \(2017\)](#) and [Bianchi and Melosi \(2017\)](#) identify a monetarily-led regime from the 1980s to the Great Recession. For the correlations we find for the period 1971Q1-2001Q1, one concern is that these correlations are driven by the subsample in the 1970s and early 1980s. We find that the consumption-inflation correlation is negative and the stock-bond return correlation is positive for the subperiod from the early 1970s to the early 1980s as well as for the subperiod from the late 1980s to the early 2000s.

3.3. Intermediate goods producers

The intermediate goods sector is monopolistically competitive. The production of intermediate goods i uses both capital and labor via the homogenous production technology

$$Y_{i,t} = \omega(z_t L_{i,t})^{1-\sigma} K_{i,t}^\sigma - z_t^+ \varphi, \tag{3.4}$$

where ω is a total factor productivity, z_t is a non-stationary labor-augmenting neutral technology process, $L_{i,t}$ and $K_{i,t}$ are the labor and capital services employed by firm i , σ is the capital share of the output, and φ is the fixed production cost parameter. Following Christiano et al. (2016), we assume that the fixed operating costs grow at the same rate as output to guarantee balanced growth in the nonstochastic steady state. We define z_t^+ as $z_t^+ \equiv \Psi_t^{1-\frac{\sigma}{\sigma}}$ z_t , where the relative price of consumption goods to investment goods Ψ_t represents the level of the investment-specific technology. We assume that z_t evolves as

$$z_t^z = z(1 - z) + z z_{t-1}^z + z e_t^z, \text{ and } e_t^z \sim \text{IID}\mathcal{N}(0, 1), \tag{3.5}$$

where $z_t^z = \Delta \log z_t$, and the NT shock e_t^z is what we refer to as the technology shock. The growth rate of investment-specific technology is constant $\Psi \equiv \Delta \log \Psi_t$. Thus, the growth rate of the economy is $z_t^+ = \Delta \log z_t^+$. The intermediate goods industry is assumed to have no entry and exit. A fixed cost φ is chosen so that intermediate goods producers earn zero profits in the steady state.

The producers take the nominal rent of capital service $P_t r_t^k$ and nominal wage rate W_t as given but have the market power to set the price of their products, facing Calvo (1983)-type price stickiness, to maximize profits. With probability p , producer i cannot reoptimize its price at period t and must set it according to $P_{i,t} = \tilde{p}_{p,t} P_{i,t-1}$, where $\tilde{p}_{p,t} = (\pi^*)^\ell (\pi_{t-1})^{1-\ell}$ is the inflation indexation, ℓ is the price indexation parameter, π^* is the targeted (steady state) inflation rate, and $\pi_t \equiv P_t/P_{t-1}$ is the actual inflation rate. Producer i sets price $P_{i,t}$ with probability $1 - p$ to maximize its profits, $\mathbb{E}_t \sum_{s=0}^{\infty} p^s M_{t,t+s} [P_{i,t+s} Y_{i,t+s} - s_{t+s} P_{t+s} Y_{i,t+s}]$, subject to the demand function $Y_{i,t+s} = Y_{t+s} \left(\frac{P_{i,t+s}}{P_{t+s}}\right)^{-\frac{p}{1-p}}$, where $\tilde{p}_{p,t+s} = \left(\prod_{s=1}^t \tilde{p}_{p,t+s}\right)$ for $t \geq 1$ and equals 1 for $t = 0$. We denote $Y_{i,t+s}$ as producer i 's output at time $t + s$ if $P_{i,t}$ is reoptimized, and s_{t+s} as the real marginal cost.

All firms that reoptimize prices at period t set the same price: $P_{i,t} = P_t^*$. The aggregate price evolves as $P_t^{\frac{1}{1-p}} = (1 - p)(P_t^*)^{\frac{1}{1-p}} + p(\tilde{p}_{p,t} P_{t-1})^{\frac{1}{1-p}}$.

3.4. The labor market

Labor contractors hire workers of different labor types through labor unions and produce homogenous labor service L_t according to the production function

$$L_t = \left[\int_0^1 L_{j,t}^{\frac{1}{w}} dj \right]^w, \quad w > 1,$$

where w measures the elasticity of substitution among different labor types. The

In the standard new Keynesian model ([Bianchi and Ilut, 2017](#); [Davig and Leeper, 2011](#)), the fiscal authority adjusts the tax as a share of output according to the tax policy

Table 2
Parameter values in the baseline model.

Parameter	Description	Value	Target moments or references
Panel A: Preference			
	discount factor	0.9974	steady state interest rate = 1.29%
	reciprocal of elasticity of intertemporal substitution	1/1.5	Vissing-Jørgensen (2002)
	risk aversion	55	match the stock Sharpe ratio
	labor supply aversion	1	Christiano et al. (2014)
b_h	habit parameter	0.85	Justiniano et al. (2011)
Panel B: Production			
σ	capital share	0.33	labor share = 0.65 (private non-farm business sector)
	capital depreciation rate	0.025	Christiano et al. (2014)
s	investment adjustment cost parameter	10.78	Christiano et al. (2014)
a	utilization rate cost parameter	2.54	Christiano et al. (2014)
p	probability that cannot re-optimize price	0.74	Christiano et al. (2014)
ℓ	price indexation parameter	0.90	Christiano et al. (2014)
ρ	degree of elasticity of substitution for goods aggregation	1.91	$C/Y = 0.65$
w	probability that cannot re-optimize wage	0.81	Christiano et al. (2014)
ℓ_w	wage indexation parameter	0.49	Christiano et al. (2014)
w	degree of elasticity of substitution for labor aggregation	1.05	Christiano et al. (2014)
ω	total factor productivity	1	normalization
z^*	growth rate of the economy	0.0035	consumption growth rate = 0.35%
ψ	growth rate of investment specific technology	0.0037	investment growth rate of investment = 0.72%
$*$	target inflation rate	1.008	average inflation rate = 0.80%
	decay rate of long-term government bonds coupon payment	0.9627	effective bond maturity = 5 years
	leverage ratio	1.35	debt-to-asset ratio = 0.26 in data
b	government-debt-to-GDP ratio	0.55	total federal debt as percent of GDP = 59%
g_y	steady-state government- spending-to-output ratio	0.18	Smets and Wouters (2007)
Panel C: Policies			
γ_1	sensitivity of interest rate to inflation (M regime)	2.7372	Bianchi and Ilut (2017)
γ_2	sensitivity of interest rate to inflation (F regime)	0.4991	Bianchi and Ilut (2017)
γ_1^y	sensitivity of interest rate to output (M regime)	0.7037	Bianchi and Ilut (2017)
γ_2^y	sensitivity of interest rate to output (F regime)	0.1520	Bianchi and Ilut (2017)
ρ_r^1	interest rate persistence (M regime)	0.91	Bianchi and Ilut (2017)
ρ_r^2	interest rate persistence (F regime)	0.6565	Bianchi and Ilut (2017)
ζ_b^1	sensitivity of tax to debt (M regime)	0.0609	Bianchi and Ilut (2017)
ζ_b^2	sensitivity of tax to debt (F regime)	0	Bianchi and Ilut (2017)
ζ_y^1	sensitivity of tax to output (M regime)	0.3504	Bianchi and Ilut (2017)
ζ_y^2	sensitivity of tax to output (F regime)	0.3504	Bianchi and Ilut (2017)
ζ_g^1	sensitivity of tax to government spending (M regime)	0.3677	Bianchi and Ilut (2017)
ζ_g^2	sensitivity of tax to government spending (F regime)	0.3677	Bianchi and Ilut (2017)
ζ^1	tax persistence (M regime)	0.9844	Bianchi and Ilut (2017)
ζ^2	tax persistence (F regime)	0.8202	Bianchi and Ilut (2017)
Panel D: Shocks			
ρ_z	persistence of the technology shock	0.15	autocorrelation of quarterly consumption
ρ_i	persistence of the investment shock	0.65	autocorrelation of quarterly investment
σ_z	standard deviation of the technology shock	0.82	volatility of consumption growth
σ_i	standard deviation of the investment shock	2.50	volatility of investment growth
σ_r	standard deviation of the MP shock	0.10	Bianchi and Ilut (2017)
σ_f	standard deviation of the FP shock	0.337	Bianchi and Ilut (2017)

Table 3
Simulated moments.

Variables	Data		Model	
	Mean	Std.Dev.	Mean	Std.Dev.
consumption growth (

Table 4
Variance decomposition.

Variables	Technology (e_z) (M / F)	Investment (e_i) (M / F)	Monetary Policy (e_r) (M / F)	Fiscal Policy (e_f) (M / F)
$r_s - r$	75.04 / 35.86	9.88 / 59.88	13.85 / 3.33	1.23 / 0.93
$r_b - r$	45.16 / 1.27	4.83 / 87.83	23.83 / 8.84	26.18 / 2.07
Δc	65.96 / 19.30	18.92 / 79.67	5.21 / 0.10	9.92 / 0.94
Δy	56.21 / 30.44	33.90 / 66.81	8.96 / 2.03	0.92 / 0.72
m	34.63 / 46.26	59.86 / 50.36	4.93 / 2.42	0.59 / 0.96
	98.98 / 99.62	0.87 / 0.32	0.06 / 0.00	0.10 / 0.06

Notes: This table reports the forecast error variance decomposition (in percentage) of the key variables in the baseline model: excess return on stocks ($r_s - r$), which is a claim on consumption, excess return on 5-year nominal bonds ($r_b - r$), inflation (π), growth rate of consumption (Δc), output growth (Δy), and nominal pricing kernel (m). The second to fifth columns are contributions of the technology shock, investment shock, monetary policy shock, and fiscal policy shock. The numbers before and after the slash (/) represent percentage contributions of the corresponding shocks in the M and F regimes.

and (C.6) in Online Appendix C. These equations hold exactly if m , r_s , and r_b follow the multivariate normal distribution.⁶ As shown in Table 3, all moments of macroeconomic variables—consumption, investment, inflation, and the short-term interest rate—match the data closely. For moments of financial variables, the model accounts for half of the observed excess return on the nominal 5-year Treasury bond and one-third of the observed excess return on the market portfolio, a reasonable success for a small scale New Keynesian model. In the following sections, we explore the model's economic mechanism via a variance decomposition and impulse responses of key variables to the four structural shocks.

4.2. Variance decomposition

Table 4 reports a variance decomposition of key macroeconomic and financial variables under the M and F regimes in our calibrated model. In the M regime, the variations of stock returns, nominal long-term bond returns, consumption growth, and inflation are driven mainly by the technology shock (75.04%, 45.16%, 56.21%, and 65.96%). In the F regime, the investment shock drives a majority of variations of these variables (59.88%, 87.83%, 66.81%, and 79.67%). The technology shock, however, drives all the variations of the pricing kernel in both regimes—almost 100%. The effects of MP and FP shocks are negligible in both regimes. These results are crucial for understanding how the consumption-inflation correlation, the stock-bond return correlation, and stock and bond risk premiums are regime-dependent.

The correlation of two variables driven by multiple fundamental shocks depends on the relative importance of each shock in contribution to the fluctuations of these variables. Intuitively, a shock that contributes most to the variances of both variables has the largest impact on their correlation. Thus, the variance decomposition results reported in Table 4 imply that the signs of the consumption-inflation and stock-bond return correlations are dominated by the technology shock under the M regime and by the investment shock under the F regime.

Risk premiums of stocks or bonds depend on the covariance between the pricing kernel and returns on stocks or bonds, as shown in equation (C.4) or (C.6) in Online Appendix C. Because the pricing kernel variation is dominated by the technology shock in both regimes, risk premiums of stocks and bonds are mostly determined by this shock. In the next several sections, we discuss the dynamic responses of financial and macroeconomic variables to the two most important structural shocks—technology and investment, and show that our results are consistent with the observed facts.⁷

4.3. Impulse responses to the technology shock

Figure 2 presents the impulse responses of excess returns of stocks and bonds, the nominal interest rate, consumption growth, and inflation to a positive one-standard-deviation technology shock in the M (blue solid lines) and F (red dashed lines) regimes.⁸ In response to a positive technology shock, consumption rises, but inflation falls. As inflation falls, the nominal interest rate declines under the Taylor rule. The stock price rises with consumption, and the bond price rises when the nominal interest rate falls. A positive technology shock, therefore, leads to a negative consumption-inflation correlation and a positive stock-bond return correlation.

Both stock and bond returns in the M regime rise more than they do in the F regime. The nominal interest rate is more responsive to the fall of inflation, amplifying the effects of the technology shock. Consequently, consumption and the stock price in the M regime rise more than in the F regime. There is a more persistent fall in the interest rate in the M regime.

⁶ We solve our model up to the first order approximation; thus, the means of the simulated equity and bond excess returns are both zero. We compute the equity and bond risk premiums using the covariance between return and pricing kernel based on the first order approximation. The covariance is driven mainly by the first order terms for the return and the pricing kernel. The second and higher order terms have negligible effects on the covariance.

⁷ The impulse responses to MP and FP shocks are discussed in Online Appendix D.

⁸ The impulse responses of other variables to a positive technology shock are displayed in Panel (a) of Figure A.1 in Online Appendix G.

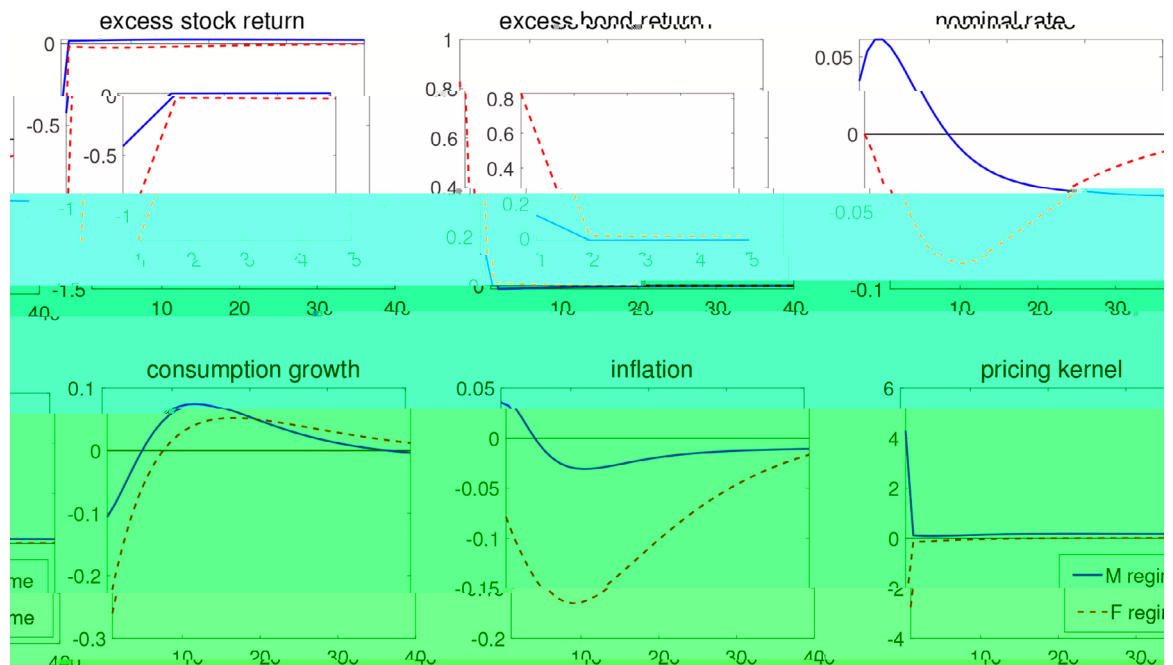


Fig. 3. Impulse responses of a positive investment shock Notes: This figure plots the impulse responses of key macro and finance variables in the model after a one-standard-deviation positive investment shock. The blue solid lines represent impulse responses in the M regime and the red dashed lines represent impulse responses in the F regime. The x-axis marks the time in quarters, and the y-axis represents the percentage change from the steady state. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

investment shock on the long-term bond price is positive. The investment shock, therefore, generates a negative stock-bond return correlation and a negative consumption-inflation correlation in the M regime.

In the F regime, however, a sharp fall in inflation is persistent in response to a positive investment shock. With active fiscal policy, an increase in output leads to an increase in tax income, and higher tax income reduces government deficits. It follows from the government budget constraint that the price level must fall to make the real value of government debt higher. With the Taylor rule, the nominal interest rate falls in all horizons, resulting in a large increase of the long-term bond price. As a result, the responses of both stock and bond returns to the investment shock are larger in the F regime than in the M regime, although the direction of these responses is the same in both regimes. The most important finding is that the consumption-inflation correlation is positive in the F regime in response to the investment shock. These dynamic responses are consistent with the variance decomposition reported in Table 4: the investment shock dominates the dynamics of stock and bond returns, consumption growth, and inflation in the F regime.

As shown in the variance decomposition reported in Table 4, the investment shock exerts little impact on the pricing kernel and thus on risk premiums of stocks and bonds. Stock returns are positively correlated with the pricing kernel in response to the investment shock in the F regime, implying a negative equity premium. Since the sign of the equity premium is determined by the technology shock, however, the equity premium is always positive regardless of the policy regime both in the model and in the data.

4.5. Summary and discussion

Three main findings summarize the analysis in the preceding sections:

1. The stock-bond return correlation is positive in the M regime, mainly driven by the technology shock; this correlation is negative in the F regime, mainly driven by the investment shock.
2. The consumption-inflation correlation is negative in the M regime, mainly driven by the technology shock; this correlation is positive in the F regime, mainly driven by the investment shock.
3. Risk premiums of stocks and nominal long-term bonds are always positive in both policy regimes, mainly driven by the technology shock.

It is informative to relate these findings to the CAPM. In an economy where the CAPM holds, a negative correlation between returns on the nominal long-term bond and on the stock market implies negative excess risk premiums of bonds. As Fama and French (1993) show, however, the CAPM fails to explain empirical data. The CAPM also fails in models with

Table 5
Correlation matrix.

Variables	$r_s - r$ (M / F)	$r_b - r$ (M / F)	(M / F)	Δc (M / F)	Δy (M / F)	m (M / F)
$r_s - r$	1.00	0.51 / -0.57	-0.45 / 0.13	0.52 / 0.59	0.19 / 0.12	-0.70 / -0.30
$r_b - r$		1.00	-0.29 / -0.14	0.25 / -0.40	0.32 / 0.31	-0.61 / -0.20
			1.00	-0.65 / 0.14	-0.30 / 0.21	0.51 / 0.25
Δc				1.00	0.45 / 0.44	-0.29 / -0.08
Δy					1.00	-0.14 / -0.08
m						1.00

Notes: This table reports the correlation matrix of financial and macroeconomic variables with all four shocks in the baseline model based on simulation of one million quarters. The variables include the excess return on stocks ($r_s - r$), the excess return on the 5-year nominal bonds ($r_b - r$), inflation (π), consumption growth (Δc), output growth (Δy), and the pricing kernel (m). The numbers before and after the slash (/) represent the correlations in the M regime and the F regime.

multiple fundamental risks like ours or in models with the nonlinear pricing kernel (Belo et al., 2017).¹⁰ In our model, because the risk premiums of stocks and long-term bonds are driven by the technology shock, they are always positive regardless of policy regime. By contrast, the stock-bond return correlation, which has the same sign as the market beta of the long-term bond, is driven mainly by the investment shock in the F regime. As a result, it becomes negative in the F regime. The coexistence of positive bond risk premiums and the negative stock-bond correlation distinguishes our work from others such as Campbell et al. (2020).

To reinforce the preceding analysis, we simulate the correlation matrix of excess returns of stocks and long-term bonds, inflation, consumption growth, and the pricing kernel in both policy regimes with our model. The results are reported in Table 5. The stock-bond return correlation is 0.51 in the M regime and -0.57 in the F regime; the consumption-inflation correlation is -0.65 in the M regime and 0.14 in the F regime. The correlation between the pricing kernel and returns on stocks are negative in both regimes: -0.70 and -0.30 ; the correlation between the pricing kernel and returns on bonds are also negative in both regimes: -0.61 and -0.20 . These results indicate positive risk premiums of stocks and bonds. Although not emphasized in the literature, the correlation between output and inflation changed sign around 2001 as did the consumption-inflation correlation: negative (-0.25) before 2001Q2 and positive (0.21) after 2001Q2. This sign change is reproduced by the model: the output-inflation correlation is -0.30 in the M regime and 0.21 in the F regime (Table 5).

5. Robustness analysis

5.1. An extended model with eight shocks

We extend our baseline model to include additional shocks commonly used in the macro-finance literature: a transitory productivity (TP) shock, an investment-specific technological (IST) shock, a price markup (PM) shock, and a wage markup (WM) shock. The stochastic processes of these additional shocks are provided in Online Appendix E. The parameter values for persistences and standard deviations of these additional shocks are taken from the prior literature and reported in Online Appendix Table A.1 together with the corresponding references. In Online Appendix G, Figure A.2 reports the impulse responses of key financial and macroeconomic variables to these additional shocks; Table A.2 reports the simulated moments of the model with all eight shocks; Table A.3 reports the variance decomposition of the extended model; Table A.4 reports the stock-bond return correlation, the consumption-inflation correlation, and the output-inflation correlation; and Table A.5 reports the correlation matrix of key variables.

All the key results in our baseline model hold in this extended model, and we report these results and provide discussions in Online Appendix E.

5.2. The ZLB as a special case of the F regime

The ZLB is an extreme case of the F regime, where the policy rate does not react to economic fluctuations at all, i.e., and y are equal to zero. Bianchi and Melosi (2017) explicitly



causes lower inflation and results in higher real interest rate.¹² This contractionary impact on the economy leads to lower consumption and thus a positive consumption–inflation correlation. Lower consumption leads to a fall in stock prices; lower inflation leads to an increase in bond prices. Returns on stocks and bonds, therefore, move in opposite directions. The negative stock–bond return correlation and the positive consumption–inflation correlation in the F regime are reinforced by the technology shock when the ZLB binds.

Online Appendix Table A.6 reports the correlation matrix when the economy is constrained by the ZLB. As one can see, the negative stock–bond return correlation and positive consumption–inflation correlation continue to hold. This result is consistent with the finding of [Gourio and Ngo \(2020\)](#), who focus on the correlation between stock returns and inflation at the ZLB.

5.3. Alternative preferences

In our baseline model, we use a recursive preference with habit formation to generate risk premiums with a reasonable magnitude. We show in this section that the relationship between stock–bond and consumption–inflation correlations and policy regime is robust to alternative preferences.

CRRA preference: Online Appendix Figure A.4 displays the impulse responses to technology and investment shocks in both policy regimes with the CRRA preference ($\gamma = 1/1.5$). The results are qualitatively similar to those for the baseline model with the recursive preference. With the CRRA preference, the finding of positive stock–bond return correlation and negative consumption–inflation correlation continues to hold in the M regime and the opposite finding is also true in the F regime (Panel A of Online Appendix Table A.7).

Recursive preference without habit: We solve a model with a recursive preference but no habit formation ($b_h = 0$). Without habit, consumption becomes more volatile as expected. The signs of key correlations, however, remain unchanged when compared with the baseline results. Both the impulse responses (Online Appendix Figure A.5) and the correlation matrix (Panel B of Online Appendix Table A.7) are qualitatively similar to the corresponding results for the baseline model.

5.4. Preference shock and lower risk aversion

We show in this section that the parameter value of risk aversion can be reduced to 10 by adding a preference shock to our model as in [Corhay et al. \(2021\)](#)¹³, while the model continues to predict these correlations.

The moments simulated from this model (Online Appendix Table A.8) are quantitatively similar to those for our baseline model. While a preference shock leads to positive stock–bond and consumption–inflation correlations in both regimes (Panel (c) of Figure A.6 in Online Appendix G), the variance decomposition reported in Online Appendix Table A.9 shows that the investment shock drives both correlations in the F regime, while the technology shock drives both correlations in the M regime. As a result, the stock–bond correlation remains positive (0.57) in the M regime and negative (−0.52) in the F regime, while the consumption–inflation correlation remains negative (−0.47) in the M regime and positive (0.22) in the F regime (Online Appendix Table A.10).

5.5. Relative importance of shocks

The baseline result depends on the relative magnitude of technology and investment shocks. In this section, we explore how robust this result is within a reasonable range of possible values for the volatilities of these two shocks.

We use [Bianchi et al. \(2019\)](#)'s estimated values of high and low volatilities of technology shocks to set the upper bound of the standard deviation of the technology shock at $\sigma_z = 0.87$ and the lower bound at $\sigma_z = 0.41$. The lower bound of the standard deviation of the investment shock is calibrated at $\sigma_i = 1.47$ to match the investment growth volatility during the Great Moderation period (1986–2007), as documented by [Stock and Watson \(2003\)](#) and [Bernanke \(2004\)](#), while the upper bound is calibrated at $\sigma_i = 4.13$ to match the investment growth volatility during 1971–1985.

We first replace the baseline value of σ_z with the lower bound σ_z . In the M regime, the MP shock contributes most to the stock–bond return correlation, followed by the technology shock; the investment shock contributes most to the consumption–inflation correlation, followed by the technology shock (Panel A of Table A.11 in Online Appendix G). Because both the MP and technology shocks generate a positive stock–bond return correlation and both the investment and technology shocks generate a negative consumption–inflation correlation, our baseline correlation results hold for the M regime. We now replace the baseline value of σ_z with the upper bound σ_z , or replace the baseline value of σ_i with the lower bound σ_i . As in our baseline case, the investment shock is the main driver of the stock–bond and consumption–inflation correlations in the F regime (Panels B and C of Table A.11 in Online Appendix G).

When we replace the baseline value of σ_i with the upper bound σ_i , the technology shock continues to be the driving force for the stock–bond return correlation in the M regime, while the investment shock contributes most to the consumption–inflation correlation, followed closely by the technology shock (Panel D of Table A.11 in Online Appendix G).

¹² See the impulse responses marked by red dashed lines in Panel (a) of Figure A.3 in Online Appendix G. The negative effect of a positive technology shock on consumption is a common result of the new Keynesian model at the ZLB ([Wieland, 2019](#); [Wu and Zhang, 2019](#)).

¹³ See Online Appendix F for the detail of the model when a preference shock is added.

Because both investment and technology shocks generate a negative consumption-inflation correlation in the M regime, our baseline correlation results hold.

In summary, Online Appendix Table A.12 reports the correlation matrix with various shock sizes. This analysis shows that our baseline results are robust to a wide range of parameter values for the volatilities of technology and investment shocks.

5.6. Importance of regime-switching parameters

Our baseline model allows five policy parameters to vary across regimes: the sensitivities of the nominal short-term interest rate to changes in inflation, the lagged interest rate, output growth (ρ , r , and y), and the sensitivities of the tax-to-output ratio to changes in the lagged debt-to-output ratio and the lagged tax-to-output ratio (ζ_b and ζ). The calibrated values in different regimes are based on the estimated results of Bianchi and Ilut (2017).

Two parameters, ρ and ζ_b , define policy regimes. If the values of ρ and ζ_b stay constant across regimes, the policy regime would be in either the M or F regime throughout our sample. In such a case, the model-generated correlations will not change. That is, the stock-bond return correlation would always be positive or negative, and the consumption-inflation correlation would always be negative or positive throughout the sample. Thus, ρ and ζ_b are the most important parameters for the model to account for a sign switch in the stock-bond and consumption-inflation correlations.

To see whether changes in values of the other three parameters are also critical to our results, we allow the values of ρ and ζ_b to change when policy switches from the M regime to the F regime as in our baseline case, but keep the values for r , y , and ζ constant at the average of their values calibrated for the M and F regimes in the baseline model. As shown in Online Appendix Table A.13, the model is still able to generate the positive stock-bond correlation and the negative consumption-inflation correlation in the M regime and the sign change of these correlations in the F regime. Except for ρ and ζ_b , therefore, other regime-switching parameters are not essential to our correlation results.

6. Conclusion

We incorporate interactions between monetary and fiscal policies into a New Keynesian model with the recursive preference to account for (1) the positive stock-bond return correlation and the negative consumption-growth correlation during 1971–2001 when monetary policy was active and fiscal policy was passive (the M regime) and (2) a sign change of these two correlations after 2001 when monetary policy was passive and fiscal policy was active (the F regime). Moreover, our model generates positive risk premiums of stocks and bonds in both policy regimes, consistent with the data. The key mechanism we discover is that the technology shock drives the fluctuation of the economy in the M regime while the investment shock is a driving force in the F regime. Our findings represent a significant step toward bridging financial markets and monetary-fiscal policy interactions in the general equilibrium framework.

Our paper is silent on a number of issues that are beyond the scope of this paper. One issue is to test various alternative theories for explaining a sign change in the correlation of stock and bond returns and to determine the most plausible explanation. Another issue is to resolve the debate on different timings of regime switching in a mix of monetary and fiscal policies (Davig and Leeper, 2011 versus Bianchi and Ilut, 2017, for example). It is our hope, however, that our findings lay the groundwork for studying these and other challenging issues in future research.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.jmoneco.2022.03.003](https://doi.org/10.1016/j.jmoneco.2022.03.003).

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