KEYNESIAN MODELS OF THE LONG-TERM INTEREST RATE

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HIGHLIGHTS

- There are several widely used benchmark models of the long-term interest rate in quantitative finance.
- However, quantitative finance literature is yet to incorporate Keynes's valuable insights about long-term interest rate dynamics. A Keynesian approach to interest rate dynamics can be useful in addressing theoretical and policy issues.
- The Keynesian approach to interest rate dynamics can be easily incorporated in the benchmark models of the long-term interest rate.
- I modify several benchmark interest rate models to take a Keynesian perspective on modeling the long-term interest rate.
- The empirical literature does support for a Keynesian view, but of course there are debates.

WHAT I SHALL DISCUSS

- Motivation
- Keynes's views on the long-term interest rate
- Look at the data
- Models
- Implications

RESEARCH QUESTIONS AND MOTIVATION

- What factors drive the long-term interest rates?
- Does the short-term interest rate influence long-term interest rates?
- Modify several benchmark interest rate models to take a Keynesian perspective on modeling the long-term interest rate.
- What else matters? What are issues in the debate?

THE CONVENTION VIEW IS BASED ON THE LOANABLE FUNDS THEORY

- The conventional wisdom on government bond yields is based on the loanable funds view of the interest rate. It holds that (1) the long-term interest rate depend on the demand and supply of funds in the capital market; and (2) an increase (decrease) in government debt and deficit ratios leads to higher (lower) government bond yields.
- In recent years this view in represented in research: **Ardagna, Caselli and Lane** (2007), **Baldacci and Kumar** (2010), **Lam and Tokuoka** (2011), **Paccagnini** (2016), **Poghosyan** (2014), **Reinhart and Rogoff** (2019), **Tokuoka** (2012), and others.

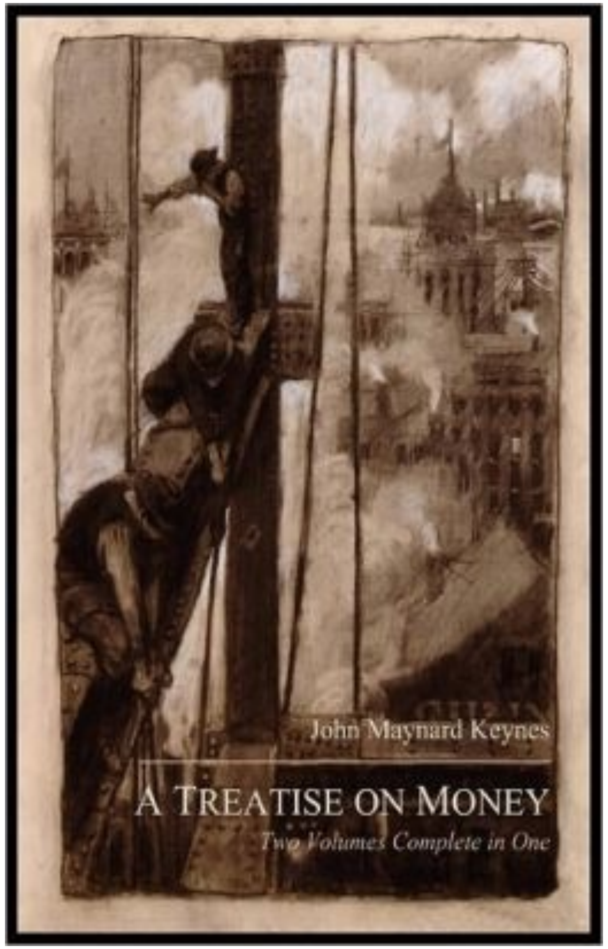
W. W. RIEFLER'S EMPIRICAL STUDIES PROMPTED KEYNES'S VIEWS

"[T]he surprising fact is not that [long-term] bond yields are relatively stable in comparison to short-term [interest] rates, but they have reflected fluctuations in short-term [interest] rates so strikingly and to a such a considerable extent."

---Winfield W. Riefler (1930, 123) cited in Keynes (1930, II: 354-355)

KEYNES ON THE IMPORTANCE OF THE POLICY RATE

- "The efficacy of the Bank rate for the management of a management money was a great discovery … its application in varying conditions were not clearly understood — and have not been clearly understood to this day." (Keynes 1930, Vol I, p.17).



KEYNES ON THE DETERMINANTS OF THE LONG-TERM INTEREST RATE

Monetary policy drives the long-term interest rate through the short-term interest rate.

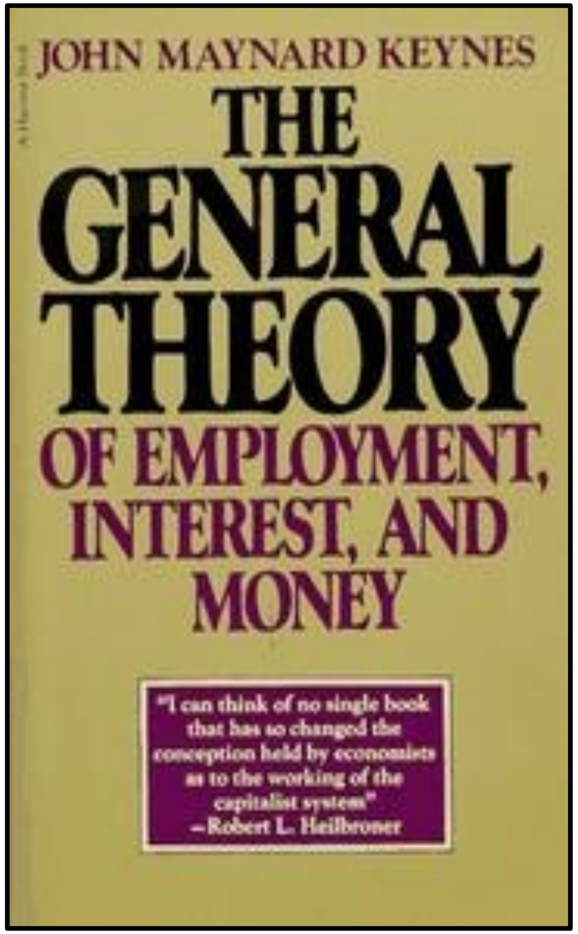
- "The influence of the short-term rate of interest on the long-term rate is much greater than anyone ... would have expected" (Keynes, 1930, Vol II, p.315).
- "Short-term rates influence long-erm rate more than the reader might expect … it is not difficult to find sufficient explanation for this observed fact." (1930, Vol II, p. 362)
- "There is no reason to doubt the ability of a Central Bank to make its short-term rate of interest effective in market. " (1930, Vol II, p 363).

KEYNES ON THE POWER OF THE CENTRAL BANK AND ITS LIMITS

- "The short-term interest rate is easily controlled by the monetary authority. … But the long-term rate may be more recalcitrant" (*General Theory*, 1936 [2007], 202-203).
- "If the monetary authority were prepared to deal both ways on the specified terms in debt of all maturities, and … in debts of varying degrees of risks, the relationship with the complex rate of interest and the quantities of the money would be direct" (*GT*, 2007 [1936), 205)
- "A complex offer by the central bank to buy and sell at stated prices gilt-edged bonds of all maturities, in place of the single bank rate for short-term bills, is the most important practical improvement that can be made in the technique of monetary management. " (*GT*, 2007 [1936], 206).
- "If the monetary authority deals only in short-term debts, we have to consider what influence the price, actual and prospective, of short-term debts excecies on debts of longer maturity." (*GT*, 2007 [1936], 206).

THE "KEYNESIAN" VIEW

- Interest rates have a **psychological and sociological basis** in a world characterized by ontological uncertainty. Economic agents in the real world have **liquidity preference**.
- The **central bank's actions** influence the long-term interest rate primarily through the current short-term interest rate.



LET'S LOOK AT THE DATA

10YR TREASURY AND 3MO TBILLS YIELDS

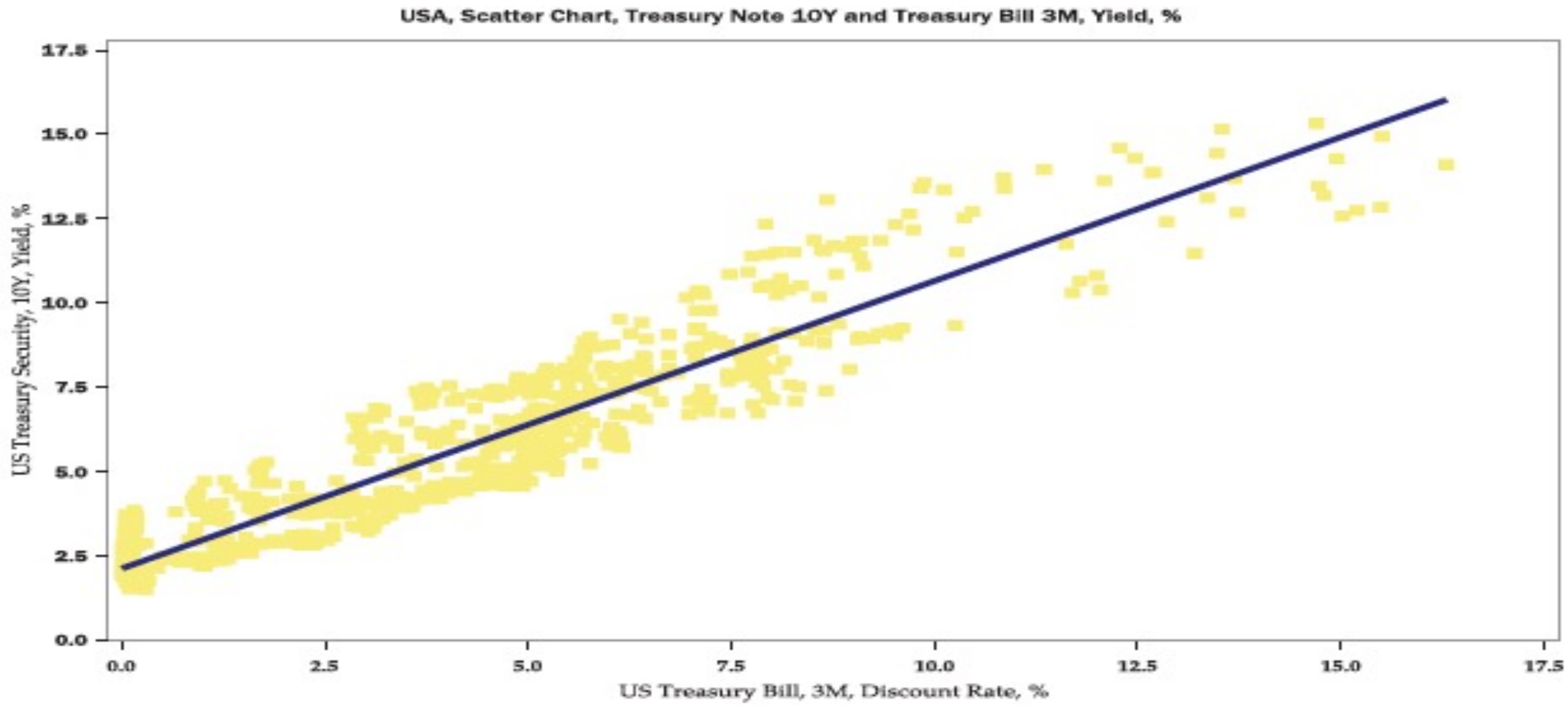


Figure 14. Scatterplot of the yields of 10-year Treasury securities and 3-month Treasury bills.

Source: Akram and Li (2019)

PPT CHANGES IN THE YIELDS OF 10YR UST AND 3MO TBILLS

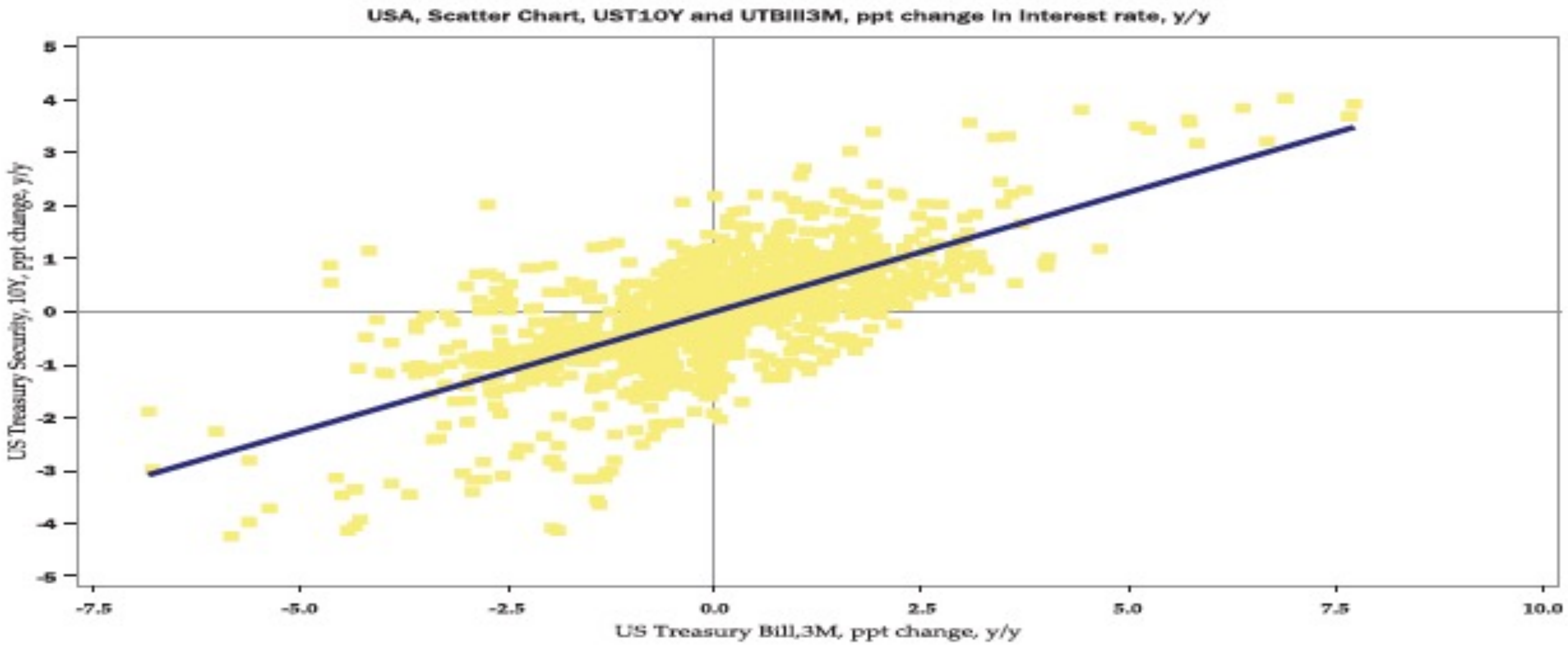
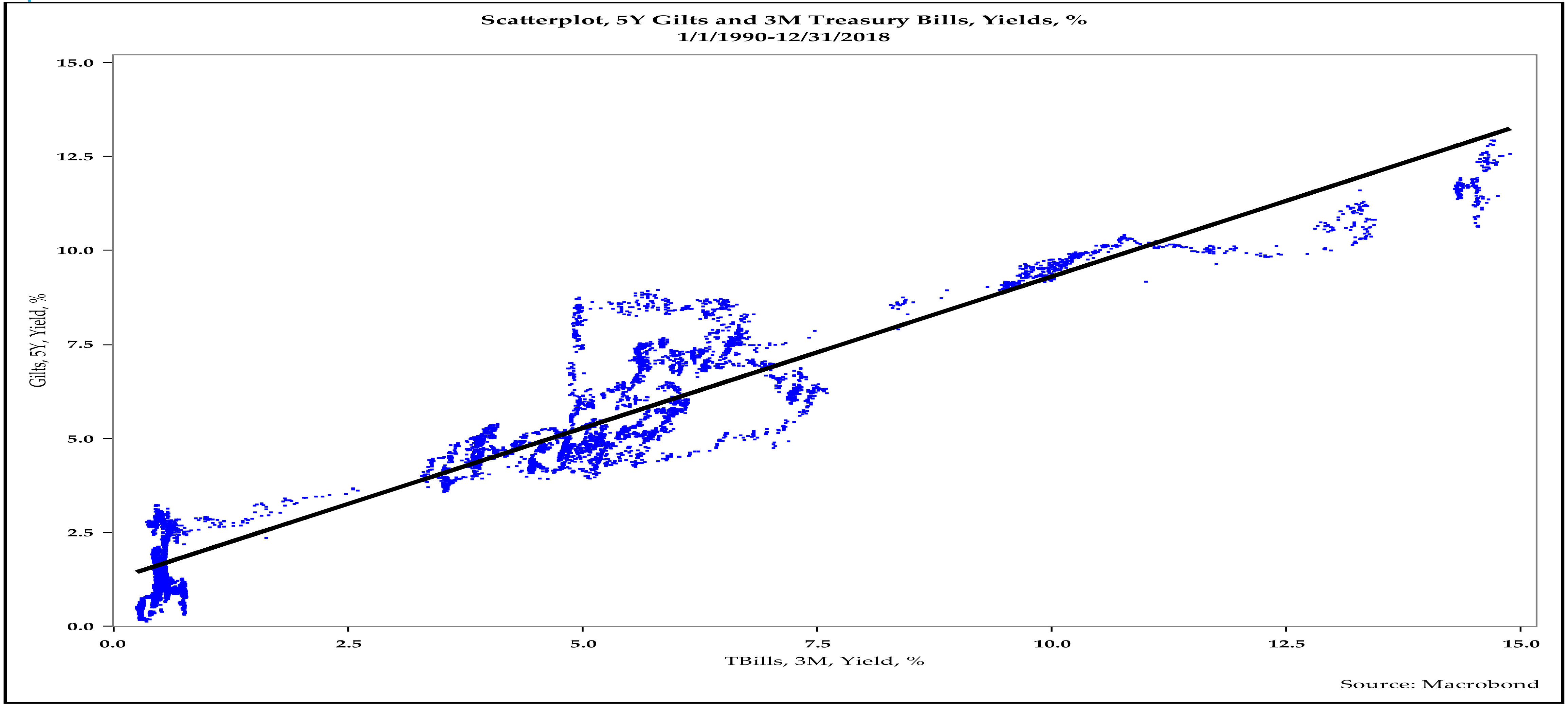


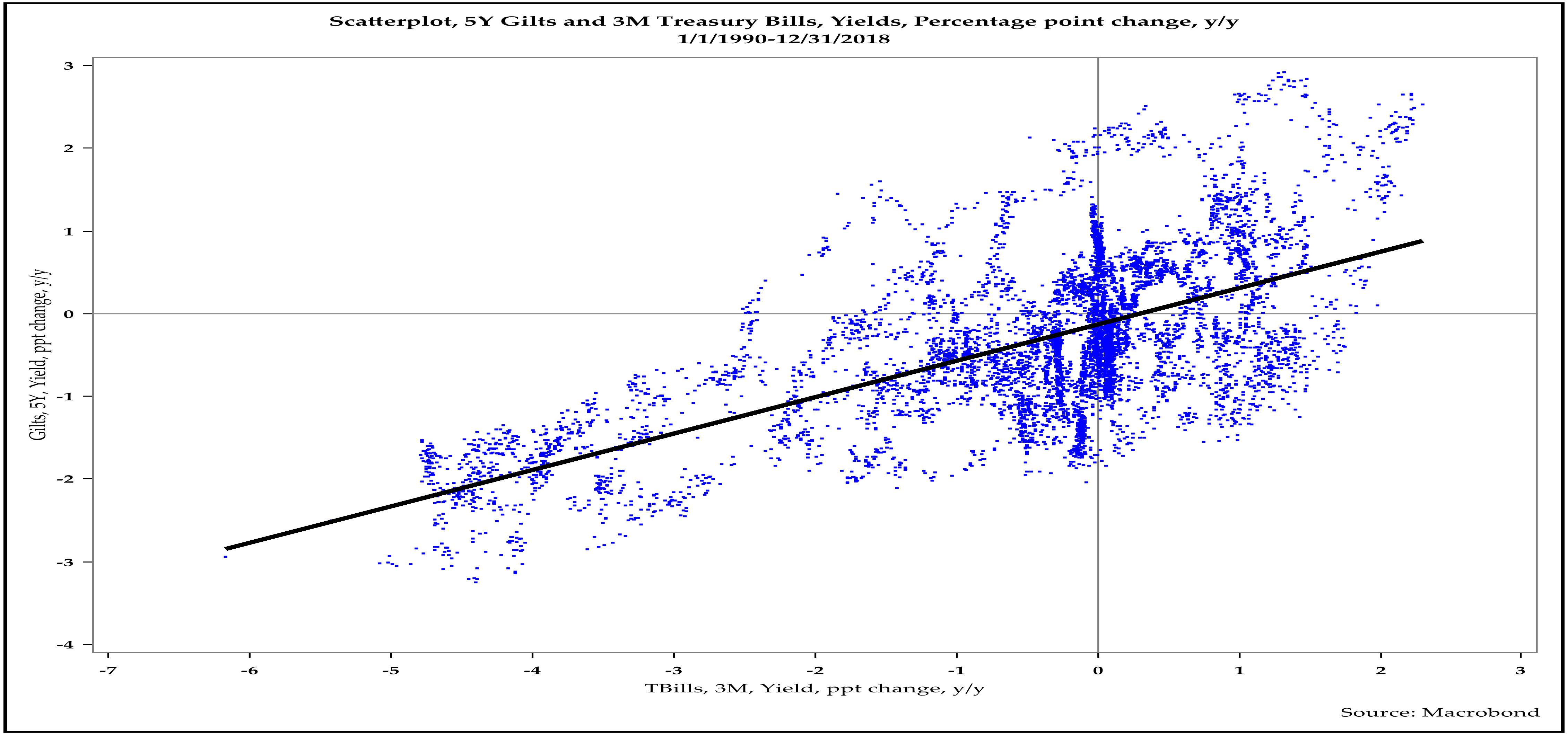
Figure 15. Scatterplot of the year-over-year percentage point changes in yields of 10-year Treasury securities and 3-month Treasury bills.

Source: Akram and Li (2019)

THE YIELDS OF 5YR GILTS AND 3MO TREASURY BILLS, 1990-2018



PPT CHANGES IN THE YIELDS OF 5YR GILTS AND 3MO TREASURY BILLS



FROM EMPIRICAL STUDIES TO MODIFYING BENCHMARK MODELS IN QUANTITATIVE FINANCE

STUDIES THAT CONNECT THE ST INTEREST RATE AND THE LT INTEREST RATE

- **United States**: Akram & Li (2017, 2020), Deleidi and Levrero (2021)
- **Euro zone**: Akram & Das (2017)
- **Japan**: Akram and Das (2014), Akram and Li (2019)
- **Canada**: Das and Akram (2020)
- **Australia**: Akram and Das (2020)
- **Latin America**: Simoski (2019), Akram and Uddin (2021, 2022)
- **India**: Chakraborty (2016), Vinod, Chakraborty, and Karun (2015), Akram and Das (2015, 2019), Pattanaik, John and Behera (2016)

BUT BENCHMARK MODELS IN FINANCE PAY NO ATTENTION TO KEYNES

- Merton (1973)
- Vasicek (1977)
- Donthan (1978)
- Cox, Ingersoll, and Ross (1985)
- Heston (1993)
- Ho and Lee (1986)
- Hull and White (1990)
- Black Derman dnd Toy (1990)
- Kolotay, Williams, and Fabozzi (1993)
- Heath, Jarrow and Morton (1992)
- Brace, Gatarek, and Musiela (1997)
- Rebonato (1996, 2004) provides an overview of these (and other) models

MODEL 1

- A modification of Merton (1973)
- $dr_{LT} = \mu dt + \sqrt{V} dW$

MODEL 2

- A modification of Vaisek (1977)
- $dr_{LT} = \mu r_{ST} dt + \sqrt{V} r_{ST} dW$

MODEL 3

- A modification of Dothan (1978)
- $dr_{LT} = \sqrt{V} r_{ST} dW$

MODEL 4

- A modification of Cox, Ingersoll & Ross (1985)
- $dr_{LT} = \rho(\kappa - r_{ST})dt + \sqrt{V}r_{ST}dW$

MODEL 5

- A modification of Ho & Lee (1986)
- $dr_{LT} = \mu(t) r_{ST} dt + \sqrt{V} dW$

MODEL 6

- A modification of Dothan (1978), Ho & Lee (1980), Black Derman, & Toy (1980)
- $dr_{LT} = \left\{\alpha(t) + \left[\frac{\sqrt{V'(t)}}{\sqrt{V(t)}}\right] ln(r_{ST})\right\} r_{ST} dt + \sqrt{V(t)} r_{ST} dW$

MODEL 7

- A modification of Black, Derman, & Toy (1990)
- $dr_{LT} = [\alpha(t) - \beta(t) r_{ST}]dt + \sqrt{V(t)}dW$

MODEL 8

- A modification of Hull & White (1990), Black & Karasinki (1991)
- $dr_{LT} = [\alpha(t) - \beta(t)ln(r_{ST})]r_{ST}dt + \sqrt{V(t)}r_{ST}dW$

MODEL 9

- A modification of Kalatay, Williams, & Fabozzi (1993) and Ho and Lee (1980)
- $dln[r_{ST}] = \mu(t)(ln[r_{ST}])dt + \sqrt{V(t)}r_{ST}dW$

MODEL 10

- A modification of Cox, Ingersoll, & Ross (1985)
- $\boldsymbol{dln[r_{ST}] = \rho(\kappa - ln[r_{ST}])dt + \sqrt{V} r_{ST} dW}$

POLICY IMPLICATIONS AND CONCLUSION

IMPLICATIONS

- Simple modifications of standard interest rate models in quantitative finance can incorporate some Keynesian insights about interest rate dynamics.
- The Keynesian approach to interest rate dynamics can be valuable for understanding and assessing the central bank's policy actions and monetary transmission mechanism.
- These models emphasize the role of the short-term interest rate as a primary driver of the Treasury yield curve and its shape. Other aspects of monetary policy, such as calendar-based and information-conditional forward guidance, policy pronouncements, large-scale asset purchases, and yield curve control, should be viewed as secondary.
- The influence of the fiscal deficit ratio or fiscal government debt ratio on government bond yields of a country with monetary sovereignty is likely to pale in comparison to the influence of the short-term interest rate and the central bank's other tools if a country has monetary sovereignty.
- There is ample scope for activist policy, without the undue fear of bond market vigilantes.