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August 2019

Working Paper 2019-18

https://www.frbsf.org/economic-research/publications/working-papers/2019/18/

Suggested citation:

Glick, Reuven. "R* and the Global Economy," Federal Reserve Bank of San Francisco Working Paper 2019-18. https://doi.org/10.24148/wp2019-18

R* and the Global Economy

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August 5, 2019

Abstract

This paper provides a synthesis of explanations for why the natural rate of interest, r*, has fallen over the last several decades. Demographic factors, declining productivity, slower output growth, and increasing inequality likely all have been important factors. Perhaps less recognized is the role of increasing global demand for safe assets, particularly by foreign investors. Suggestive empirical evidence is presented showing that foreign demand for U.S. safe assets, particularly government-provided assets, has increased dramatically, and may now be playing a much larger role in the determination of U.S. interest rates than in the past. In addition, the buildup before the 2007-2009 financial crisis of quasi-government and privately-supplied safe assets, held by both domestic and foreign investors, rendered the financial system more vulnerable to shocks that adversely affected the perceived degree of "safeness" they provided.

JEL Classifications: E43, E44, F34, F65

Keywords: natural interest rate, real rate, neutral rate, r-star, safe assets, saving, investment, asset preferences, foreign asset holdings, monetary policy

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* This paper is adapted from keynote remarks presented at the conference on "Global Safe Assets, International Reserves, and Capital Flow," sponsored by the Global Research Unit, Department of Economics and Finance, City University of Hong Kong and the Journal of International Money and Finance, held on May 20-21, 2019. It is forthcoming in the Journal of International Money and Finance. The views expressed in this paper are solely those of the author and should not be interpreted as reflecting those of the Federal Reserve Bank of San Francisco or the Federal Reserve System.
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1. Introduction

The conduct of monetary policy involves a great deal of "navigating by the stars," i.e., understanding long-term trends in key macroeconomic variables, such as the potential output growth rate, g* ("g-star"); the natural unemployment rate, u* ("u-star"); and last, but not least, the natural real interest rate, r* ("r-star"). These variables all play important roles in projecting the longer-term direction of the economy and in the setting of monetary policy.

In recent years, r* star has taken on a more central role in the policy debate on the appropriate stance for monetary policy in the United States and elsewhere. There is abundant evidence that the real interest rate has been falling. However, there is some debate about why it has been falling and how long it will remain low.[1]

There are several leading explanations for why interest rates have fallen. The first interprets declining rates primarily as a supply-side phenomena associated with lower productivity growth and aging populations, as Williams (2016, 2017) and others contend. A competing, though not necessarily mutually exclusive, explanation considers falling interest rates as mainly a demand-side phenomena stemming from secular stagnation due to insufficient aggregate demand, as Summers (2015) argues. Still others maintain that excessive global safe asset demand play an important role, as expressed in Caballero, Farhi, Gourinchas, and Jeanne in various combinations of co-authored papers (e.g., Caballero et al., 2017).

The truth is certainly that some combination of these and other factors matter. However, in my view the role of global factors is possibly underweighted in this discussion. Yes, everyone recognizes that there is a safe haven effect in global financial markets that played a role during the 2007-2009 financial crisis in increasing demand for U.S. assets, particularly U.S. Treasuries, which pushed the dollar up and Treasury rates down. And there is an awareness of international spillover effects in international capital markets that link U.S. interest rates to developments abroad. Still, in many circles these effects are typically regarded as having only a second order and/or temporary impact on the United States economy, including on r*.

The motivation of this paper is to provide evidence that foreign factors may be having a larger, maybe even first-order, long-term impact on r* in the United States, particularly as the world continues to become more integrated. This is not to argue that international factors are the main determinant of low interest rates in the U.S. and other advanced countries, but global factors may be underweighted, even for a country as large as the United States.

The current situation is reminiscent of the so-called Greenspan (2005) "conundrum" of the mid-2000s. At the time, the Federal Reserve was engaging in a cycle of policy rate hikes, but long-term bond rates were not rising much in step. Many policymakers and researchers emphasized the role of various premia that had been falling due to technological changes, lower expected inflation, etc. Relatively few were talking about the role of international factors and

[1] Analysis of changes in the other star variables is also ongoing. For recent discussion of the determination of g*, see Fernald (2016). For new estimates of u*, see Barnichon and Matthes (2017).

capital inflows from the rest of the world that may have been keeping long-term rates down. Ben Bernanke (2005) was a notable exception when he expressed his global saving glut view.

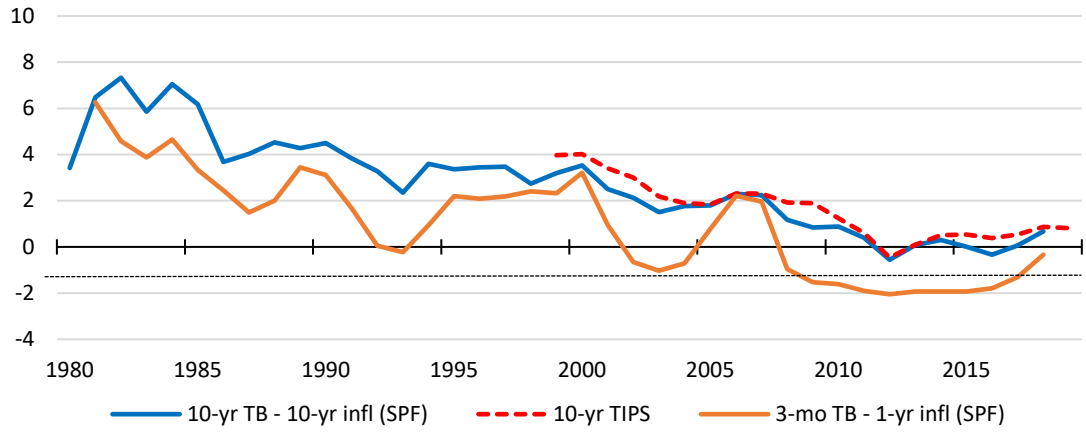
My remarks are organized as follows. Section 2 presents some stylized facts about recent estimates of the natural rate r*. Section 3 provides an overview of the determinants of r*, first from the perspective of the investment and saving balance framework, and secondly from the perspective of a newer approach focusing on the supply and demand for safe assets. To some extent the safe asset approach is like putting old wine in new bottles with fancier labels, but it provides important insights. Section 4 presents some updated empirical evidence, involving both price and quantity data, that bears on the question about how important safe asset preferences and foreign factors have been in affecting the natural interest rate. Section 5 conclude with some thoughts about the implications for the conduct of U.S. monetary policy. Much of this material may sound familiar, but the hope is that this synthesis will add some value nonetheless.

2. Real Interest Rates and Some Stylized Facts

2.1. Real Interest Measures

Figure 1 documents recent U.S. interest rate trends by plotting three different measures of U.S. real interest rates, i.e., nominal rates adjusted for expected inflation: a 10-year real rate, defined as the annualized yield on 10-year Treasury government bonds minus annualized 10-year expected inflation from the Survey of Professional Forecasters (SPF); a short-term real rate, defined as the 3-month nominal Treasury bill rate minus the 1-year expected annualized inflation also from the SPF; and the 10-year annualized yield on Inflation-indexed Treasuries (TIPS). All figures are annual averages of quarterly data. The data for the short-term rate begin in 1981 when 1-year inflation expectations from the SPF started; the TIPS data start in 1998.

Fig. 1: U.S. Real 10-year and 3-month Treasury Yields (%)



All three measures display a substantial decline in the real rates since the early 1980s, on the order of four percentage points for the 10-year Treasury rate and even more for the short rate, to their current levels of less than 1 percent.

2.2. Definitions of r*

The decline in U.S. real interest rates in recent decades is often attributed to a lower level of the natural, or equilibrium, real rate of interest, r*.

There are various definitions of r*, with subtle, but important differences. The usual definition of r* is the level of the real rate of interest that prevails when the economy is growing at its potential growth rate and inflation is at target, or, equivalently, desired saving balances with investment at these targets. With a real interest policy rate at this level of r*, monetary policy should be neither expansionary nor contractionary in affecting aggregate demand, hence the label "neutral rate" is also used.

A distinction is made sometimes between the short- and long-run natural interest rate. The short-run natural rate can be influenced by transitory shocks, such as heightened uncertainty, and business cycle headwinds and tailwinds, such as monetary and fiscal policy shocks. The long-run natural rate prevails after the effects of all these shocks have dissipated. Differences between the long-run r* and short-run r* may be interpreted as a measure of the current stance of monetary policy. If the short-run r* is less (greater) than the long-run r*, then monetary policy is expansionary (contractionary).[2] Thus the long-run r* can be understood as the level where the short-run r* is expected to be several years in the future when business cycle effects have fully waned and there are no further headwinds and tailwinds.

In empirical applications where data observations are influenced continually by shocks, estimations of r* depend on the horizon over which expectations are presumed to be formed. In this spirit, Laubach and Williams (2016) define a "longer-run" variant of r* as "the level of the real interest rate expected to prevail, say, five to ten years in the future, after the economy has emerged from any cyclical fluctuations and is expanding at its trend rate." Laubach and Williams (2003), Kiley (2015), and Holston, Laubach, and Williams (2017) use similar definitions. Economists estimating r* with structural models typically define an infinite horizon r* as the real rate expected in the very distant future -- infinite in theory, 50-100 years in simulations (e.g., Del Negro et al., 2017). This infinite-horizon r* may differ from the longer-run r* because of permanent shocks and structural breaks in economic relationships from, e.g., expected long-run changes in savings due to demographic factors.

2.3. Estimation of r*

There is a growing literature estimating the level of r* using different empirical techniques. Figure 2 shows a range of estimates of the natural rate from six different studies: Laubach and Williams (2003), Kiley (2015), Lubik and Matthes (2015), Johanssen and Mertens (2016), Holston, Laubach, and Williams (2017), and Del Negro et al. (2017).[3] The data for Laubach and

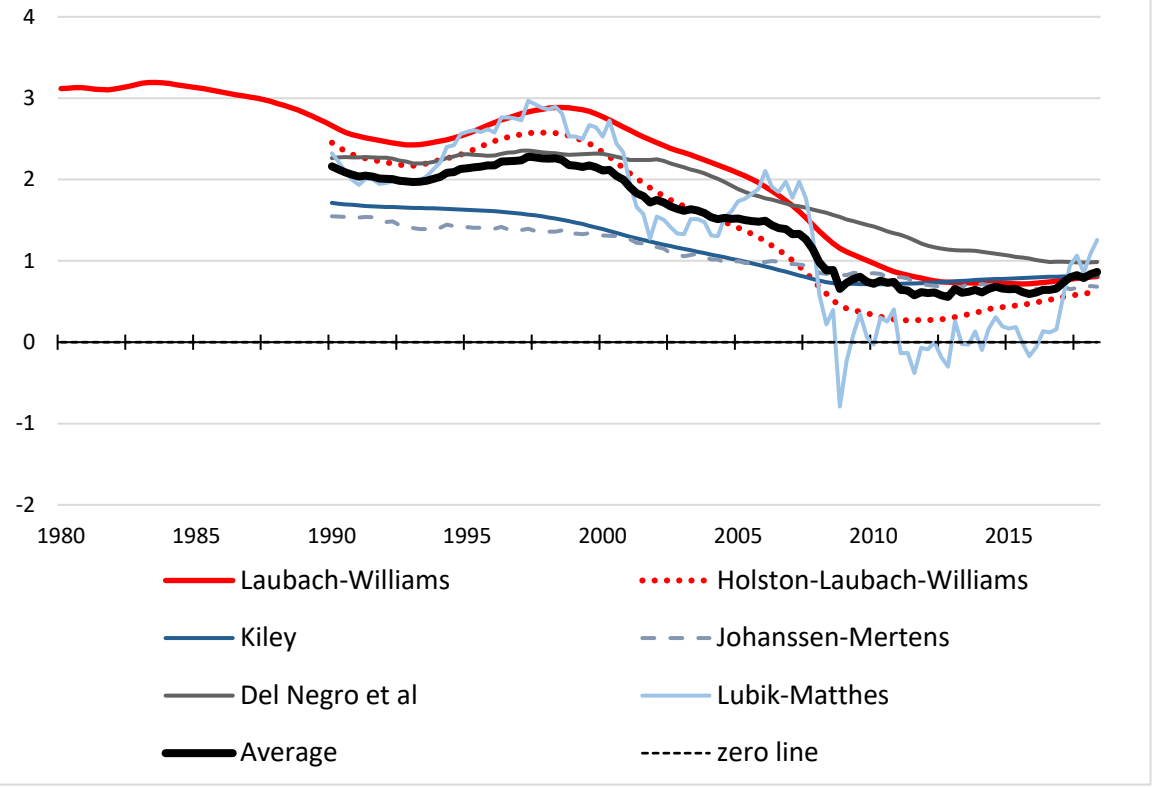
[2] In these circumstances, monetary policy can help the economy move towards its potential growth path by adjusting the policy rate in response to changes in the short-run natural rate. See Brainard (2018).

[3] The Laubach-Williams figures are "current model" quarterly data drawn from the FRBNY website at https://www.newyorkfed.org/research/policy/rstar. Appreciation is given to my colleague Michael Bauer for assembling data for the other series. All data are constructed with two-sided filters. These studies make use of macro-based models and data. An alternative financed-based approach makes use of term structure relationships.

Williams are plotted back to 1980; data for the other series extend back to 1990. The solid line in the figure plots the average of these six estimates since 1990, when data are available for all of the series.

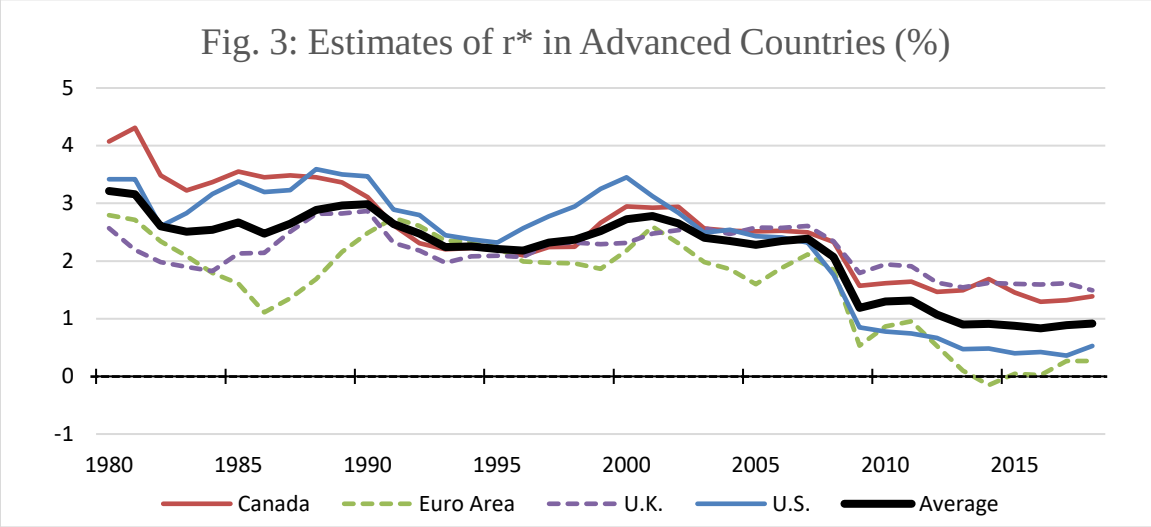
Although the estimates vary across individual studies at any point in time, the average estimate has clearly declined over the past two decades, with the downward trend apparent even before the U.S. recession and global financial crisis of 2007-2009. Laubach and Williams estimate that r* was about 3% in the 1980s, trended down to 2% in the mid-2000s, and fell further during the crisis. The average estimate followed a similar path. Currently, all of the estimates are below 1%. Thus, the decline in real interest rates observed in Figure 1 has been accompanied by a significant decline in estimates of the natural rate.

Fig. 2: Estimates of r* for the U.S. (%)



For example, Christensen and Rudebusch (2017) estimate r* using a dynamic term structure model with data for U.S. TIPS rates.

Estimates of the natural rate have declined in other major advanced economies as well. Figure 3 plots updated estimates from Holston et al. (2017) of the natural interest rate for four advanced economies -- Canada, the euro area, the United Kingdom, and the United States. [4] In all four economies, the estimated level of r* has fallen over the past decade, with the most recent estimates the lowest over the period. Rachel and Summers (2019) employ the Laubach-Williams methodology and estimate r* for OECD advanced countries as a group; they also find that r* has followed a downward path through to the current period.[5]



Source: Holston et al. (2017), updated from the Federal Reserve Bank of New York website at https://www.newyorkfed.org/research/policy/rstar. The average is unweighted.

3. Determinants of r*: Saving and Investment Balance Approach

3.1. Graphical Framework

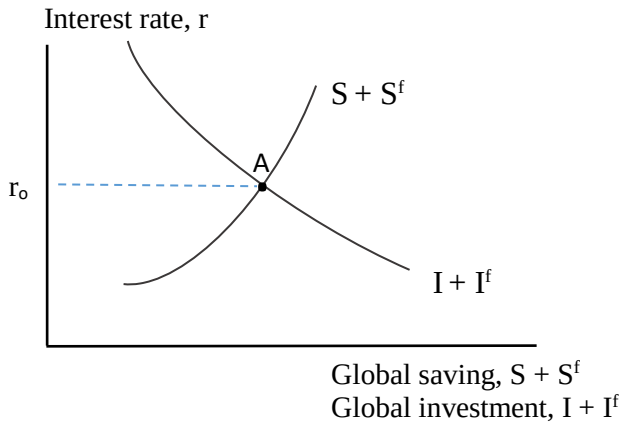
A standard approach to understanding the determination of r* is to view the natural interest rate as fundamentally determined by the balance of saving and investment demands when output is at its potential. In the simplest terms, this is illustrated in Figure 4 which depicts the determination of the equilibrium interest rate in a two-region framework with open capital

[4] These measures are annual averages of quarterly data drawn from the FRBNY website at https://www.newyorkfed.org/research/policy/rstar. The estimates are constructed with one-sided filters. As a result, the series in Figure 3 appear more volatile than those for Laubach-Williams and Holston et al. in Figure 2 that use two-sided filters. The average is unweighted. Truth in advertising warrants mentioning that there is a great deal of statistical uncertainty in each of the individual estimates.

[5] Rachel and Summers (2019) point out that estimates of the natural real rate for the United States and other open economies typically take the trade imbalance, an endogenous variable in general equilibrium, as given. This ignores the downward effect on r*in a country running a persistent current account deficit from domestic demand exceeding potential output, or equivalently from domestic investment exceeding saving. Consequently, they estimate r* using aggregated data for all advanced economies, as if they formed a single, fully integrated economy (and ignore the contribution of saving from emerging economies in the rest of the world). As a result of including many countries with high real interest rates in the 1980s, their estimate of r* is higher in the early part of their sample than those for the individual countries included in Holston et al. (2017).

markets, where the upward-sloping global saving schedule ($S + S^f$) and downward-sloping investment schedule ($I + I^f$) determine the equilibrium real interest rate and the superscript "f" denotes the foreign region, i.e., the rest of the world.[6] As discussed below, many factors may affect the levels of investment and saving in each region, including output, y. When output is at full potential, i.e. $y = y^*$, $y^f = y^{f*}$, then the equilibrium interest rate determined at point A can be interpreted as the natural rate, implying $r_o = r^*$.[7]

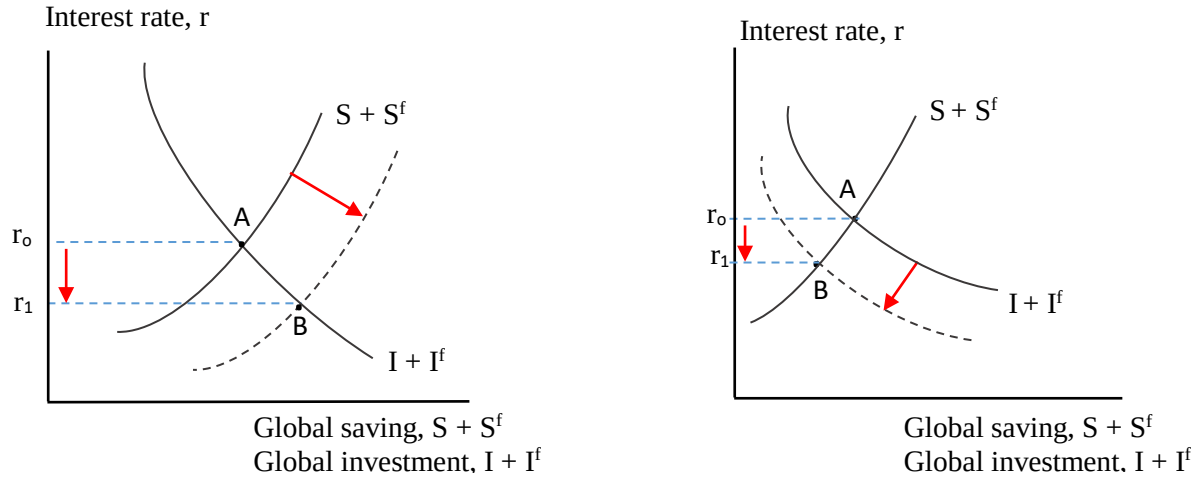
Fig. 4: Equilibrium interest rate



3.2. Saving and Investment Determinants of r*

It is immediately clear, as illustrated in Figure 5, that anything that causes investment to decline or saving to increase in either region will lower the equilibrium interest rate (r_o to r_1).

Fig 5: Effects of saving increase and investment decline on interest rate



[6] See Obstfeld and Rogoff (1996, Ch. 2) for a textbook example.

[7] Obviously if the U.S./advanced country group is large enough, then the S^f and I^f components of global investment and demand do not matter in the determination of r*. In that case, r* is exogenously determined from the perspective of the rest of the world (presuming no barriers to capital mobility).

So far this is economics 101. The challenge is understanding what has been causing these curves to shift and by how much. Are the drivers working through shifts in domestic S, I and/or foreign S^* or I^*? What is the magnitude of the effects? Are the drivers long-term or temporary? In theory there are a myriad of factors that may have lowered investment and raised saving over the past few decades, pushing down the natural real interest rate.

Factors that may possibly have increased saving (shifting the $S+S^f$ curve out right in Figure 5) include

- Demographic changes, such as aging, longer life expectancy, lower dependency burdens,
- Rising inequality,
- Fiscal spending or debt reductions,
- Faster income growth,[8]
- Excess foreign saving, and
- Risk preference shift towards safer assets.

Factors that may have reduced investment (shifting the $I+I^f$ curve down to the left in the figure) include

- Slower productivity gains and potential output growth,
- Reduced investment profitability,
- Declining competition, and
- Falling prices of investment goods.

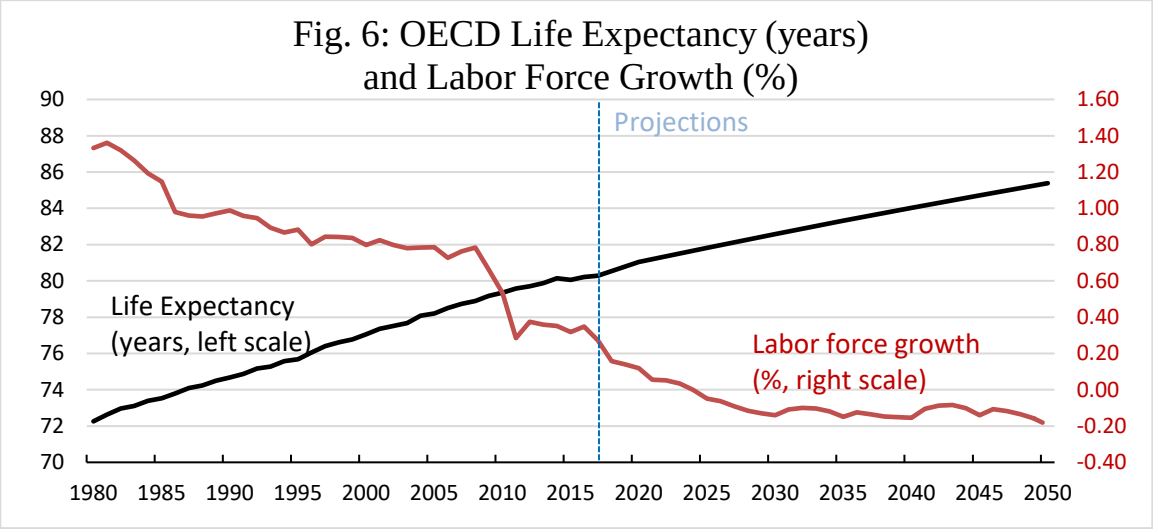
Some of these factors can be interpreted as structural, long-term economic forces; others are transitory, though possibly persistent, factors.

[8] The permanent income hypothesis implies that faster future output growth leads to greater current consumption and lower saving. However, with habit persistence, consumption will adjust sluggishly, implying saving will rise. See IMF (2014, Ch. 3) which argues that the latter mechanism explains the higher saving in fast-growing emerging market economies during the 2000s.

3.3. Magnitudes of Saving and Investment Shift Factors

There is abundant empirical evidence that the global economy is experiencing significant shifts in various factors cited above affecting saving and investment.

Demographic factors affect saving in a number of ways. As seen in Figure 6, life expectancy in more developed economies has been steadily rising and is projected to keep increasing. Greater expected life expectancy encourages more saving for a longer period of retirement, thereby putting downward pressure on interest rates (Gagnon et al., 2016). In developing countries, saving is also increasing as a result of a rising share of the working-age population and corresponding declines in dependency ratios. A lower dependency ratio results in increased saving as the working population tends to save more than retirees.

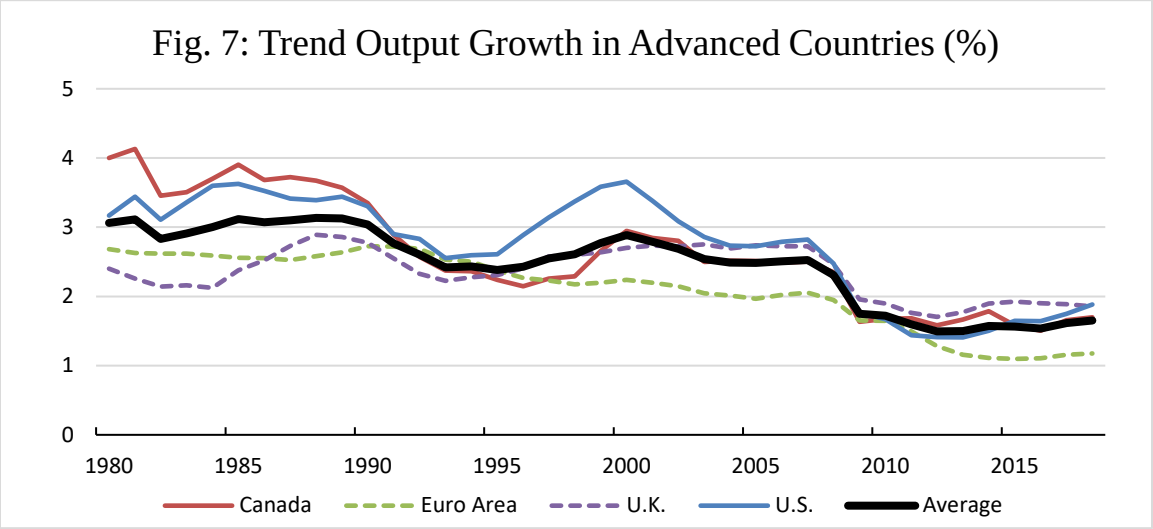


Note: Labor force defined as population aged 16-64. Source: United Nations data from World Bank database.

Greater income inequality within the United States and other countries also tends to increase aggregate saving as higher-income households have a higher propensity to save (Dynan et al., 2004). Auclert and Rognlie (2016) analyze channels through which income inequality affects real interest rates in a general equilibrium model. In addition, as Rachel and Summers (2019) discuss, increasing income inequality has increased the variance of income shocks faced by workers, thereby creating more uncertainty that leads to an increase in precautionary saving.

The slowdown of potential output is another important factor. Demographics may affect output growth and investment through the output supply channel. As fertility rates decline and populations age, labor force growth slows and eventually falls. Labor force growth in the United States has slowed, due to the retirement of baby boom generation workers as well as a lower fertility rate. Growth of the OECD working-age population peaked at 1.4% per year in the early 1980s and subsequently has fallen to a scant 0.3% (see Figure 6). Slower labor force growth implies slower output growth and less investment, which in turn pushes r*down.

Slower productivity growth will also reduce output growth. Rachel and Summers (2019) show that trend growth rates of productivity growth has declined significantly in advanced economies since the early 1980s, U.S. annual productivity growth averaged 2-3% in the 1990s and early 2000s, but began declining -- even before the financial crisis-- to much lower levels. As a result, measures of potential output growth in the United States have declined dramatically from prior periods, to 1¼ - 1¾% by some estimates (Fernald, 2016). Figure 7 shows comparable declines in estimates of trend growth in other advanced countries.



Note: Average is unweighted. Source: Holston et al. (2017), updated from the Federal Reserve Bank of New York website at https://www.newyorkfed.org/research/policy/rstar.

Some attribute low trend output growth in advanced economies, not to lower productivity, investment, or labor force growth, but to "secular stagnation." According to the secular stagnation view, trend output growth has been slow in advanced economies since the 1990s because of chronically weak aggregate demand, creating a permanent situation of less than full employment and low growth (Summers, 2015; Rachel and Summers, 2019).

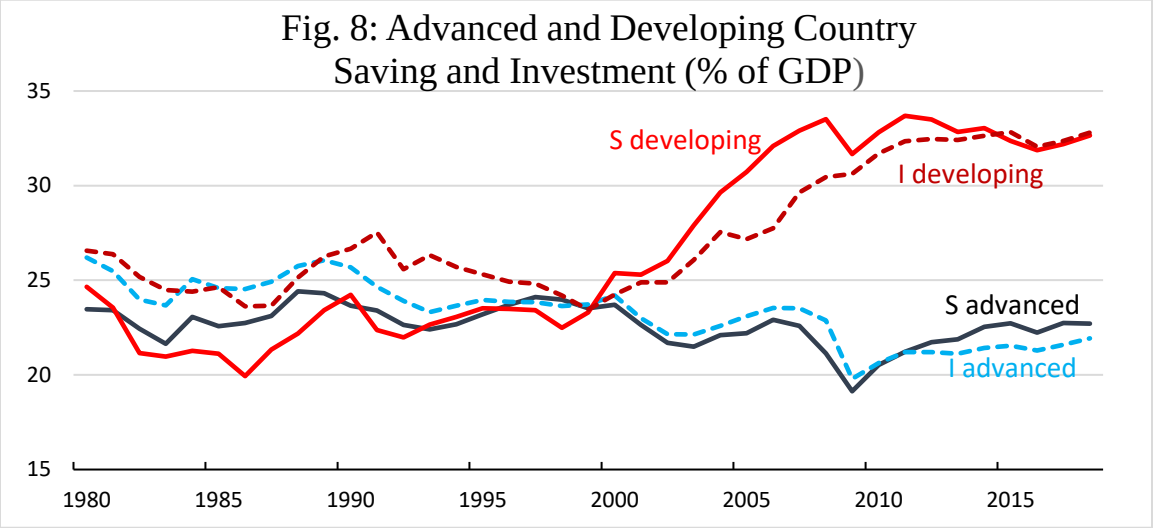
Another possible supply side factor that may have contributed to declining investment is increasing industrial concentration and the associated rise in market power of firms in the U.S. and other advanced countries. Investment-specific technological change that has resulted in a decline in the relative price of capital goods has an ambiguous effect: on the one hand, a lower cost of investment inputs for production may stimulate investment, but on the other hand, less investment is needed to produce a given level of output (Sajedi and Thwaites, 2016; IMF, 2014).

Of course, there may have been other factors pushing r* in the opposite direction. Rachel and Summers (2019) focus on the effects of fiscal policy expansion on the real interest rate. They argue that expanding social spending, government deficits, and government debt[9] since the 1980s have raised the equilibrium long-term real interest rate, other things being equal.

[9] Rachel and Summers estimate that the government debt-to-GDP ratio of advanced countries rose from 18% to 68% over the last 40 years.

What about the role of excess foreign saving? Some have pointed to high saving rates in many emerging market countries, combined with a lack of suitable domestic investment opportunities in those countries, as putting downward pressure on rates in advanced economies.

Figure 8 shows that saving and investment in developing countries rose sharply starting in the early 2000s, with the saving rate rising faster, motivated both by higher growth and by greater precautionary saving by emerging economies in the aftermath of the late-1990s Asian crisis, as well as by increased revenues earned by oil exporters from higher oil prices (IMF, 2014, Chapter 3). This saving-investment gap contributed to emerging-market current account surpluses and the "global saving glut" that Bernanke (2005) argued helped to fuel global current-account imbalances and asset price pressure in financial markets, particularly in the United States. Saving and investment fell during the financial crisis for both developing and advanced countries. During the subsequent recovery, the surpluses grew smaller in the developing country, while advanced country deficits turned to surpluses.[10]



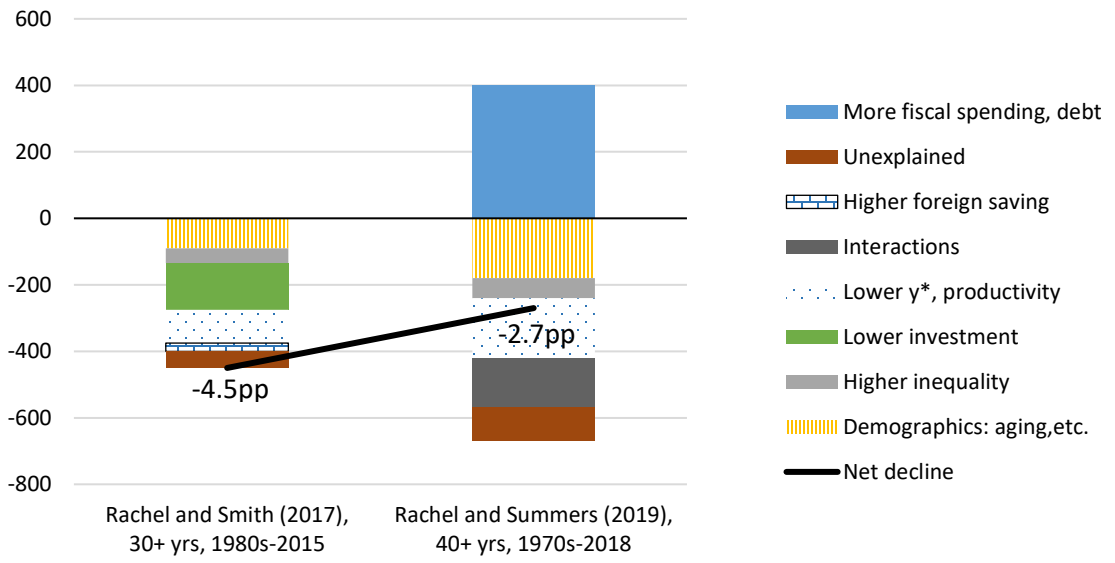
Source: IMF World Economic Outlook Database (2019). Note that saving and investment are scaled by group, not world, GDP.

[10] Note that the recent figures for the advanced country group mask the ongoing current account deficits of the United States that have been offset by surpluses of advanced European countries and Japan.

3.4. Empirical Estimates of Impact of Saving and Investment Determinants on r*

Several studies estimate the magnitudes of the effects of some of these potential factors behind the decline in real interest rates. Figure 9 compares the magnitudes of the decline attributable to specific factors in two recent studies – Rachel and Smith (2017) who use reduced-form elasticity estimates and Rachel and Summers (2019) who employ structural models.[11] Rachel and Smith seek to explain the 4½ percentage point decline in their measure of the global real interest rate since the 1980s, while Rachel and Summers try to explain the 2.7 percentage point decline in their estimate of the natural rate for OECD countries since the 1970s.[12]

Fig. 9: Decline in r* Decomposed (bps)



Rachel and Smith's analysis concludes that shifts in desired saving and investment account for about a 300 basis point (bp) decline in the real rate, with 160 bps explained by saving factor changes and 140 bps by investment factors:

- On the saving side, demographic factors operating through declines in dependency ratios in the developing world (measured as the share of dependents aged 0-19 and 65+ out of total population) explained a decline in r* of about 90 bps, rising inequality accounted for a 45 bp decline, and excess foreign saving accounted for the remaining 25 bps.

[11] IMF (2014, Ch. 3) analyzes the qualitative role of many of the same factors on global real rates over the period 1996-2012, but do not provide quantitative estimates of their magnitudes. See also Council of Economic Advisors (2015).

[12] Since inflation was low and stable for most of this period, Rachel and Smith treat the decline in their measure of the real rate as a proxy for the fall in the equilibrium natural rate. In contrast, Rachel and Summers (2019) estimate a long-term measure in the spirit of Laubach and Williams (2003, 2016) and Holston et al. (2017). This explains why Rachel and Smith's figure for the change in the real rate (4.5%) is almost 2 percentage points larger than that of Rachel and Summers (2.7%): in the early 1980s, when the former's sample begins, long-term rates were cyclically high because of tight U.S. monetary policy.

- On the investment side, they quantify the effects of a decline in the relative price of capital goods (50 bps), preference shifts away from public investment projects (20 bps), and an effective increase in the return to capital (since the return on capital has fallen much less than the natural rate, accounting for 70 bps).[13]

In addition to these factors accounting for a 300 bp decline in r*, Rachel and Smith estimate that lower long-term growth expectations attributable to slower labor supply growth and lower productivity growth account for a further 1 percentage point in the total decline in the real rate of 4.5% over the period 1980-2015 that they try to explain. The remaining 50 bps is unexplained.

Rachel and Summers (2019) focus on the effects of fiscal policy on real rates, a factor not considered by Rachel and Smith. They find that rising fiscal spending, particularly on expansions of social insurance programs, and accompanying greater government debt raised the natural real interest rate by about 4 percentage points, other things equal.

- More specifically, simulations from their dynamic general equilibrium model capturing life-cycle behavior, with workers saving for retirement and retirees spending down their wealth, suggest that shifts in fiscal policies pushed the equilibrium real rate up by over 3.2 percentage points since the early 1970s.[14]

- Simulations from a second model, with idiosyncratic income risks leading to precautionary behavior and with government debt serving as a safe asset allowing households to self-insure, suggest that the increase in the supply of government bonds from expansionary fiscal policy pushed r* up by an additional 70 bps through a precautionary "supply of safe assets" channel.

Their analysis implies that the observed 2.7 percentage point (pp) fall in the real long- term interest rate masks an even larger decline in the natural rate attributable to private sector factors:

- On the saving side, they estimate that demographic effects pushed r* down by around 180 bps and the rise in income inequality led to an additional decline of around 60 bps.

- In addition, they estimate that a slowdown in trend total factor productivity growth of 0.8% per year led to a further 180 bp decline in the natural rate.[15]

- Interaction effects account for roughly 150 bps, with another 100 bps unexplained.

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[13] The IMF's (2014, Ch. 3) analysis concludes that higher emerging market growth and saving as well as portfolio shifts towards safer bonds played a large role in the decline of real rates in the 2001-07 period, while lower investment profitability and further portfolio shifts mattered most in 2009-12. See also Fischer (2016) who reports results of Board econometric model simulations that explains a total decline in U.S. r* of 280 bps. Most of this decline is attributed to lower U.S. trend output growth, due to both lower productivity growth (85 bps) and labor force growth (30 bps), and lower saving due to demographic aging (75 bps). Relatively less of the decline is attributable to weak investment (60 bps) and slower foreign trend growth and lower interest rates abroad (30 bps).

[14] They also present results from reduced-form estimates indicating fiscal policies led to similar magnitude increases in the interest rate.

[15] It should be noted that the linkage between trend output growth and r* is built into the Laubach-Williams (2003) and Holston et al. (2017) estimation methodology used by Rachel and Summers. See Hamilton (2016).

Thus, in the absence of fiscal policy factors increasing r*, Rachel and Summers argue that these private sector factors on their own would have generated a fall of almost seven percentage points in the natural real rate since the 1970s.[16]

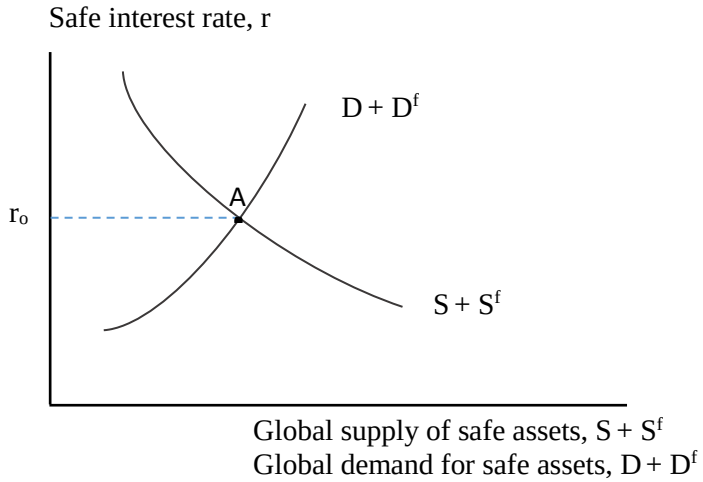
4. Determinants of r*: Demand and Supply for Safe Assets

The saving and investment framework provides a role for portfolio and asset preference shifts to affect the equilibrium real rate by shifting saving and the S curve. A new approach tries to capture these preference shifts more directly by focusing on the demand and supply for so-called "safe" assets, with the natural rate determined in the safe asset market.

4.1. Graphical framework

Figure 10 presents a simple diagram to capture the basic idea. It shows an upward-sloping global demand curve for safe assets ($D + D^f$), together with a downward-sloping global supply curve ($S + S^f$) for safe assets, each as functions of the interest rate on safe assets (which will continue to be denoted by r).[17] Demand rises as the return is higher, while the supply falls as the cost rises. (The slopes of these curves are inverse to convention because the vertical axis plots the return, not the price, of safe assets.)

Fig. 10: Equilibrium Safe Interest Rate



The intersection pins down the equilibrium safe rate. If the underlying fundamentals are consistent with output at potential, i.e. $y = y^*$, this equilibrium can be interpreted as the natural interest rate, r*.

[16] Borio et al. (2019) take a longer term view of the determinants of the natural interest rate (back to the end of the 1870s) for 19 advanced countries and conclude that (i) investment-saving determinants work less well earlier in history and (ii) interest rate levels vary significantly across monetary regime changes.

[17] Note the change of notation with "S" now denoting the supply of safe assets rather than saving.

4.2. Properties of Safe Assets

In understanding what affects the demand and supply for safe assets, it is useful to discuss what makes a safe asset? What are its essential properties? There are many overlapping definitions in the developing literature, e.g., a safe asset is

- "an asset that is (almost always) valued at face value without expensive and prolonged analysis" Gorton (2017),
- "a liquid debt claim with negligible default risk, secure store of value" (Gourinchas and Jeanne, 2012),
- "a debt instrument that is expected to preserve its value during adverse systemic events" (Caballero, Farhi, and Gourinchas, 2017).

A common thread across these definitions is that a safe asset should have the properties of providing security, i.e., it pays close to par with near certainty in the future; and liquidity, i.e., it is money-like in its availability and acceptability. [18]

Safe assets play a set of roles parallel to the traditional roles of money in serving as a (i) transaction medium, (ii) store of value, and (iii) unit of account. Safe assets play (i) a transaction role by serving as collateral in financial transactions and regulatory capital in meeting liquidity requirements, (ii) an accessible store of value role by providing a reliable return, and (iii) an accounting role by serving as a benchmark for the pricing of other assets (see IMF, 2012).

There are different potential suppliers of safe debt. Most notably, governments and central banks supply safe assets through the issuance of currency, central bank reserves, and government securities. Of course, even government-issued liabilities are never perfectly safe and depend on a government's credibility that it will stand behind its debt by creating confidence that it will not default and it will not erode its real value by permitting excessive inflation.

Private-sector financial institutions may also create safe assets by issuing short-term deposits, commercial paper, and more complex instruments, such as asset-backed securities, that provide a degree of safety through the use of collateral backing and financial engineering.[19] Governments may enhance the security of privately-created assets by providing guarantees, e.g. deposit insurance for bank deposits.

It should be noted that different forms of safe assets are not all perfect substitutes in terms of their liquidity or safety properties. For example, safe assets may vary in the mix of liquidity and security they provide, e.g., Treasury bills are more like money in providing short-term safety,

[18] Gorton (2017) refers to the liquidity/"moneyness" property as a safe asset's "No Questions Asked" (NQA) attribute. Greenwood et al. (2015) present evidence that short-term Treasuries provide an extra premium for moneyness beyond the convenience of security provided by longer-term assets. Krishnamurthy and Vissing-Jorgensen (2012) provide evidence of a safety premium on Treasury debt apart from its liquidity premium.

[19] Gourinchas and Jeane (2012) refer to government-provided safe assets as "outside liquidity" (i.e. outside the financial sector) and to private-sector produced safe assets as "inside liquidity" (i.e. inside the financial sector). As they discuss, the creation of inside liquidity by financial institutions may generate demand for other private safe assets and/or for safe government assets.

while Treasury bonds provide more long-term safety. Even cash and short-term term Treasuries may not be substitutes for each other, as Gorton (2015) has observed.

The production of safe assets by the private sector is endogenous to some extent. The private financial sector has an incentive to produce more safe assets when the government does not produce enough to meet demand.[20] However, excessive production of assets acquired to meet demand for safety may in turn make these assets more vulnerable to shocks that affect the degree safety they provide (see Golec and Perotti, 2017). Gourinchas and Jeanne (2012) make a similar point by discussing how the "frontier" between safe and unsafe assets can be sensitive to changed perceptions of security. For example, before the recent financial crisis, safe assets included the mortgage-backed obligations of U.S. Government-Sponsored Enterprises (GSEs), such as Freddie Mac and Fannie Mae, as well as privately-issued ("private label") asset-backed securities that had been rated AAA. But their status as safe assets disappeared after the crisis occurred. And even government assets may lose their safety attributes during crises, as in the case of peripheral government debt in the euro area. Evidence on how this affected holdings of these various asset types is presented in Section 5.

4.3. Determinants of Safe Interest Rate

Referring back to Figure 10, the equilibrium safe rate r* is affected by factors shifting the S and D curves, including some of the same determinants considered to affect saving and investment. However, through the lens of the safe asset market framework, other factors have a clearer, direct role.

Factors that might push the equilibrium safe rate down include from the demand side (shifting the D curve right):

- economic growth that increases transaction demand for safe assets,
- greater precautionary demand for safe assets,
- regulatory reform that increases demand for high-quality collateral,[21]

and from the supply side (shifting the S curve left):

- decreased credit quality of government or private assets,[22]
- fiscal austerity that reduces fiscal deficits and the supply of government securities.

How much of the change in r* is temporary and how much secular? How does the safe asset framework help understand recent developments?

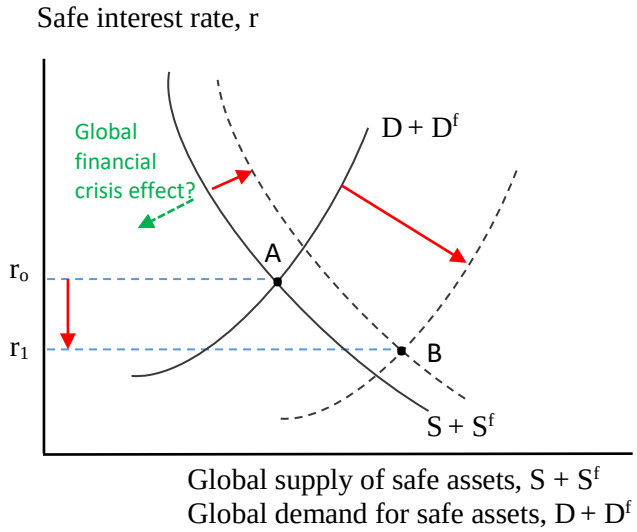
In a sequence of papers, Caballero et al. (2008, 2015, 2016, 2017) argue that since the late 1990s the global supply of safe assets has not kept pace with global demand, creating a shortage of safe assets, which has put downward pressure on the safe real rates. In particular, demand for

[20] Krishnmurthy and Vissing-Jorgenson (2015) provide evidence that the supply of short-term bank debt as a ratio of GDP rises when the privately-held ratio of government debt to GDP declines, implying these asset types are substitutable to some degree.
[21] The effect of financial regulation is ambiguous if it reduces demand for safe assets, e.g., by reducing leverage.
[22] Financial innovation leading to greater production of private safe assets would push supply and the interest rate in the opposite direction.

safe assets ha s been driven by fast-growing, high-saving emerging economies as well as by other countries with weak investor protections seeking safety.[23] The limited ability of these countries to produce their own safe assets because of government credibility issues and slow financial development curtailed supply. Caballero et al. acknowledge that the trend towards safe assets during the 1990s and 2000s was accompanied by a rapid increase in the supply of private safe assets from advanced countries, such as the private-label asset-backed securities engineered by the U.S. financial sector. However, this only damped the global shortage of safe assets.

Their characterization of how global trends affected the interest rate is illustrated in Figure 11, where the D curve shifts out further than the S curve. The resulting global excess demand for (i.e., shortage of) safe assets pushes the interest rate down.

Fig. 11: Effect on Safe Rate r if Demand Increases More Than Supply



From this perspective, the imbalance was exacerbated by the financial crisis which curtailed the global supply of safe assets from governments and the private sector while increasing demand (pushing the S curve back to left). Assets, such as private-label asset-backed securities, U.S. GSE-backed securities, and peripheral government debt in the euro area, considered to be safe, turned out to be much less safe. The resulting fall in supply of safe assets spurred demand for U.S. Treasuries.[24]

[23] Much of this increased demand has been forthcoming from the central banks of emerging market economies to accumulate foreign reserves in United States and other advanced country government securities. There is a long-standing literature on the reasons why central banks have been accumulating international reserves (Aizenman, Cheung, and Ito, 2014). Explanations considered include buffer stock demand for use in managing exchange rate regimes, precautionary demand in order to self-insure against volatile capital flows and possible sudden stops, and mercantilist motives to resist appreciation and maintain export competitiveness. Setser (2018) presents evidence that global dollar reserve holdings correlate well with total foreign purchases of U.S. Treasury and Agency securities.

[24] Several papers demonstrate that there was a safe haven demand during the global financial crisis for the dollar as well as for U.S. Treasury securities (e.g. Jiang et al., 2018).

There is some debate as to whether these effects are temporary or not. For example, McCauley (2019) argues that concerns about a global shortage of safe assets are overblown. Yes, during the crisis there might have been a spike in demand for U.S. safe assets, and a decline in the supply of global safe assets, but he regards those effects as temporary. Moreover, McCauley argues that during the crisis the U.S. government responded appropriately to maintain the supply of safe assets by expanding government guarantees to U.S. GSE debt in 2008 that rendered their debt safer.[25] And over the long term, even if growth in emerging market economies continues to outpace that in advanced countries, he does not believe that their demand for safe assets will increase proportionately. [26]

4.4. A Digression: Safe Asset Market in General Equilibrium (Caballero et al. (2016) Model)

How does the equilibrium safe rate affect the real economy and the return on other non-safe, i.e. riskier, assets? To address this question Caballero, Farhi, and Gourinchas (2016) set up a simplified IS-LM-like model with three assets – money, a safe asset with interest rate r, and a risky asset with interest rate r_r.[27] It is assumed that money and the safe asset are not perfect substitutes, because the safe asset provides benefits that money does not, e.g. collateral value in financial transactions.

The economy is characterized by three conditions:

$$\textit{Safe Asset Equilibrium}\,(SA): \ \bar{S} = \beta + \alpha_y y + \alpha r$$

$$\textit{Taylor Rule}\,(TR): \ r = r^{target} + \theta(y - y^*)$$

$$\textit{IS curve}: \ y = y^* - \delta(r - r^*) - \delta_r(r_r - r_r^*)$$

Safe asset equilibrium (SA) equates demand to the supply of safe assets ($\bar{S}$), considered exogenous for simplicity. Demand depends positively on income y because of transactions use as well as on the return to holding safe assets, r.[28] A Taylor rule (TR) posits that the central bank sets the safe rate as a function of its long run target policy rate (r^{target}) and the output gap, $y - y^*$. A higher output gap implies that the central bank will set the safe rate higher to dampen output demand. The last equation is a standard IS relation that expresses the output gap as a negative

[25] The securities of U.S. government agencies, such as the Government National Mortgage Association (Ginnie Mae), have always been fully backed by the U.S. government. Before the financial crisis, the securities of GSEs, such as the Federal Home Loan Mortgage Corporation (Freddie Mac) and the Federal National Mortgage Association (Fannie Mae), though not explicitly guaranteed historically, were implicitly thought by many in the markets to have such a guarantee. In 2008, as a result of financial insolvency, Fannie Mae and Freddie Mac were both placed in conservatorship and these guarantees became effectively explicit.

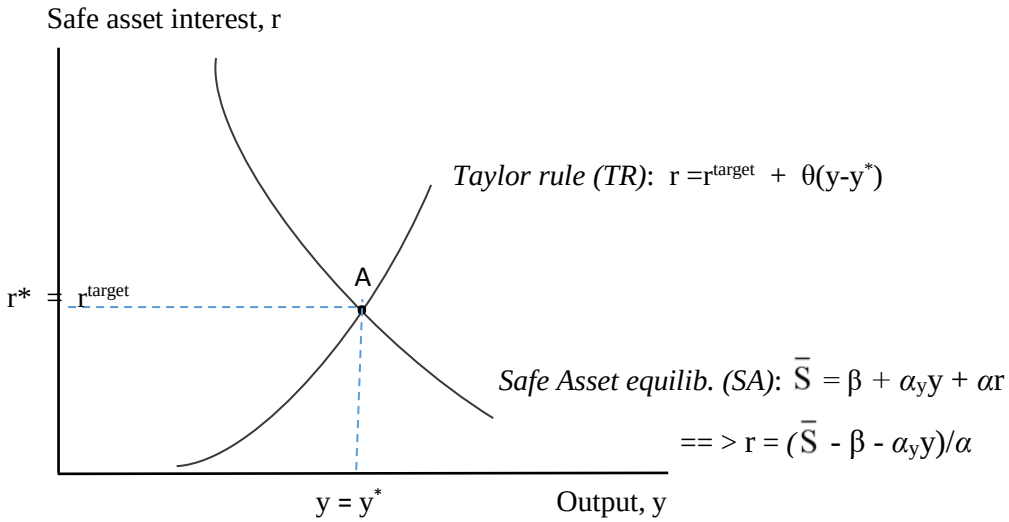
[26] Borio et al. (2019) also question the empirical validity of the excess safe asset demand hypothesis.

[27] In this model, the SA and TR conditions determine y and r, with the IS condition pinning down r_r. By Walras law, equilibrium in the safe and risky asset markets implies equilibrium in the market for the third asset, money.

[28] The SA curve may also depend on the risk spread between r and r_r, which could reflect search for yield behavior. Caballero et al. argue that, when the economy is away from the lower bound, safe asset markets will be unresponsive to the risk premium, possibly because the safe asset market is dominated by investors who don't engage in search for yield, e.g. private and official institutional investors.

function of deviations of the interest rates on the safe asset (r) and the risky asset (r_r) from their long-run, i.e. natural rates, denoted by asterisks (*).[29] Figure 12 depicts determination of equilibrium r and y from the SA and TR relationships.

Figure 12: Determination of Safe Rate in "General Equilibrium"



In r-y space, the SA curve is a negative function of y, while the TR curve is a positive function of y. The intersection of the two relationships at point A determines the natural rate of interest consistent with equilibrium in the safe asset market when output is at its potential. The central bank can achieve y=y* by setting its target rate equal to the natural interest rate. Note that with r and y determined, the IS curve in turn determines the risky rate, r_r.

In this framework a reduced supply of safe assets (i.e. lower $\bar{S}$) or increased demand for safe assets (i.e. higher β) shifts the SA curve downward, lowering r*. It is straightforward to see that if r and y both decline, then the risky rate, r_r will rise.[30]

As Caballero et al. (2008, 2015, 2016, 2017) and Caballero and Farhi (2018) discuss, if safe asset supply falls or demand rises enough to cause the safe rate to hit the lower bound, the economy enters a "safety trap," which causes output to further below potential. In this case, they argue that efforts to increase the supply of safe assets via government debt issuance, currency injections, or increased government spending are appropriate.[31]

[29] In their notation, Caballero et al. (2016) subscript r with an "s" to denote the safe rate, with r denoting the risky asset rate. The notation in this paper is intended to avoid introducing new notation for the natural rate.

[30] A fall in r and y creates excess demand in the goods market, putting pressure on the risky return to rise.

[31] In an extended version of the model the supply of safe assets endogenously increases in response to the declining interest rate by increasing the market value of existing assets (implying that the SA curve shifts right). In an open economy version of the model, the global supply of safe assets depends on the exchange rate, and a safe asset shortage leads not only to a decline in the interest rate but also to an endogenous appreciation (which also causes the SA curve to shift right). This helps adjustment by making foreigners' holdings of U.S. safe assets worth more in

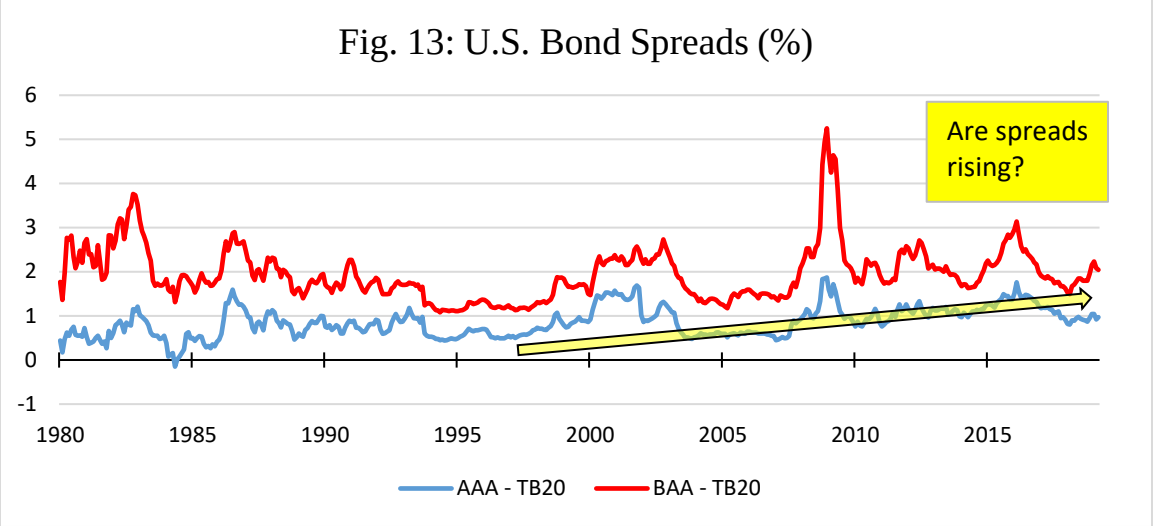
5. Empirical Evidence on Asset Preferences and Role of Rest of the World

What is the empirical evidence on the role of shifting demand for safe assets? How much of this shift in demand is associated with changes in foreign preferences? Examination of both price data on yields and quantity data on asset holdings can help provide some insight.

5.1. Price Evidence

The interpretation of bond rate spread data is somewhat ambiguous, with different researchers sometimes looking at the same data and drawing different conclusions.

Figure 13 shows the spread in interest rates between AAA and lower-rated BAA corporate bonds and that of 20-year Treasury securities. Rachel and Summers (2019) takeaway from these data is that the spread has been relatively low on average over the past decade, and, with the exception of the financial crisis, the peaks have been no higher than in the past. Consequently, they conclude corporate bond yields have fallen in line with yields on government debt, without any indication of a higher premium for holding safer government securities. Moreover, since the decline in real rates discussed earlier far exceeds the observed recent change in spreads they believe that factors relating to saving and investment demand play more of a role in explaining the long-term decline in the natural rate than do changes in liquidity or risk preferences.



Source: Spreads are monthly observations calculated from Moody's AAA, Moody's BAA, and 20-year Treasury rate data from Federal Reserve Bank of St. Louis FRED database (series codes AAA, BAA, GS20).

Caballero et al. (2017) also observe that the yield spreads for fixed income assets is lower than one might expect if there was an increasing premium for safety. However, they attribute this result to institutional frictions, i.e. a search for yield by institutional investors, e.g. pensions, life insurance companies, etc. driven by regulations and other mandates. Thus, based on this evidence they do not rule out that the demand for safe assets has increased.

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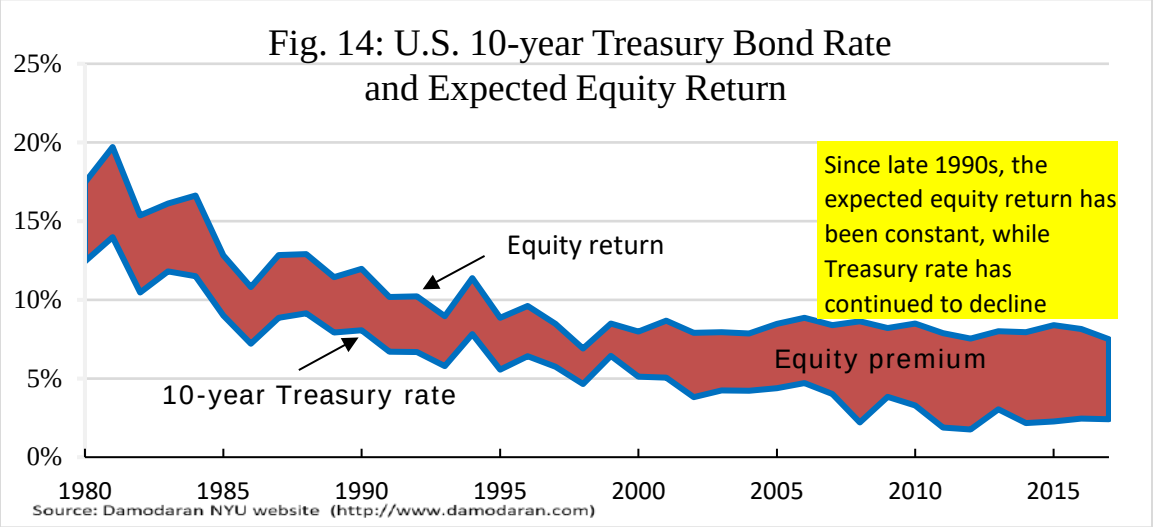
their own currencies, effectively increasing supply. Gourinchas and Rey (2016) show that the burden of currency appreciation, i.e. what they dub a "curse," is particularly significant for small-country safe asset providers.

In contrast, Del Negro et al. (2017), looking at essentially the same data, conclude that spreads have been rising since the mid-1990s (see the yellow arrow in Figure 13). They treat this interpretation as evidence of an increasing premium for safety and liquidity of assets such as Treasuries, relative to less-liquid and less-safe corporate assets. [32]

Other empirical evidence on shifting preferences towards safer assets comes from comparing returns on safe and risky equity assets. Figure 14 plots the nominal returns on U.S. 10-year Treasury bonds and equities since 1980. The difference between the two lines (in red) represents the equity risk premium. It shows the secular decline in the bond rate since the beginning of the period. Over the same period the expected return on equity fell as well until the early 2000s, when it leveled off, indicating an increase in the equity risk premium. This is consistent with a preference shift from riskier assets towards safer assets.[33]



The price-based evidence provide some indication of an increase in the risk premium that may have spurred demand for safe assets. However, none of this evidence suggests a specific role for foreign factors. To this end quantity-based evidence provides more understanding.

[32] There is other evidence that spreads are sensitive to the relative supply of safe government assets. For example, Krishnamurthy and Vissing-Jorgensen (2012) provide historical evidence that the yield spread between corporate and Treasury bonds rises when the supply of privately-held government debt to GDP falls, i.e., investors are willing to pay a higher premium for Treasuries when they are scarce. Carlson et al. (2016) find evidence that a decrease in the supply of Treasury bills leads to an increase in the spread between the yields on short-term, privately-provided safe assets and Treasury bills.

[33] Caballero et al. (2017) construct a similar chart comparing the paths of the one-year Treasury note yield and a measure of the one-year expected equity return from Duarte and Rosa (2015). They also find that the risk premium stayed roughly constant through 2005, but has risen in recent years, particularly since the financial crisis. They present other evidence showing that the return to physical capital has remained stable while the Treasury rate has fallen, implying an increase in the risk premium for physical investment.

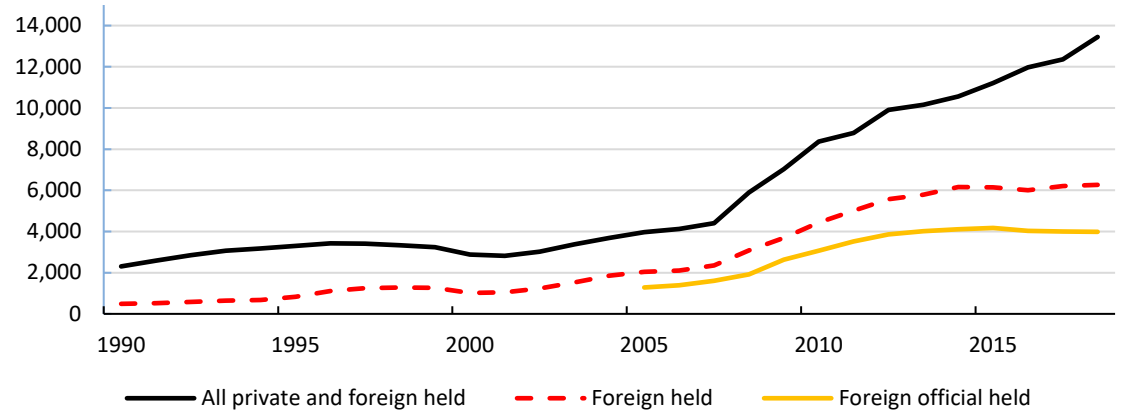
5.2. Quantity Evidence

U.S. securities are globally in demand as safe assets. This section presents various forms of quantity evidence on the increase in holdings of various types of U.S. safe assets, held domestically and by the rest of the world.[34]

We start with U.S. government bonds, which are a large fraction of safe asset holdings, particularly in the portfolios of many foreign central banks and institutions. Figure 15 shows year-end holdings of U.S. Treasury securities, both short-term and long-term, by all public investors, both domestic and foreign (excluding the Federal Reserve). Holdings of foreign official institutions, including foreign central banks and sovereign wealth funds, are also broken out.

The figure shows rising levels of U.S. government securities held abroad, by both official and non-official holders. Foreign holdings rose from around 20% of all holdings in 1990 to roughly 50% just before the 2007-2009 financial crisis, peaked at almost 60% in 2013, and then leveled off back at 50%. Though official investments provide the bulk of foreign holdings, the share of foreign private holders has been increasing over time. As of end-2018, foreign official institutions owned about $4 trillion of U.S. Treasury securities, and foreign private investors another $2 trillion, out of total outstanding issues of $12 trillion (excluding the Federal Reserve).

Fig. 15: Holdings of U.S. Treasury Securities (bil$)



Source: Treasury Bulletin, Treasury International Capital (TIC) reports.

[34] He at al (2019) formulate a model that shows how the attractiveness of a particular sovereign issuer's debt as a safe asset depends on a country's relative fundamentals, such as its fiscal condition compared to other potential issuers, as well as its size. The perceived creditworthiness of sovereign debt of other countries, particularly European peripherals, suffered during the crisis (Caballero et al., 2017). OECD data provides evidence of a decline in credit quality of 10-year sovereign bonds issued over the past decade. The IMF (2012, Ch. 3) also suggests that declines in sovereign credit quality may have effectively curtailed the global supply of safe assets. More specifically, using 5-year credit default swap (CDS) spreads above 200 bps at end-2011 as a filter to identify countries as questionable suppliers, they calculate that the total supply of safe assets from advanced country would fall by roughly 16%.

What has been the behavior of other forms of safe assets? Gourinchas and Jeanne (2012) present several stylized facts about the safe asset holding behavior of U.S. households and non-financial businesses (the "private real sector"), the domestic financial sector (excluding the Federal Reserve), and the rest of the world, breaking down safe assets between those supplied by the government and those supplied by the private financial sector. They observe that

- U.S. private real sector holdings of safe assets have been a stable 80% fraction of (U.S.) GDP for over fifty years, with the exception of a notable increase during the housing bubble period of the mid-2000s.[35]

- U.S. financial sector holdings of government safe assets were also relatively stable at 20-30% of GDP through the boom of the mid-2000s, despite the enormous buildup of risky lending to the nonfinancial real sector, including mortgages, which peaked at over 140% in 2007-2008. After the bubble burst, these holdings grew to 40% of GDP by end of their sample in 2011.

- Foreign holdings of U.S. safe assets have grown significantly, rising from less than 10% in the 1970s and 1980s to roughly 55% by 2011.

They conjecture that most of the foreign inflows were financial sector-related and infer from these data that most of increase in demand for (and supply of) safe assets before the recession occurred within the financial system.

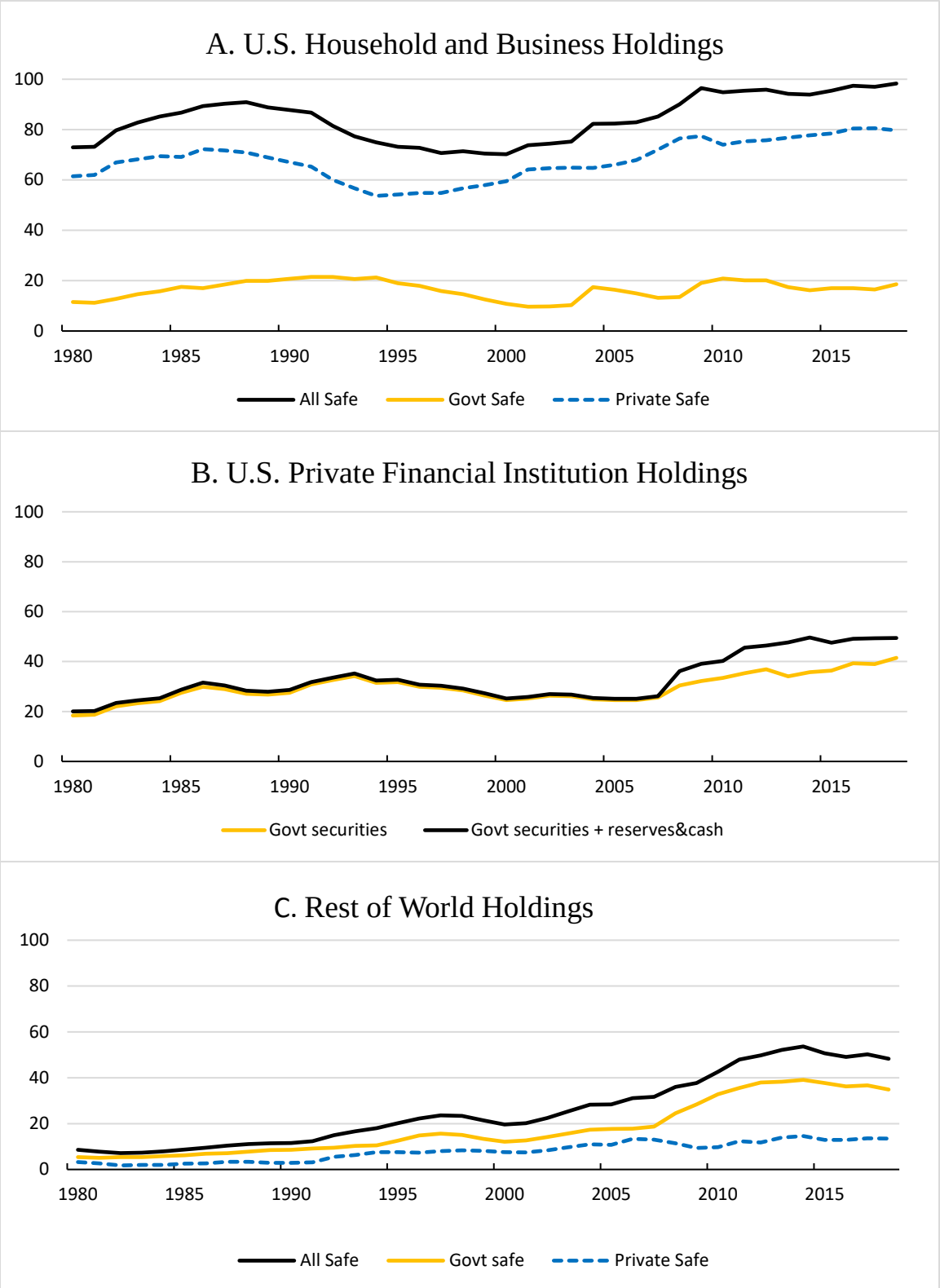
Figure 16 updates several charts of safe asset holdings from Gourinchas and Jeane (2012) with data through 2018 and supplements them with additional details to allow a clearer view of the role of the financial sector and the rest of the world demand for safe assets.[36] The definitions of safe asset measures generally follow theirs, with some differences. For the real sector, government safe assets are defined to include household and nonfinancial business holdings of currency, Treasury securities (excluding debt held by the Federal Reserve), and municipal bonds. Private financial-sector-provided safe assets include checking, time, and saving deposits, shares of money market mutual funds, commercial paper, and repos. Financial sector holdings of government safe assets include Treasury and municipal securities, as well as cash and bank reserves at the Federal Reserve. Foreign holdings of government safe assets include Treasury and municipal securities, SDRs, and currency.[37] Foreign holdings of private safe asset holdings

[35] Another significant increase in safe asset holding, that they associate with the U.S. Saving and Loan lending boom, occurred during the period 1981-1988. They show that safe asset holdings of the real private sectors in France, Germany, and the euro area also have been fairly stable (Japan is an exception, while in the U.K. holdings remained constant only through 2002, when holdings of foreign government safe assets began increasing).

[36] Their data begin in 1945 and ends in 2011; the data presented here begin in 1980 in order to focus on more recent developments.

[37] Gourinchas and Jeanne (2012) refer to this measure as "official safe assets" in the sense that they are official liabilities of the U.S. government and monetary authority. Since this measure includes holdings by foreign private as well as foreign official institutions, these assets are referred to here as government safe assets for labeling consistency.

Figure 16: Holdings of U.S. Safe Assets by Sector (% of GDP)



Notes: Agency&GSE-backed debt and private-issued ABS holdings not included in safe asset measures. See text and Appendix for details. Source: U.S. Flow of Funds.

include time and saving deposits, shares of money market mutual funds, commercial paper, and repos, as well as foreign-affiliate-related interbank transaction levels. More details are provided in the Appendix.

It should be noted these safe asset measures do not include the direct debt and asset-backed securities issued by U.S. Agencies or GSEs, such as Fannie Mae and Freddie Mac, nor the private-label asset-backed securities issued within the financial sector.[38] Behavior of these latter securities is examined separately below.

Inspection of the three panels of Figure 16 indicates that

- Panel A replicates Gourinchas and Jeanne's result that real sector holdings of safe assets in the U.S. began rising steadily in the late 1990s through the 2000s boom period. The added observations indicate that these holdings have crept higher to almost 100% of GDP; there is no evidence of any decline to the historic norm of 80%. Most of the increased holdings of safe assets by households and businesses took the form of private safe assets (with a small dip at the time of the financial crisis). Government safe assets continue to constitute a very stable 20% of household and business holdings throughout this period.

- Panel B confirms Gourinchas and Jeanne's finding that safe government assets held by the financial sector were relatively stable at roughly 25% of GDP until the financial crisis and recession of 2007-2009, when they increased quite strongly and doubled to roughly 50% of GDP. The longer series sample indicates that these holdings have continued to remain elevated. The increases took the form of both more government securities and bank reserves, with the latter rising dramatically as a result of the Federal Reserve's quantitative easing (QE) program.[39]

- Panel C shows changes in foreign holdings of government and private safe assets. It confirms the third observation of Gourinchas and Jeane that the trend of foreigners acquiring more U.S. safe assets has been ongoing for a long time, with a steady increase from 10% in the 1980s to the current level of roughly 50% of GDP. (The burst to 55% in the years immediately after the crisis was followed by a slight decline in holdings in the last few years of the sample.) A change in the composition of safe assets is also apparent since the financial crisis, with the share of government safe assets rising at the expense of safe private assets.[40]

A general conclusion from these observations is that the holdings of real private and foreign sectors are much elevated in comparison to past levels. How durable is this demand is unclear.

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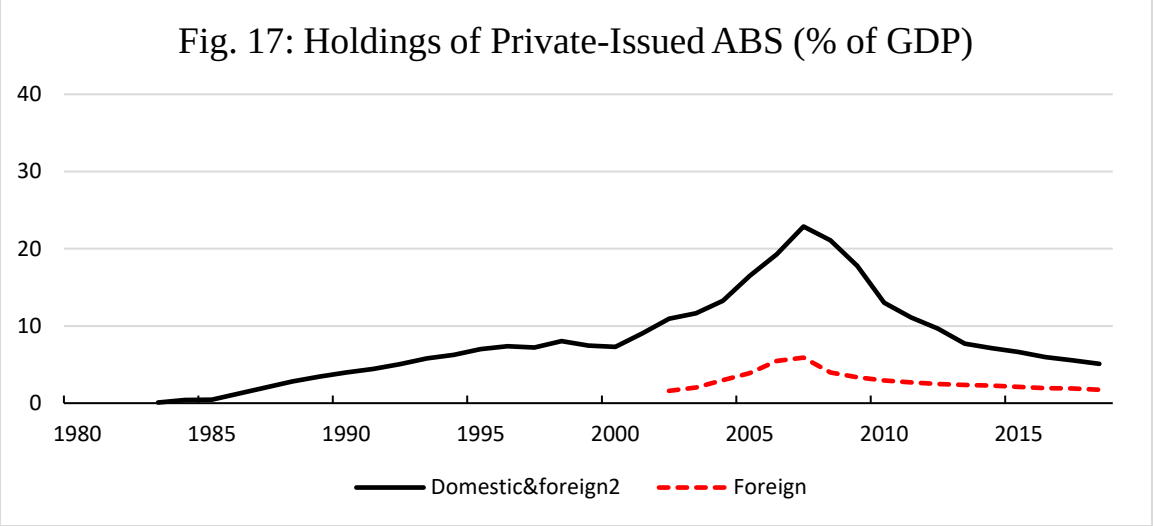
[38] Gourinchas and Jeanne include Agency&GSE-backed securities in their measure of foreign privately produced safe assets held by foreigners. This series is reported separately for both foreign and domestic holders in Figure 18.
[39] Of course, demand for safety is not the only reason for increased holdings of Treasuries by the financial sector. For example, money market mutual funds sharply increased their holdings of Treasury bills when the Federal Reserve began raising the target funds rate in 2015.
[40] There is a discernible downward blip in foreign holdings of U.S. government safe assets in the late 1990s, related to foreign central bank interventions to limit currency depreciations during and after the Asia crisis.

What is clear is that the foreign sector in particular is playing a much larger role in U.S. safe asset markets than in the past, a role that began evolving well before the crisis.

As discussed earlier, much of the increasing demand for safe assets from within the U.S. and from abroad in years before the 2007-2009 financial crisis was met through increased supplies of debt and ABS from U.S. government agencies and GSEs, which benefited from explicit or implicit Federal government guarantees. In addition, an increasing supply of private safe assets, particularly in the form of private-produced mortgage-backed securities, came from within the financial sector through securitization and derivative creation. This process lead to the transformation of relatively illiquid, risky assets into more liquid, AAA-rated safe assets. The collapse of the housing market during the crisis rendered these quasi-safe private assets much less safe.

Figures 17 and 18 provide insight who held these assets and how their holdings evolved before and after the crisis. Figure 17 shows that total holdings of private ABS rose steadily before the crisis, peaked at 23% of GDP in 2007, and then plummeted during and after the crisis to 5% of GDP.[41] Foreign investor holdings displayed a similar profile. At their peak, foreign



Source: U.S. Flow of funds.

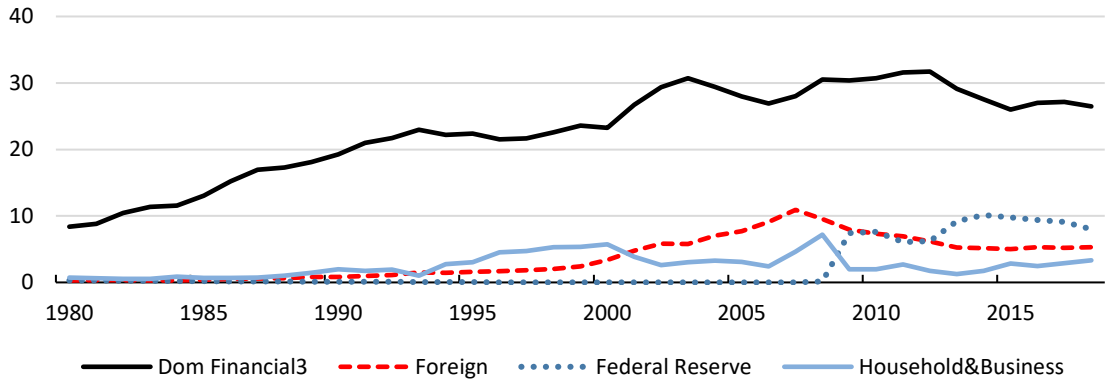
holdings amounted to about 7% of GDP, but now are less than 2% of GDP.[42] The data do not permit determining how much of the increased demand came from the U.S. domestic financial sector, though it can be conjectured that a great deal of it did.

[41] Details of construction of this measure are given in the Appendix. It should be noted that the measured holdings of the financial sector conceal a great deal of cross-holding of assets and liabilities within the overall sector balance sheet.

[42] Bernanke et al. (2011) show how European investors ramped up purchases of U.S. private-label mortgage-backed securities and other fixed-income products during the years before the financial crisis. This spurred the U.S. financial services industry to create more new investment products that "transformed" risky mortgage debt into highly-rated securities. The capital inflows from Europe to the United States associated with these investments did not show up as larger current account surpluses, as in the case of many emerging market economies, because they typically were financed in the wholesale market by issuing external liabilities, particularly commercial paper.

This conjecture is confirmed with data on holdings of Agency and GSE-backed securities shown in Figure 18. Similar to the pattern of private-label ABS holdings, the figure shows that domestic and foreign investors increased their holdings of Agency and GSE-sponsored ABS dramatically in the years leading up to the financial crisis.[43] This confirms that claims on other private financial institutions play a big role in meeting financial institutions' demand for liquidity and safe assets.

Fig. 18: Holdings of U.S. Agency&GSE-backed Securities by Sector (% of GDP)



Source: U.S. Flow of Funds.

Foreign investors were significant players in this asset category, accounting for 10% of GDP compared to the domestic financial sector's holdings of 30% of GDP at its peak.[44] The figure also breaks out holdings for households and non-financial businesses, which were never more than 7% of GDP. After the crisis, demand collapsed, deleveraging occurred in the real private and foreign sectors; holdings in these sectors remain below their prior peak levels. In contrast, financial sector holding were relatively stable and even rose slightly during the crisis, suggesting that the explicit government guarantees of GSE securities in 2008 restored some degree of confidence in their safety attributes. The figure also shows an increase in the Federal Reserve's holdings of Agency and GSE assets as a result of its QE program.

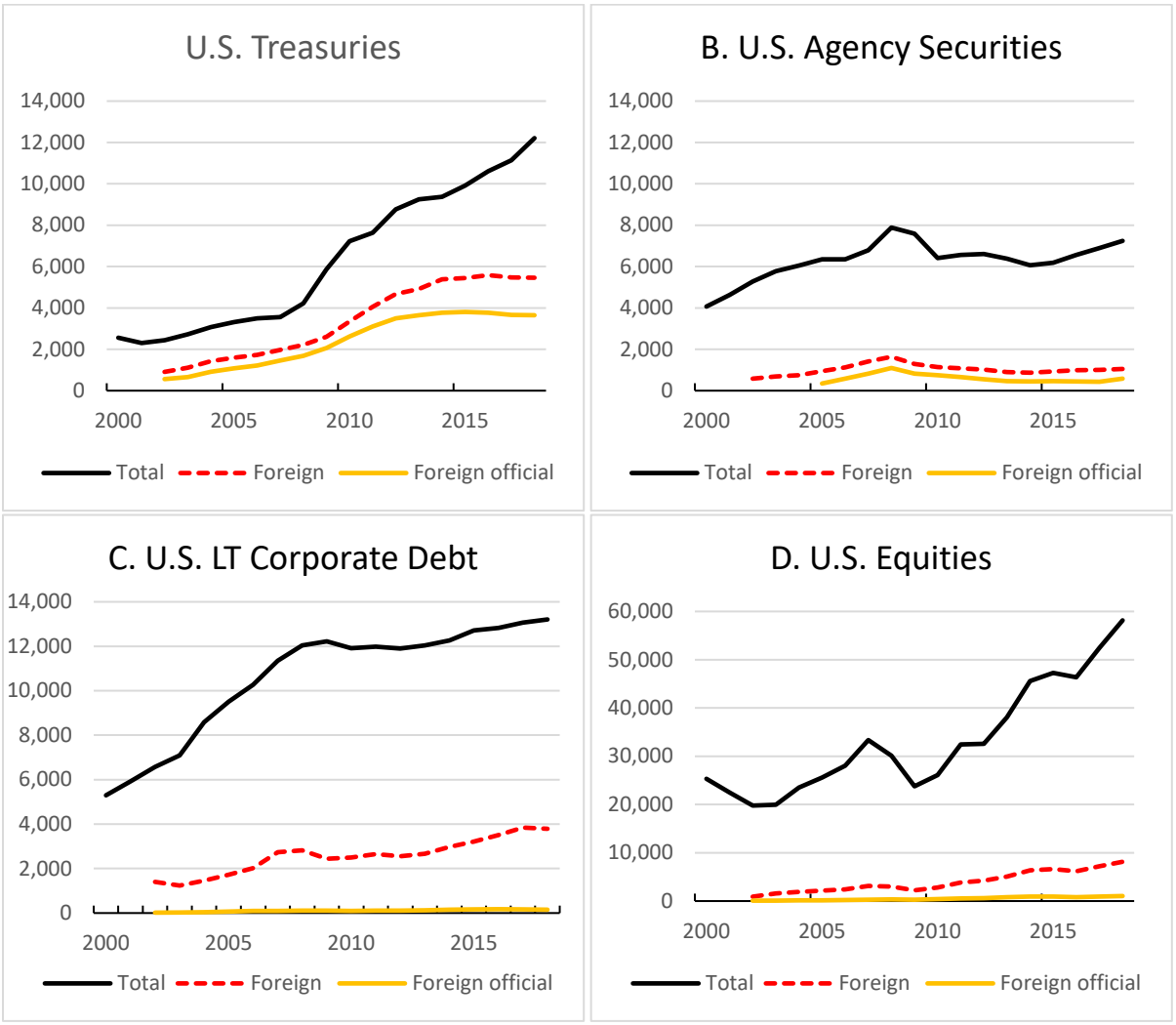
Data from the Treasury International Capital (TIC) system also provide insight into the role of foreign investment in U.S. assets. Figure 19 breaks out foreign investments into holdings of U.S. Treasuries, Agency debt, corporate bonds, and equities, for both total, foreign, and foreign official investors.[45]

[43] Note that Figure 18 is not a stacked line chart; at their peak the sum of holdings by the domestic financial sector, households and non-financial businesses, and the rest of the world exceeded holdings of private-issue ABS depicted in Figure 17.

[44] Much of this foreign demand emanated from institutional investors in Europe and East Asia, particularly government-run pension funds (Setser, 2018).

[45] The figures for total holdings of Treasury and Agency securities have been adjusted to remove Federal Reserve holdings. The TIC measure of Agency securities also includes GSE-backed securities. Long-term corporate securities include private-sector ABS and municipal securities, as well as long-term commercial paper. Reported

Figure 19. Total and Foreign Holdings of U.S. Assets (bil$)



Note: Treasury and Agency debt include short-term and long-term debt; the totals are adjusted to exclude holdings of the Federal Reserve. Source: Haver, Treasury International Capital (TIC) reports, end-June.

The figures show rising foreign holdings across asset classes over time, with the exception of Agency securities. As observed earlier, the foreign share of outstanding Treasuries has risen significantly, to roughly 50%. Though official investments provide the bulk of foreign holdings, the share of foreign private holders has been increasing over time a well. Unsurprisingly, official investors are relative insignificant in the markets for corporate bonds and equities. Consistent with the observation from Figure 18, Agency holdings by foreign investors declined after the crisis.

Summarizing the quantity data evidence, demand for private as well as government safe assets increased from both the domestic financial sector and the rest of the world. The buildup of

levels are holdings at end-June each year, and differ slightly from data reported in earlier figures, which are year-end, and reflect minor measurement differences.

private safe asset holdings rendered the financial system vulnerable to shocks that adversely affected the degree of "safeness" they provided. The quality deterioration of private safe assets that turned out to be less safe raised financial instability by directly affecting the financial sector which held those assets, particularly in debt markets that relied on using them as collateral.[46] The adverse effect on the supply of safe assets added downward pressure on interest rates.

6. Monetary Policy Implications of a Low r*

6.1. Effectiveness of Monetary Policy

A lower level of the natural rate of interest r* has important implications for the conduct and effectiveness of monetary policy (Summers 2015; Williams, 2016; Laubach and Williams, 2016).

First, all else equal, a lower level of r* suggests that episodes of monetary policy being constrained at the effective lower bound are likely to be more frequent and longer lasting than in the past. This may limit the ability of monetary policy to fully respond to adverse shocks, given the effective lower bound on the nominal interest rate. With estimates of the natural r* between 0 and 1% and an inflation target of 2%, the equilibrium nominal policy interest rate is between 2 to 3%, substantially lower than the historic norm. In the absence of any large negative shocks, nominal policy rates in this range are not problematic. But with large, adverse shocks, a low natural rate implies that monetary authorities are very likely to run out of policy space. In this event, more frequent use of unconventional policy measures, such as quantitative easing, may be warranted.

Second, a low r* environment may lessen the effectiveness of monetary policy. One of the main channels through which quantitative easing can stimulate aggregate demand is by shrinking the pool of safe assets, lowering their yields, and encouraging investors to switch their portfolios into other, more risky, assets. This portfolio rebalancing effect pushes up asset prices more widely, raising financial wealth and consumption. But if the yield on safe assets is already low, there is less scope for this portfolio channel to operate.[47]

Third, as Powell (2017) has noted, an environment with low interest rates has implications for financial stability. Low rates may have adverse effects on financial sector profitability and increase incentives to reach for yield. This could contribute to a buildup of excessive risk-taking and over-leveraging, elevating asset prices excessively and possibly resulting in increased risk to the financial system as a whole.[48]

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[46] The demand and supply of private assets are inter-related to the extent that foreign sector investors relied on borrowing in U.S. financial markets to finance their safe asset acquisitions.

[47] Uncertainty about r* may also affect monetary policy by creating an incentive to conduct policy more inertially by placing a greater weight on the lagged level of the funds rate relative to r* in the policy function (Hamilton et al., 2016).

[48] Fischer argues that low r* also may act as a signal that long-term growth prospects are weak.

The Federal Reserve's balance sheet actions have implications as well for the market for safe assets. In response to the recession and financial crisis, the Federal Reserve increased its balance sheet significantly through purchases of long-term U.S. government securities and mortgage-backed securities as part of its quantitative easing policy.[49] One view is that the purchase of these securities had no effect on the aggregate supply of safe assets, as the supply of longer-term Treasury securities removed from the private sector was offset by added bank reserves, near-money assets held by commercial banks. An alternative view (Gourinchas and Jeanne, 2012) is that bank reserves and government securities are less than perfect substitutes and that the QE actions of central banks such as the Federal Reserve exacerbated the shortage of safe assets by removing government debt from private hands at a time when they were most needed. In particular, quantitative easing adversely affected the functioning of private financial markets by reducing the availability of safe assets for collateral and other essential uses.

The question of how substitutable are different forms of safe assets is an area of further research. Carlson et al. (2016) provide evidence that, the Fed may contribute to the supply of safe assets through its own ability to supply short-term, safe instruments (STSIs) in the form of overnight reverse repos invested at the Federal Reserve that are very close substitutes for Treasury bills.

6.2. Implications of r* for Current Stance of Monetary Policy

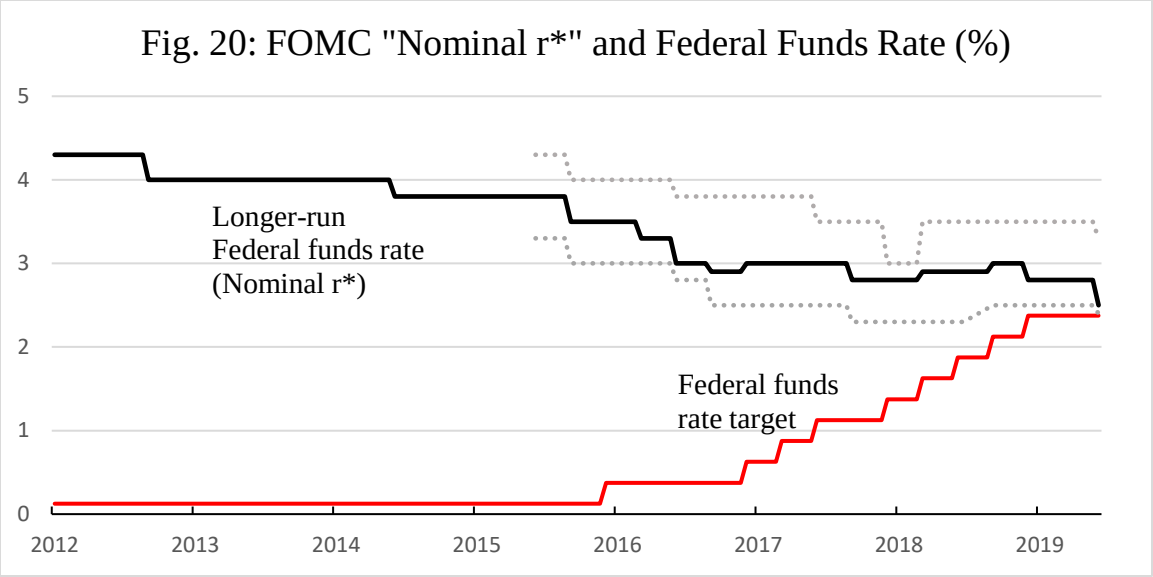
How does the level of r* affects monetary policy at the Federal Reserve? As a rough guide to the stance of U.S. monetary policy, the Taylor rule approach to conducting policy says the policy rate, the Federal Reserve funds rate (FFR), is set as a function of the natural interest rate, expected inflation, and deviations from inflation gap and the output gap:

$$FFR = r^* + \pi^e + a(\pi - \pi^*) + b(y - y^*).$$

Clearly r* is a key anchor to setting monetary policy. The U.S. Federal Open Market Committee (FOMC)'s Summary of Economic Projections (SEP) conducted quarterly asks for an "assessment of the appropriate target level for the federal funds rate … over the longer run," where the longer-run horizon is specified as "in five to six years – in the absence of further shocks." Since all FOMC participants also assume 2% for longer-run target inflation, the longer-run funds rate projection in the SEP minus 2% closely corresponds to the Laubach-Williams concept of a longer-run real r*.

Figure 20 plots SEP projections of the longer-run level of the FFR, which can be considered as a measure of nominal r*. These nominal projections have been steadily falling in line with the r* estimates presented earlier. The median projection is currently (as of June 2019) 2½%, with a considerable range that reflects the varied views among FOMC members. With a 2% inflation adjustment, the implied real policy r* is roughly ½%.

[49] In the early phases of responding to the crisis, the Federal Reserve effectively swapped risky financial assets for reserves through various emergency liquidity funds.



Notes: Figure plots midpoint of current Federal funds target range at the end of each month, together with median and range (with dotted gray lines) of the FOMC's nominal, longer-run r* projections made quarterly. Source: Haver, FOMC Summary of Economic Projections (SEP); latest data June 2019.

The Fed began normalizing monetary policy and raising the (nominal federal funds rate in a sequence of hikes from near zero in December 2015 to its current range of 2¼% to 2½%, with a midpoint of 2.375% that falls just a bit below the range of longer-run projections. The current policy stance of the Federal Reserve (as of June 2019) is to wait for more data before making further changes in the funds rate.

7. Summary and Concluding Thoughts

The natural rate of interest, r*, has fallen over the last several decades. Demographic factors, declining productivity, slower output growth, and increasing inequality likely all have played important roles in determining the natural rate of interest, with a lower real rate required to balance saving and investment.

Higher global demand for safe assets, by both domestic and foreign investors, also has played a role. Holdings of the real private, financial, and foreign sectors are all much elevated in comparison to past levels. How durable is this demand is unclear. What is clear is that foreign demand for U.S. safe assets, particularly government-provided safe assets, has increased dramatically, and possibly plays a much larger role in U.S. safe asset markets and determination of r* than in the past, a role that began evolving well before the 2007-2009 financial crisis. While official investors provide the bulk of most foreign holdings of U.S. assets, foreign private sector holdings have increased rapidly in recent years.

In the background of these longer-term trends, it should also be recognized that the buildup of quasi-government and privately-supplied safe assets, held by both domestic and foreign investors, rendered the financial system more vulnerable to shocks that adversely affected the

degree of “safeness” they provided. The quality deterioration of safe assets that turned out not to be safe contributed to financial instability by directly affecting the financial sector which held those assets, particularly in debt markets that relied on using them as collateral.

Many of the factors that determine the equilibrium interest rate, particularly investment, productivity growth, and asset preferences, are extremely difficult to project. However, in the years since the financial crisis there are no signs of a return of the natural rate to the levels of the 1980s and 1990s. For now, it appears r* will remain low for the near future.

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Data Appendix

Construction of the measures in Figures 15, 16, 17, 18, and 19 with Haver series codes and Flow of Funds table and line numbers (L.xxx denotes Flow of Fund table numbers), where applicable.

Figure 15

All private and foreign held U.S. Treasury securities
= FPDPO@GOVFIN [Est Ownership of U.S. Treasury Securities: Total Privately Held]; Treasury Bulletin, Table OFS-2

Foreign-held U.S. Treasury securities
= FPDPFIO@GOVFIN [Est Ownership of U.S. Treasury Securities: Foreign & International]; Treasury Bulletin, Table OFS-2

Foreign official holdings of U.S. Treasury securities (from TIC reports)
= FF001LTA@USINT [Foreign Official Holdings of US Long-Term Treasury Debt Securities]
+ FF001STA@USINT [Foreign Official Holdings of US Short-Term Treasury Debt Securities]

Figure 16

Real sector holdings of U.S. government safe assets
= OA15TRE5@FFUNDS [Households & Nonprofit Organizations: Asset: Treasury Securities]; L.101, line 7, LM153061105
+ OA15STO5@FFUND [Households: Assets: Municipal Securities]; L.101, line 9, LM15306200
+ OA14TRE5@FFUNDS [Nonfinancial Business: Assets: Treasury Securities]; L.102, line 9, FL143061105
+ OA14STO5@FFUNDS [Nonfinancial Business: Assets: Municipal Securities]; L.102, line 11, FL143062005

Real sector holdings of U.S. private safe assets
= OA15FPD3@FFUNDS [Households: Assets: U.S. Deposits in Foreign Countries]; L.101, line 2, LM153091003
+ OA15CCD5@FFUNDS [Households: Assets: Checkable Deposits and Currency]; L.101, line 3, FL153020005
+ OA15TID5@FFUNDS [Households: Assets: Time and Savings Deposits]; L.101 line 4, FL153030005
+ OA15MMS5@FFUNDS [Households: Assets: Money Market Shares]; L.101, line 5, FL153034005
+ OA10FPD3@FFUNDS [Nonfinancial Corp. Business: Assets: Foreign Deposits]; L.102, line 2, FL103091003
+ OA14CCD5@FFUNDS [Nonfinancial Business: Assets: Checkable Deposits & Currency]; L.102, line, 3, FL143020005
+ OA14TID5@FFUNDS [Total Nonfinancial Business: Asset; Total Time Deposits]; L.102, line 4, FL143030005
+ OA14MMS5@FFUNDS [Nonfinancial Business: Assets: Money Market Fund Shares]; L.102, line 5, FL143034005
+ OA10AHY3@FFUNDS [Nonfinancial Corporate Business: Asset: Security Repurchase Agreements]; L.102, line 6, FL102051003
+ OA10DPP0@FFUNDS [Nonfinancial Corporate Business: Assets, Commercial]; L.102, line 8, FL103069100

Rest of world holdings of U.S. government safe assets
= OL31SDR3@FFUNDS [Federal Govt; Special Drawing Rights [SDRs] Allocations; Liab]; L.133, line 2, LM313111303
+ OA26TRE5@FFUNDS [Foreign Sector: Assets: Treasury Securities]; L.133, line 10, LM263061105
+ OA26STO3@FFUNDS [Fgn Sector: Assets: U.S. Agency & GSE-backed Securities, Municipal]; L.133, line 12, FL263062003
+ OA26CUR3@FFUNDS [Foreign Sector: Assets: Currency]; L.204, 36, FL263025003

Rest of world holdings of U.S. private safe assets

= OA26CCD5@FFUNDS [Foreign Sector: Assets: U.S. Checkable Deposits & Currency]; L.133, line 4, FL263020005
+ OA26TID5@FFUNDS [Foreign Sector: Assets: Time and Savings Deposits]; L.133, line 5, FL263030005
+ OA26MMS3@FFUNDS [Foreign Sector: Assets: Money Market Fund Shares]; L.133, line 6, FL263034003
+ OA26AHY3@FFUNDS [Rest of the World: Asset: Security Repurchase Agreements]; L.133, line 7, FL262051003
+ OA26DPP3@FFUNDS [Rest of the World: Commercial Paper: Asset]; L.133, line 9, LM263069103
+ OL76GIF5@FFUNDS [U.S.-Chartered Depository Inst: Liabilities: Interbank Claims]; L.203, line 27, FL764116205
+ OL75GIF5@FFUNDS [Foreign Banking Offices in U.S.: Liabilities: Interbank Claims]; L.203, line 30, FL754116205

Note differences with definition of Gourinchas&Jeanne (2012) who

- Include OA26AGI5@FFUNDS [Foreign Sector: Assets: Agency & GSE-backed Securities]; L.133, line 7, LM263061705
- In place of OL76GIF5@FFUNDS above, use OL76AAY5@FFUNDS [US Dep Inst incl IBFs: Liab: Intrbnk Transactns Due to Fgn Affs]; L.203, line 28, FL763192605
- In place of OL75GIF5@FFUNDS above, use OL75AAY5@FFUNDS [Fgn Bnk Off in US incl IBFs: Liab: Intrbnk Trans Due to Fgn Affs]; L.203, line 31, FL753192605

Financial sector holdings of safe government securities
= OA79TRE5@FFUNDS [Financial Sectors: Assets: Treasury Securities]; L.108, line 13, FL793061105
+ OA79STO5@FFUNDS [Financial Sectors: Assets: Municipal Securities]; L.108, line 15, FL793062005
- OA71TRE3@FFUNDS [Monetary Authority: Treasury Securities]; L.109, line 10, LM713061103
- OA22MSE3@FFUNDS [State/Loc Govt Emp Def Benefit Retmnt Funds:Asset:Mun Sec & Loans]; L.120, line 10, LM223062043

Financial sector holdings of U.S. safe government assets
= Financial sector safe government securities
+ OL71MBR3@FFUNDS [Monetary Auth: Liab: Dep Inst Reserves, Excl. Fhlb Deposits] ; L.109, line 22, FL713113003
+ OA70CUR5@FFUNDS [Private Depository Institutions: Asset: Vault Cash] ; L.109, line 23, FL703025005

Real sector holdings of U.S. Agency&GSE-backed securities
= OA15AGI5@FFUNDS [Households: Assets: Agency & GSE-backed Securities ; L.101, line 8, LM153061705
+ OA10AGI3@FFUNDS [Nonfin. Corporate Bus: Assets: Agency & GSE-backed Securities]; L.102, line 10, FL103061703

Federal Reserve holdings of U.S. Agency&GSE-backed securities
= OA71AGI5@FFUNDS [Monetary Authority: Assets, Agency & GSE-backed Securities]; L. 109, line 13, LM713061705

Domestic private financial sector holdings of U.S. Agency&GSE-backed securities
= [Domestic&foreign Agency&GSE-backed securities ex Federal Reserve]
- [Real sector holdings of Agency&GSE-backed securities]
- [Foreign holdings of Agency&GSE-backed securities]

Figure 17

Domestic&foreign holdings of U.S. private ABS
= OL67COF5@FFUNDS [ABS Issuers: Liabilities; Corporate and Foreign Bonds]; L.213, line 5, FL673163005
- OA40AEO5@FFUNDS [Govt-Sponsored Enterprises: Assets: MBS & Other Asset-Backed Bonds]; L.213, line 38, FL403063605

Rest of world holding of U.S. private ABS
= OA26AEO3@FFUNDS [Rest of the World: Assets: U.S. MBS & Other U.S. Asset-Backed Bonds]; L.213, line 46, LM263063603

Figure 18

Domestic&foreign holdings of U.S. Agency&GSE-backed securities ex Federal Reserve and Govt.
= OL40AGI5@FFUNDS [GSEs: Liabilities; Agency & GSE-backed Securities]; L.211, line 3, FL403161705
+ OA41MOR5@FFUNDS [Mortgage Pools: Assets: Mortgages]; L.211, line 4, FL413065005
- OA40AGI5@FFUNDS [GSEs: Assets; Agency & GSE-backed Securities]; L.211, line 22, FL403061705
- OA71AGI5@FFUNDS [Monetary Authority: Assets, Agency & GSE-backed Securities]; L.211, line 10, LM713061705
- OA31AGI3@FFUNDS [U.S. Government: Assets: Agency & GSE-backed Securities; L.211, line 8, FL313061703
- OA67AGI3@FFUNDS [Issuers of Asset-Backed Sec: Asset: Agency- and GSE-Backed Sec]; L.211, line 23, FL673061703

Foreign holdings of U.S. Agency&GSE-backed securities
= OA26AGI5@FFUNDS [Foreign Sector: Assets: Agency & GSE-backed Securities]; L.211, line 27, LM263061705

Figure 19

Total holdings of U.S. Treasury securities
= PDIM@USECON [Treasury Securities Outstanding: Marketable]; Treasury Statement of the Public Debt, Table 1
- FTLSFE@GOVFIN [Ownership of Federal Sec: Pub Debt Sec: Pub Issue held by Res Banks]; Treasury Bulletin Table OFS-1

Total holdings of U.S. Agency debt
= OL89AGI5@FFUNDS [All Sectors: Liabilities: Agency & GSE-backed Securities]; L.211, line 1, FL893161705
- OA71AGI5@FFUNDS [Monetary Authority: Assets, Agency & GSE-backed Securities]; L.211, line 10, LM713061705

Total holdings of U.S. long-term corporate (and other) securities
= OL89COF5@FFUNDS [All Sectors: Liabilities: Corporate and Foreign Bonds]; L.213, line 1, FL893163005
- OL26COF5@FFUNDS [Rest of the World: Liability: Bonds ; L.133, line 28, LM263163005
+ OL21STL0@FFUNDS [State and Local Governments: Liab: Other LT Municipal Securities]; L.107, line 21, FL213162200

Total holdings of U.S. equities
= OA89COG5@FFUNDS [All Sectors: Assets: Market Value of Equities]; L223, line 1, LM893064105
- OL26COG0@FFUNDS [Rest of the World: Foreign Corporate Equities: Liability]; L133, line 42, LM263164100
+ OL65MFS5@FFUNDS [Mutual Funds: Mutual Fund Shares: Liability]; L224, line 1, LM653164205
+ OA63TAO5@ FFUNDS [Money Market Mutual Funds: Shares Outstanding Liabilities]; L206 line1, LM223062043