Low Interest Rates: Causes and Consequences*

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World interest rates have been declining for several decades. In a general equilibrium setting, the interest rate is determined by the interaction of a number of types of behavior: the policy of the central bank, investment in productive assets, the choice between current and future consumption, and the responses of wealth holders to risk. Central banks devote consider effort to determining equilibrium real rates, around which they set their policy rates, though measuring the equilibrium rate is challenging. The real interest rate is also connected to the marginal product of capital, though the connection is loose. Similarly, the real interest rate is connected to consumption growth through a Euler equation, but again many other influences enter the relationship between the two variables. Finally, the idea of the "global saving glut" suggests that the rise of income in countries with high propensities to save may be a factor in the decline in real rates. That idea receives support in a simple model of global financial equilibrium between countries with risk tolerance (the United States) and ones with high risk aversion (China).

JEL Codes: E21, E22, E43, E52.

Low world interest rates have stimulated new interest in the determination of the safe real rate. As a threshold matter, Rachel and Smith's figure 1 (this issue) and Juselius et al.'s figure 1 (this issue) document the pronounced downward trend of world real interest rates since the 1980s. For the purposes of this commentary, I take

the real rate to be the yield net of inflation of safe government debt of maturity around one to two years. Thus I abstract from liquidity effects at the short end of the yield curve and from issues related to the slope of the yield curve.

Structural relations governing the real interest rate include its relation to

- the central bank's payment on reserves and the extent of saturation of the financial system in reserves
- the marginal product of capital
- the rate of consumption growth (through the Euler equation)
- the terms of trade between risk-tolerant and risk-averse investors

In a complete macro model one or more equations would describe each of these structural relations. It would not be possible to divide up responsibility among them for the overall decline in the real rate. One can fashion a set of highly simplified models, each containing only one or two of the structural relations. For example, Krugman (1998) considers an economy with no capital and no uncertainty to focus on monetary policy and consumption growth and illuminate issues of the zero lower bound. But a set of models along those lines would not result in an additive breakdown of the sources of the decline in the real interest rate.

1.   Monetary Policy and the Real Interest Rate

Traditional monetary policy kept the interest paid on reserves at zero nominal and manipulated the quantity of reserves. Explaining how the central bank influenced interest rates involved consideration of the liquidity value of scarce reserves. Today, all major central banks have saturated their financial systems with reserves, so the liquidity value is zero, and the central banks execute monetary policy exclusively by manipulation of the payment made to reserve holders (in the United States, a new kind of reserves, reverse repurchase agreements, play this role).

Powerful forces of arbitrage link the central bank's policy rate paid on reserves to similar short-term government obligations. The

central bank thus controls short rates directly. But the fact of central bank control does not mean that we need look no further to understand the movements of short rates. For one thing, it is the behavior of real rates that matters and all central banks set nominal rates, though there would be no obstacle to direct setting of real rates. Hall and Reis (2016) discusses these topics in detail. Thus the behavior of inflation needs to be brought into the picture. More important, however, is that changing the policy rate has effects on output and employment relatively quickly and on inflation, with a longer lag, according to most views.

As a result of the influence of the central bank's policy rate on the other key macro variables, the other structural relations listed above come into play in the central bank's choice of the policy rate. Only the most naive observer thinks that the central bank can pick its policy rate by unilateral whim. Friedman (1968), following Wicksell, set forth a framework that remains influential fifty years later: There is a level of the real interest rate, r^*, the *natural rate*, with the property that it is infeasible for the central bank to run a monetary policy that results in a real rate permanently above or below the natural rate. Thus many discussions of the behavior of the real rate focus on quantifying r^*, generally as a quantity that varies over time. Since 1980, it has had a downward trend.

The foundations of the hypothesis that r^*_t is a cognizable feature of the economy are weak, in my opinion—see Hall (2005). It takes an economic or statistical model to extract r^*_t from data on r_t and other variables. The results are model specific. Laubach and Williams (2003) is the canon of this literature. Notwithstanding my doubts about the foundations, these authors' results seem completely reasonable. Juselius et al. (this issue) refine the canon. The middle of their figure 6 shows the real rate, which is volatile and cyclical. The Laubach-Williams natural rate is a plausibly smoothed version of the actual real rate. As Friedman's analysis predicted, the actual real rate exceeds its natural level in booms and falls below in busts. The natural rate of Juselius et al. has higher volatility and, surprisingly, a higher level. Friedman's analysis suggested fairly persuasively that the real rate should deviate above about as much as below the natural rate, but the new construction has almost all of the deviations below.

**Figure 1. Spread between the Return to Capital
and the Safe Real Interest Rate**
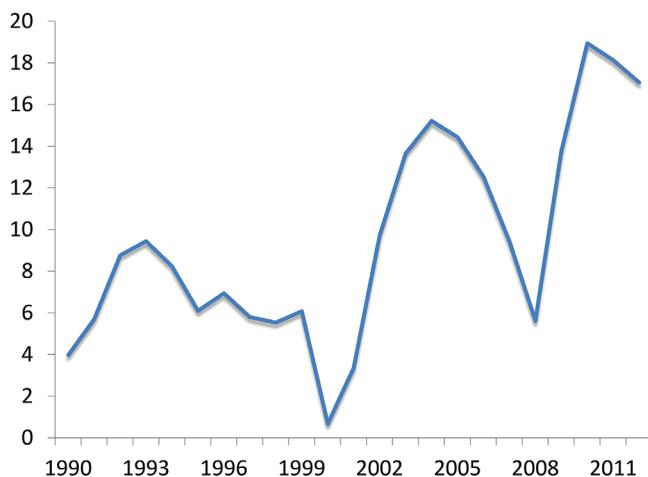
2.   The Marginal Product of Capital and
the Return to Capital

In an economy without uncertainty, the return to capital is linked
to the marginal product by the rental price of capital. Provided
the rental price includes the fluctuations in Tobin's q—the ratio
of the value of installed capital to the acquisition price of capital—
arbitrage should equate the marginal product of capital to the rental
price. To put it differently, if the rate of return is calculated from
data that accounts for q, the rate of return will track the inter-
est rate (measured over the same interval) period by period. With
uncertainty, the rate of return will include a risk premium, which
may vary over time. The recent macro literature has studied finan-
cial frictions that interpose between wealth holders and businesses
seeking to attract wealth to form business capital.

Figure 1 shows the spread between the calculated return to cap-
ital and the one-year safe real interest rate, from Hall (2015). Note
that the spread is remarkably volatile, upward trending, and high
except in recessions. Gomme, Ravikumar, and Rupert (2015) have
made similar calculations. The notion that there is a tight connec-
tion between the safe interest rate and the return to capital receives

Figure 2. U.S. Real Rate and Consumption Growth
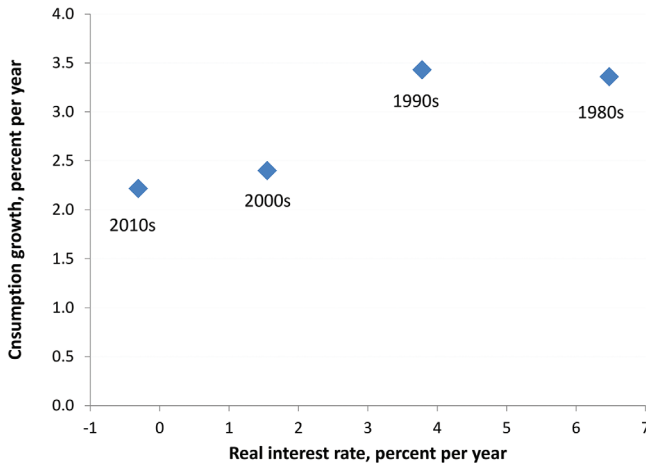
little support from this evidence. Rather, there is apparently large scope for variations over time in risk premiums, financial frictions, and other sources of the wedge between the earnings of capital and the risk-free cost of borrowing. These variations are almost certainly endogenous.

3.   Consumption Growth and the Interest Rate

Many macro models, including the New Keynesian models that have proliferated at central banks, contain an upward-sloping structural relation between expected consumption growth and the real interest rate—Rachel and Smith's equation (1) describes the Euler equation reflecting this relation. The logic is that a higher real interest rate makes future consumption cheaper than current consumption, so households consume less currently and more in the future. To put it another way, higher growth rates should have correspondingly higher real interest rates. Figure 2 shows that this proposition is somewhat true in U.S. data averaged over decades.

The proposition encounters some serious obstacles. First, Carroll and Summers (1991) observed that across countries that can trade goods and financial claims, all countries should have the same rate of growth of consumption, in accord with the worldwide real interest

rate, irrespective of their rates of growth of income. Countries with high expected income growth should borrow from slower-growing countries and gradually pay the debt off as growth occurs. In fact, the evidence shows that consumption growth is tightly linked to income growth across countries. And growth rates differ markedly across countries, with the highest growth in recent decades in east and south Asia.

Second, a household does not have a single Euler equation, but rather a different one for each asset. Hansen and Singleton (1983) is the classic citation on this point. There is nothing special about the safe real interest rate. Their paper showed that the data rejected the hypothesis that households satisfied all of the Euler equations.

Third, data on household financial holdings make it clear that households with collectively an important fraction of total income face binding constraints on borrowing. They would like to obey the Euler-equation model but cannot commit to repaying the debt that they would incur if they did. They obey a related model where a shadow borrowing rate, higher than the measured one, tracks consumption growth.

I conclude that research on consumption choices has a far richer view than the one expressed in the simple interest-only Euler equation.

4. The Role of the Interest Rate in an Economy where Risk-Tolerant Investors Insure Risk-Averse Ones by Borrowing from Them

Hall (2016) demonstrates the theoretical and practical importance of trade among heterogeneous investors. In effect, the risk-tolerant investors insure the risk-averse ones. Debt has a key role in this risk-motivated trade. By borrowing from the risk averse, the risk-tolerant investors provide the risk averse with protection against future random shocks, because the payoff of the debt is unaffected by the shocks (provided no default occurs). The interest rate on the debt describes the terms of the risk trade. If the risk tolerant have high resources relative to the risk averse, collectively, the risk averse command a good deal—they receive a high rate of interest on the funds they loan to the risk tolerant. But if there is an upward trend in the resources of the risk averse, the deal shifts disadvantageously away

from the risk averse—they earn less and less interest on the funds they lend. The paper shows that China behaves risk aversely, lending large volumes of funds to western Europe and the United States. But the Chinese resource base—measured by GDP—is growing faster than the resource base of the risk-tolerant borrowers. Hence the world real interest rate is declining on account of the differential growth.

The model backing up this analysis is rigged to avoid the other issues discussed earlier in this commentary. There is no central bank intervening in the world financial market. There is no capital, so no issue of the relation of the marginal product of capital to the interest rate. Resources are growing at the rate of zero among the risk averse and the risk tolerant, so there are no issues of growth affecting the interest rate. The model embodies standard ideas from financial markets, including the hypothesis that investors attribute a small but positive probability that a truly bad event will occur and the hypothesis that the risk-averse investors place a somewhat higher probability on that event.

My paper pursues the ideas in Bernanke et al. (2011) that there is a "global savings glut" and in Gourinchas, Rey, and Govillot (2010) and Caballero and Farhi (2016) that low real interest rates are the result of a "shortage" of safe assets. The paper derives results along those lines from the equilibrium of an Arrow-Debreu economy with complete capital markets. In place of gluts and shortages, the model hypothesizes changes over time in the resources held by the risk tolerant in relation to those held by the risk averse.

Figure 3 shows how the safe real interest rate in the model declines as the fraction of resources held by the risk tolerant declines. The decline is similar to the decline that actually occurred from 1990 to the present, with real rates at or below zero. The risk-tolerant investors in the model have modestly lower coefficients of relative risk aversion and believe that the probability of bad conditions is modestly lower, compared with the risk-averse investors.

The conclusion of the model is that heterogeneity coupled with a shift in relative resources toward the risk-averse investors can explain observed changes in the real interest rate without bringing in the declining growth rate or rising financial frictions. The paper makes no claim that the other forces are not actually influential, however. Fundamental to the success of the model is its hypothesis that both

Figure 3. As the Fraction of Resources in the Hands of the Risk Tolerant Declines, the Interest Rate Falls
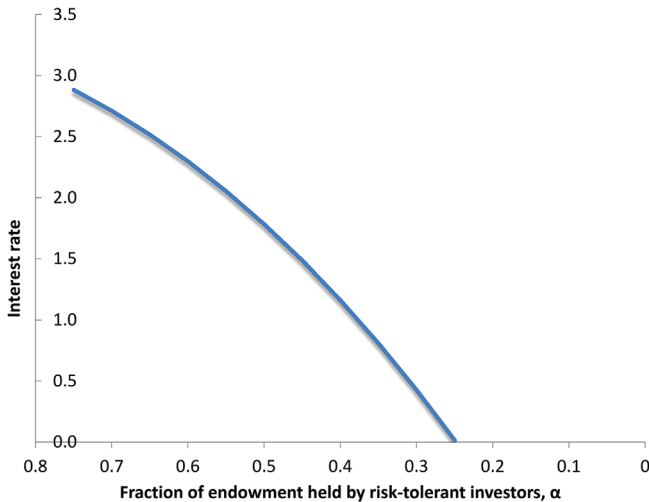

types of investors behave as if they assigned small but important probabilities to a substantial negative shock, worse than has actually occurred since the Great Depression. In this respect, the model follows the trend in recent financial economics, which finds, for example, that such beliefs about rare disasters are the most plausible way to explain the equity premium.

One of the manifestations of heterogeneity in investors' risk aversion is across countries. Investors in some countries, notably the United States, collectively take on risk from other parts of the world by maintaining positive net positions in foreign equity and negative net positions in debt—in effect, these countries borrow from the risk-averse countries and use the proceeds to buy foreign equity. Thus the United States is like a leveraged hedge fund. Countries can be divided into three groups: (i) those that absorb risk by borrowing in the global debt market and buying foreign equity, (ii) those that shed risk by lending to the risk absorbers and letting those countries take on the risk of their own equity, and (iii) those whose risk preferences are in the middle and choose not to absorb or shed risk and those whose financial markets are undeveloped and do not participate in global financial markets.

Figure 4. Countries that Absorb Risk by Holding Positive Amounts of Net Foreign Equity or by Borrowing from Foreign Lenders
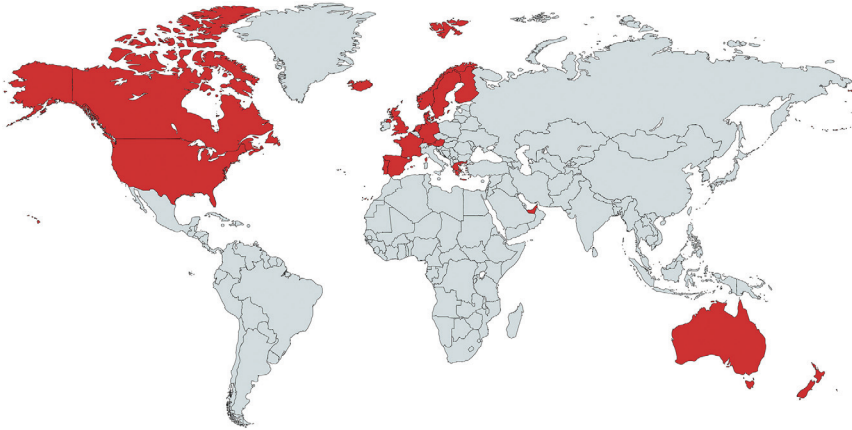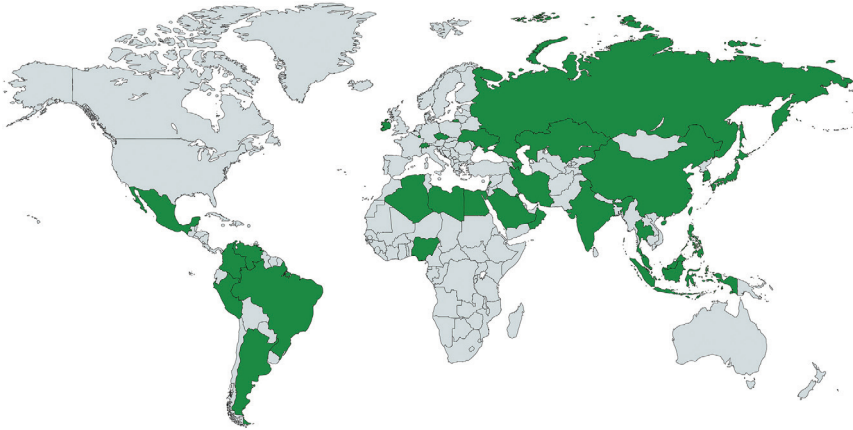

Note: Risk-absorbing countries are shown by dark shading. Created with mapchart.net.

Figure 4 shows the countries that absorb risk. They are the advanced countries of western Europe and the countries scattered around the globe that fell under the influence of those countries and became advanced themselves. There appears to be a negative correlation between risk aversion and income per person, as the risk absorbers are all high-income countries. By far the largest absorber of risk is the United States.

Figure 5 shows the countries that shed risk. Most are lower income. China is by far the largest of the shedders. China holds large amounts of dollar debt claims on the United States, with recent growth in its euro debt claims on western Europe. One high-income country, Japan, is a major risk shedder. The United States and other risk absorbers hold positive net amounts of foreign equity.

Figure 6 shows the growth of risk absorption by the United States. The upper line shows U.S. net borrowing in the debt market and the lower line net U.S. holdings of foreign equity. The upward path in debt began in the mid-1980s and the upward path of equity in the 1990s. Debt continued to rise through 2011 (the last year for which I have data) while equity fell slightly after the 2008 financial
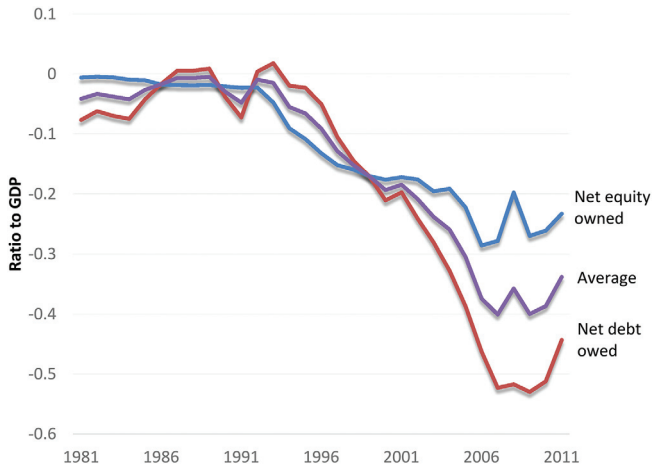
Figure 5. Countries that Shed Risk by Holding Negative Amounts of Net Foreign Equity or by Lending Positive Amounts to Foreign Borrowers

Note: Risk-shedding countries are shown by dark shading. Created with mapchart.net.

Figure 6. Risk Absorption by the United States, 1970–2011
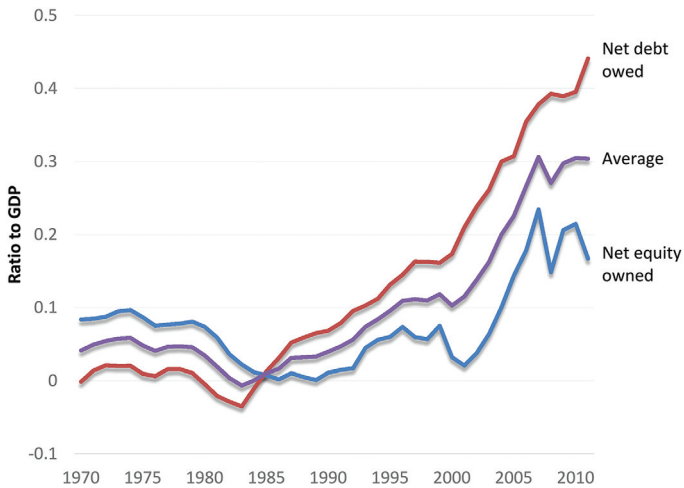
Figure 7. Risk Shedding by China, 1981–2011

crisis. The average of the two measures—taken as an overall measure of risk absorption—rose from the 1980s and reached a plateau of 0.3 years of GDP.

Figure 7 shows similar data for China starting in 1981—in earlier years, China was effectively walled off from the global economy. Starting in the early 1990s, China shed risk aggressively, reaching the point just before the crisis of the average of foreign debt owned and net foreign holdings of Chinese equity claims equal to 0.4 years of GDP. Following the crisis, Chinese risk shedding has remained at that level but has not grown.

Risk splitting occurs within the United States in large volumes as well. Table 1 shows decade averages of a variety of financial institutions that hold risky financial positions funded in part by debt—held by risk-averse investors such as pension funds—and by correspondingly riskier equity held by risk-tolerant investors such as high-wealth households. Government debt is a prominent part of the risk splitting. In the case of government, the taxpayers make up the risk-tolerant side—the marginal taxpayer with substantially higher than average wealth takes on magnified risk by insuring the holders of government debt. On the private side, numerous types of financial institutions and securities have the effect of splitting risk between a tranche of low-risk debt and high-risk residual equity claims.

Table 1. Examples of the Scale of Risk-Splitting Institutions

Decade	Government			Private Equity Funds	Securiti- zations	Private		
	Consolidated Government Debt	GSE Debt	GSE Guaranteed Debt			Non-financial Corporate Debt	Repos	Non-mortgage Household Debt
1980s	0.469	0.061	0.091	—	0.012	0.163	0.103	0.186
1990s	0.611	0.101	0.204	—	0.086	0.211	0.166	0.204
2000s	0.574	0.203	0.293	0.058	0.233	0.238	0.237	0.239
2010s	0.936	0.126	0.347	0.140	0.109	0.275	0.221	0.251

**Figure 8. Scale of Risk-Splitting Institutions
Relative to GDP**
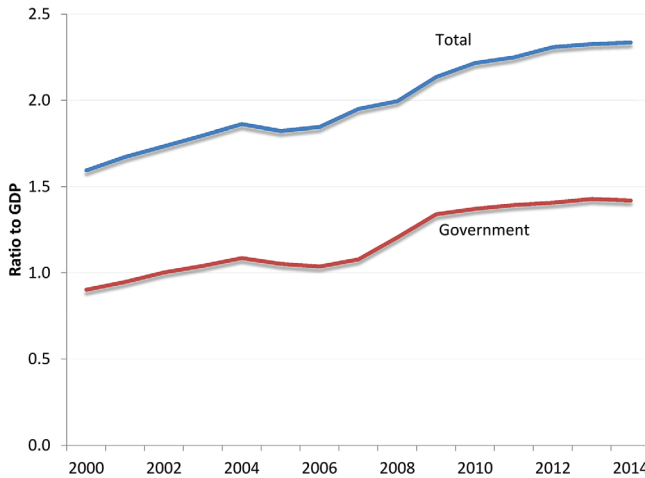
Private equity is a rapidly growing example of this type of financial arrangement. Securitizations with overcollateralized debtlike securities held by or on behalf of risk-averse investors and residual equity claims held by risk-tolerant investors grew rapidly until the crisis but have shrunk since then. Repurchase agreements split risk by overcollateralization to the extent of the repo haircut. These too have shrunk relative to GDP since the crisis.

Figure 8 shows the generally upward trend of the volume of risk splitting in the United States, stated relative to GDP. Both government and non-government contributions have risen, with some moderation after the crisis.

5.   Concluding Remarks

Prior to the financial crisis in 2008, risk splitting grew steadily, as revealed in data on both international and domestic financial positions. Safe real interest rates declined in parallel. The crisis resulted in a downward jump in real rates corresponding to the fall in nominal short rates to essentially zero soon after the crisis struck. The corresponding real rate was between –1 percent and –2 percent. Real rates have risen in the United States recently, as nominal rates have

become positive and inflation has risen close to the Federal Reserve's target of 2 percent, but real rates in other markets remain as negative as ever in the eight years since the crisis. Because the crisis hit GDP and asset value harder in advanced countries than in others, especially China, the influence studied in my analysis may explain some part of the drop in the global safe real short rate. In addition, the crisis may have raised investors' beliefs about the probability of adverse events in the future, as in Kozlowski, Veldkamp, and Venkateswaran (2015). According to the principles considered here, the safe real rate would fall if the disaster probability rose more for the risk-averse investors than for the risk tolerant.

I emphasize again that heterogeneity in risk aversion is only one of the factors entering a full explanation of the behavior of real rates over recent decades. Expansionary monetary policy, rising financial frictions, and slowing consumption growth need to be brought into a full analysis.

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