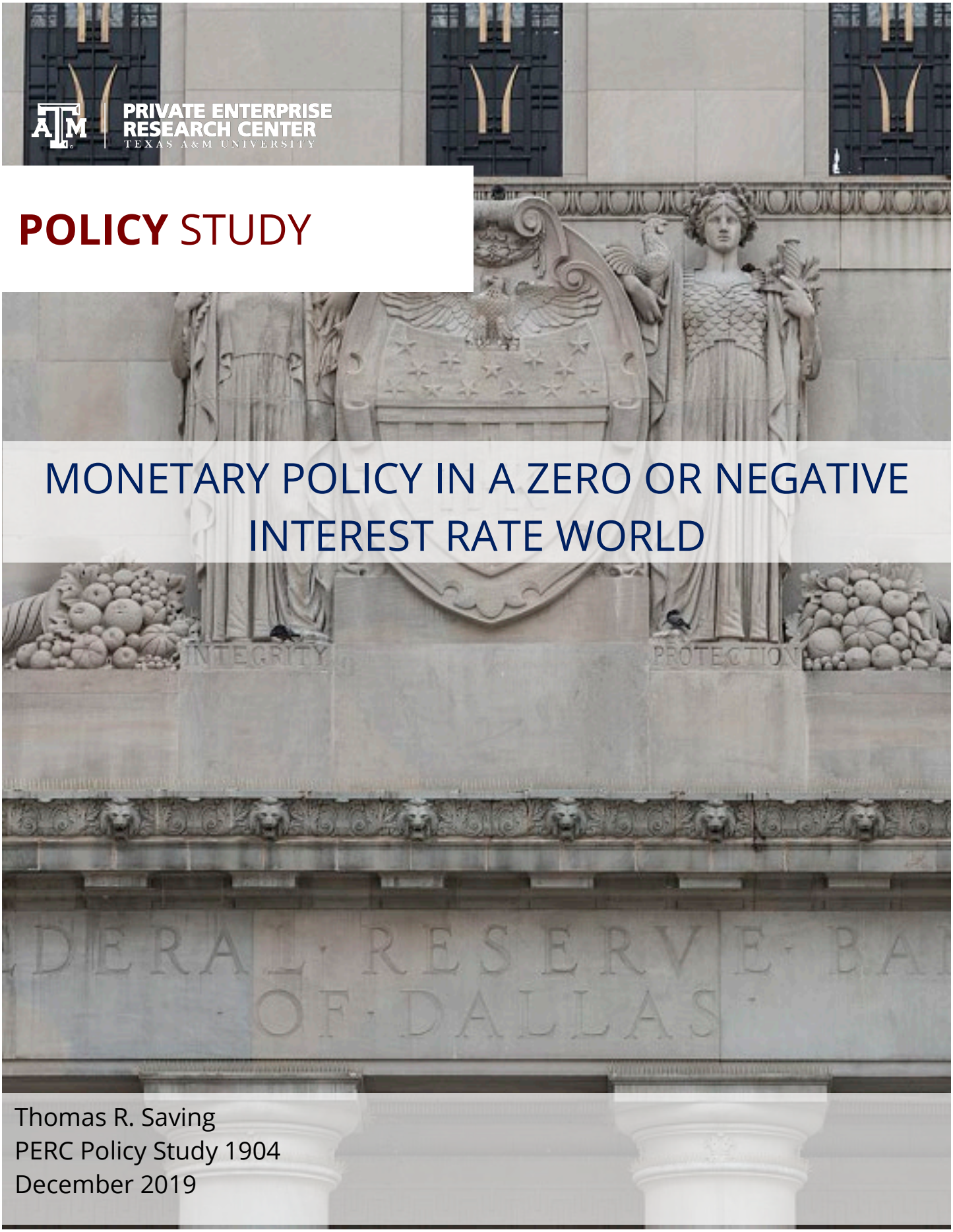

POLICY STUDY

MONETARY POLICY IN A ZERO OR NEGATIVE INTEREST RATE WORLD

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PERC Policy Study 1904
December 2019

SUMMARY

The persistence of negative interest rates in the Euro-Zone and Japan coupled with low inflation raises the question of the efficacy of central banking in a negative interest rate world. Given that interest rates have been in decline for more than thirty years, are the negative interest rates in the Euro-Zone and Japan a precursor for the future of the other countries in the developed world?

In a steady-state equilibrium, the price of future income, and therefore the rate of interest, will depend of the ratio of the young to old in the population and the rate at which the return on capital is affected by the level of the capital stock. The greater the share of the young in the population for any given rate of decline in the return on capital, the lower the price of future income, i.e., the higher the interest rate, which is the inverse of the price of future income.

In a hypothetical world, equilibrium interest rates cannot be negative since then a borrower will receive more in the present than must be paid in the future and can spend the interest and save the rest for loan repayment.

Can policy work in this negative interest rate world? Yes, central banks just print the money so that any purchase of Treasuries is all revenue for the Treasury. It also replaces the tax revenue required for expenditures independent of the interest rate. Thus, traditional monetary policy still works with negative interest rates through making the public as a whole wealthier or poorer.

Once we accept the premise that an increase in the public's wealth has an effect on their level of consumption and/or saving, monetary policy will affect the economy. Once again, this is independent of the interest rate.

Even if interest rates are negative, monetary policy that affects the public's wealth will have an effect on consumption and saving. Most importantly, this result is not dependent on the level of interest rates, either positive or negative.

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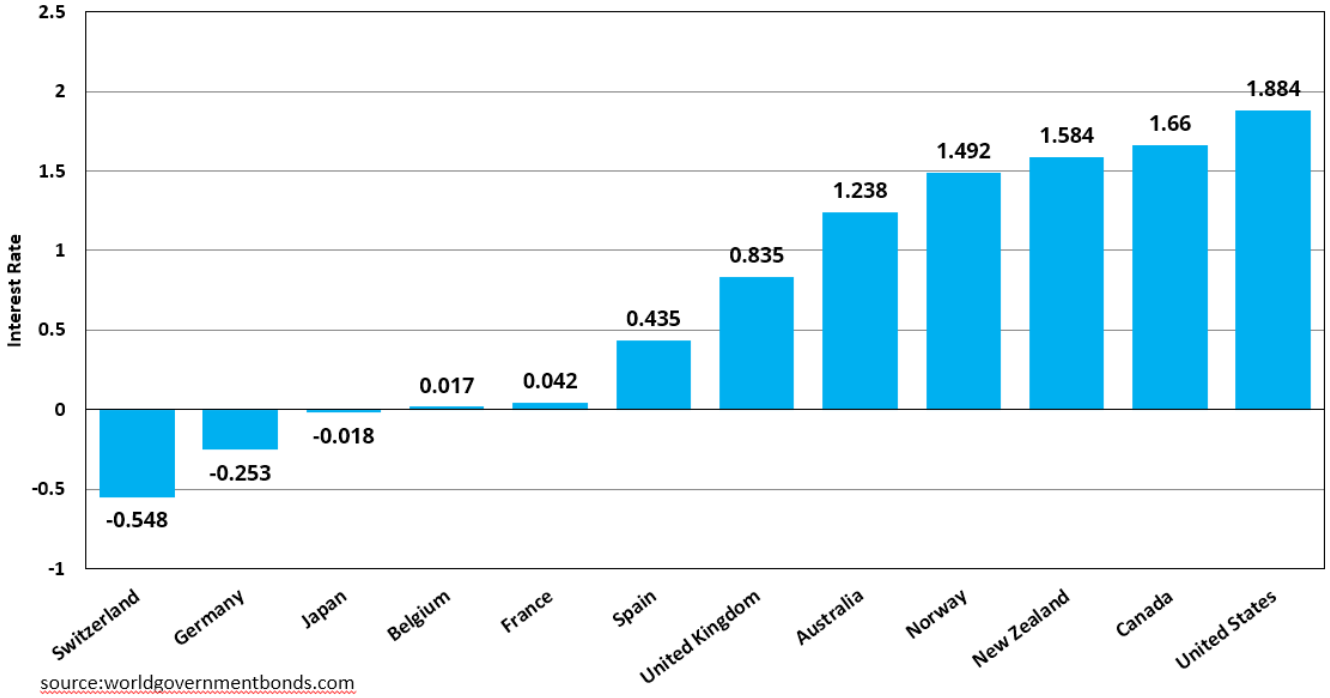
MONETARY POLICY IN A ZERO OR NEGATIVE INTEREST RATE WORLD

INTRODUCTION

The fact that worldwide interest rates are continuing to decline has raised the issue of the efficacy of monetary policy in general. The Bank of Japan and the European Central Bank (ECB) have announced negative policy rates. But it is not just policy rates that are low or even negative. Figure 1 shows the 10-Year Treasury interest rates for developed world countries. Importantly, the risk of actual default in these countries, for all intents and purposes, is zero.

Figure 1. International 10-Year Treasury Yields
December 13, 2019

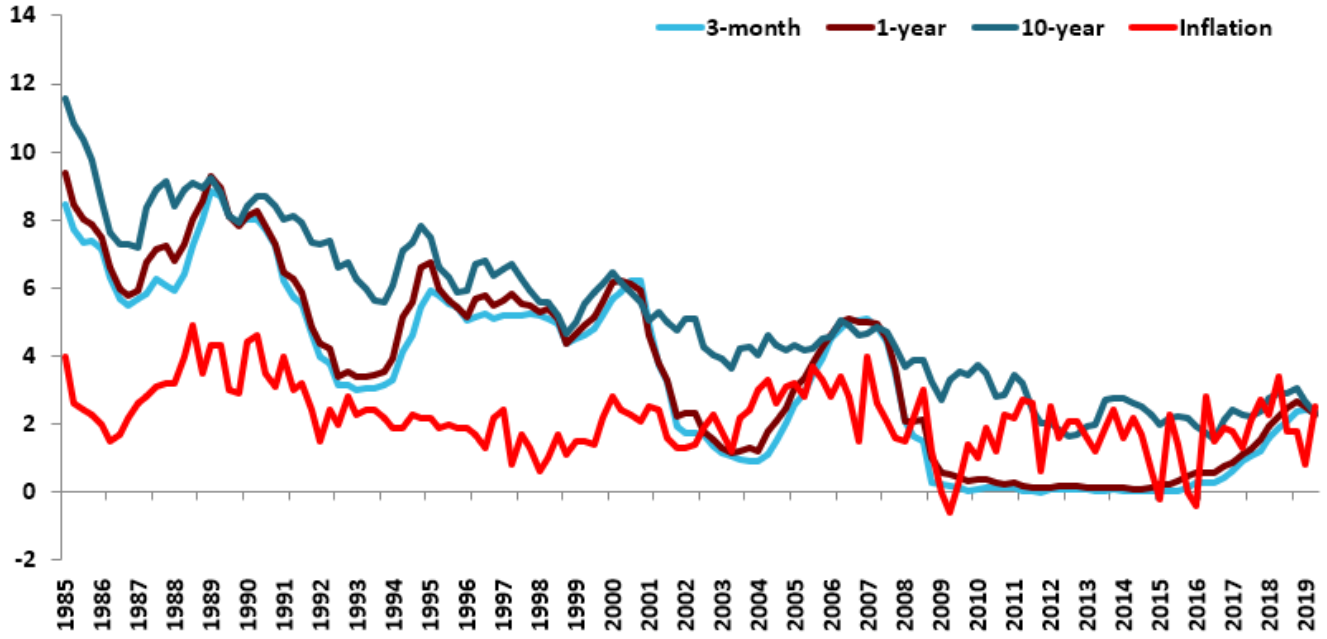


In addition, the ECB has indicated that it will engage in an additional round of quantitative easing. The question of the efficacy of monetary policy under these conditions is important and is the focus of the following discussion.

THE SECULAR DECLINE OF INTEREST RATES

The unavoidable fact is that interest rates have been declining for more than 30 years. This decline is apparent in Figure 2, which shows constant maturity 10-year, 1-year and 3-month Treasuries. Moreover, this decline cannot be attributed to falling inflation, although inflation was slightly higher, 2.86%, for the first decade, as compared to 1.90% for the last two decades. As one would expect, the 3-month and 1-year Treasuries are much more volatile than the 10-year Treasuries. But what is abundantly clear for all three is the downward trend. At the beginning of the period in 1985, the 10-year Treasuries were trading between 8.47% and 7.40%. On March 30, 2019, they were trading at 2.33%.

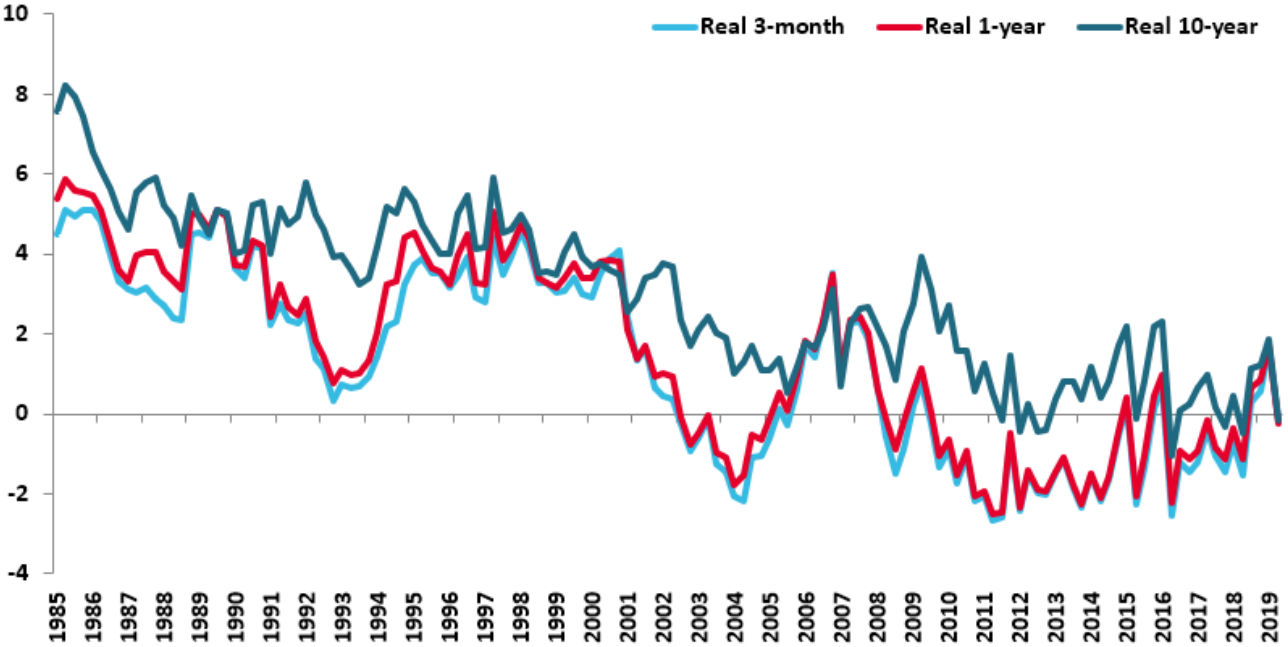
Figure 2. Treasury Rates and Inflation



Source: fred.stlouisfed.org

As shown in Figure 2, inflation as measured by the GDP deflator fell very little over the almost 35-year period. Thus, the falling nominal interest rates are indicative of falling real interest rates as well. Figure 3 shows the path of real interest rates, the difference between contemporaneous nominal interest rates and the GDP deflator. The downward trend in real interest rates is at least as apparent in this figure as it was in Figure 2. What is also apparent in both Figures 2 and 3 is that, as expected, the two short-term rates are much more closely connected with the business cycle than the long-term rates. Moreover, for the entire period the real 3-month rates have been negative for just over one-third of the quarters. Since 2000, more than two-thirds of the quarters have negative 3-month real rates.

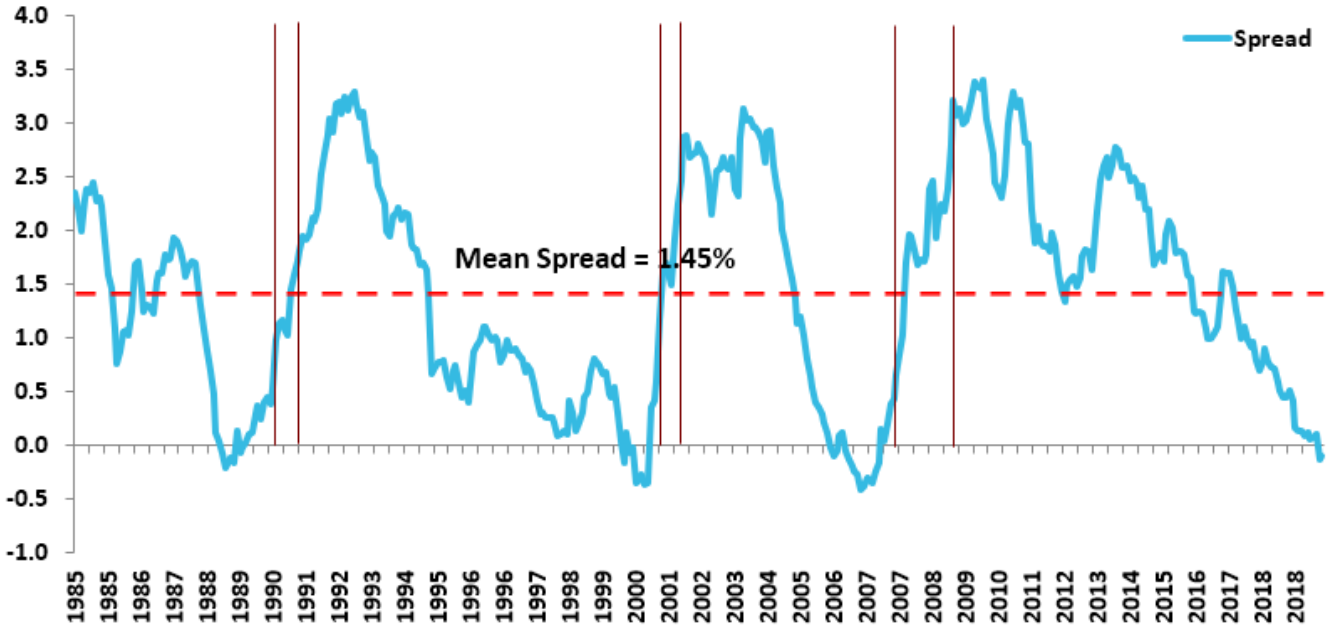
Figure 3. Real Treasury Rates



The real question is: while short-term real interest rates have been negative for most of the last decade, can this be an equilibrium? If so, what is the implication, if any, for central banks and their ability to generate wealth via money creation? Finally, can monetary policy have any effect on the economy in a zero or even negative interest rate world?

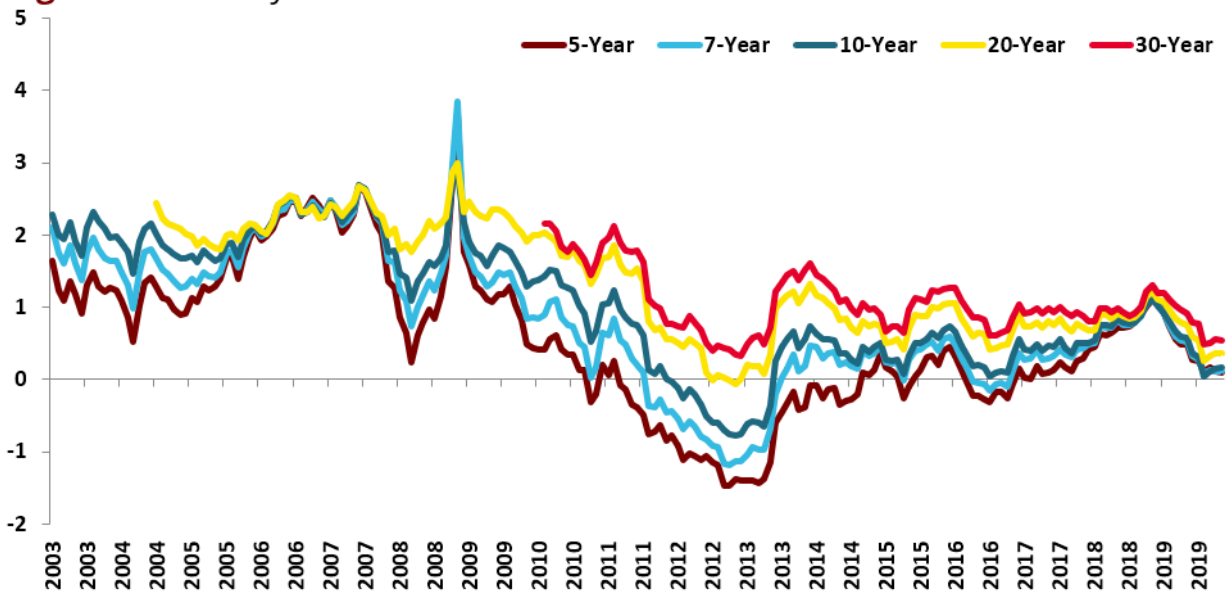
In spite of the general decline in Treasury yields over this 30-year period, on average the term structure has not changed. As Figure 4 shows, while the spread between the 10-year and 1-year Treasuries has fluctuated considerably, these fluctuations have been around the mean spread of 1.45%. The fact that the spread between the 10-year and 1-year Treasuries, while fluctuating, has been centered on the overall mean is further evidence that the interest rates have been in decline over the entire interest rate term structure. Further, Figure 4 also shows that the onset of each of three recessions depicted were preceded by a brief period where the spread between the 10-year and 1-year Treasuries was negative, indicating an inverted yield curve. Further, on average the inversion reversed nine months before the official beginning of the downturn.

Figure 4. Treasury Nominal 10-year 1-year Spread



As further evidence that negative interest rates can not only exist but can persist, Figure 5 shows the interest rates on Treasury Inflation Protected Securities (TIPS) for the period January 2008 through March 2018. In fact, all the TIPS maturities with the exception of the 30-Year TIPS had brushes with negative yields. For the shorter term TIPS these brushes with negative rates were not brushes but real sweeps. The 5-Year TIPS had negative yields that began as early as the beginning of 2010 and persisted until September 2014 and then returned briefly in both 2015 and in 2016. The 7-year TIPS had negative yields from August 2011 until July 2013 and another shorter period in 2016. Then the 10-Year TIPS had a long period of negative yields that began in December 2011 and lasted until June 2013 and returned briefly in 2016. Even the 20-year TIPS had a very brief flirtation with negative yields in 2012. Only the 30-Year TIPS escaped the projections of the market that real yields for the future looked dire.

Figure 5. Treasury Inflation Protected Interest Rates



Source: fred.stlouisfed.org

INTEREST RATES IN EQUILIBRIUM

Interest rates are almost inverse measures of the market price of future income. For example, the 1-year interest rate tells us the current price of a one year from now dollar of income. Thus, a 1-year interest rate of 1% indicates that we can buy a one year from now dollar for a current payment of 99.0099 cents. And if interest rates reflect a market price, what is this market? Who are the suppliers and who are the demanders?

Let's begin with suppliers of future income. The suppliers are entities that desire to consume more than their current income. These suppliers may be individuals, usually the young who are consumption smoothing and governments whose tax revenue is inadequate to support their current expenditure plans. The remainder of the suppliers of future income are firms whose cash flow is inadequate to support their investment in capital that will supply income in the future. So suppliers of future income sell their future income to government, firms or individuals.

Now let's move to demanders of future income. On the consumption side, demanders of future income can be consumption smoothers. Here, it is individuals whose current income exceeds consumption but who recognize that in the future they will desire more consumption than their future income will provide. In a broader sense, individuals or commercial entities may have future commitments or desires that they want be certain that the necessary income will be available.[1] Demanders of future income may also be individuals who want to provide future consumption for their heirs or favorite charity.

Assuming that lifetime utility functions exhibit diminishing returns to consumption, individuals will maximize utility by smoothing consumption. This consumption smoothing coupled with a parabolic age-income profile implies that individuals will borrow, i.e., supply future income, in their younger years

[1] In a certain world current wealth provides certain future consumption but in a world of uncertainty current wealth can be used to buy future wealth. Then the desire to insure the future increases the demand for future income.

and then save, i.e., demand future income in their middle years to be consumed when their income falls below their desired smoothed consumption.

At any point in time, it is the young that are supplying future income. As these youth age, their consumption is above their earnings but will fall below their earnings later in life. During the years of earnings in excess of consumption, individuals become demanders of future income to be consumed as their earnings ultimately fall below their smoothed consumption.

If this is all there is, then the equilibrium interest rate will be determined by the relative number of suppliers and demanders of future income. But now we must allow for an alternative to the young as suppliers of future income– investment in the capital stock. After investment, the supply side of the market for future income consists of the sum of the young population and the ability of capital to supply for the future.

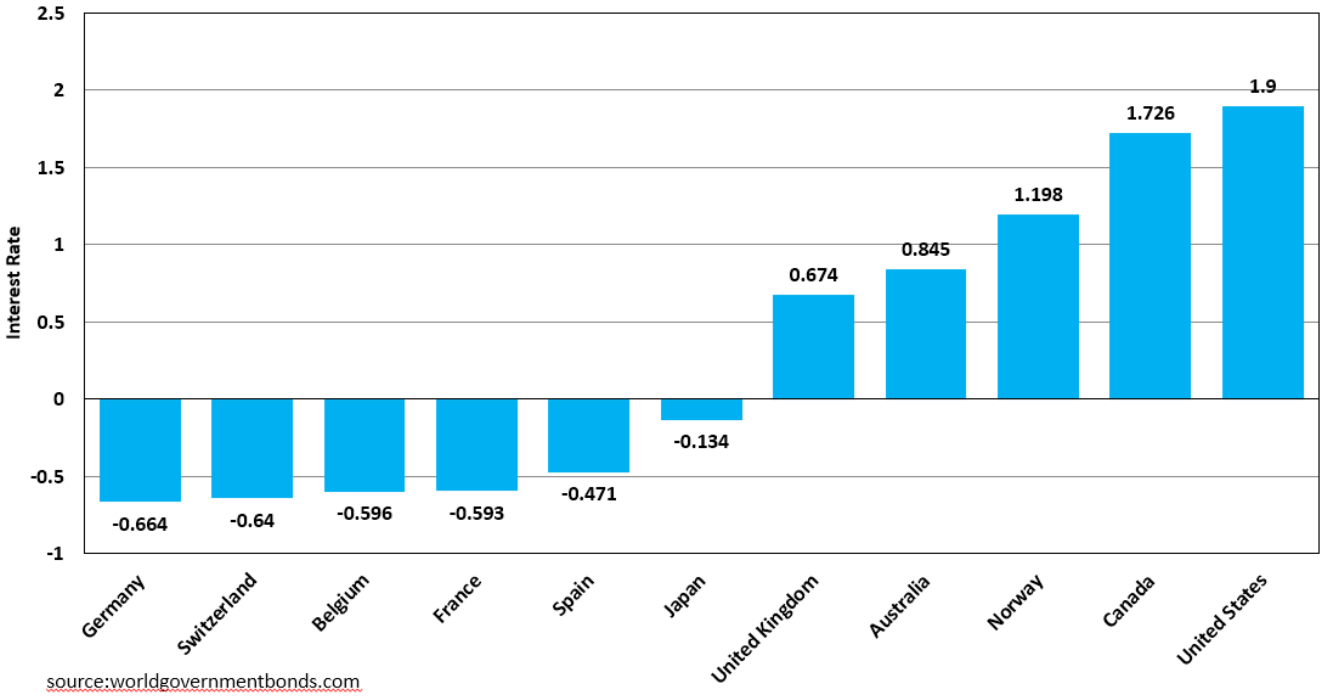
Then, the importance of the relative number of young versus middle-aged must be tempered with the effect of the rate of reduction in the rate of return on capital stock as the stock of capital expands. In an extreme case, if the rate of return on capital is independent of its stock, then the interest rate would be determined by the rate of return on capital and independent of population demographics.
In a steady-state equilibrium, the price of future income, and therefore the rate of interest, will depend of the ratio of the young to old in the population and the rate at which the return on capital is affected by the level of the capital stock. The greater the share of the young in the population for any given rate of decline in the return on capital, the lower the price of future income, i.e., the higher the interest rate which is the inverse of the price of future income.

In the long run then, two factors have equal importance, demographics and technological change. Couple this simple, but incomplete, discussion of the equilibrium interest rate with declining fertility rates and the immediate future seems to be an ever-decreasing proportion of young supplying future income relative to the demanders of future income. A declining supply of future income implies a rising price of future income, i.e., falling interest rates. Since demanders of future income should not care about the source of their future income capital and the supplying portion of the working population must compete. As a result, the rate of return on capital and the interest rate on future income sold by the young, must be equal.[2]

But just as Figure 1 showed negative 10-year interest rates for many countries in the developed world and particularly in the Euro countries, Figure 6 shows the 1-year Treasury rates for the same countries. Just as with the 10-year Treasury rates, the 1-year Treasuries rates are negative for Switzerland, the Euro-Countries and Japan. The remainder of developed countries have positive 1-year Treasury rates, admittedly low in terms of any historic period. Furthermore, the supply of Treasury securities has been rising as almost all developed countries have been running deficits and financing them with the issuance of Treasury securities. For interest rates on Treasury debt to be falling the demand for these securities must be rising faster than the increase in supply.

[2] The more common approach to interest rate determination is the market for loanable funds. A brief discussion of this approach is presented in the Appendix.

Figure 6. International 1-Year Treasury Yields
December 13, 2019



source:worldgovernmentbonds.com

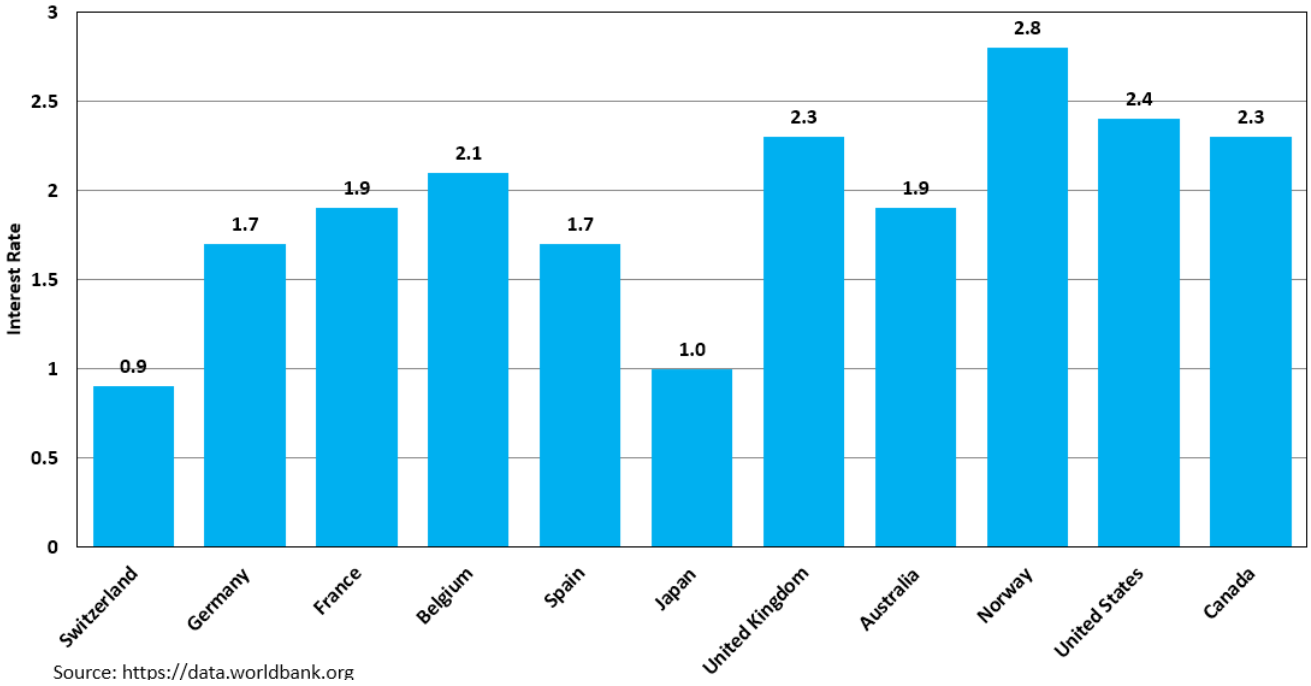
Importantly, in certain world equilibrium interest rates cannot be negative. For example, assume a certain stable price level and consider an interest rate of -10%. Then a supplier of $1,000 of income to be delivered in one year, a borrower in our usual terms, receives $1,100 in the present. In this certain world, the future income supplier, the borrower, can put $1,000 under his or her mattress, spend the $100 now, and use the saved $1,000 to supply the promised future income. Clearly, in a certain world the supply of future income becomes completely elastic at a zero interest rate, or its equivalent, a price of unity for a unit of future income.

The same proposition can be put in terms the demanders of future income. A demander of $1,000 of future income, a lender in our usual terms, with a -10% interest rate must deliver $1,100 now to get the future $1,000. In a world of certainty, a demander of future will not pay more than $1 per $1 bought since demanders can simply put the money under the mattress. Thus, it is clear that the demand for future income is zero when the price of a $1 of future income exceeds $1.

Accepting the argument that in a certain world, equilibrium interest rates cannot be negative, what explains the negative nominal interest rates that are depicted for Europe and Japan in Figures 1 and 6? The most obvious uncertainties are exchange rates and inflation rates. Exchange rate uncertainty would contribute to the lack of equality among the 1-year Treasury differentials in Figure 6. Further, real yield on all the interest rates depicted in Figure 6 will ultimately be determined by future inflation. Thus, one possible explanation the negative nominal rates in Figure 6 is the expectation that price levels will fall at rates that make real interest rates positive. But, while inflation rates in Japan and the Eurozone are low,

they are not negative. Figure 7 depicts World Bank estimates of 2018 inflation rates for the countries depicted in Figures 1 and 6.[3]

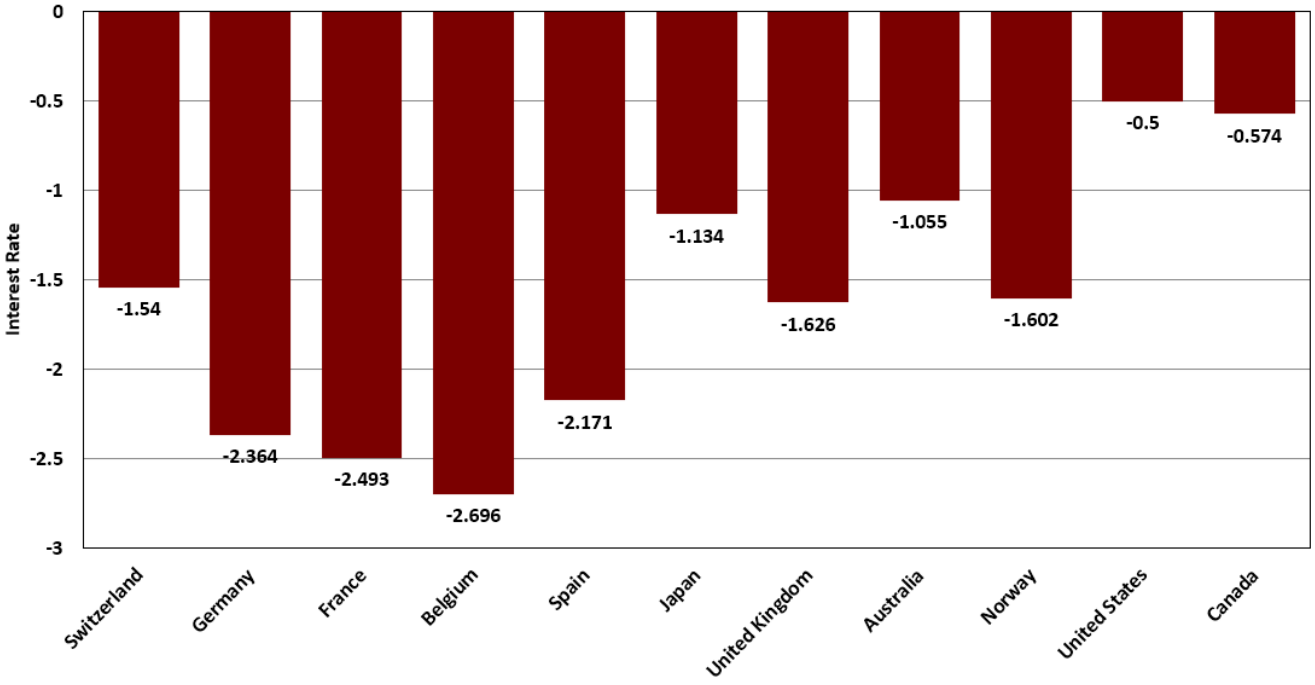
Figure 7. International Inflation Rates 2018



From Figure 7, all inflation rates are positive and, except for Switzerland at 0.9%, are 1% or greater. The Eurozone countries inflation rates are between 1.7% and 2.1%. Figure 8 shows the real interest rates for the Figure 6 countries, with the assumption that the market expects the 2018 inflation rates to continue for at the next year. Adjusted for expected inflation, all the interest rates for the countries shown in the figures are negative and significantly so.

[3] See https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG

Figure 8. International Real 1-Year Treasury Yields
December 13, 2019



In view of the fact that nominal interest rates in the Eurozone and Japan are negative and the real interest rates, adjusted for inflation, for all the developed world depicted in Figures 6 and 8 are negative, the question is why? We know that in a riskless world, nominal interest rates cannot be negative. Thus, the fact that some nominal interest rates and all real interest rates are negative implies that the participants in these markets are responding to perceived future risk.

The markets for developed world treasury debt are world markets in the sense that purchasers of these debt instruments can be citizens in any country.[4] The differences in yields across these developed world countries can stem only from exchange rate risk as all have essentially zero default risk. But since the Euro-countries all have similar inflation risk and essentially zero default risk and zero across country exchange rate risk, they can be viewed as a single entity. That said however, for the non-European countries and Japan, all the developed world nations depicted in Figures 1 and 6 have positive nominal interest rates and zero default risk, but still negative real interest rates.

Since the sovereign debt in Germany, France, the United Kingdom, Japan and the United States is default risk-free, why doesn't arbitrage result in nearly equal interest rates across these countries? One explanation is exchange rate risk, although this risk should be minimal since the Treasuries in Figure 6 are 1-year issues. Another explanation is differences in the tax treatment of foreign revenues.

The existence of negative interest rate securities indicates that the purchasers of such securities are willing to pay for the assurance that after the term of the security, they will have an asset equal to the face value of the security with certainty. The fact that even 10-year securities have negative yields in the Euro-zone and Japan indicates that real uncertainty exists in holding fixed nominal assets. Who are the purchasers of these negative nominal-yield assets? It is true that the developing world has an above average saving rate and significant property right risk. Perhaps for citizens in these countries, the safest

[4] At least any country without effective capital export controls.

way to ensure that your assets are safe is owning Treasuries of zero-default risk countries, even ones with negative yields. [5]

In a sense the nations that can sell their debt at negative interest rates are selling insurance to the purchasers of that debt. The buyers are paying for security in the same way that Swiss banks charged deposit holders for essentially secret bank accounts. Or gold dealers charged gold owners for storing their gold. Thus, such Treasury debt actually generates revenue for the Treasury.

Finally, even though negative interest rates cannot be a long-run equilibrium, they currently exist. Even a short-run equilibrium with negative interest rates raises the question as to whether the normal working of monetary policy is possible during periods of negative interest rates. Specifically, do interest rates have to be positive for central banks to deliver wealth to their government owners? This is important since the ECB just announced that it was engaging in another round of buying Euro Treasuries–all with negative interest rates. To discourage banks from depositing the resulting increase in reserves, the interest rate received on new deposits at the ECB will be -0.5%.

CAN MONETARY POLICY WORK WITH NEGATIVE INEREST RATES?

Central banks in almost all nations have a monopoly in the production of essentially zero cost legal tender.[6] When central banks issue this legal money, they acquire assets from the public, generally their country's treasury debt instruments, but more recently also private financial instruments. The increase in the central banks' holdings of financial assets is the revenue from supplying currency to the economy. As a result of the close financial connection between a nation's central bank and that nation's Treasury, all central bank assets and flows from these assets belong to the Treasury. The goal of all the worlds' major central banks–Bank of Japan, ECB, Bank of England and the Federal Reserve, is stable prices, which they all agree is a rate of inflation at or just below 2%. The continuing increase in the money supply required to achieve this stable price goal generates a flow of revenue to the Treasury. In a world of constant government expenditures the revenue flow from the central bank reduces the tax burden on the population as it reduces the cost of servicing the relevant treasuries debt.

Post the 2008 world financial crisis, all of the world's major central banks engaged in a substantial expansion of their holdings of financial assets. These expansions were referred to as "Quantitative Easings", or QEs. The Federal Reserve engaged in three QEs, the last of which ended at the close of 2014. These easings resulted in the asset portion of the Federal Reserve's balance sheet reaching more than 25% of GDP, about four times the previous average of Federal Reserve asset holdings. The inflationary effect of this unprecedented asset expansion was offset by the Federal Reserve initiating the payment of interest on bank reserves, creating a new Federal Reserve liability. This new liability absorbed much of the asset expansion with the result of very modest inflation, actually well below the 2% inflation goal for most of the period.

In an effort to return the asset portion of its balance sheet to a level consistent with its past, the Federal

[5] Of the total foreign non-government holdings of $1.7 trillion US Treasuries, $714 billion are held in Luxembourg, Switzerland and the Cayman Islands. Importantly, as acknowledged by the U.S. Treasury ownership of U.S. securities held in overseas custody accounts may not be attributed to the actual owners. See https://ticdata.treasury.gov/Publish/mfh.txt.

[6] Central banks can be privately owned or what is almost universally true be part of the government. In the latter case there is usually some form of separate control for the bank.

Reserve began in October 2017 an asset reduction program that continued through August of 2019. This asset reduction program reduced Federal Reserve assets by almost $700 billion, a 15.5% reduction. At the same time, Federal Reserve liabilities, bank reserves, fell by almost $800 billion, with a net result of Federal Reserve net assets rising by just over 8%. During the same period, real GDP rose just over 5% so that on net the Federal Reserve asset reduction program resulted in a monetary expansion consistent with its inflation goal.

The Federal Reserve's actions listed above were all done in what we might call a 'normal' positive interest rate world. But now the ECB has announced a new quantitative easing with new purchases beginning in November 2019 at a rate of €20 billion per month. The easing is to "… run for as long as necessary to reinforce the accommodative impact of its policy rates, and to end shortly before it starts raising the key ECB interest rates."[7] Since the EU is currently experiencing negative interest rates, so far as Euro Treasuries are concerned, the question is: Can a central bank affect the economy if the assets purchased by the central bank with printing press money do not have a positive yield?

Let us assume a permanent increase in a central bank's assets through the purchase with newly created money of treasuries from the public or for that matter, directly from the Treasury. In the case of a direct purchase from the Treasury, the entire purchase is revenue to the government since the newly issued money goes directly to the government while the debt remains permanently with the central bank. Further let us separate the issue of the effect of the introduction in 2008 of paying banks to hold reserves from the open-market operation effect.

In the case of a private market purchase of newly issued 1-year government debt, the newly issued money goes to the public. However, even here the total purchase directly benefits the government since when the new debt matures its repayment to the central bank must then be returned to the Treasury. Thus, buying government debt from the public is equivalent to simply buying it directly from the Treasury. Consequently, the public is better off by the amount of the purchase, independent of whether the purchase was direct from the Treasury or in the open market.

From a monetary policy standpoint the question is: how is the public's budget constraint affected? If the central bank must transfer all assets to the government then these assets, rather than tax revenues, can be used for expenditures. After a central bank purchase of treasury debt, the public has the same level of assets but a lower tax bill for that period.

For illustrative purposes, I will assume that it is the Federal Reserve rather than the ECB that is conducting the monetary expansion in a world with negative interest rates. If you like, you can just substitute the symbol € whenever you see the symbol $ in what follows.

To base the analysis on recent interest rates I use the November 1, 2019 Germany (a Euro-World country) 1-year interest rate of -0.626%, so that a newly issued $1,000 1-year Treasury has a current market value of $1,006.299. Assume that central bank policy calls for the purchase of 1 million $1,000 Treasuries. The purchase increases the monetary base by $1,006,299,434.46 ($1.0063 billion). After 1-year the central bank will receive from the Treasury $1 billion.

[7] See ECB press release, *Monetary Policy Decisions*, 12 September 2019.

A central bank is a producer and destroyer of money. The bank prints money to buy the Treasury notes. But money that is returned to the bank as the Treasury notes mature are, for all intents and purposes, shredded. In order to keep the monetary base constant, the money returned to the central bank as the Treasury notes mature must be put back in the economy through the purchase of $1 billion of 1-year Treasuries. But with negative interest rates, fewer and fewer Treasury notes will be maturing each year. In order to maintain a constant monetary base, the net assets of the central bank will fall by the level of negative interest rates (in our example, 0.626%) annually. Then in the limit in this world of negative interest rates, the billion dollar increase in the monetary base will result in no change in the net assets of the central bank but a $1 billion increase in the monetary base.

The above analysis must be tempered with the fact that in the United States banks have since October of 2008 received interest on their reserve holdings. This change in policy coincided with the tremendous increase in Fed asset holdings. Further in the Euro-world bank reserves held at the ECB have negative interest rates. Since the respective Treasury own the central bank, bank reserves that receive interest are essentially demand debt of the Treasury and as such they reduce the duration of federal debt. On the other hand, bank reserves that pay interest to the central bank are demand assets, essentially callable by their bank holders, of their respective Treasury.

In the usual positive interest rate world, the interest payments to banks for reserve holdings reduce dollar for dollar the annual remittances the Fed makes to the Treasury. Further any increase in bank reserves after a Fed purchase of Treasuries reduces the effect of the initial purchase on the money supply. Thus, the usual money multiplier that occurs when the monetary base is increased is reduced perhaps to unity if the increase in reserves equals the increase in Fed holdings of Treasuries. Essentially since the Fed controls the interest rate on excess reserves (IOER) it controls the multiplier effect of changes in the monetary base. The lower the IOER relative to Treasury rates of interest the greater the money supply multiplier of Fed Treasury security purchases (or purchases of any other market security for that matter). Thus, since the onset of paying interest on reserves a principal monetary policy tool for the Fed in this interest on reserve world is the IOER.

In a negative interest rate world, such as the ECB faces in Europe, banks pay the central bank for their deposits at the central bank. Since central banks are essentially owned by their respective Treasury, the interest flows from banks to the central bank get transferred to the Treasury. Just as in the positive interest rate world the rate of interest charged the banks on reserve holdings affects the level of reserves held and thus the monetary base. Importantly, the effect of an asset purchase by the central bank on the money supply can be partially or totally offset by changes in bank reserves. Just as in the positive interest rate world, the IOER, or its' equivalent, affects the money supply multiplier of any central bank purchase or sale. This ability of the banking system to offset central bank actions is why in its latest quantitative easing announcement the ECB has decreased the negative interest rate on new increases in bank reserve holdings by 10 basis points to -0.50%. This change is to discourage banks from actions that would reduce the effect on the money supply of the monetary base changes from the ECB quantitative easing.[8]

Even if interest rates are negative, from the perspective of the owner of the central bank, the Treasury, any purchase of assets by the central bank is all revenue by the full cost of the purchase. After all, the

[8] The existence of an insurance component investment safe sovereign debt raises some interesting issues concerning the optimal debt versus taxation financing of expenditures. Or, alternatively, recognizing that investment safe sovereign nations can raise revenue by issuing debt.

money required for the purchase is created by the central bank. Thus, in the case of the purchase of financial assets, the net result is independent of the rate of interest. But the effect on the money supply is not independent of the rate of interest as the banks can offset any change in the monetary base by their actions on reserve holdings.

In the limit the issue is whether the effect of an open market operation that expands the monetary base with newly created money depends in any way on the rate of interest on the assets purchased? In the above example, would the effect of the above $1.0063 billion purchase of 1-year Treasuries have been different if the interest rates were positive? That is, does it increase the money supply and as affect the public's budget constraint?

First, from the perspective of the money supply, the Treasuries are purchased with newly printed money so that the monetary base increases by the amount of the purchase just as it would if the yield on the Treasuries was positive. No matter the yield on Treasuries, a $1 billion open market operation increases the monetary base by $1 billion, and gives the owner of the central bank, the Treasury, the full $1 billion.[9] Furthermore, because of the intimate connection between the Treasury and the public, as taxation is the Treasury's source of revenue, the $1 billion operation affects the public as well.

Now, what about the public's budget constraint? The transaction itself removes $1 billion in 1-year Treasuries from the public and replaces them with $1 billion of the equivalent of cash. From this perspective, the public is whole in that it willingly gave up the Treasuries for the cash. Now the Federal Reserve, rather than the public, holds the $1 billion in 1-year Treasuries.

By law, when the Treasuries come due, they create income for the Federal Reserve and all profits of the Federal Reserve revert to the Treasury. Thus, the taxes that would have been necessary to redeem the 1-year Treasuries will now be unnecessary. So the public will get a tax reduction relative to the pre-open-market operation expected taxes. This tax reduction has a value equal to the Federal Reserve purchase of Treasuries. Therefore, the public budget constraint increases by the full $1.0063 billion.[10]

Essentially, the public is wealthier by the full $1.0063 billion of the open market purchase. Now the question is: Is the classic Keynesian liquidity trap relevant here? The answer is no–even if such a corner solution was reached–since the liquidity trap is about liquidity and not about wealth. Here, monetary policy that creates money by buying assets, not offset by increased Federal Reserve liabilities, increases the public's wealth. For this policy to have no effect when interest rates are zero or negative, the wealth elasticity of consumption would have to be zero!

CONCLUSION

There is no question that interest rates are at or near historic lows. As of December 11, 19, 2019, 1-year Treasuries were yielding 1.55% and 5-year inflation protected Treasuries (TIPS) were yielding 0.04%. For all the concern that we have lost control of monetary policy because interest rates are at historic lows, the

[9] We could refer to this revenue to the Treasury as seignorage if we like since it is the revenue from coinage.

[10] Perhaps the first recognition of the relation between an independent Federal Reserve System and the Treasury and then taxpayers was in Boris P. Pesek and Thomas R. Saving, "Monetary Policy, Taxes, and the Rate of Interest," *Journal of Political Economy*, Vol. LXXL, No. 4, August 1963, 347-362.

effect of monetary policy is independent of the equilibrium interest rate. This is an accurate statement so long as the monetary policy in question is the simple purchase and sale of publicly held assets, normally Treasuries, but also Mortgage-Backed Securities.[11]

The effect of traditional monetary policy works through making the public as a whole wealthier or poorer. Once we accept the premise that for the public, an increase in their wealth has an effect on their level of consumption and/or saving, monetary policy will affect the economy.

The classic idea that when interest rates get low enough the public will make all assets liquid does not affect this conclusion. Moreover, even if interest rates are negative, monetary policy that affects the public's wealth will have an effect on consumption and saving even if the public desires to hold all its financial assets in liquidity. Most importantly, this result is not dependent on why interest rates are at historically low levels.

APPENDIX – INTEREST RATES AND LOANABLE FUNDS

Consider two sides of the market for loans, including corporate and government bonds. First, the potential suppliers of loanable funds consists of all individuals who have assets. The supply schedule is upward sloping in that the greater the return on loans, the interest rate, the more assets individuals will put into the market. Essentially the suppliers of loanable funds are demanders of future income in the main body of the paper. In a world of certainty, the supply of loanable funds would be zero at a zero interest rate just as a demander of future income will not pay more than a current dollar for a dollar in the future. But in an uncertain world individuals whose assets are in danger would be willing to supply funds to insure future availability of assets.

Second, the demanders of loanable funds consists of all individuals, corporations and governments whose optimal expenditures exceed current income. The resulting demand schedule is downward sloping in that the greater the cost of acquiring current assets, the interest rate, the less assets that will be demanded. The demanders of loanable funds are the suppliers of future income in the main body of the paper. Then in a world of certainty the demand for loanable funds would be infinite at negative interest rates. But in an uncertain world demand for loanable funds will be finite and negatively sloped. Here demanders of loanable funds have two components: one supplying insurance to suppliers and two supporting current consumption.

[11] For an analysis of Federal Reserve holdings of assets on the public's wealth and government debt, see Thomas R. Saving, "Rethinking Federal Debt: What Do We Really Owe?" Private Enterprise Research Center Study, No. 1607, August 2016.