The Equilibrium Real Funds Rate: Past, Present and Future

February 2015

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I. Introduction

There is a consensus that we're heading towards a "new neutral:" an era of lower equilibrium real Fed funds rate.

- Stagnationists
- Bond market
- Summary of Economic Projections (SEP) for the FOMC

I. Introduction

•There is a consensus that we're heading towards a "new neutral:" an era of lower equilibrium real Fed funds rate.

- •Stagnationists
- •Bond market
- •Summary of Economic Projections for the FOMC

	—Median "longer run"—			Reference:
	Fed funds	PCE inflation	Implied *r*	#Fed funds ≤3.50
June 2015	3.75	2.00	1.75	8
Dec 2014	3.75	2.00	1.75	4
Dec 2012	4.00	2.00	2.00	2

Our goals

- Gauge the prospective equilibrium value of the real rate: the forecast of the real rate 5 or 10 or 12 years from now.

- Analyze the past behavior of the real rate.

    - This will lead us to spend considerable space on the relationship between output growth and the equilibrium rate.

Conclusions

•There is much uncertainty about the equilibrium rate, which varies considerably over time.

•The determinants of the equilibrium rate are manifold and time varying, with the effects of trend output growth generally dominated by those of other factors.

•One model that seems to capture much of the behavior of ex-ante U.S. real rates is a bivariate vector error correction model that

- •models the real rate as having a unit root, and
- •looks only to U.S. and world real rates.

•Looking forward, a plausible range for the equilibrium rate is wide, perhaps ranging from a little above 0 up to 2%.

Methodology

•"Equilibrium rate": real safe rate consistent with full employment and stable inflation. Equivalent to:

- •steady state real rate, and
- •forecast of the real rate 5 or 10 or 12 years from now.

•We make no attempt at structural estimation (no construction of output gaps, no estimation of Phillips curves, no debating the value of the constant term in a Taylor rule...)

•Instead, we use time series on the real short term government debt (real Fed funds for post-World War II U.S.). Take an average over a suitable period and that average will be an informative but admittedly imperfect indicator of the equilibrium rate.

•Much of our argument is informal.

II. Construction of ex-ante real rates

•Focus is on the U.S.. For the U.S., post-WWII data sources are conventional.

•We also use cross country developed country data:

- •annual data going back 150+ years, up to 17 countries,
- •quarterly data back to 1971, up to 20 countries.

Construction of real rates

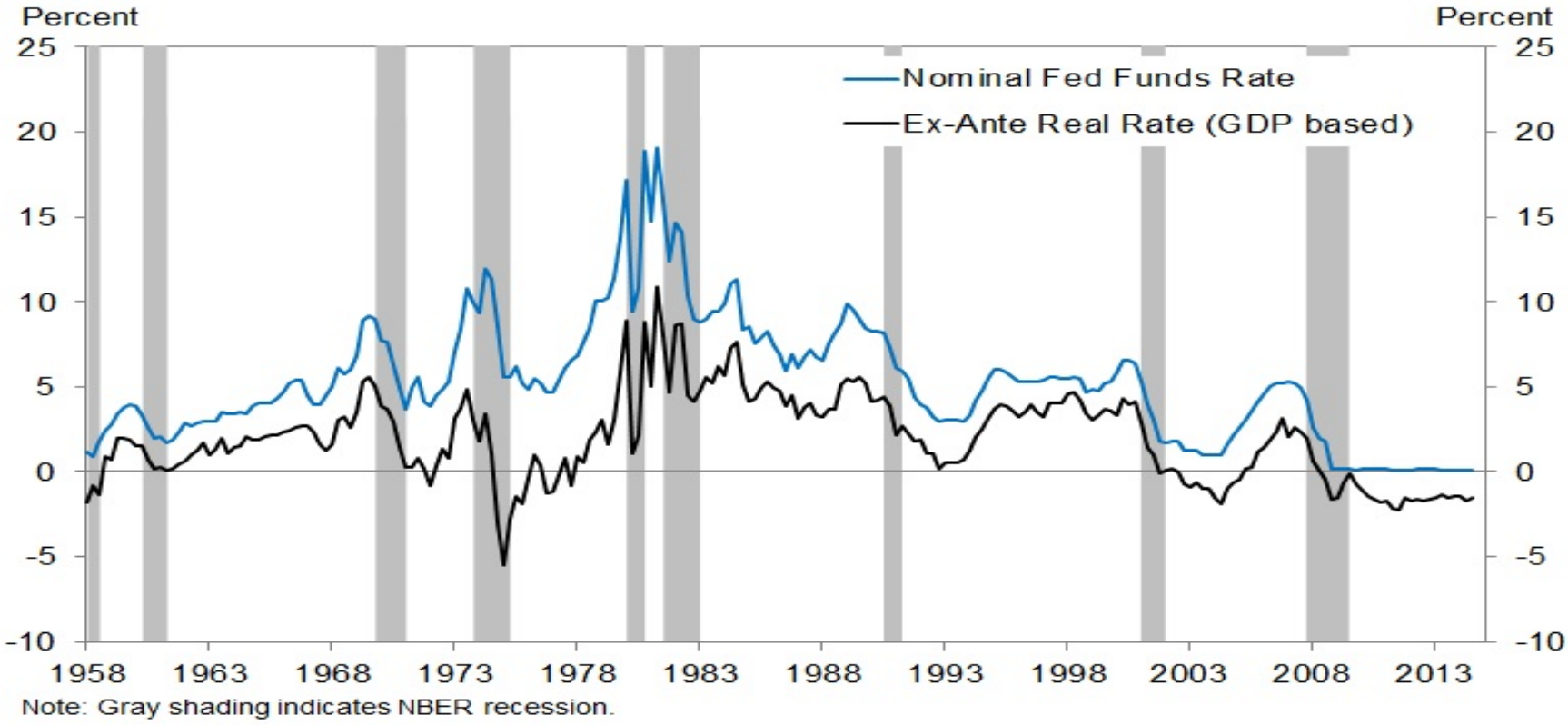
- Real rate ≡ nominal policy rate - expected inflation

- Policy rate:
  - discount rate (countries other than U.S.)
  - commercial paper rate, discount rate, Fed funds rate (U.S.)

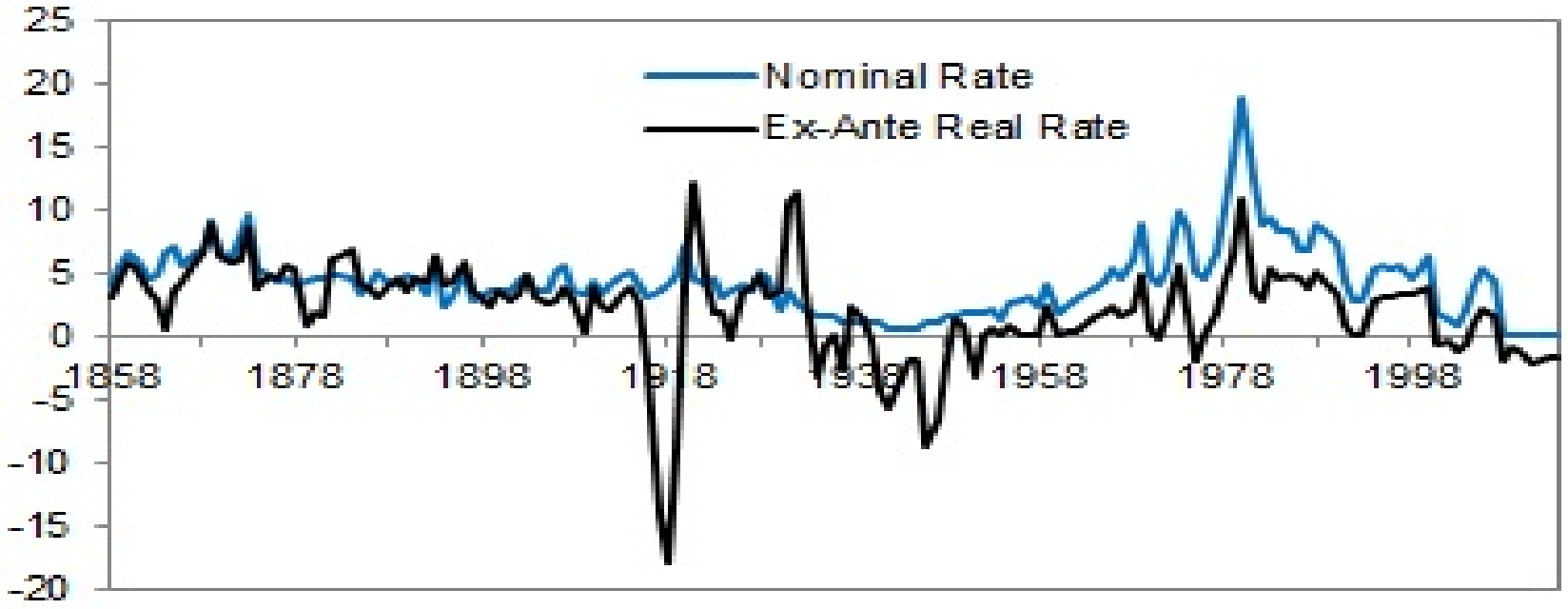
- Expected inflation from univariate AR in CPI inflation, rolling samples
  - annual: AR(1), rolling sample = 30 years
  - quarterly: AR(4), rolling sample = 40-80 quarters

- Exception: U.S. uses GDP deflator 1929-2014

Plots of quarterly and annual U.S. rates (see paper for plots from other countries):



	r	i	$E_t\pi_{t+1}$	π
mean	1.95	5.27	3.32	3.30
s.d.	2.55	3.60	2.12	2.32



	r	i	$E_t\pi_{t+1}$	π
mean	2.15	4.34	2.19	2.26
s.d.	3.89	2.76	3.37	4.82

III. The real rate, consumption growth and aggregate growth

•Real rates are often tied to growth in output or potential output.

- New Keynesian models and their offshoots, e.g., Laubach and Williams (2003).

- Discussion of secular stagnation, e.g. Summers (2013a,b).

•Depending on the model, that link works in whole or in part through the link between real rates and consumption.

•In this section, we note that in terms of r_t and consumption, there is a

- good theoretical case for a link between the two series, and
- a poor empirical case for a link between the two series.

r_t and consumption

If per period utility is $C_t^{1-\alpha}/(1-\alpha)$, the standard intertemporal IS equation is

(3.4) $\quad r_t \equiv \rho + \alpha E_t \Delta c_{t+1}$

•In NK models, the average value of r_t corresponds to the average value of the natural rate of interest: the rate consistent with output at potential and steady inflation.

•It is well known that (3.4) has wildly counterfactual properties for mean real rates–the famous "risk free rate puzzle" of Weil (1989), e.g.:

$$\rho = .04,\ \alpha=1,\ E\Delta c_{t+1}=.02 \Rightarrow Er_t = .06.$$

•Bottom line: in theory, periods with high trend growth (high mean Δc) should be associated with high mean r. In the data, not so much.

IV. The real rate and aggregate growth: empirical analysis

•Perhaps there will be a clear long-run relationship between trend output growth and the equilibrium rate, despite the weak evidence of such a relationship between consumption and the equilibrium rate.

•We compute the sample correlation between average GDP growth and average real rates over various windows.

•We focus on the robustness of the sign and magnitude of this correlation. We do not attempt to supply an economic interpretation of the estimated correlation.

The real rate and aggregate growth: empirical analysis, cont'd

- We find that the sign and magnitude of the correlation is *not* robust, but instead are sensitive to inclusion or exclusion of a small number of observations.

- As well, the magnitude of the correlation is small.

- This presentation: illustrate where the calculations are peak to peak (US) and decadal averages (cross-country). Many more results in the paper.

Average GDP growth y vs average r_t: peak to peak (U.S. data)

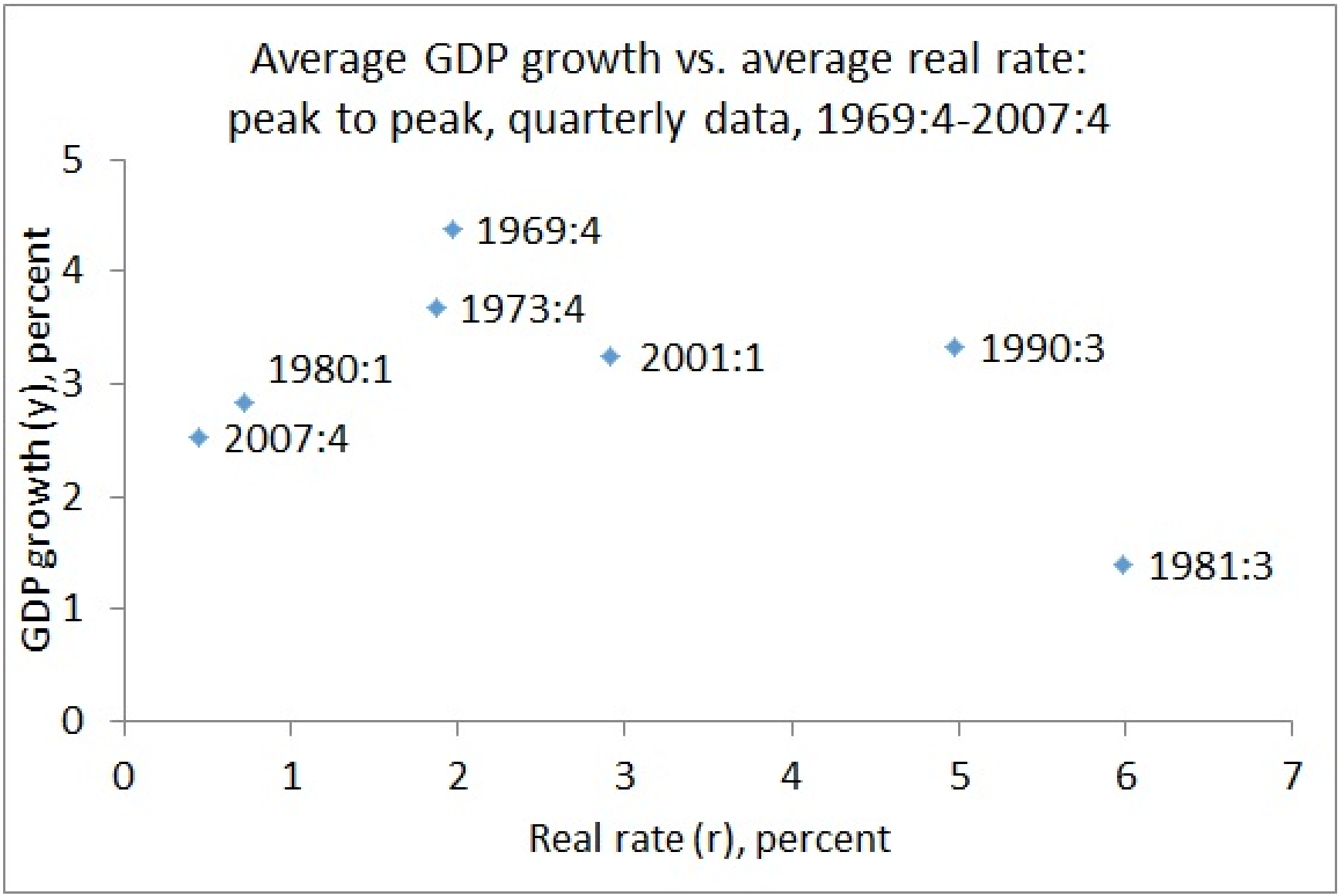
Unit of observation is (average GDP growth, average r_t), computed from a business cycle peak to the next business cycle peak.

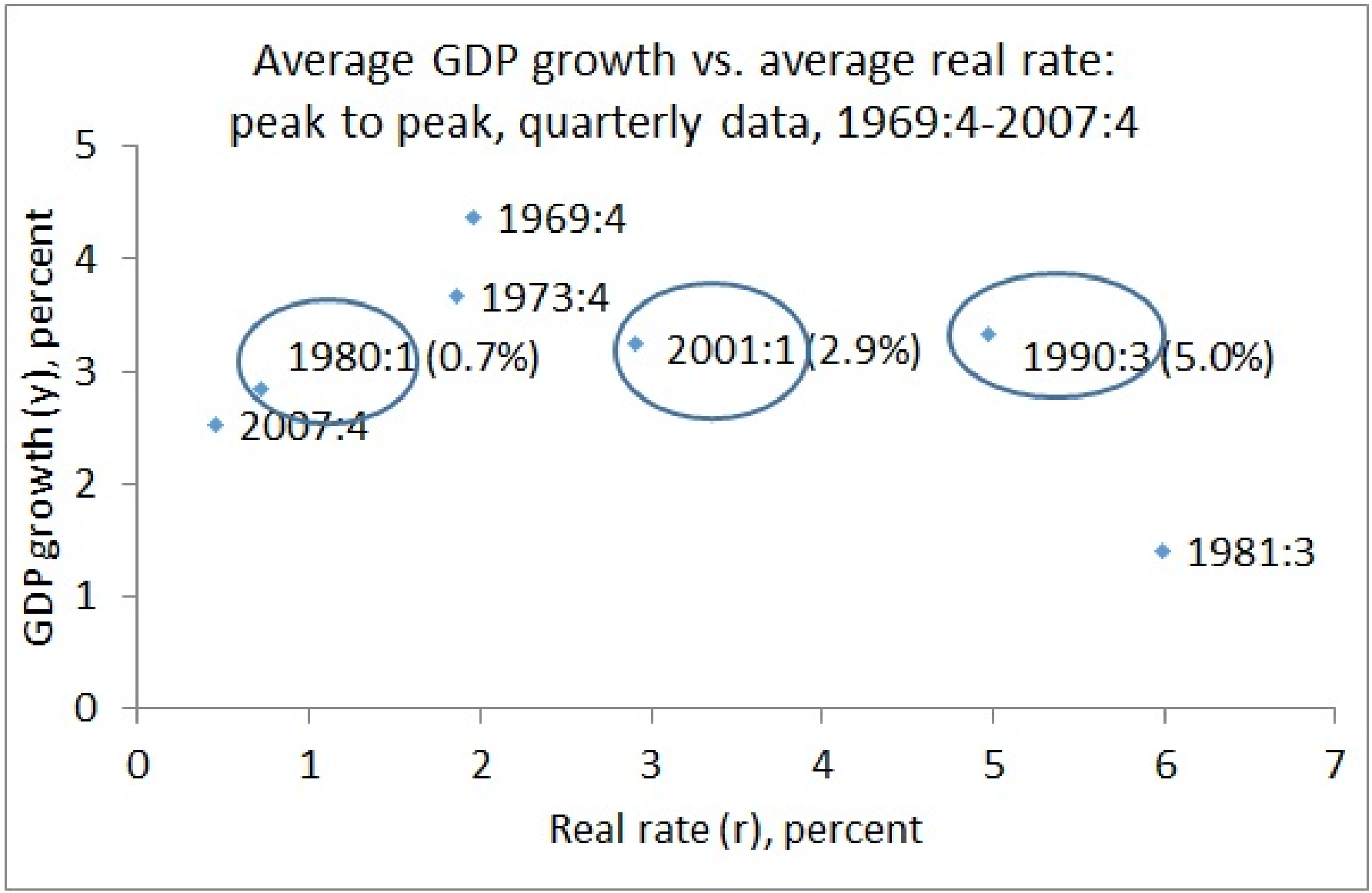
1. Quarterly

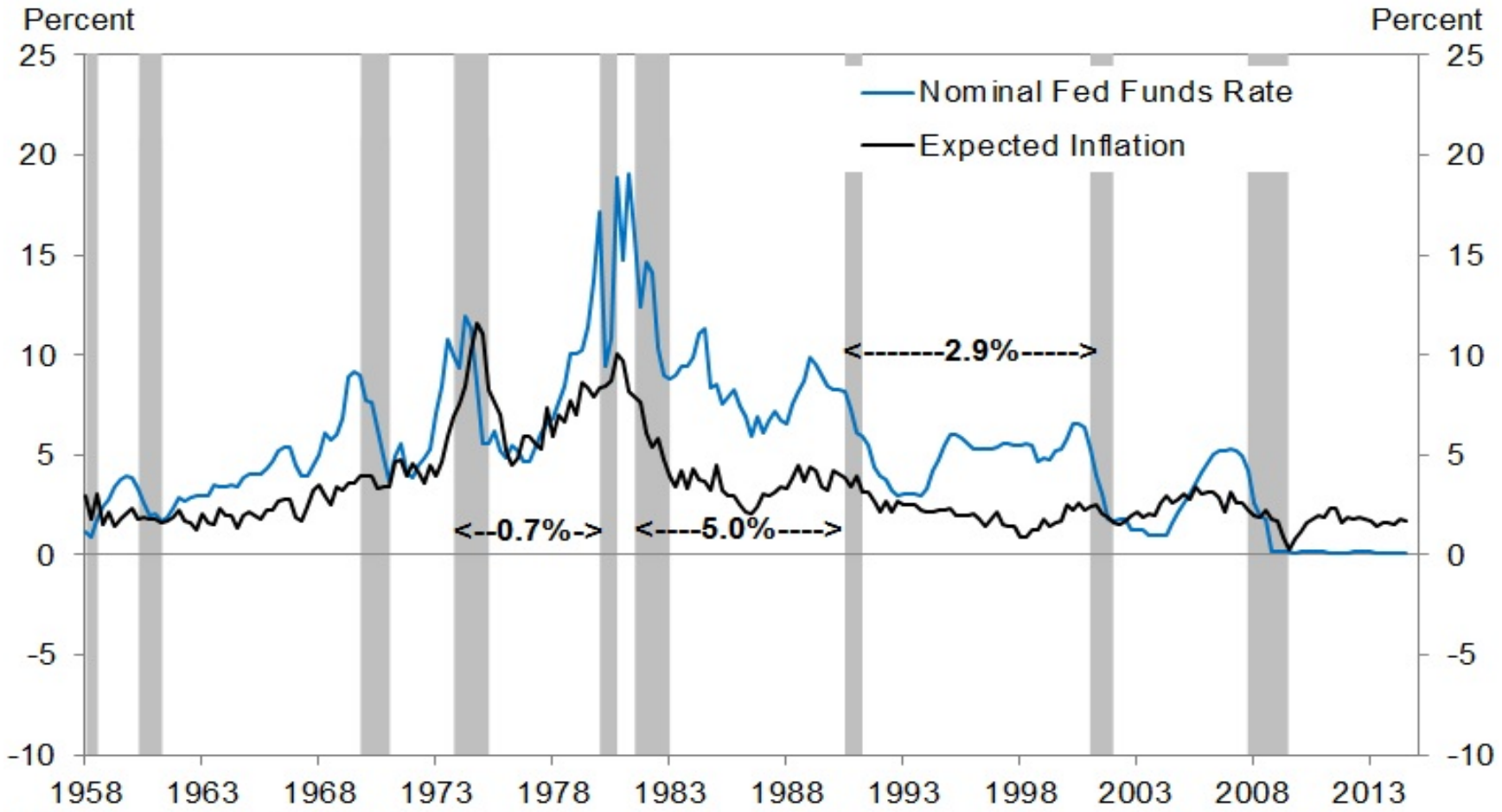
    7 data points,
        1960:2-1969:4 delivers first observation,
        2001:1-2007:4 delivers last observation.

2. Annual

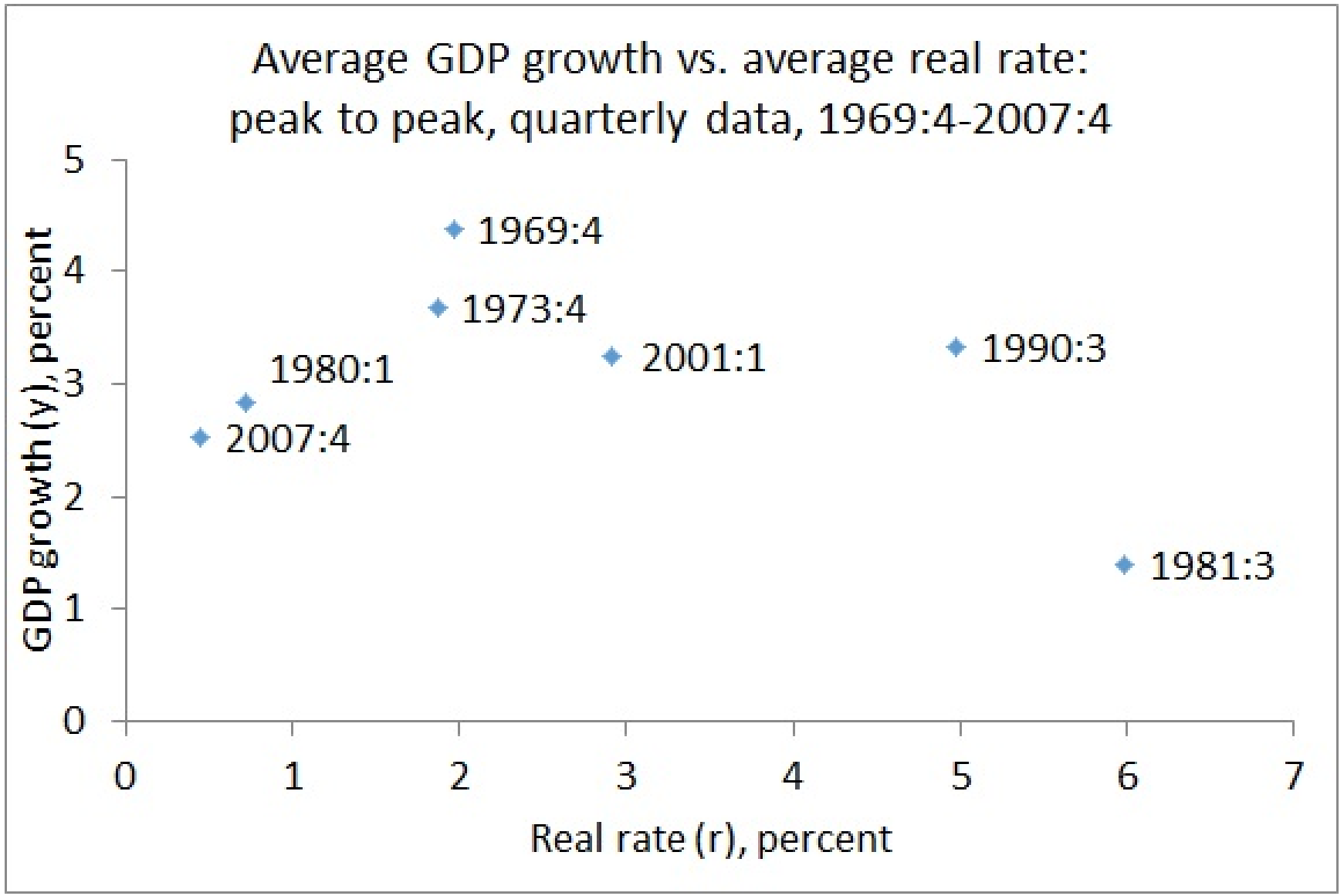
    29 data points,
        1869-1873 delivers first observation,
        2001-2007 delivers last observation.


Average GDP growth vs. average real rate:
peak to peak, quarterly data, 1969:4-2007:4
GDP growth (y), percent
Real rate (r), percent
0
1
2
3
4
5
6
7
1969:4
1973:4
2001:1
1990:3
1980:1
2007:4
1981:3


Average GDP growth vs. average real rate:
peak to peak, quarterly data, 1969:4-2007:4
GDP growth (y), percent
Real rate (r), percent
0
1
2
3
4
5
6
7
1969:4
1973:4
1980:1 (0.7%)
2001:1 (2.9%)
1990:3 (5.0%)
2007:4
1981:3



Note: Gray shading indicates NBER recession.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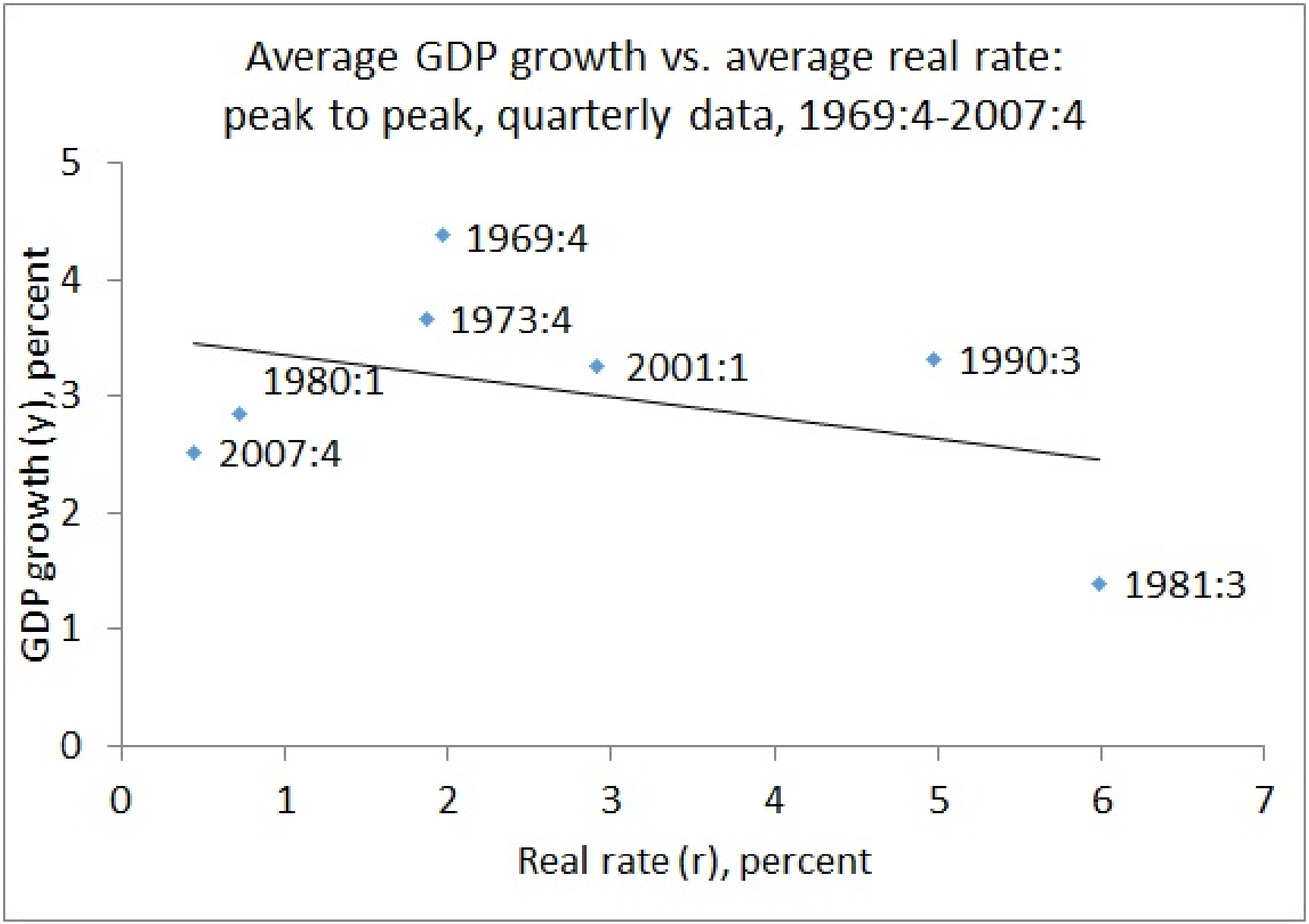
GDP growth (y), percent
Real rate (r), percent
0
1
2
3
4
5
6
7
1969:4
1973:4
1980:1
2001:1
1990:3
2007:4
1981:3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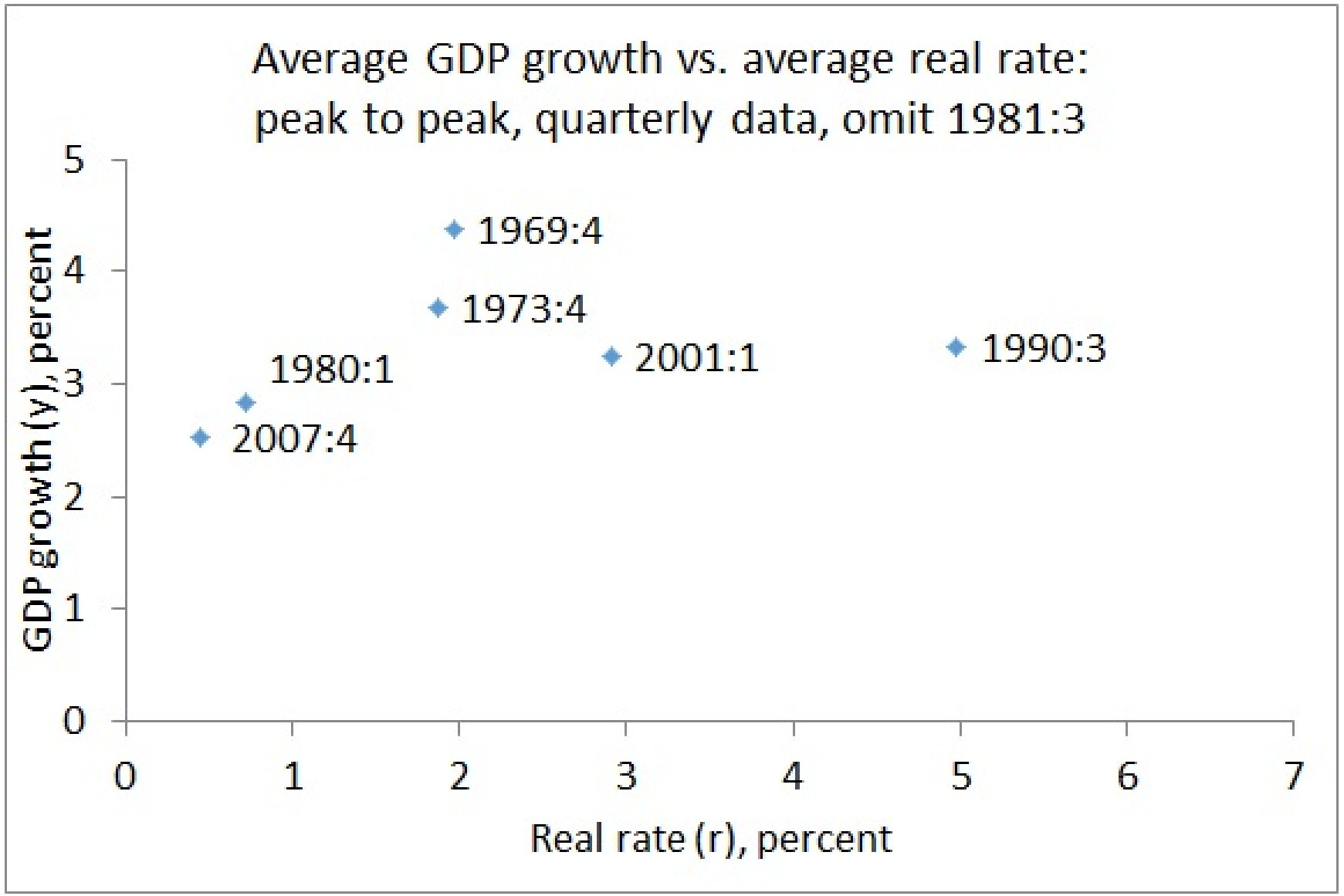
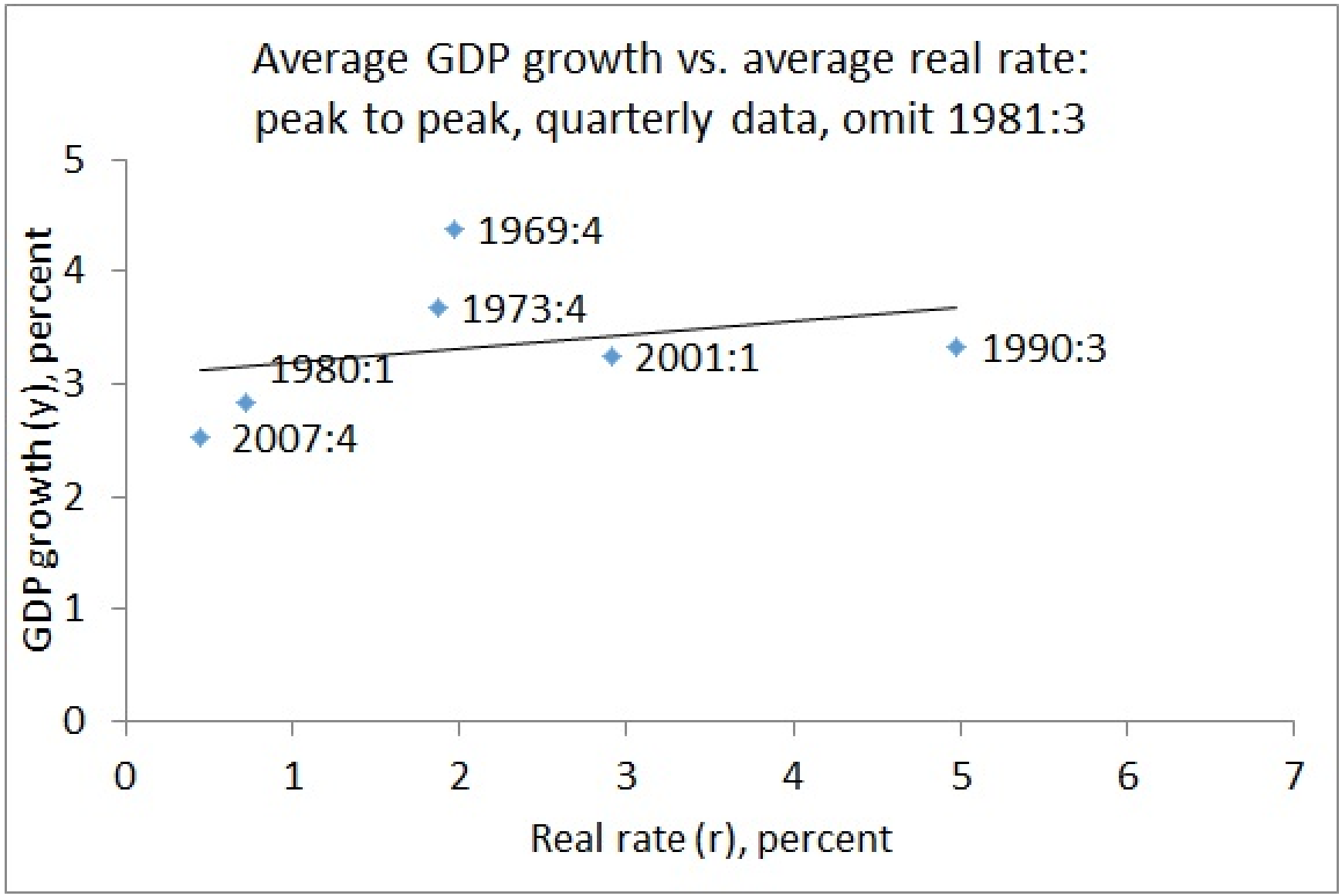
peak to peak, quarterly data, 1969:4-2007:4
GDP growth (y), percent
Real rate (r), percent
0
1
2
3
4
5
6
7
1969:4
1973:4
2001:1
1990:3
1980:1
2007:4
1981:3


Average GDP growth vs. average real rate:
peak to peak, quarterly data, omit 1981:3
GDP growth (y), percent
Real rate (r), percent
0
1
2
3
4
5
6
7
1969:4
1973:4
2001:1
1990:3
1980:1
2007:4


Average GDP growth vs. average real rate:
peak to peak, quarterly data, omit 1981:3
GDP growth (y), percent
Real rate (r), percent
0
1
2
3
4
5
6
7
1969:4
1973:4
1980:1
2001:1
1990:3
2007:4

Numerical values of correlations, peak to peak calculations

Quarterly (*N*=7)	-0.40
Quarterly, omit 1980:1-1981:3 (*N*=6)	0.32
Annual (*N*=29)	0.23
Annual, omit 1918-1920, 1944-1948 (*N*=27)	-0.23

Correlations for other samples and data measures, and for 10 year moving averages, are reported in the paper (Exhibits 3.4 and 3.5). The numbers above are representative, for both peak to peak and 10 year moving averages:

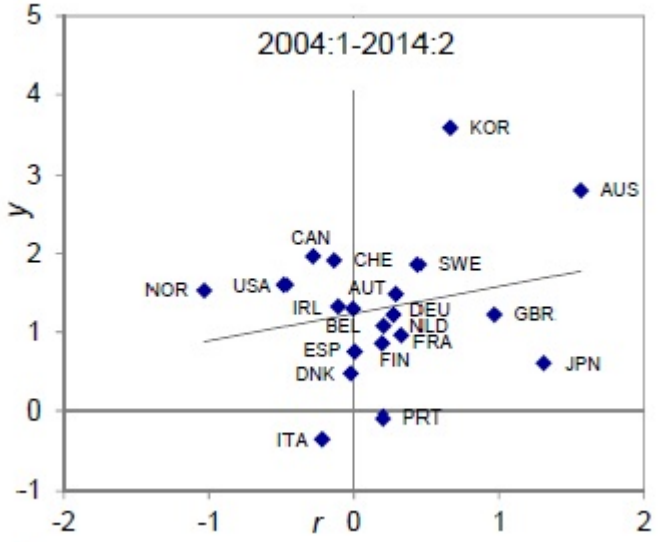
(a)The absolute value of the correlation is small.
(b)The sign of the correlation is sensitive to minor changes in sample.

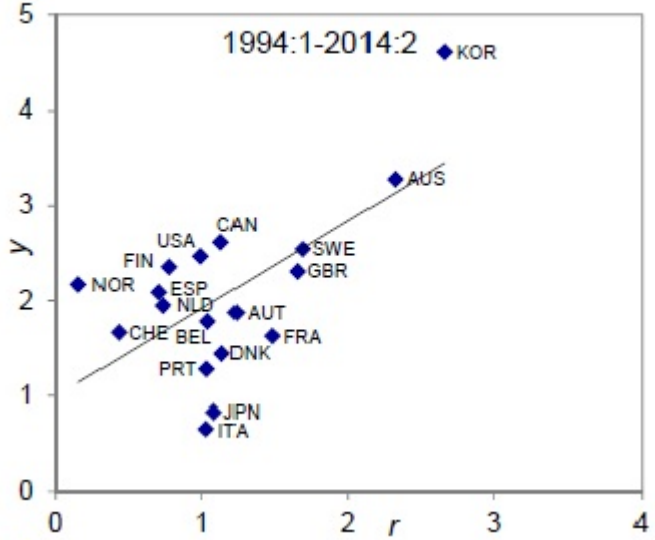
Average GDP growth y vs average r_t: cross-country data

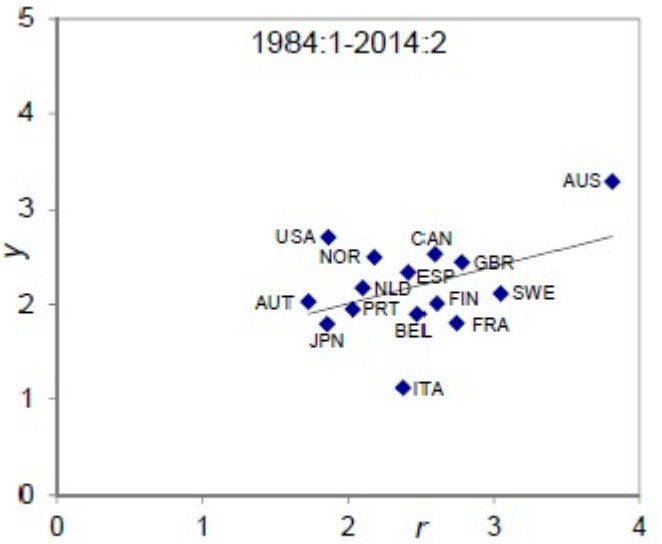
•Quarterly data

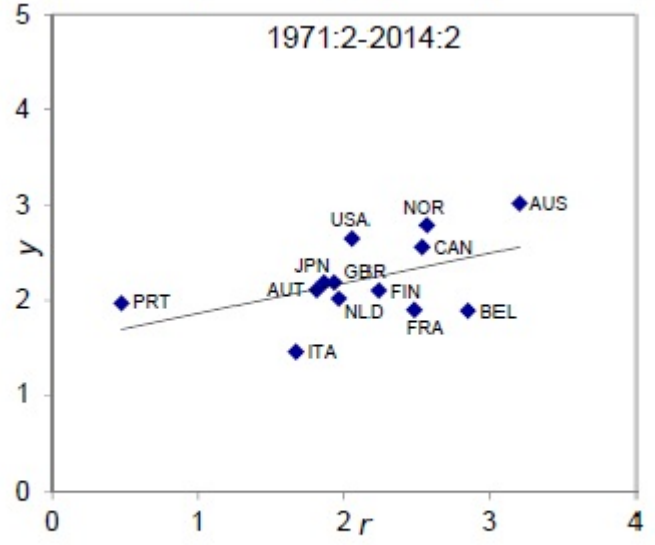
•Unit of observation is (average GDP growth, average r) for a given country, computed over four samples

- •2004:1-2014:2, N=20 countries; corr(y, r) = 0.23
- •1994:1-2014:2, N=18 countries; corr(y, r) = 0.63
- •1984:1-2014:2, N=15 countries; corr(y, r) = 0.42
- •1971:2-2014:2, N=13 countries; corr(y, r) = 0.50


2004:1-2014:2
KOR
AUS
CAN
CHE
SWE
NOR
USA
AUT
IRL
DEU
GBR
BEL
NLD
FRA
ESP
FIN
DNK
JPN
PRT
ITA
y
r


1994:1-2014:2
KOR
AUS
CAN
USA
SWE
FIN
GBR
NOR
ESP
NLD
AUT
CHE
BEL
FRA
DNK
PRT
JPN
ITA
y
r


1984:1-2014:2
AUS
USA
CAN
NOR
GBR
ESP
NLD
AUT
PRT
FIN
SWE
BEL
FRA
JPN
ITA
y
r


1971:2-2014:2
AUS
NOR
USA
CAN
JPN
GBR
AUT
FIN
PRT
NLD
BEL
FRA
ITA
y
r

Summary: average GDP growth y vs average r_t

- Wide range of average ex-ante real interest rates associated with a given average output growth rate.

- Weak correlation between average ex-ante real rate and average growth rate, with the sign and magnitude of the correlation sensitive to inclusion or exclusion of a small number of observations.

Summary: average GDP growth y vs average r_t, cont'd

One could make an argument to pay more attention to samples with a positive correlation. Whether or not one supports such an argument, there are two implications:

•If, indeed, we are headed for stagnation for supply side reasons (Gordon (2012, 2014)), any such slowdown should not be counted on to translate to a lower equilibrium rate over periods as short as a cycle or two or a decade.

•The relation between average output growth and average real rates is so noisy we are forced to conclude that other factors play a large, indeed dominant, role in determination of average real rates.

V. Narrative evidence on real rates in the U.S.

Summary:

1. Equilibrium rate sensitive to: changing policy transmission, regulatory headwinds, inflation cycles and delayed recoveries.

2. Post-WWII data allow a wide range of estimates for the equilibrium real rate, even as high as 2%. That is consistent with the SEP numbers presented above but higher than the near-zero number priced into the market and the point estimate from the VECM presented below.

3. It is hard it is to distinguish between slow recovery from financial crisis and secular stagnation, which makes it hard to forecast the equilibrium rate.

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II. Construction of ex-ante real rates

III. The real rate, consumption growth and aggregate growth

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V. Narrative evidence on real rates in the U.S.

VI. Long run tendencies of the real rate

VII. Conclusion

VI. Long run tendencies of the real rate

•Goal: develop and estimate time series model for annual data that can be used to forecast the U.S. real rate

•End product: first order bivariate vector error correction model in U.S. real rate and the "world rate"

- "error correction": we treat real rates as nonstationary

- "world rate": median over our 17 countries of country-specific average real rates, computed in each country using 30 year rolling samples

Nonstationary real rates?

•Regime shifts / structural breaks / unit roots commonly found in time series on real rates, in the U.S. and other countries

•We test for stability of the U.S. real rate, decisively rejecting the joint null of stationarity and stability.

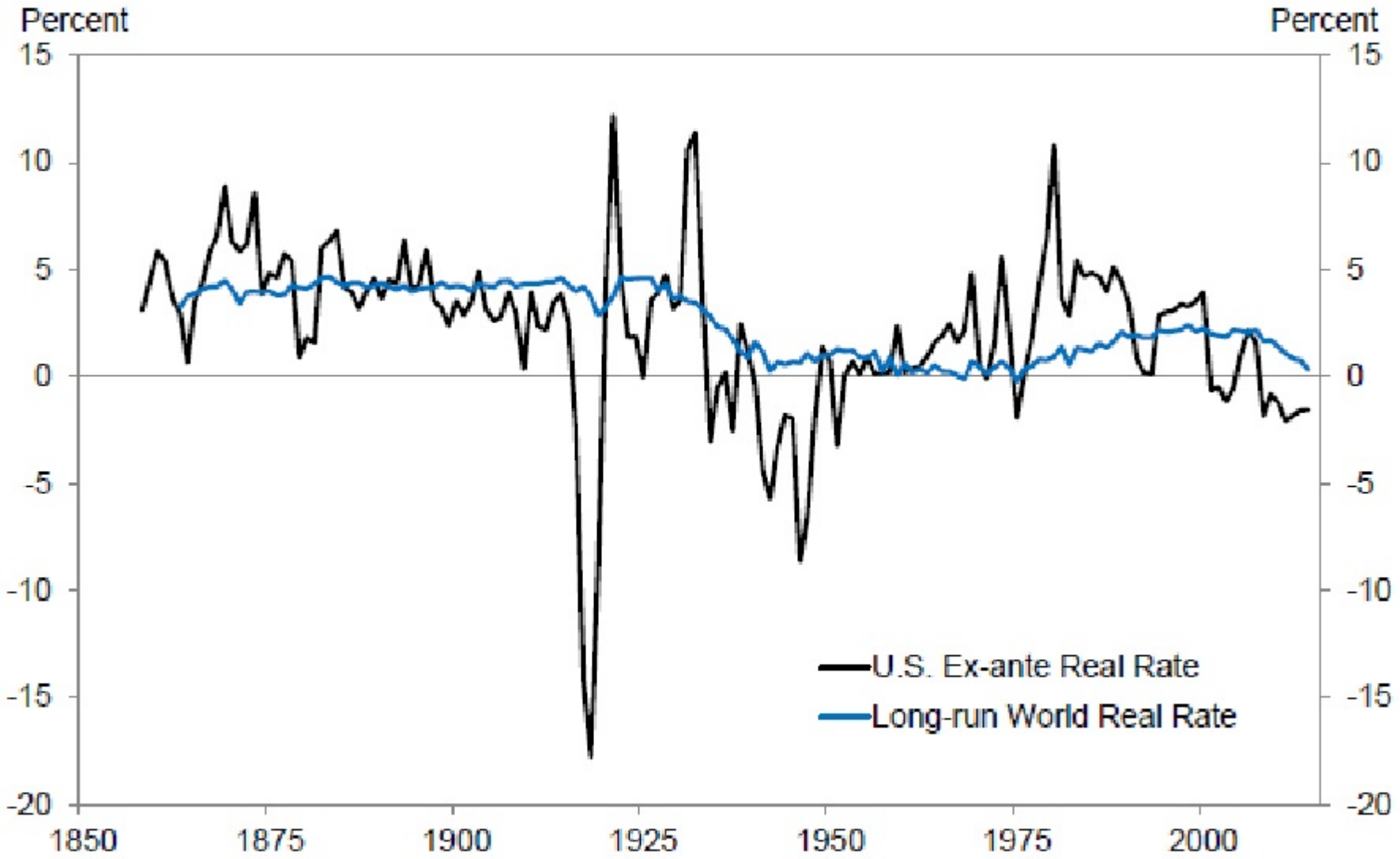
•We elect to model the data in differences, testing for stability of the VECM. The VECM does not reject the null of stability. It also does not reject the null that the constant terms are zero.

The world rate

•For country n (n=1,...,17) let r_{nt} be the real rate.

•In country n, compute the average real rate using the previous 30 years of data on r_{nt} (i.e., roll through the sample using 30 year windows). Call this ℓ_{nt}.

•The world rate ℓ_t is the median over n=1,...,17 of ℓ_{nt}.


Percent
Percent
15
10
5
0
-5
-10
-15
-20
1850
1875
1900
1925
1950
1975
2000
U.S. Ex-ante Real Rate
Long-run World Real Rate

VECM Estimates

$$\Delta r_{US,t} = 0.4\Delta r_{US,t\text{-}1} - 0.8\Delta \ell_{t\text{-}1} - 0.4(r_{US,t\text{-}1} - \ell_{t\text{-}1}) + e_{US,t},\ \hat{\sigma}_{US}=2.6,$$

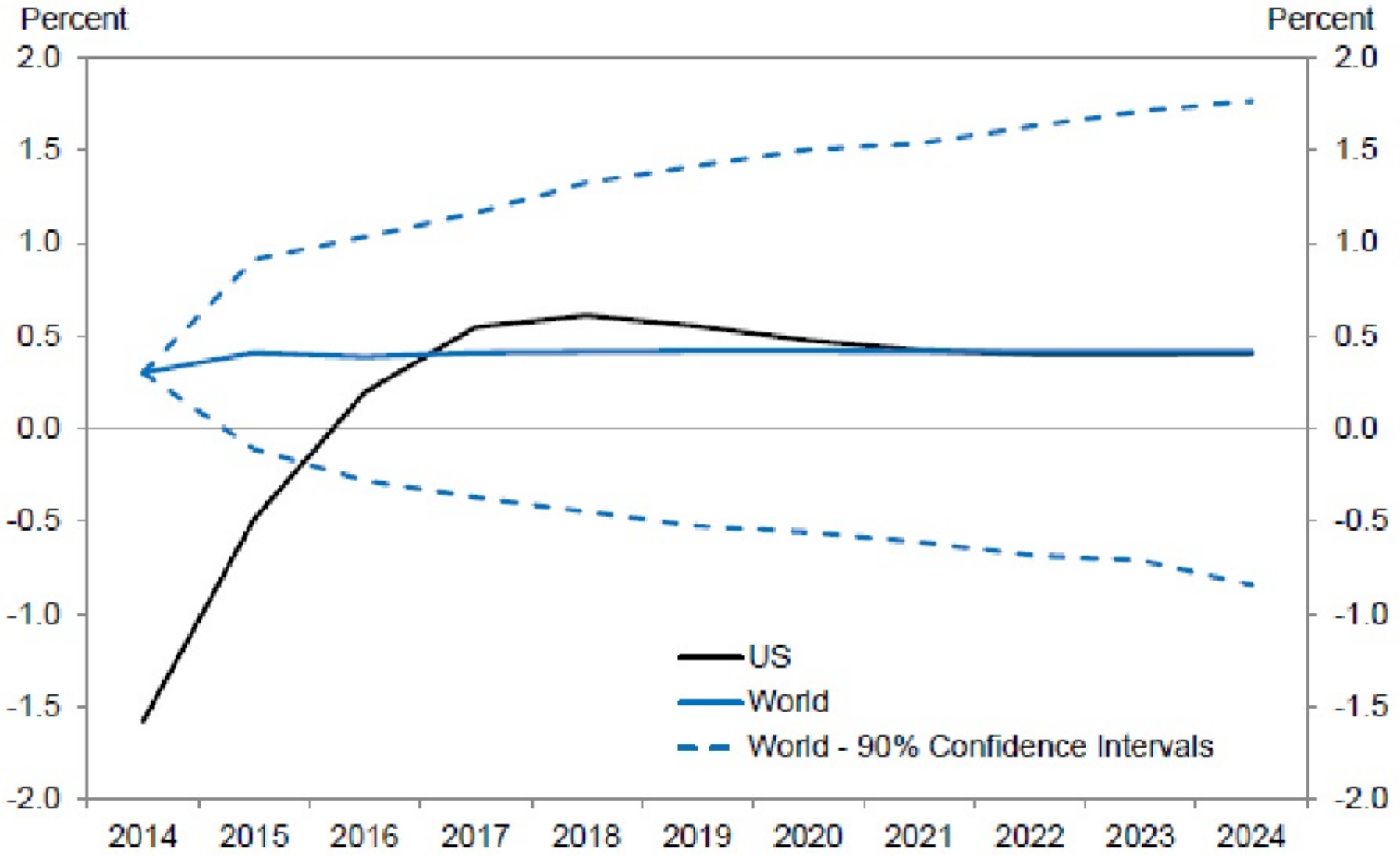
$$\Delta \ell_t = 0.03\Delta r_{US,t\text{-}1} - 0.3\Delta \ell_{t\text{-}1} + 0.02(r_{US,t\text{-}1} - \ell_{t\text{-}1}) + e_{\ell,t},\ \hat{\sigma}_{\ell}=0.3.$$

- World rate $\Delta \ell_t$: feedback from r_{US} is small

- U.S. rate $\Delta r_{US,t}$:

  - Feedback from ℓ_t is substantial. If the U.S. rate is 1% below the world rate, then all else equal we expect the U.S. rate to move 40 basis points closer to the world rate in the next year.

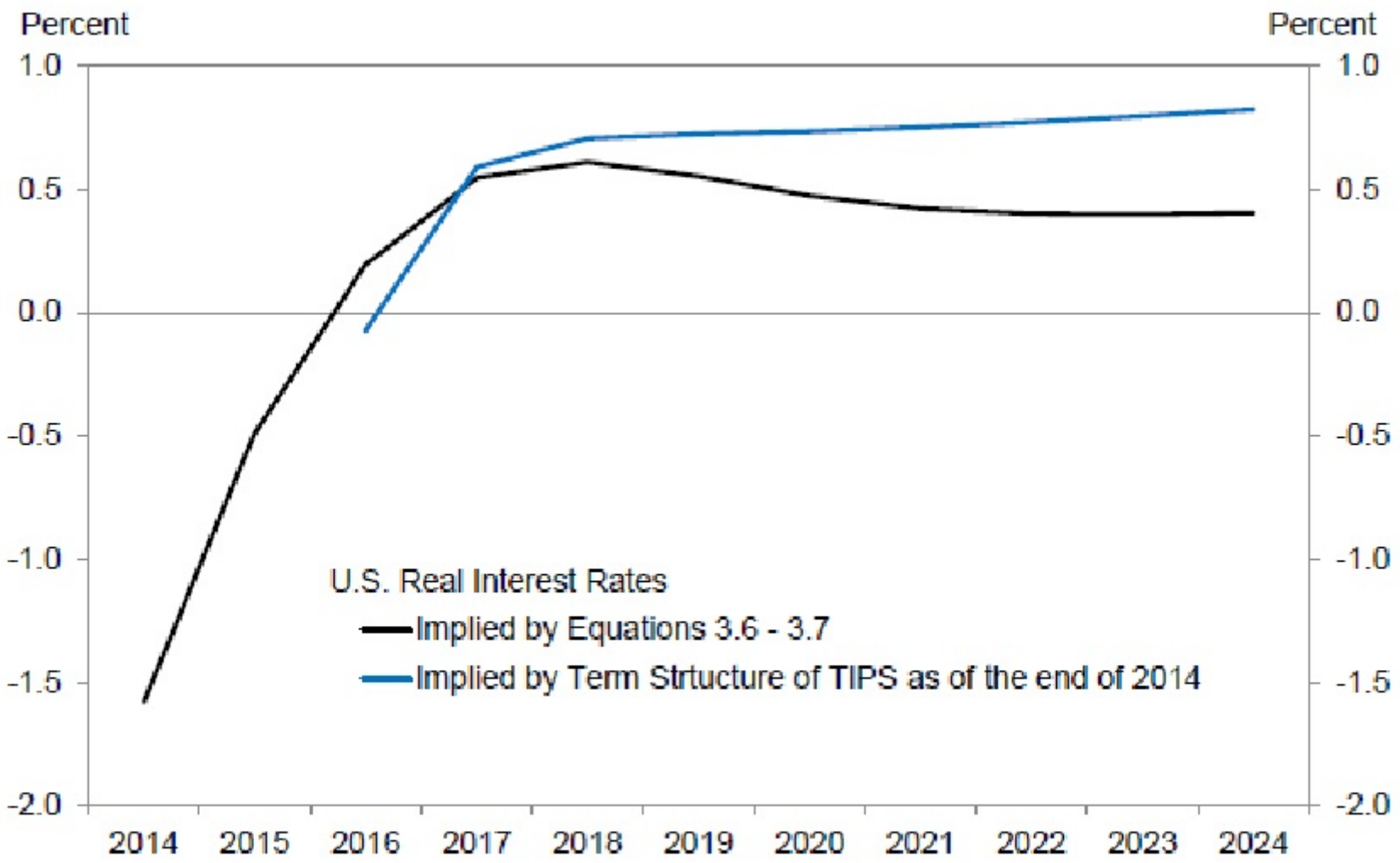
  - Std dev of residual =260 basis points: despite cointegration, in any given year, substantial divergence between U.S. and world rate is possible.


Percent
Percent
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
US
World
World - 90% Confidence Intervals

Variability and Uncertainty of Estimates in Some Other Studies

	sample period	range (%)	max discrep (bp)
Barsky et al. (2014), Fig. 1	1990-2012	-6 to +11	n.a.
Curdia et al. (2014), Fig. 1	1987-2009	-9 to +4	150bp
Clark and Kozicki (2005), Fig. 1b	1962-2004	0 to +7	200bp
Laubach and Williams (2002), Fig. 3	1961-2002	2 to 4	100bp

Note: “Range” presents the lowest and highest value in the indicated sample, using the authors’s preferred specification.
“Max discrep” is the maximum point in time discrepancy (i.e., maximum difference) in two estimates of the equilibrium rate at a given quarter, with the two estimates computed from seemingly similar specifications.


Percent
Percent
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
U.S. Real Interest Rates
Implied by Equations 3.6 - 3.7
Implied by Term Strtucture of TIPS as of the end of 2014
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024

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VII. Conclusion

•There is much uncertainty about the equilibrium rate, which varies considerably over time, and arguably is well modeled as having a unit root.

•The determinants of the equilibrium rate are manifold and time varying, with the effects of trend output growth generally dominated by those of other factors.

•A vector error correction model that looks only to U.S. and world real rates well captures the behavior of U.S. real rates.

•Looking forward, a plausible range for the equilibrium rate is wide, perhaps ranging from a little above 0 up to 2%.