THE RISE AND FALL OF THE NATURAL INTEREST RATE

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We document a rise and fall of the natural interest rate (r) for several advanced economies, which starts increasing in the 1960's and peaks around the end of the 1980's. We reach this conclusion after showing that the Laubach and Williams (2003) model cannot estimate r* accurately when either the IS curve or the Phillips curve is flat. In those empirically relevant situations, a local level specification for the observed interest rate can precisely estimate r*. An estimated Panel ECM suggests that the temporary demographic effect of the young baby-boomers mostly accounts for the rise and fall.*

At the current juncture, interest rates are historically low in most advanced economies. This fact has led many economists to put forward the proposition that the natural interest rate ($r*$), which is the rate that equates savings and investment and closes the output gap, has been falling over time. But given that the natural interest rate is a theoretical concept, it has to be measured from data. Since the seminal work of Laubach and Williams (2003, hereinafter LW2003), many papers have studied the measurement of this rate, showing that it has dramatically fallen over recent decades in tandem with a slowdown in growth (see for example Holston et al. 2017, hereinafter HLW2017). At the same time, the common perception is that the usual measures of $r*$ are generally imprecise and that the associated uncertainty could prevent the practical use of the estimated $r*$ in policy applications.[1]

The popular approach to estimate $r*$, introduced in LW2003, consists of a semi-structural econometric model whose equations are inspired by the key equations of the New Keynesian framework. Specifically, their model consists of two main equations: an aggregate demand equation (IS curve), which states that the gap between the observed real interest rate and the natural interest rate affects the output gap; and an aggregate supply equation (Phillips curve), which relates inflation to the output gap. The model is closed by assuming that the natural interest rate is the sum of two unobserved nonstationary components: the underlying trend growth of the economy and a non-growth component.

We dig into the mechanics of the LW2003 model and show that it is generally able to produce very accurate estimates of $r*$. However, the precision of the model drops in two specific circumstances:

(i) *Flat IS curve:* the output gap is insensitive to the real interest rate gap, so that information about the output gap cannot identify the non-growth component of $r*$ which affects the interest rate gap;

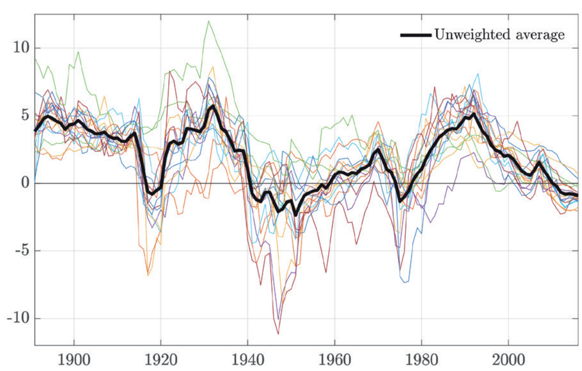
(ii) *Flat Phillips curve:* inflation is insensitive to the output gap, so the former variable can identify neither the output gap nor potential output. As a consequence, it is not possible to separately identify potential output from the non-growth component of $r*$.

In both cases, the model is said to be unobservable since it is not possible to uniquely identify the unobserved $r*$ from the available data (see Kalman, 1960).

Unfortunately, the slopes of the IS and Phillips curves estimated in the literature tend to be close to 0. This fact was already documented in LW2003 using data for the United States, and has been confirmed in several empirical papers which estimate their model for a number of advanced economies. In those circumstances, the LW2003 model is close to be unobservable, which implies a very imprecisely estimated $r*$.[2]

To solve this problem, we start by observing that the LW2003 model treats the observed real interest rate as

ESTIMATED NATURAL RATES ACROSS COUNTRIES: 1891-2016 CHART 1

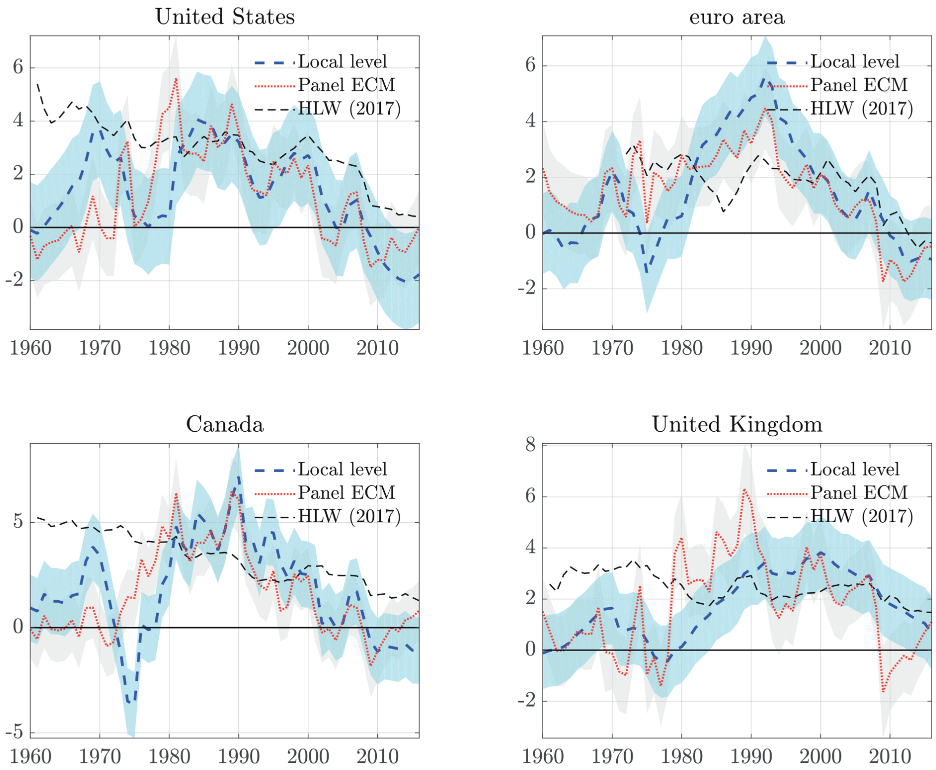


[1] See for example Clark and Kozicki (2005), Weber et al. (2008), as well as recent papers by Hamilton et al. (2016), Taylor and Wieland (2016), and Beyer and Wieland (2017).

[2] The imprecision is driven by large uncertainty of the filter, so that it remains large even with perfect knowledge of the true values of the parameters.

ESTIMATED R* BY PANEL ECM AND LOCAL LEVEL MODEL: SELECTED ECONOMIES

CHART 2



NOTES: annual data, 1960-2016. Local level model estimates in dashed blue jointly with 68% confidence bands, Panel ECM estimates in dotted red jointly with 68% confidence bands. Results from HLW (2017) in dashed black for the United States, Canada, and United Kingdom over the period 1961-2016, for the euro area over the period 1972-2016.

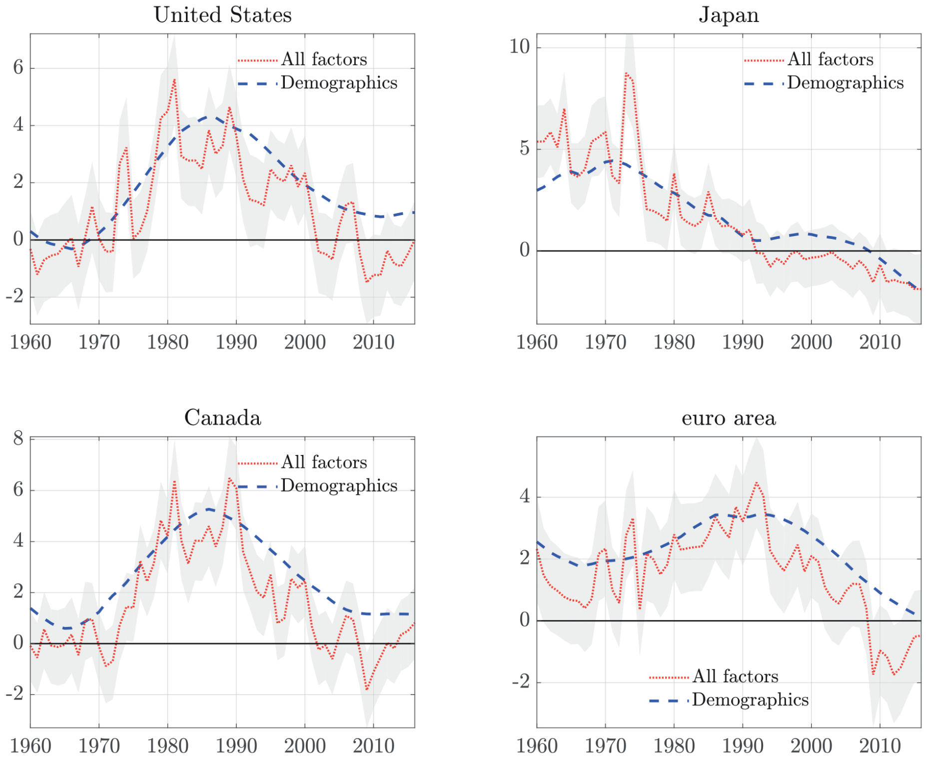
exogenous, therefore leaving the dynamic process for the interest rate gap undefined. But as soon as one imposes the stationarity of the interest rate gap, we show that one can identify both the growth and non-growth components of r^* even when the IS and Phillips curves are flat. The extra identification restriction comes from the fact that the observed rate can be decomposed into a transitory component (interest rate gap) and a permanent component (r^*).

A direct implication of our result is that, if a researcher is interested in estimating r^* but not necessarily its growth and non-growth components, then a valid alternative is to estimate a univariate local level model (Harvey, 1989), which decomposes the observed rate into its permanent and transitory components. The rationale behind our approach is that the interest rate gap, which is the stationary deviation between the observed rate and its unobserved permanent component, can be closed if and only if the observed rate coincides with its permanent component. Moreover, under a general class of New Keynesian models, output gap and inflation get completely stabilized by setting the interest rate gap to zero on a period-by-period basis. For this reason, we can think of the permanent component of the observed real interest rate as a measure of r^*. Still, the local level model cannot identify the growth and non-growth components of r^* because it exploits data on the interest rate only. Nevertheless, it is robust to situations in which the empirical estimates suggest flat IS and Phillips curves.

Next, we collect historical data at annual frequency over the period 1891-2016 for a set of seventeen advanced economies. Such a sample is likely to produce flat IS and Phillips curves for two reasons: (i) the low frequency of the annual data may be too coarse to identify any relation among output gap, interest rate gap, and inflation; and (ii) the long time span may imply structural breaks in the relationships among variables. For those reasons, we estimate the r^* of each economy, thereby using international data to externally validate our local level specification. As reported in Figure 1, we find a common decline in r^* across countries since the start of the twentieth century until the 1960's, followed by a rise and fall which peaks around the end of the 1980's. While most of the literature has already emphasized the gradual fall of r^* that occurred since the early 1990's, here we put the dynamics of the rate in a long-run perspective and focus on the rise and fall which occurred over the post-WW2 period.

THE ROLE OF DEMOGRAPHICS

CHART 3



NOTES: annual data, 1960-2016. Panel ECM estimated natural interest rate in dotted red jointly with 68% confidence bands; estimated natural interest rate which abstracts from productivity growth and risk in dashed blue.

What has driven the rise and fall of the natural interest rate? The local level model, which uses data on real interest rates only, is silent about the drivers of r^*. Hence we shed some light on this issue by estimating a Panel ECM which postulates a long-run relationship between the observed real interest rate and a set of indicators for plausibly exogenous drivers of r^*: productivity growth, demographic composition, and risk. The intuition is that, if there exists a long-run relation among the unobserved r^* and its drivers, then it should also hold among the observable counterparts. The rate predicted by the model can thus be used as a proxy for r^*. In this respect, we show that the Panel ECM predicts a rate which closely follows the r^* estimated by the local level model, as shown in Figure 2.

Through the lens of the Panel ECM, productivity growth plays a negligible role in driving the rise and fall of r^*. In contrast, we find that risk is related to important developments in r^* and it accounts for a substantial part of the fall since the 1990's. Last, but not least, we find that the changing demographic composition accounts for the bulk of the rise and fall in r^*, as shown in Figure 3. Specifically, the rise can be explained by the post-war baby boom, which temporarily increased the share of young workers in the population. Once the baby boom ends, the share of young workers goes back to its previous negatively trended path, which in turn leads to a process of population ageing.[3] This finding provides empirical support to recent studies which have emphasized the role of demographics for the evolution of the real interest rate (Aksoy et al. 2015; Carvalho et al. 2016; Favero et al. 2016a, 2016b; Gagnon et al. 2016; Lisack et al. 2017; Ferrero et al. 2017; Rachel and Smith, 2017).

[3] Interestingly, demographics account for the dynamics of r^* in Japan too, which experienced the demographic transition much earlier than the rest of advanced economies, consistently predicting the absence of the rise and fall of r^* for this economy.

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