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Why is the Interest Rate an Inverted Leading Indicator of Macroeconomic Activity in the United States?

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This article presents the findings of research carried out at the Banque de France. The ideas presented in this document are those of the authors and do not necessarily reflect the position of the Banque de France. Any errors or omissions are the responsibility of the authors.

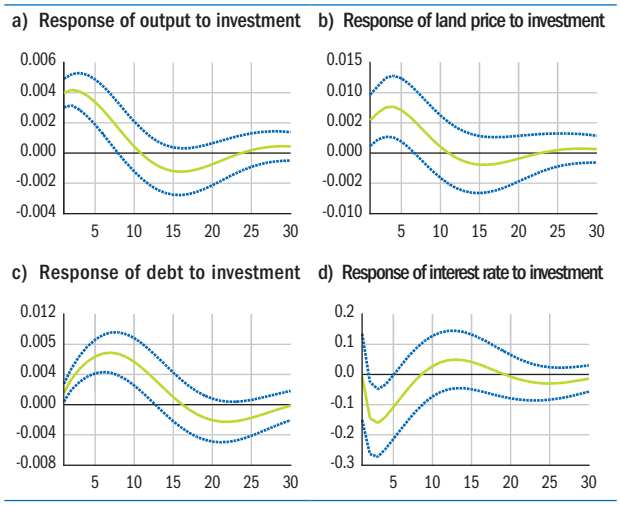
The real interest rate at which US firms borrow funds to finance their investment and other expenses has two striking features. It is low when GDP is high (and vice versa*) and it is an inverted leading indicator of real economic activity. Low interest rates today forecast future booms in GDP, consumption, investment, and employment. This* Rue de la Banque *shows that inherent to such correlations is a redistribution channel through which resources typically flow from lending entities to borrowing firms during expansions. Such a redistribution channel is driven by expectations about future levels of the borrowing cost, which accounts for a large share of the volatility of output, investment and other macroeconomic variables during business cycles.*

The real interest rate paid by US firms is countercyclical and forecasts future macroeconomic conditions

Virtually all US firms rely on some form of borrowing to finance productive investment, working capital and other types of expenses. For example, corporate firms issue bonds while non-corporate companies rely to a large extent on bank loans. A striking feature is that the real interest rate paid by US firms is countercyclical: typically low during expansions but tending to rise during recessions. Such a property has far-reaching macroeconomic consequences: when the borrowing cost is low, investment financing by firms is cheaper and the economy booms, as illustrated in Chart 1.

Suppose that firms increase this quarter their investment in productive equipment like machines and computers. In Chart 1 are reported the responses, at quarterly frequency, of several macroeconomic variables

C1 Responses of macroeconomic variables to investment growth



Source: Pintus, Wen and Xing (2016).
Note: Impulse responses – in green – to a one standard-deviation increase in investment, up to thirty quarters, based on US data from 1975 to 2010 (±2 standard-error bands in blue).

(all in real terms, i.e. with inflation removed) to such an investment boom.[1]

As shown in Chart 1, what follows is that the price of land goes up as firms' expansion requires more space, output goes up because aggregate demand goes up, and debt builds up as firms rely on credit markets to finance the investment boom. In addition, firms hire more so that the total number of hours worked goes up and so does consumption since wages increase. Such an investment boom occurs when the price of investment goods falls and when the borrowing interest rate falls as well.

Chart 1 shows that all variables are procyclical, i.e. they move hand in hand with output, *except* for the debtor interest rate. When investment booms, the interest rate stays below trend for several quarters. To the extent that both credit demand (by firms) and credit supply (by direct investors and financial intermediaries) are procyclical, this evidence suggests that changes in the supply of loanable funds dominate those in the demand for loans. In other words, during expansion periods, the willingness of creditors to extend credit rises so much that, despite an increase in credit demand, the cost of credit goes down.

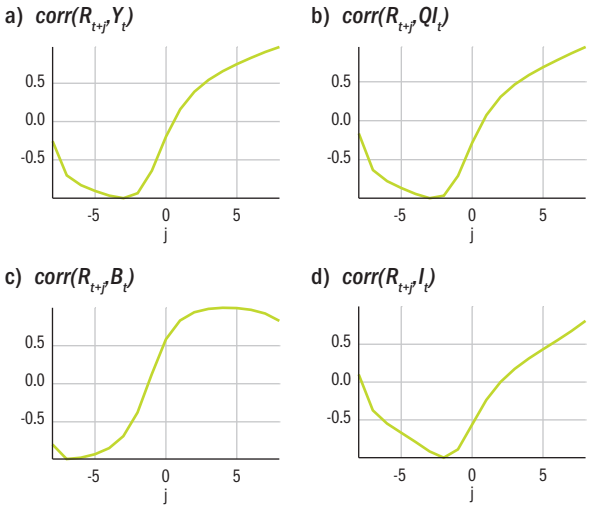
The actual correlations in the data between the interest rate at various leads and lags (in quarters) and macroeconomic variables are reported in Chart 2.

Besides contemporaneous correlations, a notable feature of Chart 2 is the so-called *inverted leading indicator property* of the interest rate: the lead-lag correlations all have an S-shaped pattern.[2] The correlations of the interest rate 5 quarters ago with current values for output and other variables are negative in Chart 2. This means that a low interest rate 5 quarters ago is associated with a boom in activity today: cheap debt then accumulates and finances a boom later on. Furthermore, a high level of output today will be accompanied by a higher interest rate 5 quarters down the road: as the economy reverts back to its trend, the interest rate tends to rise.

The consequences of a countercyclical real interest rate on the macro economy operate through a redistribution channel

The inverted leading indicator property of the borrowing cost is a long-standing puzzle. Standard business-cycle models do not accord with it: high investment and output are associated with a high interest rate in such settings. The reason behind such counterfactual predictions is rather simple. In such models the real interest rate is

C2 Correlations between the real interest rate and macroeconomic variables



Source: Pintus, Wen and Xing (2016).
Note: Empirical lead-lag correlations – up to 8 quarters – of the real interest rate (denoted R), with output (Y), land price (Ql), debt (B), and investment (I), based on US data from 1975 to 2010.

dictated by the marginal product of capital, which is proportional to the output-to-capital ratio. Given that output is more cyclical than the capital stock, high output thus always implies a high interest rate regardless of the source of shocks. In addition, such models predict positive lead-lag correlations between the borrowing cost and aggregates.

Pintus, Wen and Xing (2016) tackle this long-standing puzzle by introducing a credit market that channels funds from lenders to borrowers into the textbook business-cycle setting. Their analysis relies on the interaction of two main features. First, due to collateral constraints *à la* Kiyotaki and Moore (1997), a credit market friction creates a wedge between credit supply and credit demand. Second, they relax an assumption that is often implicit in the existing literature: loans are such that the interest rate is not pre-determined, or set when the loan is negotiated, but instead is state-contingent and responds to changes in aggregate economic conditions when the loan repayment is due. This is the case when, for example, firms borrow at a variable interest rate.[3]

1 *These impulse responses are obtained from a vector autoregressive model, using Cholesky decomposition.*
2 *Such a property has also been documented for rates on US Treasury bills by King and Watson (1996).*
3 *Vickery (2008) reports that the proportion of US firms that use variable-rate loans has been hovering around 70% since the 1970s.*

Under both assumptions – that loans have variable interest rates and that collateral is required – it turns out that the credit market features an interesting property: when the demand for loans increases, the supply of loans increases as well and to a greater extent in response to the higher credit demand, so that the equilibrium interest rate falls instead of rising. The subsequent economic boom validates the inverted leading indicator property of the real interest rate. This also suggests that the low interest rate based economic boom can be purely self-fulfilling: in the absence of any fundamental disturbances, the very anticipation by borrowers of a lower expected interest rate can stimulate credit demand and aggregate investment, resulting in an economic boom and fulfilling the initial optimistic expectations. Conversely, expectations of a high interest rate can trigger a recession and an interest rate hike in the credit market, as if a higher credit risk had materialised and reduced loanable funds even though it is in fact not the case.

Essentially, what happens is that both the demand for and the supply of credit go up during booms.[4] On the demand side, firms that rely on variable-rate loans decide to borrow and invest more when they expect interest rates to go down. In the absence of any change in credit supply, this would push up the interest rate. But when the collateral channel operates on the supply side of the credit market, this conclusion can be reversed: in effect, to the extent that the market value of collateral is larger during booms, lenders are happy to lend more.

Evidence of such a collateral channel has received strong support from the empirical micro literature, which shows in particular that a large fraction of US firms hold real estate and use it as collateral to borrow more and finance their investment. [5] In the realistic case where loan-to-value ratios are smaller than one, credit supply goes up by more than credit demand during expansions, so that the interest rate goes down and a boom follows. Provided that the rise in the market value of collateral – e.g. land price – is persistent, the boom is persistent as well. In other words, the interest rate inherits the inverted leading indicator property that is documented in Chart 2.

To sum up, collateralisable assets – most notably real estate – flow from lenders to borrowers while debt repayments from the latter to the former go down during expansions: a redistribution channel operates in favour of borrowers.

The redistribution channel triggered by interest rate changes has contributed to macroeconomic volatility in the United States over the last four decades

In order to gauge the empirical bite of such a redistribution channel that affects corporate and non-corporate firms, a medium-sized model is estimated using US data from 1975 to 2010. More specifically, a benchmark case is provided by Liu, Wang, Zha (2013), who have shown that large macroeconomic effects originate from the collateral channel documented by microeconomic studies. Two settings are in effect estimated and then compared: i) one provided by the latter authors, who assume that loans have predetermined repayments – that is, fixed interest rates –; ii) an extended one that accounts for the presence of variable-rate loans. In addition, in the latter setting, redistribution shocks that are purely expectation-driven can materialise, whereby borrowers change their views about the level of the *real* interest rate that they expect to repay in later periods.

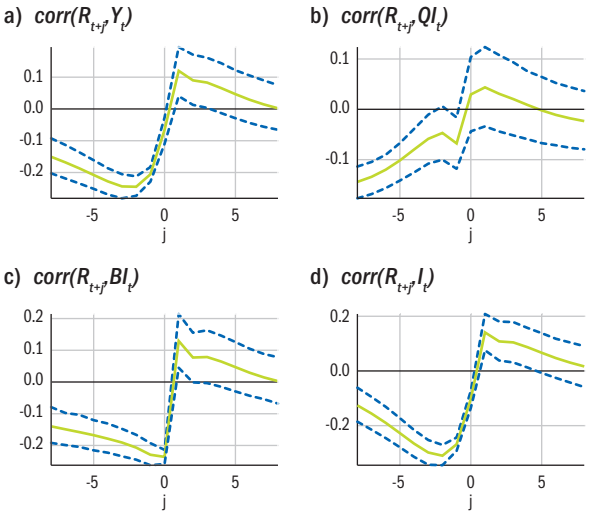
Two lessons can be drawn from the outcome of the estimation procedure. First, only the model with a significant proportion of variable-rate loans in the economy delivers the inverted leading indicator property. This can be seen from Chart 3, which is the theoretical analogue of Chart 2.

The correlations reported in Chart 3 are, of course, consistent with and follow from the description of the mechanisms at work developed in the preceding paragraph.

Second, the estimated model can also be used to measure the empirical importance of shocks to expectations about the interest rate: to what extent do they explain the volatility of output and other aggregate variables at business-cycle frequency? Chart 4 provides an answer to such a question. It shows that redistribution shocks – represented in purple in Chart 4 – play a rather significant role. For example, they account for about 30% of output volatility after eight quarters, and close to 50% after sixteen quarters.

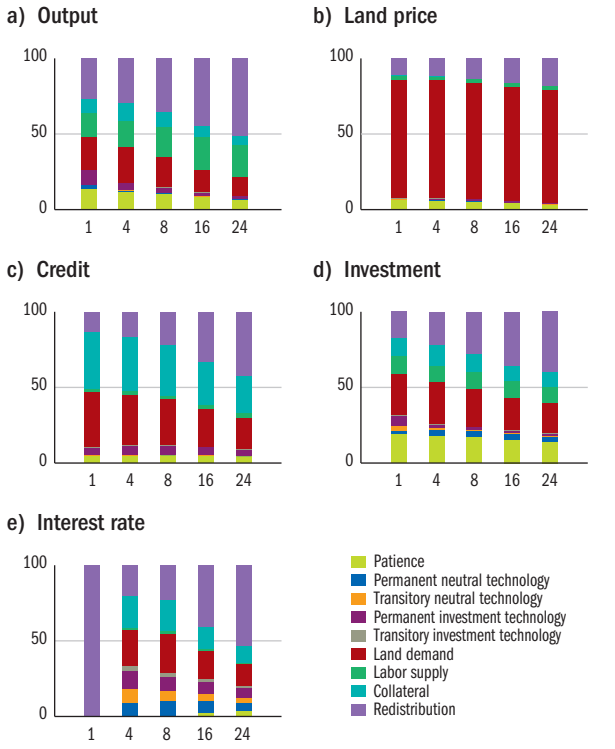
4 See Section 3.3 in Pintus, Wen, Xing (2016) for a more formal analysis in a simple example with closed-form solutions.
5 See, for example, Chaney, Sraer, Thesmar (2012).

C3 Theoretical correlations between the real interest rate and macroeconomic variables



Source: Pintus, Wen and Xing (2016)
Note: Theoretical lead-lag correlations – up to eight quarters – of the real interest rate (denoted R), with output (Y), land price (Ql), debt (B), and investment (I), based on US data from 1975 to 2010 (95% confidence bands in blue).

C4 Variance decomposition of macroeconomic variables



Source: Pintus, Wen and Xing (2016)
Note: This variance decomposition of macroeconomic variables obtained from the estimated model breaks down the contributions in % into different sources of shocks, including redistribution shocks in purple (time horizon from 1 to 24 quarters).

Similarly, expectation shocks explain a large chunk of the variances of consumption, investment, credit, hours worked, wages, and, to a lesser extent, land price.

Even though the contribution of such an analysis is to show that the redistribution channel matters empirically, it still has several shortcomings. Most importantly, it is silent on the mechanisms at the origin of such redistribution shocks; in particular since it focuses on a setting in which all magnitudes are real, not nominal. An obvious candidate is monetary policy, as the overwhelming majority of contracts that design credit market instruments are: i) denominated in nominal terms, and ii) subject to inflation risk even at short horizons. Although the literature has already pointed to such a mechanism (e.g. Gomes, Jermann, Schmid, 2016), it has not yet been able to rationalise the inverted leading indicator property of the interest rate in a nominal environment. Such a challenge should therefore be addressed in future research and would deliver precious information about the transmission of monetary policy.

Financial innovation that favours the development of floatable-rate credit market instruments is another candidate. The type of analysis provided here and its empirical counterpart could in particular highlight to what extent the effect of the Eurosystem's monetary policy varies across the countries that form the euro area but differ in the prevalence of variable-rate credit instruments used by firms but also households.

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