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Negative Interest

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1. Introduction

It was at Princeton that I first met Hans Tson Söderström, in 1975. His host there was Professor William Branson, an MIT-trained macroeconomist, engineer, and much-admired teacher doing brilliant work in open-economy macroeconomics with emphasis on stock-flow dynamics. Branson had visited the Institute for International Economic Studies at the University of Stockholm, and was about to become my thesis advisor at Princeton.

At that time, inflation had become an important issue in the United States following OPEC's oil price hike 1973-74. I was familiar with double-digit inflation from home. Iceland has had the OECD region's second highest average inflation rate since 1960, after Turkey.

In my dissertation (Gylfason, 1976) I asked: Is inflation neutral? Or does it have real effects in the short and medium run? Long-run effects of inflation or other economic forces on growth at that time were considered out of the question (apart from Nelson and Phelps´s (1966) demonstration that education could have long-run effects on growth), and did not even become a serious theoretical possibility until the endogenous growth revolution ten years later.

I started – guess what! – from a simple IS-LM model where the IS equilibrium relationship *via* consumption and investment depended on real interest and the LM equilibrium relationship *via* the demand for money depended on nominal interest. This simple asymmetry, inspired by Mundell (1963), meant that increased inflation reduced real interest and hence stimulated output and employment through aggregate demand as long as aggregate supply responded either to a change in prices or in inflation.

At this time the reaction against Keynes's *General Theory* at Chicago and other places was gaining momentum. To accommodate monetarist sentiments, my take on the supply side was to argue that labor supply, determined jointly with consumption and saving in an intertemporal setting, also depended one way or another on real interest, admittedly a thin

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reed. In this asymmetric IS-LM setup, higher inflation led to lower real interest, thereby stimulating consumption, output, and employment in the short run and, by discouraging saving, retarding economic growth in the medium term in line with Tobin (1965). This was before it was generally noticed that the duration of the medium term can be derived from the parameters of the Solow growth model, an elegant result now routinely presented even in undergraduate courses on growth, and turns out to be quite long. A medium term spanning decades clearly reduced the policy relevance of the central tenet of the Solow model that the long-run rate of growth of per capita output could be traced solely to technological progress and hence was exogenous – that is, immune to macroeconomic policy or other economic forces.

2. Around the World with Irving Fisher

The idea that real interest rates could be sensitive to inflation was controversial. Some insisted, and continue to insist, that real interest rates like other real variables must be immune to inflation, at least in the long run, and named this the Fisher effect, a remarkably cheeky label in view of the fact that Irving Fisher, Knut Wicksell's chief intellectual rival among monetary theorists, had throughout virtually his entire career written articles and books presenting arguments and evidence showing that increased inflation made real interest rates go down in financial markets around the globe. Fisher's (1930) data make this clear (Chart 1). Here the naked eye is enough as Assar Lindbeck used to say, making econometric analysis not really necessary.

While Fisher viewed real interest as a passive variable that varied inversely with inflation, Knut Wicksell (1936) regarded real interest as the expected long-term return on new investments, arguing that an increase in the real rate of interest signaled higher profits, thus encouraging bank lending with increased inflation as a result. By suggesting an inverse relationship between inflation and real interest, Fisher's data seem to contradict Wicksell's story – that is, at least, a testable hypothesis.

Chart 1: Fisher´s Data from Six Financial Centers:
Nominal Interest Rates and Inflation 1825-1927

Superfluous or not, regression analysis of Fisher's data tells the same story (Gylfason, Tomasson, and Zoega, 2015). Based on analysis as well as evidence, Fisher took nominal

interest rates *i* to adjust slowly to changes in the rate of inflation π, a formulation that is consistent with transactions-cost based models of gradual adjustment of interest rates to expected inflation as well as with models of quick adjustment combined with adaptive expectations.[1] In either case, the dynamic relationship between *i* and π *c*an be described by including a lagged dependent variable:

$$(1) \quad i = a\pi + bi_{-1} + c + e$$

Here the short-run effect of π on *i* is $a > 0$, the long-run effect is $a/(1-b) > a$ if $0 < b < 1$, the median lag is $-\log(2)/\log(b) > 0$, *c* is a constant, and *e* is an error term.

OLS regression estimates of six such equations, one for each of Fisher's six financial centers (not shown), suggest that current inflation has a weakly positive effect on interest rates in four of the six cities, all except New York and Tokyo. Where present, however, the short-run effect of inflation on interest rates is remarkably weak, ranging from 0.03 to 0.05. The lagged effect of last year's interest rate is fairly strong throughout, however, ranging from 0.35 in Calcutta to 0.69 in Paris. Even so, the long-run effect of inflation on interest rates is significantly larger than zero only in London, Berlin, and Calcutta, and is well below one throughout, ranging from 0.05 in New York to 0.17 in Paris.[2]

To repeat, if *i* adjusted fully and promptly to π, then the real interest rate originally defined by Fisher (1896) as

$$(2) \quad r = \frac{1+i}{1+\pi} - 1$$

would be roughly constant and independent of π. But this is clearly not what Chart 1 shows. On the contrary, all six panels of Chart 1 suggest with a striking consistency that nominal interest rates hardly budged anywhere when inflation changed. Accordingly, changes in inflation could have real effects through real interest rates, thereby influencing investment, saving, asset portfolios, consumption, output, and employment.

In those days, as Chart 1 shows, inflation did not hesitate to move into negative territory, but nominal interest rates did not follow. In London, wholesale prices rose merely by 9 per cent from 1820 to 1927, not per year but for the period as a whole. In New York, wholesale

[1] Examples of transactions cost in financial markets include the cost of setting up complicated models to guide financial transactions and of hiring highly paid traders to conduct business.

[2] The data do not display unit roots anywhere nor serial correlation in the residuals except in New York and London. For more, including how recent work on interest rates and inflation relates to Fisher's analysis, see Gylfason, Tomasson, and Zoega (2015).

prices remained unchanged from 1867 to 1926 as they did in Berlin from 1866 to 1911. In Paris, wholesale prices fell by 18 per cent from 1872 to 1914 (Fisher, 1930, 520-3). In Fisher's data, deflation was nearly as common as inflation, reaffirming his inference that deflation makes both real interest rates and debt burdens rise, leading to distrust, distress selling, bankruptcies, bank runs, reduced output and trade, and unemployment (Fisher, 1896, 1933). In 1933, however, presumably due to his repeated claim in 1929 that the US stock market had reached "a permanently high plateau," Fisher's incisive analysis of deflation, debt, and distress did not attract the attention it deserved until half a century later when, among others, Hans Tson Söderström during 1992-1993, as adviser to the Central Bank of Finland, then in deep crisis, invoked Fisher's analysis and recommended fiscal expansion to battle high unemployment. In any case, there can be no controversy about deflation making real interest rates rise when nominal interest rates refuse to go below zero as was the case in Fisher's data. It may have been natural in those days to expect nominal interest not to follow inflation because bouts of inflation were often followed by deflation, but Fisher did not make this observation.

In retrospect, it is remarkable that the name of one of the world's great economists – the greatest of them all according to Joseph Schumpeter, Milton Friedman, and James Tobin – came to be associated above all else with a view that he, after careful study, did not share. Fisher is not alone, however. David Ricardo has suffered a similar treatment. The proposition that government budget deficits do not matter because taxpayers are indifferent between debt-financed and tax-financed government spending as they realize that current debt needs to be serviced through future taxation and plan their saving accordingly bears Ricardo's name ("Ricardian equivalence"). This is unfair to Ricardo because, even if he exposited the logic behind it, he found the proposition unconvincing. In his own words (Ricardo, 1817, 254): "… it must not be inferred that I consider the system of borrowing as the best calculated to defray the extraordinary expenses of the State. It is a system which tends to make us less thrifty – to blind us to our real situation."

Fisher's (1930, 415, 505) view was that "… men are unable or unwilling to adjust at all accurately or promptly the money interest rates to changed price levels … changes in the purchasing power of money … affect the nominal rate of interest, in one direction and the real rate of interest in the opposite direction." Fisher understood that, under certain conditions, including perfect foresight, real interest rates might be immune to changes in

inflation, at least over the long haul, but his theoretical analysis and empirical evidence led him to reject the premises needed to erect such a theory. Even Arthur Okun (1981, 208), among many others, attributed to Fisher the notion that real interest rates were insensitive to inflation: "As Fisher saw it, an extra 1 percentage point of expected inflation raises the nominal expected rate of return on real capital assets by 1 percentage point and induces a parallel increase of 1 percentage point in bond and bill yields to keep expected returns in balance." Okun appealed to tax wedges, transactions costs, and other factors to conclude, as Fisher did, that increased inflation led to higher nominal interest rates and lower real interest rates.

Later, as Stanley Fischer (1991, 1993) pointed out, it became more widely understood that inflation can be viewed as a relative price between real and nominal assets. As such, inflation is clearly capable of having real effects *via* variations in real interest rates.

So this, with a broad brush, was my story in my dissertation and some subsequent work that appeared here and there in the 1980s and beyond. Inflation faded away after 1990 when transition from plan to market became the focal point of macroeconomic policy research and unemployment and, especially, endogenous growth attracted most of the attention in macroeconomic analysis, making it at last possible in theory as well as practice for inflation to have long-run effects on growth.

The experience of the United States is consistent with Irving Fisher's story. The two spikes in US inflation following the oil price hikes in 1973-74 and 1979-81 were both followed by a sharp drop in real interest rates, even into negative territory in the earlier episode.

3. Value in waiting: From Sweden to Japan

What do we find when we apply the same logic to Swedish data from 1970 onward?

Chart 2 shows that from 1970 to 1990 there is a clearly visible inverse relationship between the real interest rate and inflation. However, after 1990, when inflation came down, both nominal and real interest rates followed suit.

Chart 2: Sweden: Interest Rates and Inflation 1970-2013

Table 1. Sweden: Regression Results on Interest Rates and Inflation 1970-2013

Period	Constant	Short-run effect	Long-run effect	Median lag (years)	Adjusted R^2
1971-2013	-0.003	0.261*	1.685*	4.121	0.92
	(0.479)	(0.072)	(0.489)		
1971-1990	-2.124	0.084	0.435	3.248	0.65
	(2.503)	(0.167)	(0.960)		
1991-2013	-0.001	0.353*	1.811*	3.193	0.93
	(0.462)	(0.176)	(0.801)		

Note: Standard errors within parentheses. An asterisk denotes statistical significance at the 0.05 level.

The regression results shown in Table 1 tell the same story as Chart 2. During 1971-1990, the inflation rate had an insignificant effect on the nominal interest rate, represented by the lending rate. This is hardly surprising in view of the financial market regulations in force until the 1980s, followed in early 1993 by the advent of an inflation targeting regime under which interest rates were deliberately adjusted to inflation to keep inflation close to target. Further, on its way down, inflation affected interest rates during 1991-2013, and also during the sample period as a whole, 1971-2013. The long-run effect is not significantly different from one (and only weakly significantly larger than zero). The estimated median lag suggests that a half of the long-run effect is felt within four years or so. In sum, real interest rates in Sweden during 1991-2013 were only weakly sensitive to inflation as the estimates of both the short-run effect and the long-run effect are quite imprecise.

Meanwhile, in Japan, as a housing bubble burst around 1990, prices began to fall (Chart 3). Deflation became an issue. In response to the deflation, the Bank of Japan drove nominal interest rates down to zero, hitting the zero lower bound. Paul Krugman (1998) argued that BoJ should print money to credibly raise inflation expectations and make real interest rates negative, and thus encourage investment (and, I would add, consumption). For a long time, until quite recently, BoJ balked at this suggestion. After 2008, the United States and several other countries lowered nominal interest rates to zero.

Chart 3: Japan and Sweden: GDP Deflator 1970-2012 (2005 = 100)

Chart 4: Japan: Interest Rates and Inflation 1970-2012

Table 2. Japan: Regression Results on Interest Rates and Inflation 1970-2013

Period	Constant	Short-run effect	Long-run effect	Median lag (years)	Adjusted R^2
1971-2013	0.396*	0.119*	0.755*	4.026	0.96
	(0.026)	(0.027)	(0.163)		
1971-1990	2.618*	0.113*	0.252*	1.160	0.72
	(0.938)	(0.032)	(0.086)		
1991-2013	0.796*	0.305*	1.035*	1.982	0.96
	(0.293)	(0.121)	(0.239)		

Note: Standard errors within parentheses. An asterisk denotes statistical significance at the 0.05 level.

The regression results shown in Table 2 confirm the pattern of Chart 4. Inflation had a significant effect on the nominal interest rate throughout the sample period 1971-2013. The short-run effect during 1991-2013 when prices fell is nearly three times as strong as during 1971-1990 when prices rose and interest rates were regulated. Before discussing the asymmetric effects of falling vs. rising prices on interest rates, let me note that the estimated long-run effect of inflation on interest rates is significantly less than one during 1971-1990, but not significantly different from one during 1991-2013 as well as during the sample period as a whole, 1971-2013. Like in Sweden, the estimated median lag suggests that a half of the long-run effect is felt within four years. The fairly precisely estimated long-run immunity of the real interest rate to inflation in Japan after 1990 is noteworthy because falling prices are, due to the zero lower bound on nominal interest rates, more likely than rising prices to produce an inverse relationship between real interest rates and inflation.

Deflation raises several of the same issues as inflation except in reverse. Actually, the zero lower bound, if binding, makes the story about the effects of deflation clearer than the story about the effects of inflation. When prices fall and nominal interest rates refuse to fall below zero, there can be no question about the real interest rate going up as inflation goes farther into negative territory. In this case, less inflation has unambiguous, incontrovertible effects on the real interest rate and hence also on other real variables. The mirror image is clearer than the original.

The argument here is essentially the same as before. With prices falling, it pays for households to delay certain purchases just as it pays to speed up purchases when prices are rising rapidly. Why buy a new car now if it will cost 3% less next year? Why not wait? Further, deflation increases real wage costs, thus threatening jobs if nominal wages are sticky. Through these channels, deflation develops readily into a vicious cycle just as inflation does by boosting spending and thus kindling further inflation.

4. The Zero Lower Bound

Is there a zero lower bound? Some say there must be because, if nominal interest rates become negative, everyone will want to hold cash (Svensson, 2001; Eggertsson and Woodford, 2003; Buiter, 2009; Rogoff, 2014). To overcome the aversion to holding bank deposits with negative interest, some economists have proposed the taxation or even abolition of cash which, as a side benefit, would provide a potentially effective deterrent against crime (Buiter, 2009; Rogoff, 2014). Electronic cash could easily carry negative interest. Others have proposed increased inflation targets attained through quantitative easing, a reliable way of moving real interest rates into negative territory, especially in the presence of a zero lower bound on nominal interest rates (Blinder, 2012). Others yet – including Hans Tson Söderström, I presume – would stress that more firmly anchored, norm-based monetary policies might have averted the problem (see, e.g., Andersen *et al.*, 2007, Ch. 2).

Negative nominal interest accounts have long been in use in, e.g., Switzerland by customers willing to pay their Swiss banks a service fee in the form of negative nominal interest, presumably because they felt that their money was safer at the bank than in their bedroom safe, an understandable attitude as Persson (2015) also points out. How much safer the bank vault is than your bedroom safe depends on the brashness of the banks toward risk, the risk of bank robberies (including inside jobs), the ability and willingness of the fiscal and monetary authorities to bail out the banks if need arises, and the amount of traffic in your bedroom. This may help explain why depositors in Swedish, Swiss, and other banks prefer to keep their monies in accounts with effectively if not explicitly negative nominal interest.

The point here is quite simple: If X asks Y to keep Z, it is not clear *a priori* why Y should pay X rather than the other way round. Who pays whom depends on circumstances, even if Z is money. For example, if Z were livestock, who should compensate whom? You tell me.

5. Conclusion

Throughout history, real interest rates have often been negative in times of inflation. Also, inflation has quite often been negative, especially in earlier times (Bordo and Filardo, 2005). Nominal interest rates, on the other hand, have rarely been negative, but such an outcome is not unheard of in commercial banking and not necessarily unnatural in times of large surpluses of saving in excess of investment combined with low inflation or even deflation. For example, China, now the world's largest economy, saw its gross saving (production less consumption plus net transfers) rise from 32 percent of GDP in 1982 to 51 percent in 2012.

By lowering its overnight deposit rate to -0.25 per cent per year in 2009, the Bank of Sweden became the world's first central bank to employ a negative interest rate in what the *New York Times* labeled a "radical experiment" (1 October 2009). In October 2014, the Bank of Sweden went further by lowering its deposit rate to -0.75 per cent and its lending rate to 0.75 per cent. Other central banks, including the ECB and the Swiss National Bank, have followed this example, a reasonable undertaking in view of the present threat of debilitating deflation in Europe.

We face choices. Increased flexibility of nominal interest rates, including their willingness to wade into negative waters, means reduced sensitivity of real interest rates to variations in inflation. However, in situations where flexibility of employment and output is important, flexible real interest rates can be essential. In such situations the refusal of nominal interest rates to become negative – a zero lower bound – can be conducive to economic prosperity and growth through a policy-induced bout of modest inflation designed to depress real interest rates, especially when deflation poses a threat.

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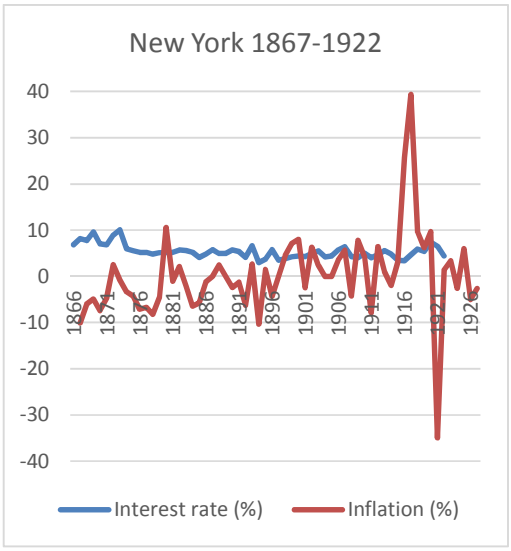
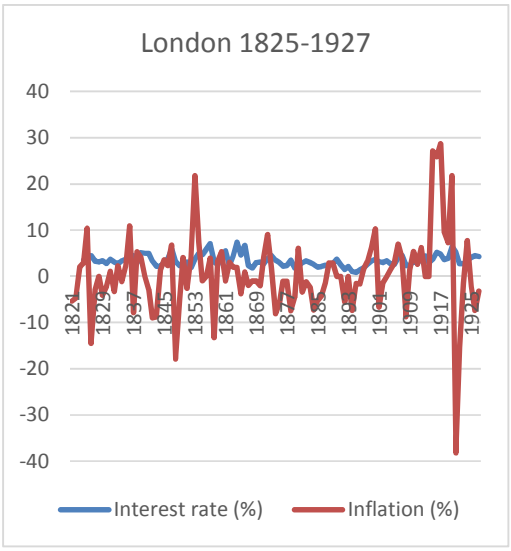
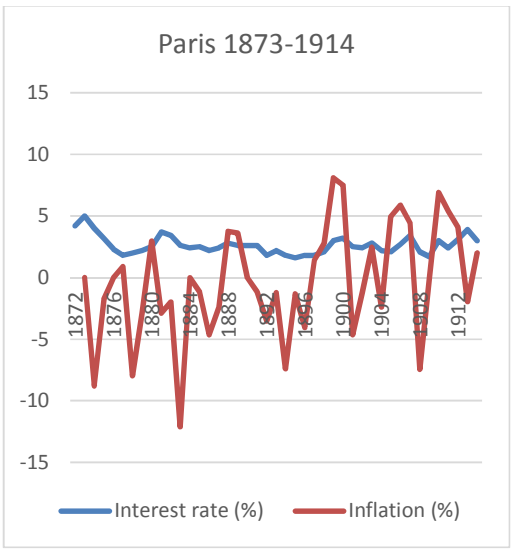
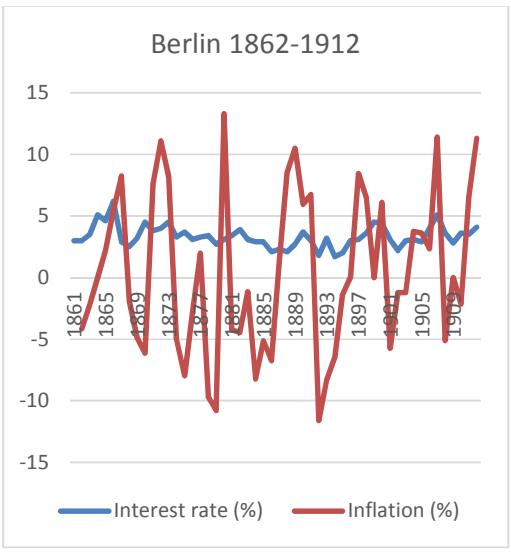
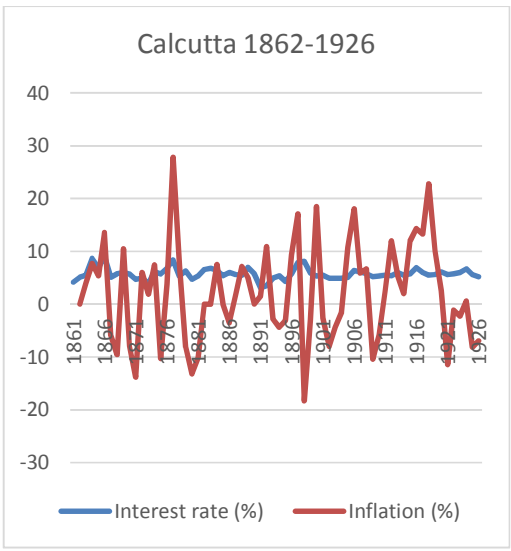
Chart 1. Fisher's Data: Nominal Interest Rates and Inflation 1825-1927

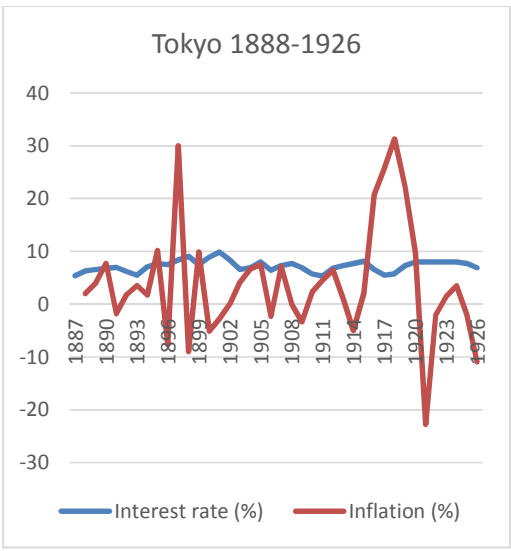












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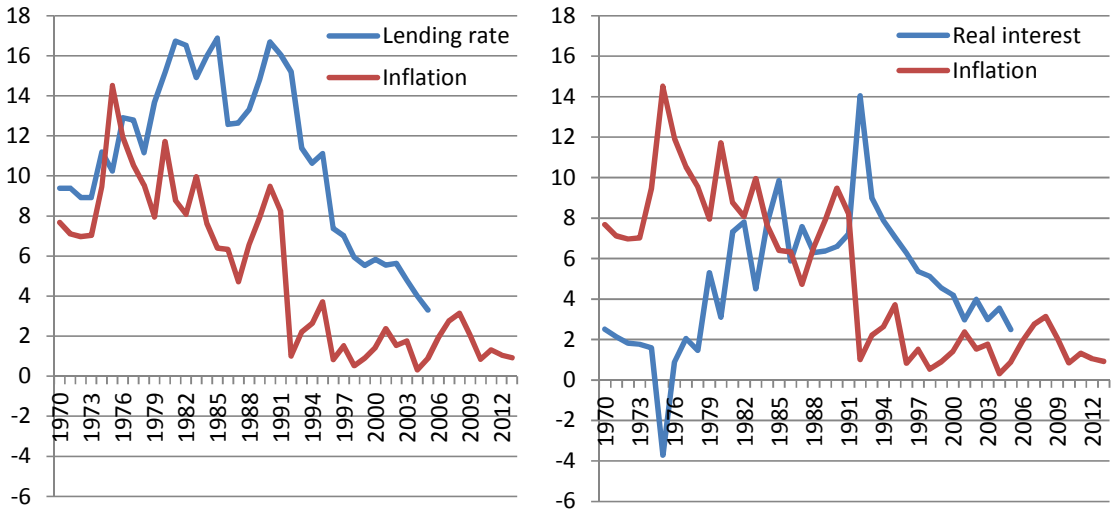
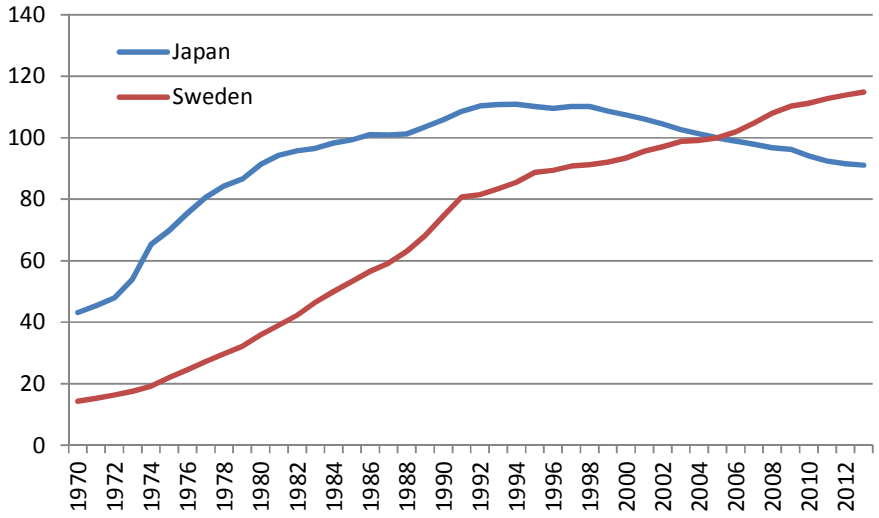


Note: Real interest is the lending rate minus the inflation rate.

Source: World Bank *World Development Indicators*.

Chart 3. Japan and Sweden: GDP Deflator 1970-2013 (2005 = 100)



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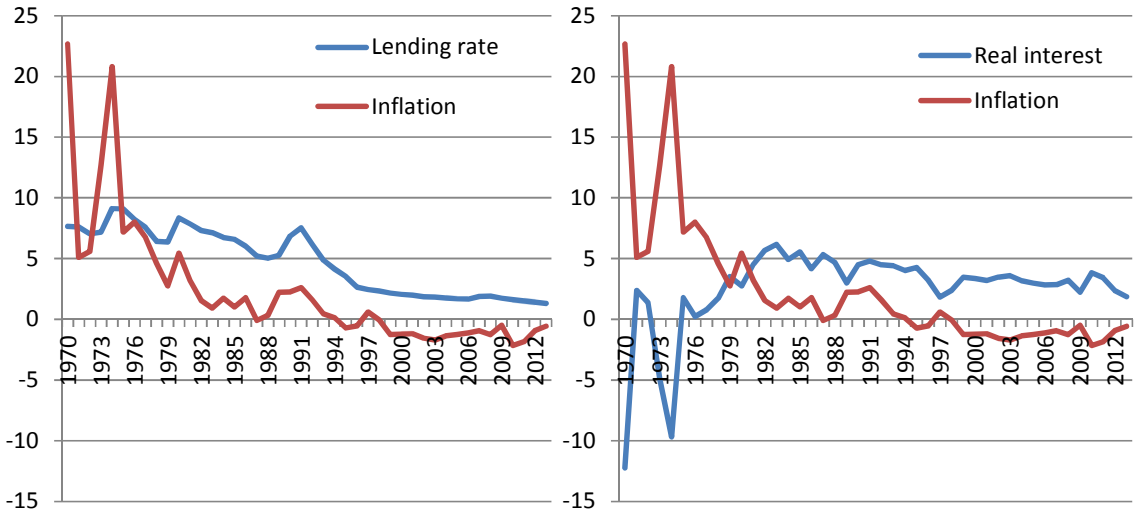

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