**Real Interest Rate and Growth: An Empirical Note.**

by

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Abstract:

Are restrictive monetary policies harmful to growth? The note aims at providing some empirical evidence to answer the question. A significant negative correlation between growth and real interest emerges over the period 1960-94; in the eighties this relationship strengthens. This result is in agreement with the traditional view of a long run positive link between growth and capital accumulation and a negative long run link between accumulation and the cost of capital. Moreover the outcome is in line with the view that links the slowdown in economic growth of the industrial countries over the last decades appears to the implementation of restrictive monetary policies

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## 1. Introduction

The motivation for this note comes from the eagerness to shed some light on the reasons of the prolonged slowdown in the growth of the industrial countries originated in the seventies, after the shocks in the commodities markets.

Different explanations have been offered for the slowdown. Some of them concern technological factors as well as political and institutional conditions. Notwithstanding, the implementation of restrictive monetary policies seems to be an important part of the tale. Remember that at the beginning of the eighties' monetary policies were everywhere aimed at curbing the core inflation and that at the end of the decade the concern had became the one of controlling inflationary pressures caused by a mismanaged cyclical expansion. More recently, the picture has become only in part less severe, with most industrial countries (especially in the EU) bent on reducing their budget deficits and coordinating fiscal and monetary policies accordingly (and Italy in particular forced to couple restrictive fiscal policy and high real rates of interest).

There are obviously theoretical underpinnings for an inverse relationship between growth and the real rate. The more direct mechanism is the one connecting accumulation and growth. As it is widely known, investments remove the constraints to growth coming from insufficient or obsolete capacity and enable the system to express its growth potentials increasingly. In addition the new capital stock incorporates technical progress and promotes further expansion of the growth potentials of the system.

In this framework, the real interest rate has a twofold role: from one side it encourages the channelling of resources towards accumulation; from the other side it represents a cost factor that reduces the amount of investment. Theoretical models (the life-cycle hypothesis, in particular) and empirical evidence stress both the first and the second role. But on empirical grounds the importance of the real rate of interest as checking factor of investment projects is overwhelming. Nevertheless at low rates the demand for capital, even in the industrial countries, looks far from being satiated.

A negative relationship between the growth rate and the real interest rate is expected. This relationship summarizes the previously mentioned mechanisms and is not therefore a structural one; its exact nature, in fact, is uncertain. According to the conventional view, that we accept, short run interest rates and the term structure are influenced by monetary policies. Obviously, these influences are conditional upon the time period considered and the international setup of capital markets.

In the following, we present very simple estimates of the relationship between overall growth rates and real rate of interest. This relationship is obviously not a behavioural one; rather, it represents a reduced form of the relevant theory, based on two assumptions:
1) even recognizing the conditioning exerted by short run shocks of technological, fiscal and possibly institutional nature, we believe that the long run movements of interest rates are basically controlled by the action of monetary authorities So that treating the long rates as exogenous variables may represent an acceptable approximation of reality[1]; 2) a negative relationship between growth and long term interest is expected to dominate (empirically) on the opposite relationship (which is also conceivable). A priori, in fact, if the growth rate of the economy may be expressed as the saving ratio times the output per unit of capital, a positive effect of an increasing rate on the saving ratio and ultimately on the growth rate may not be ruled out. Yet, on empirical grounds, we expect that the productivity of capital sensitivity to the long run interest rate dominates over the saving ratio sensitivity.

## 2. Empirical analyses of the growth process

[1] This is a very common assumption. Among recent works see for instance Ciocca and Nardozzi (1993).

Empirical analyses about the factors affecting growth are often in cross-section format and investigate the behaviour of different countries during several decades. Their purposes are evaluating the emergence of conditional convergence in labour productivity or per capita output, and investigating the distinct influence on national growth of ultimate explanatory factors such as accumulation of physical and human capital, public expenditure in consumption and infrastructure or political and institutional characteristics.

The conclusions provided by regression analyses differ, depending upon time periods, countries and choice of explanatory variables. Even the introduction of additional regressors with the purpose of isolating a limited number of really general explanatory factors of growth is not conclusive[2]. The lack of persistence of signs and the lack of robustness of the results does not necessarily mean that the empirical specifications are inadequate. Simply, some effects prevail over certain periods, others, possibly opposite, prevail in different situations.

However, one cannot be completely satisfied with cross-section analysis: all information of the time series reduces to its average value, thereby ignoring dynamic changes. The same uneasiness applies to the opposite case of a (cross-section or panel) regression that relies upon high frequency annual data, a case in which short run disturbances are preponderant.

Studies that take into account both the sectional and the temporal variability are, up to now, relatively scarce.

## 3. Purpose of the present note

This note proposes a panel analysis based on 5-year averaged data for a group of industrial countries, a compromise between the need to avoid short-run disturbances and the inclusion of a significant dynamics.

We think that profitability and the cost of capital play an overwhelming role in the process of capital accumulation in the long-run. The existence of an efficient domestic capital market is assumed, that provides information about the expected return of investments. On the other side a reduction in the real interest rate increases, via capital accumulation, economic growth. Over 5-year periods, deviations from the optimal capital stock may be assumed to be relatively insignificant. At the same time, the impact on growth of many factors subject to evolution over the time, like for example the progress of financial institution, remain completely neglected by the analysis. The empirical investigation envisages relatively homogeneous situations, in the sense that only industrial countries are considered in the estimation. A relevant a priori source of non-homogeneity has therefore been removed. Therefore we use a reduced form equation that posits a direct link between growth rates and real interest rates[3]. In our case the use of these regressions over 5-year averages represents a less intricate procedure with respect to the estimation of the dynamic panel or to the search for a cointegration vector common to all the economies of the panel.

Because of the use of 5-year averages, we do not introduce lagged variables as it is usual in short-run formulations: the 5-year average growth rate is related to the corresponding value of the real interest rate. All regressions are estimated with the OLS method. A simultaneity problem between the variables considered might potentially arise and this might lead to the inconsistency of

[2] Levine and Renelt (1992) for example show that the cross-section regressions for the growth rate are characterised by fundamental instability; investment is one of the few robust regressors (in terms of extreme bound analysis). De Long and Summers (1993) assert the crucial importance of accumulation in machinery and equipment.

[3] A neat stationarity result emerges for the real GDP growth rates; the results are not clear-cut for the real interest rate. High autocorrelation (Mishkin, 1981) and low power of non stationarity tests of the series of the real interest rate over relatively short periods might explain this outcome. Dynamic panels are used by Caselli *et al.* (1996). The issues of heterogeneity of the individual relationships and aggregation between them are analysed in Pesaran and Smith (1996) and Hall and Urga (1996).

the estimates, if this estimation method is proved to be inadequate. Therefore for all the regressions considered we have performed Hausman test about the consistency of the estimates and the results clearly suggest the adequacy of this procedure[4].

Another important assumption concerns imperfect international capital mobility: real interest rates vary over time and countries[5]. On the contrary, all other (economic, political, social and institutional) differences across the various economies are assumed to be constant over time, as they are completely summarised in the country-specific fixed coefficients of the panel regression.

## 4. Data

The regressions are based on data concerning a group of 20 industrialised economies (following the IMF definition[6]) over the period 1965-94. All data on nominal interest rate, inflation and real GDP growth (GNP for USA) come from IMF *Financial Statistics*. In the period under scrutiny, even if these countries exhibit different growth and real interest rates, they retain a fundamental homogeneity, being all market economies (albeit with different degrees of openness and regulation). Most investments are of private origin and decisions about their realisation are primarily affected by the real interest rate.

Six periods have been considered: 1965-69, 1970-74, 1975-79, 1980-84, 1985-89 e 1990-94 for a total of 120 observations.

The empirical measurement of the real interest rate is far from being trivial. Two options were obviously open. One was using real *expected* rates of interest. The other one was to use observed rates of interest averaged over sufficiently long time periods. The first alternative would have made the empirical findings conditional upon the assumed theory of price expectations, which sounded rather unpalatable. The second alternative rested upon the expectation that over long time periods agents are assumed to perceive accurately the average current inflation. We preferred to stay on the second alternative, even if recognizing that in certain circumstances forecasting errors may be long lasting. Therefore the data used in the regressions are 5-year averages[7].

The nominal yield usually considered is that of the typical government bond, that differs in maturity and other characteristics from country to country. For the US, Japan and Greece the yield is the average interest rate on long run loans. In one case (Finland) both these series are too short and the official discount rate is used. The lack of homogeneity in interest rates may represent a non minor problem[8], even if the use of fixed effects panel estimation is usually a successful remedy for the misspecification of the regression (and for possible distortions in the estimates of the coefficients), when country-specific differences prevail on time-specific differences.

## 5. Cross-section estimation

[4] The instrument considered is the lagged value of the real interest rate. See the Appendix for details.

[5] Different conditions of financial market integration and empirical tests lead to different conclusions. See e.g. Obstfeld (1994).

[6] The 20 countries are USA, Canada, Australia, New Zealand, Japan, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Holland, Norway, Spain, Sweden, Switzerland e United Kingdom.

[7] This procedure has been used, for example, in the evaluation of the degree of international capital mobility through the Feldstein- Horioka regressions. With respect to the problem of growth, 5-years averaged data have been used by Grier and Tullock (1989) and Islam (1995).

[8] Another crucial simplification is the complete neglect of the fiscal treatment, in view of the variety of possible fiscal situations and the related problem of identifying the characteristics of the marginal investor in each country and over different periods of time.

According to the cross-section analyses of the growth determinants (which neglect dynamics) only a very limited explanatory power may be attributed to the real interest rate. A first step besides the usual sectional formulation may be made through the estimation of a regression that encompasses simultaneously the seven 5-years intervals, thereby taking into account dynamics. The estimated relationship is the following:

[1] $$gy_{it} = a + b\, r_{it} + u_{it} \qquad i=1,...,20;\ t=1,...,7.$$

In the estimates, summarised in Table 1, the long run effects of the real interest rate on growth show up quite neatly in terms of t-statistics, and the sign is negative as expected: a 1% fall in the real interest rate raises the growth rate of about 1/6 of a point, a quantitatively important effect, especially when high interest rates are maintained for long intervals.

Table 1 - Pooled regression, 20 industrialised countries, 1965-1994

| | Six 5-year intervals |
|---|---|
| n. obs. | 120 |
| d. freedom | 112 |
| c | 3.53 (16.18)** |
| r | -0.16 (-3.16)** |
| $R^2$ | 0.10 |

Note: standard errors are corrected for heteroscedasticity (White procedure);
t-statistic between brackets; ** 5% significance level.

The standard errors of the coefficients are corrected for heteroscedasticity following the procedure due to White (1980). However, a common intercept for all the countries might lead to a distortion in the estimation of the r coefficient, if different country effects are present. Panel regression might represent a possible solution for this issue.

## 6. Longitudinal analysis

The crucial evaluation of the sectional effects emerges when reference to countries characterised by different situations are allowed for. Country specific averages are subtracted from the original series and a panel regression with fixed individual effects is considered. Here is estimated relationship:

[2] $$gy_{it} = a_i + b\, r_{it} + u_{it}$$

The country-specific constant summarizes different factors characterizing each country - the initial stock of human and physical capital, population growth rate, level of technical progress and other structural factors taken as constant over the period under scrutiny[9]. Moreover, the use of country-specific constants may be justified also by the non full comparability of the utilized interest rates[10].

[9] We cannot attach any clear interpretation to the country-specific intercept: it is a linear combination of several (unknown) structural factors that influence current and steady-state growth. Therefore conclusions about the emergence of conditional convergence cannot be drawn. However several studies concerning the group of industrialised countries suggest the presence of such an effect.

[10] In the simple linear regression model, the estimated intercept is equal to E(Y)-bE(X), Y and X being respectively the dependent and independent variables and b being the slope of the regression equation.

Taking into account these elements, the relationship between growth and real interest is expected emerge more clearly. The results are shown in Table 2.

Table 2 - Panel regression, 20 industrialised countries, 1965-94

| | Six 5-year interval |
|---|---|
| n. obs. | 120 |
| d. freedom | 99 |
| r | -0.21 (-4.01)** |
| $R^2$ | 0.10 |

Note: standard errors are corrected for heteroscedasticity (White procedure);
t-statistic between brackets; ** 5% significance level.

We regard the overall results of the estimate as acceptable in terms of explained variance of the dependent variable[11]. The interest rate coefficient retains its expected negative sign and has a value corresponding to the *a priori* expectations. The value of the estimated coefficient is slightly larger than the one obtained for regression [1]: an overall increase of 1% in the real interest rate implies a 1/5 fall in the rate of growth for the whole group of industrialised countries.

Even with the obvious cautions imposed by the estimation of a simple non-structural relationship, the first and most obvious evaluation criteria, checking whether the results are reasonable, is fulfilled. The increased precision in the estimate of the real interest rate coefficient is not surprising in the case of significantly different country-specific dummies. This point suggests that the estimates of Table 1 are possibly inconsistent, even if by comparing the results of tables 1 and 2, the distortion does not seem very sizeable.

## 7. Real interest rates and growth in the eighties

In the first half of the eighties, when monetary policies became restrictive in most industrial countries, not only the *nominal*, but also the *real* interest rates increased significantly almost everywhere. Since then the real rates have retained high levels for a long time. Our regression [2], in the following, is designed to evaluate the overall effect, in terms of reduced growth, of that wave of high real rates. The estimation result for the period 1985-94 is summarised in Table 3. It turns out that in this period the *real* effect of a tight monetary policy are not negligible: a 1% increase in the real rate reduces the growth of the industrialised countries, on average, of more than a third a point. So it seems that in the eighties a discontinuity has emerged in the historical tie between the real rate and growth.

From an econometric point of view this result is not particularly worrying, given the non-structural character of the estimated relationship. However, without a fully structured model it is extremely difficult to offer a clear cut explanation for these results. We must rely on a priori (and therefore somewhat arbitrary) interpretation. In the eighties' monetary policies of the industrial countries became restrictive, in the attempt to counteract the expectations of high inflation. Three elements reinforced this restrictive effect. First, most industrialized countries coupled restrictive monetary policies with restrictive fiscal policies, because of the potentially unstable dynamics of the public debt/ GDP ratios during the seventies' thereby reducing the growth process also through this channel. Moreover, the expectations of a high rate of inflation proved to be persistent over time (and monetary policy behave accordingly). Eventually, this restrictive outcome has been reinforced also by the ongoing process of financial integration, a the rise in the real interest rates spreads quickly from one country to another.

[11] A direct comparison with the $R^2$ value of the previous relationship is not possible; in the panel regression we have subtracted the individual means from the original gy and r series.

Table 3 - Panel regression, 20 industrialised countries, 1985-94.

| | Two 5-year intervals |
|---|---|
| n. obs. | 40 |
| d. freedom | 19 |
| r | -0.36 (-4.28)** |
| $R^2$ | 0.09 |

Note: standard errors are corrected for heteroscedasticity (White procedure);
t-statistic between brackets; ** 5% significance level.

## 8. Real interest rates and growth in Europe

In the last decade, the degree of monetary restriction has been more marked in Europe than in the USA or in Japan and the real rates of interest have been correspondingly higher. Therefore it is argued that the quite disappointing performance of the European economies might be influenced by this crucial factor. On the grounds of the previous argument it is possible to wonder whether the limited growth of the European economies is to be (mainly) ascribed to specific institutional features or to a relatively high sensitivity of growth to the interest rates. To try to answer this question we have estimated regression [2] for the sub-sample of the 15 European countries.

The result, shown in the first column of the Table 4, does not suggest any specific long run effect in the interest-growth relationship for this group of countries (and the same conclusion obviously holds for the group of 5 non-European countries). Over the period 1965-94, the estimated coefficient shows a slight decrease, (from -0.21 to -0.20), while the percentage of explained variation in the dependent variable remains fairly constant. Note that also in this case the trade-off between interest and growth changes remarkably in the last period. The second column of Table 4 shows the result of the panel regression over the period 1985-94. The value of the estimated coefficient nearly doubles: the effect of a 1% increase in the real interest rate leads to a fall of 0.35% in the growth rate for the average of the European countries, in line with the result obtained for the whole sample (-0.36).

Table 4 - P*anel* regression, 15 European industrialised countries, 1965-94 and 1985-94.

| | Six 5-years intervals | Two 5-years intervals |
|---|---|---|
| n. obs. | 90 | 30 |
| d. freedom | 74 | 14 |
| r | -0.20 (-3.61) ** | -0.35 (-4.95)** |
| $R^2$ | 0.08 | 0.12 |

Note: standard errors are corrected for heteroscedasticity (White procedure);
t-statistic between brackets; ** 5% significance level.

## 9. Conclusions

This paper has been concerned with empirical evidence about the long run relationship between economic growth and the real interest rate. We draw upon a panel of 20 industrialised countries; each observation refers to a (non-overlapping) 5-year average over the period 1965-94, an interval in

which no dramatic structural changes have been experienced by the OCSE countries group, but long enough to include different situations of the real interest rate and of the GDP growth.

During the last 30 years a trade-off between these variables emerges. The estimate of a simple reduced form suggests that a 1% increase in the real interest rate leads to a fall of a 1/5 of a percentage point in the average growth rate. In more recent periods, because of the prolonged increase in the real interest rate, this effect becomes quantitatively more significant. This result is in agreement with the traditional view about the existence of a positive link between growth and accumulation and a negative link between accumulation and real interest rate. However, other interpretations are possible; for example, that higher real interest rates do not necessarily reflect restrictive monetary policies, but higher expected capital productivity.

The economic policy implications of the paper are left to the reader.

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Appendix

The problem of possible existence of simultaneous influences between gy and r has been tackled as follows. For each regression shown in the text an IV estimation has been performed. The instrument used is the lagged value of the (5-year average) real interest rate. Because of the high degree of persistence of the interest rates, these two series should be highly correlated and IV estimates should be fairly reliable. In fact, some of the coefficients are not precisely estimated. For each regression we compute the Hausman (1978) test for the consistency of the OLS estimates.

The results are shown in Tables A1-A2.

Table A1- Cross-section estimation

| | 20 countries<br>Six 5-year intervals |
|---|---|
| n. obs. | 120 |
| d. freedom | 112 |
| | |
| c | 3.34 (9.71) |
| r | -0.08 (-0.78) |
| $R^2$ | 0.07 |
| Hausman test $\chi^2(2)$ | 0.19 (0.66) |

Table A2 - Panel estimation

| | 20 countries<br>1965-94 | 20 countries<br>1980-94 | 15 countries<br>1965-94 | 15 countries<br>1980-94 |
|---|---|---|---|---|
| n. obs. | 120 | 40 | 90 | 30 |
| d. freedom | 99 | 19 | 74 | 14 |
| | | | | |
| r | -0.04 (-0.32) | -0.41 (-5.79)** | 0.07 (0.49) | -0.40 (-4.55)** |
| $R^2$ | -0.01 | 0.08 | -0.20 | -0.11 |
| Hausman test $\chi^2(1)$ | 1.05 (0.31) | 0.19 (0.66) | 3.80 (0.31) | 0.15 (0.66) |