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Interest Rates, Banking Spreads and Credit Supply: the Real Effects

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RÉSUME

Dans le modèle ISLM standard, les effets de la politique monétaire sur l'économie réelle passent par la demande de monnaie et le taux d'intérêt (lequel est unique). Dans la réalité, les différentes créances, sous la forme de titres ou sous la forme de crédit bancaire, sont des substituts imparfaits et les chocs de politique monétaire sont susceptibles d'altérer la structure relative des taux d'intérêts. Dans ce document de travail, nous analysons le contenu en information de la structure des taux d'intérêts sur l'activité économique. En plus des spreads de taux d'intérêt couramment utilisés dans la littérature, nous avons défini des spreads à partir de taux d'intérêt bancaire.

L'étude de ces spreads répond à plusieurs préoccupations. D'une part les crédits bancaires restent la principale source de finance externe pour les agents non financier privés. D'autre part sous les hypothèses d'asymétrie d'information généralement admises, le crédit accordé par les intermédiaires financiers joue un caractère spécifique. L'expertise acquise par les banques dans l'évaluation de la qualité des emprunteurs et de la surveillance de leur solvabilité au cours du temps leur permet de proposer des crédits à des agents qui n'auraient pas accès à la finance directe. Dans la mesure où certaines catégories d'emprunteurs sont dépendantes des crédits bancaires, un renchérissement de ces crédits ou une limitation de l'offre de ces crédits peut se traduire par des effets récessifs.

Nous avons mené des tests de causalité à la Granger entre les variables financières et un ensemble de variables représentatives de l'activité économique, telles que le PIB, l'investissement, la production industrielle, l'emploi, la consommation privée, la consommation de bien durable et l'inflation. Le contenu en information sur l'activité des spreads bancaires a été comparé à celui des variables financières usuelles, agrégats financiers, taux d'intérêt. Les tests sont effectués pour les cinq grands pays de l'OCDE. La conclusion principale est que les spreads bancaires contiennent de l'information sur l'activité économique alors même que la relation entre agrégats financiers et activité économique s'est affaiblie. Ce résultat va dans le sens d'un rôle déterminant des banques sur le cycle économique.

ABSTRACT

In a standard IS-LM model, the effects of monetary policy on real activity are felt through the demand for money and the (unique) interest rate. In reality, shocks in monetary policy will affect the relative structure of interest rates given imperfect substitution among financial instruments. In this paper we analyse the information content of the relative structure of interest rates on economic activity. Over and above currently defined spreads, we have defined spreads based on bank determined interest rates. The importance of these spreads is straightforward. In real economies, debt finance is the major source of external funds. Moreover, under realistic conditions of information asymmetry, loans from financial intermediaries are special. The expertise acquired by banks in the process of evaluating and screening applicants, and in monitoring loan performances enables them to extend credit to customers who find it difficult or impossible to obtain credit in the open markets. A reduced supply of loans or a rise in the cost of borrowing may depress the economy, to the extent that some borrowers are dependent on bank loans for credit.

In order to analyse the information content of financial variables on economic activity, measured through a set of proxy variables like output, investment, industrial production, employment, private consumption, durable goods consumption and inflation, we have used Granger-causality tests. We have then compared the predictive power of spreads with other financial variables such as interest rates and monetary and credit aggregates. These tests were performed on five major OCDE countries. A major conclusion is that "bank" spreads are informative about economic activity even though the relationship between financial aggregates and real activity has weakened. This seems to confirm the important role banks play in economic activity.

Interest Rates, Banking Spreads And Credit Supply: The Real Effects

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INTRODUCTION

According to the textbook IS-LM model, the impact of monetary policy on real activity is mainly due to money demand and variations of a single interest rate. When imperfect substitution among financial instruments is allowed, returns across financial instruments can be different. If variations of interest rates can be linked to the stance of monetary policy then an easing of monetary policy does not necessarily produce the same effect on interest rates in every financial market. Moreover, the impact of monetary policy on real activity will not only depend on the level of interest rates but also on its effects on the structure of interest rates.

Financial deregulation has modified the nature of the monetary aggregates. In most OECD countries, the link of money and credit to economic activity has been weakening as financial innovation developed both new ways of finance and news saving products. Sims (1980), using US data, has shown that the interest rate is better than M1 in predicting GNP. Using Granger causality tests and variance decomposition from VAR models, Bernanke and Blinder (1992) have shown that the federal funds rate has a greater predictive power for real variables than the monetary aggregates M1 and M2. They also show that this rate is an exogenous instrument of monetary policy and is therefore a better indicator of the stance of monetary policy than the monetary aggregates.

Other studies, such as Stock and Watson (1989a), Bernanke (1990) and Friedman and Kuttner (1992), have shown that spreads are good leading indicators of the business cycle. They contain information on future activity that is not already contained in interest rates and monetary aggregates. In addition to the usual yield curve spread and quality spreads, we put forward here spreads constructed from banking rates. We then compare the predictive power of these spreads with the spreads normally used in the literature, and also with other financial variables, i.e. interest rates and monetary and credit aggregates. The first section is a survey of the literature on interest rate spreads. Section 2 introduces banking spreads and the assumptions about the determinants of their predictive power. These assumptions rely on the fact that banks' behaviour may be crucial in the channel of monetary policy, because most borrowers do not have access to external finance other than

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bank credit. Section 3 describes data and analyses its trend properties. The fourth section describes the methodology and releases the results of the Granger causality tests between financial variables and real variables in the G5 countries. Section 5 investigates the orthogonality of the information contained in the spreads. Section 6 analyses the evolution of the link between financial and real variables for different periods of time in the case of France.

1. Spreads and economic activity

1.1. Information contained in the yield curve

Explanations about the information contained in the yield curve rely on the theory of expectations. The basic proposition is that the long term yield of a bond of maturity m, i.e. I_t^m, equals the weighted average of expected short term interest rates i for m periods plus a risk premium depending on the length of immobilisation m :

(1) $$I_t^m = \ ^m + \frac{1}{\sum_{k=1}^{m} \ ^k} \sum_{k=0}^{m} \ ^k E_t(i_{t+k}) .$$

This basic proposition has been empirically refuted several times, which has led to changes in the theory. Yet the principle of equalisation of yields for bonds of different maturity, for which risk premia are taken into account, is still central to alternative more elaborated theories. The spread between long term and short term rates has therefore something to do with the sequence of expected short term interest rates. If expectations are rational, the yield curve can provide an unbiased forecast of future short term interest rates. The yield curve can also be used to predict inflation (by splitting the long term interest rate into an expected rate of inflation and a real interest rate) as well as real growth (through the assumption of a correlation between short term interest rates and real growth over the business cycle).

1.1.2. Yield curve spread and inflation

The increase in the yield curve can indicate an increase in future inflation (Fama 1990, Mishkin 1988, 1990a, 1990b). Following Fisher's equation, the nominal interest rate can be split into a real interest rate, which is assumed constant, and expected inflation. Thus, we have:

(2) $$E_t(\ _t^m) = i_t^m - rr_t^m$$

where the expected inflation at time t for the next *m* periods $E_t(\ _t^m)$ equals the interest rate of maturity m, i_t^m, minus the real interest rate on m periods, rr_t^m.

Two assumptions are therefore necessary:

(a) the usual assumption of rational expectations, i.e. that all the available information at time t is taken into account in the expectations, and that therefore the expectation provides an unbiased prediction of future inflation

$$ {}^{m}_{t} = E_t(\ {}^{m}_{t}) + \ {}^{m}_{t},\ \text{with}\, E_t(\ {}^{m}_{t}) = 0. $$

(b) the real yield curve is constant over time:

$$ rr_t^m - rr_t^n = rr_{t+k}^m - rr_{t+k}^n = \quad {}_{m,n}\ , \forall t, k $$ [4]

Note that this hypothesis is not as strong as the Fisher effect, which supposes a constant real rate.
The relationship between inflation and the yield curve is therefore derived:

(3) $\ {}^{m}_{t} - \ {}^{n}_{t} = \quad {}_{m,n} + \quad {}_{m,n}(i_t^m - i_t^n) + \ {}^{m,n}_{t}$

Theoretically assumption (b) states that $\ {}_{m,n}$ =1, and this is true *a fortiori* if real interest rates are constant. Mishkin (1990a) shows that $\ {}_{m,n}$ is significantly different from 0 so the yield curve can predict future inflation. He also finds that $\ {}_{m,n}$ is different from 1. Thus, the real yield curve is not constant over time and the nominal rate spreads also contain information on the real yield curve.

The assumption (b) is therefore contradicted. Two explanations for the changes of the real yield curve can be found. Either the expected real rates change in future periods or the risk premium is itself varying over time. Most tests show that risk premia vary over business cycle and that they usually increase during recessions. This variability of risk premia puts into question the ability of yield curves to predict both inflation and real rates. The mitigated empirical findings of Miskin are confirmed by Fama (1990). Fama shows, from US data, that the long horizon yield curve contains information on inflation and that the short horizon of the yield curve contains information on the real rate. He also showed that the predictions are weakened by a risk premium that varies over the business cycle.

Frankel and Lown (1994) propose including more than a single yield curve spread, as Mishkin did, and use the whole yield curve for their forecasts. They find that the yield curve is an indicator of both monetary policy and expected inflation.

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[4] More details on tests of the Fisher effect can not be found in Miskin (1992), who shows that the effect is not verified in the short term, but that there is a cointegration relationship between prices and interest rates can be interpreted as a long term Fisher effect.

1.1.3. Yield curve spreads and real activity

Estrella and Hardouvelis (1991) show the existence of a relationship between the yield curve and the future growth of GDP. They show that a reduction of the yield curve of 1,29 points forecasts a recession (i.e. a decrease in real GDP of at least two consecutive quarters) two or three quarters later. They put forward some of the explanations for the link between the yield curve and growth. Firstly, the spread can be an indicator of the stance of monetary policy. The long term rate usually demonstrates less variability than the short term rate. Therefore, the variation of the spread may depend mainly on the variations of the short term interest rate that is generally influenced by the monetary authorities. Thus, the spread may reflect the stance of monetary policy. A reverse of the yield curve, for example, demonstrates an unusually restrictive monetary policy, which leads in most cases to a reduction of future growth. This first explanation needs to be elaborated, but empirical evidence shows that spreads are significant even when short term interest rates are included in multivariate Granger causality tests. Therefore, the yield curve contains more information than the one contained in short term interest rates. If, as Bernanke and Blinder (1992) have shown, short term interest rates can be considered as good indicators of monetary policy, then yield curve spreads must be either a better indicator of the stance of the monetary policy or they must reflect something else.

Secondly, the spread can be an indicator of expected monetary policy. If, for example, agents expect an expansive monetary policy, they expect that the future reduction of short rates will boost growth. They may also expect that more inflation will follow. If they expect that this increase will be higher than the expected reduction of real interest rates, the long term rate might increase and so would the spread. Through this mechanism, an increase of future growth would be correlated with a current increase in the spread. The increase of the spread goes with both, an increase in inflation and a decrease in real rates as described in Fama (1990).

Thirdly, the spread can be linked to a consumption CAPM. Harvey (1988) proposes a partial equilibrium model that links future consumption and the yield curve spread. Empirical tests do show that aggregate consumption is one of the macroeconomic variables that are highly correlated with yield curve spreads.

Finally, real shocks in an IS-LM model can be responsible for this link. Suppose that agents expect a real shock that will move the IS curve upward. This shock will result in an increase in expected output and interest rate. Consequently, the long term rate increases as does the yield curve spread. In this case, the increase in the spread is correlated with an increase of future growth.

1.2. Interest rates and spreads as leading indicators of real activity

Another field of research is to test the usefulness of interest rates spreads, and not only yield curve spreads, as leading indicators of real activity. These tests usually compare the predictive power of spreads with other financial variables such as monetary aggregates, credit aggregate and interest rates.

1.2.1 Tests on US data

Stock and Watson (1989a) have proposed including spreads in the leading indicators of activity. They show that monetary aggregates contain information on real variables only in bivariate tests but that they do not contain information anymore when some other explanatory variables are included in regressions. Sims (1980) has shown that interest rates do better than monetary aggregates in estimations of real activity. He uses this result to conclude that monetary policy is neutral. Friedman and Kuttner (1991) as well as Bernanke and Blinder (1992) disagree with this explanation. Following MacCallum (1983), they claim that interest rates are better indicators of monetary policy than monetary aggregates and therefore the empirical finding of Sims is a proof of the non-neutrality of monetary policy.

Bernanke and Blinder (1992) have undertaken a systematic comparison of the predictive power of financial variables on real variables using Granger causality tests and variance decomposition in VAR models. They find that the predictive power of the federal funds rate clearly outperforms those of M1 and M2. Their tests show the link between this rate and the Federal Reserve Bank's conduct of monetary policy. Friedman and Kuttner (1992) show that the superiority of spreads and rates on monetary aggregates has been even more obvious recently. Monetary aggregates do not "Granger cause" real activity and cointegration between money and the GDP cannot be found. Their explanation relies on the weakening of the money channel of monetary policy. Balke and Emery (1994) have followed this track and concluded that the channel of monetary policy in the US has changed since 1982. They show that monetary aggregates did influence significantly both inflation and unemployment between 1959 and 1979, but that this influence vanished in the 1982-1992 period, as the enforcement of monetary policy changed. In contrast, the federal funds rate is still significant in the recent period.

Other works like Bernanke (1990) and Friedman and Kuttner (1989, 1991 and 1992) have also found that interest rates and spreads outperform monetary aggregates in Granger causality tests of real variables. The different studies find that the commercial paper-Treasury bills spread is a particularly good leading indicator that usually rises before recessions. Three different explanations have been put forward:

- **the rise in this spread is a proxy for the increase of the default risk on claims of private sector that goes with recessions. Yet Bernanke (1990) casts some doubts on this explanation as the correlation of this spread with other default risk spreads such as the spread of rates on BAA and AAA rated bonds is very low.**

- the rise in the spread can also result from a reduction of bank credit that leads firms to issue more commercial paper. Such a reduction of bank credit may be the consequence of a tighter monetary policy, and it is usually followed by a recession.
- the rise in the spread may be due to the increased need for funds of the firms that expect their cash flow to decrease during recession. Firms can reduce their supply (layoff employees) only with a delay. In the mean time, they issue more commercial paper as a source of external finance.

This spread might also be seen as a proxy for credit rationing by banks, which leaves commercial paper as the only available instrument for the external finance of firms. Nevertheless, Kashyap, Stein and Wilcox (1993) underline that this spread did not rise prior to the recession of 1989. They claim that this result can be due to a deepest commercial paper market. Thus, it would not be a good leading indicator anymore as the market has deepened greatly. Moreover, Konishi, Ramey, and Granger (1993) show that the significance of the spread is very sensitive to the period of estimation.

1.2.2. International comparisons

Davis and Fagan (1994) have tested the predictive power of different spreads on inflation and GDP growth in 9 countries of the European Community, in the US, in Canada and in Japan. Overall, the spreads they test do contain information on inflation and growth. Artus and Kaabi (1993) further investigated the predictive power of spreads. They construct a model where the links between the spread and future growth are not always positive, but depend on the nature of shocks experienced by the economy. Testing for Japan, Germany, France and the UK, they find that the yield curve spread is positively correlated with growth four quarters latter.

2. The banking spreads as leading indicators

Banks' behaviour may be crucial for the transmission of monetary policy. This transmission arises either through quantities - i.e. the credits that are distributed - or from prices - i.e. the interest rates on those credits. Two reasons have led us to consider that banking spreads should be linked to future growth. First, a vast majority of non-financial agents are still dependant on banking credits dispite of the deregulation financial markets. The behaviour of banks, regarding not only interest rates, but also spreads, is an important channel of transmission of monetary policy. The fact that the prime rate has lost its central reference role in favour of an increasing use of the varying rates indexed on market rates (BIS 1993) has led us to use a collection of banking rates, including average rates on the different categories of credit. Second, the banking spread variations may depend upon the imperfect substitutability between financial instruments as suggested in the theoretical explanations of the predictive power of the commercial paper-Treasury bill spread. For instance, if agents expect a recession and fear being short of liquidity, they will borrow more, which can lead to changes in the macroeconomic financial structure (Kashiap, Stein and Wilcox, 1992). If the gap between the supply and demand of financial instruments varies differently across markets over the cycle, then, variations of spreads may carry information about the business cycle.

2.1. Definitions of the banking spreads

We have constructed four groups of banking spreads:

- *intermediation margin spreads.* These are spreads between the prime rate or credit average rates and the call money rate, which is considered here as the marginal cost of finance for banks. An increase in intermediation margin may stimulate the supply of credit by banks and therefore stimulate the economic activity if some categories of agents, for instance households and small enterprises, are credit rationed and do not have access to alternative means of external finance. Such assumption is generally verified for households, see Jappelli and Pagano (1989). In this case, the stimulated supply of credit due to an increase in the spread meets excess in demand; the volume of credit rises and final demand grows. An increase in demand then precedes an increase in activity.

- *banking quality spreads*. They involve banking credit of same maturity and of different quality, typically the short term credit average rate minus the prime rate. This spread expresses the own opinion that banks have about default risk, which may vary over the business cycle.

- *banking yield curve spreads*. They are defined as the difference between two banking rates of different maturities: the long term credit rate minus the prime rate or the mortgage rate minus prime rate. This kind of spreads bears information about the expectation of the future short term credit rate as the market equivalent spreads. But, as such spreads are constructed with rates of different qualities, they might also bear default risk information.

These last two categories of banking spreads may have another meaning. Both are based on rates that are the banks' income for different categories of credit on the asset side of their balance sheets. If the market of one of these categories of credit is under excess demand and if banks consider that the borrowers of this category become less risky, for example if they depend more on the cycle and the banks expect a boom, it is possible to observe a higher increase in the rate associated with this credit category than in the other categories of credit before a boom. It is even possible to imagine that the price for, and the volume of, credit increase together and that this increase in the volume of credit stimulates the booming economy.

- lastly, we have used the spread between a long term credit rate and a public bond rate that Bernanke and Blinder (1988) have introduced. Their purpose was to promote an IS-LM model where banking credit and public bonds are imperfect substitutes. According to their model this spread, that we name here the Bernanke-Blinder spread, can carry information on the cycle. For instance, if banks expect an increase in default risks, the credit rate may increase while credit and final demand decrease. The implied downward slide of the IS curve leads to a decrease in the interest rates on public bonds. There could be a negative correlation between this spread and the activity.

2.2 Comparison of the predictive power of banking spreads with other financial variables

Our purpose is to compare the predictive power of these banking spreads to the one of other financial variables. For doing this, we test the link between the following variables:

- inflation and a collection of proxy variables for real activity, i.e. real GDP or GNP, industrial production, employment, constant prices investment, private consumption and durable consumption at constant prices.

- and financial variables: M1 and M2 monetary aggregates, credit claims on the private sector, several interest rates (call rate, bond rates, bank rates...) and several spreads of interest rates.

For comparing the predictive power of the banking spreads, we use also the following spreads :

- *the yield curve spreads* or likely yield curve spreads: public bond rate minus call money rate (YC1), public bond rate minus Treasury bill rate (YC2) or Treasury bill rate minus call money rate (YC3);

- *the quality spreads*, which are the spreads between interest rates of the same maturity for two different categories of borrowers, as the spread between the private bond rate and the public bond rate (MQ1) or the commercial paper minus Treasury bill spread (MQ2);

3. Unit roots tests

As stated by Stock and Watson (1989b), contradictory results in Granger-causality tests can be due to the use of different techniques to detrend series that arguably contain unit roots. Moreover, the asymptotic distributions of neutrality and causality tests are sensitive to the presence of unit roots and time trends in the series. In particular, Sims, Stock and Watson (1991) show that the standard F-distribution can be used to test restrictions on zero-mean, stationary variables or when the restrictions involve some variables that are dominated by a polynomial in time, but there are no other linear combinations of regressors that are dominated by stochastic trends. Otherwise, the F statistics will have a non-standard distribution. Thus, our first concern is to ascertain the order of integration of the variables.

Even if the problem of integration properties of the data can be addressed using techniques that are now familiar, results are not always independent of the procedure considered. Thus, a brief description of the unit root testing procedure is needed before presenting the results for the whole set of variables.

3.1. Methodology

Let us assume that the time series {y_t } follows an AR(1) process and can be represented as

(4) $y_t = \quad + \quad t + \quad y_{t-1} + \quad _t$

where {ε_t } is a sequence of independent random variables with a mean of zero and variance σ^2 and t is a deterministic time trend. It is further assumed that the initial condition, y_0, is a known constant.

To solve the problem of testing the null hypothesis Ho: ρ =1 versus H1: ρ<|1| (i.e. non-stationarity against stationarity around a deterministic trend) Dickey and Fuller (1979) suggest an OLS estimation of equation (4). The test is implemented through the usual t-statistic of ρ, but it will not have the standard t distributions. Three different statistics are defined: $_t$, for the model with $\beta\neq0$ and $\mu\neq0$; , when $\beta=0$ and $\mu\neq0$; and for $\beta=0$ and $\mu=0$. Critical values of the statistics are provided by Fuller (1976) and Dickey and Fuller (1981). These asymptotic distributions will depend on the presence of "nuisance" parameters in the Data Generating Process, thus, critical values have been estimated for $_t$, *and* .

Let us now consider that y_t follows an AR(q) process, instead of an AR(1) process,

(5) $$y_t = \quad + \quad t + \sum_{j=1}^{q} \quad _j y_{t-j} + \quad _t$$

then estimating (5) using (4) may generate a serious problem on the models just considered because residuals will be autocorrelated. A common response to this problem is the so-called augmented Dickey-Fuller tests, which consist in including one or more lagged changes in y in the regression, to eliminate serial correlation. Then, a test can be constructed with the regression model:

(6) $$y_t = \quad + \quad t + \quad y_{t-1} + \sum_{j=1}^{m} \quad _j \Delta y_{t-j} + \quad _t$$

Written in this way the unit root is isolated in the coefficient ρ. The tests will, again, be based on the t-statistic of ρ and will have the same critical values as those of DF statistics. The lagged changes in the dependent variable will capture auto-correlated omitted variables that would otherwise appear in the (auto-correlated) error term. It should be noticed that q will generally be unknown. If too few lags are added auto-correlation will remain in equation (6) and hence the DF distributions are inapplicable. If too many lags are considered the power of the test may be reduced. This problem is not trivial because it is often the case that the outcome of the tests depends on the particular choice of the lag truncation, m. Basically, any procedure selecting the correct auto-regressive order asymptotically (i.e. the Akaike Information Criterion or F-test of significance of additional lags) will be adequate. Another procedure, suggested by Campbell and Perron (1991), consists of selecting, *a priori*, some upper-bound on q, say q max, and estimate (6) for q

max. If the last lag included is significant then one should select q = q max. If not, one should reduce the order of the estimated regression by one until the coefficient on the last lag included is significant. It is important to note that this sequential procedure must proceed from a general model to more specific ones.

Considering the fact that, if $\neq 0$ or $= 0$ and $\neq 0$ in equation (4), the limiting distributions of τ_μ and τ_t are normal, Dolado *et alii* suggest starting by the most unrestricted model, $\neq 0$, $\neq 0$, if it is suspected that the difference series has a drift. Then, τ_t should be used to test the null hypothesis. If the null is rejected then the test should be stopped. If not, the significance of the trend under the null should be tested. If it is significant, one have to test the unit root hypothesis using the standardised normal[5]. If the trend is not significant, then the test should start with equation (4) but with $= 0$, and the same procedure should be repeated.

A second response to the problem of autocorrelation and or conditional heteroskedasticity is given by Phillips (1987) and Phillips and Perron (1988). Instead of including lagged changes in y, they use a non-parametric approach to correct the test statistics defined by Dickey and Fuller to allow for weak dependence and heterogeneity on ε_t.

Finally, if more than a single unit root is suspected, say 2, it is convenient to rewrite equation (4) as

(7) $$y_t = \quad + \quad t + \quad y_{t-1} + \quad \Delta y_{t-1} + \sum_{j=1}^{m-2} \quad {}_j \Delta^2 y_{t-j} + \quad {}_t .$$

Dickey and Pantula (1987) suggest a sequential procedure for testing the null hypothesis of (possible) multiple unit roots. Starting with the largest number of roots under consideration, the null of k unit roots against the alternative of (k-1) unit roots is tested first. If the null is rejected, then the null of (k-1) against the alternative (k-2) is tested and so forth.

3.2. Application to our data

We use quarterly data covering the period of the 1st quarter 1975 to the 4th quarter 1993, except for France, where the data are only available since 1979. The main data sources are IMF and OECD databases. Appendix A describes the data series and their samples. Some of the variables were seasonally adjusted at the source and are available only under these forms. The remaining variables have been adjusted adding seasonal dummies to the models described in the previous section. We have performed Dickey-Fuller unit root tests for the three models described in the previous section. The number of lags was chosen using the k max criteria and starting from 8. The selected lag was chosen, based on two criteria: (i) that the coefficient of the last lag is significant at the 5% level and (ii) that no auto-correlation remains in the estimated equation.

5 A possible drawback is that this result is an asymptotic one. For a discussion on this point see Hylleberg and Mizon (1989).

Beside the unit root tests, we have also looked at the value of ρ implied by the regressions. In finite samples, if the value is close to one it may be preferable to assimilate a near I(1) process to a I(1) process as their asymptotic behaviour is more adequately described by that of a unit root process, rather than by that of a stationary trend process[6]. Thus, in some cases even if the unit root was rejected, if ρ was greater than 0.97 we have taken the series in differences. Results are summarised in Table 1.

4. Granger causality tests between financial variables and real variables in the G5 countries

4.1. Methodology

The links between different financial variables and the real variables will be measured through Granger causality tests. The objective is to test whether a financial variable contains information on a real variable which is not already contained in the own history of the real variable, or in prices. The inclusion of prices in the test can be seen as a way to deflate the financial variables, which are nominal, from price variations. This method allows the information contained in the financial variables to be considered as specific and not due to the information that these variables carry on prices.

Each real variable *y* has been regressed on its own lags, the lags of prices, *p,* and the lags of one financial variable, . This financial variable is successively a monetary or credit aggregate, an interest rate or a spread. We then get the general equation:

(8) $$\Delta y_t = \sum_{i=1}^{q_1} {}_i\Delta y_{t-i} + \sum_{i=1}^{q_2} {}_i\Delta p_{t-i} + \sum_{i=1}^{q_3} {}_i\Delta \; {}_{t-i} + {}_0 + {}_1 t + {}_t$$

Granger causality tests are Fisher tests of the significance of the estimated coefficients of the lags of the financial variable φ. However, predictive power seems to be more accurate than causality in interpreting this significance. Stationary variables are used in the regressions in order to avoid any "spurious regression"[7]. Using Wold decomposition we can rewrite equation (8) as

(9) $$\Delta y_t = \sum_{i=1}^{q_1} {}_i\Delta y_{t-i} + \sum_{i=1}^{q_2} {}_i\Delta p_{t-i} + (1)\Delta \; {}_{t-1} - \sum_{i=1}^{q_3-1} {}_i^{*}\Delta^2 \; {}_{t-i} + {}_0 + {}_1 t + {}_t$$

6 For a discussion of this point see Campbell and Perron (1991), specially rules 7 and 9.

7 Cointegration relations should be tested in a second stage in order to assess on the opportunity of including correcting error terms in regressions. In case there are cointegration relations between the variables, running the estimations with differentiated series might make the financial variables appear less significant than they really are.

with $(1) = \sum_{\mathrm{i=1}}^{\mathrm{q_3}} {}_{\mathrm{i}}$ **et** ${}^{*}_{j} = \sum_{\mathrm{i=j+1}}^{\mathrm{q_3}} {}_{\mathrm{i}}$

This form allows us to test easily, through a simple t-statistic on γ(1), the significance of the sum of the estimated coefficients of the financial variable φ. Following Stock and Watson (1989b), we consider that the financial variable will be neutral if this sum is not statistically different from zero. The influence of financial variables on future inflation is also tested using the following equation:

(9i)

$$\Delta p_t = \sum_{i=1}^{q_1} {}_i\Delta p_{t-i} + \sum_{i=1}^{q_2} {}_i\Delta GDP_{t-i} + (1)\Delta {}_{t-1} - \sum_{i=1}^{q_3-1} {}^{*}_{i}\Delta^2 {}_{t-i} + {}_0 + {}_1 t + {}_t$$

where $(1) = \sum_{\mathrm{i=1}}^{\mathrm{q_3}} {}_i$ **et** ${}^{*}_{j} = \sum_{\mathrm{i=j+1}}^{\mathrm{q_3}} {}_i$.

We carried out estimations with quarterly data on the period 1979:Q3-1993:Q4 in France and on the period 1976:Q3-1993:Q4 in the other countries. We used two methods to fix the number of lags. First, we exogenously fix the number of lags equal to 4 ($q_1=q_2=q_3=4$). Second, we adopted the Akaïke criteria to choose the optimal number of lags of each of the 3 variables involved in regressions, with a maximum of 8 lags. A linear trend was included in regressions when it was significant at the 10 % level in the unrestricted equation (9) or (9i). Seasonal dummies were systematically added.

4.2. The results

The tests presented in Tables 2 are the Fisher p-values for the null hypothesis that all the coefficients associated with the lags of the financial variable are null. The sign of the sum of the coefficients of the financial variables is also provided in Tables 2, when its t-statistic is greater than 1 in absolute value.

To interpret the results correctly, it must be kept in mind that Granger causality tests do not necessarily reveal a "true" causality in the sense of cause and effect. Herein, causality from financial variables to real ones means that the financial variables contain information about real variables that is not contained in the lags of the latter. In what follows, each time we will refer to Granger causality we will refer to this "information" sense. In the following paragraphs, we present successively the performance of each category of financial variables as Granger-causing real variables and inflation.

4.2.1. Monetary and credit aggregates

The first striking result is the very poor performance of aggregates in the US and their quite poor performance in the UK and in Germany. This result is not new in the US. Among others, Friedman and Kuttner (1992) showed that on comparative period (i.e.

covering the 70's and the 90's) monetary aggregates carry no more information on real GDP. In contrast, monetary aggregates are very significant in predicting real variables in Japan and in France. Credit is also quite significant in these two latter countries. Yet, overall, it is only in France that the aggregates Granger-cause real variables and total effect are always positive. Japan's total effect of M1 on industrial production or consumption of durables is surprisingly negative. The reason why the aggregates are better predictors of real activity in France and in Japan is not straightforward.

4.2.2. Interest rates

A first category of interest rates are those related to monetary policy. At least one of the day to day rates and the discount rate carries information on real variables and on prices. The fact that these rates can be better predictors than monetary aggregates (for instance in the US), and considering that monetary authorities control these rates more easily than aggregates, confirms the thesis that there is an influence of monetary policy on the business cycle. Besides, in the US and in Japan, when these rates are significant (Granger-cause real variables and/or prices), monetary policy interest rates affect negatively real variables and positively prices. A positive influence of interest rates on prices was already shown in Sims (1992), Dale and Haldane (1993) and Barran, Coudert and Mojon (1994). One possible explanation may be that monetary authorities increase interest rates when they expect inflation to rise, so inflation increases afterwards but to a lesser extent than if no policy action has been implemend. Another explanation could be that firms increase their mark-up before recessions because of the restrictive monetary policy and to compensate for a probable shortage of cash flows (Chatelain, 1994).

The other categories of interest rates (mainly public bonds yield and different banking rates) are globally good predictors of real variables and prices. In the UK, Japan and the US similar results to those obtained for monetary policy interest rates are found. The effects of interest rates on real variables are negative or not significant, as in France. The interest rates have a positive effect on prices whenever the total effect is statistically different from zero. Yet it is not the same rate that influences inflation positively in the three countries, and therefore it is difficult to find a common explanation for this phenomenon.

4.2.3. Spreads of market interest rates

Yield curve spreads are good predictors of real variables and of prices, except in Japan. This result confirms the findings of numerous studies including Estrella and Hardouvelis (1992) for the US, Davis and Henry (1994) for the UK and Germany, and Dubois and Janci (1994) for France. The performance of yield curve spreads is most striking in Germany and the UK where they do contain information on all the real variables and prices. Overall, most significant effects of the spread on real variables are positive (i.e. an increase in the spread announces higher growth).

The reduced availability of the data allowed us to construct only two quality spreads from market interest rates. First, we have the difference between private and public bond yields in France. This spread carries information on GDP, industrial production, employment and prices. Yet the positive effect of the quality spread on real variables is counter-intuitive, as the risk premium that this spread is supposed to reflect should rise before recession. The fact that the spread does rise before an expansion might be explained by rising issues of bonds by private corporations which consider they can increase their leverage.

The spread between US commercial paper and Treasury bill has been already studied in the American literature on monetary policy, (Friedman and Kuttner (1992) among others). In our results, in contrast to Friedman and Kuttner, the spread contains information only on private consumption and not on the other real variables. This might be due to the fact that we do not use the same period of estimation. In a recent study, Konishi, Granger and Ramey (1994) do have shown that the performance of this spread as a leading indicator on economic activity depends on including the year 1974 in the sample. An other explanation for the weak performance of this spread in our results may be that we use it in first difference, since our preliminary tests have found it I(1).

4.2.4. Spreads including banking interest rates

Intermediation margin spreads are significant in the estimation of real variables in the five countries, especially in the UK. In Japan, the four intermediation spreads are significant for explaining future employment, private consumption and consumption of durable goods, but they contain no information on GDP and investment. In the UK, this category of banking spreads carries more systematically information on all the real variables tested. Yet, it is in Japan that the sign of total effect of these spreads on the real variables is the most clear. An increase in the spreads leads to an increase of private consumption and durable goods expenditure. The underlying mechanism may be the following. For any exogenous rise in the spread, intermediation is rewarded better, which is an incentive for banks to provide more credit. Then households, whose consumption is constrained by their access to liquidity, increase their expenses as credit becomes available.

Quality banking spreads are available only in the UK, in the US and in Japan. The spread contains information on real variables and prices, and the sign of the total effect is negative in the UK and the US. Hence this spread can probably be considered as a risk premium on default of borowers, which rises when a recession is expected.

Yield curve banking spreads are also available only in the UK, in the US and in Japan. They carry information on both real variables and prices. Furthermore, they have a positive effect on real variables. In fact, the sign of the total effect is always positive when significant. This result confirms what we have found with yield curve spreads constructed with market rates. Then the banking rates can be considered following market rates over the same term. Consequently, the predictive power of the yield curve between banking rates can be explained in the same way as that of the market yield curve. Nevertheless, it is also possible that the predictive power of the yield curve comes from its influence on banking rates. An increase in the yield curve is an incentive for banks to supply more long term credits, which can boost the economy if long term credits become available to credit rationed agents.

Lastly, the *Bernanke-Blinder spread* appears to be a good predictor of real and price variables in Japan, in Germany and in the UK. In the US, this spread is predictive only for one real variable out of six, namely the durable goods consumption. In Japan, the sign of the total effect of this spread on real variables is positive, while it is negative in Germany, in the UK and in the US. So it is in three countries out of four that the spread behaves as predicted in the Bernanke and Blinder (1988) model. It may be said that, over the period of estimation, a change in the assessment of credit quality by banks influences economic activity.

5. Orthogonality of the information contained in the spreads

Spreads can be interesting leading indicators if they contain information not already contained in the interest rates which they are made up of. The predictive power of spreads might only lie with the relatively more flexible rate, especially in the case where a spread is made up of a stable rate and a flexible rate. For this reason, we tested the predictive power of spreads on real variables while controlling for the information of each rate that makes up the spread. The Granger causality tests were done with the following equation:

(10)

$$\Delta y_t = \sum_{i=1}^{4} \;{}_i\Delta y_{t-i} + \sum_{i=1}^{4} \;{}_i\Delta p_{t-i} + \sum_{i=1}^{4} \;{}_i(spread)_{t-i} + \sum_{i=1}^{4} \;{}_i(rate)_{t-i} + \;{}_0 + \;{}_1 t + \;{}_t$$

In order to avoid any asymmetry between the spread and the rates that are included together in the regressions, the lags of all variables where exogenously fixed at four. As in the preceding test, GDP is included in the regression when the price index is the dependant variable. We test for the nullity of the coefficients ω, related to the lags of the spread, and for the nullity of the coefficient γ, related to the lags of the interest rates. We carried out the tests on some of the most significant spreads in Granger causality tests described in section 4.

The results are gathered in table 3. Most of the spreads contain information that is either orthogonal or superior to the that contained in the interest rates that they are made up of. YC2 in the US and in Germany, BTR2 in the US, Germany and in the UK, and BQ1 in the UK, are especially orthogonal to the two rates that they are made up of. In contrast, some spreads add information only to one of the rates that compose them. This is the case of the Japanese spreads tested: BQ2 and BTR1. The spreads in France never contain information on real variables orthogonal to any of the two rates that make them up[8].

6. The Case of France

8 An other reason for this lack of information can be that the number of lags, exogenously fixed at 4, is far for the optimal lags chosen using Akaike criteria.

In a previous study, Barran, Coudert and Mojon [1994] have already performed tests of this kind on a longer period, from 1960 to 1990. Results showed that financial variables and especially spreads of interest rates are good predictors of real activity in the United States, Japan and Germany, but not in France nor in the United Kingdom. For France, this result was contradictory with other studies such Dubois and Janci (1994) who found that the yield curve spread was significant on future activity. In fact results highly depend on the sample period. The shorter period that we have used here has greatly modified our formers results.

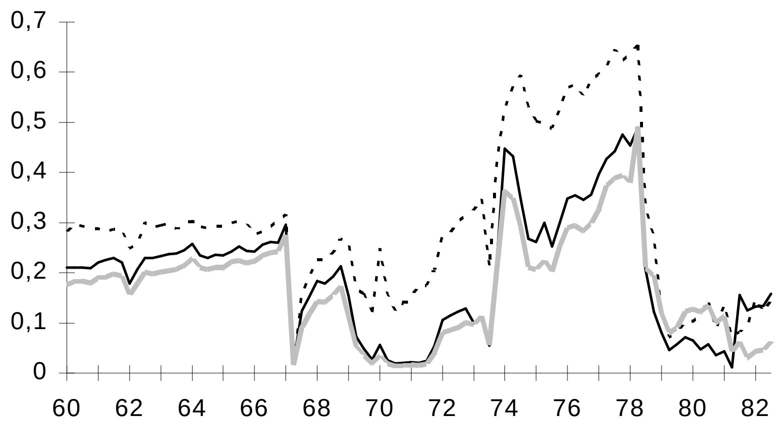
In the United States and Germany, the financial systems were already deregulated in the sixties, at least for the financial markets, so results have not changed drastically for these countries. The case of France is quite different, since the financial structures were greatly modified during the period. The French financial system shifted from being a highly regulated structure to a deregulated one with a greater role for market finance. Monetary policy, which was previously mainly implemented through quantitative instruments, such as credit ceilings, required reserves ratios, has shifted towards open market interventions and now relies mainly on the transmission mechanism through deregulated interest rates. Under these conditions, it is not surprising that relations between interest rates and economic activity have changed. The French economy now responds more to interest rates and spreads than previously.

We have compared the results of causality tests of financial variables on GDP for several periods. We have used only GDP as dependant variable for simplification. When estimation period begins in 1961, no financial variable has a significant power in explaining future GDP. When the sample is reduced so as to begin in 1965, a bank spread (BM1) becomes significant at the 10% level. Starting in 1972, interest rates on public and private bonds also become significant. When sample period starts in 1975, interest rates on bonds are found to remain significant but the level of confidence in the significance of spreads is reduced. Finally, when the sample period starts in 1978, bonds interest rates, spreads BM1 and YC1 become significant.

In the bivariate estimations where prices are excluded of equation (9), financial variables are always more significant. Most interest rates - the call rate, the bank prime rate, the rate on private bonds - and the spread between the prime rate and the call rate are significant from 1972 onwards. Nevertheless, a drawback of this method is to attribute to the financial variables a part of the explanation of future GDP, which in fact is contained in prices.

We have performed a more detailed analysis for the yield curve spread (the interest rate on public bonds less the call rate). In estimating equation (9), the starting quarter was removed continuously from the sample period. The resulting p-values are reported in Figure 1. The significance level ("p-value") of the yield curve is represented for every sample period beginning in each quarter, from 1961-Q2 to 1983-Q2 and ending in 1991-Q4.

Figure 1: P-Values of the yield curve spread in equation (9) according to the starting date of the sample



Regression (9) is estimated with: y as GDP, ϕ as the yield curve for France, with four lags.
Three cases are shown: the doted line stands for when the estimation includes the first differences of prices, the thin full line stands for when the estimation includes the second differences of prices, and the thick full line stands for an estimation without prices

The results depend drastically of the sample period. The spread is not significant for explaining future GDP if the sample period starts before 1968. It subsequently becomes significant at the 10% level, but only for some sample periods. Starting in 1975 or in 1981 greatly lowers the significance level of this spread to the 30% level.

If inflation is excluded from equation (9), the yield curve spread is significant at the 10% level for nearly the whole period. The significance level reaches 5% when starting in the seventies. These results can also be found if prices are considered as I(2)[9]. In this case, prices are no more significant but, the yield curve spread becomes highly significant whatever the starting date of the sample is.

9Unit root tests were not very conclusive discriminating between one or two unit roots.

CONCLUSION

The tests presented in this paper show that spreads and interest rates can be used as leading indicators of real activity in the five countries under consideration. This is particularly the case of bank spreads and interest rates that are introduced for the first time in Granger causality tests of real variables. Moreover, the weak information of monetary aggregates on real variables that we find in Germany and the US strengthens the opportunity of having alternative financial leading indicators of activity. Using spreads and interest rates to evaluate the stance of monetary policy might be of interest to a central bank, in order to achieve its final objective.

Furthermore, the predictive power of bank spreads allows assumptions to be made concerning on the channels between finance and real activity. The negative relationship between the spread formed with the bank credit rate and the public bond rate, and real activity shows the crucial character of the perception of default risks by banks. Moreover, the link between activity and bank margins, either those that are a proxy for the remuneration of intermediation or those that are a proxy for the differential of yield between different kinds of credit, show the influence of bank credit on the business cycle.

Table 1 : Order of integration of the series

Variables	US	Japan	Germ any	France	UK
GDP or GNP	1	1	1	1	1
investment	1	1	1	1	1
industrial production	0	1	1	1	1
employment	0	1	1	1	1
private consumption	1	1	1	1	1
consumption of durable goods	1	1c	N.A.	1	0
prices (CPI)	2	1a	2	1a	1
credit	2	2	1	1	1
M1	2	0	1	1	1
M2	1	1b	1	1	1
interest rates					
discount (txes)	1	0	1	N.A.	N.A.
day to day (txjj)	1	0	1	1	1
Treasury bills (txbt)	1	N.A.	1	N.A.	1
commercial paper (txcp)	1	N.A.	N.A.	N.A.	N.A.
public bonds (txob)	1	0	1	1	1
private bonds (txobpr)	N.A.	N.A.	N.A.	1	N.A.
prime banking (txbb or txbbct inJapan)	1	0	N.A.	1	0
long term prime (txbblt in Japan)	N.A.	0	N.A.	N.A.	N.A.
short term credit (txcrct or txcrct 1)	1	0	1	N.A.	0
discount credit (txcrct 2 in Germany)	N.A.	N.A.	1	N.A.	N.A.
long term credit (txcrlt)	1	0	N.A.	N.A.	N.A.
mortgage credit (txcrh)	1	N.A.	1	N.A.	0
spreads between:					
txob and txjj (YC1)	N.A.	0	N.A.	0	N.A.
txob and txbt (YC2)	1	N.A.	0	N.A.	1
txbt and txjj (YC3)	1	N.A.	0	N.A.	1
txobpr and txob (MQ1)	N.A.	N.A.	N.A.	0	N.A.
txcp and txbt (MQ2)	1	N.A.	N.A.	N.A.	N.A.
txbb and txjj (BM1)	1	0	1	0	1
txcrct 2 and txjj (BM2)	N.A.	0	0	N.A.	N.A.
txcrlt and txjj (BM3)	1	0	N.A.	N.A.	N.A.
txcrh and txjj (BM4)	1	N.A.	0	N.A.	0
txcrct and txbb (BQ1)	0	0	N.A.	N.A.	0
txcrlt and txbblt (BQ2)	N.A.	0	N.A.	N.A.	N.A.
txcrlt and txbb (BTR1)	0	0	N.A.	N.A.	N.A.
txcrh and txbb (BTR2)	0	0	N.A.	N.A.	0
txcrlt or txcrh and txob (BerBlin)	1	0	1	N.A.	1

N.A. non available
a Coefficient greater than 0,97, we have taken the variable in difference.
b using normal distributions, otherwise, the variable is I(2)
c I(1) at 11%

Table 3 : Orthogonality of the information contained in the spreads

USA		GDP	IP	INV	EMP	CONS	DURA	CPI
txbt	(1)	0.00	0.00	0.00	0.00	0.00	0.00	0.39
YC2	(2)	0.00	0.00	0.02	0.00	0.01	0.00	0.56
txob	(1)	0.00	0.00	0.00	0.00	0.00	0.00	0.36
YC2	(2)	0.00	0.00	0.00	0.00	0.00	0.00	0.09
txbb	(1)	0.85	0.70	0.01	0.30	0.17	0.26	0.01
BTR2	(2)	0.26	0.22	0.01	0.03	0.01	0.01	0.00
txcrh	(1)	0.82	0.63	0.02	0.25	0.22	0.24	0.01
BTR2	(2)	0.21	0.23	0.02	0.07	0.06	0.07	0.30
Japan								
txbblt	(1)	0.08	0.12	0.02	0.04	1	0.21	0.13
BQ2	(2)	0.09	0.17	0.04	0.03	0.55	0.13	0.09
txcrlt	(1)	0.21	0.13	0.02	0.04	1	0.22	0.12
BQ2	(2)	0.13	0.13	0.60	0.03	0.99	0.39	0.02
txbbct	(1)	0.68	0.19	0.44	0.41	0.08	0.66	0.06
BTR1	(2)	0.47	0.18	0.60	0.80	0.87	0.61	0.40
txcrlt	(1)	0.64	0.20	0.46	0.43	0.04	0.66	0.07
BTR1	(2)	0.61	0.08	0.27	0.84	0.11	0.09	0.06
Germany								
txbt	(1)	0.22	0.54	0.67	0.97	0.53		0.03
YC2	(2)	0.01	0.05	0.23	0.04	0.31		0.06
txob	(1)	0.21	0.50	0.81	0.98	0.65		0.21
YC2	(2)	0.01	0.01	0.05	0.01	0.39		0.20
txjj	(1)	0.10	0.62	0.27	0.79	0.85		0.61
BM4	(2)	0.02	0.13	0.40	0.15	0.40		0.99
txcrlt	(1)	0.14	0.59	0.26	0.73	0.80		0.61
BM4	(2)	0.01	0.07	0.19	0.07	0.25		0.99
France								
txjj	(1)	1	1	0.83	0.87	0.56	1	0.01
YC1	(2)	0.70	0.92	0.34	0.53	0.24	0.36	0.02
txob	(1)	1	1	0.60	0.84	0.47	0.80	0.01
YC1	(2)	0.58	0.92	0.34	0.35	0.26	0.27	0.10
txjj	(1)	1	1	0.81	0.52	1	1	0.22
BM1	(2)	0.82	0.50	0.28	0.56	0.50	0.47	0.19
txbb	(1)	1	1	0.82	0.21	1	0.99	0.01
BM1	(2)	0.65	0.96	0.35	0.29	0.63	0.34	0.41
UK								
txbt	(1)	0.13	0.17	0.01	0.10	0.71	1	0.05
YC2	(2)	0.22	0.14	0.07	0.10	0.77	0.85	0.11
txob	(1)	0.28	0.17	0.07	0.08	0.79	1	0.26
YC2	(2)	0.21	0.36	0.59	0.05	0.04	0.05	0.06
txbb	(1)	1	1	0.13	0.17	0.34	0.95	0.25
BQ1	(2)	0.04	0.11	0.01	0.28	0.01	0.14	0.05
txcrct	(1)	1	1	0.10	0.06	0.36	0.99	0.27
BQ1	(2)	0.15	0.13	0.14	0.64	0.00	0.10	0.25
txbb	(1)	0.28	0.31	1.00	0.55	0.01	0.16	0.44
BTR2	(2)	0.00	0.17	0.06	0.31	0.00	0.01	0.02
txcrh	(1)	0.20	0.47	0.69	0.82	0.06	0.04	0.13
BTR2	(2)	0.01	0.21	0.06	0.38	0.02	0.02	0.02

(1) Probability of the null hypothesis, $\gamma_i = 0$ in equation (10), i.e. that the interest rate considered in the row contains no information on the real or CPI variable in column.
(2) Probability of the null hypothesis, $\omega_i = 0$ in equation (10), i.e. that the spread considered in the row contains no information on the real or CPI variable in column.

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APPENDIX A: DATA SOURCES AND AVAILABILITY

Data are extracted form the from « International Financial Statistics » (IFS) of the « International Monetary Fund », « Quarterly National Account » (QNA) of the OECD and « Interest Rates on Domestic Markets » (IRDM) of the OECD

	AVAILABILITY
Price index	
France CPI. IFS 13264...	75.01 93.04
Germany CPI. IFS 13464...	75.01 93.04
Japan CPI IFS 15864...	75.01 93.04
U.K. CPI IFS 11264...	75.01 93.04
U.S.A. CPI IFS 11164...	75.01 93.04
Agregate product (GDP or GNP)	
France real GDP (1990 prices). IFS 13299b.r	75.01 93.04
Germany real GNP (1990 prices) IFS 13499a.r	75.01 93.04
Japan real GNP (1990 prices) IFS 15899a.r	75.01 93.04
U.K. real GDP (1990 prices) IFS 11299b.r	75.01 93.02
U.S. real GDP (1990 prices) IFS 11199b.r	75.01 93.04
Industrial production (S.A.)	
France Industrial production IFS 13266..c	75.01 93.04
Germany Industrial production IFS 13466..c	75.01 93.04
Japan Industrial production IFS 15866..c	75.01 93.04
U.K. Industrial production IFS 11266..c	75.01 93.02
U.S. Industrial production IFS 11166..c	75.01 93.04
Gross fixed capital formation of other sectors than the general government at constant prices (1985 prices)	
France QNA GFOV	75.01 93.03
Germany QNA GFOV	75.01 93.03
Japan QNA GFOV	75.01 93.03
U.K. QNA GFOV	75.01 93.03
U.S.QNA GFOV	75.01 93.03
Employment	
France Employment, S.A. IFS 13267..c	80.01 93.04
Germany Industrial employment IFS 13467...	75.01 93.04
Japan Manufacturing sector employment, S.A. IFS 15867eyc	75.01 93.04
U.K. Employment IFS 11267..C	75.01 93.03
U.S. Non Agricultural employment, S.A. IFS 11167..c	75.01 93.04

Private final consumption at constant prices (1985 prices)	
France QNA PCV	**75.01 93.03**
Germany QNA PCV	**75.01 93.03**
Japan QNA PCV	**75.01 92.01**
U.K. QNA PCV	**75.01 93.03**
U.S. QNA PCV	**75.01 93.04**
Private final expenditure of durable goods at constant prices (1985 prices)	
France QNA PCDGV	**75.01 92.04**
Germany Non available	**75.01 93.04**
Japan QNA PCDGV	**75.01 93.04**
U.K. QNA PCDGV	**75.01 93.04**
U.S. QNA PCDGV	**75.01 93.04**
Credit	
France Claims on the private sector IFS 13232d..	**78.01 93.04**
Germany Claims on the private sector IFS 13432d..[10]	**75.01 93.04**
Japan Claims on the private sector IFS 15832d..	**75.01 93.04**
U.K.Claims on the private sector IFS 11232d..	**75.01 93.04**
U.S.Claims on the private sector IFS 11132d..	**75.01 93.04**
M1	
France M1, S.A., national definition IFS 13234..c	**77.04 93.04**
Germany M1, S.A., national definition IFS 13434n.c[11]	**75.01 93.04**
Japan Money IFS 15834...	**75.01 93.04**
U.K. Money IFS 11234...[12]	**75.01 93.04**
U.S. M1, S.A., IFS 11134..b	**75.01 93.04**
M2	
France M2, S.A., national definition IFS13438nbc	**77.04 93.04**
Germany M2, S.A., national definition IFS13438nac[13]	**75.01 93.04**
Japan M1 (defined above) + quasi money IFS 15835...	**75.01 93.04**
U.K. M1 (defined above) + quasi money IFS 11235...[14]	**75.01 93.04**
U.S.M2, S.A., national definition IFS11159mbc	**75.01 93.04**
Discount rate	
France Discount rate IFS 13260...	***75.01 93.04***
Germany Discount rate IFS 13460...	**75.01 93.04**
Japan Discount rate IFS 15860...	**75.01 93.04**
U.K. Bank rate IFS 11260...,	***75.01 81.02***
U.S. Discount rate IFS 11160...	**75.01 93.04**

10Break due to reunification in 90.02.
11Break due to reunification in 91.01.
12Change in the definition of the series from 87.01.
13Break due to reunification in 91.01.
14Change in the definition of the series from 87.01.

Money market rate	
France Average call money rate IFS 13260b..	75.01 93.04
Germany Call money rate IFS 13460b..	75.01 93.04
Japan Call money rate IFS 15860b..	75.01 93.04
U.K. Overnight interbank minimum rate IFS 11260b..	75.01 93.04
U.S.Federal funds rate IFS 11260b..	75.01 93.04
Public bond rate	
France Government bond yield, monthly average, IFS 13461...	75.01 93.04
Germany Government bond yield IFS 13261...	75.01 93.04
Japan Government bond yield IFS 15861...	75.01 93.04
U.K. Government bond yield, long term, IFS 11261...	75.01 93.04
U.S. Government bond yield, 10 years, IFS 11161...	75.01 93.04
Other market rates	
France Private sector bond rate IRDM	75.01 93.04
Germany Treasury bill rate IFS 13460c..	75.03 93.04
U.K. Treasury bill rate IFS 13460c..	75.01 93.04
U.S. Treasury bill rate (6 month) IRDM	75.01 93.04
U.S. Commercial paper rate (6 month) IRDM	75.01 93.04
Prime rate	
France Banks' prime lending rate IRDM...	75.01 93.04
Japan Short term prime rate.IRDM	75.01 93.04
Japan Long term prime rate.IRDM	75.01 93.04
U.K. Minimum base rate of London clearing banks IFS 11260p..	75.01 93.04
U.S.Prime banking rate IFS 11160p..	75.01 93.04
Other banking rates	
France Basic lending rate of the main banks IFS 13260p..	75.01 90.02
France Equipment loan by the Crédit National IRDM	75.01 93.04
Germany Credit in current account rate IRDM	75.01 93.04
Germany Discount credit rate IRDM	75.01 93.04
Germany Mortages variable rate IRDM	75.01 93.04
Japan Average regulated contractual rate (short term) IRDM[15]	75.01 93.04
Japan Average non-regulated contractual rate (long term) IRDM[16]	75.01 93.04
Japan Lending rate, average on different maturities IFS 15860p..	75.01 93.04
U.K. Overdraft minimum rate IRDM	75.01 93.04
U.K. Building societies mortgage loans nominal rate IRDM	75.01 93.04
U.K. Building societies mortgage loans actuarial rate IRDM	75.01 93.04
U.S. Short term bank loans to business rate IRDM	75.01 93.04
U.S. Long term bank loans to business rate IRDM	75.01 93.04
U.S. Mortgages rate IRDM	75.01 93.04

15Interpolated in 91.01.
16Interpolated in 91.01.

APPENDIX B: RESULTS OF THE DOLADO AND ALII PROCEDURE FOR UNIT ROOTS TESTS

For each country, rows are successively the serie and its first difference and column have the following meaning with the notations defined in section 3.1. of the text: Column (1) shows the Dickey-Fuller statistic, $_{t}$, when the estimated model allows for the presence of a trend and a constant ($\beta \neq 0$ and $\mu \neq 0$). The column (2) corresponds to the model without trend ($\beta = 0$ and $\mu \neq 0$), d.e. the statistic presented is . Columns 3 corresponds to the model with $\beta = \mu = 0$. The stars signal the significance of the statisitc, either at the 10% significance level for one star or at the 5% significance level for two stars. Significance means that the estimated autoregressive parameter can be considered different from one, so that the serie or its first difference is not integrated. For each model, the number of lags was selected with the Campbell and Perron procedure.

US variables							variables						
	(1)		(2)		(3)			(1)		(2)		(3)	
P	-2.13		-1.90		0.78		txbb	-2.68		-2.32		-0.38	
dP	-1.92		-1.37		-1.03		dtxbb	-3.53	**	-3.46	**	-3.47	**
Y	-2.58		-0.96		3.49		txcrct	-1.96		-1.03		-0.48	
dY	-5.67	**	-5.73	**	-4.53	**	dtxcrct	-5.78	**	-5.37	**	-5.41	**
IP	-3.61	**	-2.11		2.14		txcrlt	-1.78		-0.99		-0.36	
dIP	-4.71	**	-4.77	**	-4.44	**	dtxcrlt	-6.32	**	-6.14	**	-6.15	**
Inv	-3.00		-2.02		1.74		txcrh	nd		nd		nd	
dInv	-4.84	**	-4.89	**	-2.08	**	dtxcrh	nd		nd		nd	
E	-3.57	**	-2.29		2.32		YC2	-1.13		-0.94		-1.08	
dE	-2.77		-2.86	*	-2.40	**	dYC2	-8.56	**	-8.39	**	-8.44	**
C	-2.08		-2.47		0.78		YC3	-2.86		-2.37		-1.07	
dC	-3.15		-1.90		-0.96		dYC3	-5.81	**	-5.92	**	-5.93	**
M1	-2.65		0.47		2.55		MQ2	-3.03		-2.52		-0.74	
dM1	-2.60		-2.57		-0.64		dMQ2	-6.42	**	-6.45	**	-6.45	**
M2	2.16		-4.43	a/	0.35		BM1	-2.44		-1.76		0.04	
dM2	-6.68	**	-1.02		-1.73	*	dBM1	-10.05	**	-9.94	**	-10.02	**
CO	-2.48		-0.58		2.52		BM2	-2.73		-3.06	**	-1.04	
dCO	-3.05		-3.12	**	-1.74	*	dBM2	-9.79	**	-9.89	**	-9.98	**
DG	-3.01		-0.14		2.11		BM3	-1.60		-1.52		-0.63	
dDG	-9.68	**	-9.68	**	-4.92	**	dBM3	-6.49	**	-6.54	**	-6.55	**
txes	-2.48		-1.77		-0.64		BM4	-2.21		-1.69		-0.95	
dtxes	-2.08		-1.73		-1.79	*	dBM4	-4.70	**	-4.70	**	-4.68	**
txjj	-2.52		-1.95		-0.66		BQ1	-5.30	**	-2.24		-2.29	**
dtxjj	-4.42	**	-2.86	*	-2.92	**	dBQ1	-8.97	**	-8.81	**	-8.83	**
txbt	-1.11		-1.04		-0.52		BTR1	-5.06	**	-4.98	**	-2.73	**
dtxbt	-5.37	**	-5.15	**	-5.18	**	dBTR1	-7.48	**	-7.48	**	-7.40	**
txob	-1.45		-1.10		-0.55		BTR2	-2.53		-2.33		-2.79	**
dtxob	-5.28	**	-4.92	**	-4.93	**	dBTR2	-2.11		-1.98		-1.98	**
txcp	-1.93		-1.44		-0.50		BB	-2.55		-2.07		-1.11	
dtxcp	-5.76	**	-5.52	**	-5.55	**	dBB	-6.91	**	-6.99	**	-7.00	**

Japan							Germany						
variables	(1)		(2)		(3)		variables	(1)		(2)		(3)	
P	-3.10		-4.04	a/	1.35		P	-2.37		-0.51		1.36	
dP	-2.70		-2.18		-2.51	**	dP	-1.65		-1.77		-1.12	
Y	-1.41		-1.97		0.99		Y	-2.61		-1.05		1.30	
dY	-4.80	**	-1.86		-1.26		dY	-2.49		-2.45		-2.17	**
IP	-0.77		-1.54		0.29		IP	-2.61		-1.05		1.28	
dIP	-2.06		-1.55		-1.78	*	dIP	-8.05	**	-8.08	**	-7.93	**
Inv	-2.30		-0.54		1.67		Inv	-2.43		-1.23		1.12	
dInv	-2.34		-2.52		-2.74	**	dInv	-3.16		-3.17	**	-2.40	**
E	-2.67		-1.04		0.94		E	-2.97		-2.14		-1.21	
dE	-2.37		-2.25		-1.94	*	dE	-1.92		-2.01		-3.05	**
C	-2.73		-1.46		0.09		C	-2.33		-1.42		2.62	
dC	-0.80		-0.42		-1.12		dC	-3.83	**	-3.85	**	-0.69	
M1	-3.69	**	-0.87		3.61		M1	-1.01		1.06		7.07	
dM1	-3.93	**	-3.97	**	-1.06		dM1	-6.23	**	-6.27	**	-0.69	
M2	-0.98		-1.90		0.64		M2	-1.24		-0.86		9.15	
dM2	-2.75		-2.05		-1.27		dM2	-7.61	**	-8.05	**	-1.14	
CO	-2.86		-0.08		2.43		CO	-2.53		-0.67		1.47	
dCO	-3.66	**	-3.70	**	-0.84		dCO	-2.33		-2.35		-1.90	*
DG	-1.94		-0.30		2.30		DG	nd		nd		nd	
dDG	-2.42		-2.48		-1.58	*	dDG	nd		nd		nd	
txes	-4.05	**	-2.57		-1.16		txes	-2.40		-2.60		-0.46	
dtxes	-2.75		-2.78	*	-2.87	**	dtxes	-4.10	**	-4.08	**	-4.22	**
txjj	-4.68	**	-3.37	**	-1.08		txjj	-2.15		-2.57		-0.56	
dtxjj	-2.50		-2.46		-2.50	**	dtxjj	-4.63	**	-4.63	**	-4.63	**
txob	-3.46	*	-1.78		-1.26		txbt	-2.16		-2.32		-0.60	
dtxob	-2.29		-2.28		-2.33	**	dtxbt	-4.25	**	-4.15	**	-4.11	**
txbbct	-4.52	**	-4.17	**	-1.01		txob	-2.27		-2.24		-0.76	
dtxbbct	-2.67		-2.65	*	-2.69	**	dtxob	-6.50	**	-6.20	**	-6.24	**
txcrct	-3.28	*	-2.63	*	-0.91		txcrct	-2.17		-2.51		-0.12	
dtxcrct	-2.08		-2.16		-2.23	**	dtxcrct	-2.75		-2.86	*	-2.85	**
txbblt	-4.11	**	-0.38		-1.67	*	txcrct	-2.26		-2.60		-0.42	
dtxbblt	-6.39	**	-6.28	**	-6.16	**	dtxcrct	-3.44	*	-3.49	**	-3.50	**
txcrlt	-3.52	**	-0.60		-1.30		txcrh	-2.81		-2.31		-0.49	
dtxcrlt	-2.47		-2.42		-2.33	**	dtxcrh	-2.39		-2.55		-2.51	**
YC1	-4.60	**	-4.37	**	-3.56	**	YC1	nd		nd		nd	
dYC1	-4.79	**	-4.98	**	-5.11	**	dYC1	nd		nd		nd	
BM1	-2.83		-2.96	**	-2.85	**	YC2	-2.15		-2.28		-2.10	
dBM1	-6.26	**	-5.93	**	-5.50	**	dYC2	-4.84	**	-4.86	**	-4.79	**
BQ1	-2.11		-2.28		-2.13	**	YC3	-2.87		-2.21		-1.58	
dBQ1	-5.47	**	-5.63	**	-5.66	**	dYC3	-5.08	**	-5.11	**	-4.97	
BQ2	-3.10		-3.00	**	-3.00	**	BM1	-2.05		-2.08		-0.60	**
dBQ2	-7.88	**	-7.61	**	-7.54	**	dBM1	-8.64	**	-8.18	**	-8.14	**
BTR1	-4.51	**	-2.36		-1.24		BM2	-3.00		-3.11	**	-1.56	**
dBTR1	-3.08		-3.18	**	-3.02	**	dBM2	-8.14	**	-6.83	**	-6.73	**
BB	-2.72		-2.58		-1.64	*	BM3	-3.42	*	-3.75	**	-1.59	
dBB	-3.37	*	-3.35	**	-3.44	**	dBM3	-5.45	**	-5.44	**	-5.44	**
							BB	-1.00		-0.59		-1.26	

							dBB	-6.44	**	-6.36	**	-5.74	

France variables							UK variables						
	(1)		(2)		(3)			(1)		(2)		(3)	
P	-3.88	a/	-3.33	a/	0.16		P	-1.33		-2.18		1.05	
dP	-2.96		-1.53		-1.23		dP	-3.00		-3.25	**	-1.86	*
Y	-1.77		-0.68		2.12		Y	-2.01		-1.11		1.94	
dY	-3.36	*	-3.38	**	-2.56	**	dY	-3.14		-3.11	**	-2.37	**
IP	-1.73		-1.35		0.65		IP	-2.38		-1.53		1.64	
dIP	-4.70	**	-3.32	**	-3.29	**	dIP	-5.66	**	-5.70	**	-5.58	**
Inv	-2.98		-2.09		-0.21		Inv	-2.55		-1.59		1.20	
dInv	-1.63		-1.65		-1.88	*	dInv	-7.86	**	-7.87	**	-7.84	**
E	-2.60		-1.23		-2.43	a/	E	-2.70		-2.43		-0.31	
dE	-3.06		-3.11	**	-1.15		dE	-4.15	**	-4.16	**	-4.18	**
C	-0.24		-2.95	a/	-0.20		C	-0.51		-1.90		1.48	
dC	-3.53	**	-1.91		-1.08		dC	-5.48	**	-5.33	**	-0.98	
M1	1.03		-2.61	*	0.89		M1	-1.60		-0.99		3.53	
dM1	-3.75	**	-1.82		-1.82	*	dM1	-5.80	**	-5.82	**	-2.36	**
M2	-0.83		-2.85	a/	0.70		M2	-1.37		-0.66		4.84	
dM2	-8.13	**	-1.74		-1.83	*	dM2	-1.73		-1.86		-2.04	**
CO	-2.29		-0.16		7.12		CO	-2.47		-0.80		1.76	
dCO	-8.28	**	-8.34	**	-1.74	*	dCO	-2.43		-2.44		-1.66	*
DG	-1.94		-1.19		1.09		DG	-3.38	*	-1.20		1.70	
dDG	-7.46	**	-7.44	**	-3.40	**	dDG	-3.16	*	-3.09	**	-4.21	**
txjj	-2.18		-1.95		-0.33		txjj	-2.38		-2.06		-1.17	
dtxjj	-4.98	**	-5.09	**	-5.06	**	dxjj	-3.97	**	-3.70	**	-3.70	**
txob	-1.77		-1.26		-0.60		txbt	-1.58		-1.50		-1.01	
dtxob	-2.44		-2.13		-2.14	**	dxbt	-4.24	**	-4.06	**	-3.06	**
txobpr	-1.79		-0.62		-0.73		txob	-2.84		-0.95		-1.27	
dtxobp	-5.43	**	-4.90	**	-4.84	**	dxob	-5.83	**	-5.87	**	-5.61	**
txbb	-1.42		-1.05		-0.40		txbb	-2.83		-2.66	*	-0.77	
dtxbb	-4.06	**	-3.98	**	-3.96	**	dxbb	-4.37	**	-4.22	**	-4.14	**
YC1	-1.41		-0.75		-2.01	**	txcrct	-3.12		-3.04	**	-0.74	
dYC1	-5.75	**	-5.47	**	-5.34	**	dxcrct	-4.87	**	-4.45	**	-4.37	**
BM1	-4.20	**	-4.16	**	-3.45	**	txcrh	-4.16	**	-4.11	**	-0.69	
dBM1	-10.33	**	-10.44	**	-10.41	**	dxcrh	-8.02	**	-8.12	**	-8.02	**
							YC2	-2.57		-1.50		-1.37	
							dYC2	-4.00	**	-4.13	**	-4.28	**
							YC3	-1.74		-0.99		-0.92	
							dYC3	-3.47	*	-3.47	**	-3.45	**
							BM1	-1.29		-0.96		-0.81	
							dBM1	-3.56	**	-3.56	**	-3.56	**
							BM2	-1.61		-0.81		-0.74	
							dBM2	-2.27		-2.32		-2.42	**
							BM3	-1.84		-1.19		-0.87	
							dBM3	-4.44	**	-4.46	**	-4.45	**
							BQ1	-2.17		-1.95		-2.70	**
							dBQ1	-3.57	**	-3.51	**	-3.48	**
							BTR2	-4.22	**	-3.55	**	-2.65	**
							dBTR	-5.14	**	-4.54	**	-4.49	**

							BB	**-2.27**		**-1.82**		**-1.58**	
							dBB	**-8.21**	**	**-8.36**	**	**-8.42**	**

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