WORKING PAPER No. 26
March 1995

CREDIT RATIONING OR MONETARY ILLUSION?
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CREDIT RATIONING OR MONETARY ILLUSION?
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GUARANTEE SCHEME

by
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ABSTRACT
Using data from the UK government's Loan Guarantee Scheme (LGS) for the period 1981-1990 we test the default probability specification of Stiglitz-Weiss (1981) and De Meza-Webb(1987) against that of Whadhwani-Simmons(1986,1989). Consistent with all three theories we find that a higher real cost of capital will increase the default rate. Stiglitz-Weiss correctly predicts that as the borrower pool expands the quality of the pool declines. This result, however, is better explained by the Whadhwani-Simmons theory of lending under symmetric information, with a bandwagon effect worsening the borrower pool as the economy expands. Inflation also increases defaults, suggesting the presence of money illusion. We conclude that failure, rather than evidence of adverse selection and debt rationing, is most plausibly the consequence of real factors and inflation-induced uncertainty under money illusion.

\textit{JEL No.s:} M2,M13,G33,H81

\textit{Key words:} Loan, default, failure, guarantee, inflation, financial constraints

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File: lgs12.pap
1. INTRODUCTION

Whilst a whole literature has grown up developing and refining the models of lending under asymmetric information developed in the wake of Stiglitz and Weiss (1981) (henceforth SW), comparatively little empirical work has been done to test the theory's predictions against the facts, and in particular to identify whether or not credit rationing is a significant phenomenon in the economy. What evidence has come to light is, moreover, ambiguous.

Evidence for debt rationing in Fazzari, Hubbard and Peterson(1988) and Hall(1994) takes the form of demonstrating a positive correlation of investment with business cashflow or retained profits. This, they argue, should not occur if internal and external funds were perfect substitutes, and the empirical finding that there is such a correlation is therefore treated as evidence of credit market imperfections. Evans and Jovanovic(1989), De Meza, Black and Jeffries(1990), Blanchflower and Oswald (1990), and more recently Holtz-Eakin, Joulaian, and Rosen (1994a,b), by contrast, attempt to show that the probability of switching from some other state into self-employment is a function of the individual's assets. This criterion for rationing suggests that business borrowing is not determined, as under First Best conditions, by the present discounted value of the firm's profit stream, but depends instead on inadequately available collateral, or on windfall gains of the entrepreneur.

Against these results, Berger and Udell(1992), in a study of the US economy, suggest that credit rationing is empirically insignificant. Their criterion for credit rationing implies that interest rates do not respond 'quickly' to shortages of debt capital. Berger and Udell show however that commercial loan rates are not "sticky" enough for credit rationing to be significantly implicated. Moreover, loan 'commitments' (lines of credit etc), where credit rationing is not feasible, should also increase in proportion to total lending if credit is rationed. They show, however, that the proportion of loan 'commitments' in the economy does not increase substantially when aggregate demand is "tight", thus contradicting the credit rationing hypothesis. Cressy(1994), paralleling the work of Holtz-Eakin et al in the States, shows in a study of some 2,000 UK startups that startup survival is not a function of the entrepreneur's assets, as implied by the Evans and Jovanovic theory under credit rationing. He shows that human, rather than financial, capital explains survival. Finally, Aston Business School(1990), and the Small Business Research Centre(1992), in contrast to the other studies, use survey approaches to the issue of credit rationing. In large samples of UK small businesses they find little subjective evidence that finance constraints present a major problem for smaller firms. Skills shortages are much more significant than shortages of finance, even amongst growth-oriented firms.

The empirical evidence for credit rationing is thus mixed. Should credit rationing exist,
however (and this has been disputed even on theoretical grounds, see de Meza and Webb, 1987, 1989 and 1990) (henceforth DW), it seems likely that it will loom large in the borrowing of smaller and younger businesses. Their relative dearth of collateral for loans and significantly shorter business track record militate against borrowing, and may result in credit being denied when projects have a positive net present value. On these grounds an empirical test of credit rationing based on small business borrowers would seem apposite.

The present study provides such a test by drawing on evidence from 33,500 loans made under the UK government’s Loan Guarantee Scheme (LGS). The Scheme, established in 1981 in response to perceived debt gaps, offers an insurance policy to banks against loan default, with the insurance premium paid by the business borrower to the government. The risk of default is therefore shared by the bank and the government (with the latter taking the lion’s share) so making small business lending more attractive. The scheme was targeted at younger, smaller businesses with no collateral available for borrowing. It therefore operates in conditions of extreme asymmetric information and provides a benchmark against which rationing theories can be tested. In the analysis that follows, a time series estimate of the two-year default probability for LGS loans is used to perform both a direct test of the SW and DW models against the data, and (as we shall see, crucially) a comparison test of the SW model against a third, symmetric information theory provided by Whadwhani(1986)-Simmons(1989) (henceforth WS).

The structure of the remainder of the paper is as follows. Section 2 provides a non-technical overview of the three theories to be tested. Section 3 describes the database and the choice of proxies for the theoretical variables. Section 4 presents the estimates and Section 5 concludes with some policy proposals.

2. THE MODELS
A mathematical exposition of the three models to be tested is provided in Appendix A. The present section provides an intuitive exposition of the three theories and derives comparative statics results. It is aimed at accessibility rather than mathematical rigor.

Stiglitz-Weiss(1981)
An entrepreneur can invest his initial wealth $W$ in one of two projects. The first project offers a safe rate of return $1+b$ and the second project a risky return, $R$, with probability $p$, and $0$ with probability $1-p$. The firm knows $p$ but the bank doesn’t. Risky projects are related by a mean-preserving spread ($pR=\text{const}$.) so that higher quality projects $p$ have lower gross returns $R$. 

File: lgs12.pap
For the risky project the firm needs to borrow an amount K over and above his wealth W. The bank charges an interest rate \(1+r\) to borrowers (firms) on such projects. Interest on the risky project is paid if the firm’s project is successful, i.e. the firm is solvent. If the project is unsuccessful the firm is insolvent, but limited liability implies that the bank rather than the firm will bear the loss.

Under the LGS there are costs and benefits to firm and bank over and above the interest rate and loan principal. The firm pays the government an insurance premium \(\beta\) proportional to the guaranteed fraction of the loan, \(\gamma\). This premium is paid in all states (being paid in advance of the loan) and is paid in addition to the interest rate \(1+r\) in successful states. It ensures that the government pays the guarantee if the firm defaults. The guarantee and the premium together with the interest rate on the loan act as components in the firm’s expected cost of capital, entering in a multiplicative manner, \(\beta \gamma\). Thus the expected cost to the firm of £1 borrowed under the scheme is £\((pr+\beta \gamma)\).

A condition of the loan under LGS is that the firm has zero collateral, so that the bank loses (exclusive of interest) £\((1-\gamma)\) on every £1 lent if default occurs. Therefore, under default the government bears a fraction \(\gamma\) of the loss and the bank the complementary fraction \(1-\gamma\).

The aggregate success probability in SW depends crucially on the existence of a marginal borrower (firm) whose expected profits from a risky project, net of opportunity cost, will be zero. This implies in SW (see Appendix A) that his success probability \(p\) satisfies

\[ \overline{\delta} = \frac{[\overline{R} - \gamma \beta K - (1+b) W]}{(1+r)K=\overline{\delta}(\overline{R}, r, \gamma \beta, K, b, W)} \]  

where

- \(\overline{R}\) bar = mean gross project return
- \(r\) = rate of interest on risky project
- \(K\) = amount of loan
- \(b\) = safe rate of interest
- \(W\) = firm’s initial wealth

It is important to note that in this model the marginal borrower is the highest quality borrower in the pool, since by lowering \(p\) the chances of paying interest on a given loan decline whilst everything else remains constant, thus raising expected firm profits above zero. The aggregate success probability of all firms in the borrower pool is given by integrating over \(p\), conditioning on the fact

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that firms are \textit{potential} borrowers ($p \leq p_{\text{bar}}$):

$$s = \int_0^{\overline{p}} p dG / G(\overline{p}) = s(\overline{R}, \overline{r}, \overline{\gamma}, K, \overline{b}, \overline{w})$$  \hspace{1cm} (2)

Here $G(p)$ is the cumulative density of $p$ with support $[0,1]$. The aggregate default rate is thus

$$\bar{q} = q(\overline{R}, \overline{r}, \overline{\gamma}, K, \overline{b}, \overline{w})$$

$$= 1 - s$$  \hspace{1cm} (3)

In the SW theory this default probability is embedded in a system of equations which determine the values of $r$ and $K$ and the equilibrium amount of credit traded in the market. Not all borrowers will necessarily receive loans in equilibrium since it turns out that the probability of default is \textit{increasing} in $r$. Raising the interest rate to choke off excess demand may actually \textit{lower} bank profits, and so be ruled out. This is the celebrated \textit{adverse selection} effect.

The signs of the derivatives of the parameters in equation 3 can be straightforwardly obtained, and are presented in Table 1.

\textit{De Meza-Webb(1987)}

In DW the model the marginal borrower satisfies the same zero profit condition as in SW. However the crucial assumption that project returns differ only by a mean-preserving spread is now dropped. $R$, rather than $pR$, is now constant. This seemingly small change has a dramatic effect. It implies that the marginal borrower is now the \textit{lowest} quality borrower in the pool and that the signs of the derivatives of the default probability are all \textit{reversed}.

The success probability of the marginal borrower now satisfies

$$s = \int_{\overline{p}}^{1} p dG / [1 - G(\overline{p})] = s(R, r, \gamma, K, b, w)$$  \hspace{1cm} (4)

where $R =$ gross project return in successful states.

Derivation of the rest of the system then follows through as for SW. The comparative statics
of DW with respect to the aggregate default probability are presented in Table 1 for comparison.

_Whadwhani (1986) - Simmons (1990)_

This model is originally due to Whadwhani (1986), but a variant is given in Simmons (1990). A modified version of the model is as follows.

There are again two projects open to the firm, one certain and the other risky. Borrowing is necessary to finance the latter. However, in this model the firm and bank are both uncertain of the return to the risky project, so that the regime is one of symmetric information under uncertainty. Uncertainty takes the form of randomness in the financial costs associated with the project, and is due to the unpredictability of economy’s input prices and the cash-flow variability this implies. Money illusion is at the heart of the model’s predictions.

Assume that a firm needs to borrow a sum $K$ in order to fund its risky project. i.e. to provide sufficient fixed investment for productive purposes. The firm’s cost of capital is uncertain, here represented by inflation ($\epsilon$) acting on the real cost of capital $1+r+\gamma$. Each firm will pay the same price for its borrowing but there is uncertainty at the time the borrowing decision is made as to the value prices will take. Money illusion implies that banks and firms make their lending decisions on nominal rather than real magnitudes.

The distribution of the inflation rate is known both to the firm and to the bank. The firm will decide how much to produce now on the basis of the expected inflation and actual inflation then determines whether the firm will make profits or go bust. Nominal interest rates may rise ex post because of unforeseen changes in the price level, creating a cash squeeze for the firm and bankruptcy as the outcome. The bank will lend if its expected profits from lending are positive. In long-run equilibrium, expected profits to all firms are zero.

Since all borrowers are the same, there is no marginal borrower in this theory. However, it is possible to define a marginal inflation rate such that if prices inflate less than this firms remain solvent, and if more, become insolvent. This inflation rate is defined by the condition that actual profits are zero:

$$ \pi = R(K, L^*, \delta) - wL^* - (1+\gamma + \beta \gamma + \beta \delta + u^*) K - (1+\delta) \omega = 0 \tag{5} $$

$$ = \pi(K, w, x+\gamma + \beta \delta + \delta, \omega, \delta) $$

where $R(K,L,\delta) = \text{concave sales function of labour (L) and capital (K)}$

$\delta = \text{shift parameter in sales, } R_\delta > 0$

File: lgs12.pap
w = wage rate
L* = \text{argmax}_{L>0} R(K,L,\delta) = \text{short-run labour input to the project}
\epsilon = \text{the rate of inflation}
\epsilon = E\epsilon + u, Eu=0.

The probability of default is therefore the same for all borrowers and is defined by the probability that nominal profits are negative:

\[ P_x [ \pi (K, w, x+\beta y + E\epsilon + \delta, w, \delta) < 0 ] = P_x [ u > u^* ] = 1 - \Phi (u^*) \]  \hspace{1cm} (6)

where
\[ u^* = \epsilon^* - E\epsilon = u^*(K,w, r+\gamma \delta + E\epsilon, W, \delta) \]
\[ \Phi(z) = \text{the cdf of } z, \Phi'(z) > 0 \]

The value of L has been chosen optimally; K is fixed for the firm, given that the borrowing decision has been made. It is easy to show that the probability of failure is increasing in the wage rate, real rate of interest, premium, guarantee, expected rate of inflation and the entrepreneur's wealth. It is decreasing in the productivity parameter (\delta) and ambiguous in the loan amount.

**Combined Comparative Statics of the Models**
Table 1 summarises the comparative statics of the three models for the default probability. We note that the qualitative predictions of SW are exactly the opposite of DW and exactly the same as WS, except for the effects of the rate of inflation, the cost parameter and the real wage.
TABLE 1: PREDICTIONS FOR THE DEFAULT RATE OF THE THREE MODELS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Stiglitz-Weiss</th>
<th>Whadwhani-Simmons</th>
<th>De Meza-Webb</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r=b+m$</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>$\beta\gamma$</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>$\epsilon$</td>
<td>0</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>$\delta$</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>$K$</td>
<td>+</td>
<td>?</td>
<td>-</td>
</tr>
<tr>
<td>$w$</td>
<td>.</td>
<td>+</td>
<td>.</td>
</tr>
<tr>
<td>$W$</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: a dot indicates no prediction in the respective theory.

Government objectives/budget constraints

Government policy plays the role of setting the parameters $\gamma$ and $\beta$ in the three models discussed above. However, policy may affect the market outcome and the econometric estimation in other ways.

The government has at any one time a policy objective with respect to the LGS. It has a budget which determines the maximum it will spend in loan guarantees and will incur in default payments. Such an objective has implications for theory and estimation since it may involve the addition of another equation to each of the three models described above, and present an endogeneity problem to boot. For example, suppose the government finds that the failure rate is so high that it violates its budget constraint. It decides to reduce its losses under the scheme by lowering the percentage guaranteed. Believing the SW theory, it expects, ceteris paribus, the failure rate to decline. If the SW theory is in fact a correct description of reality, this results in a classic simultaneous equations problem: the guarantee and the failure rate are now mutually dependent, and the OLS estimates of the single equation failure rate will in general be biased. For these reasons the exogeneity of the policy instruments must be tested if results are to be guaranteed free from statistical bias.

Inflationary expectations

We employ a simple adaptive expectations formula to represent expected inflation ($INF^e$) with weightings $\lambda$ and $1-\lambda$ to last period’s expectation and last period’s actual value ($INF$) respectively (see the definitions of variables below.)
3. THE DATA

A description of the LGS data used is obtained from the DTI and consists of a quarterly time series on the following variables:

\[ \text{TYFR}_t = \text{percentage two year default rate from quarter } t, \text{ or the proportion of loans made in quarter } t \text{ that are in default within two years (eight quarters) of the loan having been drawn down.} \]

\[ \text{PREM}_t = \text{percentage insurance premium charged in quarter } t \text{ by the government expressed as a proportion of the value of the loan} \]

\[ \text{GUAR}_t = \text{percentage of quarter } t \text{ LGS loan that is guaranteed by the government} \]

\[ \text{MARGIN}_t = \text{percentage margin above Base charged by banks on the LGS}^4. \text{ This was stated by DTI to be uniformly 2.5%, with some small but unknown variation for larger loans. We treat the variable as a known constant and which can therefore be subsumed in the intercept term of the regressions that follow.} \]

\[ \text{AVLA}_t = \text{average amount lent under LGS in quarter } t \text{ (£000s)}^5 \]

\[ \text{RAVLA}_t = \text{AVLA}_t / \text{PGDP}_t \]

The remaining variables used in the analysis are derived from standard statistical series published by the CSO:

\[ \text{PGDP}_t = \text{GDP deflator in quarter } t \]

\[ \text{BASE}_t = \text{selected retail bank’s annual Base rates in quarter } t \text{ in percentage terms} \]

\[ \text{RBASE}_t = \text{BASE}_t - \text{INF}_t = \text{real Base rate in quarter }^6 \]

\[ \text{W}_t = \text{nominal average earnings index for manufacturing industry in quarter } t \]

\[ \text{RW}_t = \text{W}_t / \text{PGDP}_t \]

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UB_t = index of the standard rate of unemployment benefit in quarter t (£s)

RUB_t = UB_t/PGDP_t

INF_t = (PGDP_t/PGDP_{t-4})*100 = annual percentage change in the GDP deflator in quarter t

HW_t = (Stock of Owner Occupied Housing * Average House Prices) - Value of Outstanding Mortgages (£m)

RHW_t = HW_t/PGDP_t

Finally, the Adaptive Expectations formula for expected inflation is:

INF^*_t = \lambda \cdot INF^*_t-1 + (1-\lambda) \cdot INF_t \ = \ \text{expected price inflation in quarter } t, \ \lambda \in [0,1].

Descriptive statistics

Table 2 below reports the descriptive statistics for the variables over the period 1981q1-1990q1.

**TABLE 2: LGS DESCRIPTIVE STATISTICS**

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. Obs.</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYFR</td>
<td>37</td>
<td>26.5</td>
<td>7.54</td>
<td>15.4</td>
<td>41.4</td>
</tr>
<tr>
<td>PREM</td>
<td>46</td>
<td>3.054</td>
<td>0.9263</td>
<td>2.5</td>
<td>5</td>
</tr>
<tr>
<td>GUAR</td>
<td>46</td>
<td>72.391</td>
<td>4.31</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>PGDP</td>
<td>47</td>
<td>76.973</td>
<td>10.7462</td>
<td>59.1</td>
<td>97.9</td>
</tr>
<tr>
<td>INF</td>
<td>46</td>
<td>6.2355</td>
<td>2.4633</td>
<td>1.9231</td>
<td>14.9805</td>
</tr>
<tr>
<td>W</td>
<td>46</td>
<td>113.763</td>
<td>31.191</td>
<td>66.4</td>
<td>171.3</td>
</tr>
<tr>
<td>BASE</td>
<td>47</td>
<td>11.489</td>
<td>2.025</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>AVLA</td>
<td>47</td>
<td>31.325</td>
<td>4.8292</td>
<td>19.78</td>
<td>38.6</td>
</tr>
<tr>
<td>GDP</td>
<td>47</td>
<td>922.7789</td>
<td>92.4991</td>
<td>802.9765</td>
<td>1077.5</td>
</tr>
<tr>
<td>MARGIN</td>
<td>47</td>
<td>2.500</td>
<td>0.000</td>
<td>2.500</td>
<td>2.500</td>
</tr>
<tr>
<td>LGS</td>
<td>47</td>
<td>713.0286</td>
<td>484.8453</td>
<td>104.0000</td>
<td>1631.0</td>
</tr>
<tr>
<td>UB</td>
<td>47</td>
<td>101.8068</td>
<td>12.1447</td>
<td>80.7721</td>
<td>121.243</td>
</tr>
<tr>
<td>HW</td>
<td>47</td>
<td>5118016</td>
<td>1616366</td>
<td>3340227</td>
<td>8297132</td>
</tr>
</tbody>
</table>
Figures 1 and 2 display the key variables in graphical form.

[Figure 1: Failure Rates and the Cost of Finance about here.]  
[Figure 2: LGS Numbers and Government Losses about here.]

Some 33,500 loans were taken out under the scheme (variable LGS) in the period 1981q3-1990q1 averaging some 700 per quarter. This mean figure, however, conceals substantial variation⁸ (see Figure 1). On the other hand, the average size of loan was some £33.2k with little variation about the mean.

Premium and guarantee percentages (PREM and GUAR) show little variation except for the year 1984 which saw a substantial rise in the premium from 3% to 5% and a substantial fall in the loan guarantee percentage from 80% to 70% (Figure 2). Whilst the premium returned to below its former level at 2.5% of loan value in 86q1, the guarantee remained at 70% throughout the subsequent period.

Default rates (TYFR) varied considerably over the decade, from a low of 15% to a high of 41%. Peaks occurred at the beginning, middle and end of the 1980s. The average two-year default rate of 26% indicates that more than one in four loans lost banks and government money. There are no signs of a quarterly component to the failure rate, an assumption confirmed by the relevant dummy variable regressions (not reported). Figure 1 also suggests that the default rate is positively correlated with the Base rate and the rate of inflation. A calculation of the simple correlation coefficients reveals these to be of the order of 75% and 80% respectively. Finally, the correlation between LGS numbers and the failure rate is surprisingly high +55%⁹.

**Government losses**

It is of value to calculate some measure of government losses under the LGS. The *minimum* loss in period t, $-\pi_t^G$, was calculated using the formula:

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\[ -\pi^C_t = (\alpha_t - \beta_t) \gamma_t \kappa_t n_t \]  

(7)

where

\[ -\pi^0_t = \text{government's capital loss (} \geq 0 \text{) for quarter } t \]

\[ n_t = \text{number of LGS loans made in quarter } t. \]

This identity shows net government disbursements in two years following the grant of the loan in quarter \( t \), and ignores any government administrative costs associated with the loan, and increases in tax revenue arising from income and expenditure generated by the loan\(^\text{10}\).

Absolute values of these losses (EPIG) are plotted in Figure 2, together with LGS numbers. They vary between £14.1m in 81q4 and £0.5m in 85q4, with a mean quarterly loss of £4.5m. Given the average failure rate of 26%, the much smaller premium of 3%, and the relative constancy of the guarantee percentage and premium, it is clear that LGS numbers (which varied considerably) are the main determinant of government losses under the scheme\(^\text{11}\). This must be considered the primary policy tool in manipulating the scheme’s public financing over the period.

Choice of dependent variable

For obvious reasons, we should like to have chosen the seven year default rate for the empirical analysis. However this would have reduced the sample period considerably, so raising the standard errors of the estimates. The two-year default rate thus chosen as a compromise between sample length and representative default rate. Due to the fact that most businesses in the sample are young, and failure tends to occur in the first two years of a business’ life (Ganguly, 1985), this rate covers the vast majority of failures.

Portfolio effects

None of the theoretical models being tested allow for portfolio effects in the banks lending
decisions. In practice, however, changes in the Base rate, etc, may alter the marginal returns to non-LGS versus LGS lending and result in an incentive to substitute funds between these two elements in the banks' loan portfolio. LGS numbers were therefore included in the initial model specification to allow for such 'portfolio' effects.

4. EMPIRICAL RESULTS

In this section we investigate, using the quarterly time-series data, the determinants of the Two Year Failure Rate (TYFR) on the LGS. The final specification of the empirical model is then tested against the three theoretical models whose predicitons are outlined in Table 4 to determine their relative validities in explaining failure rates on the scheme. The methodology adopted is to estimate an initially over-parameterised single equation OLS model, including proxies for all the relevant explanatory variables outlined in the three theoretical models. The model is then tested down to a parsimonious, data admissible form, the results of which are presented in Table 3A (Model 2), and takes the form of a one-period distributed lag specification. Further analysis is then conducted on this specification using recursive OLS estimation. This permits an examination of the time variation in the relative importance of each explanatory variable.

The proxies chosen for the variables in the theoretical models are presented in Table 4 below. The Table also restates the predicted signs of the variables from Table 1 above.

General Specification: Model 1A

Initially, models with the components of the firm's cost of capital specified individually, rather than as a sum, was estimated (see Appendix B). This model uses current values of the regressors and the adaptive expectations formula with various weights (λ) to the actual and expected values of last period. The results for $\lambda=0.5$ are reported in the Appendix B. The specification for $\lambda=.5$ yields an equation with all variables significant except for demand (RGDP) and the loan amount (RAVLA).
The model's diagnostics are largely satisfactory\textsuperscript{12} but the equation suffers from significant positive autocorrelation resistant to respecification. The model was rejected eventually in favour of Model 1 below where the cost of capital is represented by a sum term.

**General Specification: Model 1**

This model (see Table 3) uses the assumption $\lambda = 0$ with the cost of capital (RCC) as an aggregate term (see definitions above). The model is, broadly speaking, supportive of SW and WS in that the signs of the coefficients on the 'cost of capital', real wage, numbers of LGS loans issued and real GDP are all consistent with the theories and the first two coefficients are significant at the 1% level. In support of the DW model, however, the signs on real housing wealth and real average loan amount are consistent with this theory, albeit not statistically significant. The model does, however, exhibit signs of positive autocorrelation in the residuals, perhaps due to the effect of random shocks to the LGS that are felt some time after their occurrence\textsuperscript{13}. To rectify this we introduced a one period lag structure into the equation. Three variables now become insignificant, the average loan amount (RAVLA) the real wage (RHW) and real GDP (RGD)P. Deleting these variables we arrive at final specification (Model 2).

**Final Specification: Model 2**

This equation yields coefficients that are consistent both with the predictions of adverse selection theory of SW and with the symmetric information-with-uncertainty theory of WS. In terms of counting criteria, the SW model is correct on 3 out of 7 predictions, and WS on 6 out of 7. The DW model predicts incorrectly in all cases (See Table 4.) In the final model, only the real cost of capital, expected inflation, LGS numbers and the real wage are significant at the 5\% level.

In summary, the implications of the empirical model are that (a) an increase in the real cost of capital and in the real labour costs of production will raise the default rate, as will an expansion
of the number of loans issued under the LGS; (b) higher expected inflation, characterised by a higher rate of increase of the GDP deflator, will act to significantly increase failure rates.

It is apparent at this stage that the empirical results offer support for the symmetric information-under-uncertainty theory of WS but are consistent also with the adverse selection-with-asymmetric information theory of SW. In line with this we offer two alternative interpretations for our results.
<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>COEFFICIENT (T-STAT)</th>
<th>COEFFICIENT (T-STAT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td>7.9425 (2.6230)</td>
<td>-.32742 (-7.1185)</td>
</tr>
<tr>
<td>RCC</td>
<td>.010796 (4.1818)</td>
<td></td>
</tr>
<tr>
<td>RCC(-1)</td>
<td></td>
<td>.010952 (4.4420)</td>
</tr>
<tr>
<td>INF</td>
<td>-.049454 (-1.5633)</td>
<td></td>
</tr>
<tr>
<td>INF(-1)</td>
<td></td>
<td>.036868 (13.2884)</td>
</tr>
<tr>
<td>RW</td>
<td>.52773 (3.5636)</td>
<td></td>
</tr>
<tr>
<td>RW(-1)</td>
<td></td>
<td>.10028 (7.8444)</td>
</tr>
<tr>
<td>RAVLA</td>
<td>-.0026980 (-1.5942)</td>
<td></td>
</tr>
<tr>
<td>RAVLA(-1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RGDP</td>
<td>-.80800 (-2.7645)</td>
<td></td>
</tr>
<tr>
<td>RGDP(-1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LGS</td>
<td>.4558E-4 (2.5746)</td>
<td></td>
</tr>
<tr>
<td>LGS(-1)</td>
<td></td>
<td>.4826E-4 (4.2875)</td>
</tr>
<tr>
<td>RHW</td>
<td>-.1323E-9 (-.79099)</td>
<td></td>
</tr>
<tr>
<td>RHW(-1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: (i) Figures in brackets are t statistics. (ii) For Model 2 these statistics are based on White's heteroscedasticity-consistent estimators of the coefficient variances.
TABLE 3B: GOODNESS OF FIT AND DIAGNOSTIC TESTS

<table>
<thead>
<tr>
<th>CHI-SQUARED/ TEST STATISTIC</th>
<th>MODEL 1</th>
<th>MODEL 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-BAR SQUARED</td>
<td>.89841</td>
<td>.89541</td>
</tr>
<tr>
<td>DW^14</td>
<td>1.0525</td>
<td>1.8050</td>
</tr>
<tr>
<td>SERIAL CORR.(4)^15</td>
<td>14.6043</td>
<td>6.1431</td>
</tr>
<tr>
<td>FUNCTIONAL FORM(1)^16</td>
<td>.15327</td>
<td>.062792</td>
</tr>
<tr>
<td>NORMALITY(2)^17</td>
<td>.24228</td>
<td>2.7315</td>
</tr>
<tr>
<td>HETERO SK.(1)^18</td>
<td>.82356</td>
<td>3.2015</td>
</tr>
<tr>
<td>ARCH(12)^19</td>
<td>9.5050</td>
<td>10.4307</td>
</tr>
</tbody>
</table>

Notes: (i) Figures in brackets next to the name of the test statistic indicate the degrees of freedom of its Chi-squared value. (ii) The serial correlation chi-squared tests are for fourth-order effects due to the quarterly nature of the data. (iv) For details of the tests used here see Pesaran and Pesaran(1991).

SW Interpretation

According to this theory, as we have seen, all firms are potential borrowers and only firms know their default rates. However, not all firms receive loans in equilibrium if credit rationing occurs. In these circumstances the lender will not raise the price of a loan to clear the market as poorer quality borrowers are attracted into the market, increasing the default probability and reducing his expected return. Our empirical results are consistent with this theory in as much as a rise in the real cost of borrowing and an expansion in the number of firms on the scheme increases the default rate. They are inconsistent with the SW theory in as much as it suggests no role for money illusion. We find this (in common with Whadwhani, 1986) to be statistically significant in failure.

WS Interpretation

Under this theory, as we have seen, both banks and firms are assumed to be equally well informed as to the probability of success of a project. However, uncertainty arises due to a randomness in the financial costs of a project due to unpredictability in the price level. Banks and firms, act on nominal rather than real magnitudes. Thus a rise in interest rates designed to offset anticipated inflationary pressures feeds through to the firm by raising costs in the short-term and thus diverting funds from other uses within the firm. It is implicit that any price adjustment by the firm in response to an upward shift in costs is not instantaneous. Thus at best there is a short-term gap during which the firm costs have risen with no corresponding increase in prices. It is this gap combined with price
stickiness that acts to increase the probability of failure.

The implied increase in default rates caused by increases in the nominal cost of capital offer support for this theory. The role of LGS numbers in the default rate is, however, apparently inconsistent with the theory because of its association with adverse selection that the theory denies.

**An alternative interpretation**

If banks have the ability to assess risk of potential borrowers (via, say, incentive compatibility constraints, see Boot, Thakor and Udell, 1992), a competing interpretation of the role of the LGS variable in the default rate is available. Assume there exists an intertemporal dimension to the quality spectrum, so that higher quality borrowers present first and as time wears on lower quality borrowers climb onto the bandwagon. Assume also that banks respond to applications by lending to the new tranche of borrowers, subject to a portfolio balance constraint, *as they present*. These two assumptions are sufficient for a positive correlation of average borrower quality and LGS numbers. On this theory, lending would be on *equal* terms, rather than discriminating between high and low risk borrowers by charging differential margins. This implication is in fact compatible with the LGS data which apparently had the *same* margin for all borrowers. Thus we have provided an alternative explanation for the positive correlation between the default rate and LGS numbers without assuming the presence of adverse selection in the lending process.

**TABLE 4: PROXIES, EXPECTED SIGNS AND OUTCOMES**

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>PROXIES</th>
<th>Stiglitz-Weiss</th>
<th>Whadhwan-Simmons</th>
<th>De Meza-Webb</th>
<th>Outcome (Model 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>m (=margin over Base)</td>
<td>CONSTANT</td>
<td>.20</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>b+βγ-Eε</td>
<td>RCC=RBASE+P REM*GUAR</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Eε</td>
<td>INF</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>δ</td>
<td>RGDP</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>0(-)</td>
</tr>
<tr>
<td>K</td>
<td>RAVLA</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>w</td>
<td>RW</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>W</td>
<td>RUB, RHW</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>0(-)</td>
</tr>
<tr>
<td>n</td>
<td>LGS</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

*Notes: (i) A shaded cell in the Table represents a prediction consistent with the model at the 5% level on a 2-tailed test. (ii) Bracketed signs indicate that the sign obtained was not significant at the 5% level on a 2-tailed test.*
Time variation and recursive estimates of model 2

Recursive estimates of the OLS regression coefficients in Model 2 were used to assess the importance of the explanatory variables over time. The estimated recursive coefficients have large standard error bands in the early years of the 80s due to the lack of degrees of freedom. Thus we concentrate on the period from 1985q1 onwards.

Most noticeable is the increase in the importance of coefficient on LGS numbers in this period (Figure 3). These estimates show that there was a local peak in terms of the strength of the coefficient in 1985q2. Over the following year it declined in importance before starting an upward trend which continues until the end of the sample period. A particularly large upward movement in the coefficient occurred in 1989 around the peak of the economic boom. The fact that numbers of firms on the scheme came to have an increasingly important (and positive) effect on default rates as the economy grew rapidly suggests, if the interpretation provided above is correct, that as the boom gained momentum the bandwagon effect of poorer quality applicants raised the responsiveness of the failure rate to borrower numbers quite dramatically as time wore on.

5. POLICY IMPLICATIONS

The paper tested current theories of credit rationing/surplus under asymmetric information against a symmetric information alternative. We showed that failure, rather than providing evidence of adverse selection and debt rationing, is most plausibly the consequence of inflation-induced uncertainty and money illusion jointly resulting in cash-flow difficulties for the firm. The variables that explain failure are straightforward cost of capital measures: the insurance premium, loan guarantee percentage, interest rate and the rate of inflation. This finding is consistent with the results of Berger and Udell(1992) in America who found no evidence of debt gaps at the aggregate level and with those of Aston Business School(1990) and the Small Business Centre(1992) who reached the same conclusion from survey data. It is contrary to a range of other empirical studies both in the UK and across the Atlantic.22

We feel this empirical finding is robust and may have important implications for the direction of both empirical and theoretical research. The latter has recently assumed asymmetric information to be the primary determinant of both borrowing parameters and default outcomes. We find, to the contrary, that government monetary policy in the face of money illusion by the banking system is more significant and should be the primary focus of attention.

The paper also provides, by implication, evidence on the effectiveness of the LGS scheme itself as a public policy instrument. We have seen that the LGS was explicitly introduced to alleviate

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shortages of bank finance for viable projects due to insufficient business collateral. However, if failure rates can be shown to depend on factors predicted by symmetric information theories, and more associated with nominal capital cost fluctuations than with information availability, a consequence is that the LGS will accentuate the misallocation of resources, rather than help to alleviate it.

Finally, the objectives of the LGS are by implication revealed to be at variance with government macro-economic objectives, in particular with those of monetary policy. Highly geared, risky firms encouraged to borrow by banks attempting to increase market share may be ‘tipped over the brink’ as interest rates rise in line with uncertain inflation. Government, in using a combination of monetary and fiscal policy to provide macro-economic stability, must therefore co-ordinate these efforts with micro-level policies such as the LGS aimed at fostering the development of the small firms sector if the results are to be anything other than contradictory.
APPENDIX A: DETAILED EXPOSITION OF THE THREE MODELS

In this section we outline simple versions of the models to be tested in the context of the LGS, and derive their comparative static predictions with respect to the probability of survival. The models examined are two period in nature. Investment occurs now and returns occur one period hence. Banks and firms live for just two periods. The marginal borrower defines the position of the firm and a zero profit condition that of the bank.

Under the LGS the government guarantees a proportion of the bank’s loan in return for a premium paid by the business. A simple extension of the algebra is used to incorporate LGS parameters into the SW-DW framework.

Stiglitz-Weiss (1981)

An entrepreneur can invest a sum of money W completely in one of two projects. The first project offers a safe rate of return 1 + b and the second project a risky return. The risky project yields R with probability p and 0 with probability 1 - p and the bank charges an interest rate 1 + r to firms borrowing to finance it. For the risky project the firm needs to borrow an amount K to finance it. Interest on the risky project is paid if the firm’s project is successful, i.e. the firm is solvent. If the project is unsuccessful the firm is insolvent but limited liability implies that the bank bears the loss.

Moving to specifics, in SW projects are related by a mean-preserving spread so that higher quality projects have lower gross returns R:

\[ \rho R = \overline{R} \]  \hspace{1cm} (8)

Under the LGS the firm pays a premium \( \beta \) proportional to the guaranteed part of the loan, \( \gamma \). This premium is paid in all states (being paid in advance of the loan) and in addition to the interest rate 1 + r in successful states. The firm’s profit function is thus written

\[ \pi^{f} = D \left[ R - (1 + r) K \right] - \gamma \beta K - (1 + b) W \]

\[ = \left[ \overline{R} - \gamma \beta K - (1 + b) W \right] - \rho (1 + r) K \]  \hspace{1cm} (9)
A marginal borrower is defined by the condition that firm profits are zero. This implies that his success probability \( p \) satisfies

\[
\overline{p} = [\overline{R} - \gamma \beta K - (1+b) \overline{W}] / (1+r) K = \overline{p}(\overline{R}, \overline{r}, \gamma \beta, K, b, \overline{W})
\] (10)

The aggregate success probability of all firms in the borrower pool is therefore given by integrating over all firms ps, conditioned on the fact that they are potential borrowers:

\[
s = \int_0^{\overline{p}} p dG(p) = s(\overline{R}, \overline{r}, \gamma \beta, K, b, \overline{W})
\] (11)

Here \( G(p) \) is the cumulative density of \( p \) with support \([0,1]\). The aggregate default rate is thus \( q = 1-s \).

The bank like the firm can invest funds either in a risky project or a dae project. On the risky project the bank receives \( 1+r \) in success states for every \( \ell \) lent and gets back from the government a fraction \( \gamma \) of each unsuccessful \( \ell \). It has an opportunity cost of lent funds, \( 1+b \) per \( \ell \). The bank’s return to borrower \( p \) is therefore given by

\[
\pi^B = [p (1+r) + (1-p) \gamma - (1+b)] K
\] (12)

The bank’s average profit over all borrowers is therefore

\[
E\pi^B = \int_0^{\overline{p}} \pi^B(p) dG(G) = K[s(1+r) + (1-s) \gamma - (1+b)]
\] (13)
Market equilibrium requires that \( r \) maximises this expression, a necessary condition for which is that

\[
\frac{\partial \pi^B}{\partial r} = 0 \tag{14}
\]

This implies \( r \) is now defined by the function

\[
x = x^* (\overline{R}, \gamma, \beta, K, b, \mathcal{W}) \tag{15}
\]

where 11 has been used to solve for \( p \) bar.

However, competition amongst identical banks also drives expected bank profits to zero:

\[
E\pi^B = 0 \tag{16}
\]

or

\[
s (1 + x) + (1 - s) \gamma = 1 + b \tag{17}
\]

where \( b \) is the bank’s cost of funds (generally different from the firm’s). Thus the expected return to risky projects must equal the safe rate. \( K \) now satisfies

\[
K = K^* (\overline{R}, \gamma, \beta, b, \mathcal{W}) \tag{18}
\]

The supply of loans by banks must satisfy the equilibrium conditions 15 and 17 so that if the demand for loans at an interest rate \( r \) is greater than the supply banks do not have an incentive to raise the rate of interest. This will simply lower their profits by worsening the quality of the borrower.
Thus the equations of the system are 12, 16 and 19 together with

\[ Q(r^*) = \min[D(r^*), S(r^*)] \]  

(19)

where \( Q(r^*) \) = the equilibrium quantity of risky loans. \( D(r^*) \) is the demand for risky loans by firms, given by

\[ D(r^*) = G[\bar{D}(r^*)] \]  

(20)

and \( S(r^*) \) = supply of risky funds by the banking system. The latter is determined by deposits with the banking system, \( B(r^*) = S(r^*) \). These four equations determine the four variables \( s, r, K, \) and \( Q \).

We are interested in examining the effect on the default rate of variations in the interest rate \( r \), so that we shall consider the system defined by these four equations *though only explicitly estimating* 12.

*De Meza-Webb (1987)*

The DW model drops the assumption of equation 9 and assumes that \( R \) is a constant for all firms \( p \). The Firm's objective function is thus

\[ \pi^p = \mathcal{D}[R - (1 + r) K] - \gamma \beta K - (1 + b) W \]  

(21)

Hence the marginal success probability is defined by

\[ \bar{D} = [ (1 + b) W + \gamma \beta K ] / [ R - (1 + r) K] \]  

(23)
The aggregate success probability in the borrower pool is therefore

\[ s = \int_{\bar{p}}^{1} dG / [1 - G(\bar{p})] \]  \hspace{1cm} (24)

The rest of the system then follows through as for SW. Note however that the signs of the comparative statics on the default probability are now reversed.

*Wadwhani-Simmons* (1986, 1990)

A simplified version of this model originally due to Wadwhani (1986), but a variant is given in Simmons (1990). We simplify the model considerably to obtain a comparable set of equations to SW and DW.

Assume that a firm needs to borrow a sum K in order to fund its operations, i.e. provide sufficient fixed investment for productive purposes. The firm's capital costs are uncertain, here represented by a random product inflation rate \( \varepsilon \). Each firm will receive the same price for its product and pay the same prices for its inputs, and the real rate of interest on its capital, known at the outset. However, inflation may, ex post of the project investment (borrowing) decision, raise nominal interest costs. These may rise faster than the prices of its inputs and output, facing the firm with a cash flow squeeze.

The distribution of the inflation rate is known both to the firm and to the bank. The firm will decide how much to produce now on the basis of the expected costs and inflation then determines whether the firm will make profits or go bust. The bank will lend on similar criteria, namely if its expected profits from lending are positive. In equilibrium, expected profits are zero.

The firm’s long run profit function is written:

\[ E\pi = R(K, L^*, \delta) - \omega L^* - (1 + \gamma + \beta\gamma + \bar{E}\varepsilon + \bar{U}) K - (1 + b) W \]  \hspace{1cm} (25)

where

- \( r \) = real rate of interest
- \( \varepsilon = \bar{E}\varepsilon + u \) = inflation rate

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Ee = expected rate of inflation (Ee=0)

w = wage rate

R(.) is the indirect short run profit function. In other words, R(.) solves, for fixed K and P, the problem

\[ \max_{\ell, \delta} R = F(K, L, \delta) - \ell w L \]  \hspace{1cm} (26)

and where

\[ L^*(K, w, \delta) = \text{argmax}_L[R] \]  \hspace{1cm} (27)

Define a critical value of \( u, u^* \), satisfying

\[ \pi^* = R(K, L^*, \delta) - \ell w L^* - (1 + r + \beta \gamma + \beta Ee + u^*) K - (1 + \beta) W = 0 \]  \hspace{1cm} (28)

Hence \( u^* \) is defined as the following function:

\[ u^* = [R(K, L^*, \delta) - \ell w L^* - (1 + \beta) W] / (1 + \beta + \beta Ee) \]

\[ = u^*(K, w, \delta, x + \beta \gamma + \beta Ee, \ell), \text{ } L^* = L^*(K, w, \delta) \]  \hspace{1cm} (29)

The firm will, however, become insolvent if realised profits (not known in advance) are negative, i.e. \( u > u^* \). The probability of insolvency is given by:

\[ Pr(\hat{\pi} < 0) = Pr(\hat{\pi} > u^*) = 1 - \Phi(u^*) \]  \hspace{1cm} (30)

where \( \Phi(z) \) is the cdf of \( z \).

It is straightforward to show that 30 is increasing in \( w, r, \beta, \gamma, \) W and Ee, and decreasing in \( \delta \), where \( \delta \) is a parameter in the firm's revenue function, F, and \( F_\delta > 0 \). It is ambiguous in K.
The bank's expected profits from lending to a firm are

$$\pi^B = \left[ (1 + r) \Phi(u^*) + \gamma (1 + r)(1 - \Phi(u^*)) - (1 + b) \right] K$$

Expected profit over all firms $n$ is thus

$$E\pi^B = n\pi^B$$ (32)

A zero profit condition operates on banks implying an equation similar to SW's equation 17 above. Total demand for credit is therefore simply $nK$, which is the amount supplied by banks in equilibrium. The equilibrium demand for credit will increase in the long run if profits rise above the competitive rate. This will influence the probability of default iff it arises through a change in one of the parameters in the default probability.
### Table 5A: OLS Tyfr Estimates for the Period 1981Q3-1990Q1

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>( \lambda = 0 )</th>
<th>( \lambda = .5 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>COEFFICIENT</td>
<td>T-STAT</td>
</tr>
<tr>
<td><strong>CONSTANT</strong></td>
<td>7.4187</td>
<td>(2.3886)</td>
</tr>
<tr>
<td><strong>BG</strong></td>
<td>0.0152</td>
<td>(1.4396)</td>
</tr>
<tr>
<td><strong>INF</strong></td>
<td>-.0425</td>
<td>(1.2958)</td>
</tr>
<tr>
<td><strong>INF5</strong></td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td><strong>RW</strong></td>
<td>0.6265</td>
<td>(4.2257)</td>
</tr>
<tr>
<td><strong>RBASE</strong></td>
<td>0.0115</td>
<td>(3.4297)</td>
</tr>
<tr>
<td><strong>RAVLA</strong></td>
<td>-.0027234</td>
<td>(-1.2692)</td>
</tr>
<tr>
<td><strong>RGDP</strong></td>
<td>-.7734</td>
<td>(-2.5763)</td>
</tr>
<tr>
<td><strong>LGS</strong></td>
<td>0.000621</td>
<td>(3.0863)</td>
</tr>
<tr>
<td><strong>RHW</strong></td>
<td>-.00000000</td>
<td>(-1.8390)</td>
</tr>
</tbody>
</table>

*Note: Figures in brackets are t statistics.*
<table>
<thead>
<tr>
<th>CHI-SQUARED/ TEST STATISTIC</th>
<th>$\lambda=0$</th>
<th>$\lambda=.5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-BAR SQUARED</td>
<td>0.8989</td>
<td>.9645</td>
</tr>
<tr>
<td>DW$^{24}$</td>
<td>1.0130</td>
<td>1.2960</td>
</tr>
<tr>
<td>SERIAL CORR.(4)$^{25}$</td>
<td>16.6810</td>
<td>9.2142</td>
</tr>
<tr>
<td>FUNCTIONAL FORM(1)$^{26}$</td>
<td>0.0404</td>
<td>0.0425</td>
</tr>
<tr>
<td>NORMALITY(2)$^{27}$</td>
<td>0.9753</td>
<td>2.9697</td>
</tr>
<tr>
<td>HETEROSK.(1)$^{28}$</td>
<td>0.2761</td>
<td>.0572</td>
</tr>
</tbody>
</table>

Note: Figures in brackets next to the name of the test statistic indicate the degrees of freedom of its Chi-squared value. The serial correlation chi-squared tests are for fourth-order effects due to the quarterly nature of the data. For details of the tests used here see Pesaran and Pesaran(1991).
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28. Test for heteroscedasticity based on the auxiliary regression

$$e_t^2 = \text{const.} + \alpha y_t^2$$