'ὴ ἀγαπήσομεν, ἐὰν 'ό τι ἐγγύτατα αὐτῆs ῇ
καὶ πλεῖστα τῶν 'άλλων ἐκείνηs μετέχῃ;
Οὕτωs, 'έφη · ἀγαπήσομεν.

PLATO *Republic*

THE CONSEQUENCES OF PERVASIVE REGULATION IN THE FINANCIAL SYSTEM: THE EXAMPLE OF PRIVATE FIXED INVESTMENT IN GREECE 1958-1985

by

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ABSTRACT

This thesis examines the impact of pervasive regulation in the financial system on the economy, in general, and on private investment activity, in particular. A survey of the relevant literature concentrates on the issue of the arguments for, and against, financial deregulation. A macroeconomic growth model is analysed which focuses on the implications of an abrupt rise in the (private) debt service burden, following a removal of interest rate ceilings. Subsequently, selected models of investment are estimated on Greek annual data covering the period 1958-1985. The aim of the empirical work is to detect the effects of the elaborate controls imposed on the Greek banking system. (The possibility of such effects, and associated policy implications, were discussed in the preceding, theoretical, part of the thesis.) Particular effort has been expended to generate the appropriate series required for the estimations, especially those relating to the fiscal factors which influence investment behaviour. The empirical results reveal the important role of policy induced financial rationing in the determination of aggregate investment in Greece.

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INTRODUCTION

This thesis enquires into the effect on aggregate investment of the operation of the Greek financial system. The enquiry takes as its starting point the pervasiveness of regulations, i.e. interest rate ceilings, reserve requirements etc., in the Greek financial system. Some detail about the particular institutional structure of the financial system in Greece is given towards the end of this introduction.

The thesis begins with a categorization and formalization of the issues confronting heavily regulated financial systems, in general. Chapter 1 surveys the literature that deals specifically with such economies: the '<u>financial repression</u>' literature. Blinder (1987, p.336) describes it as "a growing literature in development economics that argues - on both institutional and econometric grounds - that credit restrictions, which reduce the supply of credit for either working capital or investment, are a major channel through which financial policies have real effects". A substantial part of this literature is characterised by Jao (1985) as the "Stanford financial development school".

We analyse the drawbacks of pervasive regulations. We point out their adverse consequences both from a microeconomic and a macroeconomic perspective. The main policy issue confronting repressed financial systems is the issue of deregulation. The central question, however, is whether financial liberalization contributes to an increase in output growth or not. In Chapter 1 we summarise the position of both sides in this debate. Some of the arguments in this debate are expressed by means of formal models, which characterise the short run dynamic path to be followed by the economy after financial liberalization. We analyse these models.

A consideration, which appears often rather casually in this debate, is that financial regulations may be imposed in order to extract government revenue. Therefore financial liberalization may induce a reduction in the resources available for public investment. This would tend to reduce output growth. In order to pursue this argument we are led in two directions. First, we discuss some formal models which elaborate on the following issues that are subsidiary to the argument:

(i) How is the lending behaviour of financial intermediaries affected by the imposition of regulations? In particular, what is the trade-off between the extraction of government revenue and the finance of private investment from banks?

(ii) What is the net impact on the economy from the financing efforts (by financial restriction) of the government, assuming that government revenue is channelled to public capital formation?

Second, we explore whether there are reasons, other than the extraction of government revenue, that motivate the imposition of pervasive financial regulations. Such reasons could be political economic, prudential or distributional in nature. It is important to discover whether financial regulations serve some purpose. For, in that case, benefits (to at least some agents) are foregone upon their removal.

Chapter 2 develops several possibilities, first discussed in Chapter 1:

(i) It is stated in Chapter 1, that a significant argument against financial liberalization could be the accompanying increase in the burden of interest payments on borrowing firms. This consideration, together with the implications of deregulation for government finances, are aspects of the matter which those concerned with the Greek economy ought not to ignore.

This is suggested, for example, in the latest (July 1987) OECD Survey of Greece: "By 1979, after a marked deterioration in the second half of the 1970s the net profit rate had dropped to barely 8 per cent with nearly 40 per cent of firms reporting losses.... The increase in financial charges contributed almost two-fifths to the swing from net profits in 1979 to net losses in 1984" (pp.32-33). In the same Survey we read: "... The $3\frac{1}{2}$ percentage point rise of the PSBR to 17.7 per cent of GNP between 1981 and 1985 was almost fully accounted for by higher interest net payments. Continuation of existing trends would have resulted in an explosive deficit-debt spiral" (pp.48-49). (Nb. At the time much more than half the outstanding public debt was domestic).

Accordingly, in Chapter 2 our attention turns to the workings of a particular macromodel which places emphasis on the complications (reckoned in terms of potential reductions in private investment) that may arise because of the steep increase in interest rates in the course of financial liberalization.

(ii) It is noted in Chapter 1 that the rationing of loans, under financial repression, is potentially inefficient. Therefore, financial liberalization may entail an economywide rise in profits. An associated increase in retained profits could boost investment. In Chapter 2 we model this effect. We examine whether the tendency for private investment to rise, because of the increase in economywide retained profits, is likely to outweigh the effect of increased debt service (see (i) above), which is contractionary for investment.

(iii) In Chapter 1, we take the view that the implications of financial deregulation for government revenue (hence government investment) are somewhat neglected in the literature. In Chapter 2 we attempt to make good this omission. In the model, we assume that the government raises an inflation tax on bank reserves in order to finance capital formation (having covered the operating losses of banks).

We organise the exposition of Chapter 2 as follows: First the basic model, originally developed by Currie and Anyadike-Danes (1980), is set out and its recursive structure is analysed in detail. Then, we add to this basic model the features described under (i) to (iii) above, step by step. At each stage we work out the 'verdict' of the (steady state reduced form of the) model on whether a rise in the deposit rate is likely to increase the growth rate of the economy.

In much of the work surveyed in Chapter 1 and also in the theoretical model of Chapter 2, one can distinguish a preoccupation with the potential of credit expansion for the stimulation of economic activity. Indeed, (as recently argued e.g. in Bernanke and Blinder 1988; Gertler 1988), this mechanism appears either alien or capable of a trivial interpretation only to somebody educated in the wider IS/LM tradition. However, recent theoretical work (e.g. Greenwald and Stiglitz 1988a, 1988b) and empirical research (e.g. Fazzari, Hubbard and Petersen 1988a) relates investment to a similar influence, the availability of internal funds. This work is based on the presence of rationing caused by imperfect information, mainly in the equities (and also loans) markets, in advanced financial systems. Less subtle, though perhaps more compelling, is the prevalence of loan rationing due to interest rate ceilings under financial repression. Under rationing, the short side of the market determines the volume of transactions, therefore the availability of loans influences the aggregate level of investment.

Thus in Chapter 3 we attempt to detect the existence and to discern the precise nature of a potential dependence of investment expenditures on credit conditions. A number of issues need to be settled before this can be accomplished: First an estimating investment function must be derived from firm behaviour. Here we adopt the neoclassical approach and put forward four distinct specifications of the investment equation. Second, we must clarify this matter: Do such neoclassical investment equations (with a measure of credit as an additional regressor) provide an adequate test of the theoretical view of the determination of investment under financial repression, (which was developed in Chapter 1 and Chapter 2)? Third, the appropriate variables (e.g. private net investment, private net capital stock) have to be constructed from the available raw, aggregate data (e.g. private gross investment, total [private plus public] consumption of fixed capital). This is done here. The sample is annual and covers the period 1958-1985 in Greece.

A considerable part of the literature on investment behaviour deals with the impact of tax policy on investment. We take a particular interest in the role of fiscal parameters in an investment function for another reason as well: Within the neoclassical framework, fiscal policy impinges on investment via the user cost (in a complicated manner which we analyse in the opening Sections of Chapter 4). The sign on the user cost variable in an investment equation may indicate the presence of financial repression. In order to be able to detect this effect with some confidence, we must obtain as precise a measure of the user cost as possible. Therefore our measure for the user cost must not leave out the relevant fiscal parameters. Otherwise the sign on our user cost variable may be the outcome of mispecification.

Thus, Chapter 4 refines the construction of a series for the user cost, which began in Chapter 3. In Chapter 4, we compute an adjustment to the user cost variable, required to represent the influence of corporate taxation and investment incentives. To carry out these calculations we must become familiar with the detail of the Greek legislation providing for corporate taxation, investment allowances, investment grants, depreciation for tax purposes and allowable accelerations of tax depreciation.

Constrained by the availability of data, we manage to compute effective rates for corporate taxation, depreciation for tax purposes and investment allowances only. This latter set of estimates, enables us to obtain an additional by-product from Chapter 4. It enables us to assess the quantitative importance, on an aggregate level, of the string of policy measures that granted generous investment allowances in Greece, over the extended period 1959-1985. Further calculations illuminate the factors that may have limited the actual importance of these investment incentives.

In Chapter 5, we estimate the four distinct specifications of the investment equation that are worked out in Chapter 3. We employ a variety of alternative measures for dependent and independent variables, constructed in Chapter 3 and Chapter 4. The empirical methods of Chapter 5 aim to establish whether the principal characteristics of financial repression can be identified in our sample.

Specifically, in Chapter 5 we wish to examine empirically the following questions:

(i) Whether credit conditions play a large and significant part in the determination of investment.

(ii) Whether investment is more closely related to a measure of credit availability that subtracts the interest payments on outstanding loans from the flow of new loans than to one that does not. Indeed, that this might be so is the premise from which the argument of (most of) Chapter 2, that financial liberalization might not promote growth, is deduced.

(iii) Whether the negative dependence of investment on the user cost (according to neoclassical theory) is masked under conditions of financial repression. As argued in Chapter 1, this can happen if investment responds positively to some other variables that are themselves positively associated with the real interest rate. It is suggested in Chapter 1 that such variables would comprise the availability of credit or of internal funds. Chapter 1 also explains why self financed investment may be positively related to the real deposit rate, under financial repression. The conclusions of Chapter 5 (especially concerning this point) could be read as having far reaching policy implications: If investment is found <u>not</u> to be negatively affected by rises in real interest rates, many of (but not all) the objections to financial deregulation, discussed in Chapter 1, cannot be sustained.

In order to resolve these issues validly, we estimate the investment function adopting (a simple version of) an econometric methodology that "... is part of a tradition which originated at the London School of Economics in the 1950's and 1960's" (Gilbert 1986, p.305; see also Gilbert 1989). We check the robustness of our answers to questions (i) to (iii) above, across alternative estimation techniques, different equation specifications and numerous variable definitions.

This thesis represents an effort to understand the effect on investment of the operation of the Greek financial system. The way it proceeds is first to classify the Greek economy in the class of financially repressed economies. Then, theory is invoked to delineate the characteristic tendencies in such economies (Chapter 1 and Chapter 2). Finally, empirical methods are applied to identify exactly how such tendencies are manifested in Greece (Chapter 3, Chapter 4 and Chapter 5).

To what extent are we justified in assuming, at the outset, that the approach of financial repression is relevant to Greece? From a practical point of view, to what extent can we expect the application of this approach (rather than any other), to the Greek case, to be fruitful? The scientific method judges assumptions on the basis of the comparison of any conclusions deduced therefrom with the empirical data. So, strictly speaking, these questions cannot be resolved before Chapter 5.

However, a brief outline of the institutions in the Greek financial system and their recent history, reveals that the scope of regulation has been so pervasive, so as to leave little doubt about the appropriateness of the financial repression approach. Furthermore our approach seems to be relevant on this count as well: that practitioners in banking and academics in Greece, are aware and speak of those same issues and problems that standard financial repression analysis of the financial system would have identified.

X. Zolotas, who was the Governor of the Bank of Greece for about a quarter of a century, proclaimed in 1963 that:

> In the less developed countries ... The people who are willing and able to pay the higher interest rates on bank loans are mainly those engaged in trade, who use credit to finance imports or luxury products, or to finance consumer credit, thus diverting to consumption funds that would otherwise be available for economic development ... we have to direct banking activities towards economic development targets by applying the appropriate credit controls. (Zolotas 1977, p.392)

It seems that opinion on the effectiveness of pervasive financial regulations changed with the passage of time. For example, D. Halikias, then on the staff later to be appointed Governor of the Bank of Greece, concluded in a monograph on money and credit in the developing economy of Greece, published in 1978, that:

> The highly complex system of qualitative credit regulations, the structure of the official interest rates and a series of other legal restrictions on the establishment of new banking institutions or branches of foreign banks and on the operation of the capital and money markets in general, are obstacles to the development of a flexible and more efficient credit mechanism ... (Halikias 1978, p.237).

Academic economists in Greece seem to espouse this view. For example we read in Demopoulos (1981, pp.21-22) that "... the prevailing structure of reserve requirements is accompanied by negative allocative effects on bank credit, introduces uncertainty in the implementation of monetary policy, and gives rise to losses of economic welfare .... controls over the availability of credit and artificially low interest rates produce perverse effects on the desired objectives of economic development and stabilization. Therefore, it is inferred that a policy of market determined interest rates should be slowly adopted". Similar remarks can be found in Papadakis (1979, pp.110-115) mainly in connection with the destabilizing role of administered interest rates.

Over the past decade the matter has moved into the focus of debate on policy making. Two major committee reports (Bank of Greece 1981; Union of Greek Banks 1987) were compiled and the 1985/86 OECD Survey of Greece (OECD 1986) devoted an entire 'part' to the examination of prospective 'financial reforms'. All these documents condemned the existing nexus of selective credit controls, reserve requirements and other bank portfolio constraints as well as interest rate ceilings and recommended financial liberalization.

In the section 'interest rate and credit controls' in the Karadjas report (Union of Greek Banks 1987), we read that the basic characteristics of the Greek financial system are the poor development of the securities markets, administered interest rates and the heavy dependence of the public sector on the banks for finance. Further it is claimed that the misallocation of resources towards less productive lines of activity or speculative uses, the creation of credit over-intensive projects and the restriction of bank competition are among the adverse consequences of the (then) existing arrangements in the Greek financial system. Taken together these tendencies fit the description of financial repression given say in Fry (1988, Chapter 1), perfectly. The report also acknowledged the resulting limitation of the possibilities of monetary policy and related macroeconomic instability as implications of the controls. (Cf. Blinder 1987). The view occurs in the same report that financial deregulation is feasible only if accompanied by a reduction of the public sector borrowing requirement and by a favourable macroeconomic climate e.g. in Dooley and Mathieson (1986). The policy proposal that selective credit controls be replaced with transparent subsidies through the government budget is also standard.

Indeed after certain preliminary policy measures (e.g. deregulation of the interbank market in 1978) the main thrust of liberalization came in 1987, when loan rates and rates payable on a progressively broadened range of deposits were effectively freed from official control, and bank portfolio constraints were somewhat relaxed. In particular during 1987 short term deposits and medium term certificates of deposit, both bearing a negotiable rate, were introduced as financial innovations. Interest rates and other contractual conditions on bank bonds and term deposits with initial maturity over three months as well as savings deposits on notice were also liberalised. Over the same period loan rate 'ceilings' on short term loans and long term advances to manufacturing, mining, tourism and the shipbuilding industries were replaced by 'floors' which were subsequently abolished. As stated by the Governor of the Bank of Greece (Bank of Greece 1988, p.27) by 1988 rates were deregulated on approximately 80% of the commercial banks and 100% of the development banks private loan portfolios. In addition banks were relieved of the obligation to onlend at least 15% of their drachma deposits for 'productive investment' or place the amount in a (low) interest bearing deposit with the Central Bank. However in the annual report (for 1987) by S. Panagopoulos, the Governor of the major commercial bank in Greece, the National Bank of Greece, doubt was cast on the pervasiveness of reform:

> Banks are still compelled to earmark a specified proportion of their deposits for special purposes (purchase of treasury bills, lending to public enterprises and organizations, credit to small-scale manufacturing industry, deposits with the Central Bank), which absorb nearly 66% of aggregate deposits .... for a similar pecentage of bank deposits, the interest rate is also determined exogenously, since both for savings deposits - representing 60% of total drachma deposits with commercial banks - and for the bulk of foreign exchange deposits, interest rates are set by administrative decisions ....
>
> [The monetary authorities] gradually raised the percentage of commercial banks' compulsory deposits with the Bank of Greece ... [and] raised the percentage of funds earmarked for the financing of public enterprises and organizations. The combined effect of these two increases was the absorption of the funds released by the abolition of the requirement that banks allocate 15% of their deposits to finance productive investment. (National Bank of Greece 1988, pp.18-20)

There was further backtracking as the government, worried by spiralling nominal interest rates, administered a reduction in (savings) deposit rates in the second half of 1988. So, the subject of this thesis is regarded as an immediate and important issue of policy in Greece.

CHAPTER 1

FINANCIAL SYSTEMS UNDER PERVASIVE REGULATION: A SURVEY OF THE LITERATURE

Section 1.1

Introduction

We first discuss in Section 1.2 a number of the basic arguments advanced in favour of liberalizing previously repressed financial systems. This latter concept is illustrated by a diagram for the market for loanable funds under interest rate ceilings. It is suggested that, in this situation, externally financed investment is positively related to the interest rate. We discuss also the McKinnon hypothesis and its recent elaborations. In this approach it is argued that internally financed investment as well responds positively to the deposit rate, under financial repression. There follows a brief discussion of likely loan rationing practices in this situation. This naturally leads on to a survey of the literature on the microeconomic consequences of financial repression; for these are mostly due to the fact that loans are rationed by non-price criteria. Having presented its microeconomic implications, we proceed to analyse the macroeconomics of financial repression. Specifically, we summarise the models of Kapur (1976), Mathieson (1980) and Blinder (1987). Kapur and Mathieson examine the short run path followed by the economy once interest rate ceilings are relaxed or removed completely. Blinder deals with the dynamic instability which is likely to be particularly conspicuous in a financially repressed economy.

Then, in Section 1.3 we summarise the model of van Wijnbergen (1983). This advises against financial liberalization on the grounds that it is likely to result in stagflation. In Section 1.4 we deal with some further objections to financial liberalization. The model of Mathieson (1980) is revisited since this gives some attention to the financial problems for banks that may be entailed by financial liberalization. However, financial liberalization may cause financial difficulties to other (e.g. industrial) firms as well, though the majority of the literature makes only passing references to that serious problem. The single article (Currie and Anyadike-Danes 1980) which provides a relevant formal discussion is reviewed extensively in Chapter 2. We conclude Section 1.4 with summaries of two recent theoretical models that are quite sceptical about the potentialities of financial liberalization.

Section 1.5 begins by setting out the following argument: Some of the work surveyed in the previous Sections of this Chapter condemns the repression of the financial system and supports financial liberalization. However, repression seems to be the result of official regulation. Therefore it is caused deliberately by a government. Hence it might be serving some 'purpose'. Presumably this 'purpose' would no longer be fulfilled when financial liberalization removes repression. To the extent, then, that the 'purpose' served by financial repression was beneficial, financial liberalization must entail the loss of some benefit. Therefore the literature which gives unequivocal support to financial liberalization is incomplete: support for financial liberalization can only be conditional on a comparison of benefits with costs.

The question arises, what could be the purpose of financial repression? It is usually stated in the literature, that this is the extraction of government revenue from the financial system. We also generalise the notion of financial repression (which was understood until now as a situation of rationing under deposit rate ceilings) to include situations where loan rate ceilings or reserve requirements are imposed. We are now ready to restate, in specific terms, the argument cast in the beginning of Section 1.5 in very general terms: Assume that the government revenue, that is extracted by financial restriction, finances government capital formation. In this case, financial liberalization (when this revenue is lost) stimulates private investment only at the expense of government investment. Hence financial liberalization does not necessarily maximise output growth (since growth depends on total i.e. private plus government investment).

This is conditional on the proposition that financial repression fulfills a well defined purpose. This proposition can be challenged - financial repression may be an accident or an error of policy. Furthermore, there are some indications in the literature that financial repression should better be viewed as a political economic phenomenon: it is suggested that financial regulations are devices designed to benefit directly some 'class' of economic agents.

Having realised that the 'purpose' of financial repression must remain an open question, we change direction. We assume that it is sufficient to view financial repression as a means to raise government revenue. We assume that government revenue finances government capital formation. On the other hand, private investment is crowded out in the process of extracting government revenue from the financial system. What is the net impact on the economy from these two tendencies: the expansion due to government capital formation and the contraction because private investment is crowded out as the government raises revenue by financial restriction/repression?

There are two separate sets of papers relating to our question: First, there is the literature on inflationary finance and growth (part of which is summarised in this section), and second the papers (Courakis 1984; Fry 1981a,1981b) discussed in the succeeding Section 1.6. First, we survey the literature on inflationary finance and growth: This studies the impact on the economy from government capital formation financed by inflation, interacting with a required reserve requirement. (This could be interpreted as a situation of financial repression/restriction).

In Section 1.6, we summarize Courakis (1984) who explores the trade-off between additional private investment (enabled by financial liberalization) and government investment (financed by revenue extracted by financial restriction) by means of the following procedure: He assumes that the government maintains its investment (at the pre-liberalization level) after liberalization. The revenue which the government foregoes because of the discontinuation of financial restriction, it replaces by borrowing from banks (at the market interest rate). Under this procedure, the issue of the favourability of financial liberalization takes the form of the following comparison: Which situation delivers a higher volume of loanable funds and thus, potentially, greater output growth - financial restriction/repression or removal of controls combined with borrowing by the government?

We begin by discussing this comparison when the regulation imposed on banks is a reserve ratio. We sketch the considerations that would be relevant in this comparison if inflation tax revenues plus bank profits were taken as the measure of government revenue. Next, we compare the volume of loanable funds in a situation with a loan rate ceiling to the volume of funds in a situation without a loan rate ceiling. We note that apart from being devices of financial restriction, loan rate ceilings may be imposed in the context of selective credit policies. We sketch the considerations that are relevant when the situation with selective credit controls (restriction/repression) is compared to the situation after the removal of such controls (liberalization).

At this point our attention turns to the role of deposit rate ceilings. There is a puzzle: Does this regulation contribute to the extraction of government revenue? We discuss a number of possibilities which support the interpretation of deposit rate ceilings as instruments of financial restriction (i.e. revenue extraction). Finally, we suggest that deposit rate ceilings may fulfill prudential functions. Hence their removal in the course of financial liberalization may precipitate a systemic crisis.

Readers who are not interested in the details of the literature might prefer to slip to the concluding Section, 1.7.

Section 1.2

Some Reasons For Not Maintaining Artificially Low Interest Rates

Administratively fixed interest rates enable disequilibrium in the market for loanable funds to persist (diagram 1). (Cf. Fry 1978, Fig.1; Fry 1980, Fig.1; Fry 1982b, Fig.1; Fry 1988, Fig.1.4; Kitchen 1986, Fig.3.1; Roe 1982, Fig.2). For such financial systems the market for loanable funds may be identified more or less with the banking system[1] according as 'unofficial' money markets are (quantitatively) important or not. Hence S (in diagram 1) could be interpreted as the supply of bank deposits. Disequilibrium generates the following surprising result: under disequilibrium the familiar negative interest sensitivity of investment cannot be relied upon for policy purposes. Therefore the Keynesian rationale for maintaining low interest rates is not valid. By contrast there should be a distinction between the desired level of investment (point B in diagram 1) and the level of investment which can be financed (point A in diagram 1) by the forthcoming volume of loanable funds. Since the latter responds positively to the deposit rate, it follows that actual investment responds positively to the deposit rate (A → A'). There is a vicious circle operating in the sense that because of repression (hence insufficient investment) income can never grow so as to close the gap of excess demand for loanable funds by shifting the S schedule to the right. Rises in the inflation rate reduce the real rate corresponding to the nominal ceiling and thus accentuate repression.

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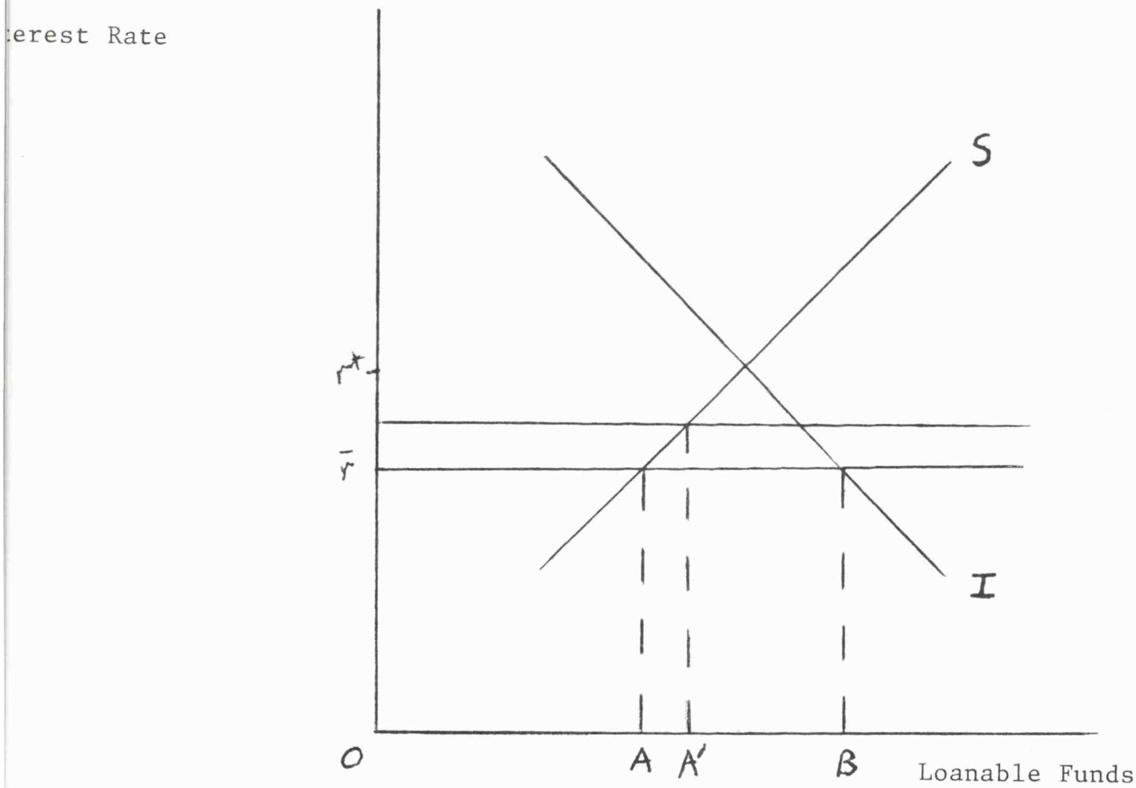
1. Indeed in the 1986 OECD Survey of Greece we read that: "Issues of securities accounted for less than 0.25 percent of total identified finance to the private sector over the last ten years" (OECD 1986, p.53).

Diagram 1



There are some further (seemingly paradoxical) effects in a situation where administrative ceilings keep interest rates artificially low. For example, another paradox is proposed in van Wijnbergen (1983): Here, a rise in the administered loan rate reduces holdings of free reserves thus increases bank loans thereby reducing the unofficial market rate with an expansionary result. Under McKinnon's (1973) complementarity hypothesis, the requirement for accumulation of monetary balances prior to indivisible investment expenditures (under internal finance), implies that the costliness of the investment process increases when the deposit rate declines. Therefore there may be a positive dependence of self financed investment on the deposit rate. Kumar (1983) constructs a macroeconomic system exhibiting some corresponding comparative dynamics (co-movements in the capital labour ratio and in real money balances). Molho (1986a) presents a microeconomic intertemporal asset choice rationale for the McKinnon hypothesis. He argues that a rise in the deposit rate, by attracting additional deposits and also generating higher accruals of interest earnings to existing deposits, stimulates future investment (conduit role). However, the rise in the deposit rate may discourage current investment in capital assets by the standard substitution mechanism, when a diversified portfolio (comprising deposits and capital) is held because of uncertainty. In order to capture these effects, he recommends the inclusion of distant lags of the interest rate in empirical specifications of the investment function.

In diagram 1 reference has so far been made to a deposit rate ceiling only. Distinguishing now between deposit and loan rate, fixing the former below the S-I intersection (diagram 1), is the only necessary feature of the analysis. Available loanable funds may be rationed either by charging a high effective loan rate[2] or by non-price criteria such as collateral assessment, if loan rates are fixed administratively. If the resultant bank profits are significant, then the consequences of interest rate repression are mitigated as the S curve shifts rightwards. This is because profits inspire depositor confidence and may be used to finance devices for non-price competition such as branching (Brimmer 1971). In the literature, Liang (1988) attempts to differentiate between the macroeconomic implications of alternative loan rationing practices. We deal with this issue in Chapter 2.

At this stage, let us call the situation of financial disequilibrium, pictured in diagram 1, and described in the preceding paragraphs, 'financial repression'. In the following paragraphs we give a discussion of its microeconomic and macroeconomic consequences. There is an issue on the productivity implications of financial repression: the investment expenditures that are financed are quite likely to be characterised by low but safe returns. This is because the bank can benefit from the associated low risk while its pay-off is unaffected by (unlikely) high returns to the investment project over and above the value of its collateral (Demopoulos 1981, p.104). The tendency to rely on collateral is stressed by Costopoulos quoted in Courakis (1981b, p.225) for Greece. Fry (1978, p.465) writes, describing the loan rationing practices under financial repression:

2. Suggested for Greece in Bank of Greece (1981, p.107); loans given to those willing to pay the ceiling rate plus some premium effected by bringing other intermediation services above cost. Similarly Halikias (1978, p.230).

"Nonprice rationing of investable funds must occur. This typically takes place on the basis of quality of collateral, political pressures, 'name', loan size and covert benefits to the responsible loan officers. These criteria can be counted on to discriminate inefficiently between investment opportunities". Tybout (1984) shows that administrative ceilings on loan rates induce banks to look for loan contracts with larger borrowers than otherwise in order to maintain expected profits. This result comes out as a matter of arithmetic, but is also due to economies of scale in information collection and the perception that small firms are more risky. This explains also Maniatis's (1972) findings of "a high degree of concentration of bank loans of all maturities in a limited number of large industrial enterprises" (p.150), in Greece. (Similar observations about Greece in Ross and Thomadakis 1983). In Galbis (1977,1982) a model is suggested where the alternative open to wealth holders, (faced with deposits bearing repressed interest rates), consists in self-financing little productive investment projects. Thus, even when the total level of investment may not change upon a rise in the deposit rate, there is a reallocation towards bank financed investments which are more productive. Sundararajan (1987) detects empirically an association between (economywide) productivity and the level of real interest rates in a financially repressed economy. In Kim and Kwon (1977) financial reform is associated with an increase in the rate of utilization of capital.

The next step is to state and formalise the macroeconomic consequences of interest rate repression. Generally these involve lower investment, and hence growth rate. Accordingly the costs of repression have been expressed (Fry 1980) simply in terms of percentage points of growth lost compared to a situation of liberalization. Formal analyses of the interconnections through which interest rate repression affects the growth rate are traced in the articles by Kapur (1976), Mathieson (1980) and van Wijnbergen (1983). They provide frameworks in which the growth rate and the inflation rate are determined simultaneously, so that a policy of financial reform has stabilisation implications. We summarise also the article by Blinder (1987). This models the problem of dynamic instability which is likely to be particularly acute under financial repression.

In Kapur's model the growth of bank loans translates into the growth of working capital,[3] after allowing for bank credit taken up to maintain the real value of the existing stock of working capital in the face of inflation. Feeding the growth of working capital through a fixed coefficients production function, he then obtains the growth rate of output. In the model, inflation exceeds its expected value because of an excess supply of money; inflationary expectations are adaptive. A policy of administrative increases in the deposit rate is compared to a policy of lowering monetary growth. Between steady states they both yield similar comparative statics by raising the real deposit rate. But a deposit rate policy yields a more favourable short-run adjustment path, one that does not involve declines in the growth rate at any point. By contast, as monetary growth is lowered below the growth of prices, the real scale of the banking system (and thus output growth) is reduced initially. In the short run sluggish

3. Kapur states that this approach is motivated by the prevalence of bank finance (rather than financial disequilibrium) under financial repression.

inflationary expectations do not fully internalise the implications of a reduction in money growth (for expected inflation hence) for the value of the real deposit rate corresponding to the nominal ceiling. Within Kapur's model the size of the banking system is determined by the real supply of money, whose divergence from the real demand for money generates the Phillips curve dynamics. Hence the initial effect of a rise in the deposit rate is to increase money demand and thus to reduce the rate of inflation. This implies that the real amount of loans necessary to maintain the real stock of working capital declines. Therefore funds are freed for net additions to the growth of the real stock of working capital. Hence output growth is stimulated at once. In addition, as the reduced inflation rate feeds into lower prices, the real scale of the banking system expands. These are the particular forms that the dependence of growth on credit availability takes in Kapur's model.

In Mathieson (1980) there is a standard investment demand function for fixed capital with the real cost of loans as an argument. A fraction of the capital stock is (constrained by assumption to be) financed from the banking system generating a demand for loans. Once a stabilisation-deregulation package is introduced, the deposit rate is administratively manipulated to ensure loan market clearing. The structure under repression is not analysed here, whereas in Kapur (op.cit.) the structure under repression (credit availability channel) is maintained after the administered rise in the deposit rate. The contribution of interest rate reform is to produce a one-off rise in the investment/growth rate as the gap of unsatisfied loan, demands is closed. This counterbalances the initial real effects of 'stabilization', i.e. the reduction in monetary growth. (We have a combination of a step rise in the scale of the banking system with a reduction in its nominal rate of growth [affecting future nominal scale]).

The following macroeconomic phenomenon is likely to be particularly conspicuous under financial repression. Blinder (1987) demonstrates that credit rationing may cause dynamic instability. Assume credit rationing tightens (because of a reduction in reserves by the monetary authorities). Then aggregate supply declines since production requires working capital (given a time lag between factor payments and sales). Due to a wealth effect (of money) aggregate demand is reduced as well. Under plausible values for the structural parameters the former ~~latter~~ effect predominates. As a result, (under Walrasian adjustment, but not under Phillips curve dynamics) prices are bid up, eroding the real value of loans, hence further accentuating credit rationing. A similar result may occur when loans financing expenditures on fixed capital are rationed. Here, prices inflate because firms, unable to expand their plant (due to credit rationing), have to operate beyond capacity in order to meet demand. As prices inflate, credit rationing is accentuated etc. The problem of dynamic instability may not, however, disappear after financial liberalization since some credit rationing is likely to remain even then (cf. Cho 1986). Indeed Blinder and Stiglitz (1983) suggest that credit rationing prevails, not only under financial repression, but also in developed financial systems (due to Stiglitz and Weiss [1981] reasons). A firm denied borrowing by its bank cannot obtain (external) finance elsewhere (especially if small) and becomes constrained by the availability of credit. This is attributed to the specificity of information on creditworthiness (acquired by a single bank in part through handling the customer's transactions) and to the tendency for loan contracts to be contingent on past behaviour. However, dynamic instability is likely to be more acute in a situation of financial repression. This is suggested, for example, by Leff and Sato (1980). They remind us that movements in interest rates, which may be stabilizing, are prevented under financial repression.

Section 1.3

A Formal Model Advising Against Financial Liberalization

A class of models, known as 'new structuralist', argue, more or less, against financial liberalization. They draw our attention to the operation of unofficial funds markets, in financially repressed economies. Such models focus on the portfolio substitution possibilities between bank deposits, unofficial loans and inflation hedges and also introduce the cost of borrowing in the aggregate supply (of goods) function. They are represented here by van Wijnbergen (1983).

In van Wijnbergen (op.cit.) no channel of credit availability is included, and all effects are transmitted through the interest rate in the unofficial money market. This is because the total market for loanable funds is not in disequilibrium; loan demands unsatisfied by the banking system are met in the parallel market. Once the interest rate is determined in the unofficial money market, it feeds into aggregate expenditure and allowing for feed-back the equilibrium level of income is determined in classic IS/LM fashion.

Another channel, pointed out by new structuralists, through which credit finance acquires macroeconomic implications, is aggregate supply. This channel is assigned importance in such financial systems, because of the large fraction of working capital externally (bank) financed under financial repression.[4] The aggregate supply curve is derived from the profit maximising condition of an economy wide price-taking firm. Hence a rise in the unofficial money market rate (in real terms) represents an adverse supply shock. Assume that the contractionary effect (of the rise in the unofficial rate) on aggregate supply exceeds the Keynesian contraction (due to higher interest rates) in aggregate demand (Cavallo hypothesis). Then the inflation rate (determined by excess demand for goods) rises upon a rise in the unofficial money market rate caused by an administered rise in the deposit rate. Therefore interest rate reform leads to stagflation. Given an investment function depending on the real unofficial money market rate and the level of income per unit capital, the growth rate declines. It is assumed that the McKinnon effect on savings, because of higher saving propensities under the higher unofficial rate, is reversed by the decline in income. Buffie (1984), however, shows that if the McKinnon effect on savings is sufficiently strong, even a new structuralist model may yield conclusions favouring

4. For a recent exposition of this mechanism see Rojas-Suarez (1987). It is less frequently discussed with reference to developed economies, perhaps because the opportunity cost of internal finance is neglected or does not affect decision making. An exception is provided by Shaller (1983) who introduces working capital costs in the aggregate supply of a developed economy.

liberalization in the longer run.

In van Wijnbergen (op.cit.) the macroeconomic implications of a rise in the deposit rate rest solely on its impact on the interest rate in the unofficial money market[5]. Upon the rise in the deposit rate, substitution into deposits leads to a reduction in the supply of unofficial loans. The new structuralist assumption, made by van Wijnbergen, is that there is relatively less substitution from third alternatives (typically tangible inflation hedges). In addition, new bank deposits only fractionally translate into new bank loans, due to reserve requirements. So the reduction in the pressure of demand for loans from the unofficial market falls short of the reduction in the supply of funds to this market. Hence the net result is excess demand for unofficial loans. The interest rate in the unofficial money market is bid up but the volume of unofficial transactions is reduced.

However, one could question the assumption (in the new structuralist arguments) that bank reserves lay idle and are not rerouted (say through special credit institutions) as loans, thus easing the pressure for funds from the unofficial market. Nor do the new structuralist models consider that proceeds from the reserve requirement may finance government investment, thus promoting growth. Moreover, the shrinkage of the unofficial market achieved by a deposit rate rise should be an independent policy desideratum both on normative and efficiency grounds. Assuming that the unofficial market brings together lenders and borrowers directly, all the cost savings, in

5. Analytically similar roles to the unofficial market have been assigned to the equities market (Horiuchi 1984).

a general sense, which have provided economic explanations for the existence of financial intermediaries (Goodhart 1975, Chapter 6) are achieved when it contracts. These gains should be set against any direct growth losses caused by a deposit rate rise. Furthermore, if the recipients of unofficial loans are identified with, say, consumers,[6] then the new structuralist crunch will not hit supply or the rate of investment directly but only to the extent the latter responds to consumer demand.[7]

Section 1.4

Other Difficulties Possibly Accompanying Financial Liberalization

Next we discuss a model which deals with the short- run financial difficulties that may be encountered by financial firms, following

6. For Lanyi and Saracoglu (1983) they are typically small urban borrowers and the population of the rural areas. In fact in Greece selective credit controls aim to discourage the provision of credit to commercial (rather than manufacturing) enterprises and consumers.

7. It seems that in Greece an unofficial inter-firm market is operative, whereby established borrowers relend to (commercial) firms downstream or final consumers, thus appearing 'overborrowed'. Identification of the suppliers in the unofficial market with borrowing and on-lending firms should mean that switches out of supplies of unofficial loans free equal amounts of funds for the banking system, leave the equilibrium of the unofficial market unchanged and have no further effect. The quantitative importance of this second round of intermediation is pointed out in Courakis (1981b). This feature is mentioned also in Halikias (1978, e.g. p.31), Union of Greek Banks (1987, p.24) and in the 1986 OECD Survey of Greece (OECD 1986). In addition, stockbroking firms in the small Athens Stock Exchange may have (illegally) diversified into intermediation functions in unofficial parallel money markets (Bank of Greece 1981, p.218). The press also occasionally reports cases of usury (see for example Nea 8 and 9 August 1988). On inflation hedges in Greece see Brissimis and Leventakis (1981) as well as Niarchos and Granger (1972).

financial liberalization. Mathieson (1980) models the profit squeeze faced in times of rising interest rates by financial intermediaries which are typically characterised by mismatch, whereby their assets have longer maturities than their liabilities. It is assumed that the intermediaries hold an (exponentially declining) stock of old loans contracted at the 'repressed' loan rate. Therefore a competitive relationship (as under unfettered liberalization[8]) cannot be established between the new (i.e. deregulated) deposit rate and the loan rate without losses. The authorities are concerned (though not via their objective function as set out in this model) about the prospect of a (growth defeating) banking crisis. (Cf. Snowden 1987). Hence they accept, as a constraint on their optimal programme, the requirement that an administered loan rate guarantees zero profits to (established) banks at all times during the stabilisation/financial reform. The (non-inflationary) alternative of dealing with such difficulties by a tax-cum-subsidy scheme is rejected, by Mathieson, on grounds of higher costs of administration, given an existing nexus of interest rate controls. In addition the real deposit rate is constrained to ensure that the size of the banking system is sufficient to finance a fixed fraction of the demand for capital. Given these constraints the authorities are modelled as choosing the path of monetary growth so as to minimise losses accumulating over time. Losses are computed on the basis of a quadratic loss function defined over departures from growth/inflation rate objectives. The path of inflation is determined by the loan market equilibrium condition (which appears as a portfolio balance equation). Given an

8. Such a relationship could be established in a competitive fringe of, say, new entrants. Note also that liberalization (Competition and Credit Control) preceded the secondary banking crisis in the U.K.

assumption on inflationary expectations, the administered nominal deposit and loan rates are determined. The moral of this model is that solvency problems of financial firms (dissolving exponentially) can be remedied by carefully administered rises in deposit and loan rates. The model recommends gradualism in financial liberalization. No hindrance is put on deposit rate rises but there is a delay in the approach to the growth objective (since higher loan rates mean lower investment demand).

Next we record some references in the literature to the prospects for financial difficulties among non-financial firms upon financial liberalization. That such problems may result from financial liberalization is proposed in very general terms, in e.g. Jao (1985) or Lanyi and Saracoglu (1983). The analysis of such problems will be particularly relevant to Greece, where a large number of major enterprises are facing the prospect of bankruptcy (OECD 1986, 1987). Assuming that established borrowers have not been rationed by high effective loan rates (which would come down), upon interest rate reform they would face a steep rise in financing costs. In turn, this could create difficulties for financial firms. In order to avoid the emergence of such problems, Kapur (1976) restricts the rise in the deposit rate to be such that, given a competitive relationship, the loan rate does not rise above the constant rate of return on working capital (when loan demand collapses). Fry (1988) (and similarly Khatkhate 1980) points out that this danger never exists under liberalization (rather than administered rises) when an infinitely elastic demand for loans, at the rate of return on capital, (assumed constant), determines the loan rate, and this in turn determines the deposit rate. However, the implications of financial difficulties consequent upon rises in interest rates, are emphasized in Currie and Anyadike-Danes (1980). In this model, a rise in the loan rate eats into the retained earnings of borrowers. Hence there is an economywide reduction in the internal funds available for investment, not compensated by the increase in the availability of bank finance. Similar discussions can be found in Hong (1985) and Snowden (1987). These authors assume that before financial deregulation (the majority of) firms obtained (limited) finance at the repressed official interest rates. However, one could take the view that liberalization, rather than adding to, may bring relief from the burden of interest charges, as the black market (where rates presumably reach exorbitant [above competitive equilibrium] levels) dissolves.

Two recent theoretical models have also expressed some skepticism about the potentialities of financial liberalization. Montiel's (1986) model is built around the principle that "... in a regime of credit rationing, the quantity of credit extended to the private sector would appear directly in private demand functions. Such a conclusion derives from ... Clower ..." (p.586). Still this model lends only qualified support to the presumed influence of credit availability on investment expenditures (on which advocacy of financial liberalization often relies). It is assumed that households choose under perfect certainty paths for consumption and holdings of (productive) capital and (transactions costs reducing) money. Their objective is to maximise the present discounted value of utility from consuming over an infinite horizon subject to a (lifetime) balance sheet and an (instantaneous) budget constraint and a ceiling on credit. Formal representations for the following familiar features of financial repression are derived thereby: The marginal product of capital exceeds the administered loan rate; effective demands (for capital etc.) are insensitive to the administered loan rate. However, the administered loan rate influences (consumption) behaviour by affecting the amounts of interest payments by households. Thus a rise in the administered loan (deposit) rate or the credit ceiling reduces (increases) consumption both on impact and in the steady state. By contrast, increases in the administered rates or the credit ceiling, within the context of financial deregulation, cannot have lasting effects on the capital stock of the economy. This is because the steady state value for the capital stock must equalise the marginal product of capital to the rate of time preference (which is invariant). A similar condition pegs the ratio of money to consumption (which determines the productivity of money balances). However, financial liberalization has transitory effects on the holdings of capital: A relaxation in credit rationing enables a step increase in investment as it allows private portfolios to expand. An increase in the loan rate induces, on impact, portfolio redistributions from money to capital (since consumption falls, required money balances decline). By contrast a rise in the administered deposit rate causes a reallocation from capital to money (McKinnon's complementarity between money and capital does not obtain in this model). All these changes in the holdings of capital (which take place upon financial deregulation) are gradually reversed during the movement to the new (post-deregulation) steady state. Thus, one could argue that, if an investment boom takes place upon financial liberalization, this happens only at the cost of a succeeding slowdown. In Kahkonen's (1987) two period general equilibrium model, if financial deregulation (rise in the deposit rate towards world levels) is not implemented simultaneously with trade liberalization (reduction in tariffs), welfare may decline on second best grounds. It is argued that tariffs levied during the first period cause excessive savings. The divergence of savings from the (all-markets-liberalised) optimum widens if the factor by which consumers discount future flows of income is reduced by a rise in the administered deposit rate. Thus a second best case can be made for maintaining low deposit rates given that tariffs are imposed. This conclusion is partly overturned if capital flight is taken into account (Haaparanta 1988).

Section 1.5
Financial Restriction and Financial Repression

Presumably there must be a purpose behind the tight system of regulations imposed on some financial systems, otherwise what is inhibiting governments from liberalising? The unequivocal support for financial liberalization, often encountered in the literature, should rather give way to a more balanced approach. Of particular concern must be the implications of liberalization for government finances, a consideration which is given some prominence in Jao (1985) and in Dooley and Mathieson (1986) but is little discussed elsewhere.

First, we reconsider the definition of financial restriction and financial repression. Both rate and quantity controls (e.g. interest rate ceilings, reserve ratios) are identified in the literature as a means to direct financial flows into channels which are easily (or traditionally) tapped by government. This attempt, to influence financial flows in order to extract government revenues, is called financial restriction. It (mysteriously) leads to financial repression. Financial repression could be defined as a situation where financial flows (through official markets) are less than what they would have otherwise been. Financial repression is usually thought of in terms of its adverse implications for growth. There is a difference between the interpretation of repression as a situation of disequilibrium (diagram 1) and the Courakis (1984) and McKinnon (1981) interpretation of repression as an equilibrium of the banking system, but in the presence of government imposed controls. This latter interpretation is espoused in the argument to follow.

Next we examine whether financial restriction is distinct from financial repression. The description of the institutional set of controls underlying repression does not differ[9] from that set of controls which implement financial restriction. The relationship between financial restriction and repression is not clear. Is restriction (i.e. the imposition of constraints), the action and repression, the natural result (i.e. the response of the equilibrium size of the banking system)? Or is it that only occasionally an

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9. Quoting from Fry (1973, p.372): "Foreign exchange controls, maximum interest rates, high reserve requirements etc. can be imposed to increase the flow of resources to the public sector .... Such financial control might be termed financial restriction as opposed to financial repression"; (p.381 referring to McKinnon): "... financial repression a situation in which the rate of interest is held below the free market rate, foreign exchange controls exist and the capital market is deliberately fragmented by government policies".

extraneous causal mechanism turns restriction into repression? (In which case the latter is an unintended[10] consequence of the former to be prevented by suitable policies). Perhaps there is a difference in degree (of the contraction in the balance sheet of the banking system) distinguishing restriction from repression. The only way to differentiate between restriction and repression is connected with the existence of measures, to be mentioned below, which sustain government receipts (and therefore constitute restriction) but, unlike other measures, do not result in a lower level of intermediation (hence are not repressive).

Assume that financial repression is synonymous to financial restriction. That some objective, associated with government revenues, is singled out to motivate financial restriction/ repression, enables us to think of this situation as the outcome of premeditated (if not optimal) behaviour on the part of the government. If we believe that financial liberalization must take place in order to alleviate repression and pursue a growth objective, trivially we must recognise that in the process the objective served by financial restriction (e.g. equity) will have to be given up, at least in part. One might have to analyse the trade-off between restriction and liberalization as a manifestation of the trade-off between equity and efficiency. Moreover, distributional ideals exist, while distributional weights have been applied in analysis to justify distortionary taxation and could be invoked, by analogy, to justify

10. Fry (1988, p.16): "Typically, it seems, financial repression is the unintended consequence of low fixed nominal interest rates combined with high and rising inflation" - no further comments on 'unintended' follow.

repression.[11] But it is not necessarily the case that the objective pursued by financial restriction is antagonistic to the growth objective inspiring liberalization. Firstly, government revenues (in a general sense) extracted through financial restriction may contribute to growth directly (and perhaps even more so than private loans) by financing investment expenditures. Secondly, complete abolition of all rate and quantity controls may not maximise the growth objective by not maximising the sum of private and government loanable funds. Insistence in full liberalization in the face of such possibilities suggests perhaps that the potential of government expenditure to generate growth is doubted.

Consider now, the other possible alternative to the above (i.e. that financial restriction/repression has a purpose). The alternative is to view financial repression as a haphazard situation whereby an accidental rise in inflation causes a shrinkage in the banking system because of the presence of reserve ratios and administratively fixed rates. However even in this case the government may become concerned with its revenues (since some sources may decline as inflation accelerates), and tighten reserve ratios, or seek to increase currency issue, while seldom abandoning rate ceilings, thus accentuating repression. Even on this view, it is government revenue which is extracted in exchange for further financial repression (so all the comments in the previous paragraph apply). Possibly there could exist in the background issues of government rationality. Perhaps we cannot

11. However Fry (1988, pp.102-103) surveys evidence that financial repression leads to adverse redistribution from small depositors to mostly large borrowers. Similarly Roe (1982, p.215) points out the perverse distributional effects of cheap agricultural credit programmes.

claim that the government is causing financial repression by setting the values of constraints optimally with respect to some objective. For this would require information on asset demand (deposits - loans) parameters unlikely to be generated in such a regime where interest rates are rarely changed (Courakis 1981). On the other hand, we could adapt Friedman's (1971) argument that the relevant optimisation horizon of a government is its short incumbency period, so that it generally pays to increase money growth, beyond what would be optimal on the basis of inflation tax calculations for the steady state, because of lags in the response of prices and in turn of real money demand.[12]

This issue (i.e. whether financial repression is an accident or whether it has some purpose) is overlooked in the literature. An exception is provided by Burkett (1987). According to Burkett some, political economic, explanations attribute financial repression to erroneous Keynesian rationales for low interest rates, or to ill conceived distributional (cf. rural credit) policies. Others view the maintenance of pervasive financial regulations as the outcome of pressure from interest groups. For example, Hong (1985, p.358) suggests that "... the chosen few, who may well turn out to be the existing group of influential big entrepreneurs would be able to enjoy using very low cost capital". We add that capital market imperfections are a standard textbook 'source of monopoly' (cf. Gravelle and Rees 1981, p.298). The potential beneficiaries from

12. But in Lanyi and Saracoglu (1983, p.7) it is asserted, for Brazil: "A brief departure from its historical policies [of maintaining high real interest rates] in 1979-80 brought an immediate response from savers". Also for an indication of the time horizon involved in financial liberalization for Turkey, liberalization in July 1980 was followed during six quarters by a quarterly deposit growth of 25% while inflation fell from 100% to 50% within a year.

financial liberalization do not exercise sufficient countervailing power because of free rider problems or limited access to "politically relevant resources". Burkett's preferred explanation states that "... interest rate restrictions have been used in attempts [i.e. import substitution industrialization] to alter the international division of labor in favour of domestic capital" (p.11). Alternatively governments with "... main goal ... to ensure the domestic stability required for the continued enrichment of state bureaucrats ...." (p.14) make "... use of subsidized credit as patronage ... dispensed to wealthy landowners and large firms in exchange for political support" (p.7).

At this point we leave the question of the motives behind financial restriction/repression. We turn to a number of authors who have explored the idea that revenue raised by the government, by what is effectively a form of financial restriction (e.g. sustained inflation in the presence of reserve requirements), finances investment expenditures.[13] In Mundell (1965) the government uses inflation tax revenue to finance (one for one) capital formation thus inducing (given the capital output ratio) output growth. But the possibilities of inflationary finance are limited due to the shrinkage of the tax base of equilibrium real balances as the inflation rate is raised. Given a linear and also a Cagan-type velocity function and reasonable values for the relevant parameters, the growth rate that can be achieved by infinite inflation is of the order of 1.5%. Aghevli (1977) argues that the gains in growth from inflation may not be significant (in

13. On average, government expenditures amounted to as much as half of the aggregate investment expenditure of the private sector in Greece in the forty years to 1985.

absolute terms) and also that the costs of inflation have to be considered. Costs are calculated à la Bailey (1956) and subtracted from consumption to reach utility. Maximisation of discounted future utility with respect to the inflation rate hinges on this trade-off: Increases in future utility, produced by the capacity created by government investment, involve sacrifices in current 'effective' consumption because of the welfare costs incurred. For some parameter values inflation may be a preferable tax characterised by relatively low collection costs (i.e. ratio welfare costs/revenue). Marty (1967,1973) shows that the collection costs of the inflation tax given a Cagan-type money demand function and reasonable parameter values are reduced by only a few percentage points when the revenue from the inflation tax is used to induce further growth (the comparison is made at identical rates of inflation/money growth).

Next we compare and contrast the literature on inflationary finance and growth to the (mainstream) financial repression literature, which was surveyed in the previous Sections of this Chapter. Within Mundell's framework the influence of the financing efforts of the government on private sector behaviour is confined to the response of real money demand as the government pulls the lever of inflation. And this, in turn, puts a limit to the government's financing potential rather than working on the level of private investment. However the reduction of the availability of credit for private investment seems to be the predominant mechanism by which financial restriction is thought to affect the economy. Similarly Aghevli (1977) models the costs of inflationary finance (i.e. the costs of financial repression in this simple set up), disregarding however any impact on private investment.

This is because neither authors consider a rationing determination of investment. Yet their conclusions that the growth gains by inflationary finance are not significant prejudges liberalization to be a preferred policy. A model of the short run dynamics following financial liberalization, where it is assumed that the government extracts inflation tax from its currency issue and directs it to capital formation, is provided by Hong (1985).[14]

Somewhat more favourable evidence for inflationary finance is provided by a model simulation by von Furstenberg (1983). In addition, Newlyn (1977) offers arguments for the effectiveness of inflationary finance, e.g. it is not only the currency issue which finances government (as assumed by most of the previous authors) but also quantitatively significant borrowing from commercial banks. Newlyn's calculations, based on an estimated velocity function, show that significant growth rates are sustainable by inflationary finance but we are cautioned as to the adverse implications for growth that may result from consequent balance of payments problems.

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14. Another complication which could be introduced is that discussed by Aghevli and Khan (1978). They point out that the budget deficit (and therefore the supply of high-powered money) is endogenous under inflation. This is due to lags in tax collection appreciably longer than those in the (proportionate) adjustment of government revenue (in nominal terms) during inflation in developing countries. A full model of the feedback, whereby the endogenous rise in high-powered money causes further inflation, is estimated, simulated and compared with the actual inflationary experience of various countries. However this possibility is dismissed for Greece in Batavia, Lash and Malliaris (1986).

Section 1.6

Financial Restriction, Financial Intermediation and Financial Liberalization

There are two directions towards which one's thinking could evolve from here. One could develop the insight that the authorities have at their disposal other controls over the yield of the inflation tax apart from variations in the rate of inflation and that financial restriction is precisely the application of such policy instruments.[15] Simultaneously one could consider more complicated models for the financial intermediaries explaining how private investment is crowded-out in the course of financial restriction. With these aims, we single out reserve ratios, loan rate ceilings, deposit rate ceilings and floors and analyse how each accomplishes financial restriction as well as the implications of liberalization, i.e. the abolition of each of the aforementioned constraints separately.

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15. In Fry (1973, p.372): "Successful financial restriction would be exemplified by three effects on the demand for money, namely, a rightward shift in the function, higher income and lower cost elasticities of demand". In Nichols (1974, p.423): "A government can shift the location and elasticity of that demand curve through the use of various controls and regulations and thereby change the level of inflationary tax receipts that is associated with any given level of inflation". Fischer (1982, Table A.1) gives an average for the ratio of the change in H to the change in H plus government revenue (where H is reserve money) which is around 14% for Greece over the period 1973-78. Over the same period the average for all industrial countries stands at 6% while the highest value recorded for this ratio is 46% for Argentina in the period 1960-1975. By contrast, Lanyi and Saracoglu (1983) suggest mechanisms through which government revenues are favourably affected by liberalization: the intermediation of wealth holdings from tangible assets into deposits implies the generation of interest income flows more easily taxable than capital gains. Higher loan rates put pressure on public enterprises for rationalisation, hence savings. Also hopefully tax revenues respond to the outcome for growth. Petrochilos (1985, p.62) describing the Greek financial system states that "the admini- strative determination of interest rates and the quantitative and quali- tative controls have, in effect, meant that successive governments have been able to finance their deficits with 'cheap money'".

Suppose we are concerned with assessing which situation (financial restriction/repression or liberalization) is more conducive to growth. For most of the analysis that follows, we adopt a common yardstick based on the belief that the availability of finance is a constraint on growth. We also assume that 1 Dr of private loans promotes growth by exactly as much as 1 Dr of government expenditure. It follows that the criterion of the comparison (of a situation with controls to a situation without controls) should be the volume of loanable funds, the sum of private bank loans and government revenues (from financial restriction). It is an issue to be examined whether the appropriate measure of government revenue from financial restriction should be the proceeds from the reserve ratio (Courakis 1984), inflation tax revenues on currency and reserves or inflation tax plus banking profits (Fry 1981a,1981b; Siegel 1981) on the grounds that typically the government would hold shares in the banks in such a system.

Consider liberalization as the abolition of a zero interest bearing reserve requirement. Then liberalization is entailed by the complete loss of the tax base of reserves. It also implies the disappearance of the reserve ratio as an instrument set to influence the equilibrium interest rates chosen by banks and thereby the volume of, hence inflation tax on, currency (Siegel 1981). Hence liberalization should lower inflation tax revenues. Even after liberalization, however, the rate of inflation remains as an instrument, which could be set by the authorities to 'maximise' inflation tax on currency. As far as (lump-sum taxes on) bank profits contribute to government revenue, they rise when the reserve ratio (or the inflation rate) declines. But to work out the implications (of the abolition of the reserve ratio) for a joint objective of bank profits and inflation tax, we should take into account the change in the 'optimal' inflation rate (that may accompany such financial liberalization).

We may now discuss which situation is most conducive to output growth, sustainance or removal of the reserve ratio. As Courakis (1984) points out, simple abolition of any reserve ratio will always lead to a rise in the volume of private loans. But, somehow, the adverse growth implications of the consequent loss of government revenue (and hence of government expenditure) also have to be taken into account. In order to avoid accounting in growth terms for this loss (and to consider the most realistic alternative open to a government) we assume that government expenditure is maintained after liberalization. To avoid analysing the impact on output growth of distortions introduced by non-lump sum taxes, we might assume that government expenditure is financed then by borrowing from the banking system at the going loan rate. This assumption is consistent with the 'typical inelasticity of tax revenues' as well as the absence of open markets for securities in developing countries. Furthermore, the interest bill of the government is financed by per unit taxes added to the cost of attracting deposits. The distortions from the taxes involved in this exercise are taken into account (i.e. the taxes have an impact on the size of the banking system). And the size of the banking system (i.e. total loanable funds) determines the potential of the economy for output growth. However, government expenditure is unchanged. Thus we may decide which situation is more conducive to growth by comparing the volume of private loans.

Courakis restricts government revenue to that obtained from bank reserves and also compares situations with identical zero inflation. Both assumptions could be relaxed in order to generalise the concept of government revenue to inflation tax revenue (plus [part of] bank profits), and to acknowledge that the 'optimal' inflation rate might change following liberalization.

Courakis (op.cit.) concludes that under a perfectly competitive banking system the two situations[16] yield identical volumes of private loans, whereas under a monopoly banking system liberalization results in a lower volume of private loans for any value of the reserve ratio. How might we adapt this result for a framework where the government sets the inflation rate so as to maximize some measure of inflation tax revenues? This result would probably carry forward if the optimal inflation rate under restriction were relatively low, irrespective of how the latter changes upon liberalization (since in the absence of a reserve requirement inflation is neutral).[17]

Consider now liberalization as the abolition of <u>loan rate ceilings</u>. As Courakis demonstrates, in the case of a monopoly bank a loan rate ceiling in an appropriate range results in a higher volume of deposits and loans thus unequivocally serving a growth objective.

16. Imposition of a reserve ratio is compared to bank borrowing by the government combined with taxation of interest.

17. We abstract from the borrowing of differences in inflation tax revenues. These can be worked out only if the change in optimal inflation rates is known.

Hence also a loan rate ceiling in combination with any given reserve ratio results in higher government proceeds (than if no ceiling were imposed). Therefore it can be identified as a measure of financial restriction not antagonistic to the growth objective. But the volume of deposits, hence the growth objective, can be maximised (given a monopoly bank) by a combination of a reserve ratio and loan rate ceiling which does not necessarily deliver the highest level of reserves and hence government revenues.

On the other hand, rather than being motivated by a revenue objective, loan rate ceiling policies can be inspired by a subsidisation ideal, whereby loan rate ceilings combined with selective rationing of credit correct 'divergences between private and social returns'. They aim at favouring sectors thought to be contributing more than others to economic growth. Compare next a situation involving selective credit controls with a situation where loan rate ceilings have been removed. When selective credit controls are in place, we are not on loan demand curves as in Courakis. Assume that, as in diagram 1, there is a low administered deposit rate allowing banks to break-even (given the ceiling on the loan rate) but depressing the volume of deposits. Suppose that, upon abolition of the ceiling rate, subsidies (to the favoured sectors) are to be maintained and financed by taxation or by diverting government revenues from other uses (cf. Johnson 1974; Khatkhate and Villanueva 1978). Then the distortions introduced by taxes or the suspension of 'other uses' have to be set against the benefits from liberalization (cf. Silber 1973). To compare (on the basis of the volume of loanable funds) the two situations, the amount of subsidies could be borrowed from banks or taxes imposed on the latter. Assume, by contrast, that subsidies are withdrawn but abolition of the loan rate ceiling enables abolition of the deposit rate ceiling and therefore results in a larger volume of loanable funds. Then the comparison is (perhaps more difficult) essentially between quantity and quality. Allegedly growth promoting sectors (previously not constrained by the availability of finance) are hit by higher loan rates and shrink, while other sectors (only recently entitled to credit) thrive. The net result on growth is an average of these two opposing tendencies.

Consider now deposit rate ceilings. What is the purpose of this type of financial regulation? Does it accomplish financial restriction? It is clear how financial restriction is accomplished by ceilings on, usury laws, unfavourable tax treatment of, interest rates payable on private capital issues. It is not clear what such purpose is served by ceilings on rates attracting funds into (favoured) bank liabilities. Because to the extent proceeds from reserves represent revenue to the government these decline, at any given level of the reserve ratio. For the imposition of deposit rate ceilings invariably detracts from the equilibrium volume of deposits (both under monopoly and perfect competition). One explanation for the imposition of deposit rate ceilings is the following: For presentational reasons, all rates may have to be pegged in order to administer a structure favouring bank liabilities (rather than merely fixing rates on competing instruments). Thus bank deposit rates may be low in absolute but not relative terms. Similarly administered deposit rates may be part of the presentation of an interest rate structure aiming to keep government borrowing costs or loan rates to favoured borrowers at low levels. One could also argue along lines suggested by Nichols (1974) that ceilings on deposit rates may be motivated by a desire to maintain relatively high currency holdings on which inflation tax is extracted[18]. However, this happens at the cost of lower deposits, hence lower reserves backing them which latter are taxed as well.

But whatever the direction of the relationship between inflation tax revenues and deposit rates, the government may seek to use the deposit rate as an instrument (affecting the equilibrium of the banking system) to maximise inflation tax revenues. This is indicated in Fry (1981a,1981b) who models a nationalised banking system. Furthermore, he shows that maximising (with respect to the inflation rate and the deposit rate) inflation tax on currency and deposits net of the real interest bill, may result in negative real deposit rates. The following comment is in order, here: Unlike Fry (op.cit.), an appropriate objective of a government owned money industry might be the sum of inflation tax on currency plus profits from monopoly intermediation. This is the natural extension of viewing maximisation of inflation tax revenue from fiat money as the optimisation of a 'mineral spring' monopolist. And it is not in general equivalent to the Fry objective function unless a perfectly elastic demand for loans at the inflation rate is assumed (a point made explicit in Siegel 1981). Considering a downward sloping demand for loans would of course alter the optimal values for the instruments and the objective. Thus the results of Fry (op.cit.) would not necessarily carry over in a model that adopts the appropriate objective for a government owned

18. In the twenty years to 1985 in Greece, currency holdings averaged to 50% of total deposits with commercial banks (excluding foreign currency deposits).

money industry. However his approach opens the way for the interpretation of deposit rate ceilings as devices for financial restriction. For example, in the case where the banking system is private but its profits contribute to government revenues by being (lump-sum) taxed, the conclusions of Fry (op.cit.) make us suspect that pursuit of the revenue objective may call for relatively low real deposit rates. These would have to be enforced by ceilings because this outcome would not be reached by a private monopolist. Intuitively, this is because, on the one hand, he would not have control over the inflation rate and, on the other hand, he would not have concern with the inflation tax to be made on currency.

The following arguments hinge on semantics but enable understanding of deposit rate 'ceilings' as devices of financial restriction: One could propose that what are called ceilings are rates determined freely (by banks in response to government policies) which appear low in comparison to the equilibrium of a perfectly competitive banking industry (but on which there is no upward pressure as in Fry (1988, Fig.1.4) or as in diagram 1). This could be illustrated within the framework of Siegel (1981) where the government is not given the choice to set the deposit rate. Here, the deposit rate is determined by a (bank) monopolist in response to the value for the reserve ratio and the inflation rate. The latter are set by the government to maximise either the inflation tax on currency and reserves or a joint objective of inflation tax plus bank profits (that are taxed away). Another reason for relatively low deposit rates could be the following: Abstracting from inflation tax considerations, the government may be running a nationalised banking system as a monopoly or may be sheltering a private monopoly (Jao 1985, p.199) because of concern with bank profitability. Somewhat differently, if repression is associated with high inflation rates, in the presence of a reserve ratio even a perfectly competitive banking system is bound to yield low equilibrium real interest rates. Under such circumstances deposit rates below competitive levels, i.e. ceilings by our semantics, imply the generation of some form of revenue to the government. For liberalization to be interpreted as the removal of such 'ceilings' it must be envisaged as a privatisation/ trust busting policy (cf. Dooley and Mathieson 1986; Jao 1985).

To the extent that deposit rate ceilings augment government revenues, directly or indirectly, the following issue arises: Assuming that government revenues extracted by means of deposit rate ceilings would be channelled into investment, their reduction upon liberalization has to be set against the gain in private loans to reach the net outcome for growth. This issue is not discussed in the literature, at least as far as the removal of conventional deposit rate ceilings is concerned. However, an analysis similar in spirit but revolving around a slightly different aspect of financial deregulation, appears in Siegel (1981). This relates to the outcome of 'financial liberalization' interpreted as privatisation or trust busting in the banking industry. The result obtained by Siegel (op.cit.) is as follows: The maximum revenue to the government from (completely taxed away) profits of a monopoly bank and inflation tax on currency is equal to the (maximised) inflation tax revenue on currency and reserves under perfect competition. This is analogous to maintaining the level of government revenue by borrowing after liberalization as in the Courakis comparisons and in the example worked out by Siegel the volume of private loans is higher under monopoly.[19]

Further reliance on semantics enables us along with Courakis (1984) to suggest that "... governments sometimes actually enforce (what are formally defined as) deposit rate ceilings as floors" (p.345). As Courakis has shown suitable values for the deposit floor increase the equilibrium volume of deposits under monopoly. Hence, as for loan rate ceilings, imposition of a deposit floor in the presence of a reserve requirement contributes both to financial restriction and growth objectives. However, the combination of values for ratio and floor that optimises the latter does not necessarily maximise the former.

The optimum optimorum for the growth objective, i.e. the perfectly competitive equilibrium level of deposits, could be replicated under a monopoly structure by a combination of a deposit rate floor with a loan rate ceiling. This conclusion by Courakis would obviously carry forward in the presence of the reserve ratio. Hence it is confirmed that administered rates in financial markets, characterised by imperfections, could optimise the growth objective together with furthering (but not maximising and abstracting throughout from inflation tax) government revenues. We note that this conclusion illustrates the following general point as well: The market structure in banking is a crucial consideration when evaluating whether the removal rather than the maintenance of regulations is most conducive to

19. Since the deposit rate under both situations comes out identical, the volume of deposits is the same; but only under perfect competition is the reserve ratio non-zero.

output growth.

Finally, there may well be more to intermediary behaviour (thus bearing on the issues of repression and liberalization) than the models in Courakis (op.cit.) or as illustrated in diagram 1. Assume that the regime is one of loan rate ceilings as well as deposit rate ceilings. Loan rate ceilings are decided 'first' on the basis either of a 'subsidisation ideal' or a government revenue or a growth objective. Alternatively a quantity for loans could be specified and rationed selectively at a low loan rate, off the demand curve for loans. Trivially then, there is no need for imposing a deposit rate ceiling[20] as well since the bank finds the level of the deposit rate so that sufficient deposits are attracted to satisfy the balance-sheet identity. Notice that this is a reversal of diagram 1 (and Fry 1988, Fig.1.4) where the rate on deposits is set first, for some reason below the perfectly competitive equilibrium and either an effective loan rate is reached to satisfy the balance sheet constraint or funds are otherwise rationed. It could be that we have to consider dynamic models to justify deposit rate ceilings (and their coexistence with loan rate ceilings as well as entry controls) because of concern of the authorities with the repercussions of aggressive competitive outbidding among banks (cf. Smith 1984). The destabilisation[21] of the financial system has to be seen as a potential cost of liberalization. Indeed prudential considerations lie behind a number of financial regulations

20. Of course it may be thought by policy makers that a reduction of the variance of the return on such instruments may improve their attractiveness in an inflationless long run ('leaning into the wind' etc.).

21. Footnote on next page.

(e.g. reserve ratios) and restrictive practices (cartelised rates, barriers to entry) as pointed out in Goodhart (1987, p.31) and specifically for financial repression in Fry (1982a, p.1052) and in Jao (1985, p.213)[22].

Section 1.7

Summary and Suggestions for Further Research

A body of theoretical and empirical work has been established which comes out clearly in favour of financial liberalization. It is shown that financial liberalization possesses a considerable potential for promoting investment and output growth. The key to this conclusion and in the analysis that precedes it, lies in the determination of investment by the availability of credit under rationing. Some theory and evidence on the complementarity of bank deposits and physical capital and on the adverse consequences of financial repression for productivity and efficiency, is also available.

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21. Dooley and Mathieson (1986) also argue that financial liberalization is likely to give rise to many supervisory problems (esp. in connection with conflicts of interest due to the joint ownership of banks and industrial borrowers, frequently encountered in repressed financial systems).

22. E.g. "the original impetus for deposit rate ceilings in the United States rested on the argument that excessive competition for deposits promoted instability of the banking system by raising the cost of funds and by encouraging banks to make higher-risk loans" (Taggart 1981, p.36). Beckerman (1988, e.g. p.234) employs similar arguments to suggest that financial liberalization is undesirable since it may drive the banks into increasingly riskier lines of business.

Reservations have been expressed in the literature about the desirability of financial liberalization in connection with the general rise in interest rates that may accompany it. This rise would affect intermediaries undertaking maturity transformation and firms borrowing from the banks or from the unofficial market (cf. new structuralists). In addition, financial liberalization may have a negative impact on government revenues and thus public investment programmes - a similar problem is analysed in the literature on inflationary finance and growth. Finally the removal of certain regulations on banks may, under specific conditions, lead to a smaller equilibrium volume of loanable funds thus defeating the purpose of financial liberalization. We concluded Chapter 1 by identifying prudential complications (cf. Smith 1984) as possible side effects of such financial reforms.

Further extensions of the literature could follow two directions. First there ought to be some modelling representation of the dilemma that although financial liberalization is desirable, because it enables an increase in private investment, it may cause a reduction in government revenues and thus public investment. A similar trade-off may exist in connection with the removal of selective credit controls and their replacement by fiscal schemes. Second the analysis of financial repression should take place on the basis of a detailed model for banks, (unlike the practice in most of the existing work). This is required since the nexus of regulations affects the economy mainly via the behaviour and in particular the scale of financial intermediaries. Courakis's (1984) model of the intermediary under repression could be incorporated within the macroeconomic system set out in Chapter 2 (in lieu of the equation for the rudimentary banking system). An adaptation of this static model to the dynamic framework (e.g. a change from the proceeds of the reserve ratio to inflation tax on reserves, as the concept of government revenue) would be necessary. Incorporation of Courakis's model could modify our conclusions and perhaps reduce the critical loan rates (see Chapter 2). This is because Courakis (op.cit.) has shown that under certain circumstances the removal of regulations leads to a reduction in the equilibrium volume of private loans and/or total loanable funds.

An intriguing, but perhaps not unexpected, feature of the repressed financial system is the existence of parallel (capital) markets, which play a crucial role in new structuralist models. Curiosity about the detail of their operation can never be satisfied entirely. However, the acquisition of indirect evidence on underground economic activity is not infeasible. Pavlopoulos (1987, p.120) who has undertaken a quantitative assessment of the black economy in Greece, states that he is not prepared to hazard a guess about the turnover of unofficial money (and foreign exchange) markets, the existence of which he acknowledges. At this stage we have recorded various casual references to these markets; obviously there is always scope for further research here.

One fails to find a complete explanation of the purpose of repressive financial regulations in the relevant literature. Policy errors, financial restriction (i.e. extraction of government revenue) or political economic motives are the reasons usually given. In particular, it is difficult to rationalise ceilings on deposit rates as instruments of financial restriction. The financial repression literature needs to be extended along the lines of Fry (1981a, 1981b, 1982a), Jao (1985) in order to clarify this specific issue. The answer to the broader question (why repress the financial system) may have to be sought in political economy along the lines of Burkett (1987) and Hong (1985).

CHAPTER 2

A MACROMODEL FOR AN ECONOMY UNDER FINANCIAL REPRESSION AND ITS VARIANTS

Section 2.1

Introduction

Section 2.2 begins by setting out the equations (static and dynamic) of the basic macroeconomic model to be extended in the course of Chapter 2. The key equation, which links the output growth rate to the net flow of finance, reflecting the prevalence of loan rationing in the banking system, is derived in Subsection 2.2.1. Subsequently the procedure to be followed throughout Chapter 2 is explained: In Subsection 2.2.2, an equation is derived for steady state growth. In Subsection 2.2.3, the partial derivative of the expression for steady state growth with respect to the deposit rate, is worked out. The comparative dynamics of a change in the deposit rate are explained. As discussed in Subsection 2.2.6, we calculate the maximum value of the real loan rate for which the partial derivative takes a positive sign, and therefore, for which a policy of increase in the administered interest rate promotes output growth. In Subsection 2.2.4, we discuss how, given values for the predetermined and the exogenous variables, the endogenous variables are determined recursively. In Subsection 2.2.5, we describe the short-run transmission of the effects of an administered increase in the deposit rate.

In Section 2.3, we discuss the inspiration for the extensions to the basic model which we undertake. First, in the spirit of the financial regression approach, we view the role of the reserve ratio to be the extraction of government revenue. Second, in line with the literature on inflationary finance and growth, we assume that the government channels the proceeds from such financial restriction to capital formation. Third, following the rationale on the basis of which the basic model was developed as an extension of Kapur (1976), we model the impact of bank losses on aggregate capital formation.

Subsequently, in Section 2.4, we develop five Variants of the basic model. In Variant 1, we analyse the effect of directing inflation tax on reserves to government capital formation. In Variant 4, we examine the effect of bank losses. In the intervening two variants both extensions are considered in combination. In Variant 5, we study the effect of making the volume of profits, which are reinvested, depend on the real interest rate, as stipulated in the financial repression literature. For each Variant we analyse the extra complications introduced in the recursive structure of the model. We also examine how the extensions modify the conclusions of the basic model as to the impact of increases in deposit rates on the growth rate of the economy.

Note on presentation: Word processing difficulties have forced me to segregate maths to Appendices A-K.

Section 2.2

The Model and the Method

The models discussed are all variants of the model used by Currie and Anyadike-Danes (1980) (referred to as Currie/Danes).

The equations comprising the model of Currie/Danes are (Appendix A):

- A Cagan-type demand for money relating desired real deposits (there is no currency) per unit income to the expected real deposit rate.
- A production function relating the stock of capital to output by a constant coefficient.
- An equation for the banking system equating the nominal loan rate to the administered deposit rate.

Subsequently the latter two equations are condensed in the growth equation.

The underlying dynamics (used only in the linearisation) are described by:

- A Phillips curve relating actual inflation to the discrepancy between actual and demanded real money balances per unit income and expected inflation.
- An adaptive expectations scheme relating the rate of change of expected inflation to the discrepancy between actual and expected inflation.
- Use is made of an identity relating the rate of growth of actual real money balances per unit income to the monetary and income growth rate as well as the actual inflation rate.

2.2.1
The growth equation (Appendix B)

The crucial equation is similar to that of Kapur (1976) and relates capital formation to the net flow of loans to the private sector, all per unit income and in real terms. The significant feature introduced by Currie/Danes is that to reach the net flow of finance, interest payments on outstanding loans have to be subtracted from total credit extension. Specifically, new capital formation (per unit income) per period is equal to the flow of profits before interest[1] (per unit income) plus the real value (per unit income) of the volume of new loans extended per period minus the real value (per unit income) of the total payments of interest on outstanding loans per period. The real value (per unit income) of new loans is equal to the growth rate of loans multiplied by the real stock of loans (per unit income) whereas the real value (per unit income) of the interest bill is equal to the nominal loan rate multiplied by the real stock of outstanding loans per unit income. So capital formation (per unit income) per period is equal to the flow of real profits per unit income plus the product of the real stock of loans (per unit income) by the difference between the growth rate of loans and the nominal loan rate. The banking system

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1. This term which is constant seems at first sight to have no function since it does not appear in the expression for 'the partial' and vanishes in the linearisation under the assumption that σ is constant. However its omission could give rise to curiosities and be unrealistic: Say in a situation of zero monetary growth with some loans outstanding, neglecting profits we would conclude that the capital stock is shrinking at a proportionate rate equal to the nominal rate of interest.

   In general loans would not be taken out at all in the absence of profitable opportunities. Further if additional loans are to be absorbed after the loan rate rises upon liberalisation it must be that before liberalisation the rate on loans fell short of the yield on their marginal use given a downward sloping marginal efficiency of investments, unless, say, expectational mistakes on the profitability of new projects are made. This is quite likely because loan rates are repressed and thus bound to be below economy wide profit rates before liberalisation hence it would not be realistic to assume that recipients of loans are making zero profits. On the other hand, we have the familiar argument whereby under rationing the latter are selected to be among those undertaking less risky hence less profitable projects. Correspondingly even if established borrowers can no longer realise positive profits after loan rates rise, there is likely to exist a fringe of hitherto excluded borrowers with highly profitable projects ready to take up the newly available loans. Obviously the growth equation involves extreme aggregation and such redistributive implications of liberalisation are not uncovered. Further justifying a possible omission of the consideration of profits in capital formation, the realities of a repressed economy could be well represented by assuming that a very low proportion of profits is in fact retained due to high consumption or the tax regime. Also the assumption of the constancy of the share of profits is no less arbitrary but say presupposes a Cobb-Douglas production function and perfect competition.

is subject to a reserve ratio. Since there is no currency the stock of loans equals the stock of money (deposits) multiplied by 1 - reserve ratio. Because the reserve ratio is not changing continuously over time, reserves, deposits and loans all grow at a common constant growth rate, the monetary growth rate. By the specific assumption about the banking system the nominal loan rate equals the administered deposit rate. Thus substituting out for the real stock of loans per unit income the growth rate of loans and the loan rate we may equate capital formation per unit income to the constant flow of profits per unit income plus the product of the real stock of money per unit income by 1 - reserve ratio times the difference between the monetary growth rate and the administered deposit rate. Given new capital formation (per unit income) per period we may read-off from the production function the resultant per period increase in the capacity level of income of the economy (expressed per unit income which is the income growth rate).

2.2.2

Steady state growth (Appendix C)

The steady state is described by constancy of actual real money balances per unit income and involves fulfilment of inflationary expectations and equality between actual and desired money balances per unit income. Because of the constancy of actual real money balances per unit income over time in the steady state, we have that the actual rate of price inflation (and hence expected inflation as well) equal the difference between the monetary growth rate and the growth rate of income. Thus we write an expression for the steady state (income) growth rate by substituting in the growth equation the real stock of deposits per unit income by the demand for real deposits per unit income, the latter being a function of the expected real deposit rate, i.e. the administered deposit rate less the difference between monetary and income growth.

2.2.3 'The partial'

The policies of liberalisation are summarised in an increase in the nominal rate payable on deposits and they are pronounced beneficial or harmful by examining the sign of the partial derivative of the expression for steady state growth with respect to the nominal deposit rate ('the partial').(Appendix C)

This exercise is one of comparative statics between steady states and no use of the dynamic equations is made in the computation of 'the partial'. Intuitively the mechanisms reflected in this computation are as follows: Between steady states a change in the administered deposit rate, changes the demand for real deposits (desired real money balances) per unit income both directly but also by affecting the steady state (income) growth rate hence the (expected) steady state inflation given monetary growth, thus the steady state (expected) real deposit rate. Therefore with a given reserve ratio, the real stock of loans (per unit income) in the steady state changes. Given the monetary growth rate, the real value (per unit income) of new loans extended per steady state period changes. However the change in the deposit rate is passed onto a change in the nominal loan rate. This, combining with the change in the steady state real stock of loans (per unit income), yields a change in the real value of interest payments (per unit income) per period in the steady state. Since the flow of profits (per unit income) is constant, the resultant change in capital formation (per unit income) and thus the change in steady state growth is related to the change in the real value of the steady state net flow of loans which can be deduced by superimposing the above two tendencies. This ambiguity is reflected in the computations since in general neither the numerator nor the denominator of the partial can be signed unequivocally on the basis of the conventional assumptions about the signs of the structural parameters involved. Thus stability has to be invoked and it requires, in all variants, that the sign of the denominator be positive.

In order to reach the stability conditions the growth equation is written in time derivative, as well as 'level' form. The equations of the model are subsequently linearised around the steady state and condensed into a system of two differential equations in the variables of growth and expected inflation. Stability imposes that the sign of the determinant of the characteristic matrix be positive whereas the sign of the trace be negative. The denominator of 'the partial' can be signed at once on the basis of the determinental condition.(Appendix D)

2.2.4
The recursive structure of the model to be linearised (Appendix A)

To discern the recursive structure of the system of equations used in the stability analysis - linearisation consider the system out of the steady state as evolving discretely over time.

Initial values for expected inflation and actual real money balances per unit income are given. The reserve ratio, the monetary growth rate and the deposit rate are administered exogenously, while the flow of profits per unit income is a constant.

Given the initial value for actual real money balances per unit income, the growth equation determines the income growth rate within the initial period.

Given the initial value for expected inflation, the Cagan demand function determines desired real money balances per unit income in the initial period.

Having derived desired real money balances per unit income and given the initial values for actual real money balances per unit income as well as for expected inflation, the Phillips curve determines the actual rate of inflation within the initial period.

Having derived the actual rate of inflation and the income growth rate and given the exogenous monetary growth rate and the initial value for actual real money balances per unit income we may compute the change in actual real money balances per unit income over the initial period.

Having determined the actual rate of inflation in the initial period and given the initial value for expected inflation the adaptive expectations equation determines the change in expected inflation over the initial period.

Having determined the changes over the initial period in actual real money balances per unit income and in expected inflation we may predetermine their respective starting values for the next period and repeat this recursive procedure until a steady state is reached (if at all).

As for algebraic manipulations, in view of the above it would be natural to condense the equations of the model into a system of two differential equations, in the variables of actual real money balances per unit income and expected inflation. However, Currie/Danes using the growth equation substitute out the level and time derivative of actual real money balances per unit income, in terms of the level and time derivative of the growth rate, in anticipation of their phase diagram analysis where for expositional convenience they would rather have the path of the growth rate represented directly. We stick to this convention and easily verify for VARIANT 0 that of course the determinental stability condition of the system in terms of actual real money balances per unit income and expected inflation is the same as that derived by Currie/Danes. (Appendix E)

2.2.5

The intuition behind the recursive structure (Appendix A)

The following is a possible intuitive account of the events that follow a change in the administered deposit rate starting from the steady state:

The change in the deposit rate causes a step change in desired real money balances per unit income according to the Cagan demand function. Since in the steady state desired and actual real money balances per unit income are just equal a discrepancy opens between the two instantaneously.

As in Kapur (1976) here in the model of Currie/Danes actual real money balances rather than the demand for real money (deposits) per unit income determine the scale of the banking system and are therefore pertinent for the income growth rate. In turn actual real money balances per unit income depend on the rate of monetary growth thus could be influenced by variations in the rate of issue of high powered money by the monetary authority.

However, the change in the deposit rate causes a change in the real value per unit income of total interest payments at any given level of actual real money balances per unit income and thus a change in the net flow of finance hence a step change to growth given a constant flow of profits per unit income.

The opening of the discrepancy (per unit income) between actual and desired real money balances leads to a step divergence of the actual rate of inflation from its expected value. The intuition is of course that of 'hot potato money' whereby the collective attempt of money holders say to accumulate money balances to desired levels above actual levels has as its counterpart a 'glut' of goods and thus a depression in the rate of inflation from what it would otherwise be (by some unspecified bidding process that changes the underlying equilibrium goods prices combined with gradual adjustment of actual prices to equilibrium levels).

The change in the actual rate of inflation together with the change in the growth rate of income induce a gradual change in the real value of actual real money balances per unit income. This gradual change in actual real money balances per unit income implies a change in the scale of intermediation, thus the net flow of loans at a given deposit/loan rate hence itself gradually influencing the growth rate of income.

The change in the actual rate of inflation also leads to a gradual adaptation of inflationary expectations and thus to a gradual change in desired real money balances per unit income.

Thus the width of the discrepancy per unit income between actual and desired real money balances which lies behind the movement of the system is modified and thus the stability considerations.

Also the change in expected inflation feeds back into a change in actual inflation.

2.2.6 Signing and the critical real loan rate (Appendix F)

The sign of the numerator is studied at plausible values for the semi-elasticity of money demand and the growth rate (as well as the nominal deposit rate and the reserve ratio in other variants). Specifically the critical real loan rate is defined as that level of the loan rate which makes the numerator of 'the partial' equal to zero. For any higher 'starting' values of the real loan rate 'the partial' takes a negative sign and therefore a policy of raising the deposit rate is harmful for growth.

All these relationships, as well as the steps undertaken in order to sign 'the partial' appear in the variants we consider, which are therefore descendants of the Currie and Anyadike-Danes (1980) paper and consequently of the Kapur (1976) article as well.

Section 2.3

Extensions: Our Variants

Currie/Danes interpret their findings of strongly negative critical real loan rates as implying that in actual economies the prospect for liberalisation are likely to be unfavourable. Their pessimism, contrasting with Kapur and other liberalisation literature, is attributable to the additional mechanism introduced: upon a rise in the deposit rate the scale of the banking system, hence the flow of credit increase. But because the rise in the deposit rate is passed onto a rise in the loan rate, at the new steady state, debt servicing payments are bound to increase by so much for plausible parameter values, that the net flow of finance to the private sector, hence growth, declines.

Our task lies in examining whether such pessimistic conclusions for liberalisation carry over when the model employed by Currie/Danes is extended in various directions suggested both by realism and consistency.

We make use of the idea of 'financial restriction' whereby a number of the regulations imposed on banks in less developed financial systems are motivated by the augmentation of government revenue. The realities of Greece in particular are best represented by attributing to the government a significant participation in capital formation. Although the Currie/Danes specification incorporates a reserve ratio, this seems to have no function: By contrast we give a role to the reserve ratio, that of enabling the government to raise inflation tax revenue on reserves. In turn the government channels its proceeds to capital formation, an idea encountered in Mundell(1965). Therefore in our growth equation we relate the growth rate to the inflation tax revenue alongside the net flow of finance to the private sector - a full generalisation would involve inclusion of the inflation tax on currency in circulation.

Specifically in VARIANT 1, we write total capital formation (per unit income) per period to be equal to the sum of private and government capital formation (per unit income). Private capital formation (per unit income) is the same as in Currie/Danes - VARIANT 0. Government capital formation (per unit income) is equal to the real inflation tax revenue on reserves (per unit income), i.e. the monetary growth rate multiplied by the reserve ratio times actual real money balances per unit income. Feeding this through the production function we get the corresponding modification of the growth equation.

In a sense we are bringing together the literature on the short-run dynamics upon financial liberalisation with the literature on growth under inflationary finance remedying the omission of a government sector from the former and the omission of private investment from the latter.

Since the financial liberalisation literature concedes that the motive behind repression is the extraction of government revenue, it would follow that liberalisation (a generalised removal of repressive regulations) results in significant changes (indeed reductions unless restrictive measures are counterproductive) in government revenue. If the outcome of liberalisation for growth is sought, this must be taken into account since the change in government revenue must inevitably have an impact on government capital formation. Yet the attention of models of short-run dynamics is confined to the impact of liberalisation on the scale of financial intermediation and thereby private investment and growth (and Currie/Danes point out that such computations are incomplete).

On the other hand, we take from the literature on growth under inflationary finance a conveniently simplified description of what we refer to in general terms as financial restriction and corresponding precise government revenue goal: imposing a reserve ratio on banks and running monetary growth in order to extract inflation tax. Obviously this is far from exhausting the plurality of regulations which allegedly accomplish financial restriction but it can be readily modelled.

Yet this literature neglects the main problematic of financial liberalisation models namely the impact of the financing efforts of the government on private investment. Within this literature the impact of the financing efforts on private behaviour is confined to the response of the equilibrium real money balances to increases in inflation, which 'matters' only because it limits the potential for government revenue extraction thus government capital formation. If other adversities caused to the private sector by inflationary finance are analysed, these are the costs of inflation à la Bailey.

Analogously to this literature but rather than considering variations in the inflation rate, we consider the impact on growth of variations in the degree of financial restriction represented by the value of the administered deposit rate ceiling and also the existence or not of the reserve ratio (these imply variations in the potentialities of inflationary finance). However, supplementing this literature in these exercises we view the transmission of the effects not simply via their impact on government but also on private capital formation.

Although we do not actually pursue such a line, our variants could be suitably deployed to provide an expression for the growth maximising (or optimal given say a multiperiod utility function) inflation rate and carry out the conventional exercises with plausible parameter values etc., once we take more explicitly into account the impact of inflation on the equilibrium of the banking system hence the net flow of finance and private capital formation.

Further, we attempt to complicate the banking system considered in Currie/Danes and examine to what extent this would modify the conclusions as to the favourability of liberalisation.

Currie/Danes set the nominal loan rate equal to the nominal deposit rate. Presumably within the general context of financial repression there is rationing in the banking system: the deposit rate is set administratively, determining the volume of deposits along the Cagan demand function. A fraction equal to the compulsory reserve ratio is retained as reserves and the residual is rationed out as loans at a nominal rate equal to the deposit rate. The role of the reserve ratio as introducing a wedge between the deposit and loan rates is ignored and as a consequence banks are making losses which widen as the nominal deposit rate rises upon 'liberalisation'.

Currie/Danes envisage their model as a development of the basic model of Kapur on the rationale that the increased costs of loan servicing upon liberalisation cannot be left unaccounted for but must come out of the cash flow of firms, otherwise financing capital formation. Consistency in this rationale suggests that the losses of banks must have some manifestation as well. Although (commercial) banks do not normally take part in capital formation it cannot be that they sustain losses in the steady state indefinitely. So it must be either that we have no losses, or in case we have losses that we cover them.

We therefore consider a variant whereby a sufficiently high nominal loan rate is administered so that given the deposit rate and the reserve ratio, zero profits are guaranteed to the banks. Evidently our conclusions should not alter qualitatively if (perhaps closer to reality) a positive target rate of return is guaranteed instead.

Specifically in VARIANT 2 we modify the expression for private capital formation of Currie/Danes - VARIANT 0 - by substituting out the loan rate by the deposit rate divided by 1 - reserve ratio. Feeding this through the production function we get the corresponding modification of the growth equation.

On the other hand, the government may not wish to see the substantial rise in the loan rate upon liberalisation, implied by the zero profit condition, in order to protect private investment (nourished by selective credit policies for years). In this case we assume that the government administers a nominal loan rate equal to the deposit rate but covers the consequent losses of banks by grants from its inflation tax revenues.

Specifically in VARIANT 3 private capital formation (per unit income) is the same as in Currie/Danes - VARIANT 0. However, government capital formation (per unit income) is equal to the real inflation tax revenue on reserves (per unit income) minus real banking losses (per unit income) (the latter being the product of the administered deposit rate times the reserve ratio times actual real money balances (per unit income)).

Fry (1988, pp.41-43) has remarked on the simplistic nature of the Currie and Anyadike-Danes banking system and has suggested instead that the likely state of affairs in repressed financial systems is market clearing by effective loan rates. Here given the administered deposit rate the demand for deposits and the reserve ratio the volume of funds available for on-lending is determined. This is rationed out along the underlying loan demand, by price, at an effective level which exceeds what may be the formal ceiling for the loan rate. Importantly upon a rise in the deposit rate the effective loan rate has to decline so that the higher volume of available funds can be absorbed by borrowers. Thus the effect which led Currie and Anyadike-Danes to pessimistic conclusions does not obtain.

Section 2.4
Our Results

The presentation of each of our variants goes as follows: After arranging the assumptions behind the variant in question the account is divided into two parts. The first part is the suitable adaptation of the verbal analysis of the Currie/Danes model. It can be skipped if immediately obvious from the arrangement of the assumptions. The second part describes briefly our particular results mainly in connection with the signing of the partial and related discussion.

VARIANT : 0 : The model of Currie/Danes with $s = 1$, $c = 1$, σ constant. (Appendices A, B, C, D).

2.4.1
VARIANT : 1

Banking system : Administered deposit rate equals the nominal loan rate.

Government : Participates in capital formation by investing the inflation tax revenue on reserves.

Banks make losses.

Part 1: (Appendix G)

As far as the mechanisms reflected in the computation of the partial are concerned to those of Currie/Danes - VARIANT 0 - we add the following: Between steady states a change in the administered deposit rate changes the demand for real deposits (desired real money balances) per unit income. Therefore with a given reserve ratio, the real stock of reserves per unit income in the steady state changes. Given the monetary growth rate real inflation tax revenue (per unit income) extracted per steady state period, hence government capital formation per unit income, change and contribute to a change in growth.

As far as the intuition behind the recursive structure is concerned here in VARIANT 1 we have all the events which follow a change in the administered deposit rate in Currie/Danes - VARIANT 0 - and make two additional observations.

First when out of the steady state it is actual rather than desired real money balances per unit income which determine the volume of reserves on the basis of which inflation tax is extracted and are pertinent for government capital formation and the income growth rate.

Second here in VARIANT 1 the gradual change in actual real money balances per unit income driven by changes in actual inflation and growth implies a change in the scale of intermediation and hence not only loans and private capital formation per unit income but also reserves, hence real inflation tax revenues thus government capital formation. Thus the growth rate of income is influenced on two counts and in turn affects actual real money balances per unit income.

Part 2:

We expect that the consideration of government as a participant in capital formation should not only lead to a higher absolute level of growth compared to VARIANT 0 but also tilt the conclusions in favour of liberalisation: For within VARIANT 1 a rise in the deposit rate by increasing the volume of reserves would contribute to inflation tax revenues hence growth without inducing any costs (such as debt servicing) over and above those occurring in VARIANT 0.

Within this variant we work out 'the partial' and sign the denominator to be positive by stability. (Appendix G).

In order to sign the numerator/work out the critical real loan rate alternative plausible values are given to the following parameters: the growth rate (0.1); the interest semielasticity of deposit demand (3, 1.5, 1, 0.5); the reserve ratio (0.2-0.9); the administered nominal deposit rate (0-0.5).

For common plausible values for the growth rate and the interest semi-elasticity the answers for the critical rate are the same as those of VARIANT 0, only if we assume that the deposit rate is administered at strongly negative nominal levels (-0.33, -0.67, -1, -2 order corresponds to the values for the semielasticity) or if there is a rate of deflation equal to -0.1. (Table 2.1) For any higher levels of the deposit rate or inflation irrespective of the assumed value for the reserve ratio the critical rates in VARIANT 1 are algebraically higher than those within VARIANT 0. Thus for a certain range of starting values for the real loan rate VARIANT 1 yields favourable predictions for liberalisation thus conflicting with the predictions of VARIANT 0. The divergence between the answers of the two variants for the critical rate is wider the higher the reserve ratio, the higher the deposit rate and/or the inflation rate and the lower the interest semielasticity (since that depresses the critical rate in VARIANT 0 by more). (Appendix F).

However upon working out the critical rates for VARIANT 1 it becomes apparent that only if the values for the semielasticity and/or (less potently) the reserve ratio and the administered deposit rate are towards the top of the plausible ranges, we get resultant critical rates that do not fall below what could have been observed in actual economies and possibly Greece. Once the implied rate of inflation is also reported we may distinguish in the tabulations some quadruples of values of deposit rate, inflation rate, real loan rate and reserve ratio which may describe the circumstances of a financially repressed economy such as Greece. (Tables 2.2-2.5).

In view of these results deposit rate ceilings may be justified as the necessary prerequisites of low loan rate policies which seem to be successful in promoting growth. By contrast from the point of view of financial restriction deposit rate ceilings may appear ill-thought since they hinder the realisation of inflation tax on reserves. On the other hand, they may be 'protecting' the holdings of currency in circulation (close to 70% of M1 in

Greece) on which inflation tax is made. In this case, assuming that government participates in capital formation, the role of deposit rate ceilings as a growth promoting policy is also reinforced.

Within VARIANT 0 it may be thought that an obvious remedy for the financial difficulties of firms after liberalisation is the provision of government grants. Within VARIANT 1 it follows quite trivially that this would make no difference since it would engage government revenues otherwise channelled into capital formation.

2.4.2
VARIANT : 2

Banking system : Zero profits.

Government : Participates in capital formation by investing the inflation tax revenue on reserves.

VARIANT : 3

Banking system : Administered deposit rate equals the nominal loan rate.

Government : Participates in capital formation by investing the inflation tax revenue on reserves, after the losses of banks have been covered by grants.

Part 1: (Appendix H)

As far as the mechanisms reflected in the computation of the partial are concerned to those of Currie/Danes - VARIANT 0 - we add the following: Between steady states a change in the administered deposit rate changes the demand for real deposits (desired real money balances) (per unit income). Therefore with a given reserve ratio the real stock of reserves in the steady state hence real tax revenue (per unit income) change. However, the change in the administered deposit rate, combining also with the change in the steady state stock of real money balances (per unit income) yields a change in real banking losses (per unit income). Since the government covers real banking losses to reach the net change in real government revenues, thus change in government capital formation (per unit income) contributing to a change in income growth, we need add this to the change in real inflation tax revenue (per unit income).

As far as the intuition behind the recursive structure is concerned here in VARIANT 3 we have all the events that follow a change in the administered deposit rate in Currie/Danes - VARIANT 0 - and in addition the following mechanisms.

A change in the deposit rate causes a change in real banking losses per unit income at any given level of actual real money balances per unit income and thus a change in net real government revenue per unit income, in government capital formation per unit income and thus a step change in growth. This together with the change in the actual rate of inflation (by the Phillips curve) induces a gradual change in the real value of actual real money balances per unit income.

This gradual change in actual real money balances per unit income implies a change in the scale of intermediation and hence not only private capital formation per unit income but also real banking losses per unit income at the given deposit rate and reserves thus real inflation tax revenues per unit income. The latter two tendencies combine to yield the change in government capital formation per unit income. The change in government and private capital formation per unit income combine and yield a gradual change in the growth rate of income which in turn affects actual real money balances per unit income.

Part 2:

We derive identical growth equations and 'partials' for VARIANTS 2 and 3;

further these are equal to the corresponding expression encountered in VARIANT 0 multiplied by a factor equal to 1/(1 - reserve ratio). We sign the denominator to be positive by stability. The critical real loan rates are the same as those under VARIANT 0. (Appendix H and Table 2.1).

It makes no difference for the growth outcome whether firms take the full brunt of liberalisation in the form of relatively higher loan rates ensuring zero profits to the banks, or whether the rise in the loan rate is moderated to protect firms but the government makes good the consequent losses of banks at the expense of its capital formation.

The expressions for growth under VARIANTS 2 and 3 could be obtained directly by setting a value of zero for the reserve ratio in the expression for growth in VARIANT 0. The government intervenes by imposing a reserve requirement (apart from a deposit rate ceiling) in order to channel the proceeds into capital formation but in the process it either raises the loan rate crowding out private investment (the inflation tax is paid out of the cash flow of firms) or it imposes equal losses on the banking system. Thus our attitude towards such intervention should be neutral. It seems that inflationary finance (in Mundell's sense) has no potential.

2.4.3
VARIANT : 4

Banking system : Zero profits.

No government investment.

Part 2:

Within this variant we work out 'the partial' and sign the denominator to be positive by stability. (Appendix I).

In order to sign the numerator/work out the critical real loan rate alternative plausible values are given to the following parameters: the growth rate (0.1); the interest semielasticity of deposit demand (3,1,0.5); the reserve ratio (0.2-0.6). For common values of the other parameters and any non-zero reserve ratio, the critical rates are algebraically lower than those of VARIANT 0 with the divergence widening as the reserve ratio rises. (Appendix F and Table 2.6).

Thus Currie/Danes (i.e. VARIANT 0) do not draw out consistently the full implication of the rationale which they invoke to extend Kapur (i.e. that debt servicing payments cannot come out of nowhere). Both their neglect of government capital formation and the emergence of persistent losses to banks serve to bias their conclusions as to the favourability of liberalisation compared to a variant where either of these features is treated consistently (i.e. VARIANTS 1 and 4). But compared to a 'complete' variant (i.e. 2 and 3) where both features coexist and are handled consistently the Currie/Danes predictions as to the favourability of liberalisation are correct, although their expressions underestimate the possible extent of the benefits attained by changes in the administered deposit rate.

For an illustration we consider the prospects for liberalization in Greece over the period 1973-1982 during which (excluding the observations for 1975, 1978 and 1980) actual real loan rates fell below zero. Over this same period the average growth rate was 3% and the average nominal loan rate was 15%. We selected the period average of the ratio of Reserve Money minus Currency Outside Banks over Total (i.e. Demand plus Time plus Savings plus Other) Deposits with Commercial Banks as the value for the reserve ratio. The (real) interest semielasticity of Total Commercial Bank Deposits was estimated (Chapter 5) to be close to 1.5. Accordingly we computed that the critical real loan rate for variants 0, 2 and 3 is -64%, for variant 1 is -52% and for variant 4 is -76%. (Note that we substitute the average value of the nominal loan rate for δ in the formulae of Appendix F.) On comparison with the real loan rate of -4% prevailing on average over the period we may conclude that rises in interest rates would have further reduced growth (with an average capital output ratio of 30% and real deposits per unit income equal to 35% the stability condition is satisfied).

2.4.4

VARIANT 5

Banking system: Administered deposit rate equals the nominal loan rate.

Government: Participates in capital formation by investing the inflation tax revenue on reserves.

Banks sustain losses.

The new feature introduced: Real profits per unit income are not constant but a positive exponential function of the (expected) real deposit rate. A considerable part of the literature on financial repression suggests that aggregate profits (before interest payments) should be made to depend positively on the level of real interest rates to represent mechanisms such as the following:

When the real interest rate rises, from all projects that depend on loans it is those having the lowest profitability which can no longer break even and withdraw to be replaced by projects of necessarily higher profitability that were rationed out previously by means of non price criteria; consequently the average profitability in the pool of projects with access to finance rises. Assuming that on the whole projects cannot materialize without some accompanying bank finance the argument justifies a positive dependence of economy wide profitability on the level of the real interest rate. At the same time a rise in the real deposit rate discourages self financed (typically low scale) projects by rendering placements in deposits more attractive. In turn banks using their superior project evaluation expertise and capable of pooling small holdings, lend out those funds to finance higher yielding large-scale projects (in the private or via reserve asset requirements or otherwise, the public sector). Again a rise in the level of real interest rates is associated with a rise in economy wide profitability. A higher flow of profits creates greater opportunities for retainement and reinvestment. The exponential form is chosen to represent this dependence because of the convenient interpretation of the parameter in the exponent as a semielasticity.

The dependence on the expected rather than the actual real deposit rate allows this variant to retain the recursive structure and linearisation procedure as in all preceding variants. It is similar to the specification of the dependence of the output/capital ratio on the expected real deposit rate by Currie and Anyadike Danes. It makes no essential difference since the exercise (the calculation of the 'partial' and related computations below) is one of comparing steady states when expected inflation is equal to actual inflation.

Part 1: (Appendix J)

As far as the mechanisms reflected in the <u>computation of the partial</u> are concerned to those of VARIANT 1 we add the following:

The change in the steady state expected real deposit rate changes the flow of real profits (per unit income) per steady state period, exponentially.

The resultant change in the steady state private capital formation (per unit income) can be deduced by adding the change in the steady state real flow of profits (per unit income) on the change in the steady state net flow of loans. Since the change in the steady state net flow of loans is the result of two opposing tendencies (the change in the real value of interest payments (per unit income) set against the change in real value (per unit income) of new loans) its direction is ambiguous.

As far as the recursive structure is concerned here in VARIANT 5 we have the following mechanisms additional to those appearing in VARIANT 0. Given the initial value for expected inflation real profits per unit income in the initial period are determined. Given real profits per unit income in the initial period and given the initial value for actual real money balances per unit income, the growth equation determines the income growth rate within the initial period.

Part 2:

We work out 'the partial' and sign the denominator to be positive by stability (Appendix J). We relate the critical real loan rate within this variant, to the critical real loan rate in VARIANT 1 (Appendix K).

The critical real loan rate in VARIANT 5 exceeds the critical real loan rate in VARIANT 1 by a (positive) term which is higher the higher the semielasticity of real profits per unit income w.r.t. the real deposit rate, the lower the interest rate semielasticity of money demand, the higher the (starting) steady state level of real profits per unit income and the lower the (starting) steady state stock of real money balances per unit income.

Not surprisingly incorporating the sensitivity of real profits per unit income to the real deposit rate inclines our conclusions in favour of liberalisation since it implies critical loan rates which are generally higher compared to those of VARIANT 1.

The question arises whether the magnitude of this effect could be such as to render liberalisation a commonly successful policy. For we have seen that within VARIANT 1 liberalisation is successful only in the unlikely circumstances either of the prevalence of highly negative real loan rates or of a highly elastic deposit demand and/or very high reserve ratios.

Choosing plausible values for the steady state growth rate, the interest semielasticity of money demand, the reserve ratio and the administered deposit rate we have computed the critical real loan rate within VARIANT 1.

Using also the plausible values suggested by Currie/Danes for the real stock of money balances per unit income and the level of real profits per unit income in the steady state and specifying a range of plausible values for the semielasticity of real profits per unit income w.r.t. the real deposit rate, we could have computed the term which we need add onto the critical real loan rate of VARIANT 1 in order to reach the critical real loan rate in VARIANT 5.

However we have no prior expectations as to the magnitude of the semielasticity of real profits per unit income w.r.t. the real deposit rate.

Instead, motivated by this difficulty, we choose to calculate what should be the implied value for the semielasticity of real profits per unit income w.r.t. the real deposit rate, for the critical real loan rate in VARIANT 5 to come out to be equal to zero, given assumed values for all other parameters. (Appendix K).

We select zero as a convenient baseline since it represents perhaps an upper limit to the level of the real loan rate that is likely to prevail in economies contemplating policies of financial liberalisation.

By definition of the critical real loan rate, if a rise in the nominal deposit rate is administered, starting from a situation characterised by a real loan (and deposit) rate below the critical level, then the steady state growth rate increases as a result.

By setting the critical real loan rate to be equal to zero we solve for the minimum value of the semielasticity of real profits which is required to ensure that starting from a situation with at most a zero real loan (and deposit) rate, liberalisation is successful.

We tabulate the implied values for the semielasticity of real profits per unit income w.r.t. the real deposit rate at selected plausible values for the steady state growth rate, the interest semielasticity of money demand, the reserve ratio and the administered deposit rate. (Table 2.7).

Although we have no prior expectations as to the likely magnitude of the semielasticity of real profits per unit income, it is easier to visualise limits to the width of the range over which we are prepared to accept that the share of profits (or for that matter reinvested profits in real terms and per unit income) could ever be observed to vary in actual economies.[2]

The semielasticity indicates the proportion by which real profits per unit income (i.e. the share of profits) increase when there is a rise in the real deposit rate by one unit.

2. E.g. in the period 1958-1985 in Greece the ratio of 'Income from Property and Entrepreneurship' (given in the OECD Surveys) to GDP averaged to 30% with a standard deviation of 2%. The minimum (maximum) value for this ratio was 25% (33%).

Using this interpretation for concreteness we tabulate the percentage points by which the share of profits is meant to increase upon a rise in the real deposit rate by 10% if the value of the semielasticity of real profits per unit income is such as to ensure that liberalisation, starting from a situation with at most a zero real loan (and deposit) rate, raises the growth rate. (Table 2.7).[3]

Glancing at the tabulations we discover that taking the view that liberalisation is a favourable policy in the circumstances of negative real deposit/loan rates, most likely to be encountered in the economies where the issue arises, does not presuppose reliance on the possibility that the share of profits varies by unreasonably large percentages.

Note that the sensitivity of the critical real loan rate in VARIANT 1 to the assumed value for the interest semielasticity of money demand did not translate into a corresponding dispersion of the implied values for the semielasticity of real profits per unit income. This is because to derive the latter we multiply the corresponding critical real loan rate in VARIANT 1 by a factor which is higher the lower the interest semielasticity of money demand and thus, in turn, the lower the critical real loan rate in VARIANT 1. Hence conclusions as to the favourability of liberalisation in VARIANT 5 do not hinge, as crucially as they did in VARIANT 1, on assuming a high value for the interest semielasticity of money demand.

Further although there is some variation in the computed implied

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3. We treat this 10% rise as if it were a small increment, around an initial steady state. This is purely for presentational reasons (i.e. we could have tabulated the percentage points by which the share of profits increases upon a genuinely small increment of say 1% and then multiplied by 10).

values for the semielasticity of real profits per unit income as the assumed reserve ratio and deposit rate are varied at a given interest semielasticity of money demand there is no variation, so to speak, in the favourability of their implications; all corresponding percentage movements in the share seem plausible hence favourable for liberalisation whereas in VARIANT 1 critical real rates came out to be high and thus favourable for liberalisation only at extreme assumed values for the reserve ratio and the deposit rate.

In conclusion, introducing the sensitivity of profits to the real deposit rate at a magnitude that does not imply spectacular variations in the share of profits upon a standard rise in the real deposit rate, converts our basic model from one which conclusions contradict on the whole (as in VARIANTS 1-4) to one which conclusions share the optimism of the financial liberalisation literature as to the impact of liberalisation on growth.

These results contrast to Currie/Danes who, even after giving an expression to the same arguments that motivate us in connection with the improvement in the 'quality' of the activities financed upon liberalisation by specifying a sensitivity of the capital output ratio to the real deposit rate, still find the prospects for liberalisation to be unfavourable.[4]

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4. One may find some difficulty in envisaging how the flow of real profits per unit income increases without any change in the ratio of output to capital. Such is our modelling and accordingly our calculations are purely illustrative. In fact as Currie/Danes show, acknowledging a positive dependence of the output to capital ratio to the real deposit rate yields higher critical real loan rates ceteris paribus thus would reinforce the conclusions from VARIANT 5.

Section 2.5

Summary and Suggestions for Further Research

In Chapter 2 we present a number of variants of a macroeconomic model which formalizes the influence of credit availability on investment and output growth. Attention is focused on the implications of the increase in the burden of interest payments on outstanding loans because of the generalized rise in interest rates during the course of financial liberalization. For plausible parameter values the impact of increased loan interest payments (which is contractionary for investment) is likely to outweigh the expansionary effect of the availability of new loans (and additional government net revenues) following an administered rise in interest rates. Therefore calculations undertaken with variants 1-4 and the basic model indicate that a policy of liberalization is not likely to promote output growth. Apart from borrowing, internal funds also may finance investment. The financial repression literature puts forward a number of arguments to justify a direct relationship between the profitability of the projects obtaining finance and the level of real interest rates. In variant 5 we show that this mechanism need only be capable of raising the flow of real profits per unit income (channelled to investment) by few percentage points, for financial liberalization to increase the growth rate of the economy.

The basic model was developed by Currie and Anyadike-Danes (1980). Before proceeding to extend this model, we gave the following discussion and derivations (which cannot be found in the original):

i) detailed derivation of the partial; linearization of the system around the steady state; condensation of the system in two differential equations in actual real money balances per unit income and expected inflation; demonstration that the stability condition for these differential equations coincides with that given in Currie and Anyadike-Danes (op.cit.),

ii) detailed verbal exposition of the workings (i.e. the recursive structure) of the model.

Subsequently we added onto the basic model the following mechanisms: a) the government extracts inflation tax on bank reserves, b) the government finances bank losses from such revenue and channels any residual to capital formation. We showed that when both these modifications are incorporated, the critical real loan rates are not altered. Therefore the precise conclusions of Currie and Anyadike-Danes as to the favourability of financial liberalization carry over on this particular set of adjusted assumptions. Furthermore, we demonstrate that the growth outcome is the same, whether no reserve requirement is imposed, whether a wedge between deposit and loan rates guarantees zero profits to banks in the presence of a reserve requirement, or whether bank losses are covered by grants that would have otherwise financed government investment.

If no government investment is introduced, but it is acknowledged that a competitive relationship must be established between deposit and loan rates in order for banks not to realize losses, the conclusions as to the prospects of financial deregulation become even more pessimistic than in Currie and Anyadike-Danes (1980). If the existence of bank losses is ignored and it is assumed that the proceeds from the inflation tax on reserves are invested by the government, the conclusions as to the prospects of liberalization become more optimistic compared to the basic model.

It has been suggested that, typically under financial repression, while deposit rates are administered, the effective level of the loan rate (the official ceiling plus indirect charges for banking services) rises to clear the loan market. Accordingly, a possible extension would be to devise a variant where interest payments of firms (entering the growth equation) are calculated on the basis of a market clearing effective rate. Upon liberalization the effective rate would come down and therefore one would expect this variant to indicate that investment and growth would increase unequivocally. The main difficulty with modelling this within our framework relates to the fact that we set the volume of loans to be equal to a fraction of the supply of high powered money by the authorities. The model does not incorporate a demand for loans and it is acknowledged that a discrepancy must be sustained between the supply and the demand for money outside the steady state. But it would be necessary to write down a demand for loans in order for an effective loan rate to be defined at its intersection with the demand for deposits. In order to retain the present framework it would have to be conceded that, while the price of loans is determined by the demands for deposits and loans, the actual quantity of loans depends on the creation of high powered money (which actual stock in real terms is not equal to its desired levels). Similar difficulties would be encountered if attempting to incorporate intermediaries of the type analysed by Courakis (1984) where again loan and deposit volumes and rates are determined by equilibrium-market clearing. A way out is suggested in Bernanke and Blinder (1988) who construct a model involving both a money and a credit market.

CHAPTER 2: TABLES

Table 2.1

VARIANT 0: Tabulation of critical real loan rates given: $\gamma^e = 0.1$

a	r_o
3.0	-0.23
1.5	-0.57
1.0	-0.90
0.5	-1.90

VARIANT 1: Tabulation of $\tilde{\delta}$

a	$\tilde{\delta}$
3.0	-0.33
1.5	-0.67
1.0	-1.0
0.5	-2.0

Table 2.2

VARIANT 1: Tabulation of critical real loan rates given: $\gamma^e = 0.1$, $a = 3$

		r_1	$\pi_1 = \delta - r_1$
k = 0.2			
	$\delta = 0.0$	−0.16	+0.16
	$\delta = 0.1$	−0.14	+0.24
	$\delta = 0.2$	−0.12	+0.32
	$\delta = 0.3$	−0.10	+0.40
	$\delta = 0.4$	−0.08	+0.48
k = 0.5			
	$\delta = 0.0$	−0.06	+0.06
	$\delta = 0.1$	−0.01	+0.11
	$\delta = 0.2$	+0.03	+0.17
	$\delta = 0.3$	+0.09	+0.21
	$\delta = 0.4$	+0.14	+0.26
k = 0.6			
	$\delta = 0.0$	−0.03	+0.03
	$\delta = 0.1$	+0.03	+0.07
	$\delta = 0.2$	+0.09	+0.11
	$\delta = 0.3$	+0.15	+0.15
	$\delta = 0.4$	+0.21	+0.19
k = 0.7			
	$\delta = 0.0$	+0.00	+0.00
	$\delta = 0.1$	+0.07	+0.00
	$\delta = 0.2$	+0.14	+0.10
	$\delta = 0.3$	+0.21	+0.10
	$\delta = 0.4$	+0.28	+0.12

Table 2.3

VARIANT 1: Tabulation of critical real loan rates given: $\gamma^e = 0.1$, $a = 1.5$

		r_1	$\pi_1 = \delta - r_1$
$k = 0.2$			
	$\delta = 0.0$	-0.43	+0.43
	$\delta = 0.1$	-0.41	+0.51
	$\delta = 0.2$	-0.40	+0.60
	$\delta = 0.3$	-0.28	+0.58
	$\delta = 0.4$	-0.14	+0.54
$k = 0.5$			
	$\delta = 0.0$	-0.23	+0.23
	$\delta = 0.1$	-0.18	+0.28
	$\delta = 0.2$	-0.13	+0.33
	$\delta = 0.3$	-0.08	+0.38
	$\delta = 0.4$	-0.03	+0.42
$k = 0.6$			
	$\delta = 0.0$	-0.17	+0.17
	$\delta = 0.1$	-0.11	+0.21
	$\delta = 0.2$	-0.05	+0.25
	$\delta = 0.3$	+0.01	+0.29
	$\delta = 0.4$	+0.07	+0.33
$k = 0.7$			
	$\delta = 0.0$	-0.10	+0.10
	$\delta = 0.1$	-0.03	+0.13
	$\delta = 0.2$	+0.04	+0.16
	$\delta = 0.3$	+0.11	+0.19
	$\delta = 0.4$	+0.18	+0.22

Table 2.4

VARIANT 1: Tabulation of critical real loan rates given:
$\gamma^e = 0.1$, $a = 1$

		r_1	$\pi_1 = \delta - r_1$
k = 0.2			
	$\delta = 0.0$	-0.70	+0.70
	$\delta = 0.1$	-0.68	+0.78
	$\delta = 0.2$	-0.66	+0.86
	$\delta = 0.3$	-0.64	+0.94
	$\delta = 0.4$	-0.62	+1.02
k = 0.5			
	$\delta = 0.0$	-0.40	+0.40
	$\delta = 0.1$	-0.35	+0.45
	$\delta = 0.2$	-0.30	+0.50
	$\delta = 0.3$	-0.25	+0.55
	$\delta = 0.4$	-0.20	+0.60
k = 0.6			
	$\delta = 0.0$	-0.30	+0.30
	$\delta = 0.1$	-0.24	+0.34
	$\delta = 0.2$	-0.18	+0.38
	$\delta = 0.3$	-0.12	+0.42
	$\delta = 0.4$	-0.06	+0.46
k = 0.7			
	$\delta = 0.0$	-0.20	+0.20
	$\delta = 0.1$	-0.13	+0.23
	$\delta = 0.2$	-0.06	+0.26
	$\delta = 0.3$	+0.01	+0.29
	$\delta = 0.4$	+0.08	+0.32

Table 2.5

VARIANT 1: Tabulation of critical real loan rates given:
$\gamma^e = 0.1$, $a = 0.5$

		r_1	$\pi_1 = \delta - r_1$
k = 0.2			
	δ = 0.0	-1.50	+1.50
	δ = 0.1	-1.48	+1.58
	δ = 0.2	-1.46	+1.66
	δ = 0.3	-1.44	+1.74
	δ = 0.4	-1.42	+1.82
	δ = 0.4	-1.40	+1.9
k = 0.5			
	δ = 0.0	-0.90	+0.90
	δ = 0.1	-0.85	+0.95
	δ = 0.2	-0.80	+1.0
	δ = 0.3	-0.75	+1.05
	δ = 0.4	-0.70	+1.1
	δ = 0.5	-0.65	+1.15
k = 0.6			
	δ = 0.0	-0.70	+0.70
	δ = 0.1	-0.64	+0.74
	δ = 0.2	-0.58	+0.78
	δ = 0.3	-0.52	+0.82
	δ = 0.4	-0.46	+0.86
	δ = 0.5	-0.40	+0.90
k = 0.7			
	δ = 0.0	-0.50	+0.50
	δ = 0.1	-0.43	+0.53
	δ = 0.2	-0.36	+0.56
	δ = 0.3	-0.29	+0.59
	δ = 0.4	-0.22	+0.62
	δ = 0.5	-0.15	+0.65

Table 2.5 - continued

		r_1	$\pi_1 = \delta - r_1$
k = 0.75			
	δ = 0.0	−0.40	+0.40
	δ = 0.1	−0.33	+0.43
	δ = 0.2	−0.25	+0.45
	δ = 0.3	−0.18	+0.48
	δ = 0.4	−0.10	+0.50
	δ = 0.5	−0.03	+0.53
k = 0.80			
	δ = 0.0	−0.30	+0.30
	δ = 0.05	−0.26	+0.31
	δ = 0.1	−0.22	+0.32
	δ = 0.15	−0.18	+0.33
	δ = 0.2	−0.14	+0.34
	δ = 0.25	−0.10	+0.35
	δ = 0.3	−0.06	+0.36
	δ = 0.35	−0.02	+0.37
	δ = 0.4	+0.02	+0.38
	δ = 0.45	+0.06	+0.39
	δ = 0.5	+0.10	+0.40
k = 0.85			
	δ = 0.0	−0.20	+0.20
	δ = 0.05	−0.16	+0.21
	δ = 0.1	−0.12	+0.22
	δ = 0.15	−0.07	+0.22
	δ = 0.2	−0.03	+0.23
	δ = 0.25	+0.01	+0.26
	δ = 0.3	+0.06	+0.36
	δ = 0.35	+0.10	+0.45
	δ = 0.4	+0.14	+0.54
	δ = 0.45	+0.18	+0.63
	δ = 0.5	+0.22	+0.72

Table 2.5 - continued

		r_1	$\pi_1 = \delta - r_1$
$k = 0.90$			
	$\delta =$ 0.0	−0.10	+0.10
	$\delta =$ 0.05	−0.06	+0.11
	$\delta =$ 0.1	−0.01	+0.11
	$\delta =$ 0.15	+0.04	+0.12
	$\delta =$ 0.2	+0.08	+0.12
	$\delta =$ 0.25	+0.13	+0.13
	$\delta =$ 0.3	+0.17	+0.13
	$\delta =$ 0.35	+0.22	+0.14
	$\delta =$ 0.4	+0.26	+0.14
	$\delta =$ 0.45	+0.30	+0.15
	$\delta =$ 0.5	+0.35	+0.15

Table 2.6

VARIANT 4: Tabulation of critical real loan rate given: $\gamma^e = 0.1$

	a = 3	a = 1.5	a = 1	a = 0.5
k = 0.2	-0.32	-0.74	-1.2	-2.4
k = 0.5	-0.57	-1.24	-1.9	-3.9
k = 0.6	-0.73	-1.57	-2.4	-4.0

N.B. For all tabulations it has been checked that the stability condition is satisfied at the assumed parameter values.

Table 2.7

VARIANT 5: Tabulation of implied value for semielasticity of profits and for final share of profits

$\tilde{f}$: Implied value for semielasticity of real profits per unit income w.r.t. real deposit rate.

$\tilde{\lambda}$: New share of profits after 10% rise in real deposit rate, given beginning share of λ^e and semielasticity $\tilde{f}$.

AT $a = 3$ $\lambda^e = 10\%$ $m^e = 0.2$

	$\lambda^e = 10\%$		$\lambda^e = 20\%$		$\lambda^e = 30\%$		$\lambda^e = 40\%$	
	$\tilde{f}$	$\tilde{\lambda}$ in %	$\tilde{f}$	$\tilde{\lambda}$ in %	$\tilde{f}$	$\tilde{\lambda}$ in %	$\tilde{f}$	$\tilde{\lambda}$ in %
K = 0.2								
$\delta = 0.0$	0.96	11	0.48	21	0.32	31	0.24	41
$\delta = 10\%$	0.84	10.8	0.42	20.8	0.28	30.8	0.21	40.8
$\delta = 30\%$	0.60	10.6	0.3	20.6	0.20	30.6	0.15	40.6
K = 0.5								
$\delta = 0.0$	0.36	10.4	0.18	20.4	0.12	30.4	0.09	30.4
$\delta = 10\%$	0.06	10.1	0.03	20.1	0.02	30.1	0.015	30.1
$\delta = 30\%$	-	-	-	-	-	-	-	-

Table 2.7 - continued

AT $a = 0.5$; $\lambda^e = 10\%$; $m^e = 0.2$

	$\lambda^e = 10\%$		$\lambda^e = 20\%$		$\lambda^e = 30\%$		$\lambda^e = 40\%$	
	$\tilde{f}$	$\tilde{\lambda}$ in %	$\tilde{f}$	$\tilde{\lambda}$ in %	$\tilde{f}$	$\tilde{\lambda}$ in %	$\tilde{f}$	$\tilde{\lambda}$ in %
K = 0.2								
δ = 0%	1.50	11.5	0.75	21.5	0.5	31.5	0.38	41.5
δ = 30%	1.44	11.4	0.72	21.4	0.48	31.4	0.36	41.4
δ = 50%	1.40	11.4	0.70	21.4	0.46	31.4	0.35	41.4
K = 0.5								
δ = 0%	0.90	10.9	0.45	20.9	0.30	30.9	0.23	40.9
δ = 30%	0.75	10.8	0.38	20.8	0.25	30.8	0.19	40.8
δ = 50%	0.65	10.7	0.33	20.7	0.21	30.7	0.16	40.7
K = 0.6								
δ = 0%	0.70	10.7	0.35	20.7	0.23	30.7	0.18	40.7
δ = 30%	0.52	10.5	0.26	20.5	0.17	30.5	0.13	40.5
δ = 50%	0.40	10.4	0.20	20.4	0.13	30.4	0.1	40.4
K = 0.8								
δ = 0%	0.30	10.3	0.15	20.3	0.10	30.3	0.08	40.3
δ = 30%	0.06	10.1	0.03	20.1	0.02	30.1	0.02	40.1
δ = 50%	-	-	-	-	-	-	-	-

NB: By (14): $\frac{d\lambda}{\lambda} = fd(\delta - \pi^*)$

Let $d(\delta - \pi^*) = 10\% = 0.1$

Then $\tilde{\lambda} = \lambda^e(1 + \frac{d\lambda}{\lambda}) = \lambda^e(1 + 0.1\tilde{f})$

APPENDICES A-K

MATHEMATICAL APPENDICES TO CHAPTER 2

APPENDIX A

VARIANT 0

Growth equation: $\gamma = \sigma[(1-k)m(\mu-\delta)+\lambda]$ (1)

Cagan deposit demand function: $m^* = \exp a(\delta - \pi^*)$ $\quad a > 0$ (2)

Banking system: $\delta = r + \pi = \rho$ (3)

Identity: $\dot{m} = m[\mu - \pi - \gamma]$ (4)

Phillips curve: $\pi = h(m - m^*) + \pi^*$ $\quad h > 0$ (5)

Adaptive expectations: $\dot{\pi}^* = \beta(\pi - \pi^*)$ $\quad \beta > 0$ (6)

Production function: $Y = \sigma K$ (7)

Notation:

Y : output

K : capital stock

$\gamma = \frac{\dot{Y}}{Y}$ (output) growth rate

$m = \frac{M}{pY}$ actual real money (deposit) balances per unit income

m^* : desired real money (deposit) balances per unit income

μ : monetary growth rate

δ : nominal deposit rate

r : real loan rate

ρ : nominal loan rate

π : actual inflation rate

π^* : expected inflation rate

λ : flow of profits before interest payments per unit income (share)

The notation has been selected to be as similar as possible to Currie/Danes.

APPENDIX B

VARIANT 0 : Development of the growth equation

- Net flow of finance to private sector = New credit extended - interest charges on outstanding loans

therefore $\dot{L} - (r+\pi)L$ (i)

where L : volume of loans

- Capital formation per unit income:

$$\frac{\dot{K}}{Y} = \frac{\dot{L} - (r+\pi)L}{PY} + \lambda = \frac{L}{PY}\left[\frac{\dot{L}}{L} - (r+\pi)\right] + \lambda \qquad \text{(ii)}$$

- Reserve requirement: $L = (1-k)M$ (iii)

- Monetary growth : $\mu = \frac{\dot{M}}{M} = \frac{\dot{L}}{L}$ (iv)

- By (3) and (iii) and (iv) into (ii):

$$\frac{\dot{K}}{Y} = (1-k)\frac{M}{PY}(\mu-\delta) + \lambda \qquad \text{(v)}$$

- Production function:

$$Y = \sigma K \Rightarrow \frac{\dot{Y}}{Y} = \sigma\frac{\dot{K}}{Y} \qquad \text{(vi)}$$

- By (v) into (vi):

$$\gamma = \sigma\left[(1-k)\frac{M}{PY}(\mu-\delta) + \lambda\right]$$

$$= \sigma\left[(1-k)m(\mu-\delta) + \lambda\right]$$

APPENDIX C

VARIANT 0 : Steady state

The 'e' superscript denotes steady state equilibrium values.

Assumptions : $\pi = \pi^* = \pi^e$ (S_1)

$m = m^* = m^e$ (S_2)

$\dot{m} = 0$ (S_3)

By (4) and (S_3) $\mu = \pi^e + \gamma^e$ (S_4)

Steady state growth: By (2) and (S_2) and (S_4) into (1):

$$\gamma^e = (1-k)[\exp a(\delta - \mu + \gamma^e)](\mu - \delta) + \lambda \qquad (S5)$$

Partial $\partial\gamma^e/\partial\delta$

$$\frac{\partial\gamma^e}{\partial\delta} = \sigma(1-k)\left[\frac{\partial}{\partial\delta}\exp a(\delta-\mu+\gamma^e)\right](\mu-\delta) + \sigma(1-k)\exp a(\delta-\mu+\gamma^e)\left[\frac{\partial}{\partial\delta}(\mu-\delta)\right]$$

$$= \sigma(1-k)\exp a(\delta-\mu+\gamma^e)\left[a\left(1+\frac{\partial\gamma^e}{\partial\delta}\right)\right](\mu-\delta) - \sigma(1-k)\exp a(\delta-\mu+\gamma^e)$$

therefore

$$\frac{\partial\gamma^e}{\partial\delta} = \frac{-\sigma(1-k)m^e(1-a(\mu-\delta))}{1 - a\sigma(1-k)m^e(\mu-\delta)} \qquad (P_o)$$

APPENDIX D

VARIANT 0: Linearization around the steady state

From (1): $d\gamma = \sigma(1 - k)(\mu - \delta)dm$ (1')

From (1): $d\dot{\gamma} = \sigma(1 - k)(\mu - \delta)d\dot{m}$ (1")

From (2): $dm^* = -am^e d\pi^*$ (2')

From (4): $d\dot{m} = - m^e d\pi - m^e d\gamma$ (4')

and (S_2) and (S_4)

From (5): $d\pi = hdm - hdm^* + d\pi^*$ (5')

From (6): $d\dot{\pi}^* = \beta d\pi - \beta d\pi^*$ (6')

- By (1') and (2') into (5')

$$d\pi = \frac{h}{\sigma(1-k)(\mu-\delta)} d\gamma + (ham^e + 1)d\pi^* \quad (5^I)$$

- By (5^I) and (4') into (1")

$$d\dot{\gamma} = [m^e h + \sigma(1-k)(\mu-\delta)m^e]d\gamma - \sigma(1-k)(\mu-\delta)m^e(ham^e + 1)d\pi^* \quad (L_1)$$

- By (5^I) into (6')

$$d\dot{\pi}^* = \frac{\beta h}{\sigma(1-k)(\mu-\delta)} d\gamma + \beta ham^e d\pi^* \quad (L_2)$$

Thus

$$\begin{bmatrix} d\dot{\gamma} \\ d\dot{\pi}^* \end{bmatrix} = \begin{bmatrix} -(m^e h + \sigma(1-k)(\mu-\delta)m^e) & -\sigma(1-k)(\mu-\delta)m^e(ham^e + 1) \\ \dfrac{\beta h}{\sigma(1-k)(\mu-\delta)} & \beta ham^e \end{bmatrix} \begin{bmatrix} d\gamma \\ d\pi^* \end{bmatrix}$$

$$\det > 0 \Rightarrow \beta hm^e [1 - a\sigma(1-k)m^e(\mu-\delta)] > 0 \quad (SC_o)$$

Hence SC_o signs the denominator of P_o.

APPENDIX E

<u>Linearized VARIANT 0 condensed in a system of 2 differential equations in m and π^*</u>

By (2') and (5') into (6')

$$d\dot{\pi}^* = \beta h dm + \beta h a m^e d\pi^* \qquad (L_2)'$$

By (5') and (1') and (2') into (4')

$$d\dot{m} = - m^e[h + \sigma(1-k)(\mu-\delta)]dm - m^e[ham^e + 1]d\pi^* \qquad (L_1)'$$

Thus

$$\begin{bmatrix} d\dot{m} \\ d\dot{\pi}^* \end{bmatrix} = \begin{bmatrix} - m^e[h + \sigma(1-k)(\mu-\delta)] & - m^e[ham^e + 1] \\ \beta h & \beta ham^e \end{bmatrix} \begin{bmatrix} dm \\ d\pi^* \end{bmatrix}$$

$$\det > 0 \Rightarrow \beta hm^e[1 - a\sigma(1-k)m^e(\mu-\delta)] > 0 \qquad (SC_o)$$

QED

APPENDIX F

VARIANT 0: Critical Rates

- By (P_0) we require $1-a(\mu-\delta) = 0$

- By (S_4) and (3) $\therefore\ r_o = \gamma^e - \frac{1}{a}$ (C_1)

VARIANT 1: Critical Rates

- By (P_1) we require: $1 - a(\frac{\mu}{1-k} - \delta) = 0$

- By (S_4) and (3) $\therefore\ r_1 = (\gamma^e - \frac{1}{a}) + \frac{k}{a}(1 + a\delta)$

$$= r_o + \frac{k}{a}(1 + a\delta) \qquad (C_2)$$

$$= \frac{r_o}{1-k} + \frac{k}{1-k}[\frac{1}{a} + \pi] \qquad (C_3)$$

Conditions for equality $r_o = r_1$

- By (C_2) $\tilde{\delta} = -\frac{1}{a}$

- By (C_3) $\tilde{\pi} = -\gamma$

VARIANT 4: Critical Rates

- By (P_4) we require $1 - a(1-k)(\mu - \frac{\delta}{1-k}) = 0$

- By (S_4) and (13) $\therefore\ r_4 = \gamma^e - \frac{1}{a(1-k)}$ (C_4)

$$= r_o - \frac{k}{a(1-k)} \qquad (C_5)$$

APPENDIX G

VARIANT 1

Growth equation: $\gamma = \sigma[(1-k)m(\frac{\mu}{1-k} - \delta) + \lambda]$ (8)

All other equations as in Variant 0.

Development of the growth equation

- Real inflation tax revenue on reserves per unit income

$$\frac{G}{Y} = \mu k \frac{M}{PY} \qquad \text{(vii)}$$

- Total capital formation per unit income:

By (v) and (vii)

$$\frac{\dot{K}}{Y} = (1-k)\frac{M}{PY}(\mu-\delta) + \frac{kM}{PY}\mu + \lambda = (1-k)\frac{M}{PY}(\frac{\mu}{1-k} - \delta) + \lambda \qquad \text{(viii)}$$

By (viii) into (vi) $\gamma = \sigma[(1-k)m(\frac{\mu}{1-k} - \delta) + \lambda]$ (ix)

Steady state growth By (S_2) and (S_4) and (2) into (8)

$$\gamma^e = \sigma[(1-k)[\exp a(\delta-\mu+\gamma^e)](\frac{\mu}{1-k} - \delta) + \lambda] \qquad (S_6)$$

Partial $\frac{\partial\gamma^e}{\partial\delta}$

$$\frac{\partial\gamma^e}{\partial\delta} = \sigma(1-k)\left[\frac{\partial}{\partial\delta}\exp a(\delta-\mu+\gamma^e)\right](\frac{\mu}{1-k} - \delta) + \sigma(1-k)\exp a(\delta-\mu+\gamma^e)\left[\frac{\partial}{\partial\delta}(\frac{\mu}{1-k} - \delta)\right]$$

$$= \sigma(1-k)\exp a(\delta-\mu+\gamma^e)\left[a(1 + \frac{\partial\gamma^e}{\partial\delta})\right](\frac{\mu}{1-k} - \delta) - \sigma(1-k)\exp a(\delta-\mu+\gamma^e)$$

$$\therefore \quad \frac{\partial\gamma^e}{\partial\delta} = \frac{-\sigma(1-k)m^e[1 - a(\frac{\mu}{1-k} - \delta)]}{1 - a\sigma(1-k)m^e(\frac{\mu}{1-k} - \delta)} \qquad \text{(P1)}$$

APPENDIX G - continued

VARIANT 1: Linearization around the steady state

From (8) $d\gamma = \sigma(1-k)(\frac{\mu}{1-k} - \delta)dm$ (8')

From (8) $d\dot{\gamma} = \sigma(1-k)(\frac{\mu}{1-k} - \delta)d\dot{m}$ (8")

- By (8') and (2') into (5')

$$d\pi = \frac{h}{\sigma(1-k)(\frac{\mu}{1-k} - \delta)} d\gamma + (ham^e + 1)d\pi^* \qquad (5^{II})$$

- By (5^{II}) and (4') into (8"):

$$d\dot{\gamma} = -[m^e h + m^e\sigma(1-k)(\frac{\mu}{1-k} - \delta)]d\gamma - m^e\sigma(1-k)(\frac{\mu}{1-k} - \delta)(ham^e + 1)d\pi^* \qquad (L_3)$$

- By (5^{II}) into (6'):

$$d\pi^* = \frac{\beta h}{\sigma(1-k)(\frac{\mu}{1-k} - \delta)} d\gamma + \beta ham^e d\pi^* \qquad (L_4)$$

Thus

$$\begin{bmatrix} d\dot{\gamma} \\ d\dot{\pi}^* \end{bmatrix} = \begin{bmatrix} -[m^e h + m^e\sigma(1-k)(\frac{\mu}{1-k} - \delta)] & \vdots & -\sigma(1-k)(\frac{\mu}{1-k} - \delta)m^e(ham^e + 1) \\ \frac{\beta h}{\sigma(1-k)(\frac{\mu}{1-k} - \delta)} & \vdots & \beta ham^e \end{bmatrix} \begin{bmatrix} d\gamma \\ d\pi^* \end{bmatrix}$$

det > 0 => $\beta ham^e[1 - a\sigma(1-k)m^e(\frac{\mu}{1-k} - \delta)] > 0$ (SC_1)

Hence SC_1 signs the denominator of P_1.

APPENDIX H

VARIANT 2

Growth equation $\gamma = \sigma[m(\mu-\delta) + \lambda]$ (9)

Banking system $\delta = (1-k)(r+\pi) = (1-k)\rho$ (10)

All other equations as in variant 0.

Development of the growth equation

- Net flow of finance to the private sector per unit income. By (10), and (iii) and (iv) into (ii):

$$(1-k)\,\frac{M}{PY}\,(\mu - \frac{\delta}{1-k}) \qquad (x)$$

- Total capital formation per unit income: By (x) and (v ii)

$$\frac{\dot{K}}{Y} = k\,\frac{M}{PY}\,\mu + (1-k)\,\frac{M}{PY}\,(\mu - \frac{\delta}{1-k}) + \lambda = \frac{M}{PY}\,(\mu-\delta) + \lambda \qquad (xi)$$

By (xi) into (vi)

$$\gamma = \sigma[m(\mu-\delta) + \lambda]$$

Steady state growth: By (2) and (S_2) and (S_4) into (9)

$$\gamma^e = \sigma\left[[\exp a(\delta-\mu+\gamma^e)](\mu-\delta) + \lambda\right] \qquad (S_7)$$

Partial $\frac{\partial\gamma^e}{\partial\delta}$

$$\frac{\partial\gamma^e}{\partial\delta} = \sigma[\frac{\partial}{\partial\delta} \exp a(\delta-\mu+\gamma^e)](\mu-\delta) + \sigma \exp a\,(\delta-\mu+\gamma^e)\,\frac{\partial}{\partial\delta}\,(\mu-\delta)$$

$$= \sigma a \exp a(\delta-\mu+\gamma^e)\left(1 + \frac{\partial\gamma^e}{\partial\delta}\right)(\mu-\delta) - \sigma \exp a(\delta-\mu+\gamma^e)$$

$$\therefore \quad \frac{\partial\gamma^e}{\partial\delta} = \frac{-\sigma m^e[1 - a(\mu-\delta)]}{1 - a\sigma m^e(\mu-\delta)} \qquad (P_2)$$

VARIANT 3: Development of the growth equation.

- Net flow of finance to the private sector per unit income

By (3) and (iii) and (iv) into (ii)

$$(1-k) \frac{M}{PY} (\mu-\delta) \qquad \text{(xi-a)}$$

- Banking losses: Outlay on deposits - interest receipts on loans

$$\delta M - \delta(1-k)M = \delta kM \qquad \text{(xi-b)}$$

- Real inflation tax revenue less grants to cover banking losses per unit income

By (vii) and (xi-b)

$$\frac{G}{Y} = k \frac{M}{PY} (\mu-\delta) \qquad \text{(xi-c)}$$

- Total capital formation per unit income

By (xi-c) and (xi-a)

$$\frac{\dot{K}}{Y} = (1-k) \frac{M}{PY} (\mu-\delta) + k \frac{M}{PY} (\mu-\delta) + \lambda = \frac{M}{PY} (\mu-\delta) + \lambda \qquad \text{(xi-d)}$$

By (xi-d) into (vi)

$$\gamma = \sigma[m(\mu-\delta) + \lambda]$$

APPENDIX H - continued

VARIANT 2: Linearization around the steady state

From (9): $d\gamma = \sigma(\mu-\delta)dm$ (9')

From (9): $d\dot{\gamma} = \sigma(\mu-\delta)d\dot{m}$ (9")

- By (9') and (2') into (5')

$$d\pi = \frac{h}{\sigma(\mu-\delta)} d\gamma + (ham^e + 1)d\pi^* \qquad (5^{III})$$

- By (5^{III}) and (4') into (9")

$$d\dot{\gamma} = -[m^e h + m^e\sigma(\mu-\delta)]d\gamma - m^e\sigma(\mu-\delta)(ham^e + 1)d\pi^* \qquad (L_5)$$

- By (5^{III}) into (6')

$$d\dot{\pi}^* = \frac{\beta h}{\sigma(\mu-\delta)} d\gamma + \beta ham^e d\pi^* \qquad (L_6)$$

Thus

$$\begin{bmatrix} d\dot{\gamma} \\ d\dot{\pi}^* \end{bmatrix} = \begin{bmatrix} -(m^e h + \sigma(\mu-\delta)m^e) & \vdots & -\sigma(\mu-\delta)m^e(ham^e + 1) \\ \beta h/\sigma(\mu-\delta) & \vdots & \beta ham^e \end{bmatrix} \begin{bmatrix} d\gamma \\ d\pi^* \end{bmatrix}$$

$$\det > 0 : \beta hm^e\,(1 - a\sigma m^e(\mu-\delta)) > 0 \qquad (SC_2)$$

Hence SC_2 signs the denominator of P_2.

APPENDIX I

VARIANT 4

Growth equation: $\gamma = \sigma[(1-k)m(\mu - \frac{\delta}{1-k}) + \lambda]$ (12)

Banking system: $\delta = (1-k)(r+\pi) = (1-k)\rho$ (13)

All other equations as in variant 0.

Development of the growth equation

- By (iii) and (iv) and (13) into (ii)

$$\frac{\dot{K}}{Y} = (1-k)\frac{M}{PY}(\mu - \frac{\delta}{1-k}) + \lambda \qquad \text{(xii)}$$

- By (vi) into (xii)

$$\gamma = \sigma[(1-k)m(\mu - \frac{\delta}{1-k}) + \lambda]$$

Steady state growth:

- By (2) and (S_2) and (S_4) into (12)

$$\gamma^e = \sigma[(1-k)[\exp a(\delta-\mu+\gamma^e)](\mu - \frac{\delta}{1-k}) + \lambda] \qquad (S_8)$$

Partial $\frac{\partial\gamma^e}{\partial\delta}$

$$\frac{\partial\gamma^e}{\partial\delta} = \sigma(1-k)\left[\frac{\partial}{\partial\delta}\exp a(\delta-\mu+\gamma^e)\right](\mu - \frac{\delta}{1-k}) + \sigma(1-k)\exp a(\delta-\mu+\gamma^e)\left[\frac{\partial}{\partial\delta}(\mu - \frac{\delta}{1-k})\right]$$

$$= \sigma(1-k)\exp a(\delta-\mu+\gamma^e)a(1 + \frac{\partial\gamma^e}{\partial\delta})(\mu - \frac{\delta}{1-k}) - \sigma\exp a(\delta-\mu+\gamma^e)$$

$$\frac{\partial\gamma^e}{\partial\delta} = \frac{-\sigma m^e[1 - a(1-k)(\mu - \frac{\delta}{1-k})]}{1 - a\sigma(1-k)m^e(\mu - \frac{\delta}{1-k})} \qquad (P_4)$$

VARIANT 4: Linearization around the steady state

From (12): $$d\gamma = \sigma(1-k)(\mu - \frac{\delta}{1-k})dm \qquad (12')$$

From (12): $$d\dot{\gamma} = \sigma(1-k)(\mu - \frac{\delta}{1-k})d\dot{m} \qquad (12'')$$

- By (12') and (2') into (5')

$$d\pi = \frac{h}{\sigma(1-k)(\mu - \frac{\delta}{1-k})} d\gamma + (ham^e + 1)d\pi^* \qquad (5^{IV})$$

- By (4') and (5^{IV}) into (12")

$$d\dot{\gamma} = \left[m^e h + \sigma(1-k)(\mu - \frac{\delta}{1-k})\right] d\gamma - \sigma(1-k)(\mu - \frac{\delta}{1-k})m^e(ham^e + 1)d\pi^* \qquad (L_7)$$

- By (5^{IV}) into (6')

$$d\dot{\pi}^* = \frac{\beta h}{\sigma(1-k)(\mu - \frac{\delta}{1-k})} d\gamma + \beta ham^e d\pi^* \qquad (L_8)$$

Thus

$$\begin{bmatrix} d\dot{\gamma} \\ d\dot{\pi}^* \end{bmatrix} = \begin{bmatrix} -[m^e h + \sigma(1-k)(\mu - \frac{\delta}{1-k})] & \vdots & -\sigma(1-k)(\mu - \frac{\delta}{1-k})m^e(ham^e + 1) \\ \beta h/\sigma(1-k)(\mu - \frac{\hat{\delta}}{1-k}) & \vdots & \beta ham^e \end{bmatrix} \begin{bmatrix} d\gamma \\ d\pi^* \end{bmatrix}$$

det > o => $\beta hm^e[1 - a\sigma(1-k)m^e(\mu - \frac{\delta}{1-k})] > 0$ $\qquad SC_4$

Hence SC_4 signs the denominator of P_4.

APPENDIX J

VARIANT 5

Dependence of real profits per unit income $\lambda = \lambda_0 \exp f(\delta - \pi^*)$ (14)

All other equations as in VARIANT 1

Partial $\frac{\partial \gamma^e}{\partial \delta}$

$$\frac{\partial \gamma^e}{\partial \delta} = \sigma \left[\frac{\partial}{\partial \delta} \exp a(\delta - \mu + \gamma^e) \right] \left[\mu - (1 - k)\delta \right] + \sigma \exp a(\delta - \mu + \gamma^e) \left[\frac{\partial}{\partial \delta} (\mu - (1 - k)\delta) \right]$$

$$+ \sigma \lambda_o \left[\frac{\partial}{\partial \delta} \exp f(\delta - \mu + \gamma^e) \right]$$

$$= \sigma \exp a(\delta - \mu + \gamma^e) \left[a(1 + \frac{\partial \gamma^e}{\partial \delta}) \right] [\mu - (1 - k)\delta] - \sigma(1 - k) \exp a(\delta - \mu + \gamma^e)$$

$$+ \sigma \lambda_o \exp f(\delta - \mu + \gamma^e) \left[f(1 + \frac{\partial \gamma^e}{\partial \delta}) \right]$$

$$\therefore \quad \frac{\partial \gamma^e}{\partial \delta} = \frac{- \sigma m^e[1 - k - a(\mu - (1 - k)\delta)] + \sigma f \lambda^e}{1 - a \sigma m^e[\mu - (1 - k)\delta] - \sigma f \lambda^e} \qquad \text{(P5)}$$

Where:

$$m^e = \exp a(\delta - \mu + \gamma^e)$$

$$\lambda^e = \lambda_o \exp f(\delta - \mu + \gamma^e)$$

VARIANT 5

Linearization around the steady state

From (8) $d\gamma = \sigma[\mu-(1-k)\delta]dm + \sigma d\lambda$ (8')

From (2) $dm^* = -\, am^e d\pi^*$ (2')

From (4) and (S2) and (S4) $dm = -\, m^e d\pi - m^e d\gamma$ (4')

From (5) $d\pi = hdm - hdm^* + d\pi^*$ (5')

From (6) $d\dot{\pi}^* = \beta d\pi - \beta d\pi^*$ (6')

From (14) $d\lambda = -\, f\lambda^e d\pi^*$ (14')

By (2') and (5') into (6')

$$d\dot{\pi}^* = \beta hdm + \beta ham^e d\pi^* \qquad \text{(L9)}$$

By (8') and (14') and (2') and (5') into (4')

$$dm = -\left[m^e h + \sigma m^e[\mu - (1 - k)\delta]\right] dm - m^e\left[ham^e + 1 - \sigma f\lambda^e\right]d\pi^* \qquad \text{(L10)}$$

Thus:

$$\begin{bmatrix} d\dot{m} \\ d\dot{\pi}^* \end{bmatrix} = \begin{bmatrix} -\, m^e[h + \sigma(\mu - (1 - k)\delta)] & -\, m^e[ham^e + 1 - \sigma f\lambda^e] \\ \beta h & \beta ham^e \end{bmatrix} \begin{bmatrix} dm \\ d\pi^* \end{bmatrix}$$

$$\det > 0 \Rightarrow \beta hm^e[1 - a\sigma m^e(\mu - (1 - k)\delta) - \sigma f\lambda^e] > 0 \qquad \text{(SC5)}$$

APPENDIX K

VARIANT 5: Critical Real Loan Rate

By (P5) we require:

$$f\lambda^e - m^e[1 - k - a(\mu - (1 - k)\delta)] = 0$$

By (S4) and (3):

$$r_5 = k\delta + \gamma^e - \frac{(1 - k)}{a} + \frac{f\lambda^e}{am^e} \qquad (C6)$$

$$= r_1 + \frac{f\lambda^e}{am^e} \qquad (C7)$$

Implied Value for the semielasticity of real profits per unit income w.r.t. the real deposit rate

By (C7) we require:

$$0 = r_1 + \frac{\tilde{f}\ {}^e}{am^e}$$

$$\therefore \qquad \tilde{f} = (- r_1)\ \frac{am^e}{\lambda^e} \qquad (C8)$$

CHAPTER 3

INVESTMENT UNDER FINANCIAL REPRESSION

Section 3.1

Introduction

In Section 3.2 we introduce the literature on investment under financial repression. We distinguish two general tendencies in this literature: i.e. the neoclassical and the ad hoc approach. We indicate the reasons for choosing to follow the neoclassical approach (and to disregard Q models). We discuss some criticisms against the chosen approach, especially in connection with the way costs of adjustment are taken into account.

The main characteristic, which distinguishes our work from the estimation of a standard neoclassical investment function, is that we focus attention on the role of credit variables. Hence we discuss extensively the rationale on which a variable measuring the availability of finance is introduced in the investment equation. We distinguish between such rationalizations invoked for developed capital markets and the rationalization under financial repression. The latter is analysed in Section 3.3. Heavy dependence on bank credit, combined with disequilibrium rationing of loans, implies that investment is constrained by the availability of bank finance. At this point we resolve an issue which is not dealt with in the literature: Can there be a justification for investment equations with output and the user cost as explanatory variables, if investment is determined by the availability of bank finance? The existing literature postulates that the speed of adjustment is influenced by credit availability while the long run capital stock is determined by neoclassical mechanisms. We examine whether, even under financial repression, some borrowers, at least during certain time periods, are not rationed. In this case, at least part of aggregate investment would be determined by its demand, hence the appearance of income and user cost. Another possibility which we explore is the following: Income and the user cost may proxy for the effect (on investment) of changes in the availability of (internal) finance. Such changes may be induced by economywide movements in retained profits and/or in the interest burden on outstanding loans. This possibility is quite consistent with the arguments, in the financial repression literature, that economywide profitability depends on the level of real interest rates.

Having chosen, in Section 3.2, the neoclassical approach, and having reconciled this approach with the mainstream financial repression analysis in Section 3.3, and Section 3.4, we are now ready to implement it: In Section 3.5 we derive an expression for the optimal capital stock in terms of its determinants. We spell out a number of assumptions involved in this exercise. Section 3.6 begins with an enumeration of the sources of sluggishness in the investment process. Thus, using also the expressions derived in Section 3.5, we obtain our first estimating equation where investment is written as a distributed lag of changes in the optimal level of the capital stock. The coefficients in such investment functions are convolutions of all the factors which contribute to sluggish adjustment. In Subsection 3.6.1, we rationalize consistently the introduction of a number of credit variables in the distributed lag structure. We provide also a discussion about the sign to be expected on these credit lags.

In Subsection 3.6.2, we present a slightly different approach: Here the distributed lag, in the optimal capital stock, is condensed, under certain assumptions, in the simple form of a partial adjustment scheme. Thus, another two distinct estimating equations are derived according as the actual capital stock is substituted out by the perpetual inventory model or not. The fourth estimating equation is obtained by writing a partial adjustment to the discrepancy of gross investment (rather than capital stock) from its optimal level. In Section 3.7, additional distributed lags are introduced into the partial adjustment schemes in order to represent expectations. These expectations concern the optimal value of the capital stock one or more periods ahead. Finally, we enumerate various alternative approaches to the generation of expectations, which have appeared in the literature on investment functions. We also discuss the difficulties in incorporating expectations in an empirical investment function so as to accord precisely to the stipulations of theory.

Having written and motivated four estimating equations for investment, in Section 3.8, we examine the data to be used in the estimations. We indicate our data sources and discuss the selection of sample period. We justify our decision to work with a very broad investment aggregate that excludes, however, expenditures by the public sector. We point out that the availability of data constrains our choice of series for output and the discount rate. We discuss some criticisms of the latter choice given the particular features of the Greek financial system. Apart from a selection from the existing series, our study of investment requires also the construction of new series mostly from published data. We begin with the construction of a measure for the net flow of finance. The sources of imprecision in this measure are also noted at this point. The construction of series continues with the decomposition of total depreciation to a private and a public component. The assumptions made in this exercise are explained. Direct and indirect checks of the plausibility of our method of decomposition are provided. Having constructed a series for private depreciation we are able to construct a series for net private investment. This will serve as dependent variable in some of our investment equations. It can be cumulated to yield a measure for the net private capital stock, to be included as an independent variable in other investment equations. Finally, the series for private depreciation, together with the series for the net capital stock of the private sector, enable us to compute a figure for the rate of depreciation of the latter. This figure is required to compute the user cost and to construct the weighted differences of income, user cost and credit availability which are used as regressors in three out of our four estimating equations.

Section 3.2

The Literature on the Impact of Financial Repression on Investment Expenditures

Part of the literature seeks empirical confirmation for the analysis of the determination of the volume of investment under financial repression in regressions of the output growth rate on the real deposit rate or regressions of the volume of investment on some measure of credit or the money supply (the latter aiming specifically to test McKinnon's complementarity view). Usually these regressions are carried out in pooled samples. They are extensively surveyed in Fry (1988).

Another part of the literature envisages that the impact of credit controls on the volume of investment takes place on the demand side through the speed of adjustment within the context of a neoclassical flexible accelerator investment equation. This approach seems to be more sophisticated econometrically drawing on the long experience with the estimation of neoclassical investment functions in developed economies. Thus we choose to follow this approach and refer to it as '<u>the flexible accelerator cum credit variables</u>'.

Further we choose to derive our demand for investment within the framework propounded by Jorgenson (e.g. 1967). Thus of the writers on the role of credit variables in investment functions for financially repressed systems we follow Sundararajan and Thakur (1980). Blejer and Khan (1984) and Tun Wai and Wong (1982) who ignore user cost and consider the optimal capital stock to be a function of some output related variable could be viewed as special cases of our derivation.

More specifically we consider the determination of the optimal (path of the) capital stock without reference to costs of adjustment, which we invoke, only in order to justify the assumed slow adjustment of the actual capital stock to its optimal level. Thus we find ourselves out of line with a lot of theorizing on the explicit introduction of costs of adjustment in the derivation of the optimal capital policy (e.g. Galleoti 1984; Gould 1968; Lucas 1967; Steigum 1983; Treadway 1969).

Hence we come to face Gould's (op.cit., p.47) criticism that:

> The shortcomings of this [i.e. ours] approach stem largely from the fact that K^* is determined without regard to the auxiliary adjustment mechanism ... many of the variables used to define K^* such as sales or profits are in fact affected by [the adjustment process] and hence do not reflect the 'true' desired

> capital stock at any point on the investment path before full equilibrium .... Stated another way, the actual investment path is in itself a decision which will affect profits and therefore should be either in the criterion function or recognised as a constraint on the maximization of this function.

These are Nickell's (1978) 'pseudo-static' investment equations.

Nevertheless from an econometric point of view this criticism has not stopped Jorgenson's model from appearing as a 'contestant' in many relatively recent empirical papers (Bernanke, Bohn and Reiss 1988; Bischoff 1971b; Clark 1979; Feldstein 1982; Hall 1977; Jorgenson 1971; Loeb 1986; Wisley and Johnson 1985) and it is faced equally by all the aforementioned work on financially repressed systems. Indeed as Anderson (1981, p.88) remarks "... [the] plea for a theoretical underpinning of dynamic structure has yet to be acknowledged in a practical sense".

In the spirit of the general ad hocery which surrounds the slow adjustment of the actual capital stock to its desired/optimal level the speed of adjustment is made a function of credit variables. More particularly, in the literature on the determination of investment under financial repression the speed of adjustment is made to depend on some variable related to the change in the level of credit in real terms.

No justification is attempted but authors (Blejer and Khan 1984; Sundararajan and Thakur 1980; Tun Wai and Wong 1982) commonly cite Coen (1971) as a precedent to the practice of introducing some measure of fund availability in the investment function via the speed of adjustment. Indeed in Coen (op.cit.) and other literature not concerned with financial repression the speed of adjustment is made a function of some variable relating to corporate cash flow deflated by the implicit deflator for investment estimated in National Accounts. Some usual justification is attempted referring to Duesenberry's views to point out the possibility of a differential between the cost of internal and that of external finance. Indeed this rationale for introducing cash flow (or even a "stock measure of liquidity" cf. also Uri 1982) in an investment function (in an advanced financial system) has been recently revamped by Fazzari and Athey (1987) and Fazzari, Hubbard and Petersen (1987; 1988a). They point out that[1]:

> Explanations why internal finance may be less costly than new share issues and debt finance abound. Among the most prominent are transactions costs, tax advantages, agency problems, costs of financial distress and asymmetric information. (Fazzari, Hubbard and Petersen 1988a, p.148).

Alternatively as Clark (1979, pp.80-81) writes "[another possible] theoretical justification for adding a profits or cash flow term ... to an investment equation ... [is that] changes in profits should convey some new information about the future profitability of a firm possibly increasing expected future output and boosting the optimal future path of capital stock". Having established such justifications the next step would be as Coen (1971, p.138) suggests "... using the analytical approach of Eisner and Strotz ... a sound theoretical justification [to be] laid for including cash flow as a determinant of the adjustment speed .... Unfortunately the difficulties encountered in carrying out such an

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1. Note that such arguments could be directly adapted to justify the appearance of internal funds (which are likely to be sparse, see Dooley and Mathieson 1986, p.34) plus cheap loans from the banking system in the investment equation for a financially repressed economy. Here the relatively costlier funds could be those drawn from the unofficial markets. On the other hand, explanatory variables related to bank loans sometimes appear in investment equations for developed economies as well. For example Artus et al. (1981), who estimate an investment equation for France, explain on pp.15-16 that "to take into account credit rationing effects an additional variable is added .... constructed by extrapolating an (unrestricted) credit demand equation over these particular periods".

analysis are formidable". By contrast Feldstein and Flemming (1971) consider fund availability to influence (by a similar mechanism) the optimal capital output ratio. For Nickell (1978) the availability of internal funds plays a major role in investment behaviour:

> The higher the recent profit flow, the smaller the reliance which the firm has to place on borrowing from individuals who are bound to be more pessimistic about the firm's prospects and more averse to the risk inherent in the firms returns than the firm's owners .... [also] shareholders who are involved in the firm may well have considerably more information concerning the firm's future prospects than outsiders and will therefore perceive a lower risk associated with the prospects (pp.182-183)
>
> . . . .
>
> Indeed we can go further and argue that the main effect of current profits is on this rate of adjustment and not on the long-run equilibrium level of the capital stock itself, for in the long run the firm can generate enough wealth for its owners to finance its fixed equilibrium level of capital stock without recourse to expensive borrowing ... (p.185).

In an attempt to test these views (and in particular to test whether financial risk is a determinant of investment) Sinai and Eckstein (1983) include a distributed lag of the debt service burden (the ratio of interest payments on outstanding corporate debt to cash flow) in their investment equations (for the U.S.). Similar explanatory variables are used by Fazzari and Athey (1987, p.482) on the rationale that "interest commitments influence a firm's access to credit and therefore limit investment". Unlike the other researchers of financial repression Tybout (1983) traces (at least in part) the theoretical underpinnings of his regressions of investment on distributed lags of output and corporate earnings to the model of Schworm (1980). Schworm (op.cit.) together with Appelbaum and Harris (1978) develop a line of work started by Arrow (1968). They characterize investment plans that are bounded by non negativity and the requirement that the investing firm does not borrow funds or issue new equity and also with or without the option to retain earnings. We note that this settles the quest for a micro-justification of the role of the availability of funds in an investment relationship.

Finally we do not concern ourselves with the Q-theory of investment since this relies on the existence of a perfect market in corporate securities which clearly is not the case in repressed financial systems such as that of Greece.[2]

Section 3.3

Our Theoretical Framework and the Flexible Accelerator cum Credit Variables Specification

The flexible accelerator cum credit variables specification is considered in the literature as a demand for investment equation which differs from the conventional neoclassical model only because it incorporates a variable speed of adjustment.

Admittedly this interpretation differs from the view of the

2. For example volatility in the movements of the stock market is seen as subversive for the implementation of this approach even in highly developed capital markets. See the comments on Summers (1981) made by Bosworth, and Chirinko (1986,p.148). More particularly, that prices in the Athens Stock Exchange may not reflect 'fundamentals' is argued e.g. by Papaioannou (1982). Still a compelling argument in favour of a Q-model is given by Dinenis (1985) who shows empirically that the pure accelerator (in the U.K.) is not a behavioural relationship but a mirage. When investment demand rises the production of capital goods expands in response. National accounts record this as an increase in output and subsequently (after some delivery lag during which the increment is classified as works in progress) as an increase in investment. Thus investment is correlated with output lags.

determination of investment under financial repression conveyed by Fry's (1988, p.16) diagram. Yet it is the approach of Fry's diagram which underlies the determination of investment in our theoretical model.

Fry's position could be summarised as follows (see Chapter 1, diagram 1): it is a typical aspect of financial repression that there do not exist well developed capital markets in which deficit units may bid for funds from surplus units. As a consequence firms planning investments in physical capital over and above the purchasing power of their retained earnings can turn only to the banking system for finance. It is another aspect of financial repression that deposit (and loan) interest rates are administered ($\bar{r}$) below market clearing levels (r^*). Therefore there exists an excess demand for loanable funds (AB). It is also common practice under financial repression that loans are generally speaking not granted for consumption purposes. Hence we may identify the volume of loans actually extended to the private sector with its investment expenditures (over and above retained earnings). Moreover, as Dooley and Mathieson (1986, p.34) suggest, "firms would find it difficult to generate internal funds if they are already heavily dependent on subsidized credit to ensure their viability" [as is the case under financial repression]. However by the principle that under rationing the short side of the market determines the volume of transactions, the volume of loans actually extended (and thus investment) equals the volume of deposits forthcoming at the administered deposit rate (OA). (For precision we should allow also for [heavy] reserve requirements). This bears no relation to the demand for loans/investment evaluated at the official loan rate.
According to this view (and assuming that the loan market is not cleared by an effective loan rate, or even if it is, in the absence of information

on the latter) the demand for loanable funds/investment is completely redundant for the determination of the actual level of loans/investment under conditions of financial repression.

In particular within Fry's framework it may appear that once credit variables are included directly in a regression equation explaining investment, the real interest rate and income have no place since according to this view they influence investment not directly but by affecting the equilibrium stock of real money/deposit balances and thereby the availability of loans. By contrast if variables relating to the real interest rate and income show up independently from the credit variables this would seem to suggest that neoclassical demand side influences contribute to the determination of the volume of investment.[3]

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3. The literature has not discussed how investment equations which include both user cost and income as explanatory variables can be reconciled with a rationing determination of investment. However, frequently, accelerator formulations are viewed as compatible with rationing. Blejer and Khan (1984, p.386) appear to be attempting to reconcile the approach of Fry's diagram with an (flexible) accelerator cum credit variables specification by not including a user cost variable in the latter: "A clear consensus has emerged in recent years that in contrast to developed countries one of the principal constraints on investment in developing countries is the quantity rather than the cost of financial resources. The rates of return on investment in these countries typically tend to be quite high, whereas real interest rates on loanable funds are kept low by governments for a variety of reasons. In such circumstances the investor cannot be expected to equate the current marginal product of capital to its service cost. Indeed because the total amount of financing is limited and the price mechanism is not allowed to operate smoothly it would seem legitimate to hypothesize that the private investor in a developing country is restricted by the level of available bank financing". Similarly, Blinder (commenting on Fazzari, Hubbard and Petersen 1988a, p.197) attributes the stylized fact that "you have to torture the data pretty ruthlessly before they confess to an interest elasticity of investment" to credit rationing in highly developed capital markets.

Section 3.4

Attempts at Reconciliation

We discuss one possible reconciliation between the interpretation of the flexible accelerator cum credit variables found in the literature and Fry's position on the determination of the volume of investment under financial repression.

Casual empiricism suggests that the prevalence of excess demand may not correspond exactly to reality in the Greek financial system at least as far as particular loan categories are concerned. For example Courakis (1981a), OECD (1986), and more recently the Governor of the National Bank of Greece (in his Annual Reports for 1986 and 1987) pointed out that over a long period of time commercial banks have not managed to come across (sufficiently creditworthy) borrowers that would have enabled them to lend out the entire amount of funds which selective credit regulations require them to put aside for long term loans to enterprises engaged in manufacture or handicraft.

This evidence implying some segmentation of the capital market (characteristic of financial repression cf. Cho 1988) suggests that only some components of aggregate investment may be constrained by the availability of finance.[4] Therefore an equation explaining investment

4. Fazzari, Hubbard and Petersen (1987; 1988a) identify this situation in highly developed capital markets as well and attribute it to "firm heterogeneity". Similarly, Blinder and Stiglitz (1983) suggest that small (and/or new) firms are likely to be rationed in all capital markets. Stegman (1982) envisages alternating regimes over time: "The investment hypothesis suggested here ... sees investment expenditure as accelerator-determined only when firms have sufficient profits to undertake all desired investment. When their level of profitability is insufficient to undertake all desired investment, firms invest only up to the maximum amount of expenditure consistent with their liquidity and debt limits". (p.381)

should reveal both the importance of the volume of new credit and of the conventional neoclassical variables. Yet this is precisely the form of the flexible accelerator cum credit variables specification.

Hence it may be correct to interpret the flexible accelerator cum credit variables not as a structural equation but rather as a mixture of two other structural equations, one neoclassical, the other representing Fry's position, reflecting that part of aggregate investment is determined by the supply of loanable funds while another part is determined by its demand which is characterised by neoclassical theory.

We argue here that it is also quite possible to interpret the flexible accelerator cum credit variables specification as a structural equation reflecting precisely our theoretical view of the determination of investment under financial repression (which represents a slight refinement of Fry's position).

The discrete time, levels-of-variables version of the investment relationship developed in Chapter 2 setting out our theoretical framework is:

$$I = \frac{\Delta L}{P} - \rho.(1-k).f(Y,\delta-\pi^{*}) + \Lambda(Y,\delta-\pi^{*}) \qquad (A)$$

where:

I	:	investment
$\frac{\Delta L}{P}$	:	real value of new loans
ρ	:	nominal loan rate
k	:	reserve ratio
Λ	:	aggregate retained profits in real terms
f	:	real money demand

Y : real income

$\delta - \pi^*$: real deposit rate

(We have substituted the demand for real money balances for the real value of the money supply under the assumption of a steady state).

This relationship says that in a financially repressed system the volume of investment is not determined by its demand but by the supply of loanable funds. Further it incorporates the insight of Currie and Anyadike-Danes (1980) whereby the relevant measure of the supply of loanable funds is that of the net flow of finance. To reach this measure the real value of interest payments due on outstanding loans must be subtracted from the real value of new loans. In addition the flow of aggregate retained profits is acknowledged as a component of the funds available for investment.

Quite plausibly aggregate profits are modelled as depending on the level of economic activity. A considerable part of the literature on financial repression suggests that aggregate profits (before interest payments) should be made to depend positively on the level of real interest rates to represent mechanisms such as the following:

When the real interest rate rises, from all projects that depend on loans it is those having the lowest profitability which can no longer break even and withdraw to be replaced by projects of necessarily higher profitability that were rationed out previously by means of non price criteria; consequently the average profitability in the pool of projects with access to finance rises. Assuming that on the whole projects cannot materialize without some accompanying bank finance the argument justifies a positive dependence of economy wide profitability on the level of the real interest rate. At the same time a rise in the real deposit rate discourages self financed (typically low scale) projects by rendering placements in deposits more attractive. In turn banks using their superior project evaluation expertise and capable of pooling small holdings, lend out those funds to finance higher yielding large-scale projects (in the private or via reserve asset requirements or otherwise, the public sector). Again a rise in the level of real interest rates is associated with a rise in economy wide profitability. A higher flow of profits creates greater opportunities for retainement and reinvestment. However there are difficulties with the econometric detection of this dependence. It is quite apparent in the argument above that changes in the interest rate will affect investment via this channel with probably long lags, due to the time it takes for internal resources to accumulate. On more general grounds we should expect to see a change in economy wide profitability (comparable to the cyclical fluctuation) to be associated with a regime change from repression to liberalization rather than a marginal rise in the administered interest rate.

Although the theoretical relationship (A) seems to translate into a regression equation involving a unitary coefficient on the real value of new loans (or even the net flow of finance) and aggregate retained profits obviously such restrictions cannot be maintained in practice since neither the entire flow of loans nor the entire flow of retained profits go for current investment expenditures. Similarly not all outstanding loans are drawn on investing firms or bear the average rate and thus the measure of the net flow of finance that would be entered in a regression would not correspond exactly to the theoretical relationship.

On the other hand, the flexible accelerator cum credit variables specification is in summary form:

$$I = G[CR, Y, C] \qquad (B)$$

where

CR : measure of credit availability in real terms

Y : real income

C : real user cost.

Firstly we observe that a regression equation descending from the flexible accelerator cum credit variables specification contains the same variables that would appear in a regression corresponding to our theoretical relationship (A).

Specifically in (B) we write investment to depend on some measure of credit availability in real terms, real income and the real user cost of capital. All these variables appear in (A) as well since the user cost is the real interest rate plus a constant rate of depreciation.

Would then some variables show up as significant regressors if (A) and our theoretical framework were the true model but not so if the demand side interpretation of (B) were the case? A significant negative dependence of investment on the stock of outstanding loans or the nominal loan rate would not be an indication in favour of our theoretical framework. This dependence could occur equally well in the context of the interpretation given in the literature if the speed of adjustment depends on the net flow of finance in the true (yet demand side) model while the regression equation that is estimated includes only the real value of new loans in its measure of credit availability. We saw above that the literature offers no theoretical grounds for and does not actually articulate any preconception as to the precise measure of credit availability to be employed and various alternative measures have been tried by different researchers.

Secondly, we consider whether the interpretation current in the literature leads to prior expectations as to the signs of the coefficients on the real interest rate and real income in a regression explaining investment that differ from the prior expectations on the signs deduced on the basis of the interpretation given by our theoretical framework (i.e. determination of investment by the supply of loanable funds as in [A]). Throughout this discussion we assume that the true model (whether demand side or not) involves the net flow of finance as the proper measure of credit availability.

Consider the regression equation:

$$I = A \cdot \left[\frac{\Delta L}{P} - \rho . \frac{L}{P}\right] + B.Y + \Gamma.(\delta-\pi^{*})$$

where $\frac{L}{P}$ is the real value of outstanding loans.

According to the interpretation in the literature once the regression equation contains the net flow of finance as the credit availability measure all dependence on income and the interest rate should come through the neoclassical mechanisms in connection with the determination of the optimal level for the capital stock. In particular the neoclassical theory would predict a positive response of investment to real income and a negative response to the real interest rate (user cost).

Consider now the interpretation given by our theoretical framework to a regression equation consolidating the first two terms in (A) into a single independent variable. After the influence of the net flow of finance has been allowed for our theoretical framework would acknowledge a positive dependence of investment on income through the term in retained profits. On the other hand our framework leads to the expectation of a positive dependence of investment on the real interest rate again through the response of retained profits. Hence a finding of a positive sign on the user cost is evidence in favour of our theoretical framework and against the interpretation of the flexible accelerator cum credit variables specification that can be found in the literature. However such a finding seems quite unlikely in view of the reservations expressed in connection with the dependence of aggregate profits on the real interest rate. Indeed if this 'profits effect' of the real interest rate is not operational in principle (or for that matter operative in our sample) then the argument is restored that the real interest rate (but not so for the level of income) should have no place in a regression alongside credit availability unless neoclassical demand side influences are being picked up.

Consider now the regression equation:

$$I = A \cdot \frac{\Delta L}{P} + B.Y + \Gamma.(\delta - \pi^{*})$$

This regression equation does not contain the appropriate credit availability variable but only the real value of new loans. Then the prior expectations as to the signs that the interpretation current in the literature leads to are as follows: A rise in the real interest rate is contractionary for investment through the neoclassical channel (i.e. reduces the gap between the optimal and the actual level of the capital stock) but also because it results in a larger flow of interest payments given new loans (assuming it is associated with a rise in the nominal interest rate and/or by raising the equilibrium real size of the banks balance sheet) thus reducing the appropriate measure of credit availability and the variable speed at which any given gap between optimal and actual capital stock could be closed. A rise in income is expansionary for investment through the neoclassical channel (but tends to reduce the speed of adjustment and investment by increasing the real stock of deposits hence outstanding loans thus interest charges and reducing the net flow of finance). Thus income has in principle an ambiguous sign (with a presumption in favour of a positive sign reflecting the accelerator mechanism). (It is assumed, in this argument, that profits do not affect investment, independently from income, within a neoclassical framework).

Our theoretical framework does not have definite predictions about the sign on the real interest or the income variable. A rise in the real interest rate reduces the net flow of finance. On the other hand it may generate an increase in the flow of aggregate profits thus making investment subject to two opposing tendencies. Admittedly as we have shown in Chapter 2 a reasonable response of profits to the rise in the real interest rate would ensure easily that the overall effect on investment is positive. An exactly similar argument suggests that the direction of the response to a rise in income is ambiguous as well.

Hence in the case that the measure of credit availability entered in the regression is the real value of new loans, the only indication enabling us to distinguish between the two interpretations would be the appearance of a positive sign on the user cost variable, which would point in favour of our theoretical framework.

Section 3.5

Flexible Accelerator cum Credit Variables: The Derivation of the Optimal Capital Stock

The objective of the choices of the firm is to maximize[5] its net worth W, i.e. the present discounted value of the infinite stream of cash flow from its activities (i.e. the difference of revenue and costs both on current account [labour costs] and on capital account [costs of purchasing capital goods to add to the stock that is already owned]) after all implications of the tax regulations have been taken into account. The objects of the choices of the firm are the level of employment of labour L and the level of the capital stock K.

In the absence of taxation we have:

$$W = \int_0^\infty [\exp(-rt)] \,.\, [p.Y - w.L - q.I]dt \qquad (1)$$

p : output price

Y : output

5. An investment function involving all the conventional neoclassical dependences could be arrived at by assuming alternatively a firm objective of minimization of the present discounted value of the infinite stream of total (i.e. including investment) costs. Consequently the assumption of perfect competition in output markets is also dispensable (cf. Galleoti 1984, p.394 n6).

w : nominal wage

q : price of capital goods

I : investment

All variables apart from the discount rate r to be thought of as functions of time.

Perfect foresight is assumed. Some derivations consider constant, others growing nominal prices.

Conventionally two constraints are acknowledged in this maximization exercise. Firstly, that of the production function whereby the flow of output produced is determined uniquely by the flow of the labour input and the flow of capital services:

$$Y = F(L,K) \qquad (2)$$

More particularly in the words of Jorgenson (1967, p.139) it is assumed "... that the services of investment goods acquired at different points of time are perfect substitutes in production. Accordingly the flow of capital services from each investment good is proportional to the stock of capital that may be obtained by simply adding together all past acquisitions less replacements". Thus the (net) capital stock appears in the production function.

The second constraint stipulates that current gross investment raises the capital stock one for one, as a matter of definition. However, to arrive at the end of period capital stock, we need also subtract that part of the capital stock at the beginning of the period which is assumed to have decayed: i.e. to have lost the property of yielding capital services. Furthermore it is assumed that capital goods decay exponentially at a constant rate so that the flow of replacement investment, that would be required to maintain the capital stock so as to yield an unchanged level of capital services, is proportional to the existing capital stock. In particular depreciation does not relate to economic considerations such as the intensity of use of the capital goods.

$$\dot{K} = I - s.K \qquad (3)$$

s : constant rate of replacement/depreciation

The logic of the maximization is brought out (in continuous time) by means of the Euler conditions which are the analogues of first order conditions in the case that the rate of change of the choice variable appears in the objective function. It turns out that at the optimal level of employment the marginal product of the current input is set equal to its relative price (whence the familiar marginal productivity condition for labour is obtained for every point in time) and the marginal product of capital is set equal to a quantity interpreted as its real user cost.

$$\frac{\partial F}{\partial K} = [q.(r+s) - \dot{q}]/p \qquad (4)$$

Subsequently we may specify a Cobb-Douglas production function (say $Y = AL^{1-a}K^{a}$). Apart from the independent empirical support for this formulation and its frequent use by Jorgenson in his empirical work, Hall (1977) suggests the additional advantage that it leads to the specification of an investment equation less likely to be suffering from simultaneity bias essentially because of the appearance of output and user cost combined in ratio form rather than separately. Although we write the theoretical equations below under the assumption of such a production function, in the empirical part we consider also a real output variable separately from real user cost. (For recent examples of this procedure see Chirinko 1986; Chirinko and Eisner 1983).

If then the production function is Cobb-Douglas we may solve out for the optimal capital stock from the marginal productivity condition given above.

$$K^* = a \cdot \frac{pY}{c} \qquad (5)$$

$c = q.(r+s) - \dot{q}$: nominal user cost

a : elasticity of output with respect to the capital input.

We refer to PY/c as <u>the composite</u> and denote it by J.

Section 3.6

The Specification of the Investment Equation

We assume that starting from a situation of equilibrium and given a change in the determinants of the optimal capital stock the actual capital stock is not adjusted immediately to the new optimal level. The sluggishness in the adjustment enables the definition of a continuous investment function. Conventionally it is attributed (i) to the fact that the procedures involved in planning, designing, manufacturing and installing new capital cannot take place instantaneously upon the change in the determinants of the optimal capital stock. (ii) A less mechanistic rationalization (alternative to the former which is preferred by Hall) is provided by the authors who, as noted above, deduce that the costs involved in the investment process (i.e. "purchases costs [with either perfect or imperfect factor markets] and installation costs which are internal to the firm" Lucas 1967, p.80) imply the optimality of a slow adjustment. Sargent (1979) stresses the modelling importance of the assumption that these costs increase at an increasing rate with the absolute value of investment (gross or net);[6] (iii) to the lags involved in the formation of expectations on the determinants of the optimal capital stock; (iv) to price rigidities, failure of the market for investment goods to clear (Quandt and Rosen 1982); (v) even outside the flexible accelerator approach and well into the mainstream of the financial repression literature we find reasons for the introduction of distributed lags in the investment function. For example, Molho (1986a, p.115) concludes, within a model of portfolio choice attempting to provide a microjustification of the McKinnon complementarity view, that "... interest rates affect expenditure-saving decisions through a complex and possibly very long lag. Moreover, in the presence of inflationary uncertainty, the ex ante current real deposit rate may be a function of ex post rates, further complicating this lag structure".

Hence a change in the optimal capital stock does not result in a once off discontinuous step in investment but gives rise to a flow of (net) investment for a number of periods in the future. Seen differently the (net) investment observed at any given period t is motivated by changes in

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6. Nickell (1978, p.262) argues that "... there does not seem to be a very strong case for strict convexity of adjustment costs internal to the firm ... one particular type of cost ... could well save the day .... there are good a priori grounds for thinking that the cost of capital is upward sloping in the level of investment at an ever increasing rate". (Cf. also Steigum 1983).

the optimal capital stock which took place in the past as well.[7]

We therefore write:

$$I_t - s.K_{t-1} = \sum_{i=0}^{\infty} B_i.[K^*_{t-i} - K^*_{t-i-1}] \qquad (6)$$

B_i is the proportion of investment plans initiated in period t-i that can be completed only in period t. We refer to B_i as the (original) lag coefficients.

Hall and Jorgenson (1971) estimate (6) by expressing the optimal levels for the capital stock in terms of the corresponding contemporaneous actual values for the composite. This is not necessarily inconsistent with the practice of other researchers explained below who consider the target for the capital stock to depend on the expected or permanent value of its determinant J and then provide expressions for the expectations in terms of actual values. For example, the procedure of Hall and Jorgenson could be justified by an assumption of static expectations, i.e. the anticipation that current values of the variables will be maintained in the future (rational if the composite follows a random walk process). Another possibility is offered by Hall (1977) and Chirinko (1986). They warn us that the coefficients estimated on equations derived from (6)

7. As Brainard points out in his comment on Hall (1977, p.114) this kind of modelling appears somewhat odd "... why doesn't the Jorgenson-Hall firm manipulate orders to keep capital precisely on target (assuming that some capital is delivered in the period orders are placed) .... Hall gets out of that bind by assuming that capital with short delivery lags cannot substitute for capital with longer delivery lags .... How is it that capital goods that cannot substitute for each other during the investment process end up as homogeneous capital in a Cobb-Douglas production function?" Hall and Jorgenson (1971, p.22) seem to hedge against such a criticism by saying that the equation given in the text above implies that "new projects are held to be initiated in each period until the backlog of uncompleted projects is equal to the difference between desired and actual capital".

(such as the ones given below) should not be interpreted simply as a representation of the technological delays discussed above but as a convolution of the former with the sluggishness intrinsic in the process of expectations formation. The original lag coefficients are not purely structural and therefore may not be stable in the face of changes in the environment in which expectations are formed (say changes in the mode of announcement of policy induced alterations to the determinants of the optimal capital stock). Still Chirinko (1988) finds no evidence of instability of the investment function (attributable to this Lucas critique) in the U.S.

Anyhow we leave this theme and substitute (5) into (6) and truncate (at a point to be determined by experimentation below) to obtain the regression equation:

$$I_t - s.K_{t-1} = a . \sum_{i=0}^{n-1} B_i.D_{t-i} \qquad (7)$$

where $D_{t-i} = J_{t-i} - J_{t-i-1}$.

3.6.1

Introduction of credit variables

Following the approach of Blejer and Khan (1984), Sundararajan and Thakur (1980), Tun Wai and Wong (1982), we extend Hall and Jorgenson (1971) by making the lag coefficients in specification (6) a function of credit variables. We assume that the proportion of investment projects initiated in period t-i that will have been completed by period t, depends on the availability of credit relative to the magnitude of the required investment at least throughout the duration of this time interval from initiation to completion. Hence we write (cf. Artus et al. 1981):

$$B_i = B_i' + \frac{V_i[L_t, L_{t-1} \dots L_{t-i}]}{K^*_{t-i} - K^*_{t-i-1}} \quad (8)$$

It is assumed the denominator is not equal to 0. L_t is some measure of the real value of loans extended in period t.

Linearizing (8) and substituting into (6) we obtain after truncation the regression equation:

$$I_t - s.K_{t-1} = a . \sum_{i=0}^{n-1} B_i'.D_{t-i} + \sum_{i=0}^{n-1} b_i.L_{t-i} \quad (9)$$

where $D_{t-i} = J_{t-i} - J_{t-i-1}$.

b_i gives the change in current net investment if credit extended in period t-i rises by one unit. In general its sign is ambiguous. (Cf. Gardner and Sheldon 1975). If credit were tight in t-i then a smaller proportion of projects initiated in even earlier periods than t-i would have been completed by t-i than otherwise. Consequently a larger proportion of projects would have been carried forward towards the present to be completed in the current period thus tending to increase current net investment. Alternatively as Coen (1971) has suggested if credit seems relatively ample in t-i then overinvestment may take place in t-i in anticipation of credit shortages in the future: this also would work towards a negative sign on b_i. On the other hand loans extended in t-i may not have been wholly used for productive purposes in the past (say because of binding technological constraints on the delivery of capital goods) but may lay idle in the bank accounts of the debtors. Hence past loans may be carried forward to add to the aggregate credit availability of the present thus tending to contribute (unambiguously by enabling say a larger response to a change in the determinants of the optimal capital stock that has taken place since last period) to an increase in current net investment.

Hall and Jorgenson (1971) who employ specification (7) assume that the original lag coefficients B_i follow a rational lag distribution. As a consequence they sum to 1 and this restriction enables the exact identification of the original lag coefficients separately from a. An alternative would be to employ an extraneous estimate for a from the studies of the production function. In any case the priority of our study is to detect the influence of credit conditions on investment and also to demonstrate the superiority of a specification that includes credit variables compared to one that does not. This is accomplished quite satisfactorily below and the detailed assessment of the impact of neoclassical variables could perhaps be left into the background.

Alternatively and for comparability with the specifications to follow we may assume that the availability of credit only in period t−j matters for investment in period t. (j is to be determined by experimentation; in theoretical derivations it is usually set equal to zero).

We therefore write:

$$B_i = B_i' + b_i \cdot \frac{L_{t-j}}{K^*_{t-i} - K^*_{t-i-1}} \qquad (10)$$

the coefficient b_i reflects also some allocation of the loans extended in the j^{th} period over the variety of projects each of which was initiated at a different point in the past.

Substituting into (6) and truncating we obtain the regression equation:

$$I_t - s.K_{t-1} = a \cdot \sum_{i=0}^{n-1} B_i^{'}.D_{t-i} + \left[\sum_{i=0}^{n-1} b_i\right] \cdot L_{t-j} \qquad (11)$$

where $D_{t-i} = J_{t-i} - J_{t-i-1}$.

Since $\frac{\partial}{\partial L_{t-j}} \{B_i.[K^*_{t-i} - K^*_{t-i-1}]\} = b_i$ under the assumption that credit variables do not affect the optimal level for the capital stock we may sum over all lags to obtain:

$$\sum_{i=0}^{n-1} b_i = \frac{\partial}{\partial L_{t-j}} [I_t - s.K_{t-1}]$$

Therefore the interpretation of the coefficient on L_{t-j} in this specification is the same as the interpretation of b_1 in all the specifications below, i.e. it gives the absolute amount by which net investment rises when real credit availability is increased by one unit. Here it becomes transparent that net investment rises because a larger proportion of at least some of the various projects initiated at different points in the past can be completed within the current period.

3.6.2

Specifications involving partial adjustment mechanisms

Under the assumption the lag coefficients in (6) make up a Koyck distribution, i.e. $B_i = b(1-b)^i$ then (6) can be written in the form of a partial adjustment scheme with speed of adjustment b. Because of the aforementioned technological obstacles to immediate adjustment, each period investment suffices to cover, apart from replacement, only a fraction b of the gap between the actual capital stock and its optimal level. In fact this could be seen as optimal behaviour in response to a particular type of costs of adjustment under certain conditions.[8] We therefore have:

$$I_t = b_t . [K_t^* - K_{t-1}] + s.K_{t-1} \qquad (12)$$

Further the speed of adjustment is not a constant completely determined by technology but is made to depend on some measure of the availability of credit in real terms relative to the total real amount of funds needed to finance the expansion from the actual to the optimal level of the capital stock. Coen (1971) draws our attention to the plausibility of not including credit availability in absolute terms (which could be made practicable by say an exponential function) but relative to what he calls the 'investment chore'. Thus we may write a variable speed of adjustment as:

$$b_t = b_o + b_1 . \frac{L_{t-j}}{K_t^* - K_{t-1}} \qquad (13)$$

where we assume the denominator is not equal to zero.[9]

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8. Typically a partial adjustment scheme is derived by minimization of a cost function equal to the weighted sum of two quadratic terms, one representing the costs of being away from the optimal level, the other representing the costs of making an adjustment. This exercise is myopic (one period horizon) and implies continuous undershooting of a growing optimal level, a matter which the alternative of an error correction mechanism would take care of (cf. Hendry and von Ungern-Sternberg 1980, p.240).

9. Coen following Hochman (1966), suggests also an alternative expression for the speed of adjustment where it is made to depend on real credit still available after replacement investment has been financed, relative to the gap between the optimal and the actual capital stock. Thus alternatively we could write the variable speed of adjustment as

$$b_t = b_o + b_1 . \frac{L_{t-j} - s.K_{t-1}}{K_t^* - K_{t-1}}$$

where we assume the denominator is not equal to zero. Of course this form of the speed of adjustment does not imply the introduction of any continued/.....

Substituting (13) in the partial adjustment scheme we obtain the specification:

$$I_t = b_o.K_t^* + b_1.L_{t-j} + (s-b_o).K_{t-1} \qquad (14)$$

This specification is similar to those employed by Sundararajan and Thakur (1980) and requires data on the capital stock.

The need to construct a series for the capital stock can be obviated if we substitute out the actual capital stock by its expression as the infinite sum of all past net investments according to the perpetual inventory model:

$$K_{t-1} = \sum_{i=0}^{\infty} (1-s)^i.I_{t-i-1} \qquad (15)$$

Substituting (15) into the specification (14) and after some manipulations (carried out conveniently by writing the perpetual inventory model in terms of the lag operator) we obtain the specification:

$$I_t = b_o.[K_t^* - (1-s).K_{t-1}^*] + b_1.[L_{t-j} - (1-s).L_{t-1-j}]$$
$$+ (1-b_o).I_{t-1} \qquad (16)$$

This specification is similar to those employed by Coen (1971) and its main feature is that it involves essentially differencing of the credit variables.

9. continued/...
variable in the regressions additional to those occuring under (13) but only a different interpretation on the coefficient of K_{t-1} (or I_{t-1}). Note that for consistency and comparing with this specification of a variable speed of adjustment, credit availability should be reckoned relative to the requirement for gross investment in (13), i.e. the denominator of the former expression should include also a term representing replacement investment. Following Blejer and Khan (1984) and Sundararajan and Thakur (1980) we avoid this minor complication.

Instead of writing net investment as a partial adjustment to the gap between the actual and the optimal level for the capital stock Blejer and Khan (1984) set the change in actual gross investment in the current period to be equal to a fraction b of the difference between optimal and actual gross investment in the previous period:

$$I_t - I_{t-1} = b_t.[I_t^* - I_{t-1}] \qquad (17)$$

In turn optimal gross investment is defined for the steady state as that level of investment required to maintain the capital stock at the optimal level unchanged in the face of depreciation and also to bring about any adjustment in the optimal level in response to changes in its determinants:

$$I_t^* = K_t^* - K_{t-1}^* + s.K_{t-1}^* \qquad (18)$$

The adjustment speed is made to depend as before on some measure of credit availability in real terms but this time relative to the size of the discrepancy between optimal and actual investment (cf. also Fry 1988, p.54):

$$b_t = b_o + b_1 \cdot \frac{L_{t-j}}{I_t^* - I_{t-1}} \qquad (19)$$

Substituting (19) and (18) into (17) we obtain the specification:

$$I_t = b_o.[K_t^* - (1-s).K_{t-1}^*] + b_1.L_{t-j} + (1-b_o).I_{t-1} \qquad (20)$$

The justification for this alternative approach (which is only hinted in Blejer and Khan 1984) is that both (17) combined with (18) and the partial adjustment scheme for the capital stock combined with the perpetual inventory model lead to the same specification for the investment equation under the assumption of a constant speed of adjustment. When however the speed of adjustment is made to be variable the approach of Blejer and Khan leads to specification (20) which unlike specification (16) (arrived at from the partial adjustment scheme for the capital stock) does not introduce the credit variable in difference form. This is because the appearance of the actual capital stock is avoided completely in the relationships of Blejer and Khan and consequently the application of the perpetual inventory transformation that is causing the differencing is not required. For our purposes this may be an advantageous feature of the specification of Blejer and Khan since it is bound to show-up greater explanatory power for the credit variable. Specification (20) is also preferable in its stochastic form since the perpetual inventory transformation results in a first order moving average error process being tagged onto equation (16), assuming the underlying model (14) has a white noise error.

Section 3.7

The Expected Value of the Composite and our Regression Equations

In Blejer and Khan (1984), Coen (1971) and Sundararajan and Thakur (1980) the current optimal capital stock is viewed as a function of the expected or permanent, rather than the actual, values of its determinants (i.e. in our case the expected value of the composite variable).

$$K^* = a.J^e \qquad (21)$$

Various procedures are proposed for the generation of this unobservable variable from current and past actual values of the composite. Thus lags are introduced in the corresponding specifications. These lags could be viewed as of purely expectational provenance since they are brought in on top of the partial adjustment scheme which is assumed to (but may not in reality) capture all the technological delays.

In Sundararajan and Thakur (op.cit.) the expected value of the composite is expressed as an unrestricted finite distributed lag of the actual value containing also the current value.[10] Indeed, Chirinko (1986) views such representations of "extrapolative expectations" as being invariably associated with neoclassical (as opposed to 'q') models of investment.

Truncating at a lag length to be determined by experimentation with the full investment equation we have:

$$J^e = \sum_{i=0}^{m-1} d_i . J_{t-i} \qquad (22)$$

Substituting into our specification we obtain the following equations to be estimated:

$$I_t = a.b_o . \sum_{i=0}^{m-1} d_i . J_{t-i} + b_1 . L_{t-j} + (s-b_o).K_{t-1} \qquad (23)$$

$$I_t = a.b_o . \sum_{i=0}^{m-1} d_i . D_{t-i} + b_1 . DL_{t-j} + (1-b_o).I_{t-1} \qquad (24)$$

$$I_t = a.b_o . \sum_{i=0}^{m-1} d_i . D_{t-i} + b_1 . L_{t-j} + (1-b_o).I_{t-1} \qquad (25)$$

where $D_{t-i} = J_{t-i} - (1-s).J_{t-i-1}$

10. Unless an extra assumption is made the coefficients of the expectational distributed lag cannot be exactly identified separately from a. Sundararajan and Thakur (op.cit.) do not concern themselves with this difficulty. Note that Helliwell and Glorieux (1970) demonstrate (by means of some recursion) that such distributed lags may proxy expectations (containing "extrapolative, regressive and trend growth elements") about a point in the future that is further than one period ahead.

$$DL_t = L_t - (1-s).L_{t-1}$$

It is common practice in the literature to employ an independent estimate (possibly from extraneous sources) for the rate of replacement on the basis of which the series are to be transformed before being entered as regressors. Sundararajan and Thakur estimate themselves the replacement rate but separately from the investment equation. Below we explain how we arrive at such an estimate ourselves.

An alternative rationalization for the distributed lags is provided by Coen (1971, p.165): "It is assumed that the firm bases its decisions on the permanent components only and that the permanent components of each variable can be approximated by a weighted average of current and past values of the variable". A different assumption could be that expectations on the composite are formed rationally and with full information and therefore do not differ from the actualized value but for a white noise error. (Cf. McCallum 1976 who provides the basis for the representation of expectations [in the context of investment] in Abel 1980). Alternatively and following Blejer and Khan (1984) we could have considered the expected value for the composite to be generated by an adaptive expectations scheme whereby the revision in the expectations concerning the current period is a fraction of the expectational error recorded last period. Yet another approach to the generation of the unobservable expected value for the composite that determines the currently optimal capital stock involves estimating independently a regression of its current value on a number of its past values and/or other relevant variables. The fitted value from this regression is taken as the expected value for the composite and is inserted in the investment equation. The number of lags to be included in this independent regression is to be determined by experimentation (cf. Barro 1977). A special case of this approach appears in Hall (1977) who fits a first order autoregressive scheme for the composite variable. Similarly Farimani, Buongiorno and Thomson (1988) employ in their equations (many periods ahead) forecasts of the determinants of investment generated by ARIMA models. Compare also Birch and Siebert (1976) and Schiantarelli (1983) who work though with a lag structure depicting that expectations held at various different points in the past all concerning the present period are the determinants of current investment. Additionally Nickell (1978, pp.245-247) mentions the following procedures: "... suppose that the variable will continue to grow or decline as it has been doing in the past. Thus a variable of the type x(t,t+m) [expectation about value in t+m held in period t] is replaced either by $x(t).(1+g)^m$ where g is a trend rate of growth or by $x(t) \prod_{i=0}^{m} (1+g_{t-i})^{\alpha_i}$ where g_{t-i} is the rate of growth in period t-i and α_i are exponents to be estimated ... [or] proxy the expected future variable by some other completely different variable which hopefully incorporates some expectational elements". (For example, Lawrence and Siow (1985, p.374) attribute any association between investment and nominal interest rates to the latter's role as "powerful predictors of GNP").

There is little doubt that "the essential characteristic of investment decisions is that they are inherently forward-looking as they depend upon the expectations of future values of the relevant variables" (Schiantarelli 1983, p.291). However situations where investment behaviour can be analysed validly as a 'myopic' process are not unknown. For example Arrow (1964) demonstrates that reversibility and exponential depreciation are sufficient conditions for it to be the case that "... future movements of the profit function play no role in the determination of the current stock of capital and therefore of current investment" (p.23). Then also "the investment decision at any moment of time is independent of the future course of the rate of interest" (p.28). Indeed as Feldstein and Flemming (1971) point out, it is precisely under these conditions that Jorgenson's formulation [i.e. (6)] making use of the actual values of the variables (and invoking delivery lags) only, is justified.[11]

Section 3.8

Our Data

The sample is made up of annual observations from 1958 to 1985.[12] We took the following series from the Yearbook of International Financial Statistics (IFS): i) GDP in Current Prices, (employed in the construction of the series for the composite), ii) Lending rate, iii) Domestic Credit: Claims on Private Sector, iv) Nominal Wages: Hourly Earnings, while from

11. On the other hand the incorporation of expectations in an empirical investment function, according to the stipulations of theory, is not without difficulties. For example as Gould (1968) puts it "the introduction of adjustment costs forces the firm to consider profit potentials <u>over its entire horizon</u>" (p.53). Schiantarelli (1983) also argues that "if investment is irreversible ... entrepreneurs will not adjust fully to variations in the level of output demand which are deemed transitory ... [hence we may] assume that firms base their investment decisions on a weighted average of expected output <u>over the entire future</u>" (p.295) [in all the quotations above the emphasis is mine]. Of course one can always think of a possible 'fix-up' in this respect: "to make estimation possible we shall impose that ... [the] weights decrease geometrically as we move towards more distant periods" (ibid.). In fact this hardly worked as Schiantarelli found that all weights apart from the first one came out to be zero for his sample.

12. There would seem little point in extending our sample into the unsettled hyperinflationary early fifties. One would expect structural shifts to have followed the transition from hyperinflation to stability. Nevertheless the findings of Alogoskoufis (1985, pp.49-50) do not seem to corroborate this view.

the National Accounts of Greece (as reprinted in the Monthly Statistical Bulletin of the Bank of Greece and in Bank of Greece 1982) we took the series for i) GDP in Constant Prices of 1970, ii) GDP in Current Prices (employed in the construction of the series for the GDP deflator), iii) Private Gross Fixed Capital Formation in Current Prices, iv) Private Gross Fixed Capital Formation in Constant Prices of 1970.

3.8.1

The correspondence between the statistical series and the variables they are intended to measure

Gross Investment: The practice in the literature is to explain components of aggregate private investment separately. Thus Clark (1979) separates equipment from structures while Coen (1971) and Hall and Jorgenson (1971) also distinguish between manufacturing and non-farm non-manufacturing investment. However the main concern in our study is the influence of credit conditions on investment on the aggregate. It would have been quite difficult (and perhaps pointless in view of the fungibility of credit) to construct smaller credit aggregates corresponding exactly to the subclassifications of investment in published statistics. In addition, at least for Greece the breakdown of investment in components may not be quite reliable especially as far as the corresponding series in constant prices are concerned (Ward 1976).[13] Public investment as well is constrained by credit availability and indeed there are important issues associated with the 'competition' between the

13. Still we report some results obtained with the dependent variable excluding expenditures for the construction of residential buildings. Note also that a relationship between agricultural credit and investment has been recently detected on Greek data by Baltas (1983).

public and the private sector for the limited amount of funds which, at least in connection with the investment function, provide the main focus of interest in Tun Wai and Wong (1982)[14]. However (and notwithstanding the fact that the neoclassical equation can be derived from cost minimization alone) we thought that public investment would not necessarily relate to the neoclassical determinants as private investment does and therefore decided to exclude it.

Net Investment: Hall and Jorgenson (1971) construct net investment as the difference between gross investment and their estimate of the net capital stock multiplied by the number they use for the rate of depreciation. We construct our series for private net fixed capital formation in constant prices by subtracting from the series of private gross fixed capital formation in constant prices the series for depreciation/capital consumption in constant prices attributed (below) to the capital stock of the private sector.

Output: Alternative measures encountered in the literature are new orders in real terms (Coen 1971) gross value added at factor cost in nominal terms (Hall and Jorgenson 1971) etc. Since private investment is to be explained it is the output of the private sector which should enter the regressions. However such disaggregation is not published for Greece

14. These issues are also explored in Coats and Khathate (1978) who find that the implications of the financing of government debt on the part of commercial banks are different according as other private loans or rather excess reserves contract in a compensating fashion (in which case the money supply rises). By regressions controlling for the fact that excess reserves will alter as disequilibrium holdings of any other asset spillover, they show that the former are quite insensitive to changes in bank holdings of government debt for virtually all countries in their sample. By implication crowding-out must be taking place.

and accordingly and following also Blejer and Khan (1984) and Sundararajan and Thakur (1980) (the latter in their regressions for Korea) we use the GDP of the whole economy. Blejer and Khan (op.cit.) justify this practice by stating that "for simplicity we assume that private sector output is proportional to total output ..." (p.383 in footnote). The series for real output that we use is from the National Accounts of Greece and differs from the deflated value of the nominal output series (from IFS) by a statistical discrepancy.

The User Cost of Capital: The formula that we employ for the (nominal) user cost of capital is $c = q.[r + s - \dot{q}/q]$. In general this formula ignores taxation of the income of/from firms and particularly the deduction of depreciation allowances from taxable profits and tax credits on investment expenditures which have been documented to be potent investment incentives (say in the U.S.). To justify these omissions we can only cite the example of Sundararajan and Thakur (1980) who of all the literature on investment under financial repression are the only reference to consider a user cost and they compute it by an identical formula. In a subsequent chapter series for the relevant fiscal parameters are constructed in detail and the user cost is appropriately adjusted.

In the theoretical formulation r, the discount rate, reflects the opportunities of the firm to place its funds alternative to the particular investment in physical capital. However under financial repression "the rates of return on investment ... typically tend to be quite high whereas real interest rates on loanable funds are kept low by governments for a variety of reasons", Blejer and Khan (1984) suggest (p.386). It follows that our use of the lending rate as a measure of the discount rate is inappropriate unless firms perceive market loans (or bank deposits although the spread between deposit and lending rate has exhibited some variability over the years so that the latter rate does not perfectly proxy the former) as the main alternative to investment in physical capital, for some reason such as the absence of a well developed capital market. Indeed we have anecdotal evidence (Courakis 1981b; Halikias 1978; OECD 1986) for the existence of an unofficial market where second round intermediation/relending among firms takes place yet presumably not at the published figures for the lending rate. Further the series that we use for the lending rate is not comprehensive but relates to short term financing (for working capital). Given a very complex system of selective credit controls, there exists a variety of (published) loan interest rates.[15] One argument in favour of our choice is Hall's (1977) theoretical demonstration and Lawrence and Siow's (1985) empirical evidence (for the U.S.) that a short rate is appropriate for an investment equation.

To represent q we construct a series for the implicit price deflator of investment goods by dividing the current price series for private gross fixed capital formation by the constant price version of this series.

Real Credit Availability: Each regression is run for two alternative measures of credit availability. Each time the measure of credit availability is adjusted onto real terms by deflation by means of the constructed deflator for investment goods q. Using this, rather than any

15. In the papers of Paci (1985) and Schiantarelli (1983) a loan rate charged by Italian special credit institutions is identified with the discount rate of the firm. Furthermore in view of selective credit controls, Schiantarelli uses a series for the subsidized loan rate.

other price index, to work out a real measure of credit availability is the practice in most of the studies which model a variable speed of adjustment (Coen 1971; Sundararajan and Thakur 1980; Tun Wai and Wong 1982). Both our measures of real credit availability are flow concepts. Measure L does not correct for interest payments on outstanding loans but is given by the deflated first difference of the series 'Domestic Credit: Claims on Private Sector' which is recorded in the IFS. This credit aggregate is equal to the sum of Claims on Business and Individuals plus Claims on Development Banks both held by the Bank of Greece plus Claims on Private Sector of Commercial Banks. The other measure of real credit availability, LC, represents an attempt to measure the net flow of finance and is constructed by subtracting from L the deflated product of the current value of the lending rate by the lagged value of the credit aggregate. It is quite obvious that this product can provide only a rough approximation to total interest payments flowing towards banks, and is also likely to be biased upwards given the almost uninterrupted upward trend in lending rates. Specifically the current short term lending rate that is employed in the calculation gives if anything an upper limit to the range of interest rates that the loans included in the credit aggregate (many of which were contracted at preferential long term rates or anyway at a fixed rate in the distant past) are likely to bear. Finally, interest payments might have been occasionally capitalized, thus appearing as a rise in outstanding credit.

The Net Capital Stock: Following Sundararajan and Thakur (1980) we construct a series for the private net capital stock in constant prices in (end of) year t by adding private net fixed capital formation in constant prices from 1958 up to and including year t.[16] Private net fixed capital formation in constant prices is equal to private gross fixed capital formation in constant prices minus the depreciation/capital consumption in constant prices that is attributed to the private capital stock.

According to Sundararajan and Thakur (1980, p.834) the absence of a benchmark value for the capital stock should be no cause for concern "since linear investment functions are used the unknown initial capital stock can readily be absorbed into the intercept term thus obviating the need for estimating the initial capital stock".

3.8.2

Attribution of depreciation construction of series for net capital stock of private sector and computation of rate of depreciation

A series for depreciation attributed to the capital stock of the private sector i.e. separately from the capital stock of the public sector is constructed on the following rationale: Assuming that the private net capital stock K_1 and the public net capital stock K_2 are subject to exponential depreciation at the same rate s and 'DEP' is the published series measuring the flow of depreciation from the total capital stock we have:

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16. This is a simplification of the perpetual inventory method. Hall and Jorgenson (1971) also cumulate private net investment since the earliest date that data are available which is of course long before the period covered by their regressions. A proper application of the perpetual inventory method would require adding cumulatively all investment not since 1958 but since the most distant date that given typical asset life (the particular type of) capital still surviving in t could have originated (cf. Ward 1976).

$$DEP_t = s.K_{1\ t-1} + s.K_{2\ t-1}$$

$$\therefore \quad s.K_{1\ t-1} = DEP_t \cdot \left[\frac{K_1}{K_1 + K_2}\right]_{t-1}$$

Hence we may derive a measure for the depreciation attributable to the private capital stock by multiplying each observation in the published series by a corresponding estimate of $K_1/K_1 + K_2$ lagged once (which could vary from observation to observation).

Further we take as an estimate of $K_1/K_1 + K_2$ the ratio of the gross capital stock of the private sector to the total gross capital stock of the economy. To construct a series for the gross capital stock of the private sector (and also the total) we felt that we should make use of the published[17] data for the total net capital stock based on a <u>direct estimate</u> of the capital stock for 1948. Unfortunately no disaggregation of the total into a private and a public component is available. We derive a <u>benchmark</u> for our series for the private gross capital stock by multiplying the published figure for the total net capital stock for (end of year) 1957 by the average value of the ratio of private to total gross fixed capital formation in constant prices over the period 1948-1957. Our method apportions plausibly, approximately one-third of the 1957 net capital stock which did not exist in 1948.[18] It would be correct for the remaining 70% as well if the pre-1948 values of the aforementioned ratio were similar to the values for the period 1948-1957. For one thing

17. Ministry of National Economy, National Expenditure and Capital Stock Division (1983), Capital stock series also in OECD Department of Economics and Statistics (1987).

18. Understandably the figure for the capital stock in 1948 must be relatively low reflecting a history of devastation in the immediately preceding years. A similar point is made by Vernardakis (1978, p.86).

this ratio has remained relatively stable over the extended period 1948–1985 (mean 69% standard deviation 5 percentage points). The observation on the private (total) capital stock in (end of) year t is generated by adding onto the benchmark value for the 1957 private (total) capital stock the cumulative sum of private (total) gross fixed capital formation in constant prices from 1958 up to and including year t. Note that our series for total gross fixed capital formation in constant prices is the sum of private plus public gross fixed capital formation in constant prices. Subsequently we generate a series for the ratio of the private to the total gross capital stock (constructed above) lag it and multiply it into the published series for depreciation in constant prices to obtain a series for the depreciation attributable to the private capital stock, in constant prices.

The following argument suggests that our method of attribution is appropriate: Assume that every annual observation on public gross fixed capital formation is a constant proportion b of the corresponding annual observation on private gross fixed capital formation I_t both before and after the benchmark year 1957. Then we show that the value of the ratio $K_1/K_1 + K_2$ worked out for the gross capital stocks [i.e. (ii)] constructed as above is <u>equal</u> to the value if the net capital stocks were substituted in [i.e. (i)]. Denote the 1957 benchmark for the private (total) capital stock by $B_1(B)$ and note that $B = (1+b).B_1$. We have:

$$\frac{K_1}{K_1 + K_2} = \frac{\Sigma(1-s)^i.I_{t-i}}{\Sigma(1-s)^i.I_{t-i} + \Sigma(1-s)^i.b.I_{t-i}} = \frac{1}{1+b} \qquad \text{(i)}$$

But also

$$\frac{\Sigma I_{t-i} + B_1}{\Sigma I_{t-i} + \Sigma b.I_{t-i} + B} = \frac{1}{1+b} \qquad \text{(ii)}$$

therefore

$$\frac{K_1}{K_1 + K_2} = \frac{\Sigma I_{t-i} + B_1}{\Sigma I_{t-i} + \Sigma b.I_{t-i} + B}$$

Is the condition of the constancy of b fulfilled in our sample? We have found that over the whole period 1948-1985 b has a mean value of 45% with a standard deviation of 13 percentage points while somewhat more encouraging over the period 1958-1985 it has a mean value of 42% with a standard deviation of 9 percentage points. As predicted the series for the ratio $K_1/K_1 + K_2$ evaluated for the gross capital stocks runs very closely to the series for 1/1+b: The mean discrepancy between the series over the period 1963-1982 (excluding 1971 which has a different sign) is 5% of the corresponding value of the former ratio with a maximum discrepancy of 11%. As a further check, once we did come up with an estimate for the rate of depreciation (which is of course conditional on the above calculation), we generated a series for the private (public) net capital stocks using also the same benchmarks as above. We proceeded to use these to generate a series for the ratio $K_1/K_1 + K_2$ worked out for net capital stocks. The mean discrepancy between this series and the series worked out for gross capital stocks over the run 1964-1984 is 0.5% while the maximum observed discrepancy is 0.9% of the corresponding value of the ratio for gross capital stocks. Alternatively disregarding the published data we may set the benchmark for the private (total) net capital stock in 1957 equal to zero and proceed to construct a series for the private (total) gross capital stock by cumulating private (total) gross fixed capital formation in constant prices. It turns out that the series for the ratio $K_1/K_1 + K_2$ as well as depreciation attributed to the private capital stock and net investment worked out by this method are remarkably close to the corresponding series worked out by the method making use of benchmarks. The mean discrepancies between corresponding series over the period 1958-1985 expressed as a percentage of the value arrived at by the method employing benchmarks are 0.9% (with a maximum of 1.8%) for the ratio and private depreciation and 0.4% (with a maximum of 0.9%) for net investment. Thanks to the constancy of the ratio of public to private gross fixed capital formation in constant prices the initial value for the capital stock seems to be of no consequence, assuming of course that the aforementioned ratio was not very different before 1948.

Following Sundararajan and Thakur (1980) we obtain an estimate for the rate of depreciation as the coefficient on lagged private net capital stock in a regression containing also a constant and having private depreciation in constant prices as its dependent variable

$$PDEP_t = \underset{(109^*)}{4308} + \underset{(335^*)}{0.027}K_{t-1}$$

$$D.W. = 1.23^*$$

$$LM(1) = 3.44$$

(t-statistics in parentheses: "*" denotes significance at least at 95%)

The coefficient on K_{t-1} is not altered if AR(1) estimation is used instead, in order to try to eliminate first order autoregression in the error, which may be what the just significant D.W. is indicating. Furthermore an alternative estimate for the rate of depreciation obtained by regression of the series for private depreciation on the series for the private net capital stock both constructed without using benchmarks comes down to 0.027 when rounded. This estimate seems to be on the low side: it is slightly more than half the value for the rate of depreciation postulated by Blejer and Khan (1984), (0.05), and something less than half the figure employed by Hall and Jorgenson (1971) for the rate of depreciation of structures. Naturally our estimate is well within the values employed in the computation of the series for (total) depreciation in the National Accounts of Greece (1% - 1.5% structures, 3% - 10% equipment). Its relatively low magnitude is suggestive of some prevalence of structures (rather than equipment) in the capital stock of Greece which is also confirmed by the data: Indeed the ratio of (total) structures to the (total) capital stock in constant prices in net terms constructed from published series over the period 1960-1985 averages to 82% with a standard deviation of 2 percentage points.

Section 3.9

Summary and Suggestions for Further Research

A large part of the financial liberalization literature relies for its conclusions on the positive relationship between private investment expenditures and bank finance. Accordingly there have been a number of empirical studies of the investment function under financial repression. They all include a measure of the flow of real loans alongside other (e.g. neoclassical) explanatory variables. The presence of this measure is commonly justified on the grounds that the speed of adjustment within a partial adjustment neoclassical model of investment demand, is influenced by fund availability. In Chapter 3 we suggest that a similar specification can be derived (without a partial adjustment), if the proportion of investment projects initiated at various points in the past that can be completed within the current period, is made to depend on credit availability. We note that more rigorous microfoundations for such arguments in the investment function can be found within the theoretical literature.

Furthermore, we conclude that these formulations do not conflict with the theoretical view, in the financial repression literature, that investment is determined exclusively by the supply of loans, while its notional (neoclassical) demand is irrelevant. The reason is that not all borrowers are rationed all the time. At any rate, on the basis of the equation describing investment behaviour in our theoretical macro model, apart from new real loans, income and the real interest rate ought also affect the volume of investment via their influence on retained profits. The rest of Chapter 3 is taken up by the presentation of four estimable investment equations. We follow the standard, but somewhat dubious approach of first deriving an expression for the optimal capital stock and subsequently imposing some scheme for slow adjustment, in view of the well known sources of lags in the investment process. In addition, a series for the net investment and capital stock of the private sector and a figure for the rate of (physical) depreciation of capital (in Greece over the period 1958-1985) are all products of this chapter.

If further research with alternative models of investment is to be undertaken, one would contemplate the approach of Schiantarelli (1983). This would enable us to look at a theoretically more plausible model, putty clay. At the same time, such a model would allow us to incorporate consistently many-period-ahead rational expectations in the investment function. Indeed, although a lot is said about the role of expectations in the investment function, empirical research either ignores it in practice (and in the theoretical model that precedes it) or comes up against the usual difficulties of proxying an unobservable (to which mostly ad hoc solutions are available). Another direction towards which one could seek extra specifications of the investment equation, is that of error correction models. This would constitute a refinement of the partial adjustment scheme on which most of our equations are built. In addition error correction models have provided the scope for the application of an attractive econometric methodology. (Cf. Anderson 1981; Bean 1981). As far as data are concerned, there is always a wish for better series of capital stock (an alternative series could be constructed e.g. from Krengel and Mertens 1967) and more observations in general (e.g. quarterly). More specifically, we have noted how a series for private, rather than aggregate, output would have been a more appropriate explanatory variable for private investment. Similarly availability of series for private capital consumption and capital stock would have enabled us to avoid arbitrary procedures (attribution). Since we are mainly interested in the influence of the availability of finance on investment, alternative measures of credit ought also to be tried as well as measures of internal funds (e.g. the OECD gives a series for income from property and entrepreneurship that we could take as starting point). Also, a finer dissagregation of loans and corresponding interest rates (or direct data on the interest income of banks e.g. from cash flow statements) would make possible the construction of a more satisfactory measure for the net flow of finance.

CHAPTER 4

ACKNOWLEDGING THE EXISTENCE OF THE TAX AND FISCAL INCENTIVES SYSTEM

Section 4.1

Introduction

In this Chapter we discuss how to account for the influence of tax and fiscal incentive policies when estimating an investment function. Once this issue is clarified, we proceed to construct series for the relevant fiscal parameters in Greece over the period 1959-1985. Thus we are able to construct an accurate series for the user cost of capital, over the same period, to be used in the regressions of Chapter 5.

In Section 4.2, we survey some parts of the theoretical and empirical literature which bear on the issue. In Subsection 4.2.1 we state exactly how fiscal parameters should enter the user cost. We also note the precise assumptions of the resulting formula. Subsequently we discuss each (fiscal parameter) component of the user cost in isolation. First, we comment on the choice of the post tax loan interest rate as discount rate. Second, in Subsection 4.2.2, we present opposing views in the literature about which tax rate (corporate, personal or both) is relevant for investment behaviour. This tax rate should enter the user cost. Third, we present the formula for the present discounted value of the tax savings due to investment, and note the assumptions it involves.

In Subsection 4.2.3, we discuss possible refinements of the procedure which is actually adopted in Chapter 4. We note the possibility of entering fiscal parameters as separate regressors (independently from the user cost). We cite the few examples, in the literature, of calculation of the expected (as distinct from the actual) value of fiscal parameters. This is an important task because, we suggest, the anticipation of a variation in fiscal parameters may induce drastic changes in investment behaviour. Finally, we suggest that the effect of fiscal changes on investment expenditures might be transmitted via general equilibrium and liquidity channels. Moreover, fiscal incentives may influence the regional allocation, rather than the level, of aggregate investment.

In Subsection 4.2.4, we begin the construction (from Greek data) of series for the fiscal parameters which appear in the formula for the user cost. We adjust the published tax rate, on the undistributed profits of limited liability companies, for other fiscal burdens. This adjustment pays due attention to the legal detail and involves only slight imprecision (overstatement of the tax rate).

In Section 4.3, we continue the computation of the components of the user cost under taxation and fiscal incentives. We attempt to quantify investment allowances in an index. Three tasks are involved: First, we should become familiar with the precise terms (deadlines etc.) under which investment allowances were granted in law. Second, we must define an index for the effective rate of investment allowance corresponding to each decree. The literature also distinguishes between the statutory rates and the underlying effective rates. However, the practice in the literature, whereby total claims of allowances are divided by total investment in the same year, will not do. Rather, our index must capture this fact: Allowable deductions were carried forward to be subtracted against (undistributed) profits frequently long after eligible investment expenditures were incurred.

Given the originality of this index we ought to substantiate the findings which it leads to, by argument and additional evidence. First, we note that discrepancies, between the statutory rates and the computed effective rate of investment allowances, are encountered in the literature as well. Second, we illustrate that use of the simple index established in the literature would lead to findings similar to our index. Third, we interpret the provisions in the fiscal decrees which granted investment allowances. The provisions were such so as to effectively restrict the beneficiaries of investment allowances to groups whose investment expenditures were only a moderate fraction of total investment. In addition, effective rates of investment allowances were depressed because of low and undereported profits combined with a maximum percentage of profits not to be exceeded by the deduction in each period. We argue that even if claims of allowances could eventually be made, high inflation would have eroded their real value (thus lowering the corresponding effective rates). Finally, we identify some special factors which might have lowered the effective rates computed for the most recent decrees.

In Section 4.4, an examination of the detail of the legislation which offered investment grants, reveals that these were of restricted regional importance or limited to certain types of investment only. Therefore we may neglect them (and indeed we are compelled to do so by the lack of data). By contrast, we are able to compute an economywide rate of depreciation for tax purposes. However, the lack of data prevents us from accurately adjusting this rate for the proportionate reductions in tax lives (which were granted within the context of investment incentives). The coverage of such reductions was even more restricted than that of investment allowances. Hence we postulate that these measures increased the economy wide rate of tax depreciation by a small fraction only. We check whether this makes any difference to the estimation results of the investment equation.

Section 4.2
Investment and Taxation

4.2.1
The user cost under taxation

Consideration of the tax system requires modification of the nominal user cost formula which becomes:

$$c = \frac{q.(1-A)}{(1-\tau)} \cdot [(1-\tau).r + s - \dot{q}/q]$$

q : price of capital goods

s : rate of economic depreciation

τ : corporate tax rate

A : present discounted value of reduction in corporate tax liabilities consequent upon one unit value of investment.

This modification is obtained by assuming that the objective of the firm is the maximization of, the present discounted value over an infinite horizon, of the residual after taxes have been levied at a rate

τ on "accountants" (cf. Nickell 1978, p.199) profits [p.Y - w.L] minus investment expenditures, reduced however by the total amount claimed as tax depreciation and investment allowances or any tax free grants when applicable.

In addition the discount rate employed above is the post tax interest rate given full deductibility of interest payments in the Greek tax system. A more precise formulation (Anderson 1981) would weight τ in the numerator by leverage which however is likely to be very high in view of the prevalence of bank finance in Greece. Still (presumably under market determination of the interest rate) the use instead of a discount rate which (because of tax shifting) is not sensitive to tax changes has also been advocated (Sumner 1976). Gardner and Sheldon (1975) also favour using an inflexible discount rate in view of ex post fixity of factor proportions and one would think irreversibility coupled with uncertainty (cf. Schiantarelli's 1983 use of permanent income). Fiscal parameters are expressed in average and effective terms (Sinai and Eckstein 1983); it is assumed that they do not vary over the period of definition of c. As pointed out in Bean (1981) the formula implies that firms realize taxable profits, as well as having no uncertainty nor any prospect of bankruptcy. Hulten (1984) notes the implicit assumptions of debt finance with borrowers and lenders (banks) in the same marginal tax bracket. Below we challenge the assumption of sufficient profits, and avoid it in part by adjusting downwards the effective rate of investment allowance. Finally taxation of capital gains on holdings of capital is ignored, as seems to be the practice in the empirical literature. For example Chirinko and Eisner (1983, p.142) note this omission in a number of macroeconometric models for the

U.S.

4.2.2

The appropriate tax rate to enter the user cost

King (1972) argues analytically that the tax rate which is relevant for the investment decision is that imposed on retained profits irrespective of whether the firm is driven by managerial or other motives. In particular he shows that any tax rates apart from the rate on retained profits 'factor out' from the assumed objective of the firm i.e. the present discounted value of net (= after personal taxes) dividends to be maximized over an infinite horizon.

On the other hand the tax rate on retained profits must remain in the objective function since it represents the relative potential of firms' capital allowances to generate funds available for distributions ceteris paribus. In turn the amount of capital allowances that can be claimed against gross income depends on the path of investment.

By contrast, for example Feldstein and Flemming (1971) introduce personal taxes in the user cost; in part they rely on the Duesenberry rationale that the cost of finance depends on the availability of internal funds, and thus on the optimal dividend payout rate which is itself influenced by personal taxation. Evidence, (encompassing tests on alternatives etc.), that investment in physical capital is adversely affected by the taxation of distributions, is offered by Poterba and Summers (1983) from the perspective of a Q model.

More generally, Nickell (1978, pp.212-213) sees the taxation of corporate earnings to be reducing resources in the hands of the more optimistic and/or less risk averse potential investors thus contributing towards a relatively higher cost of capital. Further, he suggests an effect of personal income and capital gains taxes via their influence on the attractiveness of retentions relative to debt and points out that while King's argument neglects (innocuously for our case) equity finance, tax induced changes in the opportunity cost of retained earnings in terms of net dividends have an a priori ambiguous impact on investment.

The present discounted value of the tax reductions consequent upon a Drachma of investment in physical capital (A) is calculated by the (discrete time) formulae given in Melliss and Richardson (1976) and in accordance with the Greek institutional features of tax depreciation by the straight line method and non deductibility of investment allowances from the depreciable base.

$$A = \tau . V + \tau . d + \tau . d \; . \left[\frac{(1+(1-\tau).r)^{N} - 1}{(1-\tau).r.(1+(1-\tau).r)^{N}}\right]$$

V : effective rate of investment allowances

d : economywide annual rate of depreciation for tax purposes

N = 1-d/d

Again we discount by the post tax interest (loan) rate for consistency, but note King's (1972) conclusion about the sensitivity of the resultant effective price of capital to the value for this rate. Greek tax laws require a substantial fraction of tax liabilities to be paid effectively concurrently and not in arrears. Hence the additional complication

Table 4.1

Computed present discounted value of reduction in corporate tax liabilities consequent upon one unit value of investment

	A (rounded) Total Private Investment	A (rounded) Excluding Res. Buildings
1959	0.29	0.32
1960	0.27	0.31
1961	0.27	0.31
1962	0.30	0.34
1963	0.30	0.35
1964	0.29	0.35
1965	0.29	0.34
1966	0.29	0.34
1967	0.31	0.38
1968	0.32	0.38
1969	0.32	0.39
1970	0.32	0.39
1971	0.32	0.37
1972	0.32	0.37
1973	0.29	0.33
1974	0.26	0.31
1975	0.31	0.37
1976	0.31	0.36
1977	0.30	0.36
1978	0.29	0.35
1979	0.27	0.33
1980	0.24	0.31
1981	0.25	0.33
1982	0.30	0.38
1983	0.29	0.36
1984	0.28	0.35
1985	0.25	0.33

(cf. Boatwright and Eaton 1972) of multiplying the expression above by an extra discount factor is neglected. Over our sample period A has averaged to 29% (35%) with a small standard deviation of 2(2) percentage points (in parentheses figures corresponding to private investment excluding residential buildings). Depreciation allowances are the dominant component - the average value of investment allowances was 1% (2%) with a substantial standard deviation of 0.8 (1) percentage points.

4.2.3

Other issues

It is frequently the practice (Bean 1981; Feldstein and Flemming 1971) to introduce the tax parameters as separate regressors and not in combination within a user cost. This ad hoc procedure relies on some evidence (U.S. and U.K.) that firms may have exhibited a particularly delayed response to novel tax devices. Similarly, as Chirinko (1986) and Chirinko and Eisner (1983) argue, it may be inappropriate to constrain "all of the variables embedded in the user cost of capital to have the same set of expectations coefficients .... it is quite conceivable that expected interest rates follow a regressive pattern ... but that expected tax rates are nearly constant" (Chirinko 1986, p.144). Separation often serves to show up a significant influence of tax policy on investment (despite the notorious [e.g. Savage 1978] insensitivity of investment to interest rates). It would have added more generality to our approach, but only at the cost of further depriving us of degrees of freedom.

Typically expectations on the various fiscal parameters are taken to be static. Exceptions are provided by Auerbach and Hines (1988) and by Bernanke (1983). Bernanke uses fitted values from a one period ahead forecasting equation of the total "tax break" for investment in terms of past values of the investment subsidies and lagged investment, which latter "turns out to be an important and significant determinant of current tax laws" (p.73) (in the U.S.). A similar (but more sophisticated) procedure is implemented by Auerbach and Hines. Also King (1972) replaces some of the observations on the tax rate by widely held anticipated values in response to official hints. Paci (1985) sets the expected (present) value for investment incentives equal to a 2 yearly moving average of past values in view of "unpredictable non-economic factors" (p.777) (political climate?) by which these seem to be governed.

Generally speaking it makes a difference for the behaviour of investment over time whether fiscal changes are preannounced or unanticipated. For example Sumner (1985) demonstrates (under a cash flow system without deferment of capital allowances or possibly under accelerated depreciation) how expenditures are postponed until an expected rise in the corporate tax rate and thus an increase in the value of tax savings due to investment has materialized. According to his case study subject to the flexibility of planned spending and the sophistication of appraisal methods and despite internal disruption costs, external penalties and the opposing desires of suppliers of investment goods, postponement could have been for as long as one calendar year. An exactly similar argument appears in Chirinko and Eisner (1983, p.143). Obversely firms may bring forward expenditures to take advantage of fiscal benefits announced as temporary. Lund (1976) quotes a similar observation of Feldstein and Flemming (1971) in connection with changes in allowances, but remarks that such phenomena pertain to a 'Grand Old Duke of York' type manipulation of incentives influencing the timing of investment with short gestation lags: this differs from the Greek case with its framework of incentives sustained over the long run. At any rate we abstract from such effects with the probable consequence of leaving some of the observed variation of investment unexplained; in particular on two occasions at least there has been an extended interval (1 year) between passage of a law offering investment incentives and its provisions coming into operation.

Other complications which we do not pursue are as follows: First allowance and tax changes work on investment through general equilibrium/multiplier interconnections as well. Our central concern with a single equation leaves such links unexplored[1]. Second fiscal changes alter the liquidity position of the firm and thereby possibly investment expenditures if these depend at all on the former. This was the main concern of Coen (1971) and more recently of Fazzari, Hubbard and Petersen (1988b). According to the argument of the latter, such effects must be particularly important in Greece because of the widespread presence of rationing constraints. Third, working with broad investment aggregates we cannot detect any purely reallocational impact (often seemingly intended) from fiscal provisions (cf. Faini and Schiantarelli 1987), so that our conclusion on their effectiveness is partial.

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1. Malcomson (1982) and Sinai and Eckstein (1983) study empirically such general equilibrium links. Malcomson (op.cit.) also suggests that fiscal incentives shorten service lives thus stimulating, or perhaps merely redistributing over time, replacement investment.

4.2.4

The computation of a series for the tax rate

Throughout the sample period the Greek tax system prescribed proportionate taxation of the undistributed profits of corporations while distributed profits were taxed progressively according to the marginal income tax bracket of the recipient shareholders.

To arrive at a tax rate to be employed in the computation of the user cost we adjusted the available series for the tax rate[2] on the undistributed profits of limited liability companies by adding on a minor allowance for other fiscal burdens on the undistributed profits of such companies (substantial contributions to 'the farmers social insurance organization', stamp and other duties for local services, etc.).

In particular in each period we add onto the published series for the tax rate, the ratio of total payments on account of other fiscal burdens (OGA) to total taxable undistributed profits of limited liability companies. Before addition we weight this ratio by one minus the published rate to reflect the practice, expressly stipulated in law and only changed in the last year of our sample, of deducting contributions to the farmers' social insurance organization and other burdens before applying the published rate, i.e. we wish to construct an

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2. Data source: National Statistical Service of Greece: Statistical data on the declared income of legal entities and its taxation during the fiscal year ... (issues 1958-1985). The series for the tax rate was compiled from the Introduction to each issue while all other series (investment allowances, profits etc.) were compiled from Table 1.

effective corporate tax rate τ, while τ' is the published series and Y undistributed profits such that:

$$\tau . Y = \tau' . [Y - OGA] + OGA$$

$$\Rightarrow \quad \tau = \tau' + (1 - \tau').OGA/Y$$

There are a few elements of imprecision in this estimate. First, for some time, industrial and mining companies with share capital traded in the Athens Stock Exchange have only been subject to a lower tax rate (by 5 percentage points in 1985). Factors (information and incentive problems) mostly associated with family ownership are typically invoked (Maniatis 1971; Molho 1986b)to explain the poor development of this capital market. Thus our series for the tax rate is not simply that on minor firms discouraged by the indivisibilities in the costs of share issues and other requirements. Secondly within the general framework of fiscal incentives companies in receipt of investment grants (and earlier under some other conditions) (e.g. Provopoulos 1983, p.109) would only be taxed at a rate that was to remain 'frozen over an extended period'.

Section 4.3

Investment Allowances

Over the period 1955-1985 ten decrees (see Dryllerakis 1979; Totsis 1984) were enacted granting investment allowances in the following form: In general they allowed a percentage of corporate expenditures on investment goods (structures and/or equipment) to be deducted from undistributed profits before the latter were subjected to corporate taxation.

Table 4.2
Corporate tax rates
(published and computed effective)

	Tax Rate on undistributed profits: published series	Ratio (OGA + Other) to taxable corporate income	τ
1959	0.35	0.01	36%
1960	0.35	0.01	36%
1961	0.35	0.01	36%
1962	0.35	0.06	39%
1963	0.35	0.07	40%
1964	0.35	0.07	40%
1965	0.35	0.06	39%
1966	0.35	0.06	39%
1967	0.35	0.07	40%
1968	0.35	0.07	40%
1969	0.35	0.07	40%
1970	0.35	0.07	40%
1971	0.35	0.07	40%
1972	0.35	0.07	40%
1973	0.35	0.06	39%
1974	0.35	0.05	38%
1975	0.40	0.07	44%
1976	0.40	0.07	44%
1977	0.40	0.07	44%
1978	0.40	0.07	44%
1979	0.40	0.07	44%
1980	0.40	0.07	44%
1981	0.40	0.08	45%
1982	0.45	0.09	50%
1983	0.45	0.09	50%
1984	0.45	0.07	49%
1985	0.45	0.02	46%

Half of the decrees stipulated that the deduction in each period could not exceed a specified percentage of undistributed profits in this same period. Importantly all the decrees (with one exception) specified that in case the allowable deduction exceeded the maximum specified percentage of undistributed profits in the year that the purchases of investment goods were made, then the residual could be carried forward and deducted from undistributed profits in subsequent years.

Most of these decrees did not set a unique percentage for the rate of investment allowance, but rather prescribed a scale. Thus the applicable rate would vary quite substantially mainly according to the region where the firm was located and/or the investment would take place and also according to the sector (say whether manufacturing mining or tourism) in which the investing firm operated. Further in two out of the ten decrees the periods over which investment qualified for the allowance granted and/or the horizon over which any residual deductions could continue being brought forward, also differed on the basis of regional considerations.

For an example consider the provisions of <u>1078/71</u> (i.e. decree no.1078 of 1971) in no way the most complicated of the decrees. This concerned 'industrial', 'handicraft' and 'mining' companies. Qualifying firms located in 'region B' could deduct 50% of expenditures on plant and equipment they incurred over the period 1973-1977 from their total taxable profits minus the compulsory minimum amount to be distributed as dividends. The rate of investment allowance for firms located in 'region C' and mining companies (irrespective of location) was 100% of the investment expenditures undertaken up to 1982. Similar allowances were offered to firms located in 'region A' on account of investment in 'regions B or C'. These deductions could be carried forward until 1982 for firms in 'region B', while the deadline was extended to 1987 for firms in 'region C' and mining companies.

4.3.1

Effective rates of investment allowance in the literature

Computation of the user cost by making use of an effective rate of investment allowances (distinct from the corresponding statutory percentages) is common practice in the literature. At the very least statutory percentages are weighted by the ratio of the volume of the respective eligible type of investment to total investment and added up. (Agarwala and Goodson 1969; Malcomson 1982). Others set, as Mackrell, Frisch and Roope (1971, p.11) put it, the effective rate equal to the "proportion of total ... investment expenditure [actually] claimed by taxable companies as a deduction under the investment allowance scheme". We adopt such a procedure and provide arguments similar to those given by Bischoff (1971a) and restated by Chirinko (1986, p.142) to justify a discrepancy (of a much smaller size though) between the computed and the statutory rates for the slightly different incentive scheme of the 'investment tax credit'. These are restrictions on the applicability to certain kinds of investment, differentiation of the allowable percentages by beneficiary and confinement of the amount of credit taken in any one year to a fraction of the total corporate tax liability. Relating to our discussion below we read (Bischoff 1971a, p.88) about the latter that "because of carry-back and carry-forward provisions, it seems likely that most of this credit could eventually be claimed, although the delay would make the present value of a dollar's credit amount to less than a dollar .... it is very hard to derive an expression to introduce correctly the portion of the tentative credit not immediately claimed".

4.3.2

The computation of a series for the economywide effective rate of investment allowance

In view of the somewhat limited applicability of the decrees (by region and by sector) compared to the coverage of our series for total private gross investment (with or without expenditures on residential buildings), and also because of the practice followed not to specify a unique percentage but rather a scale, we decided to compute an economy wide effective rate for the investment allowance as follows:

For each decree we had a series for the amount of investment allowances claimed in toto by all the qualifying domestic limited liability companies. We started with 3213/55 since this did not allow carrying forward of the deductions; we worked out the ratio of the total investment allowances claimed by virtue of 3213/55 in every year t to nominal private gross investment (with and without residential buildings) in the same year t. For each of the two investment series considered we computed the average value of this ratio over the period 1959-1970 during which the decree allowed deductions against purchases of investment goods. We took this average value as the effective rate of investment allowance granted by 3213/55 in each and every year between 1959 and 1970 inclusive.

A different procedure was followed for all other decrees which entitled the firms to 'carrying forward'. Consider 1078/71 for illustration. First we worked out the real value of total deductions by virtue of this decree in every year t in terms of private investment goods prices (base 1970). Then we summed these real amounts over all the years that deductions were allowed by 1078/71 at least for some class of beneficiaries (i.e. 1973-1985). Subsequently we summed all the observations on total real private gross investment over all the years that purchases of investment goods (by at least some type of beneficiary) qualified for the investment allowances of 1078/71 (i.e. 1973-1982). This latter period is shorter than the period over which deductions were allowed because of the right to carry the latter forward.

Then we considered the ratio of the sum of the real amounts claimed as investment allowance to the sum of total real private gross investment as the effective rate of investment allowance granted by 1078/71 in every year of its duration (1973-1982). These calculations were repeated with real private gross investment excluding residential buildings and the corresponding deflator.

To reach a figure for the total economywide effective rate of investment allowance in year t as a result of the combined benefits from all the various decrees in operation in year t we added together the effective rates attributed to each one of the decrees separately, computed as above. E.g. in 1982 we had 0.013 (0.021) by virtue of 1078/71, 0.001 (0.001) by virtue of 289/76, 0.009 (0.014) by virtue of 849/78, 0.003 (0.005) by virtue of 1116/81 and 0.003 (0.003) by virtue of 1262/82 thus a total effective rate of investment allowance equal to

Table 4.3

Computed effective rate of investment allowances by decree for total private investment

	3213/55	4002/59	147/67	1078/71	1313/72	331/74	289/76	849/78	1116/81	1262/82	TOTAL
1959	.002										0.002
1960	.002	.012									0.014
1961	.002	.012									0.014
1962	.002	.012									0.014
1963	.002	.012									0.014
1964	.002	.012									0.014
1965	.002	.012									0.014
1966	.002	.012									0.014
1967	.002	.012	.05								0.064
1968	.002	.012	.05								0.064
1969	.002	.012	.05								0.064
1970	.002	.012	.05								0.064
1971			.05								0.05
1972			.05								0.05
1973				.013	.002						0.015
1974				.013	.002	.011					0.026
1975				.013	.002	.011					0.026
1976				.013	.002						0.015
1977				.013	.002		.001				0.016
1978				.013			.001				0.014
1979				.013			.001				0.014
1980				.013			.001				0.014
1981				.013			.001	.009	.003		0.026
1982				.013			.001	.009	.003	.003	0.029
1983							.001		.003	.003	0.007
1984							.001		.003	.003	0.007
1985							.001		.003	.003	0.007

Table 4.4

Computed effective rate of investment allowances, by decree for private investment excluding residential buildings

	3213/55	4002/59	147/67	1078/71	1313/72	331/74	289/76	849/78	1116/81	1262/82	TOTAL
1959	.004										0.004
1960	.004	.032									0.036
1961	.004	.032									0.036
1962	.004	.032									0.036
1963	.004	.032									0.036
1964	.004	.032									0.036
1965	.004	.032									0.036
1966	.004	.032									0.036
1967	.004	.032	.087								0.123
1968	.004	.032	.087								0.123
1969	.004	.032	.087								0.123
1970	.004	.032	.087								0.123
1971			.087								0.087
1972			.087								0.087
1973				.021	.003						0.024
1974				.021	.003	.017					0.041
1975				.021	.003	.017					0.041
1976				.021	.003						0.024
1977				.021	.003		.001				0.025
1978				.021			.001				0.022
1979				.021			.001				0.022
1980				.021			.001				0.022
1981				.021			.001	.014	.005		0.041
1982				.021			.001	.014	.005	.003	0.044
1983							.001		.005	.003	0.009
1984							.001		.005	.003	0.009
1985							.001		.005	.003	0.009

about 3% (4%). (The figures in parentheses relate to the investment aggregate excluding expenditures on residential buildings).

Although our computations involve some arbitrariness (since they do not clarify precisely what part of the deductions recorded for t is carried forward on account of investment in t-j and which part is against investment in t) the resulting series reflects clearly the introduction of new investment allowances and the termination of others by the succession of decrees.

4.3.3

Comments on our series for the total effective rate of investment allowance[3]

None of the computed rates for the total effective investment allowance comes anywhere near even the most stringent points in the percentage scales stipulated in the various decrees.

(i) Regional considerations: In part this must be explicable to the extent that at least some of the decrees provided incentives for investment in a few specific underprivileged regions, which would not and it seems in fact did not attract industries even after government intervention. Indeed for three out of the four decrees in question the computed effective rate of investment allowance is below the median value for all decrees. In all decrees, apart from one, the most generous percentages applied to investment in the apparently less

3. These comments may be read as tentative evidence against the aggregate importance of such incentives

attractive regions. In the absence of any breakdown of the investment series by the (not quite invariable) regional classification employed in the decrees we cannot assess precisely the importance of this consideration.

(ii) Sectoral considerations: In part we can account for the shortfall by the explicit limitations on the types of investment and industry qualifying for the investment allowances. A large fraction of investment expenditures on residential buildings (dwellings) was not eligible. Yet over our sample period such expenditures were on the average no less than 40% of total private investment (1970 prices). Hence we calculated effective rates by dividing allowances by private investment excluding residential buildings (transformations thereof). We note that this narrower investment series includes expenditures on non residential buildings and other structures as well as on producers' durables (vehicles, machinery and other equipment): in the vast majority of the decrees, eligible firms were entitled to investment allowances against (legal definitions of) almost all these types of investment. Not surprisingly, the total effective rates computed without including expenditures on residential buildings are on the average twice the values for total private investment. Even so the effective rates of investment allowance for this narrower investment series still do not come reasonably close to the statutory rates.

According to the classification of The Greek Economy (published by the Bank of Greece 1982) the ratio of real private gross fixed capital formation in the sectors of manufacturing, mining etc. (minor importance) and electricity etc. (minor importance) to the total for real private gross fixed investment excluding residential buildings (all in 1970 prices), averages to 35% over the period 1958-1978. If agriculture (parts of which were occassional beneficiaries of the decrees) is included the average rises substantially to 52%. Since it was these sectors (tourism also) which were invariably offered investment allowances their moderate relative importance in private investment (even excluding residential buildings) should help to explain the small computed effective rates of investment allowance. By contrast the same ratio for the sector 'Other activities', which by necessity includes private provision of all sorts of services but expressly excludes the construction of residential buildings and is separate from the other major sector of transport, etc., averages to 28%. In all probability services (and perhaps large parts of transport etc.) were generally not eligible for any of the investment allowances.

(iii) Deficient profits: Also it could be that, at least for the recent past, aggregate profits, especially in manufacturing industry, were meagre and thus probably insufficient for the full amount of the various tax savings justified by the investment undertaken to be set off against, even if the allowable deductions could be carried forward. This problem would be compounded by the provisions in half of all the decrees enacted that the investment allowance deductions could not exceed a percentage of undistributed profits in each period. The temporary lack of profits would only be a minor obstacle to companies intending to undertake investment. A high fraction of the investment expenditures (of those firms not rationed out) could be financed by bank loans. A further possibility could be that even if true profits would justify vigorous investment, declared figures against which tax deductions could be claimed would be understated. The prevalence of low profitability, extreme dependence on bank finance and the presence of tax evasion in the Greek economy are discussed at some length in say the two most recent OECD Surveys (OECD 1986, 1987), Pavlopoulos (1987) etc.

On my own calculations the average value of the ratio of the total investment allowances claimed in period t to the aggregate undistributed profits of all limited liability companies (i.e. potential claimants) in t, over the period 1959-1985, came to 57%. A sizeable standard deviation of 44 percentage points could be reflecting the succession of different provisions for the allowable maximum percentage of profits that may not be exceeded by the deduction (together with cyclical factors and shifts in distribution policies).

Consider an illustration of these points in connection with 3213/55 which provided for investment allowances to 'provincial industries'. Since it did not allow 'carrying forward', our computations avoid the arbitrary summation of investment to divide an arbitrary sum of deductions and there is no question of the benefits being eroded by inflation. Although the decree provided for a 100% deduction, (but only up to 40% of taxable corporate profits), the effective rate we computed is 0.2% (0.4% excluding residential buildings) which is an average over time with a standard deviation of one fourth (one sixth) of the mean.

(iv) Inflation: High rates of inflation can also be blamed to some extent for the diminutive size of the computed effective rate of investment allowance compared to the legally stipulated percentages. Since the benefits to the firm from these decrees were fixed in nominal value to equal a percentage of the nominal investment expenditures undertaken at some point in time, it follows that their real value declined quite steeply the later the deduction from undistributed profits was to materialise. Nevertheless firms clearly were compelled by circumstances (possible temporary deficiency of profits, combined with the stipulation of a maximum percentage of their undistributed part not to be exceeded by the deduction in each period) to carry the deduction forward.

For example 4002/59 (which did not have a limited regional coverage) granted investment allowances to the tune of at least 50% of investment expenditures, but not exceeding 50% of in fact total taxable profits for each year until 1970. It transpires that companies continued to make deductions at least up to 1985! Making the extreme assumption that the sum of the deductions actually recorded between 1970 and 1985 was claimed against investment expenditures in 1970, then we may calculate that the investment allowance from 4002/59 amounted to about 20% of total private investment in 1970, which is close to 32% of private investment excluding residential buildings and about 90% of private investment in manufacturing, mining and electricity etc. out of which latter aggregate perhaps the majority of expenditures would qualify for the credit. Since effectively the companies were not given the right to make the deductions in 1970 but rather suppose in 1985, the real value of the benefit from the tax allowance seen from the point of view of a firm which has to pay 1985 prices for its investment goods must have been diminished by no less than ten times. Abstracting from the interest foregone on these funds and any other intertemporal considerations over the interval 1970-85, this amounted to the right to claim a tax allowance of no more than 2% of total private investment in 1970 (3.2% excluding residential buildings). In fact our computations above, which are essentially a procedure for discounting by the rate of inflation, lead to a figure of 1.2% for the effective rate of investment allowance from 4002/59 (3.2%! if we exclude residential buildings) for the period 1960-1970.

Although companies were offered generous deductible percentages by the decrees, they probably reckoned in terms of much more stringent effective rates of investment allowance: they must have realized that by the time when they would have been able to make the corresponding deduction the real value of benefits granted would have been much eroded. This is the sort of behaviour that our computation above attempts to simulate.

(v) Other influences: On the other hand the use of a series for the tax credit claimed by all domestic ltd. liability companies is likely to lead to some overstatement of the investment allowances offered to private investing firms, since it includes the amounts deducted by ltd. liability companies in the public sector not all of which were indiscriminately excluded in all decrees (the omission of cooperatives and foreign corporations is comparatively minor).

Consider the two most recent decrees, introduced less than five years before the end of our sample period: First firms may have opted for the comprehensive investment grants and thus would be excluded from investment allowances. In the absence of data on accruals of grants we cannot assess the extent of this, still provisions were such that the former option must have entailed greater bureaucratic costs. Second, the problems with 'carrying forward' are likely to be more acute, i.e. the available observations on the investment allowances claimed must be much less than what will eventually be deducted against investment in the period to 1985.

Third the usual lags in the investment process mean that although investment decisions might have responded immediately to the announcement of a new package of fiscal incentives, fulfillment of orders and thus investment expenditures against which investment allowances could be claimed would come forward only after a delay. On top of this standard lag there is the argument (expressed in connection with the sluggish switching from initial to investment allowances) that firms fail to take advantage of beneficial policy measures instantaneously. However, it is unlikely that this argument is relevant in our case given the simplicity of the calculations still maybe not of the applications required in order to qualify for the investment allowances etc.

A rough indication, supporting our analysis, is that for the measures of the past two decades the real values of the recorded deductions reach their first local peak on the average three years after the investment allowance comes into operation while the global peak was attained on the average after three further years. It should not be surprising then that for the latest two decrees the available short series gives only the depressed first few observations for the investment allowance thus yielding particularly low effective rates. Of course, the fewer the expenditures incurred the less the allowances that can be claimed and therefore their ratio ought to remain constant. However because much of investment is not eligible, an increase in the eligible part of investment inducing an equiproportionate rise in the deductions increases the ratio of the latter to total investment. This complication is avoided in the computation of effective rates for the other decrees since investment allowances are added together over an extended period of time.

Section 4.4
Other Fiscal Incentives

Investment grants: Various investment grants were prescribed by law on four occasions and subsidised investment continuously since 1972. They consisted of a tax free grant usually deductible from the depreciable base. This covered a percentage of the expenditures of the firm on structures in the first two decrees, plus other investment expenditures as well in the two more recent decrees in question. This percentage varied with the location of the investment and the type of industry to which the investing firm belonged; its level changed somewhat from decree to decree. In fact all these decrees, apart from the most recent, had a limited regional scope.

There does not seem to exist any widely circulating sufficiently fine disaggregation of the entries in the government budget to reveal the total amounts paid out in this particular form of subsidy. As a consequence calculation of effective economy wide rates of investment grants was not feasible. Given the limited regional coverage of at least three out of the four policy measures concerned and the confinement of the two earlier ones to non residential structures, subsuming the effect of investment grants under the residual of our equations is in order. The alternative of a dummy for the most recent decree would be a burden on our degrees of freedom and almost certain to pick up the particularly severe investment recession of the eighties.

Depreciation for tax purposes: Most recently in 1973, the allowable annual percentage rates of depreciation for tax purposes and for the constant depreciation method (straight line formula) were specified in Greek law. These varied from 2-8% (12% in exceptional cases) for non residential structures and 10-20% (up to 35% in special circumstances) for equipment. We adopted the median rates of 5% for nonresidential buildings and 15% for equipment. Subsequently we weighted these percentages by the sample average value of the ratio of real private gross investment in nonresidential buildings (20%) and of real private gross investment in producers' durables (40%) to total real private gross investment respectively. Thus we calculated an economywide annual percentage rate of depreciation for tax purposes equal to 7% which we assume reflects the tax depreciation practices over our whole sample period. We repeated this calculation for the series of investment excluding residential buildings with weights reflecting the ratio of real private gross expenditures on producers' durables to real private gross investment excluding residential buildings (67%). Then the economy wide annual rate of tax depreciation comes out to be equal to 12%. These calculations are very close to Agarwala and Goodson (1969, pp.381-382), who however consider vehicles as a separate category as well.

Reduction in the lifetimes of new investment goods allowable for tax purposes: Reductions in the lifetimes allowable for tax purposes were offered for new investment goods in many occasions over our sample period. Since the beginning of the seventies such reductions, by means of proportionate increases in the allowable rates of tax depreciation to be applied to most newly acquired fixed assets, were authorised by law four times. As with the investment allowances and grants, the benefits were targetted to certain broad sectors and varied according to the region where the firm and/or the fixed assets were located and the intensity of their use, in terms of the number of daily shifts of workers involved in the productive process.

We found no published or otherwise readily available data on the amounts by which accruals of depreciation allowances increased on the aggregate as a result of these measures. Nor did we have any detailed information on their likely coverage, other than that the criteria for eligibility were similar to those for investment allowances over the period with the additional complication of the number of shifts. If the provisions in the latest four decrees are compared, it turns out that reductions of tax lifetimes have been offered to more or less the same beneficiaries continuously since 1973. The first three of them specified roughly the same scale of proportionate increases while the last one was somewhat less generous in the percentages but relaxed eligibility requirements. In general a 20-25% increase in tax depreciation rates was offered to firms in the prosperous 'region A' employing at least two shifts of workers and the scale went up to 150-200% for firms operating in 'region C' with three shifts. It is more difficult to assess the position with these incentives before the seventies, and the impression one gets (cf. KEPE 1967) is that mostly less generous increases were offered, usually on the basis of a less fine regional classification, and seldom across the board. Overall it may be quite plausible to conclude that the succession of measures ensured the depreciation rate for tax purposes was kept somewhat over the basic levels given above. Anyway our experience with the slight economywide importance of investment allowances suggests that the situation with the increases in tax depreciation rates cannot be much different given that the limitations on eligibility are most probably stricter (shifts etc.) in the latter case.

Still we decided to hazard a guess and thus postulated that the economywide rate of tax depreciation for new private investment went up by a factor of 10% to something less than 8% as a result of the string of measures continuously on offer since 1973. Concentrating our attention in the post 1973 period enables us to capture the effect of investment grants, as well, in the assumed reduction in the user cost. It turned out that this hardly changed the values and significance of the coefficients and other statistics in our equations; in view of the arbitrariness involved we decided <u>not</u> to pursue the exercise any further.

Section 4.5

Summary and Suggestions for Further Research

The following are products of Chapter 4:

i) a survey of the literature on the appropriate expression for the user cost under taxation. In particular, we examine the issue of which tax rate and which discount rate are to be introduced in the user cost, what are the assumptions behind the expression employed for the latter, and how the present discounted value of the tax savings consequent upon one Drachma of investment is to be worked out. We also discuss the possibility of breaking up the user cost into many separate regressors, the importance of anticipations of future tax changes, the possibility of general equilibrium, regional reallocation and cash flow effects on investment due to tax changes and the practice with the computation of effective rates for investment allowances.

ii) a survey of the numerous provisions of Greek law as to the taxation of corporations and about the various incentives to new investment (investment allowances, tax depreciation allowances, grants, reductions in the lifetimes allowable for tax purposes) over the period 1959-1985.

iii) the computation of the effective tax rate on Greek limited liability companies, taking into account other fiscal burdens imposed apart from the taxation of undistributed profits (but neglecting certain tax reductions).

iv) the computation of an effective rate for each investment allowance in operation over the period 1959-1985, taking into account the detailed stipulations of the relevant fiscal decrees.

v) the computation of a figure for the economywide rate of depreciation for tax purposes and a series for the present discounted value of tax depreciation allowances over the period 1959-1985.

Thus a series for the present discounted value of total tax savings consequent upon one Drachma of investment, hence a series for the user cost under taxation, were constructed. Computations were repeated for private gross investment excluding expenditures on residential buildings.

The main conclusion of Chapter 4 is that the effective rate of investment allowance comes out to be very low, even when the separate effects of all fiscal decrees in operation at any moment of time are added up. Consequently, any intentions of the policymakers to provide investment incentives of economywide importance rather than of a regionally or sectorally limited scope, were frustrated. From a practical point of view we have demonstrated that one may proceed in the estimation of an investment function for Greece, ignoring investment allowances altogether. Explanations for the low effective rate of investment allowances (contrasting to the generous statutory percentages) are a) the exclusion of the service industries from the benefits of these allowances and b) the erosion of the value of the investment allowances, which could not be claimed at once due to insufficiency of profits, by inflation. Possible suggestions for improvement in this respect are the indexation of the allowances and the abolition of limitations on the proportion of profits against which allowances can be claimed.

There is scope for further refinements in the computation of the series for the user cost under taxation. In particular, we neglected the following types of incentive, operative over our sample period, due to lack of data: increases in the allowable depreciation rates for tax purposes, specification of favourable terms for credit to new investment, investment grants. Data on the payments of grants should be obtainable from a sufficiently fine disaggregation of the entries in the government budget. Similarly, a disaggregation of total loans would give the fraction contracted at preferential terms. Anyway a precise calculation of the effective rate of investment allowance requires further research. In particular, we need to be able to split the published figure for the total amount claimed as investment allowances in year t into a) accruals on account of purchases of investment goods in the same year t b) the amount carried forward to be claimed on account of investment expenditures in previous years. It is possible, that such data may not be available on an aggregate, but only on a sample basis (e.g. Manassakis 1982, conducts a study of investment in a panel of Greek firms).

CHAPTER 5

ESTIMATION OF THE INVESTMENT FUNCTION IN GREECE 1958-1985

Section 5.1

Introduction

In Chapter 5, we estimate the investment function, in Greece, over the period 1958-1985. We try various models of investment, various definitions for the dependent and independent variables and run the equations by two stage least squares as well as ordinary least squares.

In Section 5.2, we discuss the methodology and the tests used to select the equations which are reported. In Section 5.3, we analyse the features shared by almost all the reported equations. We discuss the magnitude, sign and significance of the coefficient on credit availability. We provide explanations for the appearance of lagged, rather than contemporaneous, credit availability and discuss the implications of this feature for policy. We also interpret the occasional appearance of two significant lags of credit availability, which sometimes bear alternating signs, and discuss its implications for policy. We comment on the comparative performance of the measure which deducts debt service payments from new loans. We relate these observations to the theoretical literature on financial repression and, in particular, to the issue whether the prospect of an increase in the burden of interest payments on firms should dissuade from financial liberalization.

Subsequently we discuss a puzzling feature of our results i.e. the appearance of a positive sign on the user cost. This seems to be robust across specification changes, different variable definitions and estimation techniques. We relate this finding to the impact of interest rate reform, and/or inflation in the presence of rigidities in the banking system, on the growth rate of the economy. We examine a number of factors which ensure that the user cost still proxies for the availability of finance even if a measure of real loans is included in the investment equation. The possibilities which we discuss include: deficiencies in our measure of credit availability; the influence of retained profits and the McKinnon effect on self financed investment; crowding in. We consider also the kinds of mispecification that may be responsible for the (puzzling) sign on the user cost. These include simultaneity bias and the misrepresentation of expectations.

Having placed our findings in the context of the financial repression literature, we turn to discuss the specific features of the reported equations from the perspective of the literature on investment functions. In Section 5.4, we comment on the comparative performance of the accelerator specifications and the specifications employing lags of Jorgenson's composite as regressors. We note the effect of the adjustment of the user cost for fiscal parameters as well as the effect of deflation by an index of nominal wages. In the final subsection of Section 5.4, we describe the lag profiles encountered in the reported equations and attempt to relate their features to the putty-clay debate. We also attempt to justify the sign on the lagged capital stock.

In Section 5.5 we try private investment excluding residential buildings as dependent variable. We expect that the exclusion of this component of investment, which is governed by the housing decisions of individuals rather than the behaviour of firms, must lead to substantially different results. We examine the differences in connection with: the sign on the user cost (and on the contemporaneous value of credit availability in some equations); the distributed lags on the determinants of investment; the statistical performance of each equation as a whole. In Section 5.6, we re-estimate the reported equations, with total private investment as the regressand, by two stage least squares. We check whether our observations in Chapter 5 are robust to this change of estimation technique. A complete macroeconomic system of simultaneous equations is put forward in order to motivate the choice of instruments.

Section 5.2

The Econometric Procedure

5.2.1

Introduction

Regressions corresponding to each of the four basic models, as derived in Chapter 3, (three of which involve gross private investment while the remaining one has net private investment as its dependent variable) were run with a variety of independent variables:

1. The 'composite' of Jorgenson $J = P.Y/c$.

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1. The tax rate can be omitted from C, if capital expenditures are fully deductible, or if tax depreciation equals the economic rate $s - \dot{q}/q$ (assuming deductibility of interest). In practice such runs without tax parameters (cf. King 1972; Malcomson 1982, p.233) are undertaken preliminarily to full fledged estimation of the investment function.

2. Real income Y and real user cost $C = [r+s-\dot{q}/q]^1$ separately.
3. Real income Y and nominal user cost divided by an index of nominal wages $S = q.[r+s-\dot{q}/q]/w$ (cf. McLaren 1971; Sundararajan and Thakur 1980).
4. The aforementioned variables appropriately adjusted for corporate taxation and fiscal incentives, as discussed and derived in Chapter 4, and adopting also a slightly more precise deflation for the real user cost $C = q.(1-A).[(1-\tau).r+s-\dot{q}/q]/p.(1-\tau)$.
5. Two different credit variables L and LC, the latter of which subtracts (cf. Currie and Anyadike-Danes 1980) from the real flow of new credit (L) a rough measure of real interest payments on past loans.
6. In addition we have fitted pure accelerator (clay-clay or fixed proportions) variants for each of the four models, that is, in each case we excluded user cost variables from the matrix of regressors. (cf. the preambles of Bean 1981 and Schiantarelli 1983). In other words a specification search was, at least initiated, for no less than 56 distinct equations, in toto. These equations are all reported in Appendix L to this Chapter.

We selected the reported equations by a procedure similar with the 'general to specific' methodology associated with Hendry. It is somewhat aberrant that we start off with crystallized parametrizations[2]

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2. The alarm is perhaps false. In an experiment with the reported equations descending from the Hall-Jorgenson model and L as the credit measure, not one was rejected against an unrestricted broad equation containing 5 lags of the level of income, 5 lags of the level of the user cost, 5 lags of the credit variable, a constant and lagged net investment. More particularly equation 1 gave $F(7,11) = 1.86$ (against a corresponding general pure accelerator formulation) equation 2 gave $F(9,6) = 1.39$, equation 4 gave $F(9,6) = 0.84$, equation 6 gave $F(9,4) = 1.27$, equation 7 gave $F(9,4) = 1.04$.

(e.g. enter variables as weighted differences $DY_t = Y_t - (1-s).Y_{t-1}$) rather than beginning say with (log) levels and modifying the parametrization at each step in the sequence (Anderson 1981; Bean 1981; Schiantarelli 1983). Such manipulation of the parametrization may also help to achieve reductions in multicollinearity (Gilbert 1986). Still what we do is consonant with what, for example, Poterba and Summers (1983) view as their implementation of Hendry's approach; besides differencing economizes on the coefficients to be estimated and yields "separate decision variables with sensible economic interpretation" (cf. Hendry and Mizon 1978). At any rate it is our wish at this stage to run on Greek data four distinct models of investment chosen from or adapted for the financial repression literature. Of course such products of theoretical deduction seem drastic abstractions compared to (empirical) reality. Hence we intend the present as an investigation preliminary to an encompassing comparison with a completely data derived parametrization being compared too.[3]

We do not commit the logistic blunders of the specific to general progress. For each of the aforementioned models and with each of the possible combinations of independent variables, we set out a 'broad' overfitting equation to stand as our starting point and general maintained hypothesis, with reference to which testing is to be carried out. The broad equation cannot be too inadequate an approximate characterization of the underlying data generation process since we insist that it be free from residual autocorrelation at least at 5% otherwise do not proceed to simplify etc. (see 5.2.2).

3. Cf. Feldstein (1982) advocating a 'pluralist' approach to the study of investment to accommodate the notorious divergence among the results of the numerous empirical enquiries that have been carried out.

5.2.2

Residual autocorrelation and parameter stability statistics

Hendry's approach is particularly concerned with diagnosing any autocorrelation in the residual of the equation which provides the starting point of the specification search. This is partly because residual autocorrelation may be a general sign of mispecification i.e. "ignored simultaneity, omitted variables, measurement errors and incorrect functional form as well as dynamic-stochastic specification mistakes" (Hendry 1979, p.220), rather than of a non-white noise underlying error. (The common factor analysis was devised to clarify the matter in some circumstances). More specifically this concern is also justified because the conventional covariance matrix from ordinary least squares under residual autocorrelation, t-statistics, F-statistics (e.g. Chow tests) etc. are all wrong. Hence inference, inspiring perhaps subsequent simplification or adoption of the equation as the preferred end product, is misled. In fact with regressors only weakly exogenous, coefficient estimates are not simply biased in small samples but also inconsistent (Johnston 1984, p.363).

As our main indicator of residual autocorrelation we adopt the first order LM test against (remarkably) both AR(1) or MA(1) error distributed as $\chi^2(1)$ and computed as 'TR^2' by TSP. Breusch and Godfrey (1981) quote evidence of satisfactory finite sample properties for this asymptotic test which is also approximately correct when no intercept is included in the regression (Harvey 1981, p.172). All the reported equations pass this test. Few of the underlying broad equations manage only to pass comfortably its F version (as given in

TSP), which however is widely believed to be a better finite sample approximation (Kiviet 1986). The alternative Durbin-Watson bounds test (exact) is also reported. Consultation of the Savin White (1977) and the Farebrother (1980) tables (appropriate when there is no intercept), as required with many regressors, reveals that in most cases the statistic lies in the inconclusive range. The common recommendation (cf. Johnston 1984, p.316) to trust the upper bound for econometrics does not quite apply, at least in the case of the Hall-Jorgenson model, since (cf. Harvey 1981, p.201) in this case the regressors are first differences and anyway the statistic is typically much farther away from its lower limit. When presence of the once lagged dependent variable invalidates the Durbin-Watson test we report Durbin's (1970) '*h*' (asymptotic test). We are not excessively worried by the rejections it occasionally indicates, given unfavourable evidence as to its small sample performance (Spencer 1975).

The practice in the investment literature is, at least, to start with very long maximal lag lengths going from around 2½ years (Bean 1981; Schiantarelli 1983) to about 4 (Artus et al. 1981; Bergstrom and Sodersten 1984; Mackrell, Frisch and Roope 1971) or even 5 years (Hall and Jorgenson 1971) in the past. Thus although we face a tight constraint from the availability of observations, typically our broad equations are unrestricted distributed lags involving three or four annual lags of each regressor (difference). In addition we include the once lagged dependent variable or capital stock whenever appropriate, higher order lags of which never proved significant in trial runs. As may be expected, comprehensive quarterly national accounts series are not available for Greece (e.g. the OECD Quarterly

National Accounts give no quarterly disaggregation of investment into private and public components). Because our regressors are few by the standards of quarterly studies, we have avoided the arbitrary imposition of Almon polynomials, the pay-off to which, in terms of degrees of freedom savings and multicollinearity reduction, would have been low.

Those broad equations which passed the residual autocorrelation test, we proceed to specialize by sequential, data based, imposition of omission restrictions. In general we omit the most distant and/or least significant lags (cf. Anderson 1981 deleting regressors with t-statistics below unity). We often had to experiment (exhausting in fact all possible combinations of lags), since probably acute collinearity meant that variables which were insignificant in the broad equation would show up significantly in shorter versions and vice versa. In each case we reran the simplified equation to check whether omissions have induced residual autocorrelation. At this stage we may proceed to further omissions of any variables exhibiting significance at less than 10% until a parsimonious equation free from residual autocorrelation is reached.

Ultimately the criterion for selecting end-products to be reported among all those data coherent parsimonious equations corresponding to a given choice of model and combination of independent variables, is that of goodness of fit and plausibility of form. Goodness of fit we assess by means of $\bar{R}^2$ (if an intercept is included), the standard error of the equation, t-statistics on individual coefficients etc. (without running the risk caricatured by Granger and Newbold since most of our regressors are differences or pairs of lags). Plausibility of form refers mainly to the smoothness and continuity of the lag profiles. It never occured that in some equations coefficient signs were plausible but not in others (apart from the few cases where the coefficients on a subset of the credit lags were negative).

All the reported equations pass (at 5%) the Chow prediction test of parameter cum variance equality but some fail Hendry's (1979) asymptotically equivalent χ^2 test. The latter is relied upon in Hendry's approach (consumption function, money demand equation) as the final arbiter of mispecification. The only approximate validity of the F distribution with stochastic (e.g. lagged dependent) regressors does not discourage frequent use of Chow tests as the sole indicator of parameter stability: (cf. Bean 1984 on the grounds that unlike the χ^2 they correct for the loss of degrees of freedom in estimation; and Bean 1981). More specifically Pesaran, Smith and Yeo (1985) quote (Kiviet's) Monte Carlo evidence on the poor small sample performance of Hendry's asymptotic test (overejects). Pesaran, Smith and Yeo (op.cit.) recommend the Chow prediction statistic instead, and this is also favoured in Harvey (1981, p.287) because it retains a size close to nominal even when classical regression assumptions do not hold.

Not only is (even conditional one-step) forecasting ability a pragmatic requirement and a natural antidote for data mining, but it is also diagnostic of general mispecification e.g. omitted variables. Indeed Pesaran, Smith and Yeo (1985) so interpret the Chow prediction statistic (when exceeding unity) while Rea (1978) notes that an insignificant value is necessary but not sufficient for parameter stability. This is reminiscent of the common observation that while stability tests may detect genuine structural breaks, they may not reveal mispecification if this does not occur in conjunction with shifts in the data generation processes of the variables in the true model.

We report the coefficient estimates over the whole sample (as recommended in Gilbert 1986, p.291; cf. also Anderson 1981) rather than post sample (Hendry 1979), and choose 1980 as the intermediate breakpoint. The second oil shock (Opec II) that preceded this year, was particularly severe for middle income countries (Bruno and Sachs 1985, p.11) and marked the beginning of an unusually deep recession in Greece (OECD 1986, p.27). The choice of 1980 leaves also sufficient degrees of freedom in the estimation subperiod. We report the Chow prediction statistic and Hendry's test whenever reasonably valued.

Since our enquiry does not aim to come up with 'the' investment function, but rather to detect the role of credit availability in the latter within a financially repressed system, we do not report any end products which could not sustain significance of some lag of the credit variable at least at the 10% level. It is no surprise that, generally speaking, the significance of the credit variable(s) increases as poor determination due to multicollinearity (surely not wholly attributable to omission biases, cf. Davidson et al. 1978) is improved in the course of sequential simplification. Finally (as in Anderson 1981; Bean 1981; Hendry 1979; Schiantarelli 1983) we compute the F test of the linear restrictions (vis a vis the 'broad') the joint imposition of which results in the reported equation. All our equations pass this test at 5%[4] hence are "F-acceptable" (Gilbert 1986, p.287).

Those few broad equations suffering from residual autocorrelation, we did not proceed to simplify (or increase the dimensionality of the parameter space to exhaust virtually all degrees of freedom). This is because residual autocorrelation may be indicative of general mispecification and also because of the complications in estimation it entails. E.g. even maximum likelihood under an AR(1) error seriously understates standard errors (Johnston 1984, p.327) while the common CORC also fails to yield unconditional standard errors thus blurring comparability with the main body of our equations estimated by ordinary least squares.

Section 5.3
The Estimation Results:
General Observations

5.3.1
Introduction

The reported investment equations are made up of significant lags of income (differenced or not) with the correct positive sign and of significant lags of the user cost (differenced or not, various

4. In fact most of the reported equations pass (unless if specifically indicated) both χ^2 and F versions of the following diagnostics: Ramsey's 'Reset' test of functional form, Bera-Jarque's normality test and an LM test of heteroskedasticity. Cf. Loeb (1986) for a similar 'battery' of tests applied to investment functions and Uri (1982) for the extensive application of sophisticated (i.e. based on the recursive residuals) stability tests.

definitions) with a perverse positive sign. In addition the equations typically show up a single significant positively signed lag of the flow of real credit and finally the lagged capital stock (negatively signed) or the lagged dependent variable (positively signed) may or may not be included.

A number of the series employed (capital consumption, net investment, net capital stock) were constructed on the basis of an assumed disaggregation of the published national accounts data between the private and the public sector. More particularly the estimation results (excluding the accelerator version of the Hall-Jorgenson model) are conditional on the figure for the rate of physical depreciation (which enters the user cost and weights lagged levels before differencing). The latter was computed in a separate regression.[5] For convenience we repeat here the general form of the models fitted.

Hall-Jorgenson

$$NI_t = \alpha(L)[Y_t - Y_{t-1}] + \beta(L)[C_t - C_{t-1}] + \gamma(L)CR_t$$

Coen

$$I_t = \alpha(L)[Y_t - (1-s)Y_{t-1}] + \beta(L)[C_t - (1-s)C_{t-1}] + \gamma(L)[CR_t - (1-s)CR_{t-1}] + \lambda I_{t-1}$$

5. The practice is established in the literature (cf. Sundararajan and Thakur 1980), while others such as Bischoff (1971a) employ totally extraneous estimates. Yet one also encounters the alternative of a grid search for this parameter (Bean 1981) presumably maximizing the fit of the investment regressions. Since we run a large number of regressions in the context of our sequential specialization procedure the latter method would have been impracticable.

Blejer-Khan

$$I_t = \alpha(L)[Y_t - (1-s)Y_{t-1}] + \beta(L)[C_t - (1-s)C_{t-1}] + \gamma(L)CR_t + \lambda I_{t-1}$$

Sundararajan-Thakur

$$I_t = \alpha(L)Y_t + \beta(L)C_t + \gamma(L)CR_t + \lambda K_{t-1}$$

where:

NI : real private net investment

I : real private gross investment

Y : real income

C : real user cost (four alternative measures)

CR : flow of real credit to private sector (two alternative measures)

K : real private net capital stock

s : rate of physical depreciation

$\alpha(L), \beta(L), \gamma(L)$: lag polynomials.

Of all the reported equations those descending from the Hall-Jorgenson model reveal more clearly that long lags are involved in the investment process. Reported equations descending from other models are shorter, probably due to the presence of the lagged dependent variable (and less so the lagged capital stock), which proxies for influences on current investment from the past. All the reported equations descending from the Coen and the Blejer-Khan models pass Hendry's stability test at 5% while only few of the other reported equations manage to do so. This must be associated in part with the presence of lagged investment as a regressor in the former models.

Investment (being a highly autocorrelated series) is satisfactorily predicted (one step ahead) by its past value. However inclusion of other variables as well in an 'econometric' investment equation does shed extra light on behaviour (e.g. as suggested by their significant t-statistics) compared to a purely 'time series' formulation. The following representation[6] predicts adequately (as indicated by Z_3 and Z_4) but seems inferior to the econometric specifications in view of its substantially poorer standard error/within sample tracking ability.

$$I_t = \underset{(1.90^{*})}{6.2} + \underset{(13.8^{**})}{0.89} I_{t-1} \qquad S = 6.21$$

$$Z_1(1) = 0.49 \quad Z_2(1,24) = 0.45 \quad Z_3(5,20) = 0.77 \quad Z_4(5) = 5.08$$

5.3.2

Credit availability and investment

The fundamental hypothesis (reflected also in the investment function of our theoretical macroeconomic model) i.e. that under financial repression the availability of credit in real terms is a crucial constraint on the determination of the volume of investment, is fully corroborated by the empirical results.

All the reported equations have been selected so as to show up significantly (at least at 10%) and with the correct positive sign either of the measures of real credit availability adopted in this study[7]. In the majority of reported equations where L is the variable

6. I has a continuously declining correlogram, still somewhat smoother than exponential. We fit an AR(1) since higher order lags were not significant.

7. E.g. in the equations descending from the Hall-Jorgenson model, the t-statistics on the credit variable are between 5 and 10.

included, it is its second lag (t-2) and in most cases where LC is our measure it is its first lag (t-1) or less commonly its third lag (t-3) which appears significantly. Similarly the second lag of the weighted difference of L or LC is significant in the reported equations descending from the Coen model of investment.

The coefficient on L, remarkably similar across different equations suggests that about 50% (25%[8] impact - 60% total multiplier) of the real value of new loans to the private sector is channelled into net (gross) private investment, after roughly a period of two years.[9] Could this confirm the common suspicion (Bitros 1981; Halikias 1978; Molho 1986b) that funds obtained preferentially from the banking system are diverted into unauthorized uses? Presumably, often, investment in residential buildings is one such use[10] while we take it as common knowledge that there is little consumer credit in Greece. Simultaneously one is led to question the view that reallocation of savings towards the public sector by means of reserve requirements on banks etc. is particularly damaging for total capital formation because

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8. Cf. identical figure obtained by Blejer and Khan (1984, p.395) for a pooled sample of 24 developing countries and with closely similar variable definitions.

9. Some considerable sluggishness is revealed for credit policy even under rationing. The point seems little emphasized in the relevant literature: the 'unanticipated' advent of liberalization may bolster plans instantaneously but can be manifested in increased investment expenditures, and indeed production on the new capital goods, only after the usual delays in the investment process have elapsed.

10. In the equations we have run excluding residential buildings from the dependent variable the corresponding figures were 30% (15% impact - 40% total multiplier) for net (gross) investment.

of the government's propensity towards current expenditures. Still a substantial fraction of credit subsumed under our measure is officially granted to finance in essence working capital. For example we may compute from data in the Bank of Greece Statistical Bulletin that on average over our sample period no more than 30% (standard deviation 2 percentage points) of the outstanding loans to manufacturing and mining was designated as 'long term'. (The total of such loans constituted around one half of 'Domestic Credit Claims on the Private Sector').[11]

It should not be surprising that only past values of real credit availability affect current investment. Lags may act as proxies for expected future availability (cf. Fazzari and Athey 1987, p.484; Sinai and Eckstein 1983, p.135). An average of past receipts of credit may be measuring the funds available to firms, or the latter's bargaining strength vis a vis the banks for prospective loan requests etc. It could be the practice that some funds must be procured in advance upon ordering rather than the delivery of capital goods when investment is recorded in the national accounts. Or investing firms faced perhaps with uncertain and variable (e.g. from the supply side) delivery lags compounded by bureaucratic delays in the processing of loan requests etc. choose to be burdened with term loans somewhat in advance. They may take out loans as precautionary liquid holdings at the planning stages of investment given also that trade or other credit may be more expensive than official loans, and that the structure of

11. Similarly in Bank of Greece (1982) an average of 40% (s.d. 6 percentage points) of the total commercial banks credit (i.e. including advances to the public sector) is characterized as 'long term' over the period 1960-1980.

interest rates may have encouraged 'round-tripping' from time to time[12] (Union of Greek Banks 1987, p.24). Similar arguments are put forward by Fazzari, Hubbard and Petersen (1988a, pp.170-171) in order to justify the inclusion of two annual lags of fund availability in their investment equations. In particular they suggest that "lagged values of cash flow may have explanatory power for investment in a time-to-built context for example".

Some of the broad 'starting point' equations could be specialized to corresponding narrow equations free of residual autocorrelation with every included variable significant at least at 10% and, notably, involving two lags of the credit variable (distributed over adjacent periods either side of t-2). Sometimes these had alternating signs. We do not report specifically the above (apart from some Sundararajan-Thakur type equations) but rather other equations descending from the same models which in fact exhibit superior fit and/or statistical properties. In any case the appearance of a negative sign on some lags of new real loans, rather than disproving the role of fund availability in investment, has been proposed within just such a framework by Gardner and Sheldon (1975) and indeed discussed by us in Chapter 3. Consider the following example:

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12. It is unlikely that "the well known collinearity of such variables with those of the accelerator type" (Nickell 1978, p.270) is responsible for the inability of contemporaneous values to show up significantly. In fact although L_t moves together with the levels, its correlation coefficient with the differences of income or user cost is below 30% (an attractive feature of differenced formulations). For LC_t the position is reversed (and this might go part of the way towards explaining the relatively poorer performance of this variable in all formulations apart from Sundararajan-Thakur) but still the values of the respective correlation coefficients are low below 50%.

$$I_t = 0.57DY_t + 0.26L_{t-1} - 0.22L_{t-3} + 0.77I_{t-1}$$
$$(6.72^{**}) \quad (2.20^{**}) \quad (-2.04^{*}) \quad (11.55^{**})$$

$S = 3.86$

$Z_1(1) = 1.17 \quad Z_2(1,19) = 0.97 \quad h = -1.05$

$Z_3(5,15) = 0.38 \quad Z_4(5) = 5.13 \quad Z_5(6,14) = 0.45$

$$I_t = /CON/\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DY_{t-3}/L_t/L_{t-1}/L_{t-2}/L_{t-3}/\underset{**}{I_{t-1}}$$

Essentially, with reference to any one project, abundant credit in the current period implies that a relatively larger fraction of the total orders required can be placed in the present. Therefore fewer orders are left for the future. Hence investment in some future period may be negatively associated with credit availability in the current period. Indeed it is the more distant credit lag which bears a negative sign in the example given above. Another possibility could be that negatively signed lags of L may be capturing the contractionary effect that an increased amount of interest payments, due to a larger volume of new loans, has on investment. Nevertheless the sign pattern in some of the reported equations descending from the Sundararajan-Thakur model, where the contemporaneous value is negatively signed while credit lags are positive, remains a disturbing feature of the results[13] (yet the total effect is above zero). Tun Wai and Wong

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13. One could speculate that over our sample, credit requirements were obtained well before the expenditures financed. So more often than not periods of high investment took place at the same time that the demand for credit was lax, hence the negative association contemporaneously. Self finance with deposits being converted to currency after purchases of capital goods or crowding in with advances to the private and the public sector moving in opposite directions, is another possibility. There is sparse evidence that housing investment may be responsible: When equations 27 and 28 were run for investment excluding residential buildings all the (continued on next page)

(1982), who estimate a similar equation with Greek data, also find that contemporaneous credit availability is negatively signed.

The statistical performance of L as a measure of real credit availability is more favourable than that of LC. Comparing from the reported equations those identical in all respects but for the choice of definition of real credit availability, and also by more general observation, we may conclude that: Typically LC bears a noticeably lower t statistic (hardly significant at 5%), yields a higher standard error of estimate (with a simultaneous substantial rise in the t-statistic on the lagged dependent variable especially in the Blejer-Khan model) and worse residual autocorrelation statistics (thus suggesting some mispecification) for the equation as a whole. (Cf. Equations 11 to 12, 14 to 15, 16 to 17, 31 to 32.) There cannot be found many such comparable pairs of equations because it seems that inclusion of LC gives rise to a substantially different dynamic structure than obtained with L.

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13. Continued/...
variables retained significance apart from the contemporaneous perversely signed credit availability which became totally insignificant. Similarly the example below suggests that while housing investment is preceded by the accumulation of monetary balances (M is akin to M3) it occurs at the same time as a contraction in the real money supply (e.g. housing investment is stimulated during a general portfolio shift into inflation hedges or foreign assets).

$$NI_t = \underset{(6.51^{**})}{0.43HY_t} + \underset{(6.38^{**})}{0.51HY_{t-2}} + \underset{(3.76^{**})}{21.0HC_{t-1}} + \underset{(2.18^{**})}{10.0HC_{t-2}}$$

$$- \underset{(-3.47^{**})}{0.16M_t} + \underset{(4.01^{**})}{0.19M_{t-1}}$$

$$S = 2.88 \quad Z_1(1) = 0.46 \quad Z_2(1,17) = 0.33 \quad D.W. = 1.98$$

(Nb C is appropriately adjusted for this investment aggregate. Note that the inspiration for this equation is similar to that of Kelly and Norton (1971) who apart from the constituents of the user cost introduce a liquid wealth argument, into their equation for investment in dwellings.)

As far as theory is concerned, the insight of the Currie and Anyadike-Danes (1980) model lies in equating the volume of funds available to the firm for investment with retained profits plus new loans minus interest payments on outstanding loans. Fazzari and Athey (1987), as well as Sinai and Eckstein (1983), also acknowledge debt servicing payments as a signal of creditworthiness which influences the availability of further loans or other external funds to the firm. That LC is not much of a significant determinant of investment is discouraging for this perspective. In Currie and Anyadike-Danes (1980) the fact that firms will have to pay increased interest bills when deposit rates are raised advises, considered in isolation, against liberalisation. (Cf. also Lanyi and Saracoglu 1983, p.17; Jao 1985 etc.). Rather the superior standing of L vindicates Fry's approach which almost neglects any implications of the increased burden of interest payments. This approach concentrates on the beneficial impact of a larger flow of new loans on investment and growth upon financial liberalization.

On the other hand the relatively poor performance of LC may only be attributable to inadequacies in the incorporated representation of total interest payments (by the product of the current loan rate given in the IFS times the stock of outstanding loans lagged once). This is crude since in view of extensive selective credit controls, applicable loan rates are highly differentiated at any point in time, while a large fraction of the outstanding loans may have been extended in the distant past at radically different fixed rates.[14] For example Sinai

14. E.g. in 1985 the Bank of Greece Statistical Bulletin distinguished seven official loan rate ceilings for commercial banks with an unweighted mean of 16% and a considerable standard deviation of 3 percentage points while over time the employed IFS series averages to 12% with a standard deviation about half as large as this mean.

and Eckstein (1983, p.139) employ "weighted averages of current and past interest rates with a term to approximate average maturity" distinguishing also between different types of debt, in order to construct a proxy for debt service. Finally note that, to the extent that "the debt service variable acts to restrain investment spending through interest rate effects as well" (ibid.), the poor performance of LC may be associated with the perverse (yet weak) response of investment to nominal interest rates in our sample.

5.3.3

The sign on the user cost

A striking feature of the results is that irrespective of the estimation method (whether OLSQ or IV) or the underlying model of investment or the particular dependent variable explained (whether net or gross investment and whether including or not expenditures on residential buildings) or the specific measure employed (whether tax adjusted or not) the sign on all the significant lags of the user cost in the reported equations comes out positive against the predictions of neoclassical theory.

At first sight this could be welcome given the belief held in the liberalization literature (excluding new structuralists) about the expansionary influence that a rise in the real deposit rate has on capital formation. This it achieves by increasing the availability of loanable funds from the banks since alternative sources of finance cannot be found. Of course the user cost (whether adjusted for fiscal parameters or not) is a series close to the real deposit rate (evaluated on the basis of the GDP deflator) with a correlation coefficient around 0.7. We confirmed that it is 'the real deposit rate component' $RD = (1-\tau).r + s - \dot{q}/q$ (0.82 correlation coefficient with real deposit rate) rather than the relative price component $RP = q.(1-A)/p.(1-\tau)$ of user cost $(= q.(1-A).[(1-\tau).r+s-\dot{q}/q]/p.(1-\tau))$ which really shows up in our regressions by the following experiment: We run selected reported equations (4, 13, 23, 28) separating RD from RP (or the differences thereof). In every case it was the lags of RD which each retained significance and positive sign whilst the lags of RP were always individually insignificant and positively signed more often than not Cf. the counterpart to equation 4:

$$\begin{aligned} NI_t = {} & \underset{(5.10^{**})}{0.52HY_t} + \underset{(5.90^{**})}{0.71HY_{t-1}} + \underset{(3.03^{**})}{0.47HY_{t-2}} + \underset{(3.83^{**})}{0.45HY_{t-3}} + \underset{(0.01)}{0.14HRP_t} \\ & + \underset{(2.59^{**})}{70.0HRD_t} - \underset{(-1.0)}{23.0HRP_{t-1}} + \underset{(1.85^{*})}{60.0HRD_{t-1}} + \underset{(1.0)}{2.76HRP_{t-2}} \\ & + \underset{(4.83^{**})}{78.0HRD_{t-2}} + \underset{(10.55^{**})}{0.57L_{t-2}} \end{aligned}$$

$S = 3.01 \quad Z_1(1) = 1.57 \quad Z_2(1,12) = 0.84 \quad D.W. = 1.55?$

(The joint significance of HRP lags is $F(3,13) = 0.52$).

By contrast if inflation rises with inflexible ceilings for the nominal deposit rates and/or reserve ratios, funds are switched from bank deposits into various inflation hedges starving firms of (bank) finance (in real terms). Thus we may add to the list of the costs of (perfectly anticipated) inflation in the presence of rigidities, the overall reduction in investment (or even production in general). Indeed it is a negative reaction of investment to the rate of (capital goods) inflation which seems to be underlying the perverse sign on the 'user cost' while the loan rate plus rate of depreciation seems less important. To pursue this we run selected reported equations (2, 11, 20, 26 from those not adjusting the user cost for fiscal parameters) decomposing $C = r + s - \dot{q}/q$ into $RS = r + s$ and $GQ = \dot{q}/q$. We found that almost invariably lags of GQ (differenced) were individually highly significant and had a negative sign, while lags of RS (differenced) were less significant (in part due to collinearity exactly because the administered rate has remained rather inflexible over our sample period) and generally bearing a (wrong) positive sign. To illustrate consider the counterpart to equation 26.

$$\underset{}{I_t} = \underset{(-6.37^{**})}{-91.0} + \underset{(5.48^{**})}{0.56Y_t} + \underset{(2.00^{*})}{0.20Y_{t-1}} + \underset{(2.49^{**})}{151.0RS_t} - \underset{(-2.02^{*})}{39.0GQ_t} - \underset{(-0.06)}{5.7RS_{t-1}}$$

$$- \underset{(-3.28^{**})}{53.0GQ_{t-1}} + \underset{(0.25)}{16.0RS_{t-2}} - \underset{(-2.33^{**})}{31.0GQ_{t-2}} + \underset{(2.83^{**})}{0.30L_{t-2}} - \underset{(-7.06^{**})}{0.23K_{t-1}}$$

$S = 2.44 \quad \bar{R}^2 = 0.98 \quad Z_1(1) = 1.17 \quad Z_2(1,13) = 0.64 \quad D.W. = 2.37?$

Omitting the lags of RS (not jointly significant $F(2,14) = 0.03$) we obtain:

$$I_t = \underset{(-11.0^{**})}{-89.0} + \underset{(6.70^{**})}{0.54Y_t} + \underset{(2.19^{**})}{0.20Y_{t-1}} + \underset{(4.10^{**})}{149.0RS_t} - \underset{(-2.69^{**})}{41.0GQ_t} - \underset{(-4.47^{**})}{55.0GQ_{t-1}}$$

$$- \underset{(-2.83^{**})}{32.0GQ_{t-2}} + \underset{(3.07^{**})}{0.31L_{t-2}} - \underset{(-13.0^{**})}{0.23K_{t-1}}$$

$S = 2.29 \quad \bar{R}^2 = 0.98 \quad Z_1(1) = 1.27 \quad Z_2(1,15) = 0.80 \quad D.W. = 2.29?$

For every ceteris paribus percentage point long term rise in inflation, investment declines by around 1bn (1970 Dr) i.e. around 2% of its average value over the sample or an elasticity (evaluated at the means) of 0.2.[15]

15. The consequences of interest rate controls together with a similar argument why inflation may reduce investment via portfolio redistributions towards short term assets or because of the real effects of nominal government institutions (e.g. depreciation allowances) in Fischer and Modigliani (1978).

In Appendices N-O we have empirically substantiated that a wide range of monetary and deposit aggregates (including the broadest series known as 'liquid liabilities' in the IFS) respond positively and significantly to the (actual) real deposit rate. Also one encounters in the literature regression equations with the (ex ante) real deposit rate positively signed and capable (together with other variables) of tracing the rate of investment (e.g. Kitchen 1986, p.92 in an otherwise pure accelerator formulation) or income growth (Fry 1980) in many financially repressed economies.

The problem with such analysis in our circumstances is that we include the real flow of new loans as an explanatory variable anyway. Therefore any further positive influence of the user cost on investment must be direct i.e. have an independent existence after the partial effect of credit has been taken into account.

On the other hand our measure of credit may not be sufficiently comprehensive and therefore the positive sign on the user cost may represent an expansion of the availability of uncaptured sources of finance as real loan rates, perhaps alongside other, even curb market,[16] interest rates rise generally. Our measure though is the broadest available from official sources.[17] The financial

16. Strictly under new-structuralist assumptions the official loan rate and the volume of unofficial transactions would move in opposite directions.

17. Our measure is the (deflated first difference of the) line 'Domestic Credit: Claims on Private Sector' in the IFS. It includes claims on business and individuals and claims on development banks held by the Bank of Greece as well as claims on the private sector held by Commercial Banks. This may omit any claims on the private sector by Special Credit Institutions which are not funds borrowed by the latter from the Central Bank and onlent.

liberalisation literature provides a rationale for an aggregate dependence of profits on the real interest rate. A relatively higher rate rations out the lowest return borrowers and persuades prospective small self financed entrepreneurs to deposit their resources with banks. There, because of pooling, superior expertise/information, funds are channelled towards higher productivity uses. Sundararajan (1987) is an example of an empirical study which detects this effect. In addition in much of the work on investment within an environment of developed financial markets, retained profits are an influence on investment expenditures given difficulties in drawing on alternative sources of finance or their informational role. From such a standpoint we have mispecified our equations by omitting this determinant of investment which, in view of the above discussion, could be proxied by the user cost variables consequently showing a positive sign. Further to the extent that a fraction of investment is self financed, McKinnon (1973) proposes a positive relationship between it and the attractiveness of deposits quite independently from bank advances to the private sector. This is so, because monetary balances have to be accumulated until a threshold amount below which holdings of physical capital are indivisible, is exceeded. Keeping within this same literature, Blejer and Khan (1984) and Sundararajan and Thakur (1980) discover for some countries that private investment is positively related to public investment (say because the latter contributes to infrastructural improvements). Maybe government investment is financed by loans that do not necessarily move together with the aggregate included in our regressions but rather relate to the total size of the banking system which varies with the level of real interest rates. Both the possibility of crowding-in and a positive dependence of private investment on retained profits, are empirically substantiated for Greece by Tun Wai and Wong (1982).

Alternatively we may take the view that the role of the user cost is neoclassical. It (as well as income) has a place as a regressor in an investment function alongside the real flow of loans. This is the case either because the system is not continuously rationed (cf. Stegman 1982 for a different approach in such circumstances) but only say in times of tight money (Blinder and Stiglitz 1983; Greenwald, Stiglitz and Weiss 1984) or because there exist some (highly creditworthy and/or favoured) firms which investment plans are constrained effectively only by the price of funds. In this case, however, the positive sign is perverse and ought to be attributed to some mispecification. There are suggestions in the literature that there may exist underlying simultaneity quite apart from that between investment and the current values of its determinants which only we ameliorate by our application of the instrumental variables technique below. For example, Lund (1976, p.262) quotes the observation "that a one period lag on the price of capital goods in an investment expenditure equation is not a sufficient condition for non-simultaneity since if current investment reflects last periods' new orders, [lagged] price and new orders [hence current investment] may then have been simultaneously determined".

More concretely, there has developed a line of thought (Abel 1980; Ando et al. 1974; Bernanke 1983; Birch and Siebert 1976; Feldstein and Flemming 1971; Helliwell and Glorieux 1970; Nickell 1978; Schiantarelli 1983 etc.) portraying investment as, par excellence, a forward looking exercise. This approach challenges the assumptions of perfect certainty and reversibility on which use of actual values for the explanatory variables rests. Its more recent advocates recommend against representations of expectations by distributed lags in favour of rational expectations generated as fitted values from some econometric forecasting scheme. Bean (1981) warns us specifically that using the actual, rather than some proxy for the expected, values of inflation in the construction of a measure for the user cost is particularly inappropriate in periods of volatility of the former. Feldstein and Flemming (1971, p.428) also, cast doubt on the meaningfulness of their results in connection with the relative price component of the user cost. In their view, the employed observed values for the latter only very imperfectly capture the expectations to which investment genuinely responds. It follows that perhaps we should not reach a definite conclusion on the interpretation of the perverse sign on the user cost unless some adequate modelling of expectations, at least of inflation, is also attempted.

Section 5.4
The Reported Equations

5.4.1
Issues in the reported equations

Comparing the pure accelerator version with other reported equations ultimately descending from the same model we have: The inclusion of lags of (differences of) the user cost variable (however measured) does not change the total effect of income (differences), always leads to a reduction in the standard error of estimate[18] and in the case of the Hall-Jorgenson equations brings about a substantial improvement of the residual autocorrelation statistics (that presumably were warning for the omitted variables) (Cf. Broad Equations 1 to 2).

When Jorgenson's composite J (whether adjusted or not for fiscal parameters) was tried as the independent variable, out of all the eight combinations of model and credit measure each giving a distinct broad equation for a starting point, our procedure of sequential specialization led to only a single reportable equation (equation 9) descending in fact from the Hall-Jorgenson model and employing a measure without adjustment for fiscal parameters. In the majority of cases (especially for broad equations representing the Hall-Jorgenson or the Sundararajan-Thakur models where a lagged dependent variable was not present to 'soak up' the serial correlation) highly significant residual autocorrelation statistics (Z_2) at the outset averted any further specialization. Also the single reported equation has a very

18. Halving in the case of Hall-Jorgenson: All the t-statistics on the lags of the first difference of income also rose substantially. Since the pure accelerator version of this model (Equation 1) happens to be nested within the other reported equations that include user cost variables we are able to give their joint significance as follows: In equation 2 we have $F(3,16) = 13.42$ -, in equation 4 $F(3,16) = 15.35$-, in equation 6 $F(3,14) = 6.81$-, in equation 7 $F(3,14) = 7.75$-. Whether reflecting mechanisms under financial repression or possessing a neoclassical (but mispecified) role, user cost variables make a significant contribution to the explanation of investment. Thus we can hardly agree with the common conclusion (e.g. Shapiro 1986), most recently reconfirmed (by means of tests of non-nested alternatives, in the presence of residual autocorrelation) in Bernanke, Bohn and Reiss (1988, p.294) "that there is modest support for investment models that use output or sales variables, and that there is little support for models that employ user cost of capital or Q variables".

much worse fit than any other reported regression explaining net investment: These are indications of mispecification, more particularly that the restriction incorporated in the composite and implied by the assumption of a Cobb-Douglas production function is not accepted by our data.[19]

The adjustment[20] of our measure of the user cost for the various relevant fiscal provisions makes little difference to the statistical properties of our equations and leaves the dynamic structure almost unaltered (as demonstrated by those reported equations descending from Coen's or from Blejer-Khan's model). This further reveals the role of the user cost not to be here as stipulated by the neoclassical analysis. If neoclassical mechanisms were operative (barring extreme inelasticities), taking into account the substantial changes in the effective price of capital goods due to fiscal incentives, as well as the movements in the user cost due to alterations in the rate of corporate taxation, should have been capable of improving the explanation of the behaviour of the investment series. Assume that the user cost mainly proxies the effect of the real interest rate on the volume of deposits, hence on credit availability and investment. Then indeed this influence ought not be directly (apart from liquidity effects) responsive to changes in corporate taxation (deposit interest

19. The poor performance of the composite may be associated with the perverse response of investment to the user cost. Alternatively, as Chirinko (1986) would suggest, it may be due to the fact that the influence of income on investment takes place at a different lag from the influence of the user cost.

20. Together with this we change from q to p as the deflator of the nominal user cost, which also accords more with a neoclassical interpretation, and further differentiates the measure from a real interest rate (but itself makes a negligible difference for the results).

income is tax free in Greece), or to changes in tax depreciation, investment allowances etc. on physical capital (apart from portfolio effects).

Compare from the reported equations those differing only in whether they incorporate fiscal parameters in any given measure of the user cost or not: This adjustment, (leaves of course unaltered the value of the coefficients on the income variables), may change the standard error of estimate and t-statistics on the user cost lags either way but only slightly (tending to increase them when C is the measure), lowers the residual autocorrelation statistics in most cases hardly noticeably and consistently reduces the value of the coefficients on the lags of the user cost[21]. (Cf. Equations 2 to 4, 11 to 13, 14 to 16, 20 to 22, 24 to 25 and the Broad Equations 11 to 13, 14 to 16, 29 to 31 and 30 to 32).

Nor are there any clearcut indications as to which is the appropriate measure of the user cost, C or S, whether adjusted or not for fiscal parameters. A comparison comes up against the difficulty that the available series for S begins two years later than that for C; combined with the small number of observations overall, this almost makes for non identical samples. No dramatic differences can be seen but for example the comparison of broad equation 5 to 8, of equation 13 to 16 and 26 to 29 suggests that S yields best overall fit (on the basis of the standard error of estimate) and residual autocorrelation

21. Cf. King (1972, p.139) "if we exclude investment incentives the result is that we appear to overestimate the true coefficient of the relative factor price term because we are underestimating the rise in relative factor prices".

statistics, while the position is reversed with respect to fit for the pairs equation 4 and 7, 11 and 14, 12 and 15.

5.4.2

Details of the reported equations

We turn to a detailed look at the reported equations by model of origin (most features retained intact after instrumentation).

The Hall-Jorgenson model: Equations descending from this model comprise four lags of the first difference of income (t-3 being the farthest) with a median lag of just under a year and three lags of the first difference of whatever measure of the user cost is employed (t-2 being the farthest). Where L is the credit measure, the lag profile on the user cost variable is such that coefficients increase as we move from the current value towards the longest lag, t-2, which is also the most significant. By contrast the most significant lag of the first difference of income is the contemporaneous or first lag (their t statistics are anyway very close); its lag profile is hump shaped rising smoothly to a single peak one or two years in the past and then declining continuously. The lag profile on income in the pure accelerator version of this, as well as in the Blejer-Khan model, is continuously declining.

The Coen model: The reported equations descending from this model are the shortest, containing the current value of (the weighted difference of) income the first lag of (the weighted difference of) whichever measure of the user cost is employed and the second lag of (the weighted difference of) real credit availability. In all cases apart from one both L and LC give rise to otherwise identical reportable equations. Significant autocorrelation in the residual, to be expected because the model is obtained by the application of the Koyck transformation to eliminate the capital stock, is not detectable in the data.

The Blejer-Khan model: These equations include at most two to three lags of (the weighted difference of) income, (t-2 being the farthest) and at most two lags of (the weighted difference of) whatever measure of the user cost is tried. The fit of these equations is close to the fit of the reported equations descending from Coen's model. The standard error of estimate ranges from around 3 to about 4 (6-8% of the mean of the dependent variable). In those reported equations with several lags of income, the lag profile is V-shaped with the current value giving the largest and most significant response. The coefficients and t-statistics on the user cost are continuously declining (in contrast to what was found for the Hall-Jorgenson equations).

The lag profile and t-statistics on the user cost in the reported equations of the Hall-Jorgenson model are ascending. The current value of the user cost is invariably absent (the distributed lag begins from t-1) in the reported equations of the Coen and the Blejer-Khan models. These could be taken as hints that the reaction of investment to the user cost builds up somewhat more slowly than in response to income. Such a delay is commonly attributed to ex post fixity of proportions whereby a change in the optimal capital-output ratio induced by a movement in the user cost cannot be implemented instantaneously on the existing capital stock (e.g. cf. Eisner and Nadiri 1968, p.377). A putty clay interpretation of the role of the user cost is, however, hardly compatible with the perverse sign taken by this variable in the regressions. Alternatively within a financial repression interpretation, we can invoke Molho (1986a), who has suggested particularly long lags in the influence of the real interest rate, associated with the intertemporal nature of McKinnon's accumulation mechanism.

The Sundararajan-Thakur model: A prima facie alarming feature is the invariable appearance of a negative sign on the lagged capital stock in these reported equations. However, this is not ruled out by the assumptions of the model, if the rate of depreciation should fall short of the constant component of the speed of adjustment. In fact this finding occurs also in the regressions presented in the paper of Sundararajan and Thakur (1980) and in the paper of Tun Wai and Wong (1982) (for Greece). The blame, however, cannot be placed exclusively on the constructed series for the private net capital stock. This can be demonstrated by experimentally fitting an equation,[22] such as those of Mackrell, Frisch and Roope (1971). Here the coefficient on lagged capital stock comes out positive and with a magnitude close to the rate of depreciation. Thus the suggestion, by Tun Wai and Wong (op.cit.), that the negative sign on lagged capital stock is attributable to multicollinearity, might be correct. Indeed, the capital stock is

22. Note the slightly superior fit of this equation compared to those descending from Coen and Blejer-Khan on average, its much inferior fit compared to the Sundararajan-Thakur equations, and finally the appearance of L_{t-2} as the pertinent lag of the credit variable (in contrast to the Sundararajan-Thakur equations).

more highly correlated with the level than with the difference of income. Apart from picking up the initial capital stock at the beginning of the sample the constant may indicate non-exponential depreciation (Clark 1979, pp.108-110; Dinenis 1985, p.30).

$$I_t = \underset{(1.90*)}{4.10} + \underset{(7.05**)}{0.54HY_t} + \underset{(6.03**)}{0.63HY_{t-1}} + \underset{(4.93**)}{0.54HY_{t-2}} + \underset{(4.11**)}{0.41HY_{t-3}}$$

$$+ \underset{(1.90*)}{33.0HC_t} + \underset{(3.81**)}{50.0HC_{t-1}} + \underset{(5.33**)}{63.0HC_{t-2}} + \underset{(2.71**)}{0.41L_{t-2}} + \underset{(5.92**)}{0.03K_{t-1}}$$

$S = 2.94$

$Z_1(1) = 0.83 \quad Z_2(1,14) = 0.50 \quad D.W. = 1.65$

$Z_3(5,10) = 0.32 \quad Z_5(5,9) = 0.70$

$$I_t = /CON/\underset{**}{HY_t}/\underset{**}{HY_{t-1}}/\underset{**}{HY_{t-2}}/\underset{**}{HY_{t-3}}/\underset{**}{HC_t}/\underset{*}{HC_{t-1}}/\underset{**}{HC_{t-2}}/HC_{t-3}/L_t/L_{t-1}/\underset{**}{L_{t-2}}/$$

$$/L_{t-3}/\underset{**}{K_{t-1}}$$

Otherwise most of the reported equations comprise two lags of the level of income and three lags of the level of the user cost. The lag profiles on both income and user cost are declining with the current value of income and the first lag of the user cost being the most significant. Fit and residual autocorrelation statistics are the best among equations explaining gross investment. An exception to the rule that L yields superior fit to LC is provided by the comparison of equations 29 to 30 and equations 31 to 32.

Section 5.5

Equations with Real Gross Private Fixed Capital Formation Excluding Expenditures on Residential Buildings as the Dependent Variable

To provide yet another variation on our results (and to check if this would correct the perverse sign on the user cost) we tried private investment minus expenditures on the construction of residential buildings/dwellings (which average to a 40% of the total) as the dependent variable. Here we undertook specification searches (to arrive at equations to be reported) for only two of our investment models, that of Hall-Jorgenson and that of Blejer-Khan. We tried most of our combinations of independent variables but did not run any equations for the measures of user cost which exclude fiscal parameters. We report only the best equation from those obtained by the two alternative credit variables employed. To undertake these estimations it was necessary to repeat with this investment aggregate the steps (described in Chapter 3) required to attribute capital consumption to the private sector, thus construct a series for private net investment and the private net capital stock excluding residential buildings, and thus compute a figure for the rate of depreciation of the latter (s = 0.036 as expected higher than the rate of 0.027 worked out for the total private net capital stock).[23]

Comparing the reported equations descending from the Hall-Jorgenson model with, and without, expenditures on residential buildings in the

23. $DEP_t = 2.69 + 0.036K_{t-1}$ (78.0**)(282.0**) $\bar{R}^2 = 0.99$ D.W. = 1.05-
(Fitting an AR(1) or AR(2) error by ML or CORC does not change the [rounded] figure for the rate of depreciation.)

regressand we note a lengthening of the distributed lag on income and user cost. The t-4th difference of income is present here as a significant explanatory variable and correspondingly the median lag rises from just under to a bit over a year. A similar observation can be made in the single reported equation (equation 34) containing a distributed lag of the user cost where the t-3rd difference of the user cost turns up and the median lag almost doubles (compared to equation 4) to over a year. Also the lag profile on income changes to become bimodal while that on the user cost becomes declining. It may be that the construction of residential buildings can take place over a relatively short duration and therefore the exclusion of such expenditures from the investment series, leaves an aggregate of types of investment which respond to changes in their determinants with somewhat longer delays.

However in this set of reported equations we do not find again the almost invariable appearance of L_{t-2}, but rather more 'recent' lags of the credit variable. This may be a hint that the longer lags of the flow of real credit reflected influences less relevant to the credit availability mechanism.[24] This mechanism may be more clearly depicted by the present set of estimates, which points to a faster response to credit conditions (a delay of one year or less). The coefficient on the flow of real credit drops by about 1/3.

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24. E.g. more distant lags of the difference of income (which here are significant on their own right). Also common sense would link residential investment with the level of deposits sometime before the construction of housing although direct mortgage lending would not be very usual in Greece.

The two instances of pure accelerator specifications which we report here (equations 33 and 36 descending from either models of investment) both show a substantially lower residual autocorrelation statistic and a better standard error of estimate as a proportion of the mean (although goodness of fit cannot be strictly comparable) contrasted to their (only approximate in the case of equation 33 which also has much better stability tests) counterparts with total private investment (equations 1 and 18 respectively). As might be expected, the selected models of investment explain the behaviour of capital expenditures undertaken in the majority by firms better than when using a series a sizeable component of which is governed by the housing decisions of individuals. Lack of comparability between the respective reported equations prevents us from generalizing this conclusion beyond the pure accelerator versions.

Section 5.6
Instrumental Variables Estimation

The problem of simultaneity in the estimation of investment functions is commonly noted and could be acute in our case since we work with annual observations. Various ways of coping with this difficulty have been put forward: Hall (1977) favours the use of Jorgenson's composite as the explanatory variable (which gave poor results with our sample) while Harberger (quoted in Lund 1976, p.253 n27) remarks that this may also help to reduce the effect of errors in the measurement of the elusive user cost. Anderson (1981) and Schiantarelli (1983) avoid simultaneity by omitting the contemporaneous value of income from their specifications. Bean (1981) reassures himself that the resultant biases are negligible after also applying instrumental variables to the equation which provided the starting point for his sequential specialization.

To eliminate simultaneity bias and obtain consistent (albeit not unbiased) estimates of the coefficients of each of our reported (structural) investment equations, we made use of 2SLS interpreted as an instrumental variables method.[25] In order to motivate the use of a number of exogenous variables in this exercise we embedded each reported investment equation, say:

$$NI_t = \alpha_0 HY_t + \alpha_1 HY_{t-1} + \alpha_2 HY_{t-2} + \alpha_3 HY_{t-3} + \alpha_4 HC_t + \alpha_5 HC_{t-1} + \alpha_6 HC_{t-2} + \alpha_7 L_{t-2} \qquad (I)$$

into a plausible system of simultaneous equations comprising a relationship that links gross to net investment by means of exponential depreciation:

$$I_t = CON^{26} + s.K_{t-1} + NI_t \qquad (II)$$

an output exhaustion equation:

$$Y_t = CO_t + I_t + G_t + (X-M)_t \qquad (III)$$

the determination of net exports by competitiveness $\beta_0(eP^*)_t + \beta_1 P_t$, world trade WT_t and income:

25. The method is operative in large samples under the assumption of no residual autocorrelation which is accepted by our data, as verified by means of the LM(1) statistic adapted for instrumental variables estimation.

26. The constant absorbs the benchmark value of the capital stock in the beginning of our sample not included in K_{t-1}.

$$(X\text{-}M)_t = \beta_0(eP^*)_t + \beta_1 P_t + \beta_2 WT_t + \beta_3 Y_t \qquad \text{(IV)}$$

a simple consumption function:

$$CO_t = CON + \gamma_1 Y_t \qquad \text{(V)}$$

and the determination of domestic prices by a money market clearing condition:

$$P_t = \delta_0 r_t^d + \delta_1 \left[\frac{\dot{P}}{P}\right]_t + \delta_2 Y_t + \delta_3 M_t + \delta_4 . TREND^{27} \qquad \text{(VI)}$$

To gain some additional instruments for investment equations of the Sundararajan-Thakur type we introduce a ratchet effect as well as lagged real net wealth $(RLQ)_{t-1}$ in the consumption function:

$$CO_t = CON + \gamma_1 Y_t + \gamma_2 (RLQ)_{t-1} + \gamma_3 CO_{t-1} \qquad \text{(Va)}$$

and also assume a partial adjustment of money holdings to desired levels:

$$P_t = \delta_0 r_t^d + \delta_1 \left[\frac{\dot{P}}{P}\right]_t + \delta_2 Y_t + \delta_3 M_t + \delta_4 M_{t-1}$$
$$+ \delta_5 P_{t-1} + \delta_6 . TREND \qquad \text{(VIa)}$$

Similarly when the investment equation is descending from the Coen or the Blejer-Khan model[28] we describe world trade by four distinct component series while real government expenditure and foreign prices are each resolved into a pair of components. In addition we justify the presence of two lagged values of income on account of a dependence of consumption (or money demand) on some (backward looking) measure of

27. The trend comes from money demand and stands for financial innovation.

28. In this case also we do not write the relationship between gross and net investment (since the latter does not appear anywhere).

permanent income, alongside the wealth effect:

$$CO_t = CON + \gamma_1 Y_t + \gamma_2 Y_{t-1} + \gamma_3 Y_{t-2} + \gamma_4 (RLQ)_{t-1} \qquad \text{(Vb)}$$

We retain partial adjustment in the money market, and also put the rate of exchange rate depreciation in the demand for money function, as an approximation to the return on assets alternative (feasibly in view of capital flight) to domestic monetary balances.

$$P_t = \delta_0 r_t^d + \delta_1 \left[\frac{\dot{P}}{P}\right]_t + \delta_2 \left[\frac{\dot{e}}{e}\right]_t + \delta_3 Y_t + \delta_4 M_t$$
$$+ \delta_5 M_{t-1} + \delta_6 P_{t-1} + \delta_7 .TREND \qquad \text{(VIb)}$$

For the cases where the contemporaneous value of the user cost turns up as an endogenous right hand side variable in the investment equation, we close the system with an index for the price of capital goods placing perhaps greatest weight on imported investment goods the price q^* of which is set in world markets (cf. Bilsborrow 1977, p.702). Thus we write an expression for the domestic rate of inflation of capital goods prices and adding the loan rate (remember $C = r - \dot{q}/q + s$ taking no cognizance of the tax system) we obtain an equation for the real user cost:

$$C_t = CON + \theta_0 \left[\frac{\dot{e}}{e}\right]_t + \theta_1 \left[\frac{\dot{q}^*}{q^*}\right]_t + \theta_2 \left[\frac{\dot{P}}{P}\right]_t + r_t \qquad \text{(VII)}$$

while if fiscal parameters are introduced as well:

$$C_t = \theta_0 \left[\frac{\dot{e}}{e}\right]_t + \theta_1 \left[\frac{\dot{q}^*}{q^*}\right]_t + \theta_2 \left[\frac{\dot{P}}{P}\right]_t + \theta_3 A_t$$
$$+ \theta_4 \tau_t + \theta_5 r_t \qquad \text{(VIIa)}$$

Finally we ignore at this stage any complications arising in connection with the measure of the user cost S_t which is deflated by an index of nominal wages.

The underlying macroeconomics could be something as follows: Income is determined by output exhaustion (III). There exists the usual element of feedback since income influences investment (I), consumption (V) and net exports (IV), which expenditures in turn add up to give income. Income also affects money demand, hence the price level required (VI) to deflate the exogenous nominal money supply to equality with the former. In turn domestic prices determine competitiveness; hence affecting net exports (IV); as well as the current (given past prices) rate of inflation for capital goods; thus the user cost and investment (I).

Since it is the first differences of income and user cost which need be instrumented both in the investment equations descending from the Hall-Jorgenson model, and approximately so in those descending from the Coen and Blejer-Khan models, we put this system in differenced form: The level form of the system is used (apart from II but with Va and VIb) in the case of the Sundararajan-Thakur model. In these latter equations the contemporaneous value of real loans shows up as well, and could be viewed as endogenous. Under financial repression the real volume of loans is determined by the real supply of deposits (after allowing for the requirements of government expenditures) which depends on the real deposit rate and income, therefore not contributing any further exogenous variables to our system. Still the contribution from the identity defining LC is taken into account:

Table 5.1

For a Hall-Jorgenson type investment equation

The system in differenced form (H: first difference)

$$NI_t = \alpha_0 HY_t + \alpha_1 HY_{t-1} + \alpha_2 HY_{t-2} + \alpha_3 HY_{t-3} + \alpha_4 HC_t + \alpha_5 HC_{t-1} + \alpha_6 HC_{t-2} + \alpha_7 L_{t-2} \quad \text{(I)}$$

$$HI_t = CON + s.K_{t-1} + NI_t - I_{t-1} \quad \text{(II)}$$

$$HY_t = HCO_t + HI_t + HG_t + H(X-M)_t \quad \text{(III)}$$

$$H(X-M)_t = \beta_0 H(eP^*)_t + \beta_1 HP_t + \beta_2 HWT_t + \beta_3 HY_t \quad \text{(IV)}$$

$$HCO_t = \gamma_1 HY_t \quad \text{(V)}$$

$$HP_t = \delta_0 Hr_t^d + \delta_1 H\left[\frac{P_t}{P_{t-1}}\right] + \delta_2 HY_t + \delta_3 HM_t + CON \quad \text{(VI)}$$

$$HC_t = \theta_0 H\left[\frac{e_t}{e_{t-1}}\right] + \theta_1 H\left[\frac{q_t^*}{q_{t-1}^*}\right] + \theta_2 H\left[\frac{P_t}{P_{t-1}}\right] + Hr_t + \{\theta_3 HA_t + \theta_4 H\tau_t + \theta_5 Hr_t\}^{29} \quad \text{(VII)}$$

$$H\left[\frac{P_t}{P_{t-1}}\right] = \lambda_0 HP_t + \lambda_1 HP_{t-1} \quad \text{(VIII)}$$

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29. Bracket applicable in case of adjustment for fiscal parameters.

Table 5.2

For a Coen or Blejer-Khan type[30] investment equation

The system in differenced form (H: first difference)

$$I_t = \alpha_0 HY_t + \alpha_1 HY_{t-1} + \alpha_2 HY_{t-2} + \alpha_3 HC_{t-1} + \alpha_4 HC_{t-2} + \alpha_5 L_{t-2} + \alpha_6 I_{t-1} \quad \text{(I)}$$

$$HI_t = I_t - I_{t-1} \quad \text{(II)}$$

$$HY_t = HCO_t + HI_t + HG_t + H(X-M)_t \quad \text{(III)}$$

$$H(X-M)_t = \beta_0 H(eP^*)_t + \beta_1 HP_t + \beta_2 HWT_t + \beta_3 HY_t \quad \text{(IV)}$$

$$HCO_t = \gamma_1 HY_t + \gamma_2 HY_{t-1} + \gamma_3 HY_{t-2} + \gamma_4 H(RLQ)_{t-1} \quad \text{(Vb)}$$

$$HP_t = \delta_0 Hr^d_t + \delta_1 H\left[\frac{P_t}{P_{t-1}}\right] + \delta_2 H\left[\frac{e_t}{e_{t-1}}\right] + \delta_3 HM_t + \delta_4 HM_{t-1} + \delta_5 HP_{t-1} + CON \quad \text{(VIb)}$$

---

30. There is no equation determining the user cost since its contemporaneous value doesn't ever appear in the reported equations descending from these models.

$$LC_t = L_t - r_t \cdot \left[\frac{\text{Domestic Credit: Claims on private sector}}{q}\right]_{t-1}$$

We consider as exogenous all lags (including those found in the investment equation), constants and trends as well as the following contemporaneous variables as they appear in the differenced system: Output exhaustion gives differenced government expenditure in real terms,[31] the determination of net exports gives the differenced domestic price of foreign goods[32] (since the exchange rate is a policy instrument) and naturally the differenced measure of world trade[33]. The money market clearing equation gives the differenced administered rate on deposits[34] as well as the differenced nominal broad money supply[35] (the exogeneity of which may be contentious but is maintained e.g. by Alogoskoufis 1982, pp.296-297 n6 and Leventakis 1980, p.554 for a more unlikely narrow aggregate). A wealth effect and a ratchet effect in consumption and a partial adjustment in the money market give lagged differences of real net financial wealth[36] and real

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31. Cf. Bean (1981), standard textbook. For Coen and Blejer-Khan equations we distinguish government investment and government consumption in real terms (Nat. Acc.).

32. Dr/$ exchange rate <u>times</u> $ index of world import unit values (IFS). Additionally for Coen and Blejer/Khan equations, Dr/$ exchange rate <u>times</u> $ index of industrial countries import unit values (IFS).

33. $ value of industrial countries imports/$ index of industrial countries import unit values (IFS). For Coen and Blejer/Khan equations the following as well. $ value of non-oil developing countries exports/$ index of non oil developing countries export unit values, world real GDP and developing countries real GDP. (All from IFS).

34. In fact we use the Central Bank discount rate for which a complete series exists in IFS.

35. Money <u>plus</u> Quasi Money (IFS)

36. Coarsely measured by outstanding claims of commercial banks on government/GDP deflator.

consumption as exogenous variables. The equation for the user cost gives the differenced rate of exchange rate depreciation,[37] the differenced rate of inflation of foreign capital goods,[38] the differenced loan rate and in the case where fiscal parameters are incorporated, the differenced corporate tax rate and the differenced present value of tax savings consequent upon a unit value of investment.

Subsequently the contemporaneous value of the difference (or level whenever appropriate) of income (and user cost or credit availability if required) was regressed on <u>all</u> the exogenous variables selected above. Then the reported (overidentified) investment equation was run by the instrumental variables technique. Besides the predetermined variables, the respective fitted values from the aforementioned reduced form regression were employed as (indeed the optimal in the circumstances) instruments for the current difference (or level) of income and user cost or credit availability. The two stage least squares estimates of our equations are shown in Appendix M. The changes in the magnitudes of coefficients and in the standard error of estimate with this method compared to the ordinary least squares results were slight, never exceeding one tenth in proportionate terms. The coefficient on the contemporaneous value of income (or difference thereof) tended to rise. The coefficients on all the other variables (apart from the current level of the user cost and sometimes credit availability in the Sundararajan-Thakur type equations) were reduced or left unchanged.

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37. Annual average of Dr/$ exchange rate (IFS).

38. Crudely on the basis of the GDP deflator of industrial countries (IFS).

Section 5.7

Summary and Suggestions for Further Research

In Chapter 5 we present estimates of the investment function in Greece over the period 1958-1985. We adopted an econometric procedure inspired by the 'general to specific' methodology. Common elements include a) concern with residual autocorrelation and parameter stability b) the sequential data based specialization of a general equation by means of restrictions that are jointly tested. This procedure was applied to a number of investment models, using a variety of alternative measures for the dependent and independent variables and reporting the best equation in each case.

The broad conclusions from this exercise are as follows:
The availability of credit influences private investment expenditures positively and quite significantly with a (reasonable) lag, which is shortest for investment excluding dwellings. Occasionally, many lags of the credit variable were significant and bore alternating signs, as expected. The flow of new private loans in real terms does not translate to private investment one for one but there are leakages. The measure of credit availability subtracting interest payments on outstanding debt from new loans, does not perform well in the regressions. Overall our results confirm the importance given to credit in the financial repression literature but do not lend support (subject to reservations about the precision of our measure) to the particular approach of Currie and Anyadike-Danes (1980) and Chapter 2.

A surprising feature of the results is that the sign on the user cost invariably comes out to be positive (perverse). It could be that the user cost (close to the real deposit rate) proxies for the availability of loanable funds, only imperfectly captured by our measure of real loans. We have substantiated that a broad range of deposit aggregates all respond positively to the real deposit rate. Alternatively, the user cost may be proxying the effects of profits on investment, since, according to the financial repression literature, profits are positively related to the real deposit rate. Also, according to McKinnon, self financed investment ought to vary directly with the real deposit rate. Finally the disturbing sign on the user cost may be attributable to (remaining) simultaneity or to inadequacies in the representation of expectations on the determinants of investment by distributed lags of their actual values.

Other, more specific, observations are that the user cost variables possess significant joint explanatory power (reflecting primarily a negative reaction of investment to inflation) although accelerator equations are also satisfactory. Jorgenson's composite cannot explain our investment series. Adjustment of the user cost for fiscal parameters and/or deflation of the nominal user cost by the nominal wage rather than the GDP or the investment deflator, makes little difference to the fit or the diagnostic statistics of the investment regression. The reported equations including the lagged dependent variable (i.e. those descending from the Coen and the Blejer-Khan models) are the shortest and stablest while those descending from the Sundararajan-Thakur model show better fit and residual autocorrelation statistics than the former. The longest equations, exhibiting the most significant influence for the credit variables, are those descending from the Hall-Jorgenson model. Finally we ran each reported investment equation by two stage least squares after embedding it in a simple macroeconomic model to motivate the choice of instruments. The results were almost indistinguishable from those of ordinary least squares estimation.

An immediate extension of the empirical work in Chapter 5 would be to substitute forecast values for the (capital goods) inflation term in the user cost, generated by a separate (but ideally jointly estimated) econometric equation. (Cf. Sarantis 1984, pp.10-13 for Greek consumer prices.) This could reveal the cause for the perverse sign on the user cost in our regressions. It can be implemented without altering the structure of the investment equation. Note that recent work (e.g. Bean 1981) does not involve any additional sophistication in the representation of the role of expectations in the investment function.

There is a tradition for studies of investment to evolve around a comparison of alternative specifications (e.g. Bischoff 1971a; Clark 1979; Feldstein 1982; Jorgenson 1971). Although we provide a corresponding informal discussion, an interesting extension would be to carry out strict encompassing tests (cf. Bean 1981; Bernanke, Bohn and Reiss 1988; Wisley and Johnson 1985) of the numerous investment equations reported here, against each other.

A relationship alluded to in our argument is that between the real value of profits and the real interest rate. It ought to be tested. One of the measures of the real user cost that we make use of, divides the nominal user cost adjusted for the various fiscal parameters by an index for the nominal wage. For consistency the nominal wage must be adjusted for (employer) taxes as well.

APPENDIX L

OLS ESTIMATES OF THE INVESTMENT FUNCTION

IN GREECE 1958-1985

NOTES ON THE PRESENTATION OF RESULTS

I. Sample: Annual Data 1958-1985

II. t-statistics in parentheses

III. Significance: (i) For t-statistics significance at least at 10% is indicated by a single asterisk (*) while significance at least at 5% is shown by a double asterisk (**)

(ii) For all other statistics significance at least at 5% is indicated by a hyphen (-)

(iii) A question mark denotes an inconclusive D.W. statistic.

IV. Broad equations: (i) Underneath each reported equation we state the form (i.e. the lags included and their significance) of the broad equation which provided the starting point of the sequential specialisation procedure with end product the reported equation

(ii) We indicate also in case the broad equation manages to pass only the F version of the LM(1) test of residual autocorrelation and in case the reported equation fails any of a number of secondary diagnostic tests computed by DFIT [Functional form, normality or heteroscedasticity].

THE STATISTICS

D.W.	:	Durbin Watson statistic for residual autocorrelation
S	:	Standard error of estimate
$\bar{R}^2$	:	Adjusted coefficient of determination
Z_1	:	First order LM test of residual autocorrelation distributed as $\chi^2(1)$
Z_2	:	F version of the above with the indicated degrees of freedom
Z_3	:	Chow prediction test with 1980 as breakpoint distributed as F with the indicated degrees of freedom
Z_4	:	Hendry's predictive failure test with 1980 as breakpoint distributed as $\chi^2(5)$
Z_5	:	F test of the restrictions incorporated in the reported equation versus the unrestricted broad equation underneath with the indicated degrees of freedom.

THE SYMBOLS

A : Computed present discounted value of tax reductions consequent upon a drachma of investment

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C : Computed measure of the real user cost

(i) unadjusted for fiscal parameters

$$C = [r+s-\dot{q}/q]$$

(ii) adjusted for fiscal parameters

$$C = q.(1-A).[(1-\tau).r+s-\dot{q}/q]/P.(1-\tau)$$

---

c : Computed corresponding measure of the nominal user cost

I : Real gross private fixed capital formation (investment) [National Accounts of Greece]

J : Computed Jorgenson's composite, with or without adjustment for fiscal parameters

$$J = p.Y/c$$

K : Computed real net private capital stock

L : Computed real flow of new credit to the private sector

L = First difference of 'Domestic Credit: Claims on Private Sector' deflated by q.

LC : Computed real 'net flow of finance' to the private sector

$$LC = L-r.[\text{'Domestic Credit: Claims on Private Sector'}]_{-1}/q$$

NI : Computed real net private fixed capital formation (investment)

---

p : Computed implicit GDP deflator

---

q : Computed implicit deflator for gross private fixed capital formation (investment)

---

r : loan rate [IFS]

S : Computed nominal user cost divided by an index of nominal wages.

(i) unadjusted for fiscal parameters

$$S = q.[r+s-\dot{q}/q]/W$$

(ii) adjusted for fiscal parameters

$$S = q.(1-A).[(1-\tau).r+s-\dot{q}/q]/W.(1-\tau)$$

---

s : Computed rate of physical depreciation of private capital stock

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τ : Computed rate of corporate taxation

Y : Real gross domestic product [National Accounts of Greece]

W : Index of nominal wages [IFS]

<u>First differences</u>:

$HC_t = C_t - C_{t-1}$

$HJ_t = J_t - J_{t-1}$

$HS_t = S_t - S_{t-1}$

$HY_t = Y_t - Y_{t-1}$

Weighted differences

$DC_t = C_t - (1-s).C_{t-1}$

$DJ_t = J_t - (1-s).J_{t-1}$

$DL_t = L_t - (1-s).L_{t-1}$

$DLC_t = LC_t - (1-s).LC_{t-1}$

$DS_t = S_t - (1-s).S_{t-1}$

$DY_t = Y_t - (1-s).Y_{t-1}$

Nb. Quantities (I, NI, Y, L, LC, K) are measured in (American) Billions of 1970 Drachmas. Rates are defined per year.

EQUATIONS DESCENDING FROM THE HALL/JORGENSON MODEL

PURE ACCELERATOR VERSION

CREDIT MEASURE: L

EQUATION 1

$$NI_t = \underset{(4.81^{**})}{0.57HY_t} + \underset{(4.49^{**})}{0.55HY_{t-1}} + \underset{(3.63^{**})}{0.45HY_{t-2}} + \underset{(2.87^{**})}{0.36HY_{t-3}} + \underset{(7.58^{**})}{0.61L_{t-2}}$$

S = 5.13

$Z_1(1) = 2.60$ $Z_2(1,18) = 2.03$ D.W. = 1.32?

$Z_3(5,14) = 2.27$ $Z_4(5) = 18.03-$ $Z_5(4,15) = 1.96$

$$NI_t = /CON/\underset{**}{HY_t}/\underset{**}{HY_{t-1}}/\underset{**}{HY_{t-2}}/HY_{t-3}/L_t/L_{t-1}/\underset{**}{L_{t-2}}/L_{t-3}$$

(LM(1): F version only non-significant)

REAL USER COST NOT ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 2

$$NI_t = \underset{(7.92^{**})}{0.55HY_t} + \underset{(7.11^{**})}{0.65HY_{t-1}} + \underset{(4.74^{**})}{0.51HY_{t-2}} + \underset{(3.79^{**})}{0.37HY_{t-3}} + \underset{(2.91^{**})}{48.0HC_t}$$

$$+ \underset{(3.89^{**})}{62.0HC_{t-1}} + \underset{(5.22^{**})}{71.0HC_{t-2}} + \underset{(11.05^{**})}{0.54L_{t-2}}$$

S = 2.98

$Z_1(1) = 1.67$ $Z_2(1,15) = 1.09$ D.W. = 1.44?

$Z_3(5,11) = 0.54$ $Z_5(5,10) = 0.34$

$$NI_t = /CON/\underset{**}{HY_t}/\underset{**}{HY_{t-1}}/\underset{**}{HY_{t-2}}/\underset{**}{HY_{t-3}}/HC_t/\underset{**}{HC_{t-1}}/\underset{**}{HC_{t-2}}/HC_{t-3}/L_t$$

$$/L_{t-1}/\underset{**}{L_{t-2}}/L_{t-3}$$

REAL USER COST NOT ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: LC

EQUATION 3

$$NI_t = \underset{(3.14^{**})}{0.58HY_t} + \underset{(3.05^{**})}{0.58HY_{t-1}} + \underset{(3.25^{**})}{0.78HY_{t-2}} + \underset{(2.21^{**})}{0.58HY_{t-3}} + \underset{(2.52^{**})}{121.0HC_{t-1}}$$

$$+ \underset{(3.76^{**})}{129.0HC_{t-2}} + \underset{(2.04^{*})}{64.0HC_{t-3}} + \underset{(1.81^{*})}{0.55LC_{t-3}}$$

$S = 7.59$

$Z_1(1) = 3.48$ $Z_2(1,14) = 2.21$ D.W. = 1.10?

$Z_3(5,10) = 6.04-$ $Z_5(4,11) = 1.10$

$$NI_t = /\underset{**}{HY_t}/\underset{**}{HY_{t-1}}/\underset{*}{HY_{t-2}}/\underset{**}{HY_{t-3}}/HC_t/\underset{**}{HC_{t-1}}/\underset{**}{HC_{t-2}}/HC_{t-3}/LC_t/$$

$$LC_{t-1}/LC_{t-2}/LC_{t-3}$$

Nb. Problems with 'other'statistics

REAL USER COST ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 4

$$NI_t = \underset{(7.86^{**})}{0.52HY_t} + \underset{(7.97^{**})}{0.69HY_{t-1}} + \underset{(5.00^{**})}{0.49HY_{t-2}} + \underset{(4.21^{**})}{0.38HY_{t-3}} + \underset{(3.79^{**})}{47.0HC_t}$$

$$+ \underset{(4.52^{**})}{54.0HC_{t-1}} + \underset{(5.58^{**})}{60.0HC_{t-2}} + \underset{(12.46^{**})}{0.58L_{t-2}}$$

$S = 2.84$

$Z_1(1) = 1.44$ $Z_2(1,15) = 0.94$ D.W. = 1.49?

$Z_3(5,11) = 0.21$ $Z_5(5,10) = 0.25$

$$NI_t = /CON/\underset{**}{HY_t}/\underset{**}{HY_{t-1}}/\underset{**}{HY_{t-2}}/\underset{**}{HY_{t-3}}/HC_t/\underset{**}{HC_{t-1}}/\underset{**}{HC_{t-2}}/HC_{t-3}/$$

$$L_t/L_{t-1}/\underset{*}{L_{t-2}}/L_{t-3}$$

REAL USER COST ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: LC

EQUATION 5

$$NI_t = \underset{(3.60^{**})}{0.46HY_t} + \underset{(3.57^{**})}{0.44HY_{t-1}} + \underset{(5.72^{**})}{0.83HY_{t-2}} + \underset{(5.81^{**})}{0.84HY_{t-4}} + \underset{(6.05^{**})}{154.0HC_{t-1}}$$

$$+ \underset{(3.35^{**})}{74.0HC_{t-2}} + \underset{(5.98^{**})}{130.0HC_{t-3}} + \underset{(2.98^{**})}{60.0HC_{t-4}} + \underset{(3.93^{**})}{0.80LC_{t-3}}$$

$S = 4.60$

$Z_1(1) = 0.35$ $Z_2(1,12) = 0.20$ D.W. = 1.87?

$Z_3(5,8) = 1.34$ $Z_5(6,7) = 0.18$

$$NI_t = /CON/HY_t/HY_{t-1}/\underset{**}{HY_{t-2}}/HY_{t-3}/HY_{t-4}/HC_t/\underset{**}{HC_{t-1}}/\underset{*}{HC_{t-2}}/HC_{t-3}/$$

$$/HC_{t-4}/LC_t/LC_{t-1}/LC_{t-2}/\underset{*}{LC_{t-3}}$$

NOMINAL USER COST DIVIDED BY INDEX OF NOMINAL WAGES AND NOT ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 6

$$NI_t = \underset{(1.90*)}{5.60} + \underset{(4.26**)}{0.44HY_t} + \underset{(4.31**)}{0.45HY_{t-1}} + \underset{(4.45**)}{0.59HY_{t-2}} + \underset{(2.70**)}{0.35HY_{t-3}}$$

$$+ \underset{(2.42**)}{891.0HS_{t-1}} + \underset{(3.30**)}{917.0HS_{t-2}} + \underset{(5.23**)}{0.44L_{t-2}}$$

$S = 3.81 \quad \bar{R}^2 = 0.87$

$Z_1(1) = 0.79 \quad Z_2(1,13) = 0.49 \quad D.W. = 1.63?$

$Z_3(5,9) = 0.31 \quad Z_5(5,8) = 0.52$

$$NI_t = /CON/\underset{**}{HY_t}/\underset{**}{HY_{t-1}}/\underset{**}{HY_{t-2}}/\underset{**}{HY_{t-3}}/HS_t/HS_{t-1}/\underset{**}{HS_{t-2}}/HS_{t-3}/$$

$$/L_t/L_{t-1}/\underset{*}{L_{t-2}}/L_{t-3}$$

<u>NOMINAL USER COST DIVIDED BY INDEX OF NOMINAL WAGES AND ADJUSTED FOR FISCAL PARAMETERS</u>

<u>CREDIT MEASURE: L</u>

EQUATION 7

$$NI_t = \underset{(5.23^{**})}{0.48HY_t} + \underset{(5.54^{**})}{0.67HY_{t-1}} + \underset{(3.84^{**})}{0.54HY_{t-2}} + \underset{(3.54^{**})}{0.45HY_{t-3}} + \underset{(2.19^{**})}{714.0HS_t}$$

$$+ \underset{(3.17^{**})}{940.0HS_{t-1}} + \underset{(3.94^{**})}{994.0HS_{t-2}} + \underset{(8.69^{**})}{0.53L_{t-2}}$$

$S = 3.66$

$Z_1(1) = 0.58$ $Z_2(1,13) = 0.36$ D.W. = 1.65?

$Z_3(5,9) = 0.58$ $Z_5(5,8) = 0.49$

$$NI_t = /CON/\underset{**}{HY_t}/\underset{**}{HY_{t-1}}/\underset{**}{HY_{t-2}}/\underset{**}{HY_{t-3}}/HS_t/\underset{*}{HS_{t-1}}/\underset{**}{HS_{t-2}}/HS_{t-3}/L_t/L_{t-1}/$$

$$/\underset{*}{L_{t-2}}/L_{t-3}$$

(LM(1): F version only non-significant)

<u>NOMINAL USER COST DIVIDED BY INDEX OF NOMINAL WAGES AND ADJUSTED FOR FISCAL PARAMETERS</u>

<u>CREDIT MEASURE: LC</u>

EQUATION 8

$$NI_t = \underset{(11.69^{**})}{19.0} + \underset{(2.14^{*})}{0.18HY_t} + \underset{(4.39^{**})}{0.37HY_{t-1}} + \underset{(6.98^{**})}{0.73HY_{t-2}} + \underset{(7.04^{**})}{1804.0HS_{t-1}} +$$

$$+ \underset{(5.88^{**})}{1286.0HS_{t-2}} + \underset{(3.00^{**})}{512.0HS_{t-4}} + \underset{(3.10^{**})}{0.30LC_{t-2}} + \underset{(2.94^{**})}{0.34LC_{t-3}}$$

$S = 2.89$ $\quad \bar{R}^2 = 0.92$

$Z_1(1) = 0.83$ $\quad Z_2(1,10) = 0.44$ $\quad$ D.W. = 1.70?

$Z_3(5,6) = 2.86$ $\quad Z_5(6,5) = 0.98$

$$NI_t = /\underset{**}{CON}/HY_t/\underset{*}{HY_{t-1}}/\underset{**}{HY_{t-2}}/HY_{t-3}/HY_{t-4}/HS_t/\underset{**}{HS_{t-1}}/\underset{**}{HS_{t-2}}/HS_{t-3}/$$

$$/HS_{t-4}/LC_t/LC_{t-1}/LC_{t-2}/\underset{*}{LC_{t-3}}$$

JORGENSON COMPOSITE NOT ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: LC

EQUATION 9

$$NI_t = \underset{(1.78*)}{0.57E^{-3}HJ_{t-1}} + \underset{(3.42**)}{1.31E^{-3}HJ_{t-2}} + \underset{(1.97*)}{0.71E^{-3}HJ_{t-3}} + \underset{(2.86**)}{1.72LC_{t-2}}$$

$$+ \underset{(3.45**)}{2.12LC_{t-3}}$$

S = 18.64

$Z_1(1) = 1.76$ $Z_2(1,17) = 1.36$ D.W. = 1.12?

$Z_3(5,13) = 2.03$ $Z_4(5) = 17.83-$ $Z_5(3,15) = 2.05$

$$NI_t = /\underset{*}{HJ_t}/\underset{**}{HJ_{t-1}}/\underset{**}{HJ_{t-2}}/HJ_{t-3}/LC_t/LC_{t-1}/LC_{t-2}/\underset{**}{LC_{t-3}}/$$

Nb. Problems with 'other' statistics.

EQUATIONS DESCENDING FROM THE COEN MODEL

PURE ACCELERATOR VERSION

CREDIT MEASURE: L

EQUATION 10

$$I_t = \underset{(6.94^{**})}{0.59DY_t} + \underset{(2.40^{**})}{0.28DL_{t-2}} + \underset{(22.04^{**})}{0.78I_{t-1}}$$

$S = 3.91$

$Z_1(1) = 0.85$ $Z_2(1,20) = 0.74$ $h = -0.77$

$Z_3(5,16) = 0.77$ $Z_4(5) = 3.94$ $Z_5(7,13) = 0.54$

$$I_t = /CON/\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DY_{t-3}/DL_t/DL_{t-1}/DL_{t-2}/DL_{t-3}/\underset{**}{I_{t-1}}$$

REAL USER COST NOT ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 11

$$I_t = \underset{(7.12^{**})}{0.58DY_t} + \underset{(1.76^{*})}{26.0DC_{t-1}} + \underset{(1.98^{*})}{0.23DL_{t-2}} + \underset{(23.17^{**})}{0.79I_{t-1}}$$

$S = 3.73$

$Z_1(1) = 2.30 \quad Z_2(1,19) = 1.9 \quad h = -1.43$

$Z_3(5,15) = 0.55 \quad Z_4(5) = 3.25 \quad Z_5(9,10) = 0.80$

$I_t = /\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DY_{t-3}/DC_t/DC_{t-1}/DC_{t-2}/DC_{t-3}/DL_t/$

$/DL_{t-1}/DL_{t-2}/DL_{t-3}/\underset{**}{I_{t-1}}$

REAL USER COST NOT ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: LC

EQUATION 12

$$I_t = \underset{(6.97^{**})}{0.57DY_t} + \underset{(1.85^{*})}{27.0DC_{t-1}} + \underset{(1.91^{*})}{0.20DLC_{t-2}} + \underset{(23.76^{**})}{0.80I_{t-1}}$$

$S = 3.75$

$Z_1(1) = 2.53$ $Z_2(1,19) = 2.09$ $h = -1.47$

$Z_3(5,15) = 0.54$ $Z_4(5) = 3.03$ $Z_5(9,10) = 0.86$

$$I_t = /\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DY_{t-3}/DC_t/DC_{t-1}/DC_{t-2}/DC_{t-3}/DLC_t/$$

$$/DLC_{t-1}/DLC_{t-2}/DLC_{t-3}/\underset{**}{I_{t-1}}$$

REAL USER COST ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 13

$$I_t = \underset{(7.05^{**})}{0.58DY_t} + \underset{(1.73^{*})}{21.0DC_{t-1}} + \underset{(1.81^{*})}{0.21DL_{t-2}} + \underset{(23.02^{**})}{0.79I_{t-1}}$$

$S = 3.74$

$Z_1(1) = 1.99$ $Z_2(1,19) = 1.64$ $h = -1.32$

$Z_3(5,15) = 0.48$ $Z_4(5) = 2.82$ $Z_5(9,10) = 0.74$

$I_t = /\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DY_{t-3}/DC_t/DC_{t-1}/DC_{t-2}/DC_{t-3}/DL_t/$

$/DL_{t-1}/DL_{t-2}/DL_{t-3}/\underset{**}{I_{t-1}}$

NOMINAL USER COST DIVIDED BY INDEX OF NOMINAL WAGES AND NOT ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 14

$$I_t = \underset{(7.10^{**})}{0.58DY_t} + \underset{(1.80^{*})}{406.0DS_{t-1}} + \underset{(2.14^{*})}{0.24DL_{t-2}} + \underset{(22.99^{**})}{0.79I_{t-1}}$$

$S = 3.73$

$Z_1(1) = 1.88 \quad Z_2(1,18) = 1.54 \quad h = -1.33$

$Z_3(5,14) = 0.60 \quad Z_4(5) = 3.14 \quad Z_5(10,7) = 0.52$

$$I_t = /CON/\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DY_{t-3}/DS_t/DS_{t-1}/DS_{t-2}/DS_{t-3}/DL_t/DL_{t-1}/$$

$$/DL_{t-2}/DL_{t-3}/\underset{**}{I_{t-1}}$$

(LM(1): F version only non-significant)

NOMINAL USER COST DIVIDED BY INDEX OF NOMINAL WAGES AND NOT ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: LC

EQUATION 15

$$I_t = \underset{(6.95^{**})}{0.57DY_t} + \underset{(1.89^{*})}{426.0DS_{t-1}} + \underset{(2.09^{*})}{0.22DLC_{t-2}} + \underset{(23.85^{**})}{0.80I_{t-1}}$$

$S = 3.75$

$Z_1(1) = 2.10$ $Z_2(1,18) = 1.72$ $h = -1.39$

$Z_3(5,14) = 0.61$ $Z_4(5) = 3.16$ $Z_5(10,7) = 0.52$

$$I_t = /CON/\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DY_{t-3}/DS_t/DS_{t-1}/DS_{t-2}/DS_{t-3}/DLC_t/$$

$$/DLC_{t-1}/DLC_{t-2}/DLC_{t-3}/\underset{**}{I_{t-1}}$$

(LM(1): F version only non-significant)

NOMINAL USER COST DIVIDED BY INDEX OF NOMINAL WAGES AND ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 16

$$I_t = \underset{(7.07^{**})}{0.58DY_t} + \underset{(1.85^{*})}{354.0DS_{t-1}} + \underset{(2.00^{*})}{0.23DL_{t-2}} + \underset{(23.02^{**})}{0.79I_{t-1}}$$

$S = 3.72$

$Z_1(1) = 1.77$ $Z_2(1,18) = 1.45$ $h = -1.30$

$Z_3(5,14) = 0.57$ $Z_4(5) = 3.03$ $Z_5(8,10) = 0.84$

$$I_t = /CON/\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DS_t/\underset{*}{DS_{t-1}}/DS_{t-2}/DL_t/DL_{t-1}/DL_{t-2}/$$

$$/DL_{t-3}/\underset{**}{I_{t-1}}$$

(LM(1): F version only non-significant)

NOMINAL USER COST DIVIDED BY INDEX OF NOMINAL WAGES AND ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: LC

EQUATION 17

$$I_t = \underset{(6.93^{**})}{0.56DY_t} + \underset{(1.94^{*})}{371.0DS_{t-1}} + \underset{(1.95^{*})}{0.20DLC_{t-2}} + \underset{(23.66^{**})}{0.80I_{t-1}}$$

$S = 3.74$

$Z_1(1) = 1.98$ $Z_2(1,18) = 1.62$ $h = -1.35$

$Z_3(5,14) = 0.58$ $Z_4(5) = 3.06$ $Z_5(10,7) = 0.55$

$$I_t = /CON/\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DY_{t-3}/DS_t/DS_{t-1}/DS_{t-2}/DS_{t-3}/$$

$$/DLC_t/DLC_{t-1}/DLC_{t-2}/DLC_{t-3}/\underset{**}{I_{t-1}}$$

(LM(1): F version only non-significant)

EQUATIONS DESCENDING FROM THE BLEJER/KHAN MODEL

PURE ACCELERATOR VERSION

CREDIT MEASURE: L

EQUATION 18

$$I_t = \underset{(5.99^{**})}{0.51DY_t} + \underset{(2.11^{**})}{0.23DY_{t-1}} + \underset{(2.41^{**})}{0.29L_{t-1}} + \underset{(8.06^{**})}{0.61I_{t-1}}$$

$S = 3.86$

$Z_1(1) = 0.95$ $Z_2(1,21) = 0.80$ $h = -0.87$

$Z_3(5,17) = 0.96$ $Z_4(5) = 5.76$ $Z_5(7,12) = 0.61$

$$I_t = /CON/\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DY_{t-3}/DY_{t-4}/L_t/L_{t-1}/L_{t-2}/L_{t-3}/$$

$$/\underset{**}{I_{t-1}}/$$

PURE ACCELERATOR VERSION

CREDIT MEASURE: LC

EQUATION 19

$$I_t = \underset{(5.56^{**})}{0.50DY_t} + \underset{(1.90^{*})}{0.20LC_{t-1}} + \underset{(22.09^{**})}{0.80I_{t-1}}$$

$S = 4.09$

$Z_1(1) = 2.19$ $Z_2(1,22) = 1.92$ $h = -1.47$

$Z_2(5,18) = 0.68$ $Z_4(5) = 4.80$ $Z_5(7,14) = 0.68$

$$I_t = /CON/\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DY_{t-3}/LC_t/LC_{t-1}/LC_{t-2}/LC_{t-3}/\underset{**}{I_{t-1}}$$

REAL USER COST NOT ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 20

$$I_t = \underset{(7.37^{**})}{0.52DY_t} + \underset{(2.28^{**})}{0.21DY_{t-1}} + \underset{(2.93^{**})}{0.36DY_{t-2}} + \underset{(4.30^{**})}{65.0DC_{t-1}} + \underset{(2.83^{**})}{36.0DC_{t-2}}$$

$$+ \underset{(2.10^{*})}{0.24L_{t-2}} + \underset{(5.22^{**})}{0.51I_{t-1}}$$

$S = 3.08$

$Z_1(1) = 2.91$ $Z_2(1,16) = 2.03$ $h = -1.86-$

$Z_3(5,12) = 0.25$ $Z_4(5) = 2.35$ $Z_5(6,10) = 0.47$

$$I_t = /\underset{**}{DY_t}/\underset{**}{DY_{t-1}}/DY_{t-2}/DY_{t-3}/DC_t/\underset{**}{DC_{t-1}}/\underset{*}{DC_{t-2}}/DC_{t-3}/L_t/L_{t-1}/L_{t-2}$$

$$/L_{t-3}/I_{t-1}$$

REAL USER COST NOT ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: LC

EQUATION 21

$$I_t = \underset{(6.80^{**})}{0.53DY_t} + \underset{(2.89^{**})}{40.0DC_{t-1}} + \underset{(2.05^{**})}{28.0DC_{t-2}} + \underset{(1.87^{*})}{0.17LC_{t-1}}$$

$$+ \underset{(25.30^{**})}{0.79I_{t-1}}$$

$S = 3.47$

$Z_1(1) = 3.48$ $Z_2(1,18) = 2.72$ $h = -1.85-$

$Z_3(5,14) = 0.42$ $Z_4(5) = 3.81$ $Z_5(6,13) = 0.89$

$$I_t = /\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DC_t/\underset{**}{DC_{t-1}}/\underset{**}{DC_{t-2}}/LC_t/LC_{t-1}/LC_{t-2}/LC_{t-3}/$$

$$/\underset{**}{I_{t-1}}/$$

REAL USER COST ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 22

$$I_t = \underset{(7.27**)}{0.52DY_t} + \underset{(1.95*)}{0.18DY_{t-1}} + \underset{(2.72**)}{0.33DY_{t-2}} + \underset{(4.28**)}{51.0DC_{t-1}} + \underset{(2.74**)}{29.0DC_{t-2}}$$

$$+ \underset{(1.86*)}{0.22L_{t-2}} + \underset{(5.71**)}{0.55I_{t-1}}$$

$S = 3.11$

$Z_1(1) = 2.25 \quad Z_2(1,16) = 1.56 \quad h = -1.63$

$Z_3(5,12) = 0.19 \quad Z_4(5) = 2.16 \quad Z_5(4,13) = 0.55$

$$I_t = /\underset{**}{DY_t}/\underset{**}{DY_{t-1}}/\underset{*}{DY_{t-2}}/DC_t/\underset{**}{DC_{t-1}}/\underset{**}{DC_{t-2}}/L_t/L_{t-1}/L_{t-2}/L_{t-3}/$$

$$/\underset{**}{I_{t-1}}/$$

REAL USER COST ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: LC

EQUATION 23

$$I_t = \underset{(5.59^{**})}{0.48DY_t} + \underset{(1.88^{*})}{22.0DC_{t-1}} + \underset{(1.83^{*})}{0.19LC_{t-1}} + \underset{(22.95^{**})}{0.81I_{t-1}}$$

$S = 3.94$

$Z_1(1) = 3.28$ $Z_2(1,20) = 2.73$ $h = -1.36$

$Z_3(5,16) = 0.19$ $Z_4(5) = 2.01$ $Z_5(9,10) = 1.15$

$$I_t = /\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DY_{t-3}/DC_t/DC_{t-1}/DC_{t-2}/DC_{t-3}/LC_t/$$

$$/LC_{t-1}/LC_{t-2}/LC_{t-3}/\underset{**}{I_{t-1}}$$

(LM(1): F version only non-significant)

NOMINAL USER COST DIVIDED BY INDEX OF NOMINAL WAGES AND NOT ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: LC

EQUATION 24

$$I_t = \underset{(6.02^{**})}{0.52DY_t} + \underset{(2.08^{*})}{471.0DS_{t-1}} + \underset{(1.94^{*})}{0.19LC_{t-1}} + \underset{(23.08^{**})}{0.79I_{t-1}}$$

$S = 3.80$

$Z_1(1) = 2.67$ $Z_2(1,18) = 2.19$ $h = -1.65$~

$Z_3(5,14) = 0.49$ $Z_4(5) = 4.43$ $Z_5(10,7) = 0.58$

$$I_t = /CON/\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DY_{t-3}/DS_t/DS_{t-1}/DS_{t-2}/DS_{t-3}/LC_t/LC_{t-1}/$$

$$/LC_{t-2}/LC_{t-3}/\underset{**}{I_{t-1}}$$

(LM(1): F version only non-significant)

<u>NOMINAL USER COST DIVIDED BY INDEX OF NOMINAL WAGES AND ADJUSTED FOR FISCAL PARAMETERS</u>

<u>CREDIT MEASURE: LC</u>

EQUATION 25

$$I_t = \underset{(6.08^{**})}{0.51DY_t} + \underset{(2.22^{*})}{420.0DS_{t-1}} + \underset{(1.91^{*})}{0.18LC_{t-1}} + \underset{(23.39^{**})}{0.80I_{t-1}}$$

S = 3.75

$Z_1(1) = 2.74$ $Z_2(1,18) = 2.25$ $h = -1.67$ -

$Z_3(5,14) = 0.44$ $Z_4(5) = 4.27$ $Z_5(10,7) = 0.58$

$$I_t = /CON/\underset{**}{DY_t}/DY_{t-1}/DY_{t-2}/DY_{t-3}/DS_t/DS_{t-1}/DS_{t-2}/DS_{t-3}/LC_t/$$

$$/LC_{t-1}/LC_{t-2}/LC_{t-3}/\underset{**}{I_{t-1}}$$

(LM(1): F version only non-significant)

EQUATIONS DESCENDING FROM THE SUNDARARAJAN/THAKUR MODEL

REAL USER COST NOT ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 26

$$I_t = \underset{(-10.29^{**})}{-87.0} + \underset{(7.15^{**})}{0.48Y_t} + \underset{(3.06^{**})}{0.28Y_{t-1}} + \underset{(2.75^{**})}{44.0C_t} + \underset{(3.35^{**})}{45.0C_{t-1}}$$

$$+ \underset{(2.31^{**})}{28.0C_{t-2}} + \underset{(2.50^{**})}{0.28L_{t-2}} - \underset{(-12.48^{**})}{0.23K_{t-1}}$$

$S = 2.62 \quad \bar{R}^2 = 0.97$

$Z_1(1) = 0.53 \quad Z_2(1,16) = 0.35 \quad D.W. = 1.73?$

$Z_3(5,12) = 0.62 \quad Z_5(4,12) = 0.45$

$$I_t = /\underset{**}{CON}/\underset{**}{Y_t}/\underset{*}{Y_{t-1}}/Y_{t-2}/C_t/\underset{*}{C_{t-1}}/C_{t-2}/L_t/L_{t-1}/L_{t-2}/L_{t-3}/$$

$$/\underset{**}{K_{t-1}}$$

REAL USER COST NOT ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: LC

EQUATION 27

$$I_t = \underset{(-10.27^{**})}{-90.0} + \underset{(7.75^{**})}{0.50Y_t} + \underset{(3.35^{**})}{0.29Y_{t-1}} + \underset{(3.04^{**})}{45.0C_t} + \underset{(3.70^{**})}{45.0C_{t-1}}$$

$$\underset{(2.11^{*})}{24.0C_{t-2}} - \underset{(-1.90^{*})}{0.17LC_t} + \underset{(2.39^{**})}{0.24LC_{t-2}} - \underset{(-10.36^{**})}{0.23K_{t-1}}$$

$S = 2.42$ $\bar{R}^2 = 0.98$

$Z_1(1) = 0.01$ $Z_2(1,15) = 0.06$ D.W. = 2.11?

$Z_3(5,11) = 0.49$ $Z_5(3,12) = 0.12$

$$I_t = /\overset{}{\underset{**}{CON}}/\underset{**}{Y_t}/\underset{*}{Y_{t-1}}/Y_{t-2}/C_t/\underset{**}{C_{t-1}}/\underset{*}{C_{t-2}}/LC_t/LC_{t-1}/LC_{t-2}/$$

$$/LC_{t-3}/\underset{**}{K_{t-1}}$$

Nb. Problems with 'other' statistics.

REAL USER COST ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 28

$$I_t = \underset{(-6.14^{**})}{-74.0} + \underset{(4.72^{**})}{0.45Y_t} + \underset{(1.91^{*})}{0.27Y_{t-1}} + \underset{(2.48^{**})}{52.0C_t} - \underset{(-1.87^{*})}{0.30L_t}$$

$$+ \underset{(2.05^{*})}{0.34L_{t-2}} - \underset{(-7.64^{**})}{0.21K_{t-1}}$$

$S = 3.69$ $\quad \bar{R}^2 = 0.95$

$Z_1(1) = 0.54$ $\quad Z_2(1,17) = 0.38$ $\quad$ D.W. = 1.73?

$Z_3(5,13) = 1.68$ $\quad Z_5(7,10) = 1.71$

$I_t = /\underset{**}{CON}/\underset{**}{Y_t}/Y_{t-1}/Y_{t-2}/Y_{t-3}/C_t/C_{t-1}/C_{t-2}/C_{t-3}/L_t/L_{t-1}/$

$/L_{t-2}/L_{t-3}/\underset{**}{K_{t-1}}$

NOMINAL USER COST DIVIDED BY INDEX OF NOMINAL WAGES AND NOT ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 29

$$I_t = \underset{(-9.04^{**})}{-105.0} + \underset{(7.47^{**})}{0.53Y_t} + \underset{(3.26^{**})}{0.30Y_{t-1}} + \underset{(3.13^{**})}{893.0S_t} + \underset{(3.71^{**})}{765.0S_{t-1}}$$

$$+ \underset{(3.19^{**})}{653.0S_{t-2}} + \underset{(2.72^{**})}{0.28L_{t-2}} - \underset{(-11.90^{**})}{0.24K_{t-1}}$$

$S = 2.51 \quad \bar{R}^2 = 0.97$

$Z_1(1) = 0.42 \quad Z_2(1,14) = 0.27 \quad D.W. = 2.09?$

$Z_3(5,10) = 0.21 \quad Z_5(4,11) = 0.52$

$$I_t = /\underset{**}{CON}/\underset{**}{Y_t}/Y_{t-1}/Y_{t-2}/\underset{*}{S_t}/\underset{**}{S_{t-1}}/\underset{**}{S_{t-2}}/L_t/L_{t-1}/L_{t-2}/L_{t-3}/$$

$$/\underset{*}{K_{t-1}}$$

<u>NOMINAL USER COST DIVIDED BY INDEX OF NOMINAL WAGES AND NOT ADJUSTED FOR FISCAL PARAMETERS</u>

<u>CREDIT MEASURE: LC</u>

EQUATION 30

$$I_t = \underset{(-8.71^{**})}{-100.0} + \underset{(7.34^{**})}{0.51Y_t} + \underset{(2.99^{**})}{0.28Y_{t-1}} + \underset{(3.13^{**})}{876.0S_t} + \underset{(3.91^{**})}{800.0S_{t-1}}$$

$$+ \underset{(3.37^{**})}{687.0S_{t-2}} + \underset{(2.78^{**})}{0.27LC_{t-2}} - \underset{(-10.36^{**})}{0.22K_{t-1}}$$

$S = 2.49 \quad \bar{R}^2 = 0.97$

$Z_1(1) = 0.47 \quad Z_2(1,14) = 0.30 \quad$ D.W. = 2.13?

$Z_3(5,10) = 0.21 \quad Z_5(4,11) = 0.53$

$$I_t = /\underset{**}{CON}/\underset{**}{Y_t}/Y_{t-1}/Y_{t-2}/S_t/\underset{**}{S_{t-1}}/\underset{**}{S_{t-2}}/LC_t/LC_{t-1}/LC_{t-2}/LC_{t-3}/$$

$$/\underset{**}{K_{t-1}}$$

NOMINAL USER COST DIVIDED BY INDEX OF NOMINAL WAGES AND ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 31

$$I_t = -95.0 + 0.46Y_t + 0.35Y_{t-1} + 865.0S_t + 676.0S_{t-1}$$
(-8.69**) (6.26**) (3.39**) (3.10**) (3.67**)

$$+ 517.0S_{t-2} + 0.28L_{t-2} - 0.23K_{t-1}$$
(2.83**) (2.57**) (-11.34**)

$S = 2.64$ $\bar{R}^2 = 0.97$

$Z_1(1) = 0.94$ $Z_2(1,14) = 0.60$ D.W. = 2.05?

$Z_3(5,10) = 0.36$ $Z_5(6,8) = 1.14$

I_t = /CON/Y_t/Y_{t-1}/Y_{t-2}/Y_{t-3}/S_t/S_{t-1}/S_{t-2}/S_{t-3}/L_t/L_{t-1}
CON **, Y_t **, Y_{t-1} **, S_t *, S_{t-1} **

/L_{t-2}/L_{t-3}/K_{t-1}
K_{t-1} **

NOMINAL USER COST DIVIDED BY INDEX OF NOMINAL WAGES AND ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: LC

EQUATION 32

$$I_t = \underset{(-8.29**)}{-91.0} + \underset{(6.06**)}{0.44Y_t} + \underset{(3.16**)}{0.32Y_{t-1}} + \underset{(3.10**)}{853.0S_t} + \underset{(3.87**)}{708.0S_{t-1}}$$

$$\underset{(2.99**)}{546.0S_{t-2}} + \underset{(2.61**)}{0.27LC_{t-2}} - \underset{(-9.76**)}{0.21K_{t-1}}$$

$S = 2.62 \quad \bar{R}^2 = 0.97$

$Z_1(1) = 0.97 \quad Z_2(1,14) = 0.62 \quad D.W. = 2.09?$

$Z_3(5,10) = 0.35 \quad Z_5(6,8) = 1.13$

$$I_t = /\underset{**}{CON}/\underset{**}{Y_t}/\underset{*}{Y_{t-1}}/Y_{t-2}/Y_{t-3}/S_t/\underset{**}{S_{t-1}}/S_{t-2}/S_{t-3}/LC_t/LC_{t-1}/$$

$$/LC_{t-2}/LC_{t-3}/\underset{**}{K_{t-1}}$$

(LM(1): F version only non-significant)

EQUATIONS DESCENDING FROM THE HALL/JORGENSON MODEL

DEPENDENT VARIABLE EXCLUDES RESIDENTIAL CONSTRUCTION

PURE ACCELERATOR VERSION

CREDIT MEASURE: L

EQUATION 33

$$NI_t = \underset{(2.25^{**})}{3.54} + \underset{(2.25^{**})}{0.13HY_t} + \underset{(5.41^{**})}{0.31HY_{t-1}} + \underset{(3.60^{**})}{0.20HY_{t-2}} + \underset{(2.73^{**})}{0.16HY_{t-3}}$$

$$+ \underset{(1.82^{*})}{0.12HY_{t-4}} + \underset{(5.80^{**})}{0.28L_{t-1}}$$

$S = 2.19 \quad \bar{R}^2 = 0.87$

$Z_1(1) = 1.13 \quad Z_2(1,15) = 0.77 \quad D.W. = 1.55?$

$Z_3(5,11) = 1.27 \quad Z_4(5) = 8.0 \quad Z_5(3,13) = 2.1$

$$NI_t = /CON/\underset{**}{HY_t}/\underset{**}{HY_{t-1}}/\underset{**}{HY_{t-2}}/\underset{**}{HY_{t-3}}/\underset{*}{HY_{t-4}}/L_t/$$

$$/L_{t-1}/\underset{*}{L_{t-2}}/L_{t-3}$$

(LM(1): F version only non-significant)

DEPENDENT VARIABLE EXCLUDES RESIDENTIAL CONSTRUCTION

REAL USER COST ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 34

$$NI_t = \underset{(5.04^{**})}{0.22HY_t} + \underset{(5.01^{**})}{0.25HY_{t-1}} + \underset{(5.23^{**})}{0.28HY_{t-2}} + \underset{(2.73^{**})}{0.16HY_{t-3}} +$$

$$+ \underset{(3.63^{**})}{0.26HY_{t-4}} + \underset{(4.46^{**})}{43.0HC_{t-1}} + \underset{(3.52^{**})}{36.0HC_{t-2}} + \underset{(2.24^{**})}{29.0HC_{t-3}}$$

$$+ \underset{(2.77^{**})}{0.17L_t} + \underset{(3.44^{**})}{0.16L_{t-3}}$$

$S = 1.80$

$Z_1(1) = 1.29$ $Z_2(1,12) = 0.70$ D.W. = 1.56?

$Z_3(5,8) = 0.80$ $Z_5(5,7) = 0.91$

$$NI_t = /CON/\underset{**}{HY_t}/\underset{**}{HY_{t-1}}/\underset{**}{HY_{t-2}}/\underset{**}{HY_{t-3}}/HY_{t-4}/HC_t/HC_{t-1}/\underset{**}{HC_{t-2}}/$$

$$/HC_{t-3}/HC_{t-4}/L_t/L_{t-1}/L_{t-2}/L_{t-3}$$

DEPENDENT VARIABLE EXCLUDES RESIDENTIAL CONSTRUCTION

NOMINAL USER COST DIVIDED BY INDEX OF NOMINAL WAGES AND ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 35

$$NI_t = \underset{(2.86^{**})}{0.18HY_t} + \underset{(5.80^{**})}{0.38HY_{t-1}} + \underset{(2.84^{**})}{0.20HY_{t-2}} + \underset{(3.60^{**})}{0.28HY_{t-3}}$$

$$+ \underset{(2.03^{*})}{374.0HS_{t-2}} + \underset{(9.24^{**})}{0.38L_{t-1}}$$

$S = 2.51$

$Z_1(1) = 0.61$ $Z_2(1,15) = 0.44$ D.W. = 1.64?

$Z_3(5,11) = 0.91$ $Z_4(5) = 6.64$ $Z_5(8,6) = 1.54$

$$NI_t = /\underset{**}{HY_t}/\underset{*}{HY_{t-1}}/\underset{**}{HY_{t-2}}/HY_{t-3}/HY_{t-4}/HS_t/HS_{t-1}/HS_{t-2}/$$

$$HS_{t-3}/HS_{t-4}/L_t/L_{t-1}/L_{t-2}/L_{t-3}$$

EQUATIONS DESCENDING FROM THE BLEJER/KHAN MODEL

DEPENDENT VARIABLE EXCLUDES RESIDENTIAL CONSTRUCTION

PURE ACCELERATOR VERSION

CREDIT MEASURE: L

EQUATION 36

$$I_t = \underset{(4.44^{**})}{0.16DY_t} + \underset{(4.87^{**})}{0.22DY_{t-1}} + \underset{(2.42^{**})}{0.14L_{t-1}} + \underset{(11.21^{**})}{0.66I_{t-1}}$$

$S = 1.68$

$Z_1(1) = 0.26$ $Z_2(1,21) = 0.22$ $h = -0.41$

$Z_3(5,17) = 1.20$ $Z_4(5) = 7.66$ $Z_5(6,14) = 0.7$

$$I_t = /CON/\underset{**}{DY_t}/\underset{**}{DY_{t-1}}/DY_{t-2}/DY_{t-3}/L_t/L_{t-1}/L_{t-2}/$$

$$/L_{t-3}/\underset{**}{I_{t-1}}$$

DEPENDENT VARIABLE EXCLUDES RESIDENTIAL CONSTRUCTION

REAL USER COST ADJUSTED FOR FISCAL PARAMETERS

CREDIT MEASURE: L

EQUATION 37

$$I_t = \underset{(4.64^{**})}{0.17DY_t} + \underset{(4.51^{**})}{0.19DY_{t-1}} + \underset{(1.86^{*})}{15.0DC_t} + \underset{(3.28^{**})}{26.0DC_{t-1}}$$

$$+\underset{(2.48^{**})}{17.0DC_{t-2}} + \underset{(1.95^{*})}{0.10L_t} + \underset{(14.26^{**})}{0.71I_{t-1}}$$

$S = 1.47$

$Z_1(1) = 2.55$ $Z_2(1,16) = 1.77$ $h = -0.35$

$Z_3(5,12) = 0.49$ $Z_4(5) = 6.79$ $Z_5(7,9) = 0.33$

$$I_t = /CON/\underset{**}{DY_t}/\underset{**}{DY_{t-1}}/DY_{t-2}/DY_{t-3}/DC_t/DC_{t-1}/DC_{t-2}/$$

$$/DC_{t-3}/L_t/L_{t-1}/L_{t-2}/L_{t-3}/\underset{**}{I_{t-1}}$$

(LM(1): F version only non-significant)

APPENDIX M

INSTRUMENTAL VARIABLES (2SLS) ESTIMATES OF THE INVESTMENT FUNCTION IN GREECE 1958-1985

The equations are numbered so as to correspond to the reported OLSQ estimates.

Nb $Z_6(1)$ is an LM test of first order residual autocorrelation under instrumental variables estimation, distributed as $\chi^2(1)$.

EQUATION 1

$$NI_t = \underset{(4.61^{**})}{0.62HY_t} + \underset{(4.23^{**})}{0.53HY_{t-1}} + \underset{(3.51^{**})}{0.44HY_{t-2}} + \underset{(2.76^{**})}{0.35HY_{t-3}}$$

$$+ \underset{(7.47^{**})}{0.60L_{t-2}}$$

$S = 5.16$

$Z_6(1) = 3.18$

EQUATION 2

$$NI_t = \underset{(7.73^{**})}{0.57HY_t} + \underset{(6.72^{**})}{0.64HY_{t-1}} + \underset{(4.66^{**})}{0.51HY_{t-2}} + \underset{(3.75^{**})}{0.37HY_{t-3}}$$

$$+ \underset{(2.64^{**})}{47.0HC_t} + \underset{(3.86^{**})}{62.0HC_{t-1}} + \underset{(5.16^{**})}{70.0HC_{t-2}} + \underset{(11.0^{**})}{0.54L_{t-2}}$$

$S = 2.99$

$Z_6(1) = 1.65$

EQUATION 3

$$NI_t = \underset{(3.14^{**})}{0.64HY_t} + \underset{(2.85^{**})}{0.55HY_{t-1}} + \underset{(3.15^{**})}{0.76HY_{t-2}} + \underset{(2.18^{**})}{0.58HY_{t-3}}$$

$$+ \underset{(2.46^{**})}{119.0HC_{t-1}} + \underset{(3.73^{**})}{129.0HC_{t-2}} + \underset{(2.05^{**})}{69.0HC_{t-3}} + \underset{(1.70)}{0.52LC_{t-3}}$$

$S = 7.62$

$Z_6(1) = 4.25$ -

EQUATION 4

$$NI_t = \underset{(7.82^{**})}{0.53HY_t} + \underset{(7.80^{**})}{0.68HY_{t-1}} + \underset{(5.0^{**})}{0.50HY_{t-2}} + \underset{(4.18^{**})}{0.38HY_{t-3}}$$

$$+ \underset{(3.65^{**})}{46.0HC_t} + \underset{(4.50^{**})}{54.0HC_{t-1}} + \underset{(5.54^{**})}{59.0HC_{t-2}} + \underset{(12.41^{**})}{0.58L_{t-2}}$$

S = 2.84

$Z_6(1) = 1.55$

EQUATION 5

$$NI_t = \underset{(3.52^{**})}{0.52HY_t} + \underset{(3.24^{**})}{0.42HY_{t-1}} + \underset{(5.44^{**})}{0.81HY_{t-2}} + \underset{(5.81^{**})}{0.85HY_{t-4}}$$

$$+ \underset{(5.62^{**})}{149.0HC_{t-1}} + \underset{(3.14^{**})}{71.0HC_{t-2}} + \underset{(5.89^{**})}{129.0HC_{t-3}} + \underset{(2.73^{**})}{56.0HC_{t-4}}$$

$$+ \underset{(3.59^{**})}{0.76LC_{t-3}}$$

S = 4.64

$Z_6(1) = 0.02$

EQUATION 6

$$NI_t = \underset{(1.62)}{4.90} + \underset{(4.17^{**})}{0.50HY_t} + \underset{(4.07^{**})}{0.44HY_{t-1}} + \underset{(4.35^{**})}{0.59HY_{t-2}} + \underset{(2.65^{**})}{0.35HY_{t-3}}$$

$$+ \underset{(2.31^{**})}{863.0HS_{t-1}} + \underset{(3.21^{**})}{905.0HS_{t-2}} + \underset{(5.24^{**})}{0.45L_{t-2}}$$

S = 3.86

$Z_6(1) = 0.84$

EQUATION 7

$$NI_t = \underset{(5.27^{**})}{0.50HY_t} + \underset{(5.22^{**})}{0.64HY_{t-1}} + \underset{(3.84^{**})}{0.55HY_{t-2}} + \underset{(3.47^{**})}{0.44HY_{t-3}}$$

$$+ \underset{(1.93^{*})}{659.0HS_t} + \underset{(3.10^{**})}{925.0HS_{t-1}} + \underset{(3.82^{**})}{973.0HS_{t-2}} + \underset{(8.66^{**})}{0.53L_{t-2}}$$

$S = 3.67$

$Z_6(1) = 0.72$

EQUATION 8[1]

$$NI_t = \underset{(11.63^{**})}{19.0} + \underset{(1.82^{*})}{0.16HY_t} + \underset{(4.39^{**})}{0.37HY_{t-1}} + \underset{(6.98^{**})}{0.73HY_{t-2}} + \underset{(7.03^{**})}{1814.0HS_{t-1}}$$

$$+ \underset{(5.88^{**})}{1288.0HS_{t-2}} + \underset{(3.02^{**})}{517.0HS_{t-4}} + \underset{(3.10^{**})}{0.30LC_{t-2}} + \underset{(2.96^{**})}{0.35LC_{t-3}}$$

$S = 2.89$

$Z_6(1) = 0.60$

EQUATION 10

$$I_t = \underset{(6.81^{**})}{0.60DY_t} + \underset{(2.41^{**})}{0.28DL_{t-2}} + \underset{(21.14^{**})}{0.78I_{t-1}}$$

$S = 3.91$

$Z_6(1) = 0.81$

---

1. Nb Equation 9 does not require instrumentation.

EQUATION 11

$$I_t = \underset{(7.14^{**})}{0.60DY_t} + \underset{(1.73^{*})}{26.0DC_{t-1}} + \underset{(2.01^{*})}{0.23DL_{t-2}} + \underset{(22.18^{**})}{0.78I_{t-1}}$$

S = 3.74

$Z_6(1) = 2.38$

EQUATION 12

$$I_t = \underset{(6.99^{**})}{0.59DY_t} + \underset{(1.83^{*})}{27.0DC_{t-1}} + \underset{(1.92^{*})}{0.20DLC_{t-2}} + \underset{(22.78^{**})}{0.79I_{t-1}}$$

S = 3.76

$Z_6(1) = 2.59$

EQUATION 13

$$I_t = \underset{(7.10^{**})}{0.60DY_t} + \underset{(1.70)}{20.0DC_{t-1}} + \underset{(1.84^{*})}{0.22DL_{t-2}} + \underset{(22.04^{**})}{0.78I_{t-1}}$$

S = 3.75

$Z_6(1) = 2.04$

EQUATION 14

$$I_t = \underset{(7.12^{**})}{0.59DY_t} + \underset{(1.79^{*})}{404.0DS_{t-1}} + \underset{(2.15^{**})}{0.24DL_{t-2}} + \underset{(22.76^{**})}{0.78I_{t-1}}$$

S = 3.73

$Z_6(1) = 1.98$

EQUATION 15

$$I_t = \underset{(6.95^{**})}{0.57DY_t} + \underset{(1.88^{*})}{425.0DS_{t-1}} + \underset{(2.09^{*})}{0.22DLC_{t-2}} + \underset{(23.30^{**})}{0.80I_{t-1}}$$

$S = 3.75$

$Z_6(1) = 2.19$

EQUATION 16

$$I_t = \underset{(7.09^{**})}{0.58DY_t} + \underset{(1.84^{*})}{353.0DS_{t-1}} + \underset{(2.01^{*})}{0.23DL_{t-2}} + \underset{(22.80^{**})}{0.79I_{t-1}}$$

$S = 3.72$

$Z_6(1) = 1.86$

EQUATION 17

$$I_t = \underset{(6.93^{**})}{0.57DY_t} + \underset{(1.93^{*})}{369.0DS_{t-1}} + \underset{(1.95^{*})}{0.20DLC_{t-2}} + \underset{(23.38^{**})}{0.80I_{t-1}}$$

$S = 3.74$

$Z_6(1) = 2.06$

EQUATION 18

$$I_t = \underset{(5.65^{**})}{0.51DY_t} + \underset{(2.06^{*})}{0.23DY_{t-1}} + \underset{(2.44^{**})}{0.30L_{t-1}} + \underset{(7.82^{**})}{0.61I_{t-1}}$$

$S = 3.91$

$Z_6(1) = 0.62$

EQUATION 19

$$I_t = \underset{(5.22^{**})}{0.50DY_t} + \underset{(1.86^{*})}{0.20LC_{t-1}} + \underset{(20.84^{**})}{0.80I_{t-1}}$$

$S = 4.16$

$Z_6(1) = 1.86$

EQUATION 20

$$I_t = \underset{(7.32^{**})}{0.54DY_t} + \underset{(2.19^{**})}{0.21DY_{t-1}} + \underset{(2.89^{**})}{0.35DY_{t-2}} + \underset{(4.26^{**})}{64.0DC_{t-1}}$$

$$+ \underset{(2.83^{**})}{36.0DC_{t-2}} + \underset{(2.10^{*})}{0.24L_{t-2}} + \underset{(5.16^{**})}{0.50I_{t-1}}$$

$S = 3.09$

$Z_6(1) = 2.82$

EQUATION 21

$$I_t = \underset{(6.74^{**})}{0.55DY_t} + \underset{(2.89^{**})}{40.0DC_{t-1}} + \underset{(2.07^{*})}{28.0DC_{t-2}} + \underset{(1.79^{*})}{0.16LC_{t-1}} + \underset{(24.28^{**})}{0.78I_{t-1}}$$

$S = 3.47$

$Z_6(1) = 3.62$

EQUATION 22

$$I_t = \underset{(7.23^{**})}{0.54DY_t} + \underset{(1.88^{*})}{0.18DY_{t-1}} + \underset{(2.69^{**})}{0.32DY_{t-2}} + \underset{(4.24^{**})}{51.0DC_{t-1}}$$

$$+ \underset{(2.74^{**})}{29.0DC_{t-2}} + \underset{(1.87^{*})}{0.22L_{t-2}} + \underset{(5.65^{**})}{0.55I_{t-1}}$$

$S = 3.12$

$Z_6(1) = 2.17$

EQUATION 23

$$I_t = \underset{(5.45^{**})}{0.49DY_t} + \underset{(1.87^{*})}{22.0DC_{t-1}} + \underset{(1.80^{*})}{0.18LC_{t-1}} + \underset{(22.10^{**})}{0.80I_{t-1}}$$

$S = 3.94$

$Z_6(1) = 2.95$

EQUATION 24

$$I_t = \underset{(5.90^{**})}{0.52DY_t} + \underset{(2.07^{*})}{470.0DS_{t-1}} + \underset{(1.91^{*})}{0.19LC_{t-1}} + \underset{(22.41^{**})}{0.79I_{t-1}}$$

$S = 3.80$

$Z_6(1) = 2.79$

EQUATION 25

$$I_t = \underset{(5.98^{**})}{0.52DY_t} + \underset{(2.21^{**})}{419.0DS_{t-1}} + \underset{(1.87^{*})}{0.18LC_{t-1}} + \underset{(22.71^{**})}{0.79I_{t-1}}$$

$S = 3.75$

$Z_6(1) = 2.83$

EQUATION 26

$$I_t = -88.0 + 0.51Y_t + 0.25Y_{t-1} + 48.0C_t + 44.0C_{t-1}$$
(-10.15**)(7.26**) (2.60**) (2.77**) (3.25**)

$$+ 28.0C_{t-2} + 0.29L_{t-2} - 0.23K_{t-1}$$
(2.33**) (2.53**) (-12.17**)

S = 2.64

$Z_6(1) = 0.87$

EQUATION 27

$$I_t = -91.0 + 0.54Y_t + 0.26Y_{t-1} + 47.0C_t + 45.0C_{t-1}$$
(-10.21**)(7.86**) (2.85**) (2.93**) (3.60**)

$$+ 24.0C_{t-2} - 0.20LC_t + 0.24LC_{t-2} - 0.23K_{t-1}$$
(2.04*) (-2.02*) (2.27**) (-10.23**)

S = 2.45

$Z_6(1) = 0.04$

EQUATION 28

$$I_t = -76.0 + 0.46Y_t + 0.27Y_{t-1} + 54.0C_t - 0.33L_t + 0.34L_{t-2}$$
(-6.11**)(4.69**) (1.87*) (2.40**) (-1.97*) (1.97*)

$$- 0.21K_{t-1}$$
(-7.56**)

S = 3.69

$Z_6(1) = 0.30$

EQUATION 29

$$I_t = -108.0 + 0.56Y_t + 0.29Y_{t-1} + 1001.0S_t + 746.0S_{t-1}$$
(-9.0**) (7.56**) (2.96**) (3.29**) (3.58**)

$$+ 682.0S_{t-2} + 0.29L_{t-2} - 0.25K_{t-1}$$
(3.29**) (2.80**) (-11.68**)

$S = 2.53$

$Z_6(1) = 0.04$

EQUATION 30

$$I_t = -104.0 + 0.55Y_t + 0.26Y_{t-1} + 989.0S_t + 780.0S_{t-1}$$
(-8.71**)(7.47**) (2.67**) (3.30**) (3.77**)

$$+ 721.0S_{t-2} + 0.28LC_{t-2} - 0.22K_{t-1}$$
(3.48**) (2.82**) (-10.27**)

$S = 2.51$

$Z_6(1) = 0.08$

EQUATION 31

$$I_t = -96.0 + 0.46Y_t + 0.35Y_{t-1} + 904.0S_t + 671.S_{t-1}$$
(-8.71**)(6.28**) (3.38**) (3.18**) (3.63**)

$$+ 525.0S_{t-2} + 0.29L_{t-2} - 0.23K_{t-1}$$
(2.87**) (2.62**) (-11.33**)

$S = 2.64$

$Z_6(1) = 0.07$

EQUATION 32

$$I_t = -91.0 + 0.45Y_t + 0.32Y_{t-1} + 888.0S_t + 703.0S_{t-1}$$
$$(-8.31^{**})(6.09^{**})\ (3.12^{**})\ (3.17^{**})\ (3.84^{**})$$

$$+ 554.0S_{t-2} + 0.28LC_{t-2} - 0.21K_{t-1}$$
$$(3.03^{**})\ (2.65^{**})\ (-9.77^{**})$$

$S = 2.63$

$Z_6(1) = 0.12$

APPENDIX N

THE RELATIONSHIP OF DEPOSITS TO INCOME, THE DEPOSIT RATE AND INFLATION IN GREECE, 1961-1985

Introduction

Whereas in highly developed financial systems where there are many alternative financial assets, the demand for money function is normally taken to be a negative function of nominal interest rates on some substitute non-monetary financial asset, in financially repressed economies where hardly any alternative financial assets exist, the demand for money is generally seen as a positive function of the real rate of interest available on such deposits.

The nature of the relationship between the level of real interest rates and the volume of bank deposits is an important element in the financial repression and liberalization literature. Complete deregulation or generous administered rises in bank deposit rates are integral components of financial liberalization programmes. Whether financial liberalization is likely to promote output growth depends to a large extent on the response of the volume of bank deposits to the administered rises in deposit rates. If this response is sufficiently vigorous, financial liberalization will ensure a substantial increase in the resources available to banks for onlending. The increase in the resources of banks is bound to be used to reduce the excess demand for loans, which is pervasive under financial repression. Investment projects that could not materialize under financial repression, for the lack of finance, will be carried out after financial liberalization. Therefore the accumulation of capital and thus the growth rate of aggregate output will be increased by financial liberalization.

A number of studies (summarised in Fry 1988) have found the relationship between bank deposits and real interest rates to be statistically significant in pooled samples of financially repressed economies. We attempt to estimate this relationship on Greek data in the context of our effort to apply the financial repression approach to the Greek economy. However, we take an interest in this relationship for the following reason as well:

In our empirical study of the investment function in Greece (Chapter 5), we discovered that the sign on all the included significant lags of the real user cost variable turned out to be positive. This result proved robust to changes in specification, (dependent and independent) variable definitions and estimation technique. This result seems perverse from a neoclassical point of view. However, we attributed the appearance of the positive sign on the user cost to the presence of credit rationing, on the following rationale: When the real deposit rate (which is a series very close to the user cost) is raised, the volume of funds deposited with banks (and possibly with the unofficial market) rises. Thus the flow of new loans and (credit constrained) investment can increase. In addition, the accumulation of monetary balances which is required before (self financed) purchases of indivisible physical capital can occur, becomes more attractive. Therefore, a positive association between investment expenditures and the real user cost would be justified[1]. In this Appendix we examine whether this posited relationship between credit availability and deposit rates, on which these explanations are predicated, exists. If not, there would be little point

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1. We do not need to discuss here whether these explanations (for the appearance of a positive sign on the real user cost variable) are valid when a measure of credit availability is also included in the investment equation. This is discussed in Chapter 5.

in entertaining such explanations in the first place.

<u>Comparison with other studies of money demand</u>

We shall assess the relationship between interest rates and deposits by fitting a (deposit) money demand equation. That is, an equation with a measure of real (deposit) money balances as its dependent variable and various lags of real income, of the real deposit rate (or the nominal deposit rate and the rate of inflation separately), as well as lags of the dependent variable, as regressors. We note that such estimating equations should not always be interpreted as structural demand functions (Gordon 1984). However, when we adopt such estimating equations, we are able to compare and contrast our econometric procedure and results with a very limited sample of studies of money demand in Greece. From those recent studies of the demand for money in Greece that have been published in English, we select for comparison the papers by Brissimis and Leventakis (1981) and Prodromidis (1984).

The similarities and differences between our study and the aforementioned papers are as follows: We consider more or less the same explanatory variables. Brissimis and Leventakis (op.cit.) do not run equations including interest rates and the rate of inflation at the same time. Neither paper includes the real interest rate as a regressor. They take their data from Greek sources while our data come from the International Financial Statistics (IFS) of the IMF (IMF 1986). The period covered by our sample is more recent and overlaps only partly with the samples of either earlier paper. Brissimis and Leventakis (op.cit.) (and I) work with annual data while Prodromidis (op.cit.) makes use of (seasonally adjusted) quarterly observations on the monetary aggregates.

Although Brissimis and Leventakis (op.cit.) and Prodromidis (op.cit.) adopt almost identical explanatory variables as here, they explain different monetary aggregates. This is due, in part, to the difference in the data sources. For example the IFS do not disaggregate between time and savings deposits. However in Prodromidis (op.cit.) the difference between his measures M2 and M3 is that the latter (but not the former) includes private time deposits.

In part, the differences in the dependent variables employed are attributable to a difference in the objectives of our study (compared to their work). Brissimis and Leventakis (1981) and Prodromidis (1984) undertake standard demand for money studies. Accordingly, the authors expend some effort to fit equations for M1 and M2. By contrast, the main concern of this study is to detect a positive sensitivity of the volume of loanable funds (through the banking system) to movements in the real deposit rate. Thus we take no particular interest in the demand for currency. So, we do not concern ourselves with M1, a large fraction of which is currency (70% on average over our sample period). M2 (as defined by Prodromidis op.cit.) does not have an easily interpretable credit counterpart and hence is of little interest as well. For our purposes, it would not suffice to detect a positive response to the real deposit rate for a single narrow deposit aggregate. A positive response of any particular narrow aggregate would have no effect on the volume of loanable funds if it were offset, say, by a simultaneous reduction in some other deposit aggregate. We need establish that comprehensive deposit aggregates respond positively to the real deposit rate. Consequently, we share with Prodromidis an interest in the demand for M3.

Rather than focusing attention on broad measures of deposits, we could establish that each separate component of total deposits responds positively to the real deposit rate. Below we indicate a number of deposit aggregates that we constructed from the data in the IFS. They are ranked in an order from narrower to broader. The criterion of the ranking is the fraction of total domestic credit represented by each deposit aggregate on average over the period 1961-1985. We fit a demand function for each of these aggregates. Thus we confirm that both very comprehensive monetary aggregates (e.g. RLQ, RM) and their individual components (e.g. RDD, RSD, RBM) respond positively to the real deposit rate.

The coverage of our monetary aggregates in terms of loanable funds

(Deposit) Money	% of Total Domestic Credit (1961-1985)	% of Domestic Credit: Claims on Private Sector (1961-1985)
RDD: Demand Deposits with Commercial Banks	8%	12%
RSD: Time, Savings and Other Deposits with Commercial Banks	47%	68%
RTD: RSD plus RDD	55%	80%
RBM: Time, Savings and Foreign Currency Deposits of Residents	57%	83%
RDM: Demand Deposits of Private Sector plus RBM	69%	99%
RM: Currency Outside Banks plus RDM	96%	136%
RLQ: Liabilities of Commercial Banks and other Financial Institutions	106%	153%

As far as methodology is concerned, our approach differs from Brissimis and Leventakis (1981) and Prodromidis (1984) in various ways: For example, Prodromidis (op.cit.) tends to 'correct' for residual autocorrelation by applying the iterative CORC technique.[2] We take the view that residual autocorrelation may be a general sign of mispecification. We try to avoid that here by adopting a sufficiently general dynamic specification. By contrast, both authors present 'long run' money demand equations with current values for the independent variables as the only regressors. Not surprisingly, therefore, both authors find highly significant values for the D.W. statistic on these equations. None of our reported equations (some of which involve comparable dependent variables) reached by a structured specification search, assumes this form (i.e. includes current values only).

As Brissimis and Leventakis (op.cit.) verify, inclusion of the lagged dependent variable (on the assumption of a partial adjustment of actual to desired money holdings), 'soaks up' the autocorrelation in the residual. This confirms the appropriateness of our methodology. We start our specification search with a broad equation which possesses a rich dynamic structure. Subsequently, we do not impose any a priori (as the authors do) but only data derived simplifications. The parsimonious reported equations, reached by this procedure all involve a highly significant dependent variable.[3]

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2. Note that this fails to yield unconditional standard errors and also leads to an overstatement of coefficient significance (Johnston 1984, p.327).

3. An equation with current valued explanatory variables is prone to simultaneity problems. This possibility is not entertained by Brissimis and Leventakis (op.cit.) or Prodromidis (op.cit.). We deal with the problem of simultaneity by providing two stage least squares estimates as well. We find that simultaneity biases may be quite important (at least for annual data).

The D.W. test is, strictly speaking, invalid in equations with a lagged dependent variable. Both authors report values for Durbin's h test as well. However, the performance of this statistic in small samples is not good (both authors work with less than 50 observations). So, instead we assess residual autocorrelation on the basis of the LM(1) test (χ^2 and F version). None of these tests are invalidated by the presence of the lagged dependent variable. It is suggested (ibid.) that the modified LM(1) test performs satisfactorily in very small samples (e.g. 20 observations).

Although Brissimis and Leventakis (1981) and Prodromidis (1984) are not so much concerned about residual autocorrelation, they share our concern with the other diagnostic of mispecification i.e. parameter stability tests. Their equations exhibit instability around the time of the first oil shock. Our equations are superior in that they prove quite stable in the face of the second oil shock (which was more destabilising than the first one as argued in Chapter 5). Finally, we start our specification search from broad equations which include three lags of each variable. Given very limited degrees of freedom we cannot enter lags of prices as separate regressors. Thus homogeneity with respect to prices has to be imposed. This contrasts with the authors who test this restriction; we rely on their findings that the restriction is acceptable for all monetary aggregates M1, M2, M3.

Our econometric procedure

We estimate the relationship of each of seven monetary aggregates in real terms to real income, the interest rate and inflation. In all the equations, the real values of the monetary aggregate and income are entered in logarithms. For each monetary aggregate, we run a) equations entering the nominal interest rate and the inflation rate separately (cf. semilogarithmic money demand); b) equations entering the nominal interest rate and the inflation rate separately and in logarithms (cf. doublelogarithmic money demand) and c) equations entering the nominal interest rate minus the inflation rate (i.e. the real interest rate).

For each of the 21 possible combinations of monetary aggregate and functional form, we begin a specification search by estimating a broad equation. This broad equation includes as regressors the current value and two lags of each explanatory variable, as well as two lags of the dependent variable. If this broad equation is free from residual autocorrelation, we proceed to simplify it by omitting more distant and/or less significant lags. We continue the simplification until an equation is derived with all included variables significant at least at 10%. At each stage in the specification search we make sure that none of the omissions has induced residual autocorrelation. From such parsimonious equations free from residual autocorrelation, we select to report the equations with best fit and insignificant parameter stability tests.

As indicators of residual autocorrelation we employ the LM(1) test as well as the modified LM(1) test suggested by Durbin (see Harvey 1981, p.276). As indicators of parameter stability we employ the Chow 'prediction' test as well as Hendry's χ^2 statistic (Hendry 1979). Finally, we report the F test of the linear restrictions imposed on the broad equation (from which we start the specification search) in order to obtain the parsimonious equation which is reported. All our equations pass comfortably the residual autocorrelation and parameter stability tests (at 5%). A few reported equations have F tests (vis à vis the broad) with marginally significant values at 5%.

For the majority of monetary aggregates the semilogarithmic equations yield the best fit and residual autocorrelation statistics. The reported equations entering the real interest rate follow, with the doublelog specification yielding the worst results. Tests of heteroskedasticity and functional form (undertaken but not reported here) do not guide us on whether the semilogarithmic or double logarithmic functional form is preferable.

We begin by discussing the equations which include the real deposit rate as a regressor. All the monetary aggregates considered are significantly related to (a single lag of) real income, (a single lag of) the real interest rate and their own (once) lagged value. The coefficient on the real deposit rate is positive and significant at least at 5% in all the reported equations. The highest t-statistics on this variable can be seen in the reported equations with RSD, RTD or RLQ as the regressand.

RTD and RLQ are very comprehensive aggregates (total commercial bank deposits and total liabilities of banks and other financial institutions respectively). Consequently, our finding that these aggregates are significantly responsive to the real deposit rate, confirms that the latter influences the availability of loanable funds from the financial system. Accordingly the real user cost (a series very close to the real deposit rate) may proxy for credit conditions. Thus, the real user cost may appear in the investment function with a (perverse) positive sign.

In many of the reported equations, the first lag of the real deposit rate, rather than its contemporaneous value, is significant. A possible explanation is that the lagged actual value proxies best for the expected or permanent real deposit rate. Behaviour (i.e. money demand) may respond more closely to expected rather than actual values. Alternatively, simultaneity or multicollinearity with other regressors may blur the significance of the current value of the real interest rate. This finding can be related to a similar feature of the reported investment equations (Chapter 5). There, we noted that frequently the contemporaneous value of the user cost did not appear at all as a significant explanatory variable. Rather lags of the user cost (most commonly the first lag in the Coen and Blejer-Khan equations) were significant. In other equations (those descending from the Hall-Jorgenson model) the contemporaneous value of the real user cost appeared but the median lag came down to around a year. We are suggesting that the real interest rate affects the volume of loanable funds with a delay. The influence of the real interest rate on investment takes place with a similar delay. This is a further indication that this latter influence is transmitted via the availability of credit.

We may now turn to the semilogarithmic and doublelogarithmic reported regressions. All the monetary aggregates considered are significantly related to (a single lag of) real income, (a single lag of) the rate of inflation or its logarithm and their own (once) lagged value. (Note that the doublelog equation for RM contains two lags of the inflation rate.

Also the second lag of the dependent variable is significant in the equations for RDD). The nominal interest rate shows up significantly and with the correct positive sign only in the reported equations for RSD, RLQ and RTD. Furthermore in the reported equations for RLQ and RTD it fails to attain significance at 5%. In fact when these equations were run by two stage least squares, the t values on the nominal interest rate declined below the 10% level of significance. There is a single instance (equation XVIII) where the validity of combining nominal deposit rate and rate of inflation in a real deposit rate, can be tested directly. The restriction that the coefficient on the nominal deposit rate equals in magnitude but is opposite in sign to the coefficient on the rate of inflation is easily accepted. The F test of equation XVIII against equation XIX is $F(1,18) = 0.187$.

How can we explain the failure of the nominal deposit rate to appear significantly in most of the reported equations? We believe that the following considerations are relevant: We employ the only series given for the deposit rate in the IFS. By comparison with data in the Bank of Greece Statistical Bulletin we verified that this series gives the rate on commercial bank time deposits held by the private sector with an original maturity of 3-6 months. Although a decomposition is not available in the IFS, it is likely that a large fraction of RSD (savings plus time deposits with commercial banks) is made up of 3-6 months time deposits. This is probably why the nominal deposit rate is significant in the semilog and doublelog regressions for RSD. By contrast, the other monetary aggregates contain, apart from 3-6 months time deposits, other types of deposits each bearing a different interest rate, as well as, currency. For example, the ratio of RSD to RM averages to 50% over our sample period. This figure provides an upper bound to the proportion of total time deposits with commercial banks in RM (i.e. money plus quasi-money). The figure suggests that the 3-6 month time deposit rate may not provide an adequate proxy for the (effective) own interest rate on monetary aggregates such as RM. Indeed, the Bank of Greece Statistical Bulletin distinguishes 15 types of deposits, no two of which bear the same interest rate. In the end of 1980 the (unweighted) average deposit rate was 15.4% with a sizeable standard deviation of 3 percentage points. It is no surprise then, that the movements of our series for the deposit rate do not provide a significant explanation for the movements in monetary aggregates other than RSD. Even if each of those other monetary aggregates responds vigorously to its own rate, that rate is not entered in the regressions. Therefore we cannot detect the response.

Nevertheless in Greece rates on different types of deposits are changed (by decree) more or less simultaneously. The coefficient of variation (i.e. standard deviation divided by mean) of the administered deposit rate, over the different deposit types given in the Bank of Greece Statistical Bulletin, was 0.39 in 1961, 0.33 in 1970 and 0.20 in 1980. We decided to use a single series for the deposit rate in all our regressions because we assumed that such variation in the structure of interest rates would be negligible. However, it seems that this did not work for most monetary aggregates. Furthermore, monetary aggregates, made up of types of deposits other than those included in RSD, may contract upon a rise in our series for the deposit rate. This could happen if the rates set on those other types of deposits follow a rise in the 3-6 month rate only after a delay. This would tend to blur (or even render negative) the statistical relationship between those other types of deposits and our series for the deposit rate. This may be the cause of the frequent failure of the nominal interest rate to attain even a 10% level of significance in our equations, and also of the negative signs on the current value of the deposit rate (combined with positive coefficients on its first lag) encountered in the course of our specification searches. This may also account for the negative and significant coefficients on the own rate (both for M2 and M3) reported in Prodromidis (1984).

We were not able to calculate precise effective own interest rates for each of our monetary aggregates. This is because the series for the monetary aggregates in the IFS cannot be paired with the detailed data on deposit rates given in the Bank of Greece Statistical Bulletin. For example, the latter distinguishes between time and savings bank deposit rates. No disaggregation between the two types is available in the IFS. Both time and savings deposits with commercial banks are merged in RSD.

In the vast majority of the reported equations the contemporaneous value of the rate of inflation appears very significantly and with the correct negative sign. In a few of these equations lagged, rather than the contemporaneous, values of inflation are significant. In all cases, the t-statistics on the rate of inflation exceed the 5% critical value. They are almost always higher than the t-statistics on any other regressor in the equation.

This result has an important counterpart in the investment equations, reported in Chapter 5. There, we found that investment is remarkably sensitive to inflation while it is less sensitive to changes in the level of nominal (loan) interest rates. Furthermore, we found that the response of investment to the rate of (capital goods) inflation was not positive, as predicted by neoclassical theory, but rather negative. We may now interpret these features of the investment equations in the light of our findings with the regressions for the monetary aggregates. Over our sample period the real volume of funds available to the banking system for onlending was inversely related to the rate of inflation. For statistical or other reasons, the resources available to the banking system for onlending did not seem to increase significantly with rises in (at least our measure of) nominal interest rates. Thus to the extent that investment depended on credit conditions over our sample period a) it would be markedly reduced upon rises in the rate of inflation, b) it would be hardly affected (and if at all it would be positively affected, as suggested by reported equations such as those for RSD) by rises in nominal interest rates.

The finding that the liabilities of the banking system are significantly (negatively) related to the inflation rate but not significantly (positively) related to the nominal deposit rate, is still consistent with the financial repression approach. Of course, this approach stresses the potential of administered rises in the nominal deposit rate to promote output growth by enabling increases in loans. If only because such administered rises took place only very seldom over our sample period, it is not surprising that this effect is captured in only a few of the reported equations.

The profile of the series for the deposit rate is that of a staircase. Over our sample period deposit rates were set by decree of the Greek monetary authorities. Administrative discretion is typically associated with sluggishness (even for monetary control by market intervention). Indeed, in the 25 years of our sample the series for the nominal deposit rate moved (by more than 1%) only 6 times (5 of which were rises), giving a coefficient of variation around 0.4. By contrast, the rate of inflation was much more volatile with a coefficient of variation almost twice as large.

Apart from stressing the potentialities of interest rate reform, the financial repression literature also emphasizes the adverse consequences of high rates of inflation. It is claimed that inflation causes a shrinkage to the size of the banking system when reserve ratios and/or inflexible interest rate ceilings are imposed. Our results confirm that the demand for deposits in real terms contracts under inflation. This explains also the negative association between inflation and investment. As a matter of fact nominal deposit rates did not move sufficiently to counteract this tendency in Greece over the period 1961-1985.

The significance of the current value of the rate of inflation also has the following implications: First, the significance of the real deposit rate (in the equations not entering the nominal rate and inflation separately) is probably due to the underlying response of monetary aggregates to the rate of inflation.[4] Second, it is doubtful whether

4. The real deposit rate is most significant in the equations for RSD, RLQ and RTD. These are also the only monetary aggregates which are significantly associated with the nominal deposit rate in the semilog and doublelog equations.

the common finding here that it is lags of the real interest rate, rather than its contemporaneous value, which show up significantly in many reported equations could be due to a delayed response of desired money holdings to the actual level of inflation (which delayed response we would expect, since deposit holdings may depend on the anticipated real interest rate or, if simultaneity were present). By default, the delayed response of money holdings to the real deposit rate should be attributable to a delayed response to its nominal rate component. We have already discussed a possible reason for a delayed response (of virtually every monetary aggregate apart from RSD) to movements in our series for the nominal deposit rate. There may, however, be additional reasons for a delay: Indeed, even in the reported semilog and doublelog equations for RSD, it is the first lag of the interest rate which is significant. A partial explanation for this feature is the following: Interest earnings (accruing towards the end of the year or even on a six monthly basis) are automatically credited to the deposits on which they are due. This mechanism could also explain the absence of the nominal interest rate from the reported semilog and doublelog equations especially for RM and less so for RDD: The latter is made up of low or non-interest bearing demand deposits. A substantial fraction of the former monetary aggregate is currency (30% on average over the sample period). In either case, there must be only a small proportionate rise in these monetary aggregates when banks credit interest earnings to deposits.

The result, that the nominal interest rate is hardly significant while the rate of inflation is a significant determinant of money (under various definitions), is also found by Brissimis and Leventakis (1981) and also Prodromidis (1984). The interest responses of the monetary aggregates, examined by the them, are either positive but insignificant (Brissimis and Leventakis op.cit. for M1 and M2) or wrongly (negatively) signed and quite significant (Prodromidis op.cit. for M2 and M3). By contrast, the coefficient on the log of their measure of inflation comes out negative and quite significant. This happens with M2 and M3 but not with M1 as Brissimis and Leventakis find. (Note that the measure of inflation employed in both papers differs algebraically from our measure. Therefore we cannot easily compare our estimates with the coefficients they report).

Whenever we report a significant coefficient for the nominal interest rate, its sign is positive. The positive sign on the interest rate, in a demand for money function, is another of those paradoxical features of the financial repression literature. (Cf. also the response of investment to a rise in interest rates). In the standard literature, on money demand in developed financial systems, the sign on the nominal interest rate is expected to be negative. This is because the main interest bearing asset and alternative to money in such financial systems is (government) bonds. However, there exist no well developed markets for, nor any substantial (non-bank) holdings of, government bonds in repressed financial systems in general and in Greece in particular (Courakis 1981b, e.g. p.210). The major (widely available) interest bearing asset in these economies is bank deposits (e.g. in Greece even bank deposits designated as 'sight deposits' have been interest bearing for some decades now). Accordingly, 'the interest rate' relates primarily to those rates payable on various types of bank liabilities (or loan assets). Most of these rates are changed, almost in step, by decree. If that is 'the interest rate', the demand for a monetary aggregate, which is made up mainly by interest bearing deposits, ought to be positively related to it.

But, if 'the interest rate' is the own rate on money, what is the opportunity cost of holding money? In the absence of other domestic financial assets (and given at least partially effective exchange controls), the only alternative to holding money is goods. This is reflected in the equations, which determine the inflation rate by the excess supply of money,[5] in the macromodels of the financial repression literature. (These are identified as Phelpsian Phillips curves in Fry 1988, p.67). The nominal rate of return on goods, hence the opportunity cost of holding money balances, is the rate of goods prices inflation. Indeed, the Keynesian transmission mechanism of monetary policy is not operative in financially repressed economies which essentially lack markets determining bond prices. Individuals, who find that their holdings of money exceed desired levels, attempt to exchange them with goods. Thus, changes in the supply of money are transmitted to inflationary shocks. In fact our findings suggest that disequilibrium is likely to persist in the money market and may even become explosive. For as prices accelerate with an excess supply of money we have found that the demand for money contracts further and quite rapidly.

We have dealt with the deposit rate and rate of inflation variables. We may now assess the performance of the income variable. Income appears significantly at least at 10% and with the correct positive sign (that

5. There seems little point in relating the rate of inflation to the excess supply for narrow money. Excess supply for a particular component of money would presumably spill over to other monetary assets. Rather it is laxity in overall monetary conditions which is likely to spill over to goods markets.

would be expected in a demand for money function) in all the reported equations. However, in a number of reported equations, the income variable fails to reach significance at 5%. This contrasts with the invariable appearance of the rate of inflation or the real interest rate as regressors significant at 5% or stricter.

We compare now coefficients across reported equations with the same functional form (e.g. doublelog) but which explain different monetary aggregates. The estimated value for the long run elasticity with respect to income increases as we move towards monetary aggregates dominated by types of deposits that are likely to serve more as assets, rather than media of exchange. This finding accords with the common belief (e.g. Laidler 1985, p.145) that economies of scale are more pronounced with transactions balances. For example, RM, which includes currency and deposits, is less income elastic than RDM, which excludes currency. In turn, RDM is less income elastic than RBM, which excludes demand deposits (contains 'savings', 'time' and 'foreign currency'[6] deposits which presumably fulfill the asset function). Similarly demand deposits with banks (RDD) are less income elastic than savings and time deposits (RSD) with banks.

The long-run income elasticities in the reported doublelog equations for RLQ(1.650), RM(1.589) and RDM(1.889) are very close to the income elasticities (1.7-1.8) in similar equations reported for the aggregate M3 by Prodromidis (1984). This is not surprising, since M3 cannot differ by much from RM (i.e. currency plus all types of deposits) or RLQ (liabilities of commercial banks and other financial institutions).

6. Foreign currency deposits obviously cause noise to our estimates.

Finally, in many of the reported equations, we do not find the contemporaneous value, but rather a lag (most commonly the second lag) of the income variable, being significant. A possible explanation is that simultaneity or multicollinearity with other included regressors is blurring the significance of the current value. Alternatively, the demand for money holdings may be associated more closely with expected or permanent, rather than actual, income. In turn, the expected or permanent value may be proxied best by the second lag of income. It is commonly believed that the current, rather than the permanent, value of income is more likely to show up in a transactions demand for money. This belief (opposed somewhat in Laidler 1985, p.119) is upheld by the results from the equations for RDD (demand deposits with commercial banks). Unlike all other (but for RLQ) mostly broad monetary aggregates, RDD is significantly explained by current, rather than lagged, income.

Instrumental variables estimation

Each reported equation was run by two stage least squares. For all equations, the predetermined variables used in this exercise include a constant, two lags of income and two lags of the monetary aggregate (in real terms and in logarithms). For semilog (doublelog) reported equations two lags of the (log of the) deposit rate and two lags of the (log of the) rate of inflation provide additional predetermined variables. For equations entering the real deposit rate, we use two lags of the former as predetermined variables. The two stage least squares estimates of all the reported equations are free from residual autocorrelation at 5%, as indicated by the LM(1) statistic adapted for instrumental variables.

The two stage least squares estimates are quite different from the estimates obtained by ordinary least squares. Long run coefficients on income and inflation variables almost double for most reported equations. This may not be entirely due to simultaneity. If substantial simultaneity were present, we would observe large differences between the coefficients of reported equations including current values and reported equations (for the same monetary aggregate but with different functional form) with predetermined regressors only. Although such comparisons (cf. IV to V) reveal differences in coefficients, these are not as large as the differences induced by instrumentation. The former differences may reflect the change in functional form (e.g. IV involves the real rate while V is semi log) rather than the removal of simultaneity. Moreover, equations with predetermined regressors only tend to have lower long run coefficients on the lag of income, compared to equations reported for the same monetary aggregate but including current valued regressors. By contrast, the long run coefficients on the income variables are increased upon instrumentation. In particular, the cause for the rise in long run coefficients is that the coefficient on the lagged dependent variable invariably rises upon instrumentation. This may indicate that the instruments, generated by the two stage least squares procedure, have poor explanatory power, thereby causing a substantial difference from the ordinary least squares estimates. Yet, the correlation coefficients, of our current valued explanatory variables (apart from the real interest rate) with their instruments, are frequently of the order of 0.9.

APPENDIX O

ESTIMATES OF THE RELATIONSHIP OF DEPOSITS TO INCOME, THE DEPOSIT RATE, AND INFLATION IN GREECE 1961-1985

Estimates of the Relationship between Various Monetary Aggregates, Income and the Interest Rate as well as Inflation

EXPLANATION OF THE SYMBOLS

All series taken from IFS [Annual 1961-1985] Series in Real Terms are deflated by the GDP deflator and measured in (American) Bn of 1980 Drachmas.

Monetary Aggregates in Real Terms:

RLQ: Liabilities of Commercial Banks plus Liabilities of other Financial Institutions

RBM: Time, Savings and Foreign Currency Deposits of Residents

RM: Currency Outside Banks plus Demand Deposits of Private Sector plus RBM

RDM: RM - Currency Outside Banks

RSD: Time, Savings and Other Deposits with Commercial Banks

RDD: Demand Deposits with Commercial Banks

RTD: RDD + RSD

Other Series

Y: Real Income

R: Nominal Deposit Rate [in Logarithms LR] (%)

DP: Rate of Inflation of GDP deflator [in Logarithms LDP] (%)

RR: R - DP (%).

Monetary Aggregates and Income are entered in Logarithms in the regressions.

Notes on the Presentation of Results

a) t-statistics in parentheses

b) Significance: (i) For t-statistics significance at least at 10% is indicated by a single asterisk (*) while significance at least at 5% is shown by a double asterisk (**)

(ii) For all other statistics significance at least at 5% is indicated by a hyphen (-)

c) Broad-equations: (i) Underneath each reported equation we state the form (i.e. the lags included and their significance) of the broad equation which provided the starting point of the sequential specialisation procedure whose end product is the reported equation

(ii) If the broad equation passes only the F version (Z_2, for more explanation see below) of the LM(1) test of residual autocorrelation and fails the χ^2 version (Z_1) of the same test, the following note appears: 'LM(1): F version only non-significant'.

The Statistics

S	:	Standard error of estimate
$\bar{R}^2$	:	Adjusted coefficient of determination
Z_1	:	First order LM test of residual autocorrelation distributed as $\chi^2(1)$
Z_2	:	F version of the above with the indicated degrees of freedom
Z_3	:	Chow prediction test with 1980 as breakpoint distributed as F with the indicated degrees of freedom

Z_4 : Hendry's predictive failure test with 1980 as breakpoint distributed as $\chi^2(5)$

Z_5 : F test of the restrictions incorporated in the reported equation versus the unrestricted broad equation underneath with the indicated degrees of freedom

EQUATION I

$RLQ_t = -1.260 + 0.372Y_t + 0.009RR_t + 0.802RLQ_{t-1}$
(-2.057*)(2.233**) (4.129**) (8.758**)

S = 0.037 $\bar{R}^2$ = 0.997 $Z_1(1)$ = 1.139 $Z_2(1,19)$ = 0.941

$Z_3(5,15)$ = 0.808 $Z_4(5)$ = 14.185- $Z_5(5,13)$ = 1.790

RLQ_t = /CON/Y_t/Y_{t-1}/Y_{t-2}/RR_t/RR_{t-1}/RR_{t-2}/RLQ_{t-1}/RLQ_{t-2}
** ** **

EQUATION II

$RLQ_t = -1.598 + 0.495Y_t + 0.011R_{t-1} - 0.007DP_t + 0.713RLQ_{t-1}$
(-1.851*)(1.798*) (1.914*) (-3.129**) (3.907**)

S = 0.037 $\bar{R}^2$ = 0.997 $Z_1(1)$ = 1.028 $Z_2(1,18)$ = 0.804

$Z_3(5,14)$ = 0.463 $Z_4(5)$ = 5.786 $Z_5(7,10)$ = 1.548

RLQ_t = /CON/Y_t/Y_{t-1}/Y_{t-2}/R_t/R_{t-1}/R_{t-2}/DP_t/DP_{t-1}/DP_{t-2}/RLQ_{t-1}/RLQ_{t-2}
** **

EQUATION III

$RLQ_t = -1.960 + 0.599Y_t + 0.109LR_{t-1} - 0.051LDP_t + 0.637RLQ_{t-1}$
(-2.486**) (2.584**) (2.03*) (-2.717**) (4.194**)

S = 0.039 $\bar{R}^2$ = 0.996 $Z_1(1)$ = 2.394 $Z_2(1,18)$ = 1.874

$Z_3(5,14)$ = 0.470 $Z_4(5)$ = 12.119- $Z_5(7,10)$ = 1.160

RLQ_t = /CON/Y_t/Y_{t-1}/Y_{t-2}/LR_t/LR_{t-1}/LR_{t-2}/LDP_t/LDP_{t-1}/LDP_{t-2}/RLQ_{t-1}/RLQ_{t-2}
* *

EQUATION IV

$$RBM_t = \underset{(-2.333^{**})}{-2.898} + \underset{(2.544^{**})}{0.775Y_{t-2}} + \underset{(2.411^{**})}{0.009RR_{t-1}} + \underset{(3.722^{**})}{0.583RBM_{t-1}}$$

$S = 0.059$ $\bar{R}^2 = 0.992$ $Z_1(1) = 1.471$ $Z_2(1,18) = 1.204$

$Z_3(5,14) = 0.233$ $Z_4(5) = 1.425$ $Z_5(5,13) = 2.852$

$$RBM_t = /CON/\underset{*}{Y_t}/Y_{t-1}/Y_{t-2}/\underset{**}{RR_t}/RR_{t-1}/RR_{t-2}/\underset{**}{RBM_{t-1}}/RBM_{t-2}$$

EQUATION V

$$RBM_t = \underset{(-2.747^{**})}{-2.022} + \underset{(2.448^{**})}{0.453Y_{t-2}} - \underset{(-5.717^{**})}{0.013DP_t} + \underset{(8.251^{**})}{0.843RBM_{t-1}}$$

$S = 0.041$ $\bar{R}^2 = 0.996$ $Z_1(1) = 0.938$ $Z_2(1,18) = 0.768$

$Z_3(5,14) = 1.034$ $Z_4(5) = 8.285$ $Z_5(8,10) = 1.029$

$$RBM_t = /CON/Y_t/Y_{t-1}/Y_{t-2}/R_t/R_{t-1}/R_{t-2}/\underset{**}{DP_t}/DP_{t-1}/DP_{t-2}/\underset{**}{RBM_{t-1}}/RBM_{t-2}$$

EQUATION VI

$$RBM_t = \underset{(-2.165^{**})}{-1.670} + \underset{(1.887^{*})}{0.371Y_{t-2}} - \underset{(-5.196^{**})}{0.119LDP_t} + \underset{(8.089^{**})}{0.900RBM_{t-1}}$$

$S = 0.043$ $\bar{R}^2 = 0.996$ $Z_1(1) = 1.023$ $Z_2(1,18) = 0.837$

$Z_3(5,14) = 0.335$ $Z_4(5) = 1.918$ $Z_5(8,10) = 0.911$

$$RBM_t = /CON/Y_t/Y_{t-1}/Y_{t-2}/LR_t/LR_{t-1}/LR_{t-2}/\underset{**}{LDP_t}/LDP_{t-1}/LDP_{t-2}/RBM_{t-1}/RBM_{t-2}$$

EQUATION VII

$$RM_t = \underset{(-2.175^{**})}{-1.752} + \underset{(2.607^{**})}{0.689Y_{t-2}} + \underset{(2.749^{**})}{0.007RR_{t-1}} + \underset{(3.145^{**})}{0.528RM_{t-1}}$$

S = 0.040 $\bar{R}^2$ = 0.994 $Z_1(1)$ = 2.725 $Z_2(1,18)$ = 2.230

$Z_3(5,14)$ = 0.393 $Z_4(5)$ = 2.958 $Z_5(5,13)$ = 3.611 -

RM_t = /CON**/Y_t/Y_{t-1}/Y_{t-2}**/RR_t/RR_{t-1}/RR_{t-2}**/RM_{t-1}*/RM_{t-2}

EQUATION VIII

$$RM_t = \underset{(-2.457^{**})}{-1.095} + \underset{(2.152^{**})}{0.326Y_{t-2}} - \underset{(-6.200^{**})}{0.010DP_t} + \underset{(8.223^{**})}{0.841RM_{t-1}}$$

S = 0.027 $\bar{R}^2$ = 0.997 $Z_1(1)$ = 0.858 $Z_2(1,18)$ = 0.702

$Z_3(5,14)$ = 1.289 $Z_4(5)$ = 9.871 $Z_5(8,10)$ = 1.25

RM_t = /CON/Y_t/Y_{t-1}/Y_{t-2}/R_t/R_{t-1}/R_{t-2}/DP_t**/DP_{t-1}/DP_{t-2}/RM_{t-1}**/RM_{t-2}

(LM(1): F-version only non-significant)

EQUATION IX

$$RM_t = \underset{(-1.627)}{-2.067} + \underset{(1.862^{*})}{0.715Y_{t-1}} - \underset{(-2.696^{**})}{0.067LDP_{t-1}} + \underset{(1.798^{*})}{0.035LDP_{t-2}} + \underset{(2.379^{**})}{0.550RM_{t-1}}$$

S = 0.042 $\bar{R}^2$ = 0.993 $Z_1(1)$ = 1.418 $Z_2(1,16)$ = 1.080

$Z_3(5,12)$ = 0.119 $Z_4(5)$ = 0.835 $Z_5(7,10)$ = 2.468

RM_t = /CON/Y_t/Y_{t-1}/Y_{t-2}/LR_t/LR_{t-1}/LR_{t-2}/LDP_t*/LDP_{t-1}/LDP_{t-2}/RM_{t-1}/RM_{t-2}

(LM(1): F-version only non-significant)

EQUATION X

$$RDM_t = \underset{(-2.489^{**})}{-2.680} + \underset{(2.737^{**})}{0.782Y_{t-2}} + \underset{(2.599^{**})}{0.009RR_{t-1}} + \underset{(3.478^{**})}{0.550RDM_{t-1}}$$

$S = 0.056$ $\bar{R}^2 = 0.992$ $Z_1(1) = 1.333$ $Z_2(1,18) = 1.091$

$Z_3(5,14) = 0.192$ $Z_4(5) = 1.227$ $Z_5(5,13) = 2.048$

$$RDM_t = /\underset{*}{CON}/Y_t/Y_{t-1}/Y_{t-2}/\underset{**}{RR_t}/RR_{t-1}/RR_{t-2}/\underset{**}{RDM_{t-1}}/RDM_{t-2}$$

EQUATION XI

$$RDM_t = \underset{(-2.670^{**})}{-1.821} + \underset{(2.299^{**})}{0.430Y_{t-2}} - \underset{(-5.306^{**})}{0.013DP_t} + \underset{(7.500^{**})}{0.839RDM_{t-1}}$$

$S = 0.041$ $\bar{R}^2 = 0.995$ $Z_1(1) = 1.800$ $Z_2(1,18) = 1.473$

$Z_3(5,14) = 0.985$ $Z_4(5) = 7.680$ $Z_5(8,10) = 1.11$

$$RDM_t = /CON/Y_t/Y_{t-1}/Y_{t-2}/R_t/R_{t-1}/R_{t-2}/\underset{**}{DP_t}/\underset{*}{DP_{t-1}}/DP_{t-2}/\underset{**}{RDM_{t-1}}/RDM_{t-2}$$

(LM(1): F version only non-significant)

EQUATION XII

$$RDM_t = \underset{(-2.692^{**})}{-3.079} + \underset{(2.913^{**})}{0.865Y_{t-2}} - \underset{(-2.693^{**})}{0.075LDP_{t-1}} + \underset{(3.449^{**})}{0.542RDM_{t-1}}$$

$S = 0.055$ $\bar{R}^2 = 0.992$ $Z_1(1) = 2.945$ $Z_2(1,18) = 2.41$

$Z_3(5,14) = 1.758$ $Z_4(5) = 0.233$ $Z_5(8,10) = 2.794$

$$RDM_t = /\underset{*}{CON}/Y_t/Y_{t-1}/Y_{t-2}/\underset{**}{LR_t}/LR_{t-1}/LR_{t-2}/\underset{**}{LDP_t}/\underset{*}{LDP_{t-1}}/LDP_{t-2}/RDM_{t-1}/RDM_{t-2}$$

EQUATION XIII

$$RSD_t = \underset{(-2.035*)}{-1.907} + \underset{(2.049*)}{0.454Y_{t-2}} + \underset{(4.490**)}{0.014RR_t} + \underset{(7.007**)}{0.797RSD_{t-1}}$$

$S = 0.055$ $\bar{R}^2 = 0.994$ $Z_1(1) = 0.392$ $Z_2(1,18) = 0.321$

$Z_3(5,14) = 0.471$ $Z_4(5) = 2.962$ $Z_5(5,13) = 1.015$

$$RSD_t = /\underset{**}{CON}/Y_t/Y_{t-1}/Y_{t-2}/\underset{**}{RR_t}/RR_{t-1}/RR_{t-2}/\underset{**}{RSD_{t-1}}/RSD_{t-2}$$

EQUATION XIV

$$RSD_t = \underset{(-1.908*)}{-2.325} + \underset{(1.998*)}{0.549Y_{t-1}} + \underset{(2.494**)}{0.015R_{t-1}} - \underset{(-4.269**)}{0.013DP_t} + \underset{(5.464**)}{0.746RSD_{t-1}}$$

$S = 0.058$ $\bar{R}^2 = 0.994$ $Z_1(1) = 1.121$ $Z_2(1,18) = 0.878$

$Z_3(5,14) = 0.372$ $Z_4(5) = 3.373$ $Z_5(7,10) = 2.662$

$$ESD_t = /CON/\underset{*}{Y_t}/Y_{t-1}/Y_{t-2}/R_t/R_{t-1}/R_{t-2}/\underset{**}{DP_t}/\underset{*}{DP_{t-1}}/DP_{t-2}/\underset{**}{RSD_{t-1}}/RSD_{t-2}$$

(LM(1): F-version only non-significant)

EQUATION XV

$$RSD_t = \underset{(-1.949*)}{-2.429} + \underset{(2.019*)}{0.561Y_{t-1}} + \underset{(2.057*)}{0.124LR_{t-1}} - \underset{(-4.079**)}{0.111LDP_t} + \underset{(5.454**)}{0.742RSD_{t-1}}$$

$S = 0.059$ $\bar{R}^2 = 0.994$ $Z_1(1) = 3.200$ $Z_2(1,18) = 2.505$

$Z_3(5,14) = 0.190$ $Z_4(5) = 1.005$ $Z_5(7,10) = 2.143$

$$RSD_t = /CON/\underset{*}{Y_t}/Y_{t-1}/Y_{t-2}/LR_t/LR_{t-1}/LR_{t-2}/\underset{**}{LDP_t}/LDP_{t-1}/LDP_{t-2}/RSD_{t-1}/RSD_{t-2}$$

EQUATION XVI

$$RDD_t = \underset{(-3.387^{**})}{-3.989} + \underset{(3.197^{**})}{0.892Y_t} + \underset{(2.392^{**})}{0.016RR_{t-1}} + \underset{(1.843^{*})}{0.416RDD_{t-2}}$$

$S = 0.069$ $\bar{R}^2 = 0.976$ $Z_1(1) = 2.319$ $Z_2(1,18) = 1.897$

$Z_3(5,14) = 1.012$ $Z_4(5) = 9.224$ $Z_5(5,13) = 0.985$

$$RDD_t = /CON/\underset{*}{Y_t}/Y_{t-1}/Y_{t-2}/RR_t/RR_{t-1}/RR_{t-2}/RDD_{t-1}/\underset{*}{RDD_{t-2}}$$

EQUATION XVII

$$RDD_t = \underset{(-4.806^{**})}{-4.537} + \underset{(4.363^{**})}{0.975Y_t} - \underset{(-3.054^{**})}{0.014DP_{t-1}} + \underset{(2.247^{**})}{0.436RDD_{t-2}}$$

$S = 0.065$ $\bar{R}^2 = 0.979$ $Z_1(1) = 0.894$ $Z_2(1,18) = 0.731$

$Z_3(5,14) = 0.779$ $Z_4(5) = 4.864$ $Z_5(8,10) = 0.513$

$$RDD_t = /CON/Y_t/Y_{t-1}/Y_{t-2}/R_t/R_{t-1}/DP_t/DP_{t-1}/DP_{t-2}/RDD_{t-1}/\underset{*}{RDD_{t-2}}$$

EQUATION XVIII

$$RTD_t = \underset{(-2.685^{**})}{-3.400} + \underset{(2.866^{**})}{0.873Y_{t-2}} + \underset{(2.738^{**})}{0.011RR_{t-1}} + \underset{(3.570^{**})}{0.549RTD_{t-1}}$$

$S = 0.064$ $\bar{R}^2 = 0.991$ $Z_1(1) = 1.037$ $Z_2(1,18) = 0.848$

$Z_3(5,14) = 0.325$ $Z_4(5) = 2.455$ $Z_5(5,13) = 2.566$

$$RTD_t = /\underset{*}{CON}/Y_t/Y_{t-1}/Y_{t-2}/\underset{**}{RR_t}/RR_{t-1}/RR_{t-2}/\underset{**}{RTD_{t-1}}/RTD_{t-2}$$

EQUATION XIX

$$RTD_t = \underset{(-2.450^{**})}{-3.261} + \underset{(2.703^{**})}{0.851Y_{t-2}} + \underset{(1.795^{*})}{0.014R_{t-1}} - \underset{(-2.670^{**})}{0.011DP_{t-1}} + \underset{(3.477^{**})}{0.547RTD_{t-1}}$$

$S = 0.065$ $\bar{R}^2 = 0.991$ $Z_1(1) = 1.150$ $Z_2(1,17) = 0.889$

$Z_3(5,13) = 0.288$ $Z_4(5) = 4.093$ $Z_5(7,10) = 3.354$-

$$RTD_t = /CON/Y_t/Y_{t-1}/Y_{t-2}/R_t/R_{t-1}/R_{t-2}/\underset{**}{DP_t}/\underset{**}{DP_{t-1}}/DP_{t-2}/\underset{**}{RTD_{t-1}}/RTD_{t-2}$$

EQUATION XX

$$RTD_t = \underset{(-2.644^{**})}{-2.159} + \underset{(2.333^{**})}{0.472Y_{t-2}} - \underset{(-5.143^{**})}{0.133LDP_t} + \underset{(7.702^{**})}{0.865RTD_{t-1}}$$

$S = 0.049$ $\bar{R}^2 = 0.995$ $Z_1(1) = 3.084$ $Z_2(1,18) = 2.524$

$Z_3(5,14) = 0.610$ $Z_4(5) = 3.171$ $Z_5(8,10) = 1.00$

$$RTD_t = /\underset{*}{CON}/Y_t/Y_{t-1}/Y_{t-2}/LR_t/LR_{t-1}/LR_{t-2}/\underset{**}{LDP_t}/\underset{*}{LDP_{t-1}}/LDP_{t-2}/RTD_{t-1}/RTD_{t-2}$$

Two Stage Least Squares Estimates of the Relationship between Various Monetary Aggregates, Income and the Interest Rate as well as Inflation

EQUATION I

$$RLQ_t = \underset{(-3.301^{**})}{-2.549} + \underset{(3.319^{**})}{0.653Y_t} + \underset{(3.447^{**})}{0.012RR_t} + \underset{(6.734^{**})}{0.691RLQ_{t-1}}$$

$S = 0.036 \quad Z_6(1)^{\dagger} = 0.246$

EQUATION II

$$RLQ_t = \underset{(-2.605^{**})}{-2.445} + \underset{(1.975^{*})}{0.618Y_t} + \underset{(1.462)}{0.009R_{t-1}} - \underset{(-2.520^{**})}{0.011DP_t} + \underset{(3.214^{**})}{0.716RLQ_{t-1}}$$

$S = 0.035 \quad Z_6(1) = 1.941$

EQUATION III

$$RLQ_t = \underset{(-2.515^{**})}{-2.297} + \underset{(2.233^{**})}{0.596Y_t} + \underset{(1.249)}{0.071LR_{t-1}} - \underset{(-2.667^{**})}{0.082LDP_t} + \underset{(3.975^{**})}{0.715RLQ_{t-1}}$$

$S = 0.037 \quad Z_6(1) = 0.815$

EQUATION IV — No instrumentation required. All variables predetermined.

EQUATION V

$$RBM_t = \underset{(-2.987^{**})}{-2.326} + \underset{(2.461^{**})}{0.464Y_{t-2}} - \underset{(-4.059^{**})}{0.018DP_t} + \underset{(8.159^{**})}{0.891RBM_{t-1}}$$

$S = 0.041 \quad Z_6(1) = 0.864$

EQUATION VI

$$RBM_t = \underset{(-2.123^{**})}{-1.751} + \underset{(1.716)}{0.359Y_{t-2}} - \underset{(-4.069^{**})}{0.147LDP_t} + \underset{(7.573^{**})}{0.938RBM_{t-1}}$$

$S = 0.045 \quad Z_6(1) = 0.881$

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† LM(1) test for (first order) residual autocorrelation under instrumental variables estimation.

EQUATION VII — No instrumentation required. All variables predetermined

EQUATION VIII

$$RM_t = \underset{(-2.367^{**})}{-1.109} + \underset{(1.648)}{0.259Y_{t-2}} - \underset{(-4.605^{**})}{0.012DP_t} + \underset{(8.195^{**})}{0.921RM_{t-1}}$$

S = 0.027 $Z_6(1)$ = 0.003

EQUATION IX — No instrumentation required. All variables predetermined

EQUATION X — No instrumentation required. All variables predetermined

EQUATION XI

$$RDM_t = \underset{(-2.828^{**})}{-2.136} + \underset{(2.118^{**})}{0.422Y_{t-2}} - \underset{(-3.868^{**})}{0.018DP_t} + \underset{(7.134^{**})}{0.911RDM_{t-1}}$$

S = 0.044 $Z_6(1)$ = 0.044

EQUATION XII — No instrumentation required. All variables predetermined

EQUATION XIII

$$RSD_t = \underset{(-2.060^{*})}{-2.026} + \underset{(1.892^{*})}{0.439Y_{t-2}} + \underset{(3.043^{**})}{0.020RR_t} + \underset{(6.783^{**})}{0.838RSD_{t-1}}$$

S = 0.057 $Z_6(1)$ = 0.000

EQUATION XIV

$$RSD_t = \underset{(-2.933^{**})}{-3.972} + \underset{(2.749^{**})}{0.789Y_{t-1}} + \underset{(1.891^{*})}{0.012R_{t-1}} - \underset{(-3.747^{**})}{0.023DP_t} + \underset{(5.535^{**})}{0.759RSD_{t-1}}$$

S = 0.055 $Z_6(1)$ = 0.597

EQUATION XV

$$RSD_t = \underset{(-2.628^{**})}{-3.155} + \underset{(2.451^{**})}{0.639Y_{t-1}} + \underset{(1.253)}{0.072LR_{t-1}} - \underset{(-4.100^{**})}{0.168LDP_t} + \underset{(6.339^{**})}{0.812RSD_{t-1}}$$

S = 0.052 $Z_6(1)$ = 1.621

EQUATION XVI

$$RDD_t = \underset{(-2.437^{**})}{-3.489} + \underset{(2.328^{**})}{0.772Y_t} + \underset{(2.517^{**})}{0.018RR_{t-1}} + \underset{(1.976^{*})}{0.511RDD_{t-2}}$$

S = 0.071 $Z_6(1)$ = 2.025

EQUATION XVII

$$RDD_t = \underset{(-4.408^{**})}{-4.694} + \underset{(4.078^{**})}{0.995Y_t} - \underset{(-3.130^{**})}{0.015DP_{t-1}} + \underset{(2.171^{**})}{0.441RDD_{t-2}}$$

S = 0.065 $Z_6(1)$ = 0.543

EQUATION XVIII — No instrumentation required
All variables predetermined

EQUATION XIX — No instrumentation required
All variables predetermined

EQUATION XX

$$RTD_t = \underset{(2.628^{**})}{-2.285} + \underset{(2.228^{**})}{0.474Y_{t-2}} - \underset{(-3.983^{**})}{0.157LDP_t} + \underset{(7.307^{**})}{0.894RTD_{t-1}}$$

S = 0.051 $Z_6(1)$ = 3.010

CONCLUSIONS

What insights can be drawn from the financial repression literature, concerning an economy such as that of Greece? We expect to find disequilibrium in the loan market. As a consequence, aggregate private investment is likely to be maintained below what could be financed in equilibrium. Moreover, investment (both externally and internally financed) may respond positively to increases in interest rates, in contrast to a developed financial system. Dynamic macroeconomic instability may be manifested as a result of the prevalence of financial rationing and inflexible interest rates. We expect to encounter wasteful and inefficient loan rationing practices. These are likely to rely heavily on collateral and/or to favour large borrowers (as has actually been observed in Greece). We expect to find parallel capital markets. Their existence also has been noted by observers in Greece; it implies that those economic benefits, which require the emergence of financial intermediaries to be obtained, are not exploited in full.

Advocates of financial liberalization have been vocal. Consequently policy makers must have realized that increases in the level of administered interest rates could promote output growth, both by enabling a higher volume of aggregate investment and by improving the allocation of resources. Indeed, while this thesis was being researched, a number of policy measures were taken (mainly during 1987 and 1988) in order to deregulate the Greek banking system. This should be sufficient to emphasize the relevance of our work to current major problems of economic policy.

This thesis enables us to offer detailed advice to a policy maker who is contemplating the liberalization of the financial system in Greece.

We have confirmed that the rationale, on which part of the literature summarized in Chapter 1 unequivocally recommends financial liberalization, is valid in the Greek case.

According to this rationale, under financial repression, investment depends on the availability of credit. Indeed, under financial repression, typically there is extreme dependence on bank finance. We have also noted that bank loans are rationed. Thus, investment becomes constrained by the availability of loanable funds.

However, as argued in Chapter 3, it does not follow that an investment equation, for a financially repressed economy, should not include other explanatory variables (e.g. income and user cost) apart from credit availability. In fact, this is a point on which this thesis has clarified the existing literature on investment functions under financial repression. We have pointed out that not all borrowers are rationed all the time. We have produced some evidence that such is the situation in Greece. Thus, we concluded that only some components of aggregate investment are determined by the availability of finance, while other parts are determined by their (neoclassical) demand. Therefore, aggregate investment is affected both by movements in income and user cost (on account of the latter components) and by changes in the availability of credit (on account of the former components). Moreover, we have argued that the user cost and income may proxy for the effect of movements in retained profits, and/or in debt service, on the availability of funds for investment. Under this interpretation, the sign on the user cost in an investment function is most likely to come out positive. This is precisely what we found in Chapter 5.

In Chapter 3, we have drawn a parallel with a recently (re)developing line of work on the impact of financial conditions on investment in highly developed financial systems. The availability of (internal) funds is put forward as a crucial explanatory variable in investment functions. This is because, for a variety of reasons, internal funds are comparatively cheaper than external funds. In the limit, the latter may be entirely unavailable due to equilibrium credit rationing in the loans and/or equities markets. A measure of outstanding loans may also be included to reflect the fact that the higher corporate indebtedness is, the more difficult it is to obtain further external finance. Further, internal funds may proxy for expectations about the prospects of the firm.

It is argued, in the financial repression literature (Chapter 1), that rises in interest rates induce an expansion in the volume of bank deposits. Therefore, an increase in bank loans is made possible. In addition, economywide profits (available for reinvestment) increase for reasons explained in Chapter 1, Chapter 2 and Chapter 3 and restated below. On both counts, investment expenditures are stimulated.

The empirical work in this thesis confirms that these mechanisms are present in Greece. Therefore, they could be exploited by a policy maker who undertakes interest rate (or more generally financial) deregulation. Of course, the ability to rely on past regularities for future policy purposes is always limited by the possibility of substantial structural changes in the course of financial deregulation. Indeed, the possibility of instability was raised in Chapter 3 in connection with the coefficients of our investment equations. However, we have enumerated the difficulties preventing a more satisfactory representation of expectations (which could resolve this problem).

Specifically, the empirical results in Chapter 5 demonstrate that private investment has been positively and very significantly associated to the volume of loans to the private sector, in Greece over the past 30 years. The empirical results in the appendix to Chapter 5 indicate that the volume of deposit liabilities of commercial banks and other financial institutions would respond positively and significantly to increases in the real deposit rate, according to the experience of (roughly) the past 30 years. Moreover, these econometric results are robust across alternative specifications of the investment function, alternative definitions of the dependent and independent variables (both in the investment and the deposit demand functions), and alternative estimation techniques.

Not only have we detected the existence of a general relationship between the availability of loans and capital formation but we can also illuminate the particulars of the transmission from credit to private investment. This is a refinement of the financial repression literature. This literature invokes the association between credit conditions and investment quite frequently but does not give much detail about its operation.

In Chapter 5, we found that the expansionary influence of an increase in credit, in real terms, on private investment takes place only after a considerable delay of around two years. We may conclude that financial liberalization (or more generally credit policy) is one of those sluggish policies which cannot safely be used for fine tuning. Admittedly, this conclusion is not upheld by the equations explaining private investment excluding expenditures on residential buildings. We have argued that the medium term nature of credit policy should not be surprising. We have pointed out that it can be attributed to the well known delays in the investment process or to lags in the formation of expectations about the availability of credit. For example, the length of gestation periods may be subject to uncertainty. Thus firms, in our sample, may have taken out bank loans as precautionary liquid holdings, more often than not, before the actual delivery of investment goods. This tendency would be reinforced by variable bureaucratic delays in the processing of loan applications, lack of alternative cheap sources of finance and occasional opportunities for round-tripping, downpayment requirements on orders of capital goods etc.

We have also explored (both from a theoretical and an empirical point of view) the possibility of a dependence of investment on multiple lags of credit. Rather than invoking an ad hoc justification, we have actually formalised this possibility in Chapter 3. We have contributed a small extension of the specification of the investment function, by Hall and Jorgenson, as a distributed lag of changes in the optimal capital stock. We made the lag coefficients depend, in a consistent manner, on the availability of credit throughout the period from initiation to completion of investment projects. We have also argued that the sign on the various lags of credit availability is ambiguous. For example, even if the provision of abundant credit stimulates investment almost contemporaneously, it may only do so at the expense of future investment. For abundant credit may merely enable orders of investment goods (which would have anyway been placed some time in the future) to be brought forward towards the present. Or overinvestment may occur in anticipation of future credit shortages. This is reminiscent of an idea encountered in the literature surveyed in Chapter 1 and Chapter 3. It is often argued that the availability of funds affects only the speed of adjustment towards, and not the long run value of, the optimal capital stock and investment. Indeed, in Chapter 5, we found that private investment in Greece is subject to the influence of loans extended at different points in the past. Sometimes the most distant credit lags bear a negative sign but the total effect of credit is positive.

The empirical work in Chapter 5 reveals a further qualification about the potency of credit policy, namely that it is subject to leakages. It is commonly assumed, in the financial repression literature, that new loans finance accretions to the capital stock. Therefore, the real value of new loans need only be multiplied by the output to capital ratio in order to obtain the resulting increment in aggregate output. Our findings suggest that this assumption must be qualified. A rise in domestic credit to the private sector, in real terms, does not translate one for one to expenditures for fixed capital formation. Part of the expansion in credit is (officially) intended for the finance of working capital, thus enabling the maintenance of the current level of production. Another substantial part (more than a third) is associated with expenditures on residential buildings. Finally, part of the expansion in credit might be diverted to totally 'unauthorised' and 'unproductive' uses. These results corroborate existing evidence on the ineffectiveness of selective credit controls. They suggest that the imposition of reserve ratios might serve to divert funds away from consumption uses (by the private sector) towards capital formation (by the public sector). They do not accord with the view in the literature that reserve ratios invariably detract from capital formation.

It is not simply our empirical work (mostly in Chapter 5) which provides only qualified support for financial deregulation. It is also the theoretical work of Chapter 1 and Chapter 2 which suggests that support for financial liberalization cannot be unequivocal. In particular, we can give the following words of caution to a policy maker who is contemplating the policy option of financial liberalization:

Financial repression is a political economic phenomenon and therefore financial liberalization may be fiercely opposed by vested interest. For example, in Greece financial liberalization was clearly opposed by the handicraft industries which would lose significant borrowing privileges.[1]

The discussion in Chapter 1 urges the policy maker to evaluate carefully the impact of financial liberalization on government finances. For financial regulations may be the means of extracting government revenue. The expenditures financed thereby (or even financial regulations themselves e.g. loan rate ceilings) may serve distributional goals. Then, financial liberalization may achieve an increase in efficiency and growth at the expense of equity. However, the prevalent view in the literature is that regulations are counter-productive and that financial repression is itself a source of inequities. On the other hand, government expenditures may finance capital formation. Then, there must be a tendency for output growth to decline, as government revenues are reduced because of deregulation. In particular, the outcome of

1. Cf. Oikonomikos Tachydromos, 19 May 1988.

financial liberalization for the total volume of loanable funds, (which measures the potential for public plus private investment hence output growth), depends crucially on the market structure in the banking system. For example, a monopoly banking system might react to loan rate deregulation by contracting in size.

Financial regulations (e.g. barriers to entry, deposit rate ceilings) may fulfil prudential functions. Therefore, their removal may lead on to prudential problems and destabilization of the financial system. For example, it has been argued in the literature, that deposit rate ceilings are required in order to prevent episodes of intense competitive outbidding among banks, for deposits, which could precipitate a systemic crisis.

The consequences of the abrupt rise in the level of interest rates, which typically accompanies financial liberalization, occasion major objections to this policy. It is well known that an uncontrolled rise in interest rates causes a severe profit squeeze to financial intermediaries with assets longer than liabilities. Indeed, it was recently suggested in the financial press in Greece[2] that interest rate subsidies had to be given to certain Greek banks. In part, this was necessary in order to enable them to cope with profitability problems accentuated by financial deregulation in 1987-1988.

Banks may also be faced with a deterioration in the quality of their loan portfolios upon financial deregulation. The general increase in interest rates is bound to put financial stress on firms which borrow in order to undertake investment in physical capital. This is an issue of

2. Oikonomikos Tachydromos, 16 February 1989

particular relevance to Greece in recent years. In the Introduction to this thesis, we have cited evidence that a significant number of firms appeared to be loss making and to be overburdened with debt service payments (even before the implementation of financial deregulation in 1987-1988).

So, in Chapter 2 we provided an extensive discussion of this problem, within the context of a suitable macromodel. We distinguished three effects of the rise in interest rates:

(i) It tends to increase investable funds by attracting additional bank deposits. Thus, it makes possible additional private loans and also raises inflation tax revenues on bank reserves.

(ii) It tends to reduce investable funds since it increases the flow of interest payments on outstanding loans.

(iii) It tends to raise the volume of investable funds by increasing economywide profits (which, potentially, may be retained for reinvestment). Indeed, when bank real interest rates rise, from all projects that depend on bank loans, it is those having the lowest profitability which can no longer break even, and withdraw. They are replaced by projects, of necessarily higher profitability, which were rationed out previously by means of non-price criteria. In addition, a rise in the real bank deposit rate may discourage (contemporaneously) self-financed, (typically low-scale), projects by rendering placements in deposits more attractive. The banks, using their superior project evaluation expertise and capable of pooling small holdings, lend out the intermediated funds to finance, higher yielding, large-scale projects.

We demonstrated that if only effects (i) and (ii) are operative, the rise in interest rates, accompanying financial deregulation, is likely to reduce steady state output growth. Moreoever, higher interest charges might be passed on in higher prices (a point elaborated in new structuralist models). However, if effect (iii) is reasonably vigorous, financial liberalization has an overall positive impact on output growth.

Although the basic model of Chapter 2 existed already in the literature, this thesis has extended and refined it. We have incorporated a government sector which raises an inflation tax on bank reserves and channels its revenues to capital formation. This modelling assumption, borrowed from the literature on inflationary finance and growth, enabled us to explore the implications of variations in government revenues induced by financial liberalization. We proved that removal of the reserve ratio is neutral for total capital formation. The rise in deposit rates would, in fact, augment government revenues within our model. But the consequent increase in government capital formation does not suffice to compensate for the decrease in private investment due to higher debt service. We have also modelled effect (iii) by expressing the share of profits in output (rather than merely the capital output ratio) as a function of the real interest rate. This was an important departure from the basic model (in the literature) since it led us to conclusions that clearly support financial deregulation.

Apart from theoretical analysis of the relevant considerations, this thesis also offers empirical evidence about the likely consequences of the general rise in interest rates during financial deregulation. More specifically, the empirical methods of Chapter 5 have not detected any particular sensitivity of private investment to changes in debt service. For the past 30 years, private investment in Greece was much more closely associated to the real value of new loans than to a measure of new credit netting out interest payments on outstanding loans. Moreover, the declines in real interest rates which took place over the past 30 years in Greece, (mostly as a result of accelerating inflation), are statistically associated with reductions in private investment. Therefore, we would expect the increases in real interest rates during financial liberalization to stimulate, rather than discourage, private investment. This is all the more likely, since financial liberalization is usually accompanied by declines in inflation, as we suggest in Chapter 1.

Additional insights can be gained from the fact that, in Chapter 5, we obtained a positive relationship between investment and the real interest rate (user cost) even after allowing, in our regressions, for the positive influence of bank credit on investment. We put forward the following interpretation for this finding: Private investment is not reduced by increases in real interest rates because economywide profits (thus the availability of internal investable funds) expand in response (i.e. effect (iii) above). Alternatively, we may be picking up (for the first time for Greece) McKinnon's effect: There may exist a positive relationship between the self-financed component of our investment series and the attractiveness of deposits, quite independently from bank advances to the private sector. This is because monetary balances have to be accumulated, prior to self-financed investment, until a threshold amount, below which holdings of physical capital are indivisible, is exceeded. A final possibility is that the user cost proxies for the flow of bank loans to the government. This would work towards a positive sign on the user cost assuming that government investment, (financed by bank loans), crowds-in private investment expenditures. Both the possibility of crowding-in and a positive dependence of private investment on retained profits have been empirically substantiated for Greece by previous authors.

Apart from assessing the impact of financial repression on capital formation, this thesis contributes to various aspects of the estimation of the investment function, in Greece, in its own right. Someone wishing to undertake research on investment in Greece can find series for total depreciation and total net capital stock only, in published statistics. Unless he/she is prepared to estimate an (implausible) equation for private and public investment together, the published data are not sufficient. However, in Chapter 3, we proposed a method to disaggregate depreciation between the private and the public sector. This enabled us to construct a series for net private investment. This was cumulated to yield a series for the net private capital stock. These series are required to be used as dependent and independent variables respectively in two distinct investment specifications. The series for private depreciation and net capital stock are also quite indispensable in order to compute a figure for the economywide (exponential) rate of depreciation. It is hard to think of a study of the investment function that could proceed without this figure. The figure is necessary in order to calculate the user cost and also in order to construct the weighted differences of income and user cost which are used as regressors in a wide range of specifications of the investment function.

Our method of 'attributing' a part of total depreciation to the capital stock of the private sector relies on two assumptions: First, that private and public capital stock depreciate at the same rate. Second, that the ratio of private to public capital formation remains constant. We have checked that the second assumption is not far from true, at least for part of our sample period. We have also provided independent checks that the series for private depreciation and private net investment are quite insensitive to the relaxation of our assumptions. Very similar series would have been obtained if we set the (assumed) benchmark values for net capital stock equal to zero, or if we had series for net (rather than gross) capital stocks. In line with our interest in the role of credit in investment, we proposed a measure for the net flow of finance, in Chapter 3. This has not been tried before in the literature on investment under financial repression. The measure nets interest payments on outstanding loans from new credit. We have discussed its accuracy given selective credit controls and long-term (fixed rate) loans.

In Chapter 4, we made further contributions to the construction of a series for the user cost in Greece. We took as our task the correct incorporation of a number of fiscal parameters in the latter. This refinement was necessary not only for the study of the investment function in general but also for the study of financial repression in Greece. If the interpretation of the positive sign on the user cost was to be maintained with some confidence, we had to make sure that our measure was as accurate as possible. Such detailed calculations are not encountered elsewhere in the literature on investment under financial repression. In order to carry out this adjustment we had to survey the relevant stipulations of the theoretical and empirical literature and adapt them for the institutional setting of Greece. Specifically, we constructed a series for the tax rate on the undistributed profits of Greek corporations. Our series is preferable to the published (statutory) rate. This is because it incorporates a non-negligible adjustment for other fiscal burdens on the undistributed profits of limited liability companies. Similarly, we transformed, (by means of appropriate weighting), the statutory allowable percentage annual rates of depreciation for tax purposes, (differentiated by type of capital), to an economywide effective rate to be inserted in the user cost of capital.

Our most significant contribution to the computation of a series for the user cost in Greece relates to investment allowances. We constructed an index in order to calculate the effective rate of investment allowances in Greece over the period 1959-1985. Our contribution is both theoretical and empirical-institutional in nature. Our index involves additional sophistication compared to what is done in the literature in connection with effective rates of investment allowances. Additional sophistication was required in order to account for specific institutional features. In particular, we attempted to capture the implications of the provision that deductions (on account of investment allowances) could be, and in fact were, brought forward long after investment expenditures had been incurred. The index captures the consequences of 'carrying foward' by averaging claims of investment allowances and investment expenditures (all in real terms) over time. Moreover, in order to deploy this index with precision, we had to take carefully into account the detail of the decrees which granted investment allowances (especially in relation to the periods over which investment was eligible and/or the deductions could be brought forward).

Not only is the index novel but the findings to which it led are also quite remarkable. Our findings of very low (total economywide) effective rates of investment allowances contrast with the very generous allowable deductions specified in the statutes (as a percentage of the eligible investment expenditures incurred). In Chapter 4, we have identified a number of factors that may explain these findings. Our analysis was guided by the detail of the legislation on investment allowances and the available disaggregations of the investment series in Greece. Thus, we have ensured that our results are not an artefact of a somewhat idiosyncratic index. Rather, we have produced independent evidence that our index gives rise to reasonable answers. For example, we calculated the effective rate of investment allowance, for the single decree which did not provide for 'carrying forward', by the method employed in the literature. This effective rate, too, turned out to be very much lower than the corresponding statutory percentage. The analysis of Chapter 4 has also enabled us to reach an informed, and unique, conclusion on the importance of investment allowances for aggregate investment: it was slight. Even so, the authorities continued to grant fresh investment allowances over a period exceeding 30 years. Perhaps no other investment incentive was offered so persistently and to such a wide range of beneficiaries. Surely, this must be an indication that investment allowances were (mistakenly) viewed as a fiscal instrument of prime importance. The analysis of Chapter 4 leads to the following recommendations in this connection. For investment allowances to have a noticeable influence on the level of aggregate investment:

a) eligibility for their benefits must be extended (at least to the service sector);

b) the allowances must be indexed (to price inflation);

c) the stipulation of a maximum percentage of profits not to be exceeded by the deductions in any single period must be abolished.

What are the general conclusions that can be drawn about the features of the investment function in Greece (apart from the influence of credit conditions)? The common conclusion from studies of investment in the US, (restated most recently by, for example, Bernanke, Bohn and Reiss 1988), that an accelerator specification performs best, is not confirmed by our findings. Although the precise role of the user cost remains subject to some uncertainty, we have found that this variable contributes to a better explanation of investment and better statistical properties for the investment equation. Moreover, ours is one of the few studies to apply the 'general to specific' econometric methodology (with its panoply of diagnostic statistics) to the specification of the investment function and indeed on Greek data. Given annual observations, only a simplified version of this methodology could be applied. This econometric procedure ensured that we obtain investment equations free from residual autocorrelation (and mostly stable). By contrast, a number of the equations reported in the mainstream literature (e.g. ibid) suffer from an autocorrelated error. The importance of this difference from the literature can be appreciated if residual autocorrelation is viewed as a warning sign for mispecification. Similarly, the investment literature acknowledges the possibility of simultaneity bias. However, this problem is actually dealt with only infrequently. By contrast we have verified that our estimates remain unchanged when two stage least squares are applied. A complete macroeconomic model of simultaneous (structural) equations was put forward to motivate the exogenous variables used in this exercise. On the other hand, we have confirmed the common observation (Chirinko 1986) that the 'neoclassical' investment specification does not perform as well as other formulations of the investment function. An investment equation with lags of Jorgenson's composite (and credit availability) as regressors does not fit on Greek data.

Our empirical work, in Chapter 4 and Chapter 5, led us to a major conclusion about the impact of taxes and fiscal incentive policies on investment in Greece. We may advise researchers of investment in Greece that adjustment of the user cost for fiscal parameters makes very little difference to the estimates of the investment equation. In part, this may be a further indication that the influence of the user cost on investment, in the Greek economy, has not been neoclassical but, rather, as described in the financial repression literature. Specifically, we obtained the following results as well: Reductions in asset lifetimes, allowable for tax purposes, were granted many times over our sample period. We demonstrated that incorporation of a corresponding small adjustment to the economywide rate of tax depreciation makes a negligible difference for the estimates of the investment function. Similarly, we undertook an analysis of the detail of the legislation which provided for investment grants. Thus, we concluded that the economywide importance of this incentive (eligibility being limited to selected regions and types of investment) was slight. Hence, we are able to recommend that grants can be safely ignored when estimating investment functions for Greece. We then proved that the remaining type of investment incentive (i.e. investment allowances) induced only minor reductions in the effective price of capital goods in Greece.

Finally, we have demonstrated that the measure which deflates the nominal user cost by an index of nominal wages (rather than output prices) does not yield substantially different estimation results. Our research indicates that what does make some difference for the structure of the investment equation in Greece is the precise choice of dependent variable. In particular, the statistical properties of the equation, and the form of the distributed lag, change when investment excluding expenditures on residential buildings is tried as the regressand. This is not surprising, since the housing decisions of individuals are bound to be subject to different influences from the production decisions of firms. Nevertheless, private investment excluding residential buildings, too, is positively, rather than negatively, related to the corresponding measure of the user cost.

I began researching this thesis with a rather vague intuition that the Greek economy is bound to be somewhat different from the (Anglo-Saxon) economies, about which I was taught at the LSE. Work on the Greek economy cannot be original, insightful or useful (e.g. for policy purposes) unless such differences are acknowledged[3]. In the Introduction, Chapter 1 and Chapter 2 of this thesis, I was able to present the financial repression approach. I believe this approach describes, quite aptly, crucial phenomena in the Greek economy. Finally, in Chapter 3, Chapter 4 and Chapter 5, I confirmed, by means of empirical methods, that the features of financial repression (especially in connection with aggregate private investment) can be identified in the Greek economy.

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3. For example, the standard reference, Meltzer (1951), cannot illuminate the monetary transmission mechanism in Greece where interest rates were administered by the authorities (until 1987).

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