Structural Change as an Equilibrium or Disequilibrium Process – An Introduction

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Contents

1. A "Model" History of the Swedish Economy

The postwar development of the Swedish economy is reflected in the history of its medium-term macroeconomic models. The 50s and 60s were a period of fast growth and relative price stability. Swedish exports were boosted first by reconstruction needs in war-ravished Europe and later by the trade liberalization which, part of the time, was reinforced by an undervaluation of the Swedish crown. The stability of the international monetary system and the seemingly well established pattern of expanding world trade induced the government to take for granted continued industrial competitiveness and the possibility of full employment policies. Medium-term policies were focused on distributing the gains of industrial productivity growth and international trade through a fastly expanding public welfare system.

The main task of the government's medium-term surveys was to check on the consistency of allocative schemes and to provide a framework for the long-term public expenditure plans, which – in the 60s – were becoming increasingly elaborate by means of various PPBS[1]-procedures. When the first medium-term macroeconomic model was developed by the Treasury in the late 60s, its aim was mainly to enhance computational convenience and further ensuring internal consistency in constructing balanced growth scenarios for the medium-term surveys (Åberg 1971). A static multisectoral model was used to compute desired equilibrium values at some future target date and to describe – or prescribe – balanced growth paths from the present to the target. The model only dealt with developments in real terms with consistent aggregate price and wage structures being computed afterwards. Although becoming successively more detailed and elaborate in terms of sector disaggregation etc., the methodology of Treasury models remained unchanged throughout the 70s (Ministry of Finance 1976).

Meanwhile the focus of medium-term problems changed drastically during the 70s. The increased price and exchange rate instability and uncertainty, demonstrated, and partly caused by, the oil price hikes, gave in Sweden rise to dramatic swings in industrial production and investment activity during the latter part of the decade. The shifts in world market demand also revealed a seriously deteriorated position for many of the raw materials and investment goods on which Swedish exports had been traditionally based. Interest became focused on the need for structural adjustment in industry to eliminate a mounting balance of payment deficit. The rapid expansion of local government consumption and central government transfers, partly used as a means of "bridging" the employment problems during international recessions, had simultaneously created a domestic budget deficit problem, which, with mounting real interest rates, threatened to lead fiscal policy into a "debttrap".

These problems meant new challenges for macromodelling. A major task of medium-term models now had to be to take explicit account of the price uncertainty and to measure the propagation and impact of changes in world market prices

[1] *P*lanning – *P*rogramming – *B*udgeting – *S*ystems.

and in Swedish competitiveness. It thus became of strategic importance to integrate price and wage formation into the models and to be able to use the models for tracing the effects of price changes on industrial profitability and investment in different sectors.

To be able to analyze the mechanisms of structural change the models must furthermore be dynamic in the sense of i.a. taking explicit account of the economic inertia represented by a given vintage structure of industrial capital and the lagged response of consumer demand. Finally, to provide a basis for policy analysis, the models should make it possible to study how various kinds of price policies and stabilization regimes could be used to ease the necessary structural and financial adjustments.

The two models documented in this book represent the first attempts – started in the late 70s – to meet these challenges.[2] They are based on widely different modelling concepts but did nevertheless result from a cooperative effort, incorporate many common dynamic mechanisms, exploit the same data-base and share many common econometric estimates. They were also initially employed to analyze the same problems, namely the impact of oil price shocks on the Swedish economy and possible policy means to insure in advance against, and/or to ease the adjustment after, unexpected dramatic changes in world market prices. The results of that study have already been extensively documented (cf. Ysander 1983b,c).

The first model, ELIAS,[3] is a six sector multiperiod equilibrium model developed by Lars Bergman at the Stockholm School of Business as a dynamic counterpart to an earlier static model of his (Bergman 1982). Like the other model, ISAC,[4] it incorporates price and wage formation and explicit links with the world market, treats capital accumulation in terms of vintages and determines consumer demand by linear expenditure functions. Apart from these dynamic elements it does not however – unlike ISAC – recognize any other sources of market inertia or rigidities. The market for both products and factors are thus assumed to clear by price adjustment in each period – where however the "period" may be interpreted as extending over several years.

The ELIAS model, as well as separate submodels developed by Bergman for different sectors of energy use, has been extensively used for the analysis and evaluation of Swedish energy policy. Besides the studies resulting from the common project already mentioned above (cf. Bergman-Mäler 1981, 1983) the model was used for evaluating the probable impact of discontinuing nuclear power production in Sweden (Bergman 1981).

The second model, ISAC, is a 36 sector disequilibrium model, developed by Ysander, Nordström and Jansson at the Industrial Institute for Economic and Social Research (IUI) in Stockholm, building on an earlier static model at the institute resembling the above mentioned Treasury model. By incorporating va-

[2] For a discussion of other models, mainly developed for pedagogical purposes, cf. Lybeck et al. (1984).

[3] *E*nergy, *L*abor, *I*nvestment *A*llocation and *S*ubstitution.

[4] *I*ndustrial *S*tructure *A*nd *C*apital Growth.

rious kinds of rigidities in price and wage formation it allows for disequilibria both in foreign trade and in the factor markets. The behavior of local governments, who employ about a quarter of total labor in Sweden, is endogenously determined by way of an integrated submodel. A fairly detailed treatment of central government taxes and transfers makes it possible also to use the model for simulating various kinds of fiscal policies and stabilization regimes.

The ISAC model has been used for several different kinds of policy evaluation studies. The studies concerning energy policy have already been mentioned (cf. Ysander 1983a, Nordström-Ysander 1983 and Ysander-Nordström 1983). A medium-term macroeconomic forecast was carried out by model simulations in 1979 (Ysander-Jansson-Nordström 1979). The long-term interrelation between industrial structural change and government expansion was analyzed in a study in 1980 (Nordström-Ysander 1980). Finally the efficiency of fiscal policy and wage policy in controlling local governments has been analyzed by model simulations (Ysander-Nordström 1985).

The Swedish Treasury has also recently raised its ambitions in regard to medium-term models. Partly based on the experience of the ISAC model and with the aid of two of its authors, an aggregate dynamic model, incorporating for the first time price and wage formation, was developed within the Treasury during 1982 and used for the 1984 medium-term survey. (Cf. Nordström 1982, Ministry of Finance 1984).

2. International Trade and Structural Change

A common starting point for the modelling work is the fact that Sweden is a small open economy which in both models is interpreted to mean i.a. that the supply of imports is perfectly elastic and that developments in the world economy can be treated as exogenously given.

A major task for the macromodels is to represent as accurately as possible the mechanisms by which price and demand changes in the world market are transmitted to the Swedish economy and there induce structural adjustment.

The transmission is modelled by export- and import-functions for the tradable goods sector of Swedish industry. In both models the level of export and import for each type of commodity depends on relative price and on the demand in world market and domestic market, respectively. Econometric estimates of price and demand elasticities are used, directly in ISAC and modified by theoretical considerations in ELIAS.

The prices of Swedish producers can thus deviate from those of foreign competitors. In Bergman's competitive equilibrium model this is explained by the assumption of "country-specific" commodities (cf. Armington 1969), while ISAC assumes price-setting producers in monopolistic competition adjusting their profit margins with regard both to the competitors' prices and to capacity utilization.

This specification of export and import functions must, however, be regarded as very rough approximations. There are reasons to expect that in some cases it is the

relative change rather than the level that will be a function of relative price development. The elasticity can moreover be expected to vary depending both on specific competitive conditions limiting the range of price competition and on general business conditions. The market reactions to price increases and price decreases are not necessarily symmetrical in amplitude and time-structure. A particular form of specification bias is also implied by the omission of all transaction and marketing costs other than price.

In the macromodels these behavior patterns are aggregated over different commodities and different time-phases which means i.a. that sight is lost of the changes in commodity composition within each aggregate. This may in itself make it difficult to interpret the price elasticities. We may be comparing aggregates of different compositions – e.g. domestic sales versus imports of a certain composite good or exports versus world market trade – which means that the measured changes in relative price may in part not be due to different price development for individual goods but simply reflect the different composition of the aggregates. Changes in composition may moreover call forth changes in the aggregate rate of price change even without a changing rate in any individual line of goods. There is e.g. some evidence indicating that Swedish firms react to a profit squeeze by concentrating their marketing efforts on those less contested markets and commodity lines where they can raise prices without losing too many customers. The fact that the estimated relative price elasticities are rather low in magnitude – between 1 and 2 – may therefore partly be explained by marketing efforts being concentrated to price-insensitive subgroups within each aggregate.

The price elasticities used may thus be biased particularly in measuring effects of general relative price changes. However, sensitivity analysis seems to indicate that for a reasonable range of elasticity values the demand growth will still exert a dominant influence (Nordström 1982).

Changes in world market growth and/or price can be expected to affect Swedish industry in several stages. The immediate impact on sales will first be reflected in changing factor earnings – wages and profits. It will be further buffered by a changed rate of scrapping of old production capacity, and in ISAC – with producers in monopolistic competition – also by modified price-setting in foreign and domestic markets, respectively. By changing price and profit expectations the transmitted signals will in the next stage also influence investment behavior and by that the long-term resource allocation and industrial structure.

3. The Dynamics of Capital Accumulation

The time-lags and inertia in structural adjustment are in both models represented by distinguishing the various vintages of productive capital. Capital is thus modelled as being "putty-clay". In the ex ante production functions there are no restrictions on input substitution. The shares for capital, labor and energy can be freely selected in order to minimize cost in terms of expected input prices. Once installed however the capacity becomes "clay", i.e. the capital ratio is fixed and no

further substitutions between major input aggregates are possible. At any given point of time the total production capacity of an industrial sector will thus be made up of a long line of different vintages, whose diverse input ratios "embody" the price expectations current at the time each vintage capital was invested. As a consequence the ex post functions will exhibit decreasing returns to scale in labor even when the ex ante production functions are linearly homogeneous.

The vintage structure of capital explains both why structural adjustment to world market changes is slow and why complete specialization is avoided even in competitive equilibrium models like ELIAS.

A long-term deterioration in the international competitive position of a particular branch of Swedish industry will only gradually be reflected in a shrinking of the productive capacity of that industry. The structural adjustment will come about by an increase in the scrapping of old plants and a decrease in the investment in new capacity. The funds and real resources thus released will successively be transferred to other and move profitable lines of production. In the same manner increased capital costs, caused e.g. by raised real interest rates, will only gradually become fully reflected in changed capital ratios.

The structural adjustment will in general proceed somewhat slower in ISAC than in the competitive equilibrium world of ELIAS, since "sticky" pricing and an evening out of utilization between plants – due to technological reasons and employment considerations – will delay the weeding out of plants earning a zero or negative quasi-rent. On the other hand, the decline in sales and profit will for the same reason be correspondingly greater and will react both on prices and investment and thus reinforce adjustment. Altogether adjustments in ISAC will, however, be somewhat slower and carried out on a lower profit level than what would be the case in a perfectly competitive world.

Since both models assume a fixed exchange rate regime, a deterioration of the terms-of-trade by e.g. import price increases not matched by price increases in the export markets, will not be accommodated by a changing exchange rate. Adjustment to the diminished real national income must instead come about through lowered real wages and various kinds of import substitutions. Tendencies of rising deficits in the balance of payments will in the ELIAS model be automatically countered by a rise in domestic saving, while in ISAC this would normally require government intervention. In both models the change in import prices would modify the pattern of input prices and thus influence both the choice of technology and the allocation of investment resources. Changed profit expectations and capacity utilization will also affect investment decisions in ISAC, where these decisions are represented by investment functions, while in ELIAS the total gross saving ratio is exogenously given.

4. The Energy Economy

The experience of the oil price hikes in the 70s made it particularly interesting to model and measure the effects on the Swedish economy of changes in the interna-

tional energy markets. As already mentioned the concern about the impact of oil price changes was in fact one of the major reasons for starting the modelling work.

A principal ambition in both models has therefore been to represent as accurately as possible the structure of energy demand both by households and by industry. In modelling industrial energy demand technological choices are represented in a way that can be interpreted as reflecting a multistage decision-making. In ELIAS nested CES-functions are used. The first choice is between a capital-labor composite and an energy composite. In the second stage the substitution possibilities within the composite commodities are exploited, capital versus labor and electricity versus fuels, respectively. Once these ex ante choices are made, the input shares are regarded as fixed for that vintage.

In ISAC an ex ante choice is made regarding the input shares for capital, labor, electricity, fuels and other intermediate goods. Within the fuels aggregate, however, ex post substitution can be made between oil, coal and domestic fuels. The rationale behind this assumption is that the choice of fuel often has only limited effects on the rest of the installed production technology.

This relatively detailed specification of industrial energy demand combined with the vintage capital approach makes it possible to study the technological adjustment necessitated by e.g. sudden oil price increases. One of the main results of the energy policy studies mentioned earlier was to show that a major part of the macroeconomic impact of oil price hikes on the Swedish economy is due to various kinds of economic inflexibility. The ELIAS simulations were particularly concerned with the technological inflexibilities and with ways of designing and investing more flexibility in regard to energy use into the economy. In the study employing the ISAC model which incorporates a good deal of price and market inflexibilities as well as a wide range of government policy instruments, interest was more focused on designing and safeguarding flexible policies to compensate for the rigidities of the markets (Ysander 1983b,c).

5. Classical versus Keynesian Modelling

We have so far mainly dealt with the aims and features common to the two models – the way price signals and shifts in the world markets are transmitted through foreign trade into Sweden's small open economy and there gradually transform capital structure, production technology and energy use through the successive replacement of old vintages.

Of at least equal importance and interest, however, are the conceptual differences in approach between the models. They, in fact, seem well suited to exemplify the methodological dissimilarities between the two traditions in macromodelling often, somewhat inaccurately and simplistically, identified as "classical" and "Keynesian".[5]

[5] For a stringent but more narrow definition of classical and Keynesian macromodels, cf. e.g. Sargent (1979).

The label "classical" is here meant to refer not so much to the common foundations of neoclassical analysis as to some characteristic premises and priorities shared both by "old" and "new" classical economists. Models in this tradition are usually built on the assumption of a competitive equilibrium with immediate market clearing, and priority treatment is often given to the supply side of the economy, with demand, and particularly public demand and policy, dealt with in a more summary fashion. In the unavoidable trade-off between on the one hand theoretical consistency and coherence and on the other hand empirical verification and realism, model builders in this tradition tend moreover to favor the former.

The "Keynesian" modellers usually lean the other way and therefore tend to incorporate various forms of marked rigidities and limits to competition into their macromodels, even at the risk of having to accept "adhocery" and divergencies from the postulates of rational behavior. The recognition of market failures is moreover seen as implying the need for government intervention and demand management, requiring a more detailed specification of demand structure and policy instruments.

In terms of this oversimplified dichotomy ELIAS should undoubtedly be called a classical model while ISAC seems well qualified for the Keynesian label.

ELIAS is a competitive equilibrium model, assuming immediate market clearing. It extends the earlier analysis of multisectoral growth by Leif Johansen (1960) mainly by "opening" the model and explicitly formulating the linkage to the world markets and by taking account of the dynamics of capital accumulation by using a vintage representation of technological choice. The emphasis is on analyzing supply side developments although household demand is represented by a linear expenditure system, common with ISAC. Government demand is taken as an exogenously given aggregate and no taxes or any other policy instruments are explicitly specified. The specification of the model is to a large extent directly derived from neoclassical economic theory. To achieve this some empirical accuracy must be sacrificed by substituting calibrations and "guesstimates" for econometric estimates. It is also in line with the ambition of theoretical transparency to keep the model relatively small and compact. The specification has moreover been formulated so as to make it possible to use rational expectations and some simulation experiments have indeed been based on this assumption.

In ISAC, belonging to the tradition of Keynesian disequilibrium models (cf. Barker 1976), the modellers have gone far in the opposite direction, trying to incorporate various kinds of adjustment obstacles – besides immalleable vintage capital also sticky wages and prices, cash-flow restrictions on investment financing and the inertia and lags observed in both private and local government consumption. Government demand and policy instruments are specified in some detail with local government budgets being endogenously determined. The model is "extra-Keynesian" in the sense that it has been designed to make it possible to take into consideration also rigidities in local governments and various possible constraints on central government policy. These ambitions together with the desire to be able to exploit available statistics and survey data on individual industrial branches have made the model big and rather complex. This unavoidably entails the risk for

inconsistencies and difficulties in tracing unambiguously the effects of variations in the exogenous variables. As far as possible the implementation of the model has been based on econometrical estimates.

These differences between the models will affect the analysis of structural change in important ways. With the equilibrium assumptions of the ELIAS model we can study in isolation the long-run impact of world market disturbances on Sweden's industrial structure with the immalleability of capital as the only factor of inertia and without getting the causal picture blurred and distorted by central government interventions and endogenous local government reactions. The picture will be clear but partial in the sense of neglecting interrelations between private and public sectors and focusing only on the industrial structure.

With the ISAC approach market disequilibria – surpluses or deficits of foreign exchange, public budgets, production capacity and labor – will be a normal feature of model projections and will have feed-back effects in the form of price modifications, rationing of supply and changing patterns of local government allocations. From a disequilibrium situation the model economy may finally – with the help of or despite economic policy measures – fetch up in a new equilibrium or steady-state growth, barring new disturbances. The adjustment path will in most cases affect the final structure in several important ways. To study this interdependence between short-run instability and long-term structural growth is indeed one of the main purposes of the ISAC model.

6. Market Behavior

The differences between the two models are best exemplified by looking at the functioning of the various markets.

In the *markets for tradable goods* flexible prices will guarantee equilibrium between demand and supply in ELIAS. Total demand is composed of export demand, investment demand, household demand and intermediate demand. The intermediate demand – apart from energy – is determined by input coefficients, which are the same for all vintages. The demand for investment goods is derived from the investment within the different sectors. Household demand is determined by the aggregate consumption propensity – assumed constant in ISAC and indirectly determined in ELIAS by the given gross saving ratio. The distribution of total household demand between different commodities is in both models determined by a linear expenditure system. Supply by the profit maximizing and price-taking firm will in the assumed competitive equilibrium be set at levels equating market price with marginal cost.

In ISAC the producers are instead price-setters in monopolistic competition. Their profit-maximization is moreover constrained by i.a. employment considerations, forcing them to try to keep an even rate of utilization between the plants in operation,[6] although successively scrapping units with a negative quasi-rent. The

[6] For a discussion of the modelling of constrained optimization in disequilibrium model, cf. i.a. Bureau-Miqueu-Norotte (1984).

producers may also discriminate in their price-setting between foreign sales and the home market. In both cases their pricing can be said to reflect an attempt to cover costs, computed as average variable cost plus planned depreciation and a target rate of return on installed capital. This "cost-price" is then modified to take account both of foreign competition and of variations in capacity utilization. As already exemplified above, the "sticky" prices and the evening out of capacity use will tend to slow down structural adjustment, while the possibility of price discrimination will sometimes mean that home consumers subsidize foreign sales by inflated domestic prices. Production is assumed to adjust to actual sales with proportionate variations in stock-keeping. Disequilibria will thus occur in the form of over- and underutilization of capital. A slow adjustment of capacity will take place, since investments are determined by the rate of utilization as well as by past profit performance.

Supply in the *labor market* is exogenously given in both models. Demand is derived from the levels of current production in the private and public sectors.

The mechanism for wage determination is, however, very different in the two models. In ELIAS the general wage level is determined as an equilibrium price, guaranteeing full employment. In order to take account of labor heterogeneity, however, an exogenous wage structure is imposed by multiplying the general wage with sector-specific coefficients.

Wage-setting in ISAC is instead modelled as the outcome of a negotiating process, where wage earners try to get compensated for both inflation and productivity gains but where the final result will be modified by current market conditions, i.e. unemployment. Long-run wage adjustment will thus be reinforced by the change in total employment, resulting from the current bargaining. For public employees a one-year lag in wage settlement, relative to the private sector, has been usual and has been assumed to continue in the future. Apart from this time-lag in compensation, there are no sector specific wage differentials in ISAC.

There are no explicit financial markets in either model. The rate of exchange is in both models assumed to be exogenously determined. The treatment of *capital transactions,* i.e. investments is however different.

In ELIAS the gross saving ratio in the economy is assumed to be given. Since the size of the balance of payment deficit or surplus is further assumed to be set by government at some target value, total domestic saving or investment will be determined along with domestic production. Investment resources are then allocated between the different production sectors in proportion to the expected relative profitability of new capacity within each sector. In principle the market rate of interest is determined as the "cut-off" rate which makes total investment demand equal to the given supply of investment resources. In practice, however, a slightly more roundabout way is employed to ensure also that rates of return will tend to equalize between sectors despite the absence of returns to scale in the ex ante production functions. The capital market implicit in this modelling can perhaps be described in terms of a given "loanable fund" with the market rate of interest determined by the "marginal efficiency of capital".

In ISAC the rate of interest is instead assumed to be determined by conditions in

the international financial markets. The small open economy with its heavy dependence on international finance is supposedly unable under a fixed exchange rate regime to deviate substantially and persistently from international standards of yield. This assumption could be interpreted as implying a central bank policy of monetary accommodation aimed at keeping the public's demand for money satisfied at the given rate of interest. The internationally determined rate of return requirement is further transformed in the model to a particular rate for each branch of industry by taking account of differences in depreciation rate, tax treatment and solidity.

Investments in the different sectors are in ISAC functions of capacity utilization and past "excess" profits. These excess profits are measured relative to the user cost of capital, with the rate of return requirement as a major component. The required rate of return will influence the firm's pricing and investment and by that also its saving, but will not affect the saving ratio for households. The main burden of adjusting total domestic saving to avoid surpluses or deficits in external payments will thus fall on the public budgets, particularly the state budget.

7. Government Behavior and Stabilization Regimes

In deterministic equilibrium models, where instant market clearing is insured by flexible prices, stabilization and incomes policies are almost by definition superfluous. There is consequently no need for a detailed specification of public budgets in order to pinpoint the various available policy instruments or to study the possible destabilizing effects of endogenous local government action. It is thus consistent with the modelling ambition in ELIAS to treat public spending as an exogenous aggregate and to define taxing only implicitly by the assumed constant ratio of gross saving in the economy.

The opposite is true of the disequilibrium model, ISAC. The interrelation between stabilization problems and structural change is here in the focus of interest. In order to be able to study these interrelations a detailed account of public allocations, of taxes and transfers and a brief accounting of their distributive effects are built into the model. By the use of a submodel, LOGOS, (cf. Ysander 1985), the behavior of local governments is moreover endogenously determined.[7]

[7] The local government sector in Sweden is, by international standards, big, financially independent and expansive. It employs more people than the manufacturing industry and thus exerts a dominant influence on wages and labor market conditions. During the 70s the overall net effect of variations in local government activity appears to have been procyclical and destabilizing. The LOGOS model is a ten-equation system determining five kinds of service expenditures, two kinds of transfers, investments, borrowing and, as a residual, the local income tax rate (cf. Ysander (forthcoming)). Its incorporation in the macromodel has made it possible to explain i.a. the inefficiency of grants policy in changing the local government share of total consumption and the possibility that local government may by itself generate cyclical movements in wages and prices and reinforce disturbances from abroad (Ysander-Nordström 1985).

One of the main purposes with the ISAC model has been to use it for policy evaluation. Apart from the studies of energy policies, already mentioned, the main emphasis has been on medium-term stabilization regimes, ranging from various fiscal policies and control measures directed at local governments to wage controls and other income policies. In Keynesian terms one could say that the exogenous interest rate in ISAC combined with inelastic household saving and sticky wages make fiscal policy needed. At the same time adaptive expectations, demand-sensitive investment functions and the absence of financial crowding-out usually ensure that fiscal measures will have a short-run impact on employment before this effect is overtaken by a wage-propelled inflation.[8]

8. Comparing Models

Having examined the various characteristics of the two models we will try to sum up the discussion by comparing the models in terms of realism, relevance, resilience and robustness.

Econometric methods are supposed to help us in determining to what extent a model explains real life events satisfactorily. Unfortunately we are seldom able – even when we try – to use econometric tests also to choose between alternative models – alternative simplifications of reality.

Some of the conceptual differences between ELIAS and ISAC belong to the core of current macroeconomic controversy. The attempts made so far to test econometrically key assumptions and parameters do not seem to have yielded very conclusive or generally convincing results. One cannot escape the impression that the macroeconomic argument is often not just about the right answers but in equal measure about the right choice of questions. We argue about *realism* even when we really disagree about *relevance.*

The different aims of our two models exemplify the range of relevant questions. The interest in ELIAS is mainly focused on analyzing as clearly as possible the mechanisms of long-term structural adjustment, while largly abstracting from the short-term aberrations and stabilization problems on the demand side. ISAC instead aims at providing quantitative answers to these short-term questions and investigates how the management of short-run problems can affect the process of long-term structural change. The choice of question may depend on your time perspective or special interests but can also be contingent on whether you think short-run problems matter and can be meaningfully treated by public policy.

[8] In practice the stabilization policy experiments are usually set up in the following manner. The multiplier effects of variation in policy instruments on certain chosen target indicators are measured for a predetermined medium-term period in relation to a reference growth path. The results are then tested to see if the dynamic structure can be viewed as approximately linear in a local neighborhood of the reference path. If this is possible it is a straightforward matter to compute "optimal policy packages" or the trade-off between policy instruments in terms of the target indicators. (For a discussion of linearized model analysis and the application of control methods, cf. e.g. Kuh-Nease 1982 and Chow 1982).

The problem of *resilience* is important both in equilibrium and disequilibrium models. With resilience we here mean the ability of an economic system to absorb temporary outside shocks and adjust back to a stable growth path close to the one initially given without intervention in the form of policy changes. Intuitively one tends to presume that models with a Walrasian market equilibrium like ELIAS will have a high degree of resilience. The flexible prices will buffer the shocks and there will be no risks that the feed-back of disequilibria will further reinforce the deviation from the original growth path. In the case of ELIAS the intuition seems true as far as can be judged from the simulations carried out. For ISAC it is more difficult to know what to expect. Experiments show, however, that feed-back mechanisms in the labor and capital markets will tend in time to restore full employment of both people and capacity. There is no corresponding mechanism though for the balance of payment.

Another important aspect of models concerns *robustness,* i.e. their structural stability as related to the parameters of the models. To what extent are the constant parameters really constant and, if not, how sensitive is the model performance to parameter changes?

A number of sensitivity tests for parameter changes has been carried out for ISAC. They show i.a. that even though the model performance changes continuously and not very dramatically with variations in single key parameters, quite large deviations may occur if several parameters are allowed to vary simultaneously. The problem with these kinds of test is of course that we have no reliable way of deciding in advance which are the parameters most important to the dynamics of the system. Methods have been developed for measuring the relative importance of parameters in terms of a linear approximation of non-linear models (cf. e.g. Kuh-Nease 1982). These methods however still leave us with the question how valid the approximation is outside the chosen reference path.

Another aspect of the problem concerns the reliability of econometric estimates, when applied deterministically in new economic situations (cf. Lucas 1976). How far do we go wrong by neglecting not only random variations but also adaptive changes by the economic agents reacting to new conditions? These are obviously important questions, particularly for models like ISAC, which depend to a great extent on econometric estimates. The fact that both external conditions and economic policy in Sweden have changed drastically since the period of estimation increases the uneasiness. We have so far no way of resolving this dilemma. We can only hope that errors of this kind will not be able to change the sign and direction of the results. A reasonable conjecture could perhaps be that the implications are less important for short-run behavior than for long-run performance (cf. Brandsma-Hughes Hallet 1984). Whatever the truth of this much work remains before we can be sure of having achieved reasonably reliable and robust models.

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