DET ØKONOMISKE RÅD

SEKRETARIATET

Structural VARs and structural changes

Has "new economics" changed the way economies work?

Hans Christian Kongsted
and
Merete Konnerup

Working Paper 1998:2

The Secretariat publishes a series of Working Papers, which primarily contains detailed information on the analyses of selected subjects of the reports by the Chairmanship. The Secretariat is responsible for the series of Working Papers.

Peder Andersen
Head of Secretariat

ISSN 0907-2977 (Arbejdspapir - Det Økonomiske Råds Sekretariat)
Tidligere udgivne arbejdspapirer: se sidste side.

Fås ved henvendelse til:

Det Økonomiske Råd
Sekretariatet
Adelgade 13, 5.
1304 København K

Tlf.: 33 13 51 28
Fax: 33 32 90 29
E-post: dors@dors.dk
Hjemmeside: www.dors.dk

Signaturforklaring:

- Oplysning kan ikke foreligge/foreligger ikke.

Som følge af afrundinger kan summen af tallene i tabellerne afvige fra totalen.

Structural VARs and structural changes
Has "new economics" changed the way economies work?

Hans Christian Kongsted,
Institute of Economics, University of Copenhagen

and

Merete Konnerup,
The Secretariat of the Danish Economic Council

Working Paper 1998:2

Abstract:
The subject of this working paper is to investigate whether "new economics" e.g. globalization and the digital revolution, has changed the way economies work at the aggregate level. The paper elaborates on the findings reported in *Danish Economy*, *Spring 1998*. The consequences of "new economics" in a standard textbook Aggregate Supply / Aggregate Demand setup are evaluated and empirically testable hypotheses are derived. Structural VARs are estimated for Denmark, West Germany, United Kingdom, and the United States. The hypothesis of a structural break in the 1990s is tested but no significant breaks are found. Although there is some support for improved performance on certain markets in certain countries there is only scarce evidence of any "new economy" at work at the aggregate level.

Keywords: "New economics", aggregate demand, aggregate supply, structural VAR

JEL: O4, E3, C3

Table of contents

1. Preface

A concept of "new economics" has emerged in recent years: The American economy in particular – and perhaps economies in general – seem to function differently in the 1990s in such a way that we are at the dawn of a prolonged period of higher than usual growth and lower than usual inflation.

The main background for "new economics" is that the American economy since the beginning of the 1990s has experienced persistently high growth and low inflation for an unprecedented period. Unemployment has fallen to a level which just a few years earlier was seen as being incompatible with a stable inflation rate. This has fuelled a belief that the known link between growth in real activity, capacity utilisation, and unemployment, on the one hand, and wage and price inflation, on the other hand, has been severed or changed. This again has spurred a search for explanations for a possible change. This paper outlines several phenomena which have been brought forward in the debate as possible causes of changes in the economic environment in the 1990s:

1. The increasing importance of the production of services
2. Globalization
3. The digital revolution
4. Changes in the financial sector
5. Changes in the market for goods and services
6. Changes in the labour market
7. Changes in macroeconomic policy

The purpose of this paper is to answer the following two questions:

What is the expected joint impact of these changes on the way the economies work?

Did the aggregate workings of the economies actually change that way?

This is a macro analysis, looking only at changes in the economy at the aggregate level. No doubt, "new economics" have had a major impact on certain parts of the industrialized economies e.g. the textile industry. But an analysis of consequences on the micro level is beyond the scope of this paper.

Accordingly, rather than going into detail with the individual changes the purpose of this paper is to assess their predicted joint impact on the economy. This is accomplished in a simple theoretical model of an economy, the Aggregate Supply/Aggregate Demand (AS/AD) model. Whether the expected effects on the

workings of the economies have indeed emerged in certain selected countries in the 1990s is tested statistically in structural Vector AutoRegressive (VAR) models of the Blanchard and Quah (1989) type.

The analyses are based on yearly data 1960-97 on real GDP and consumer price indices for the following countries: Denmark, West Germany, United Kingdom and the United States. There are two exceptions to the standard sample period: Data for Denmark starts in 1948 and data stops in 1994 for West Germany.

The United States is chosen for obvious reasons since the country and its economy fostered the "new economy" idea. Denmark and United Kingdom also experienced a favourable business cycle in the 1990s which qualify them for the analysis. As a country where economic growth has been less impressive in the 1990s West Germany is also included in the analysis.

2. "New economics" – seven phenomena

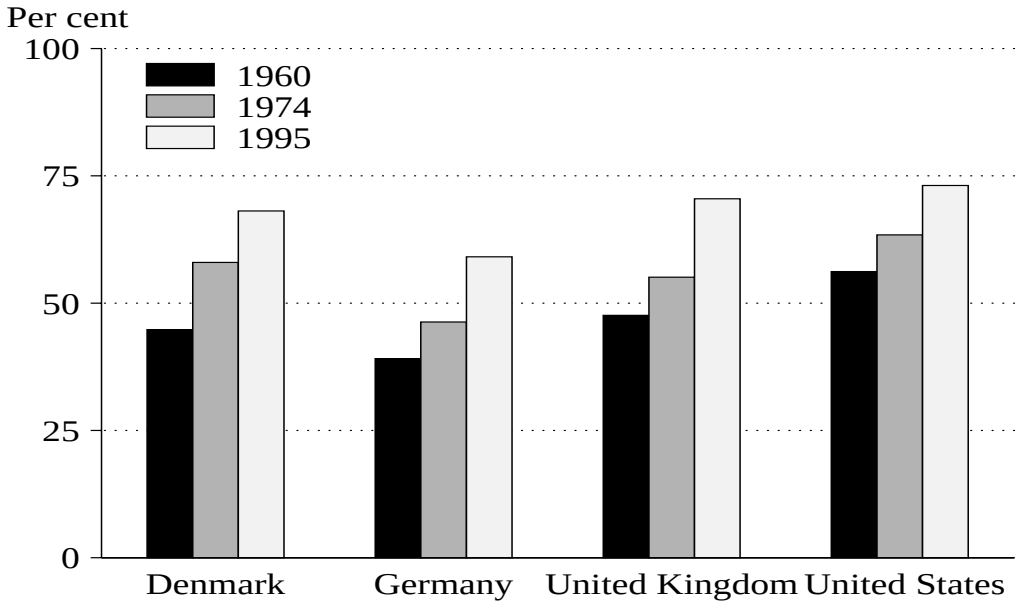
We consider a broad selection of phenomena which have been put forward in the economic debate as possible reasons why the functioning of economies could have changed in the 1990s. We evaluate to what degree each of the changes can be described as being distinctive for the 1990s. We also state for each phenomenon its expected consequences with emphasis on increasing growth, lowering inflation, or reducing the amplitude of the business cycle.[1]

2.1 The increasing importance of services

Modern Western economies are dominated by production of services. This dominance of services at the expense of primary production (e.g. agricultural products) and secondary production (e.g. machines) has emerged during the postwar period. It took off especially in the early/mid 1960s when manufacturing employment started to contract as a proportion of total employment. Between 1960 and 1995 the share of the work force employed in services rose approximately 20 percentage points in the four countries, cf. figure 2.1.

1) It appears unlikely that any of the seven phenomena will increase the rate of growth permanently. But if changes take place over a prolonged period of time they could materialize as what looks like a permanently higher growth rate even though they only have a permanent effect on the output *level* in the long run.

Figure 2.1 Share of service sector employment in total employment



Source: OECD, *Historical Statistics, 1960-1995*.

Production of services is characterized by lower growth in productivity measured as output per man-hour and a smaller inventory compared to manufacturing and agriculture. The isolated effect of a more important service sector on the workings of the economies would therefore probably be lower growth and higher inflation. A smaller overall inventory in the economy reduces the importance of unexpected stock building and therefore also the need to reduce production below demand to remove unwanted inventory following an unexpected drop in demand. The result is business cycles with a smaller amplitude.

2.2 The digital revolution

The development in information technology has been impressive both with respect to capacity and dispersion in the 1980s and the 1990s. Between 1975 and 1995 the capacity of a standard memory chip increased 4,000 fold and the price per unit of memory dropped by a factor of 650, cf. Grimm (1998).

The digital revolution could be expected to change how the economies work in a number of ways. The application of new technology would be expected to increase productivity growth and thereby increase real growth and decrease inflation. Easier and faster access to information would be expected to increase the speed with which prices and quantities in the economy adjust to exogenous

shocks. This could also be the consequence of improved management of production, stocks, distribution, sales etc. following improved technology in these areas. Overall, this should decrease the amplitude and duration of business cycles.

2.3 Globalization

This term covers the more and more closely knitting together of the economies through expanding flows of goods, services, and capital.

Between early 1970s and mid-1990 the OECD countries's trade increased from 10 to 16 per cent of GDP, cf. Finansministeriet (1997).[2] Since the share of services in GDP has expanded, the trade in goods in proportion to domestic production of goods has increased even more dramatically. The pattern of trade also shifted from exchange of different goods (inter-industrial trade) to exchange of goods of the same category (intra-industrial trade), cf. Dansk økonomi (1997). This shift in trade pattern occurred primarily before 1990 in the three countries Denmark, Germany and United Kingdom.[3] By the mid-1990s approximately ⅔ of the trade was intra-industrial compared to around ⅓ in the early 1960s.

During a period of increasing competition from foreign suppliers the mark-up of domestic producers would be squeezed successively, thereby increasing real growth and/or decreasing inflation, but growth in international trade and the change in the trade pattern did not happen abruptly in the 1990s.

Foreign direct investments (FDIs) have also increased globally in importance since the mid-1970s, the stock growing from 4½ per cent of global GDP to just below 10 per cent in mid-1990s, cf. Finansministeriet (1997). Growth has accelerated following liberalization of capital markets in the early 1980s.

Growth in FDIs could be expected to boost competition through an increased number of producers giving rise to the increased real growth and/or decreased inflation mentioned above.

Flows of short- and long-term capital also expanded considerably following the liberalizations of capital movements in the early 1980s. And this is indeed a development which seems to have accelerated in the 1990s. In 1997, international debt securities issues were 7½ per cent compared with US GDP, up from 2½ per

2) Calculated as 0.5*(imports+exports)/GDP and includes trade between OECD countries.

3) The United States was not included in the analysis.

cent just five years earlier, cf. BIS (1998).[4]

Still, this is dwarfed by turnover in financial derivative instruments traded on organised exchanges which in 1997 had a size corresponding to 44 times US GDP, up from a factor of 29 five years earlier.[5] Also spot foreign exchange turnover[6] is of a considerable dimension with the *daily* average in April 1995 amounting to 9½ per cent of US GDP for that year, up from 8½ per cent five years earlier and 2⅔ per cent ten years earlier, cf. BIS (1996).

Growth in the width and depth of international capital markets would be expected to improve the workings of the economies. Easier access to cheaper and more sophisticated financing would be expected to lead to a lower cost of capital and to increase capital stock per employee thereby increasing the level of productivity and output and/or decreasing the price level.

So-called "credit crunches" have been known in the past to contribute to the severity of downswings in economic activity. If firms are limited to credit from domestic credit institutions, financial problems in one sector of an economy could spill over to other sectors. This is because domestic credit institutions would contract credit generally in face of problems in one sector of the economy due to their large exposition to domestic risks. With the opening up of an international capital market it has become easier for credit institutions to hedge against risks in certain sectors. And vice versa for different sectors to hedge against credit contractions by certain credit institutions. This could contribute to a reduction of the amplitude of the business cycle.

2.4 Changes in the financial sector

Changes in the financial sector include the liberalization of the capital markets by early/mid 1980s and the fact that this sector in particular has benefitted from the new information technology. The result has been the impressive development in width and depth in the international markets for capital, derivatives, and currency in the 1990s mentioned above. So, the changes in the financial sector is the main factor behind the above described growth in the financial markets and the derived

4) Flow data for international bonds; for money market instruments and notes, changes in amounts outstanding, excluding exchange rate valuation effect.

5) Interest rate futures and options, currency futures and options, and stock market index futures and options measured as turnover in notional amounts.

6) Reported spot foreign exchange turnover net of local inter-dealer double-counting.

effects on real growth, inflation, and the business cycle.

The four phenomena mentioned up till now have been truly global in their scope and to a certain degree quantifiable. The last three phenomena vary more across countries and are also more difficult to convert into numbers.

2.5 Changes in the market for goods and services

Privatisation, liberalisation, and deregulation are among the structural policies aimed at increasing competition in the goods and services market.

Government ownership of industries which supply infrastructure services e.g. postal services, railways, telecommunications, electricity, airlines etc. have been widespread in many countries.

Table 2.1 Ownership of industries, May 1992

	Postal services	Rail-ways	Telecom-munications	Elec-tricity	Gas production	Air-lines
Denmark						
West Germany						
United Kingdom						
United States						

Note: More than 75 per cent government ownership

Between 25 and 75 per cent government ownership

Less than 25 per cent government ownership

Source: OECD (1995b).

This began to change in the late 1980s and the 1990s. Table 2.1 can be viewed as a status in the middle of this ongoing process. Since May 1992, Denmark has privatized telecommunication and part of the postal services. Significant reforms have recently been introduced, are pending or being contemplated in Germany.[7] At the Federal level, privatisation efforts have reduced the holding of companies

7) OECD (1995a).

from just below 1000 in 1982 to about 400 at the end of 1994. This trend continued the following years. E.g. ownership in Deutsche Telekom was reduced to 74 per cent in 1996.[8] Lufthansa was fully privatized in 1997. United Kingdom carried out an extensive privatisation programme in the 1980s and 1990s. Telecommunication, energy, water, and air and road transportation were privatised in the middle/late 1980s and railways in 1995/96.[9] The United States government's ownership of industries is not extensive and competition enhancing policies have been focused on deregulation. The latest reforms have been aimed at further deregulation of telecommunications and electricity.[10]

All in all, the late 1980s and the 1990s have seen an increased focus on privatisation, deregulation and competition enhancing policies as ways of improving efficiency in many industrialized countries. The introduction of EUs internal market in 1992 can also be viewed as part of this widespread strategy.

The overall effect of the competition enhancing policies is expected to be increased real growth and decreased inflation during the implementation period. Business cycles could also be expected to change if increased competition forces producers to react faster to changes in the economic environment.

2.6 Changes in the labour market

Structural failures in the labour market have been high on the agenda in industrialized countries in the last 10 years or so. The focus has been on institutional barriers to real wage flexibility and the reduction of unemployment. The organization of the labour market varies considerably across countries. Likewise, the structural reforms implemented vary both with respect to scope and content.

The American labour market is generally considered to be one of the more flexible. No major reforms have been implemented in the 1990s, but structural changes have taken place such as a diminished influence of labour unions. The British labour market underwent significant structural changes in the 1980s and early 1990s. A broad range of indicators point to a significant improvement in

8) OECD (1997b).

9) OECD (1996a).

10) OECD (1997c).

British labour market performance since the mid-1980s.[11] The labour market reforms embarked upon in the Danish labour market in the period 1994-96 have proved beneficial to the functioning of the economy.[12] Reforms of the German labour market have been somewhat more moderate, but there have been a wide range of developments, which can be expected to improve the functioning of the labour market.[13]

The case of significant labour market reforms is not as clear-cut as the spread of the digital revolution or globalization. But increased focus on the need to improve flexibility in the labour market have been high on the policy agenda in industrialized economies in the 1990s. A more flexible labour market would be expected to result in a quicker response of wages to changes in the economies, reducing the magnitude of business cycle variations.

2.7 Changes in macroeconomic policy

The last phenomenon to be discussed here, which might have affected the economic performance in the 1990s, is a change of priorities in macroeconomic policy. Low inflation and budgetary discipline have moved to the forefront at the cost of short-term stabilisation policies.

In the United States a law has been passed calling for a balanced budget by 2002. United Kingdom adopted an inflation target in 1992 followed by increased independence for the Bank of England in 1997. Inflation control and budgetary discipline are also central to the formation and operation of EMU and the associated Stability Pact.

A credible monetary policy backed by a credible fiscal policy aimed at keeping inflation at a low and steady level will reduce inflation expectations in the economy. Risks involved in planning investments over a longer time period is thereby reduced. This would be expected to increase the level of investment. During the period where investments adopt themselves to a lower level of risk, real growth would by higher.

11) OECD (1996a).

12) OECD (1997a).

13) OECD (1997b).

2.8 What are the expected consequences of the seven phenomena?

The timing of the seven phenomena and their respective isolated effects on the economy are not altogether similar. We have chosen the following three hypotheses to represent the expected joint consequences of the seven phenomena if they indeed have been able to change fundamentally how the economies work in the 1990s:

- The trade off between growth and inflation is expected to have changed in the 1990s. The average rate of growth being higher than the rate which has historically been consistent with a low level of inflation.[14]

- Since the seven phenomena to a varying degree are international trends and e.g. globalization has the effect of opening up the economies to outside influence, one should expect that shocks have become more correlated across countries in the 1990s.

- Business cycles are expected to have reduced their amplitude in the 1990s.

3. "New economics" and the AS/AD-model

The first step towards an assessment of the impact of the seven phenomena on the way economies work is to evaluate "new economics" in a standard theoretical economic model. We have chosen the aggregate-supply-aggregate-demand framework (the AS/AD-model) familiar from textbooks.[15] The AS/AD-model is the closest thing the economics profession possesses to a consensus model, cf. Bayoumi and Eichengreen (1994).

In this section, the AS/AD-model is introduced and the joint impact of the seven phenomena are related to the model.

There are two central assumptions in the model. First, in the long run real activity in an economy is solely determined by the amount of productive resources, tech-

14) The trade off may change permanently, i.e. as a permanent change in the long-run rate of growth, or the apparent change can be the result of a prolonged adjustment process in the output *level* over e.g. the 1990s, leaving the long-run growth rate unchanged. While the empirical analysis below in principle considers the former hypothesis, it is not distinguishable from the latter – more likely – interpretation when the change extends to the end of the sample, see also footnote 1).

15) E.g. chapter 10.3 in Blanchard and Fischer (1989).

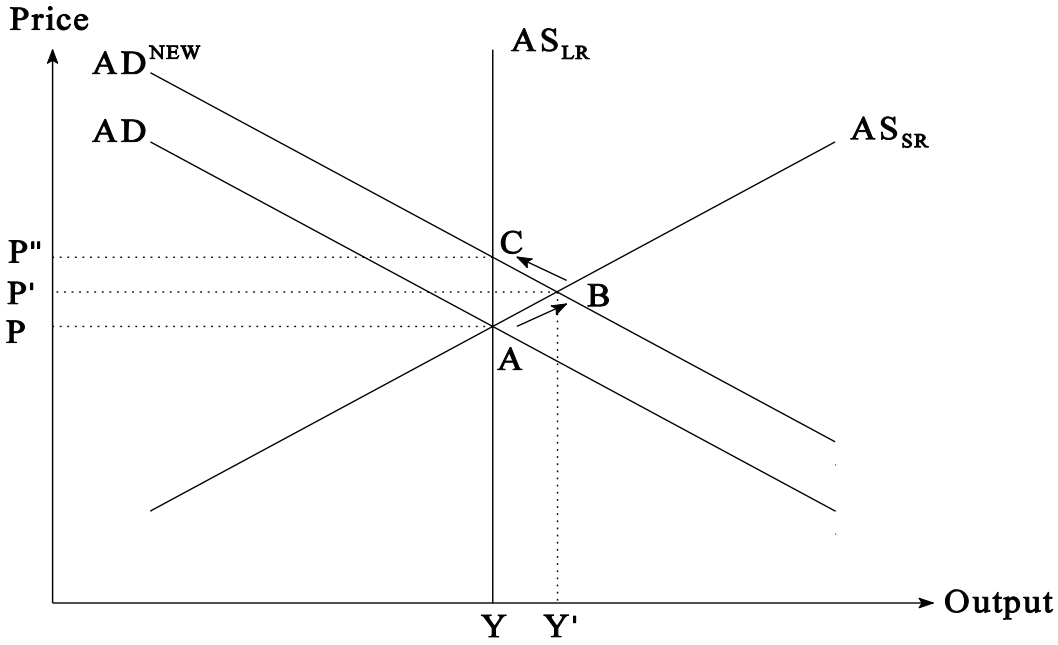
nology, and the relative prices between inputs in production. Secondly, wages and prices move sluggishly in the short run.

3.1 The AS/AD-model

The model is used in a number of articles e.g Blanchard and Quah (1989), Gerlach and Klock (1990,1991), Bayoumi and Eichengreen (1992,1994), Hansen (1997), and Keating and Nye (1998).

The AS/AD-model consists of an aggregate supply curve (AS) and an aggregate demand curve (AD), cf. figure 3.1 and 3.2. The AD-curve has a negative slope in the graphs because fewer goods and services will be demanded if prices rise.

Figure 3.1 Demand shock

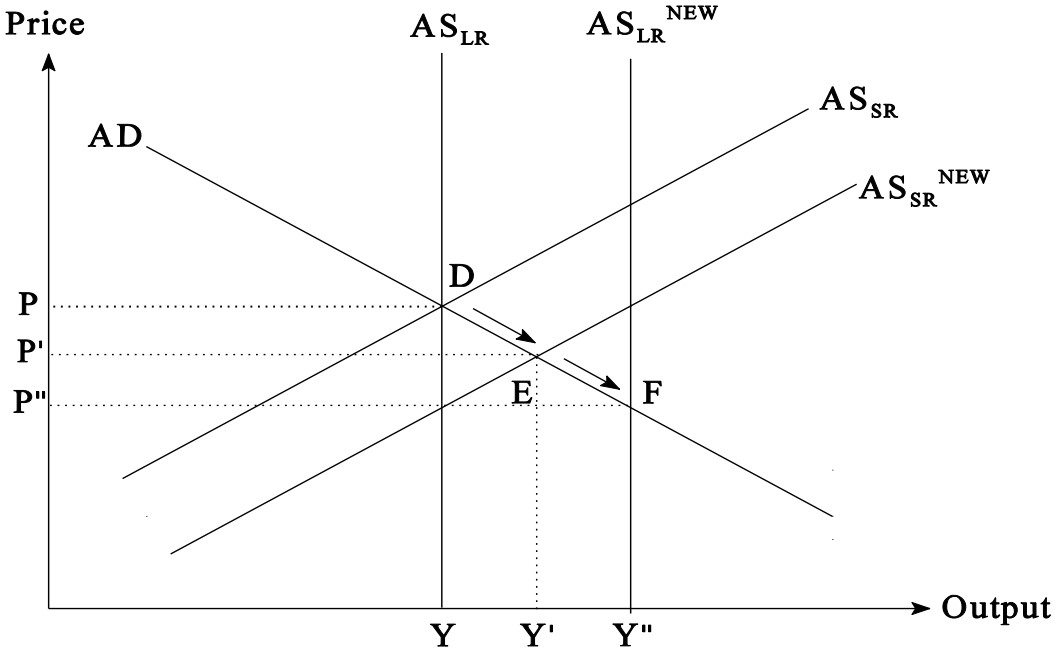


The short run AS-curve (AS_{SR}) has a positive slope because initially firms will produce larger quantities of goods and services if prices rise. In the long run, the amount of goods and services produced is independent of the price level. The equilibrium level of production depends only on the amount of productive

resources e.g. labour force, capital stock, technology, and on the long-run level of relative prices between inputs e.g. raw material, labour and capital. Therefore, the long-run AS-curve (AS_{LR}) is vertical. In the short run, production can deviate from this long-run equilibrium level through either over- or under-utilisation of resources. This will coincide with sluggish adjustment of wages and prices following a change in the economy. The sluggishness can be explained e.g. by the existence of contracts which are renegotiated only at certain intervals.

The economy starts in the equilibrium point A, cf. figure 3.1. A positive shock to demand occurs e.g. in the form of increased public consumption. The rise in demand moves the AD-curve to the North-East. First, the economy moves from A to B. The larger demand initially pushes prices up from P to P', which decreases real wages, and therefore boosts employment and production from Y to Y'. The degree to which prices and production increase in the short run depends on the slope of the short-run aggregate supply curve. Secondly, the lower real wage and the larger labour demand signifies a tighter labour market, and therefore rising wage demands. Over time, the economy consequently moves from B to C with wages and prices rising and employment and production falling. Finally at C, the economy reaches the new equilibrium where again the unchanged long-run level of goods and services Y is produced but now at a higher price level P''.

Figure 3.2 Supply shock



Alternatively, the economy could be hit by a positive shock to supply in the form of e.g. inventions which increase production per unit of capital stock. This would move the AS_{SR}-curve to the South-East and the AS_{LR}-curve to the east, cf. figure 3.2. This is equivalent to a higher long-run equilibrium level of production Y'' and a lower long-run equilibrium price level P''.

In the short run, output expands and prices fall and the economy moves from D to E. But this is only the first part of the adjustment. The drop in prices have increased real wages. This will increase labour supply and decrease nominal wages over time moving the AS_{SR}-curve further to the South-East and step by step production grows and prices fall from E to F where the new long-run equilibrium is reached. Here, the higher long-run equilibrium amount of goods and services Y'' is produced at a lower price level P''.

3.2 "New economics" interpreted in the AS/AD-model

As mentioned in section 2.8 we have framed the hypothesis that the seven phenomena have changed the way the economies work in the 1990s in the following way:

- The trade off between growth and inflation is expected to have changed in the 1990s. The average rate of growth being higher than the rate which has historically been consistent with a low level of inflation.

- Since the seven phenomena to a varying degree are international trends and e.g. globalization has the effect of opening up the economies to outside influence, one should expect that shocks have become more correlated across countries in the 1990s.

- Business cycles are expected to have reduced their amplitude in the 1990s.

In an AS/AD-model context this translates into:

- The increase in the average growth rate and the decrease in the average inflation rate are the result of an expansion of the production potential of the economies in the 1990s. This is in the AS/AD-model equivalent to a series of positive shocks to supply in the 1990s.

- Supply and demand shocks have become more correlated across countries in the 1990s.

- The expected joint impact of the seven phenomena is an increased pace of adjustment in the 1990s equivalent to a reduction in the amplitude of the business cycle. Following a shock to supply the adjustment from D to F is faster. Therefore, the new higher output level and lower price level following a positive shock to supply will be attained faster. In terms of the consequences of a positive shock to demand, a faster pace of adjustment would increase the slope of the short run aggregate supply curve. This increases the pace with which the new higher price level will be attained after a positive shock to demand while the temporary positive effect on output will diminish.

4. The structural VAR

The second step towards an understanding of the possible impact of the phenomena outlined in section 2 is to evaluate "new economics" in a so-called structural VectorAutoRegressive statistical model – a structural VAR.

This statistical model is well-suited for the analysis because it enables us to identify supply and demand shocks given the assumptions of the theoretical AS/AD-model described in section 3 and to analyse the dynamics of the impact of these shocks on the economy.

4.1 Structural VAR analysis

Setting up the model on which we base our analyses happens in three stages: First, a reduced-form VAR is estimated, secondly the estimated VAR is reformulated into a Vector Moving Average (VMA) system, and finally an identification scheme is imposed on the VMA to give us a system with two independent shocks of which only one has a long-run impact on real output.

4.1.1 Estimating a VAR

The first stage is to estimate a reduced-form VAR expressed in real growth (Δy_t) and inflation rate (Δp_t):

$$X_t = \mu + \sum_{i=1}^{k} A_i X_{t-i} + u_t \qquad \textbf{(1)}$$

where $X_t = (\Delta y_t , \Delta p_t)'$, μ is the intercept and u_t is the reduced-form error term, $u_t = (u_{yt}, u_{pt})'$.[16] The lag length *k* is determined for each country through statistical tests. Changes in real growth and inflation from one year to the next which are not explained by lagged values are called innovations or shocks. According to the model, u_t is identically distributed with an expected value of zero and a constant variance. The innovations are uncorrelated over time but are in general contemporaneously correlated.

The model is expressed in changes – real growth and inflation rate – rather than the levels of real GDP and consumer prices. This is because the time series for real GDP and price levels in the four countries do not have constant averages nor constant variances, cf. section 5. In other words, the variables are not stationary. This does not necessarily require a formulation exclusively in changes of the variables. It is possible that a linear combination of real GDP and price level is stationary – even though the two series themselves are non-stationary – meaning that the two time series cointegrate. An assumption maintained in (1) is that this is not the case, which is in agreement with the economic theory expressed by the AS/AD-model through its vertical long-run aggregate supply curve.

Another standard assumption underlying the use of (1) in the structural VAR analysis is that indeed first-differencing removes completely the non-stationarity of the variables. This assumption may be questionable, in particular with respect to the price level, which may need to be differenced twice to become stationary. This question will be addressed further in section 6.

4.1.2 Inverting the VAR

The second stage in the structural VAR analysis is to invert the estimated VAR (1) as a VMA-system with real growth and inflation as functions of the historical shocks to the system

$$X_t = \theta + u_t + \phi_1 u_{t-1} + \phi_2 u_{t-2} + \cdots = \theta + \sum_{i=0}^{\infty} \phi_i \, u_{t-i}, \quad \phi_0 = I, \quad \theta = (\sum_{i=0}^{\infty} \phi_i)\mu. \qquad \textbf{(2)}$$

An MA-coefficient, e.g. $\phi_{11,1}$, has the interpretation as the response of the real growth rate, Δy, at time *t* to a shock (impulse), u_y, of one unit to the real growth equation one period earlier.

16) In addition, the VAR is sometimes augmented by further deterministic terms, e.g. intervention dummies.

4.1.3 Identification of the structural shocks

The third and final stage in specifying a structural VAR is to generate two mutually independent shocks of which only one has a permanent effect on real output.

The first problem to address is the contemporaneous correlation between the two shocks. This makes it – on the face of it – hard to analyse the effect of an *isolated* change in just one of the shocks. But it is possible through a transformation of the original MA-system (2) to generate a vector of contemporaneously uncorrelated shocks

$$X_t = \theta + \sum_{i=0}^{\infty} \phi_i \, u_{t-i} = \theta + \sum_{i=0}^{\infty} \phi_i \, P \, P^{-1} \, u_{t-i} = \theta + \sum_{i=0}^{\infty} \gamma_i \, e_{t-i} \qquad \textbf{(3)}$$

where P is chosen such that the resulting structural shocks, e_t, are contemporaneously uncorrelated, see e.g. Blanchard and Quah (1989).

One last thing before the system is ready for the analysis is to identify one shock as the demand shock and another as the supply shock. Here we use the theoretical assumption from the AS/AD-model that shocks to demand do not have permanent effects on real output. This is equivalent to choosing the unique P matrix that imposes a zero restriction on the upper left-hand element in the infinite sum of MA coefficients,

$$\sum_{i=0}^{\infty} \gamma_i = \begin{bmatrix} 0 & \sum_{i=0}^{\infty} \gamma_{12,i} \\ \sum_{i=0}^{\infty} \gamma_{21,i} & \sum_{i=0}^{\infty} \gamma_{22,i} \end{bmatrix}, \quad e_t = \begin{pmatrix} e_{d,t} \\ e_{s,t} \end{pmatrix} . \qquad \textbf{(4)}$$

This is an exactly identifying restriction which cannot be tested statistically.

We now have a system with an identified demand shock, $e_{d,t}$, and an identified supply shock, $e_{s,t}$, which are contemporaneously uncorrelated. Before we move on, there is at least one caveat. A whole branch of economic theory deals with possible permanent output effects of *demand* shocks. E.g. if a temporary unemployment period permanently reduces the ability of a person to work, then the productive potential of the economy decreases through a lower effective labour supply and there will be a negative long-run effect on output. If this kind of causality is important in the economy a major part of the "supply" shocks identified in the empirical analysis could actually be demand shocks. But fortunately we would get an indication if this is a problem because positive permanent shocks would then in general be associated with price *increases* and not – as predicted by the AS/AD-model – price decreases. This is not the case for the four countries and the time period we have chosen, a result confirmed in e.g. Keating and Nye (1998) for ten OECD-countries over the postwar period.[17]

We are therefore ready to move on to the analyses. The empirical model will be used for three types of analysis, representing the same basic evidence from the structural VAR in three different ways.

17) Among the ten OECD-countries are those examined here, Denmark, Germany, United Kingdom, and the United States.

First, we will present a shock decomposition where the time-series of shocks can tell us whether the economies have been subject to extraordinary supply shocks in the 1990s. Correlation between supply and demand shocks across countries can tell us whether the countries have become exposed to the same international shocks to a higher degree in the 1990s.

Secondly, we look at the results from impulse-response analyses. They will tell us whether the countries have increased the speed of adjustment following a shock in the 1990s.

Finally, we will look at forecast error variance decompositions (FEVD). This type of analysis decomposes the variance of the error when the VAR is used to forecast real growth and inflation, respectively, into what can be explained by demand shocks and what can be explained by supply shocks. This will tell us if the relative contributions of demand and supply shocks have changed according to the implications of "new economics".

5. Data

We examine four countries: Denmark, West Germany, United Kingdom, and the United States. Data are GDP at fixed prices and the consumer price indices. The latter is chosen instead of the GDP-deflator because this addresses the problem of negative correlation caused by measurement errors. When national account figures are generated from nominal values an overstatement of the GDP-deflator automatically means an undervaluation of GDP at fixed prices. The sample period is generally 1960-1997 with the exception of Denmark where the sample starts in 1948 and West Germany where the sample ends in 1994.[18]

18) Danish real growth data for the period 1949 to 1988 is derived from national accounts figures in 1980-prices while 1989-97 is in 1990-prices.

Table 5.1 Average yearly real growth

	1961-1989	**1990-1997**	**1961-1997**
	---------- Per cent ----------		
Denmark[a]	3.1	2.3	3.0
	(2.9)	(1.1)	(2.7)
West Germany[b]	3.1	2.6	3.0
	(2.2)	(3.0)	(2.3)
United Kingdom	2.6	1.6	2.4
	(2.1)	(2.1)	(2.1)
United States	3.5	2.2	3.2
	(2.4)	(1.5)	(2.3)

a) Sample starts 1949.
b) Sample ends 1994.
Note: Real growth is measured as year-to-year growth in GDP at fixed prices. Standard deviations are in parentheses.
Source: Statistics Denmark, ADAMs database, OECD, *Main Economic Indicators*.

Table 5.1 and 5.2 summarize the statistics for the periods we are looking at. Already a cursory glance at the numbers reveals that the 1990s has generally not seen exceptional high growth compared to the preceding thirty years, on the contrary. There is no clear tendency across countries with respect to volatility in growth rates and thus no immediate support for a reduction in the amplitude of business cycles.

Table 5.2 Average yearly inflation

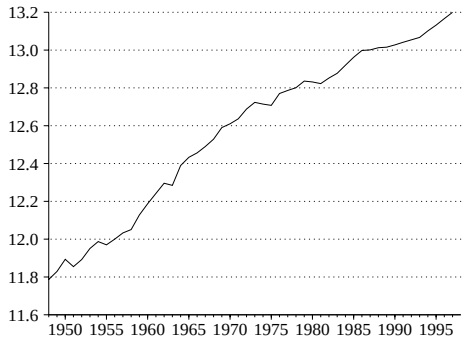
	1961-1989	**1990-1997**	**1961-1997**
	---------- Per cent ----------		
Denmark[a]	6.2	2.1	5.6
	(3.5)	(0.4)	(3.5)
West Germany[b]	3.5	3.3	3.5
	(1.9)	(0.6)	(1.7)
United Kingdom	8.1	4.0	7.2
	(5.5)	(2.6)	(5.3)
United States	5.1	3.3	4.7
	(3.3)	(1.0)	(3.1)

a) Sample starts 1949.
b) Sample ends 1994.
Note: Inflation is measured as year-to-year growth in consumer price index. Standard deviations are in parentheses.
Source: Statistics Denmark, ADAMs database, OECD, *Main Economic Indicators*.

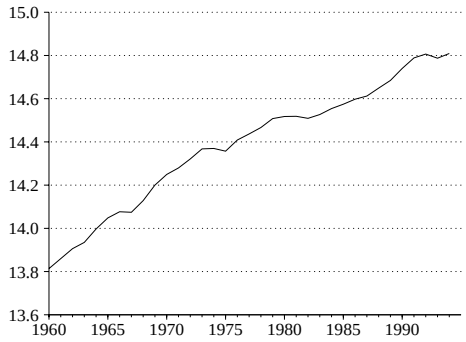
The average level of inflation has generally dropped along with volatility in all four countries. The combined story of drops in both growth and inflation in the 1990s is more an indication of negative demand shocks than of the expected positive supply shocks.

Figure 5.1 Real GDP, log transformed

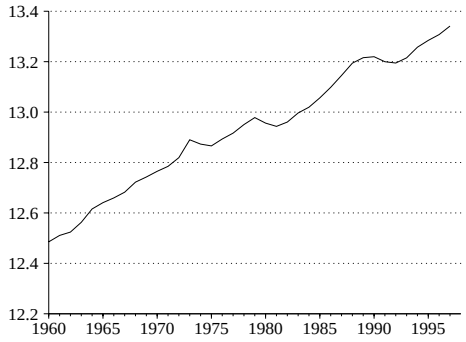
a. Denmark



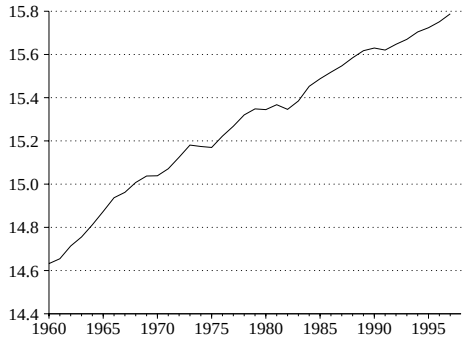
b. West Germany



c. United Kingdom



d. United States



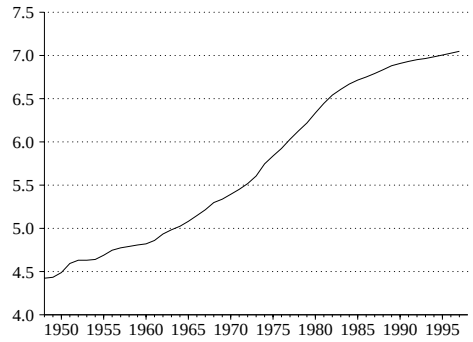
Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

As already mentioned in section 4, the VAR-model will be formulated in differences for two reasons. Firstly, GDP at constant prices and the consumer price index do not have constant mean and variance, or in other words, they are non-stationary, cf. figures 5.1 and 5.2. Secondly, the two time series do not move together in the long run i.e. they do not cointegrate.[19]

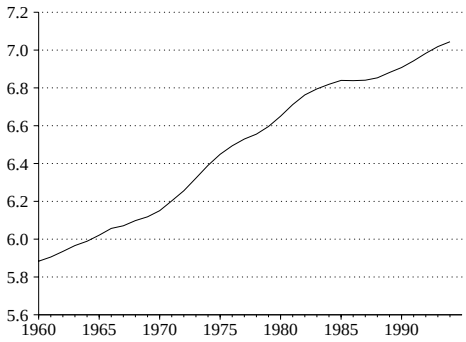
19) This will be shown in section 6.3.

Figure 5.2 Consumer price index, log transformed

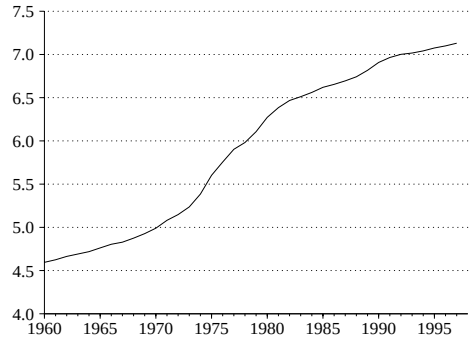
a. Denmark



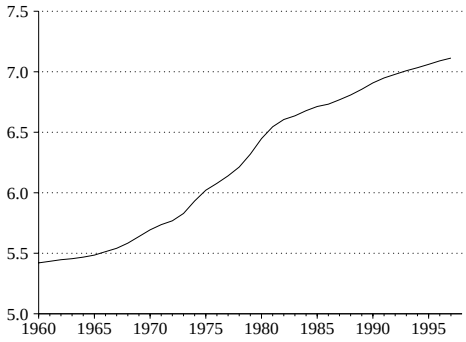
b. West Germany



c. United Kingdom



d. United States

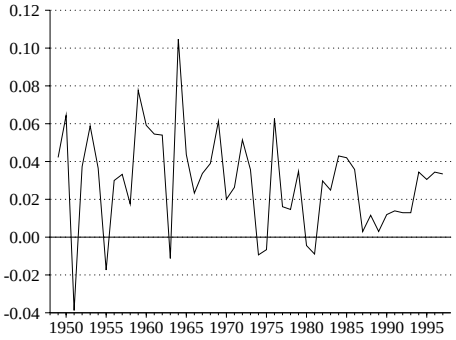


Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

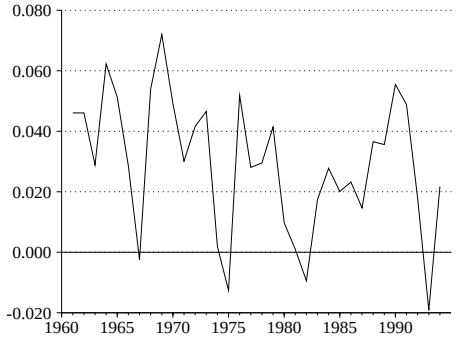
An eyeball inspection of figure 5.3 confirms the impression that the first difference of real GDP seems to be stationary in all four countries. But the first difference of the consumer price index is not an altogether clear-cut case, cf. figure 5.4. Inflation in all four countries increased in the 1970s followed by a reversal to the level of the 1960s from mid-1980s and onwards, i.e. inflation exhibited very persistent movements.

Figure 5.3 Real GDP, log transformed and first differenced

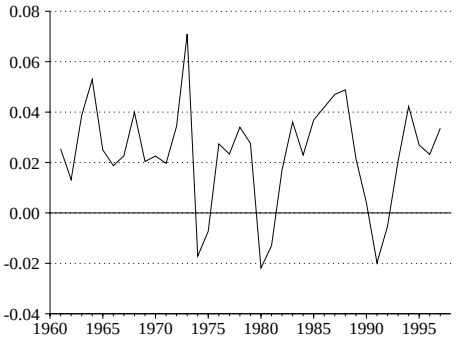
a. Denmark



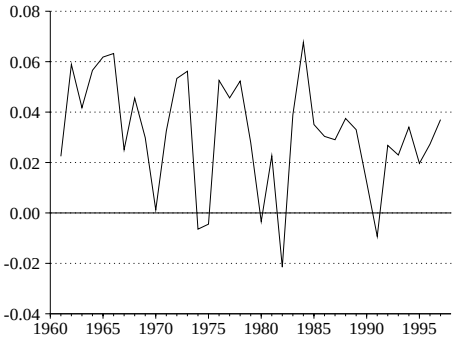
b. West Germany



c. United Kingdom



d. United States



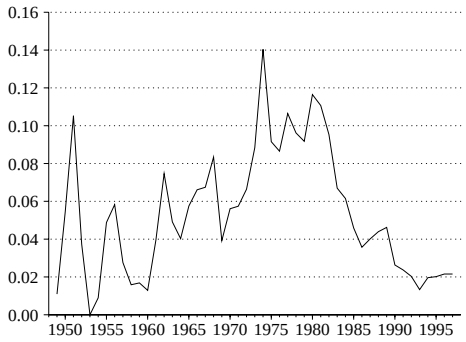
Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

This indicates that perhaps the rate of inflation is non-stationary. If one compares the first differences of the consumer price indices in figure 5.4 with the twice differenced series in figure 5.5 the latter series do look more like stationary variables. The possible non-stationarity of inflation will be addressed in section 6.3. But, as in the standard approach we continue the analysis assuming inflation to be stationary.[20]

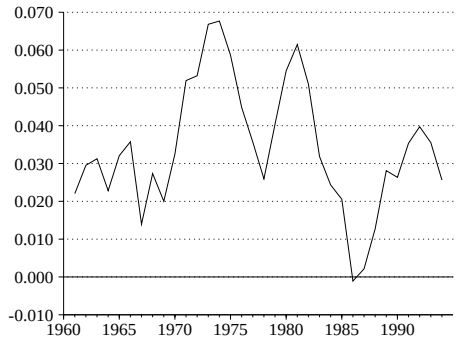
20) See e.g. Gerlach and Klock (1990, 1991), Bayoumi and Eichengreen (1992, 1994), Bergman (1996), Hansen (1997), and Keating and Nye (1998).

Figure 5.4 Consumer price index, log transformed and first differenced

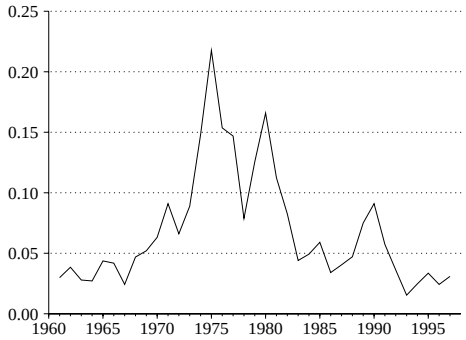
a. Denmark



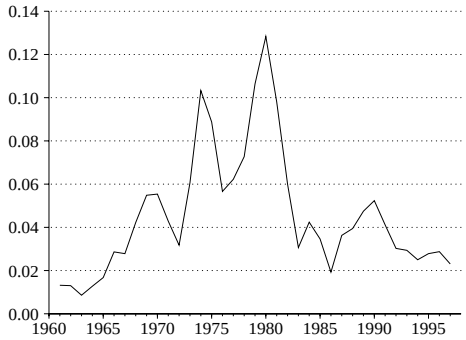
b. West Germany



c. United Kingdom



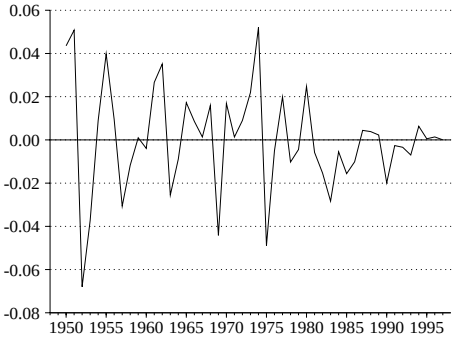
d. United States



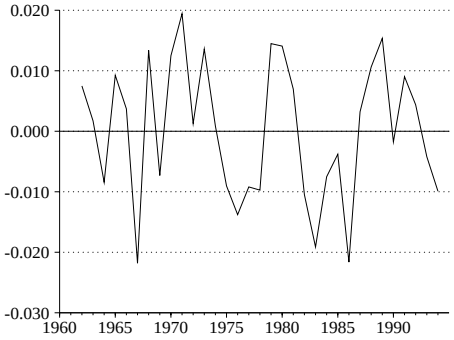
Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

Figure 5.5 Consumer price index, log transformed and twice differenced

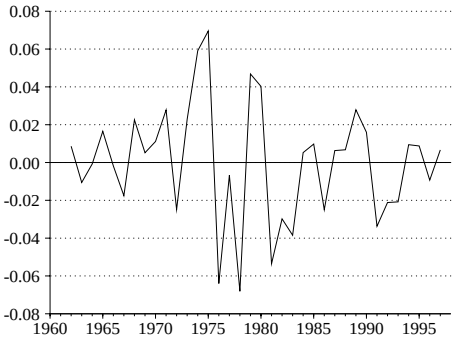
a. Denmark



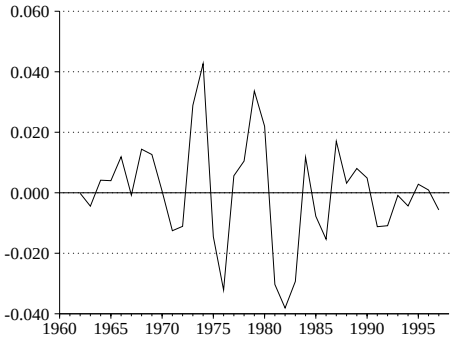
b. West Germany



c. United Kingdom



d. United States



Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

6. The estimation of the VARs[21]

In this section we show the specification of the VARs exemplified by the Danish case which will form the basis for the structural VAR analysis in sections 7 to 9. A host of design criteria will be considered when deciding the lag length and the possible inclusion of dummies.

21) The empirical analysis is carried out in PcFiml 8.1, see Doornik and Hendry (1994), and in RATS 4.2 with a programme which was kindly supplied by Henrik Hansen and Anders Warne, see http:\\www.iies.su.se\data\home\warnea and Warne (1993).

The section ends with a test of whether data for 1990s changes the estimated parameters significantly, and with some deliberations on the possible presence of cointegration and on the non-stationarity of the inflation rate.

6.1 Estimating the VAR-systems

Three pieces of information determine the optimal lag length. The Schwarz and the Hannan-Quinn criteria are minimized for the optimal lag length while the F-test is a test of the null hypothesis that the last lag, A_k in (1) in section 4, is not significant. A fourth order VAR is chosen as the largest model considered, and this also determines the sample for the estimation of the VARs of lower order when searching for the correct lag length.

Table 6.1 Optimal lag length of the Danish VAR

Lag length *j*	**Schwarz**	**Hannan-Quinn**	**F-test[a]**
1	-14.97#	-15.12	-
2	-14.89	-15.14#	2.69*
3	-14.76	-15.11	2.03
4	-14.47	-14.92	0.42

a) Tests whether lag *j* can be excluded.
Note: * means significant at a 5 per cent level, and # means minimized value.

The result from the lag criteria analysis is that the Danish VAR should be of either first or second order, cf. table 6.1. In the following, we run a variety of misspecification tests on both models on the 1951-97 sample to arrive at the final answer.[22]

Notation in variable names is as follows: "D" denotes first differences, "L" denotes a log transformation, "fy" is real GDP, "cpi" is the consumer price index, and "_ *j*" signifies that the variable is lagged *j* times.

22) With respect to the interpretation of the PcFiml output (written in italics) see Doornik and Hendry (1994). Figures in brackets are p-values, and an asterisk indicates that the test statistic is significant at a 5 per cent level.

VAR(2): *Estimating the unrestricted reduced form by OLS 1951 to 1997*

Equation 1 for DLdnkfy

Variable	*Coefficient*	*Std.Error*	*t-value*	*t-prob*
DLdnkfy_1	*-0.134*	*0.144*	*-0.933*	*0.356*
DLdnkfy_2	*0.122*	*0.156*	*0.781*	*0.439*
DLdnkcpi_1	*-0.583*	*0.179*	*-3.265*	*0.002*
DLdnkcpi_2	*0.526*	*0.183*	*2.867*	*0.006*
Constant	*0.031*	*0.011*	*2.765*	*0.008*

$\sigma = 0.024$

Equation 2 for DLdnkcpi

Variable	*Coefficient*	*Std.Error*	*t-value*	*t-prob*
DLdnkfy_1	*0.358*	*0.122*	*2.935*	*0.005*
DLdnkfy_2	*0.170*	*0.132*	*1.287*	*0.205*
DLdnkcpi_1	*0.903*	*0.151*	*5.968*	*0.000*
DLdnkcpi_2	*-0.054*	*0.155*	*-0.345*	*0.732*
Constant	*-0.007*	*0.010*	*-0.775*	*0.443*

$\sigma = 0.021$

Equation	*Test*	*Test statistics*	*p-value*
DLdnkfy	*AR 1- 2F(2, 40)*	*2.481*	*0.097*
DLdnkcpi	*AR 1- 2F(2, 40)*	*1.111*	*0.339*
DLdnkfy	*Normality Chi²(2)*	*0.688*	*0.709*
DLdnkcpi	*Normality Chi²(2)*	*1.317*	*0.518*
DLdnkfy	*ARCH 1 F(1, 40)*	*0.388*	*0.537*
DLdnkcpi	*ARCH 1 F(1, 40)*	*1.213*	*0.277*
DLdnkfy	*Xi² F(8, 33)*	*0.969*	*0.477*
DLdnkcpi	*Xi² F(8, 33)*	*1.458*	*0.210*
Vector[a]	*AR 1-2 F(8, 74)*	*2.263*	*0.032**
Vector[a]	*Normality Chi²(4)*	*1.941*	*0.747*
Vector[a]	*Xi² F(24, 90)*	*0.914*	*0.583*
Vector[a]	*Xi*Xj F(42, 74)*	*1.477*	*0.071*

a) The whole system.

The Danish VAR(2) performs reasonably well but for the indication of auto-correlated errors. We move on to test the VAR(1).

VAR(1): *Estimating the unrestricted reduced form by OLS 1951 to 1997*

Equation 1 for DLdnkfy

Variable	*Coefficient*	*Std.Error*	*t-value*	*t-prob*
DLdnkfy_1	*-0.111*	*0.155*	*-0.715*	*0.478*
DLdnkcpi_1	*-0.193*	*0.126*	*-1.538*	*0.131*
Constant	*0.042*	*0.010*	*4.075*	*0.000*

$\sigma = 0.026$

Equation 2 for DLdnkcpi

Variable	*Coefficient*	*Std.Error*	*t-value*	*t-prob*
DLdnkfy_1	*0.352*	*0.123*	*2.855*	*0.007*
DLdnkcpi_1	*0.859*	*0.100*	*8.579*	*0.000*
Constant	*-0.003*	*0.008*	*-0.359*	*0.721*

σ = 0.021

Equation	*Test*	*Test statistics*	*p-value*
DLdnkfy	*AR 1- 2F(2, 42)*	*6.786*	*0.003**
DLdnkcpi	*AR 1- 2F(2, 42)*	*1.323*	*0.277*
DLdnkfy	*Normality Chi²(2)*	*2.042*	*0.360*
DLdnkcpi	*Normality Chi²(2)*	*1.485*	*0.476*
DLdnkfy	*ARCH 1 F(1, 42)*	*0.030*	*0.864*
DLdnkcpi	*ARCH 1 F(1, 42)*	*1.230*	*0.274*
DLdnkfy	*Xi² F(4, 39)*	*0.301*	*0.876*
DLdnkcpi	*Xi² F(4, 39)*	*1.100*	*0.370*
Vector[a]	*AR 1-2 F(8, 78)*	*2.565*	*0.015**
Vector[a]	*Normality Chi²(4)*	*2.642*	*0.619*
Vector[a]	*Xi² F(12, 98)*	*0.799*	*0.650*
Vector[a]	*Xi*Xj F(15, 99)*	*0.672*	*0.806*

a) The whole system.

At a first glance, the VAR(1)-system seems to perform worse than the VAR(2)-system. Not only does the system as a whole have autocorrelated errors but now the real growth equation in itself also suffers from autocorrelation. However, if the largest outlier in 1964 is removed, then the VAR(1)-model including the dummy actually outperforms the VAR(2) without dummy i.e. none of the misspecification tests are significant.

In Denmark the year 1964 was characterized by a major turnaround in the stance of economic policy and growth switched from -1.1 per cent in 1963 to +11.0 per

cent in 1964. A dummy in 1964 is the equivalent of ignoring this observation altogether. Actually, a dummy in 1964 would also remove the problems with autocorrelation in the VAR(2)-model. But we prefer the VAR(1)-system incl. a 1964-dummy on the grounds of parsimony.

None of the misspecification tests becomes significant if we expand the sample to the longest possible for a VAR(1) i.e. 1950-1997.

VAR(1) incl. 1964-dummy: *Estimating the unrestricted reduced form by OLS 1950 to 1997*

Equation 1 for DLdnkfy

Variable	*Coefficient*	*Std.Error*	*t-value*	*t-prob*
DLdnkfy_1	*0.001*	*0.147*	*0.008*	*0.993*
DLdnkcpi_1	*-0.177*	*0.115*	*-1.545*	*0.130*
i1964	*0.077*	*0.025*	*3.057*	*0.004*
Constant	*0.037*	*0.010*	*3.830*	*0.000*

$\sigma = 0.024$

Equation 2 for DLdnkcpi

Variable	*Coefficient*	*Std.Error*	*t-value*	*t-prob*
DLdnkfy_1	*0.359*	*0.131*	*2.750*	*0.009*
DLdnkcpi_1	*0.834*	*0.102*	*8.192*	*0.000*
i1964	*0.005*	*0.022*	*0.202*	*0.841*
Constant	*-0.001*	*0.008*	*-0.139*	*0.891*

$\sigma = 0.021$

Equation	*Test*	*Test statistics*	*p-value*
DLdnkfy	*AR 1- 2F(2, 42)*	*0.555*	*0.578*
DLdnkcpi	*AR 1- 2F(2, 42)*	*1.525*	*0.230*
DLdnkfy	*Normality Chi²(2)*	*1.868*	*0.393*
DLdnkcpi	*Normality Chi²(2)*	*0.944*	*0.624*
DLdnkfy	*ARCH 1 F(1, 42)*	*0.091*	*0.764*
DLdnkcpi	*ARCH 1 F(1, 42)*	*1.144*	*0.291*
DLdnkfy	*Xi² F(5, 38)*	*0.201*	*0.960*
DLdnkcpi	*Xi² F(5, 38)*	*0.731*	*0.605*
Vector[a]	*AR 1-2 F(8, 78)*	*1.061*	*0.399*
Vector[a]	*Normality Chi²(4)*	*0.976*	*0.913*
Vector[a]	*Xi² F(15, 99)*	*0.345*	*0.989*
Vector[a]	*Xi*Xj F(18, 99)*	*0.282*	*0.998*

a) The whole system.

The conclusion on the analysis of the Danish data is that we prefer a VAR(1)-system with a dummy in 1964 and estimated over the period 1950-1997. One should take note, that the ability of the system to explain data is not impressive. The lagged endogenous variables are significant in the inflation equation but not in the growth equation.

Similar analyses are performed for the three remaining countries and we end up with the following four systems:

- Denmark: VAR(1) including a 1964-dummy
- West Germany: VAR(1)
- United Kingdom: VAR(2)
- United States: VAR(3)

It turned out not to be possible to remove heteroscedasticity completely in the

British case. The results on the British model in section 7, 8, and 9 must therefore be interpreted with caution. The higher orders of the British and American VARs most probably reflect a high degree of persistence in inflation, see section 6.3 below.

6.2 Constancy of the VARs in the 1990s

The structural VARs to be analysed in sections 7 through 9 are derived from the four reduced-form VARs. If the "new economics" phenomena have altered the workings of the four economies at the macro level, then this should appear as a structural break in the empirical models describing those economies.

Specifically, this section examines the hypothesis that the empirical model changed at the beginning of the 1990s as compared to the previous period. The performance of the real growth and inflation equations as well as the overall model is assessed when the model is estimated on the pre-1990 subsample and applied for forecasting the 1990s.

In table 6.2 a one-step (ex-post) forecast analysis is performed by Wald tests based on three different measures of the variance matrix of the forecast errors. Test no. 1 relies solely on the variance of the innovations of the VAR, neglecting the fact that the parameters of the model have been estimated. Test no. 2 takes parameter uncertainty into account and Test no. 3 in addition allows for the inter-correlations between the forecast errors.[23] The tests are distributed approximately as $\chi^2(2h)$ where h is the forecast horizon (h = 5 years for West Germany and h = 8 for the other countries). None of the tests rejects the null of parameter constancy, cf. table 6.2.

23) For details on the tests, see pp. 196-97 and p. 264 in Doornik and Hendry (1994).

Table 6.2 Parameter constancy forecast tests: Inclusion of data for the 1990s.

	Distribution under H_0	**Test no. 1**	**Test no. 2**	**Test no. 3**
Denmark	$\chi^2(16)$	8.29 [0.94]	7.51 [0.96]	5.45 [0.99]
West Germany	$\chi^2(10)$	7.39 [0.69]	7.04 [0.72]	7.27 [0.70]
United Kingdom	$\chi^2(16)$	23.4 [0.10]	18.7 [0.28]	15.8 [0.47]
United States	$\chi^2(16)$	19.4 [0.25]	15.7 [0.48]	9.72 [0.88]

Note: Numbers in brackets are p-values.

Table 6.3 reports so-called forecast F-tests testing the same null as above of constant parameters in the pre- and post-1990 subsamples. It is a Chow-type test based on the likelihood ratio principle. The p-values for the single-equation tests are derived from $F(h,T_0-k)$ where h is the forecast horizon, T_0 is the length of the pre-1990 subsample, and k is the number of regressors of the equation. The overall system test has an approximate F-distribution based on Rao's F-approximation, see Doornik and Hendry (1994, p. 268) for details. Again, there appears to be no sign of a break.

Table 6.3 Forecast F-tests: Inclusion of data for the 1990s.

	Real growth equation	**Inflation equation**	**Overall system**
Denmark	0.31[0.96]	0.09[1.00]	0.27[1.00]
West Germany	1.39[0.26]	0.04[1.00]	0.65[0.76]
United Kingdom	0.96[0.49]	0.39[0.91]	0.76[0.72]
United States	0.72[0.67]	0.10[1.00]	0.37[0.98]

Note: Numbers in brackets are p-values.

The conclusion derived from tables 6.2 and 6.3 is unchanged when the investigation is based on restricted VARs in which individually insignificant regressors have been eliminated. This is expected to lower the part of the forecast error variance associated with parameter uncertainty. Still, there are no signs of any significant break around 1990.

Our analysis of the significance of "new economics" could end here. But that would perhaps be a little unfair given the comparably large standard errors in the four VARs. The analyses of the structural VAR in sections 7 to 9 will therefore explore if the actual changes in the VARs are at least in the direction predicted by "new economics" even if not significant in a statistical sense.

6.3 Testing the standard assumptions

The analysis in sections 7 to 9 relies on the standard assumptions of the literature, e.g. Gerlach and Klock (1990, 1991), Bayomi and Eichengreen (1992, 1994) and Keating and Nye (1998), that the (log-levels of) GDP in fixed prices and the price index are first-order integrated processes which do not cointegrate. But the graphical analysis in section 5 suggested that inflation is a very persistent process. Consumer prices might thus well be second-order non-stationary contrary to the standard assumption.

Table 6.4 presents further evidence on the order of integration and possible presence of cointegration among real output and prices.[24] First, maintaining the assumption of no cointegration among the levels, y_t and p_t , we address the possible non-stationarity of the first-differences, in particular the rate of inflation. The so-called trace test, $Q_{0,1}$, is a test of the null hypothesis that a non-stationary component remains in (1) in section 4 against the alternative of stationarity. For United Kingdom and the United States, the test falls short of its critical value by a substantial margin. West Germany and Denmark are not that clear-cut having p-values of approximately 20 and 10 per cent, respectively. In the case of Denmark a different asymptotic distribution applies due to the presence of the dummy.[25] For all countries the test clearly suggests that a very persistent - and possibly non-stationary - component is present in (1).

24) The specification adopted for the levels model allows for the presence of trend-stationary combinations and the model for the differences allows for a restricted constant, see Johansen (1996, sec. 5.7.) and Rahbek, Kongsted, and Jørgensen (1998) for details. The dummy included in the Danish case is treated similarly to the trend in order to allow only for a shift in the levels of the variables.

25) The distribution of the trace statistic for the Danish case is simulated by the DisCo programme, see Johansen and Nielsen (1993) and http://www.nuff.ox.ac.uk/users/nielsen/disco.html .

A measure of the degree of persistence is provided in table 6.4 by EVC, the modulus of the largest eigenvalue of the companion matrix of the VAR in (1). Under the maintained assumption that both Δy_t and Δp_t are stationary, EVC should be strictly less than one. This is seen to be case for all four countries although again the numbers for United Kingdom and the United States point to a fairly large degree of persistence.

Evidence on the hypothesis of no cointegration among the levels is reported in table 6.4 by the trace statistic Q_0. The reported quantiles of the asymptotic distribution of Q_0 are valid under the assumption of no second-order non-stationarity. The proper critical values if one or more second-order non-stationary components are in fact present would be higher. The null of no cointegration cannot be rejected for any of the countries at a 5 per cent level, although Denmark and the United States have p-values between 10 and 20 per cent.[26]

Table 6.4 Evidence on integration and cointegration.

	$Q_{0,1}$	Q_0	EVC
Denmark	8.9[a]	18.3[a]	0.76
West Germany	5.6	16.1	0.55
United Kingdom	2.9	16.4	0.84
United States	2.6	22.9	0.85

[a] The critical values for Denmark are 11.0 for $Q_{0,1}$ and 22.7 for Q_0.
Note: 95 per cent quantile of asymptotic distribution: 9.1 for $Q_{0,1}$, 25.5 for Q_0, see Johansen (1996, tables 15.2 and 15.4).

26) A joint test based on the sum of $Q_{0,1}$ and Q_0, e.g. Rahbek et al. (1998), confirms the findings of no cointegration among the levels and gives indications of non-stationarity in the first-differences for all four countries.

Whereas the statistical evidence is broadly in favour of one of the standard assumptions underlying the use of (1) – no cointegration – it is partly against the other, stationarity of inflation. Obviously, the validity of the formal test procedures could well be questioned given the limited sample sizes in this analysis. In the following analysis we stick to the conventional assumption that the VAR in first differences has stationary although very persistent components. The persistence is going to be reflected in the analysis of the structural VARs as a very slow rate of decay of one or both shocks.

A proper analysis of non-stationary inflation would probably also require a rethinking of the relationship between the empirical model and the theoretical AD/AS model. This is left as an interesting topic for further research.

7. Decomposition of shocks

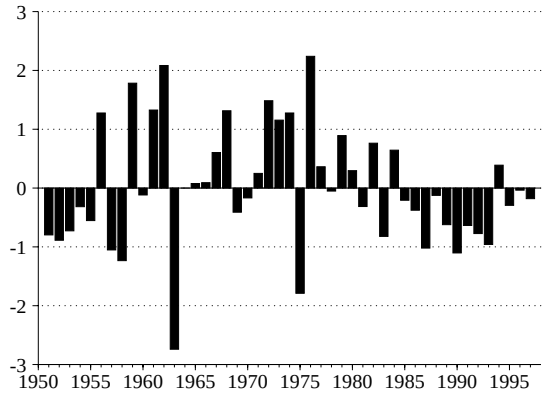
This section takes a look at two of the ways "new economics" can manifest itself in a structural VAR-analysis: The economies have experienced a series of prominent positive supply shocks, and the correlation between shocks to different countries has increased – both in the 1990s.

7.1 Was there a series of positive supply shocks in the 1990s?

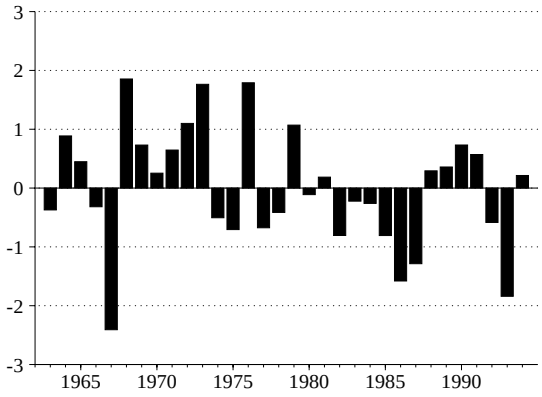
Initially, we will comment briefly on the four times two shock series that is the result of the structural VAR-analysis.

Figure 7.1 Demand shocks

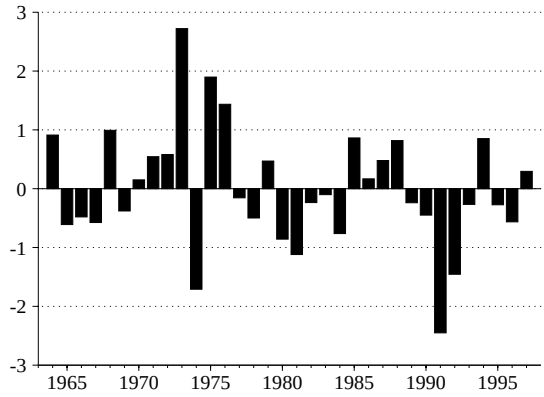
a. Denmark



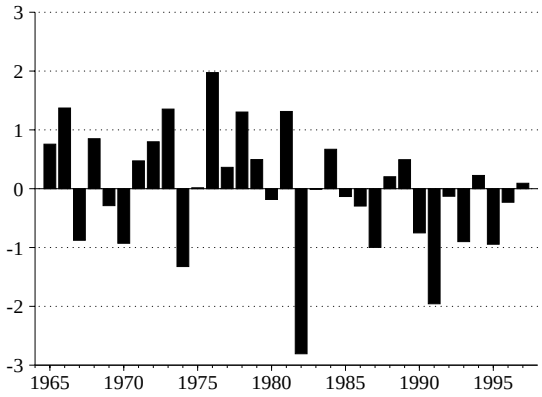
b. West Germany



c. United Kingdom



d. United States



Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

Any "pattern" in the shock time series should be evaluated in the light of the fact that these series are the output of estimated VAR-systems where shocks have been found to be white noise.[27] Statistical criteria of no non-normality, no heteroscedasticity and no autocorrelation at a five per cent significance level formed the basis for the modelling of the four VAR-systems. Still, within the boundaries of these criteria there are room for some accumulation of e.g. positive supply shocks over a certain period.

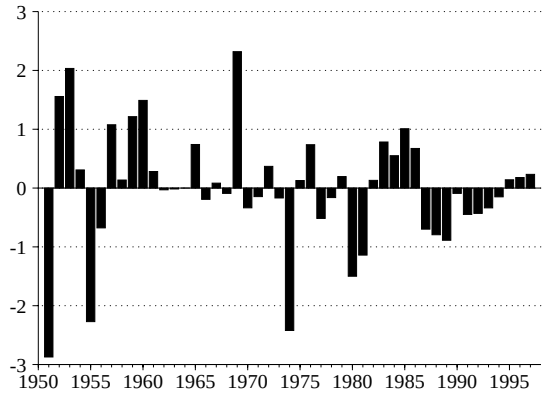
27) With the exception of heteroscedasticity in the British VAR-model.

Certain general economic history features can be recognized in the four time series, cf. figure 7.1. For all four countries, negative demand shocks seem to have been more predominant in the 1950s, 1980s, and the 1990s while positive demand shocks were more prevailing in the 1960s and 1970s. Among other things, this is driven by the different policy reaction to the two oil crises. Where the first oil crisis was followed by positive demand shocks the policy reaction to the second oil crisis was more contractionary – keeping in mind that demand shocks do include other things than demand management.

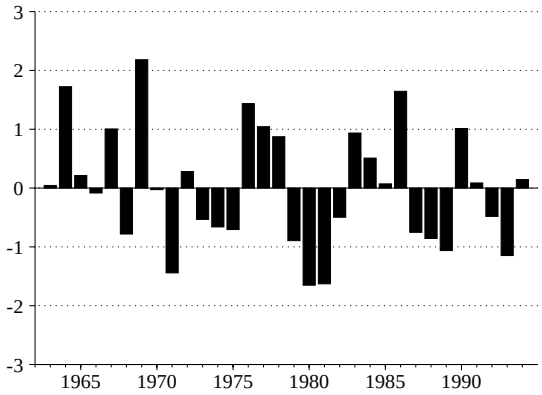
Concentrating on Denmark and comparing the demand shock series with e.g. the measure of the stance of fiscal policy in *Det Økonomiske Råd (1996)* for the period 1980-95 does not yield exactly the same story. On the one hand, the change in the stance of discretionary fiscal policy between 1982 and 1983 can be found in figure 7.1a. On the other hand, there is no trace of the expansion in 1993. The explanation rests with the fact that demand shocks are more than just discretionary fiscal policy, and 1993 also saw an appreciating DKK and low growth on the market for Danish exports.

Figure 7.2 Supply shocks

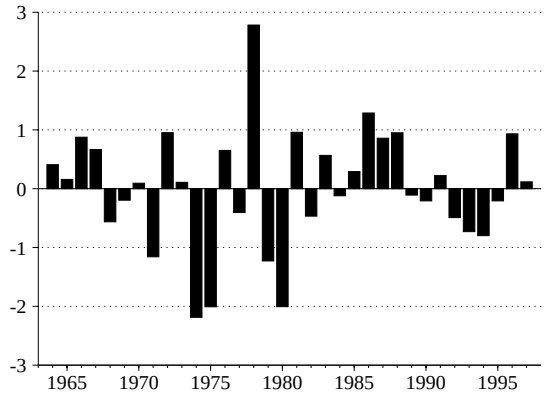
a. Denmark



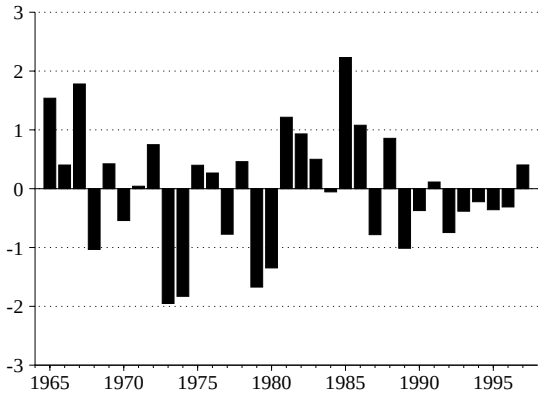
b. West Germany



c. United Kingdom



d. United States



Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

The two oil crises can be found in all four countries as negative supply shocks around 1974 and 1979, cf. figure 7.2a-d. And the drop in the oil price in 1986 coincides with positive supply shocks. Otherwise, looking for recurring patterns across countries yields only two results: The 1960s was dominated by positive supply shocks while negative supply shocks have prevailed in the 1990s.

An auxiliary regression analysis shows that the Danish supply shocks can be explained by a selection of supply-side variables:

supply shock =

$$-0.445 \underset{(2.369)}{-} 0.055\ dlog(import\ prices) \underset{(4.022)}{+} 0.354\ dlog(labour\ supply) \underset{(2.463)}{}$$

$$+0.218\ dlog(productivity) \underset{(4.614)}{+} 0.041\ dlog(hours\ worked\ in\ private\ sector) \underset{(0.979)}{}$$

$$-9.558\ diff(VAT-rate) \underset{(1.564)}{+} residual$$

$R^2 = 0.647$, $F(5,40) = 14.671$*, *t*-statistics in parentheses.

The five variables are jointly significant according to the overall F-test of significance. Individual signs of the coefficients also appear reasonable.

We already know by now from table 5.1 that growth has not been extraordinarily high in the 1990s – which seems to preclude beforehand a series of positive supply shocks. But if such a supply series coincides with a series of negative demand shocks the coexistence of not very high growth rates and a series of positive supply shocks is possible. And the 1990s has indeed seen its share of negative demand shocks.

The general predominance of negative supply shocks in the 1990s is equivalent of concluding that "new economics" does not seem to have generated a series of positive aggregate supply shocks in the 1990s. The story of the 1990s following from table 5.1, figure 7.1, and figure 7.2 is as follows: Relatively low growth has been produced by negative demand and supply shocks, while the relatively low inflation is the result of the inflation reducing effect of negative demand shocks dominating the inflation inducing effect of negative supply shocks.

7.2 Has the correlation between shocks increased?

Since the seven phenomena to a varying degree are international trends and e.g. globalization has the effect of opening up the economies to outside influence, one could expect that supply and demand shocks have become more correlated across countries in the 1990s.

Table 7.1 Correlation between demand shocks with or without the 1990s

	Denmark		West Germany		U K		United States	
	65-89	**65-97**	**65-89**	**65-94**	**65-89**	**65-97**	**65-89**	**65-97**
Denmark	1.00	1.00	0.49	0.45	0.06	0.21	0.21	0.33
West Germany			1.00	1.00	0.42	0.32[a]	0.57	0.48[a]
United Kingdom					1.00	1.00	0.28	0.41
United States							1.00	1,00

Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

Demand shocks have indeed become more correlated between Denmark, United Kingdom, and the United States but correlation has diminished vis-a-vis West Germany, cf. table 7.1. But the underlying story here is more one of parallel business cycles in the first three countries in the 1990s, than one of increased international interdependence.

Table 7.2 Correlation between supply shocks with or without the 1990s

	Denmark		West Germany		U K		United States	
	65-89	**65-97**	**65-89**	**65-94**	**65-89**	**65-97**	**65-89**	**65-97**
Denmark	1.00	1.00	0.69	0.66	0.29	0.29	0.50	0.49
West Germany			1.00	1.00	0.44	0.43[a]	0.37	0.36[a]
United Kingdom					1.00	1.00	0.50	0.49
United States							1.00	1.00

Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

Given the nature of the seven phenomena, they would be expected to be more closely related to supply than to demand shocks. But as is evident from table 7.2, including the data from the 1990s does not increase the correlation between supply shocks. The coefficients are practically unchanged.

In a statistical sense – given standard deviations around 0.2 – it is not possible to reject the hypothesis that all the correlation coefficients are unaltered when data for the 1990s are included.

All in all, the shock decomposition analysis gives an indication that the economies have not been subjected to a series of positive supply shocks in the 1990s. This indicates that perhaps "new economics" is more a lengthy and slowly moving phenomenon rather than a distinctive mark of the 1990s. It is confirmed by the fact, that globalization and the other international phenomena have not been able to increase dependence among countries to a degree that makes the 1990s differ in any measurable way.

8. Impulse-response analysis – do the economies adjust more quickly to shocks in the 1990s?

The joint impact of the seven phenomena suggests an increased pace of adjustment in the 1990s equivalent to a reduction of the amplitude of the business cycle, cf. section 2.

In the terminology of a structural VAR based on the AS/AD-model this has the implication that the higher output level and lower price level following a positive shock to supply is attained faster. Furthermore, the pace increases with which the new higher price level is attained after a positive shock to demand while the temporary positive effect on output diminishes.

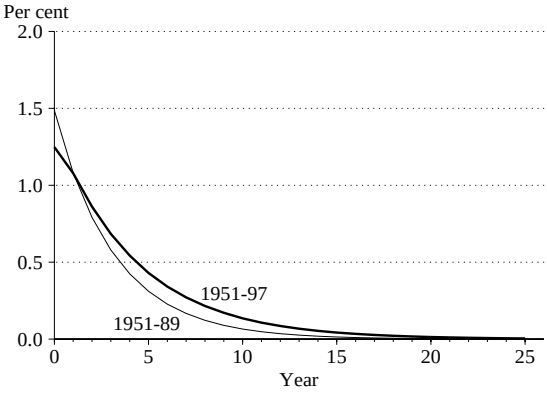
The pace of adjustment can be assessed through a so-called impulse-response analysis based on the structural VAR. The normalized MA-system in section 4 is subjected to e.g. a one standard deviation demand shock, and then the effect on output level and inflation rate is traced out.

In the following, we show four sets of figures: The effect on output level or inflation rate from a demand or a supply shock, respectively. Each set of figures contains the results for all four countries. For each country two series are shown: One is the adjustment path based on a structural VAR calculated and estimated for the entire sample period (the thick line), and the other adjustment path is based on a structural VAR calculated and estimated for a sample period excluding data for the 1990s (the thin line). The results are summarized in two tables with indicators of speed of adjustment.

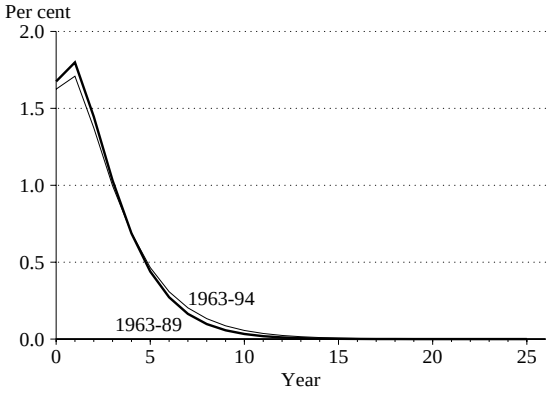
Before proceeding with the analysis, it is perhaps worth reiterating that since the 1990s do not constitute a structural break in the estimated VARs, cf. section 6.2, the differences between the long and the short sample below are therefore not statistically significant either.

Figure 8.1 Change in GDP following a demand shock

a. Denmark

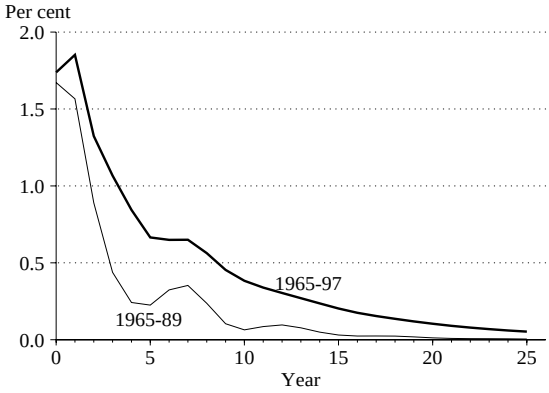


b. West Germany



c. United Kingdom

d. United States



Note.: The size of the shock is one standard deviation in the normalized MA-system, cf. section 4.

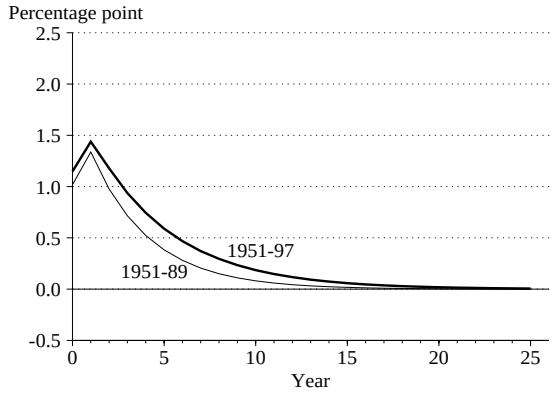
Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

In all four countries the maximum effect of a demand shock on the level of real GDP is between 1¼ and 1¾ per cent, cf. figure 8.1. But the pace of adjustment

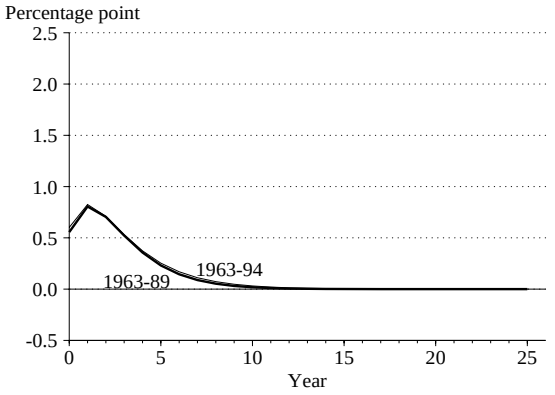
is somewhat different, with the temporary effect on GDP first disappearing in West Germany followed by Denmark, United Kingdom and the United States. This somewhat surprising ranking of the severity of an economy's nominal rigidities is confirmed in Keating and Nye (1998). Whether the pace of adjustment has increased between the short and the long sample is left to calculations in table 8.1 and 8.2.

Figure 8.2 Change in inflation following a demand shock

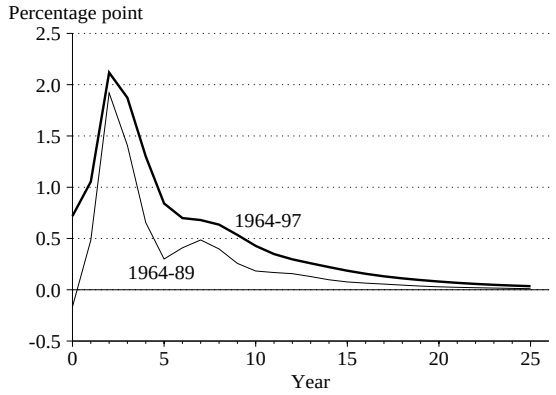
a. Denmark



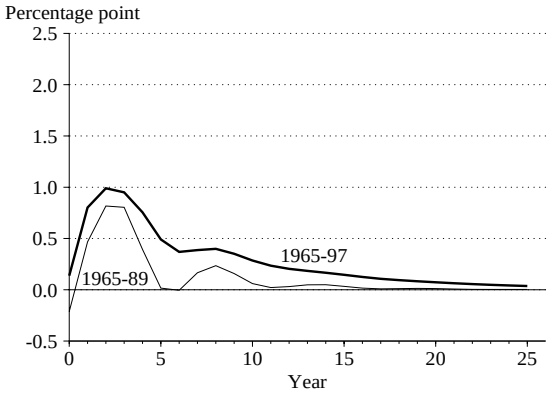
b. West Germany



c. United Kingdom



d. United States



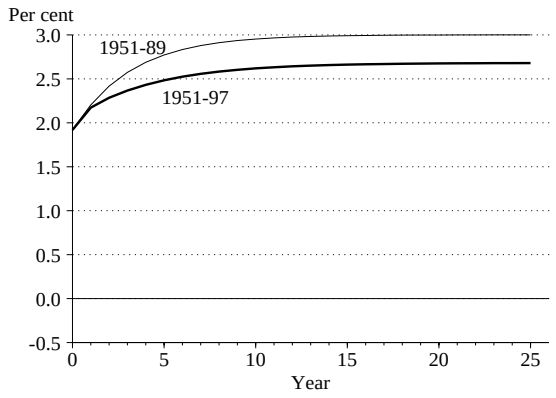
Note.: The size of the shock is one standard deviation in the normalized MA-system, cf. section 4.

Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

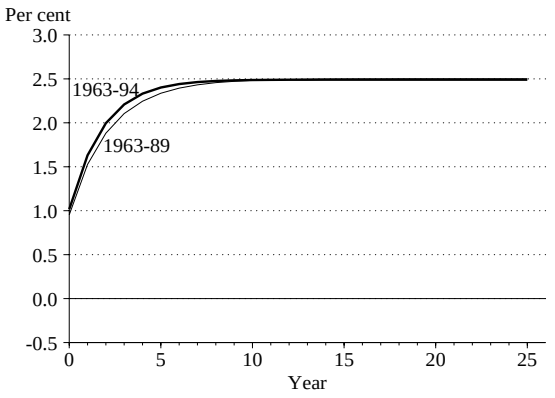
The maximum effect on inflation following a demand shock occurs generally the first or the second year after the shock, cf. figure 8.2. The pace of adjustment is again fastest in West Germany and Denmark followed by United Kingdom and the United States. The long-run effect on the price level (the area below the inflation curve) is largest in United Kingdom and smallest in West Germany. With respect to whether the adjustment pace has increased when data for the 1990s is included, see table 8.1 and 8.2.

Figure 8.3 Change in GDP following a supply shock

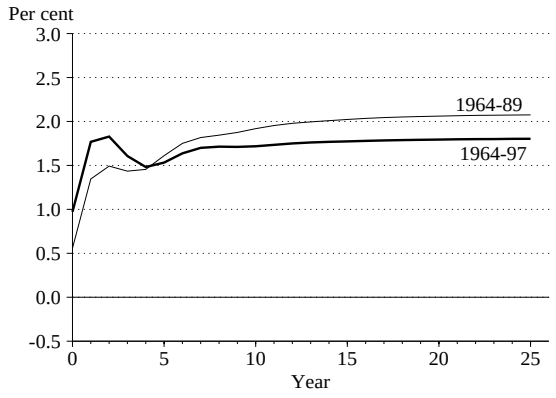
a. Denmark



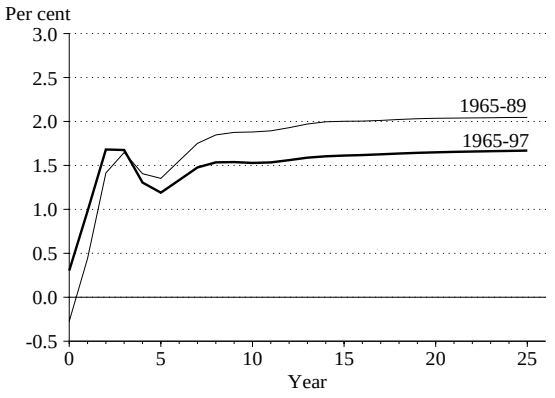
b. West Germany



c. United Kingdom



d. United States



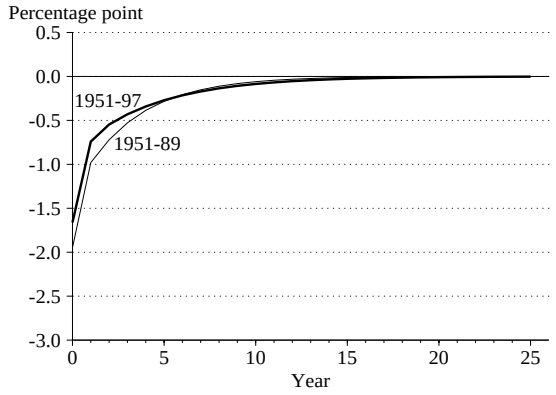
Note.: The size of the shock is one standard deviation in the normalized MA-system, cf. section 4.

Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

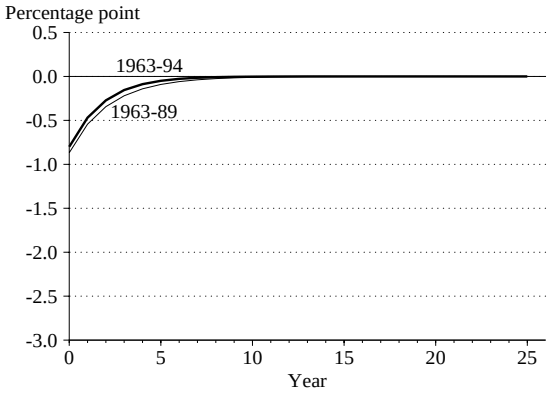
The long-run effect on the level of real GDP of a supply shock is between 1½ and 3 per cent, cf. figure 8.3. The pace of adjustment is fastest in West Germany and Denmark while both United Kingdom and the United States experience a setback in adjustment around four years after the shock. The size and profile of the American response is similar to the one reported in Keating and Nye (1998) based on the data period 1950-1994. For all countries, the first-year response increases in proportion to the long-run level between the short and the long sample, indicating a faster pace of adjustment.

Figure 8.4 Change in inflation following a supply shock

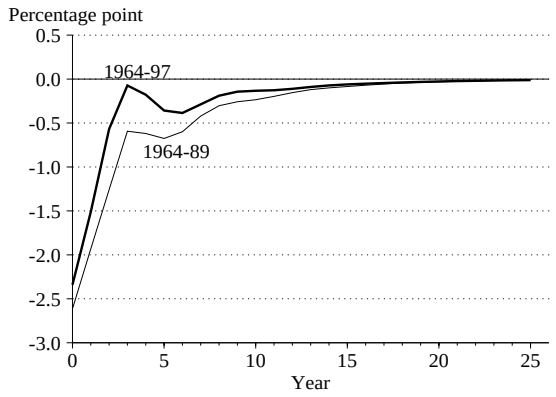
a. Denmark



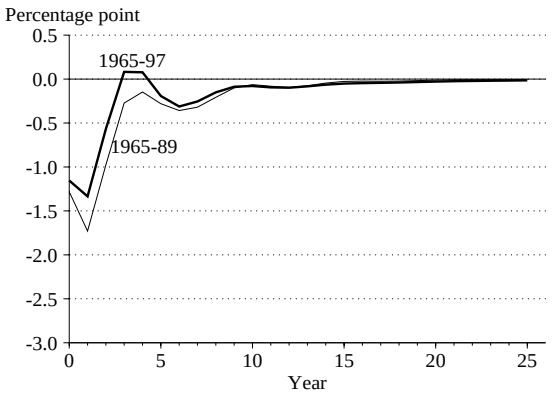
b. West Germany



c. United Kingdom



d. United States



Note.: The size of the shock is one standard deviation in the normalized MA-system, cf. section 4.

Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

The maximum effect on inflation following a supply shock occurs faster than after a demand shock, i.e. within a year or two in the case of the United States, cf. figure 8.2 and 8.4. The remaining adjustment also happens faster. The pace of adjustment is again more swift in West Germany and Denmark compared to United Kingdom and the United States. The setback in adjustment in real GDP around the fourth year to a supply shock in these two countries is mirrored in the price adjustment. The long-run effect on the price level (the area above the inflation curve) has generally diminished in the 1990s but so has the first-year

effect. Accordingly, it is in general difficult to ascertain whether the adjustment pace has increased or decreased, but an answer is suggested in table 8.1 and 8.2.

Table 8.1 First-year effect of a shock to the economy

	Estimation period	Demand shock		Supply shock	
		GDP[a]	Price level	GDP	Price level
		--------- Per cent of long-run effect --------			
Denmark	1951-89	83.0*	17.0	**64.0***	34.7*
	1951-97	86.1	13.9	**71.6***	32.9*
West Germany	1963-89	84.1*	15.9	**38.0**	**36.7***
	1963-94	84.2*	15.8	**41.0**	**42.3***
United Kingdom	1964-89	**102.3[b]***	**-2.3[c]**	**26.9**	**24.8***
	1964-97	**94.5***	**5.5**	**53.6**	**33.6***
United States	1965-89	**106.6[b]***	**-6.6[c]**	**-13.2[c]**	**20.6***
	1965-97	**98.2***	**1.8**	**17.8**	**24.2***

a) Since the long-run effect on GDP of a demand shock is zero, the first-year effect is calculated in proportion to the hypothetical effect on GDP if prices remained unchanged, equivalent to a horizontal short-run aggregate supply curve in figure 3.1.

b) The first year effect in proportion to the hypothetical effect on GDP, cf. a), is greater than 100 because the first year effect on prices is *negative*, cf. c). Therefore, the first-year effect on GDP is greater than the effect for unchanged prices.

c) The first-year effect has the opposite sign from what the AS/AD-model predicts, cf. figure 8.2c-d thin line. But it is not statistically significantly different from zero. The effect is positive from the second year and onwards.

Note: An asterisk signifies a first-year effect significantly different from zero at a 5 per cent significance level. Pairs of numbers in bold indicate change in the expected way given "new economics".

Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

The first-year effect changes in the direction predicted by "new economics" in little over two-thirds of the cases, cf. table 8.1 (pairs of numbers in bold). The first-year effect on output has generally become larger following a supply shock. It is also the case, that the first-year effect has increased universally in United Kingdom and the United States.

Table 8.2 Pace of adjustment[a] following a shock to the economy

	Estimation period	Demand shock		Supply shock	
		GDP	Inflation	GDP	Inflation
		------ Number of years after a shock -------			
Denmark	1951-89	3	2	0	1
	1951-97	4	3	0	2
West Germany	1963-89	4	2	1	1
	1963-94	4	2	1	1
United Kingdom	1964-89	3	4	**1**	**2**
	1964-97	3	4	**0**	**1**
United States	1965-89	3	3	**2**	**3**
	1965-97	4	5	**1**	**1**

a) Median lag length signifies the year following a shock where at least half of the adjustment to the new long-run equilibrium has occurred. With respect to the GDP effect of a demand shock, the year is stated in which half of the maximum effect has disappeared. The maximum effect happens generally the first year after the shock, i.e. in year 1, with the exception of the United States in the case of the short sample, cf. figure 8.1d thin line, and in the case of Denmark, cf. figure 8.1a both lines, where the maximum effect occurs simultaneously with the shock, i.e. in year 0.

Note: Pairs of numbers in bold change in the expected way given "new economics".

Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

But the encouraging news in table 8.1 of increasing first-year effects apparently does not hold in the longer run. The median lag length in table 8.2 has only decreased in one fourth of the cases. Therefore the faster pace of adjustment in the beginning is generally more than offset by a slower pace of adjustment in the medium run.

All in all, the British and the American pace of adjustments to supply shocks seem to have increased. But the rest of the picture is either a mixture of faster short-run but slower medium-run adjustment, or slower adjustment both in the short and the medium run. This lends itself more to a story of improved structures on the supply side of the British and American economies than to any story of an international trend improving how markets work in general.

9. Forecast error variance decomposition analysis - has the importance of demand shocks decreased?

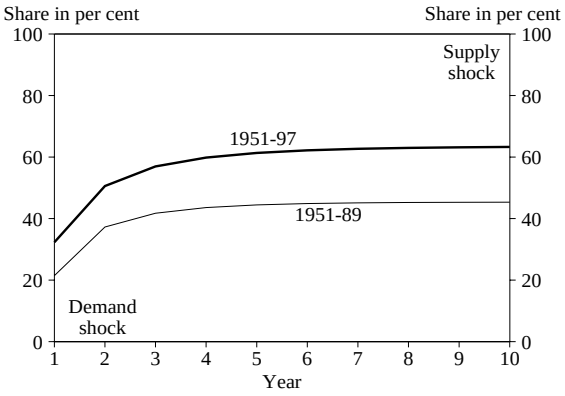
Forecast error variance decomposition (FEVD) is an alternative way of representing the results from the structural VAR. The method involves the use of the VAR to predict at time *t* the value of e.g. real GDP at time *t+h*, cf. Lütkepohl (1991). The variance of this GDP forecast is then decomposed by use of the structural VAR into independent parts due to the demand and the supply shocks.

The FEVD tells us the importance of different shocks at different horizons. For example the distribution at a horizon of approximately five years would tell us what type of shock is the most prominent in a standard business cycle.

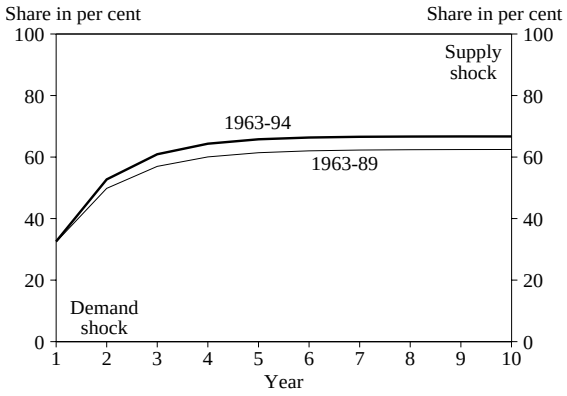
"New economics" would emerge in a FEVD as a reduced importance of demand shock for the variance of the GDP forecast in the short end of the forecast horizon. There are two reasons why this is the case. First, the temporary effect of a demand shock on real GDP is expected to diminish, reducing the importance of demand shocks over the entire forecast horizon. Secondly, the speed of adjustment to the new long-run GDP-level following a supply shock is expected to increase, i.e. more of the adjustment happens earlier. This will boost the importance of the supply shock in the short run.

Figure 9.1 Inflation forecast error variance, contribution from demand and supply shock

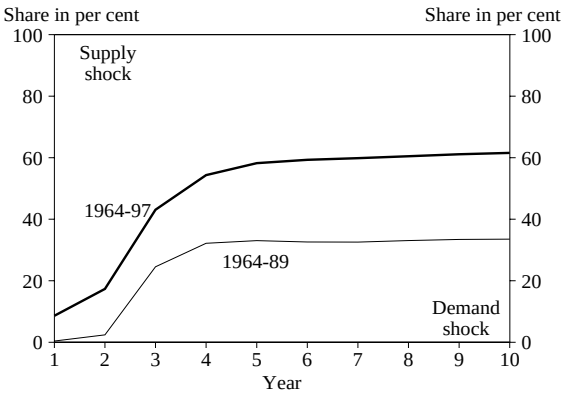
a. Denmark



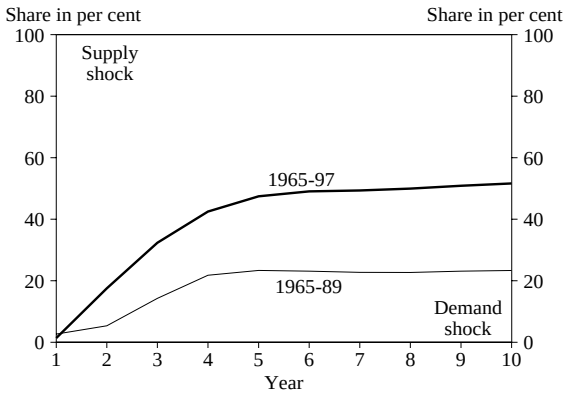
b. West Germany



c. United Kingdom



d. United States



Note: The thick line is based on a VAR estimated including data for the 1990s. The thin line is based on data excluding the 1990s. The contributions from the two shocks sum to 100 per cent. The distance below the line is the contribution from the demand shock. The distance above is from the supply shock.

Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

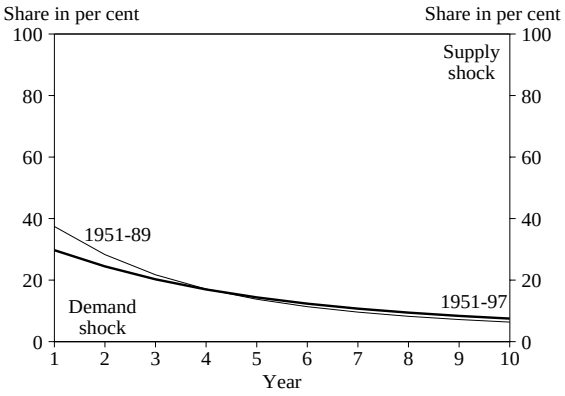
Supply shocks are more important for the short run variation in inflation in United Kingdom and the United States compared to Denmark and West Germany, cf. figure 9.1. In the long run the differences across countries diminish.

In West Germany the importance of supply shocks has decreased slightly over the entire forecast horizon except from the first year when comparing the short with the long sample. This is in accordance with the results in table 8.1 where the first year effect in proportion to the long-run level following a demand shock has diminished slightly while the effect following a supply shock has increased. This leaves relatively more of the effect of a demand shock to be adjusted in the following years hence demand shocks become more important in figure 9.1b.

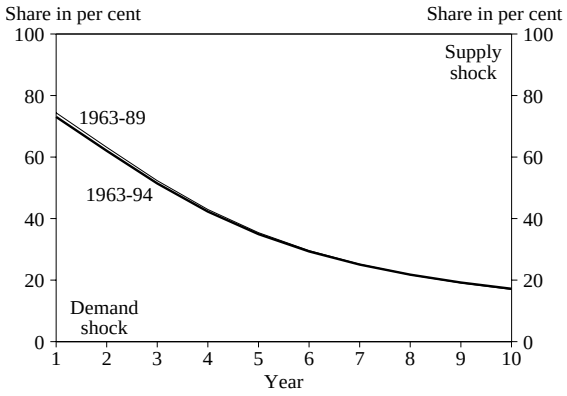
Generally, the importance of demand shocks increases at the cost of the importance of supply shocks when data for the 1990s is included in the analysis. It is not straightforward to interpret this as evidence for or against "new economics." The hypothesis is, that the adjustment pace to a new price level following *both* demand *and* supply shocks should increase. In theory, this could actually be the case even if the thin and the thick line in figure 9.1 coincided because the adjustment pace for the two types of shocks increased exactly by the same amount.

Figure 9.2 GDP forecast error variance, contribution from demand and supply shock

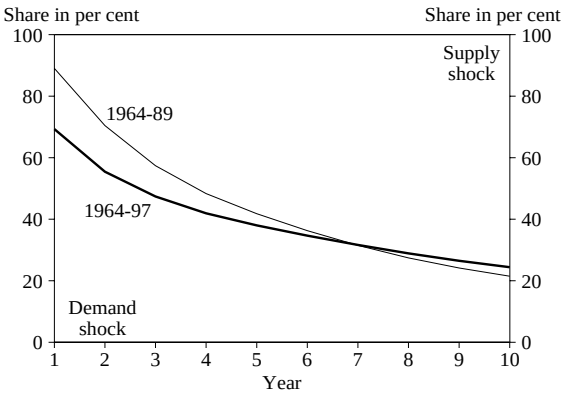
a. Denmark



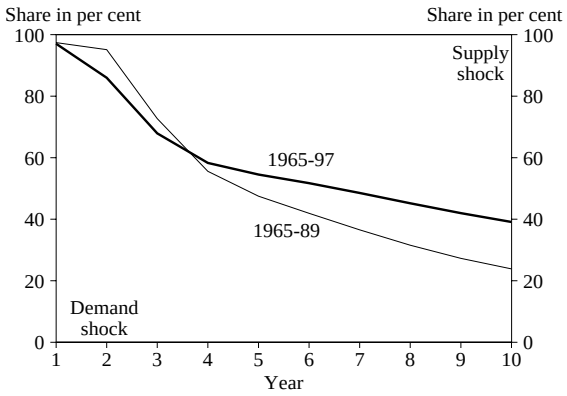
b. West Germany



c. United Kingdom



d. United States



Note.: Supply shocks explain all the GDP-forecast variance in the long run. The thick line is based on a VAR estimated including data for the 1990s. The thin line is based on data excluding the 1990s. The contributions from the two shocks sum to 100 per cent. The distance below the line is the contribution from the demand shock. The distance above is from the supply shock.

Source: Statistics Denmark, ADAM's database, OECD, *Main Economic Indicators*, and own calculations.

By construction, supply shocks explain all forecast variance in GDP in the long run. But in the very short run demand shocks play a major role explaining 70 to 100 per cent of the variance. Only Denmark is an exception with only approximately 35 per cent of the very short-run variance explained by demand shocks.

At the business-cycle horizon of approximately five years, demand shocks play a minor role in Denmark explaining only approximately 15 per cent of the variation. The importance of demand shocks increase down the line of West Germany, United Kingdom, and is maximized in the United States where supply and demand shocks are about equally important for the business cycle.

The importance of supply shocks in the short to medium run in Denmark is also found in Hansen (1997). He finds similar results for other small countries such as The Netherlands, Austria, Ireland, Sweden, and Finland. Gerlach and Klock (1990) add Norway to the list.

Generally, the inclusion of data from the 1990s reduces the importance of demand shocks in the short run consistent with what "new economics" predicts. This is just another way of representing the results already evident in the first and the third column in table 8.1. In the case of United Kingdom and the United States the first year adjustment following a supply shock has increased while the temporary effect of a demand shock has decreased. With respect to Denmark and West Germany the increased first-year effect of a supply shock more than counteracts a somewhat larger temporary effect of a demand shock.

10. Conclusion

This paper has given an empirical evaluation of the claim that due to "new economics" the economies embarked on an era of high and stable growth and low and stable inflation in the 1990s.

We have given "new economics" the following relatively broad interpretation: The increasing importance of the production of services, globalization, the digital revolution, changes in the financial sector, changes in the market for goods and services, changes in the labour market, and changes in macroeconomic policy.

If these phenomena have been developments distinctive for the 1990s then the decade should be characterized by the following:

- Higher growth and lower inflation
- A more similar economic development in different countries
- More subdued business cycles

Combining a theoretical AS/AD-model with a two-dimensional structural VAR

analysis the three predictions turn into the following three empirically testable hypotheses for the 1990s:

- The economies have been subjected to a series of positive supply shocks enhancing the long-run potential output level and reducing inflation.

- Supply and demand shocks have become more correlated across countries.

- The pace of adjustment following a shock to the economy has increased. This has three implications. First, the new long-run price level following a demand and a supply shock is attained faster. Secondly, the new long-run output level resulting from a supply shock is reached more quickly. And thirdly, the temporary effect on output following a demand shock is diminished.

The three "new economics" hypotheses are tested in the four countries: Denmark, West Germany, United Kingdom, and the United States. The data used is real GDP and consumer price indices for the period 1960-1997 with the exception of data for Denmark starting in 1948 and data for West Germany ending in 1994.

Already when estimating the VARs, it is evident that data for the 1990s does not constitute a structural break in how the economies work. This is partly due to the relatively low explanatory power of the VARs. We therefore proceed to examine whether the changes at least are in the direction predicted by "new economics" even though they are not significant in a statistical sense.

The shock decomposition does not give indications of aggregate positive supply shocks in the 1990s. Neither has the correlation between supply shocks increased. The correlation between demand shocks has increased between the countries except for West Germany. Though, this is probably more the result of parallel running business cycles in the 1990s in Denmark, United Kingdom, and the United States. All in all, no support for "new economics" in the shock decomposition analysis.

The impulse-response analysis and the forecast error variance decomposition (FEVD) analysis are alternative ways of representing the same results from the structural VAR.

The impulse-response analysis shows that the pace of adjustment to supply shocks

seems to have increased for the British and the American economies. But the rest of the picture is either a mixture of faster short-run but slower medium-run adjustment, or slower adjustment both in the short and medium run. This lends itself more to a story of improved structures on the supply side of the British and the American economy than to a story of an international trend improving how markets work in general.

The FEVD shows that the importance of demand shocks for GDP have declined in the short forecast horizon which is in accordance with the larger first-year effects from supply shocks shown in the impulse-response analysis and with the predictions of “new economics”.

All in all, there is some support for improved performance on certain markets in certain countries. But “new economics” cannot be said to have changed in general how economies work at the aggregate level.

11. Literature

BIS (1998): *Bank for international Settlements – 68th Annual Report*, Basle.

BIS (1996): *Central Bank Survey of Foreign Exchange and Derivatives Market Activity*, Basle.

Bayoumi, T. and B. Eichengreen (1994): Macroeconomic Adjustment under Bretton Woods and the Post-Bretton-Woods Float: An Impulse-Response Analysis. *The Economic Journal 104*, pp. 813-827.

Bayoumi, T. and B. Eichengreen (1992): Shocking Aspects of European Monetary Unification. *CEPR Discussion Paper Series no. 643*.

Blanchard, O. J. and S. Fischer (1989): *Lectures on Macroeconomics*. M.I.T. Press, Cambridge, Massachusetts.

Blanchard, O. J. and D. Quah (1989): The Dynamic Effects of Aggregate Demand and Supply Disturbances. *American Economic Review vol 79 no. 4*, pp. 655-673.

Det Økonomiske Råd (1998): *Dansk økonomi, forår 1998*. København.

Det Økonomiske Råd (1997): *Dansk økonomi, forår 1997*. København.

Det Økonomiske Råd (1996): *Dansk økonomi, forår 1996*. København.

Doornik, J. A. and D. F. Hendry (1994): *PcFiml 8.0. Interactive Econometric Modelling of Dynamic Systems.* International Thomson Publishing, London.

Finansministeriet (1997): *Globalisering og dansk økonomi.* København.

Gerlach, S. and J. Klock (1990): Supply Shocks, Demand Shocks, and Scandinavian Business Cycles, 1950-1988. *Working paper no. 279/90.* Brandeis University, Department of Economics.

Gerlach, S. and J. Klock (1991): Supply and Demand Disturbances and Swedish Business Cycles 1864-1988. *Skandinaviska Enskilda Banken Quarterly Review 1-2*, pp. 33-42.

Grimm, B. T. (1998): Price Indexes for Selected Semiconductors, 1974-96. *Survey of Current Business, February 1998*.

Hansen, N. L. (1997): Samvariation mellem udbuds- og efterspørgselsstød. Impuls-respons analyse af årstal for Vesteuropa og USA, 1960-95. *DØRS-arbejdspapir, 1997:3.*

Johansen, S. (1996): *Likelihood-Based Inference in Cointegrated Vector AutoRegressive Models.* Advanced Texts in Econometrics. Oxford University Press, Oxford.

Johansen, S., and B. Nielsen (1993): *Manual for the Simulation Program DisCo, Institute of Mathematical Statistics*, University of Copenhagen, Copenhagen.

Keating, W. J. and J. V. Nye (1998): Permanent and Transitory Shocks in Real Output: Estimates from Nineteenth-Century and Postwar Economies, *Journal of Money, Credit, and Banking vol. 30 no. 2*, pp.231-251.

Lütkepohl, H. (1991): *Introduction to Multiple Time Series Analysis*. Springer Verlag, Berlin.

OECD (1997a): *Economic Surveys, Denmark*, Paris.

OECD (1997b): *Economic Surveys, Germany*, Paris.

OECD (1997c): *Economic Surveys, United States*, Paris.

OECD (1996a): *Economic Surveys, United Kingdom*, Paris.

OECD (1996b): *Economic Surveys, United States*, Paris.

OECD (1995a): *Economic Surveys, Germany*, Paris.

OECD (1995b): *Economic Surveys, Switzerland*, Paris.

Rahbek, A., H.C. Kongsted, and C. Jørgensen (1998): Trend-Stationarity in the I(2) Cointegration Model, *Journal of Econometrics*, forthcoming.

Warne, Anders (1993): A Common Trends Model: Identification, Estimation and Inference. Seminar Paper no. 555, Institute for International Studies, Stockholm University, Nov. 1993.