THE BOOM AND THE DEPRESSION: AN ANALYSIS WITHIN THE AGGREGATE-DEMAND – AGGREGATE-SUPPLY FRAMEWORK

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1. INTRODUCTION

In *Sauramo* (1996) I started to analyse a most important and interesting period of Finnish economic history, the boom of the late eighties and the depression of the early nineties, by utilizing an econometric model. The main motivation for writing that paper was that the Finnish discussion about the causes of the depression would benefit from research based on econometric analysis.

One of the aims of the paper was to assess the relative merits of the various explanations about the causes of the depression. In the paper I outlined the Finnish debate by distinguishing three interpretations of the depression.

According to the first interpretation, the depression was mainly caused by factors affecting exports, i.e. by the collapse of the Soviet trade, the deterioration of competitiveness and the worsening of international economic developments. This explanation was called **the interpretation based on the traditional view of the Finnish business cycles as governed by fluctuations in exports.**

By the second interpretation, **the debt-deflation interpretation of the depression,** the ultimate cause of the depression was the false way of liberalizing the financial markets during the eighties. The deregulation process led to a debt-driven boom and finally to a depression which was characterized by a Fisherian debt-deflation (*Fisher* 1932, 1933). According to this interpretation, the depression was basically a monetary crisis during which the credit channel played a major role.[1]

[1] The interpretation could also be called **the monetary explanation of the depression**. In the Finnish context this kind of characterization has a meaning differing from that common in the US discussion about the causes of the Great

The third interpretation was called **the balance-of-payments interpretation of the depression**, since in the explanation the balance of payments constraint is the most important part of the propagation mechanism through which external shocks operate. According to this interpretation, the collapse of Soviet trade, the worsening of the terms of trade, the recession in the foreign economy and the rise in the foreign interest rates were able to cause the recession, because the balance of payments constraint magnified their negative effects (see *Tarkka* 1994). The biggest difference between the first and third interpretation is that the most important propagation mechanism through which negative external shocks operate is assumed to be different. Domestic demand has a more important role in the third than in the first interpretation.

Hardly any discussant has supported only one of these interpretations, for each of them only provides one view of the depression. Therefore, the ”best” explanation of the depression is given by a synthesis of the three interpretations. This does not mean, however, that it is worthless to ask which of the three views is the best one.

The approach used in *Sauramo* (1996) was similar to that of *Blanchard* (1993). Blanchard analysed the causes of the most recent recession in the US by using a very simple two-variable structural VAR model. According to Blanchard’s analysis the main “cause” of the recession was a “consumption shock”, an abnormal decrease in consumption. Analogously, the main result of *Sauramo* (1996), which utilized a four-variable (real GDP, private consumption, private investment, net exports) VAR model, was that consumption shocks played a major role both in the boom and the depression. Both the boom and the depression were consumption-led.

Depression. In the US debate, the monetary explanation of the Great Depression has traditionally been associated with monetarist explanations of the Great Depression. For the US debate, see, for example, *Brunner* (1981). For the most recent Finnish studies, see *Ahtiala* (1997) and *Kukkonen* (1997). For earlier ones, see, for example, *Sauramo* (1991) and *Söderström* (1993).

Therefore, one of the conclusions drawn in *Sauramo* (1996) was that something essential is missing in the first interpretation, in which the role of exports is highlighted. Negative shocks to net exports had a major influence in 1991 when GDP decreased by seven per cent, but they were not important at the onset of the depression which took place earlier. It was in 1991 that the negative effects of the collapse of the Soviet trade were most apparent.

A shock interpretation which is based on the dominant role of "consumption shocks" is consistent with both the second and the third interpretation. By using only the results of *Sauramo* (1996), it is difficult persuasively to argue for either of these two alternatives.

The interpretation of the "consumption shocks" was difficult, since the analysis was, like that of *Blanchard* (1993), measurement without any well articulated theory. For example, they could be regarded as sudden realizations of over-borrowing, an interpretation consistent with the second interpretation. But they could also reflect changes in expectations of future income, the changes being caused by worsening of the terms of trade.

The main aim of this paper is to deepen *Sauramo's* (1996) discussion by linking the econometric analysis more closely to economic theory. This is done by estimating structural VAR models which are based on the utilization of the traditional aggregate-demand – aggregate-supply framework. Typically, these models belong to the class of IS-LM models, which have been augmented with a Phillips curve. Today this is one of the most commonly used frameworks in the empirical analysis of economic fluctuations.

Even though one can expect that the use of the aggregate-demand – aggregate-supply framework makes the interpretation of shocks easier than the use of a theoretical framework such as the one utilized in *Blanchard* (1993) or in *Sauramo* (1996), this does not mean that the interpretation becomes easy.

First, the framework should fit the data. In the case of Finland this is far from being obvious. Until the mid eighties, the financial markets were regulated and therefore the standard textbook versions were more or less inapplicable in the description of the behaviour of the economy. Since the deregulation of the financial markets the situation has changed, but shifts in the exchange rate policy and monetary policy regimes complicate the use of the standard IS-LM framework or its cousin, the Mundell-Fleming framework.

Second, the shock interpretation should be useful when one discusses the relative merits of the various explanations of the causes of the depression. Obviously, it is difficult to construct a variant of the aggregate-demand – aggregate-supply model by which one could assess all the relevant aspects of the depression. At least, the model should enable one to comment on the most important standpoints of the debate. This means, first of all, that one could analyse the role of credit and the credit channel. Since credit has no role within the standard textbook versions of the aggregate-demand – aggregate-supply model, or within the IS-LM model, it is not clear how the validity of the second interpretation can be assessed by these models.[2]

It will be seen that it is not impossible.[3] Yet it will also be seen that it is not easy to find a theoretical framework on which the Finnish debate about the causes of the depression should be based. Therefore, the analysis of this paper will still be tentative.

The results of this paper mainly serve the assessment of the relative merits of the second and the third interpretation. Because the role of the terms of trade is central in the third interpretation, the importance of changes in the terms of trade during the past ten years deserves special attention.

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[2] For a discussion about the role of credit within the IS-LM framework, see *Bernanke* and *Blinder* (1988), and *Brunner* and *Meltzer* (1988).

[3] For earlier attempts, see, for example, *Cecchetti* and *Karras* (1994), and *Betts, Bordo* and *Redish* (1996).

This paper is organized as follows. In the next chapter, the framework of the investigation is introduced. Chapter 3 discusses the data. Chapter 4 contains the main results, and Chapter 5 concludes the work.

2. THE FRAMEWORK

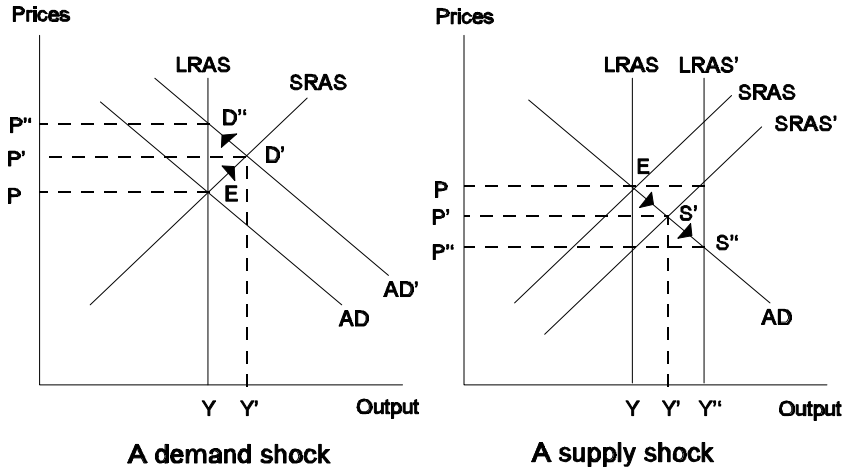
The aggregate-demand – aggregate-supply framework

A large number of recent econometric studies which utilize structural VAR models in the description of economic fluctuations have the traditional aggregate-demand – aggregate-supply framework as the point of departure.[4] Within that framework, the shocks that are the main sources of fluctuations are either aggregate-demand or aggregate-supply shocks. Figure 1, of which there are numerous examples in various textbooks, illustrates how one can distinguish between these two types of shocks (see, for instance, *Bergman* 1992, Chapter 4, and *Sterne* and *Bayoumi* 1993).[5]

[4] The major alternative has been to build the analysis upon Real Business Cycle theory.

[5] Models which are augmented with a Phillips curve can be illustrated by an analogous figure in inflation – output space.

Figure 1. Aggregate-demand – aggregate-supply model



Source: *Sterne* and *Bayoumi* (1993).

The aggregate-demand curve, AD, is downward sloping. Lower prices raise money balances (the Pigou effect) and boost aggregate-demand. The short-run aggregate supply curve, AS, is upward sloping, indicating that wages are rigid and therefore price increases lower real wages and increase real output in the short run. The long-run supply curve, LRAS, is vertical, because wages, in the long run, adjust to changes in prices.

In distinguishing the shocks, the role of the long-run vertical supply curve (or Phillips curve) becomes critical. The left-hand panel in Figure 1 depicts the effect of a (positive) shock to aggregate-demand. The aggregate demand curve shifts from AD to AD', which moves the short-run equilibrium from E to D', and raises both output and prices. At D' output is above normal, which raises prices and shifts the short-run aggregate supply curve

upwards. The economy moves gradually to the new long-run equilibrium D'' where the price level is higher than at E but output is at its initial level. Thus, a positive demand shock is expansionary and inflationary in the short run, but in the long run it only raises the price level.

The effect of a positive supply shock is depicted in the right-hand panel of the figure. The shock (for instance, a favourable technology shock or an increase in labour supply) shifts the short- and long-run supply curves rightwards. This raises output and reduces prices, moving the short-run equilibrium from E to S' first. At S' output is below the new long-run level, which decreases prices and shifts the short-run supply curve downwards. Output increases and prices decrease until the new equilibrium S'' is achieved. The important difference between aggregate-demand and aggregate-supply shocks is that positive aggregate-supply shocks have permanent positive effects on real output. Furthermore, positive supply shocks are deflationary. They reduce prices.

The classification of shocks into aggregate-demand and aggregate-supply shocks rests on the assumption about the vertical long-run supply (or Phillips) curve. If that is assumed to exist, aggregate-demand shocks do not affect output in the long-run. Obviously, this assumption is problematic, because it is easy to think of channels through which demand shocks may have long-lasting, or even permanent, effects on output (capital accumulation, hysteresis in the labour market, increasing returns to scale etc.) *Blanchard* and *Quah* (1989), who were among the first to apply the aggregate-demand – aggregate-supply framework in the identification of the shocks, noted – and proved – that if the (permanent) effects of aggregate-demand shocks are small relative to those of aggregate-supply shocks, the identification of the shocks can be based on the assumption that aggregate-demand shocks have no long-run effects on output.

I will report results from various experiments which are based on the use of the aggregate-demand – aggregate-supply framework. Also, I will discuss its validity in the Finnish context.

Identification of shocks

The essential ingredient of the identification which is based on the use of the traditional aggregate-demand – aggregate-supply framework is the utilization of long-run identifying restrictions. The first generation of structural VAR models only employed short-run restrictions. The merit in the use of long-run restrictions is that they enable one to construct models with properties similar to some attractive theoretical models. Hence the use of long-run restrictions can, in principle, make the relationship between theoretical and empirical models closer.

To illustrate the use of long-run restrictions, assume that $x_t=(\Delta y_t,\Delta p_t)'$, where y is real output and p is the price level, both in logs, and where Δ is a (first) difference operator ($\Delta y_t = y_t - y_{t-1}$), is a covariance stationary process. Assume further that the process has a moving average representation of the form

$$\begin{pmatrix} \Delta y_t \\ \Delta p_t \end{pmatrix} = A(L) \begin{pmatrix} \epsilon_{st} \\ \epsilon_{dt} \end{pmatrix}, \qquad (1)$$

where $\epsilon_t=(\epsilon_{st},\epsilon_{dt})'$ is a vector of serially uncorrelated shocks (ϵ_s is an aggregate supply shock, and ϵ_d is an aggregate-demand shock), and where *A(L)* is a 2×2 matrix polynomial in the lag operator *L*.

The model defined by equation (1) can be estimated using a vector autoregression. The reduced form autoregressive representation can be written as

$$B(L)x_t=v_t, \qquad (2)$$

where v is the vector of residuals, $B(L) \equiv [B_{ij}]$ for $i,j=1,2$, and $B(0)=I$.

The residuals are assumed to be linear combinations of the shocks, i.e. the structural disturbances. Therefore

$$v_t = S\epsilon_t, \tag{3}$$

where S is non-singular. Equations (1) and (2) imply that

$$A(L) = B(L)^{-1}S. \tag{4}$$

Matrix $A(L)$ can be estimated by using the estimated coefficients of $B(L)$ and by using some identifying restrictions by which the four elements of matrix S can be determined.

In the 2×2 case, four constraints are needed for just-identification. Three constraints are given by the assumption that the shocks are mutually orthogonal and that their variances equal to unity.

These constraints imply that

$$SS' = \Sigma, \tag{5}$$

where $\Sigma = Evv'$ (E denotes the expectational operator). Equation (5) provides three quadratic equations.

The fourth restriction is given by the assumption that in the long run the aggregate-demand shocks do not affect output .

The long-run effects of the shocks are given by the elements of $A(1)$:

$$A(1) = \begin{pmatrix} a_{ys} & a_{yd} \\ a_{ps} & a_{pd} \end{pmatrix} \qquad (6)$$

The restriction that the aggregate-demand shocks have no long-run effects on output implies that a_{yd} =0. The fourth equation can be defined by using (4), which implies that $A(1)=B(1)^{-1}$ S.

In the 2×2 case, one additional constraint, in addition to orthogonality conditions, is enough for just-identification. In more general cases, more constraints (in addition to orthogonality conditions) are needed. In their pioneering work, *Blanchard* and *Quah* (1989) estimated a bivariate structural VAR model by using one long-run constraint.

Bivariate models have the disadvantage that one cannot identify separate components of the aggregate demand and supply shocks. *Gali* (1992) estimated, by utilizing both short-run and long-run restrictions, a four-variable model by which he was able to identify four types of shocks: aggregate- supply shocks, money-supply shocks, money-demand shocks, and IS shocks. Hence, he identified three separate aggregate-demand shocks and estimated an IS-LM model which is augmented with the Phillips curve. In some studies, aggregate-supply shocks have also been separated into components. For example, *Shapiro* and *Watson* (1988) estimated a four-variable model by which they separated aggregate-supply shocks into two components: labour-supply and technology shocks.

As pointed out in the introduction, the identification of shocks within the aggregate-demand – aggregate-supply framework is not straightforward in the case of Finland. Therefore, I have estimated various models all of which belong to the class of aggregate-demand – aggregate-supply models. I will report and discuss results which are based on the estimation of two-, three-, four-, and five-dimensional structural VAR models.

3. THE DATA

I utilize data on variables, which enables the discussion about the causes of the depression, which can be included in a model which belongs to the class of traditional aggregate-demand – aggregate-supply models, and which fits the data as well as possible. Yet, because the dimension of VAR models cannot be very high, it is impossible to include all the potentially relevant variables in the model.

The choice of variables is critical, since it largely determines the nature of conceivable shock interpretations. In *Sauramo* (1996), the exploration was based on the examination of the joint behaviour of four variables: real GDP, private consumption, private fixed investment and net exports. Even though one can achieve reasonable and interesting results also by utilizing this kind of set of variables, the analysis is bound to be measurement without any well-articulated economic theory. The variables used in this study (should) tie the investigation about the causes of the boom and depression more closely to economic theory.

The following variables are utilized in the analysis: real GDP (denoted by Y), real private consumption (C), consumer prices (P), short-term interest rate (r), and the terms of trade (TOT). (Except for r, lower case letters are used to denote the logs of the variables.)

The choice of Y and P is obvious, if one wants to identify aggregate-demand and aggregate-supply shocks (see Figure 1). The use of r makes the examination of the role of real interest rate movements, and of monetary policy, possible. Also, it may be useful if one attempts to separate, in the spirit of the IS-LM model, aggregate-demand shocks into IS- and LM-shocks (see, for instance, *Gali* 1992). The choice of private consumption is not obvious, if one is searching for “ultimate” causes of the

boom and the depression. Essentially, private consumption is an endogenous variable, which makes the interpretation of "consumption shocks" very difficult. This was demonstrated by *Blanchard* (1993) and *Sauramo* (1996).[6] There are two closely related reasons for choosing private consumption as one of the variables.

According to the previous study, "consumption shocks" played a major role both in the boom and the depression. Both the boom and the depression were consumption-led. This strongly motivates the use of consumption as one explanatory variable even if the interpretation of these shocks was very difficult. But one can make progress in interpreting these shocks if private consumption is one variable in a model which is more closely tied with economic theory. Furthermore, in the second interpretation of the causes of the depression the role of credit and the credit channel is underlined. The inclusion of private consumption can make the examination (or, the speculation) of the role of credit (and the debt-deflation process) easier, even though the standard aggregate-demand – aggregate-supply models, or IS-LM models, allow no explicit role for credit (see, for example, *Bernanke* and *Blinder* 1988).

The terms of trade have been chosen as one of the variables because, by the third interpretation about the causes of the depression, it has played an important role in shaping the nature of economic developments during the past ten years.

One can argue that some very relevant variables will be missing in the models. Since Finland is a small open economy, one could expect that variables such as net exports and the real exchange rate would enter the models, and a theoretical model which belongs to the class of Mundell-Fleming models would serve as a baseline model.[7]

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[6] For a discussion of "consumption shocks", see also *Cochrane* (1994).

[7] For the use of such models, see, for instance, *Erkel-Rousse* and *Melitz* (1995) and *Schön* (1995).

The choice of variables is based on experimenting, also with variables like the real exchange rate. One conclusion which could be drawn from these experiments is that factors which operate through the real interest rate seem to have been more important that those operating through the real exchange rate. This has been one reason for omitting the real exchange rate. Furthermore, if one wants to undertake a careful analysis about the validity of the second interpretation about the depression, the real interest rate is a natural choice. In principle, both variables could, and should, enter the relevant models. According to my experiments, which have still been tentative, that would have complicated the analysis substantially without any noticeable payoff.

As noted earlier, the exploration will be based on the estimation of two-, three-, four-, and five-variable models. This means that not every variable enters every model.

The estimations will be based on quarterly data which cover the period 1975:1–1996:2. Quarterly data on GDP, private consumption and the terms of trade are from the quarterly national accounts constructed by Statistics Finland. Deflators for exports of goods and services, and imports of goods and services were used when the series for the terms of trade was constructed. Consumer prices are measured by the Consumer Price Index. Series for short-term interest rates are difficult to construct for the whole period under consideration, because owing to the regulation of the financial markets there does not exist an unbroken series for short-term interest rates. The interest rate series was constructed by splicing together two series. For the period from the first quarter of 1975 to the fourth quarter of 1986, the data have been constructed by utilizing data on three-month eurodollar rates and the discount of the FIM relative to the US dollar on three-month futures trades. From the first quarter of 1987 the data is on three-month Helibor rates.

Except for data on interest rates, the series are seasonally adjusted.

According to the standard augmented Dickey-Fuller tests, y, c, r, and tot have a unit root and are therefore I(1) variables. The best way to

characterize p is to regard it as a I(2) variable. Most of the analyses are performed under this assumption.

In the remainder of the paper, I report results from the exercises I made by utilizing the above data and by estimating two-, three-, four- and five-dimensional structural VAR models. Cointegration properties of the data are discussed when these models are specified and estimated.

4. RESULTS

The benchmark case: a bivariate VAR model

The identifying restriction used by *Blanchard* and *Quah* (1989) is attractive, because it is powerful. It enables one to separate aggregate-demand and aggregate-supply shocks by utilizing a very simple bivariate VAR model. Blanchard and Quah employed a model which desribes the joint behaviour of GNP and unemployment rate. This choice is only one alternative. For instance, in *Bayoumi* and *Eichengreen* (1994), *Bergman* (1992), *Gerlach* and *Klock* (1991), and *Sterne* and *Bayoumi* (1993) data on GDP and prices were used in the identification. This is what is done in this paper, too.

I estimate a bivariate model using data on GDP and consumer prices, and employing the restriction that aggregate-demand shocks do not affect output in the long run. According to the aggregate-demand – aggregate-supply model, positive demand shocks should raise consumer prices both in the short and in the long run, while positive supply shocks should reduce prices. These responses are not imposed, however. Therefore they can serve as over-identifying restrictions when the sensibility of the results is discussed.

My ultimate aim is to describe and analyse the boom and the depression by estimating a four- or five-variable model by which one could separate four or five shocks. The basic reason for starting the exploration by using a bivariate model is that, as will be seen, it is not at all easy to identify, by using the Finnish data, shocks which have interpretations consistent with the traditional aggregate-demand – aggregate-supply model. This can be demonstrated by a bivariate model.

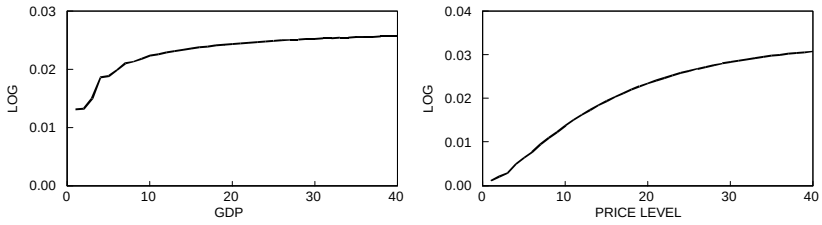
I report results which were based on the assumption that y and p are I(1) variables, which means that $x_t = (\Delta y_t, \Delta p_t)'$ is assumed to be a covariance

stationary process.[8] The results would remain qualitatively the same if p is assumed to be an I(2) variable.[9]

The characteristics of the shocks will be illustrated by using impulse responses and forecast error variance decompositions. The importance of the various shocks in shaping the boom and depression years are illustrated by using historical forecast error decompositions.

Figures 2 and 3 display the responses of GDP and consumer prices to a positive permanent and transitory shock, respectively. The permanent shock has a permanent positive effect on output. If it is to be called a supply shock, it should decrease prices. Yet this is not the case. The shock is inflationary. Also, the interpretation of the transitory shock is difficult. Like a positive aggregate-demand shock, it is inflationary, but it reduces output. It looks like a temporary negative supply shock. (Within an open economy framework the shock still can be regarded as an aggregate-demand shock: inflationary aggregate demand shocks may be contractionary, if they lead to a deterioration of competitiveness.)

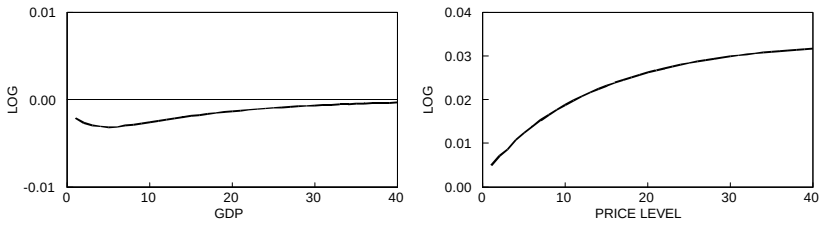
Figure 2. Dynamic responses to a permanent shock: a bivariate model



[8] Consequently, the model was estimated in the difference form. Three lags were used, with Schwarz and Hannan-Quin information criteria being the main decision-making criteria. The estimation period was 1976:1–1996:2.

[9] I also did the same exercises by using the GDP deflator instead of the Consumer Price Index. The results remained essentially the same.

Figure 3. Dynamic responses to a transitory shock: a bivariate model



In principle, positive supply shocks can be associated with increasing prices if, for instance, monetary policy authorities (over)react to such a shock by loosening the stance of monetary policy more than required. In that case impulse responses in Figures 2 and 3 would also reflect monetary policy reactions to positive supply shocks. At least in the case of Finland, this explanation is hardly plausible.

Finland is not the only country which may be associated with inflationary permanent shocks. *Bayoumi* and *Eichengreen* (1994) found that this property is common to those countries which are heavily dependent on raw material production. They argue (on page 13) that this may reflect the fact that, for raw material producers (like Indonesia, Maleysia, and Norway), positive supply shocks are associated with improvements in the terms of trade, which boost aggregate demand, and, consequently, increase prices. However, this explananation may not apply to Finland, because changes in the terms of trade in Finland seem to be independent of other shocks. This topic will be discussed later.

The first exercise demonstrates that, that the Finnish data is used, the shocks which are obtained using the Blanchard-Quah identification may not be consistent with the conventional aggregate-demand – aggregate-supply model.

This is not the first time that one obtains inflationary permanent shocks by using Finnish data and by using restrictions analogous to those used above. *Mellander, Vredin* and *Warne* (1990) obtained a similar result when they examined the joint dependence of six variables: GDP per capita, consumption (private and public) per capita, gross fixed investment per capita, terms of trade, GDP deflator, and nominal money stock per capita (M2). They utilized yearly observations from the period 1866–1985. It is worth noting that for Sweden the results were in line with the aggregate-demand – aggregate-supply framework. On the other hand, *Sterne* and *Bayoumi* (1993) were able to identify sensible supply shocks for Finland by utilizing a bivariate VAR model similar to that used in this paper and by using yearly observations from the period 1963–1988. Furthermore, *Hartikainen* (1995) could identify reasonable aggregate-demand and aggregate-supply shocks by utilizing, like *Blanchard* and *Quah* (1989), quarterly data on GDP and unemployment from the period 1970–1990, and from the subperiods 1970–1983, and 1984–1990.

Table 1 illustrates the relative importance of the two shocks. Fluctuations of GDP are almost completely attributable to permanent shocks.[10]

The dominant role of the permanent shocks is also seen in Table 2, which displays the decomposition of eight-quarter forecast errors for GDP. (Figures are yearly averages, which have been calculated by using quarterly observations. Eight quarters were chosen, because the peaks and troughs correspond closely enough to the peaks and the troughs of the GDP series.) Both the boom and the depression were caused by the permanent shocks.

The figures in Table 2 should be interpreted as follows. In 1986 the eight-quarter forecast error for GDP was 0.7 per cent, i.e. the realized level of GDP was 0.7 per cent higher than that forecast by the model. (Owing to the

[10] When GDP deflator is used instead of the Consumer Price Index, the importance of transitory shocks increases somewhat but it is still minor.

Table 1. Forecast-error variance decompositions for GDP: output – prices model

Horizon in quarters	Permanent shock	Transitory shock
Contemporaneous	97.5	2.5
4	96.9	3.1
8	97.5	2.5
12	98.0	2.0
16	98.5	1.5
20	98.8	1.2
24	99.0	1.0
100	99.8	.2

Note: In the table the forecast error variances have been decomposed to two sources. For instance, of the 8-step forecast error variance of GDP, 97.5 per cent is accounted for by permanent shocks and 2.5 percent by transitory shocks.

Table 2. Decomposition of eight-quarter forecast errors for GDP: output – prices model (yearly averages for 1986–1995)

Year	GDP	Permanent shock	Transitory shock
1986	0.7	-0.2	0.9
1987	1.5	1.1	0.4
1988	4.6	4.8	-0.2
1989	5.4	5.6	-0.2
1990	0.0	0.0	0.0
1991	-13.4	-13.1	-0.3
1992	-13.8	-12.8	-1.0
1993	-4.8	-4.2	-0.6
1994	1.3	0.9	0.4
1995	0.6	0.5	0.1

Note: Forecast errors of the first column are based on the use of the level form of the model. Consequently, the forecast errors have been obtained by subtracting the forecasts from the logs of the realized levels of GDP.

way the forecast errors are computed, see the note in Table 2; they are not exactly the same as relative forecast errors. The difference, however, is small.) Of this error, -0.2 percentage points were due to the permanent shock, and 0.9 percentage points to the transitory shock, respectively.

According to Table 2, permanent shocks caused both the boom and the depression with transitory shocks playing only a minor role. Yet this result is hard to interpret, because it is very difficult to say what these permanent shocks are. According to the vertical Phillips curve paradigm they should be permanent supply shocks, but the impulse response analysis did not confirm this interpretation. Rather, they looked like permanent demand shocks.

Obviously, there is need for further investigation. The resuIts may be due to omitted variable bias, which is one reason for the use of larger models.

A three-variable model

A natural extension of the above model is a three-variable model which allows for the separation of three shocks: one aggregate-supply shock and two aggregate-demand shocks. If one wants to identify shocks which may be interpretable within the IS-LM framework, the three variables can be, for instance, GDP, consumer prices and short-term interest rates. By using these variables, the aggegate-demand shocks can, in principle, be separated into IS and LM shocks or to monetary policy shocks.

Cecchetti and *Karras* (1994), relying on *Gali* (1992), employed this kind of model, and also other models, when they examined the causes of the Great Depression in the US. *Gerlach* and *Smets* (1995) also utilized a similar model. The use of this kind of model can be motivated by the argument that it is rather a short-term interest rate than a monetary aggregate that is the relevant policy instrument.[11] This assumption enables one to analyse

[11] For a discussion, see, for example, *Bernanke* and *Blinder* (1992), *Sims* (1992) and *Strongin* (1995).

the role of monetary policy without the use of a monetary aggregate. *Gali* (1992), however, used a four-variable model with a monetary aggregate (M1) as an additional variable, and was able to separate four types of shocks: aggregate-supply shocks, IS shocks, money-demand shocks, and money-supply shocks.

In the case of Finland, the above motivation is not very persuasive, however. During the past twenty years Finland has experienced drastic changes in the institutional environment within which monetary and exchange rate policies have been conducted. That period also embraces different monetary and exchange rate policy regimes. Therefore, for most of the time, changes in short-term interest rates may not have been due to the decisions taken by the monetary authorities. Rather, they may have reflected changes in the expectations on the future value of the FIM.

Even though it will not be easy to interpret the shocks which have been transmitted to the real sector through changes in real interest rates, this transmission channel, has, however, been important in Finland , especially during the past ten years. This motivates the subsequent analysis.

The estimation of the model is based on the assumption that $(\Delta y_t, \Delta r_t, r_t - \Delta p_t)'$, where $r - \Delta p$ is the real interest rate, is a covariance stationary process.[12] As noted earlier, it is reasonable to assume that y and r are I(1) variables. Furthermore, it is sensible to assume that also Δp is an I(1) variable. On the other hand, according to the standard Dickey-Fuller tests $r-\Delta p$ is an I(0) variable. Therefore r and Δp are assumed to be cointegrated with $(1,-1)'$ being the cointegration vector.

The resulting system describes the joint behaviour of GDP, nominal, and real interest rates. By using the model it is also possible to analyse how inflation (or the price level) responds to the various shocks. This means that responses of inflation (or the price level) can serve as an over-identifying restriction by which the sensibility of the results can be assessed.

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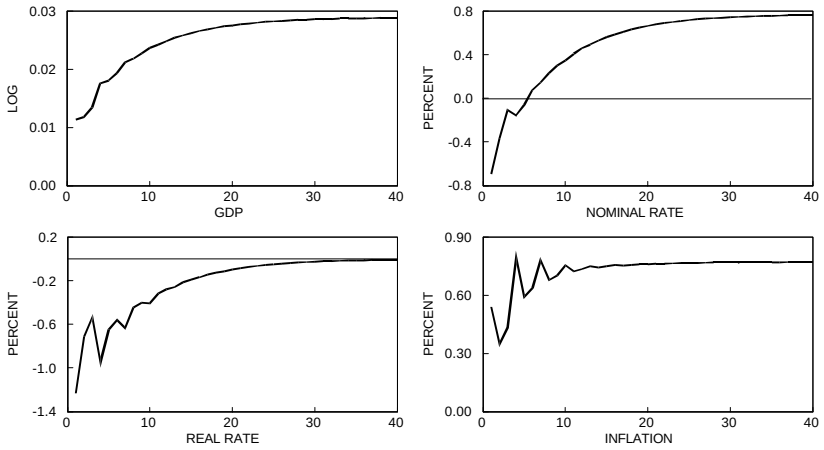
[12] Because the interest rate was measured as an annual percentage, inflation was measured in an analogous manner: $\Delta p = 400\ln(P_t / P_{t-1})$.

The identification of shocks is a straightforward generalization of the procedure presented earlier. The just-identification of shocks requires the use of nine restrictions. Six of them are provided by the orthogonality and normalization conditions. The remaining three are given by the following assumptions. Because the purpose is to identify two aggregate-demand shocks, it is asumed that neither of them has a permanent effect on real output. This gives two restrictions. The third assumption is the same which, for example, *Gali* (1992) used when he separated LM shocks from IS shocks. He assumed that, unlike IS shocks, neither money demand nor money supply shocks affect output contemporaneously. Within the three-variable framework it means that monetary (policy) disturbances are assumed not to affect output within the quarter. This assumption about the presence of outside lag was also used by *Cecchetti* and *Karras* (1994), and *Gerlach* and *Smets* (1995).

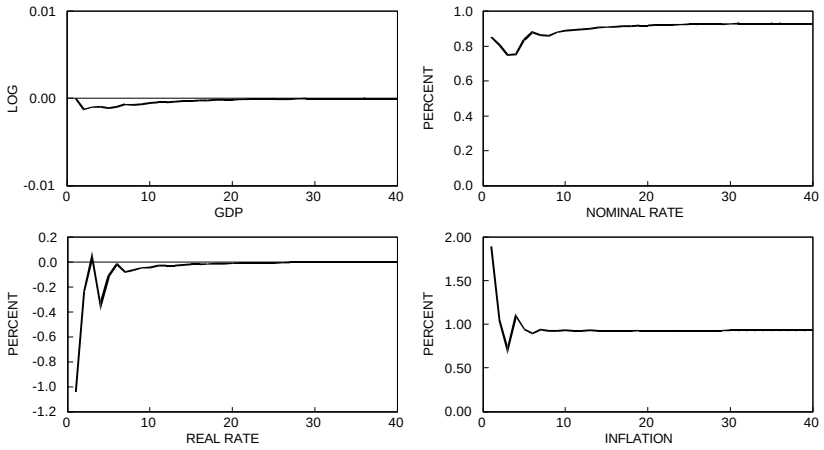
Figures 4, 5 and 6 display the impulse responses associated with the three shocks. According to Figure 4, the permanent positive shock is similar to that of Figure 2. It is not deflationary but inflationary, which, in addition, is associated with a transitory decrease in the real interest rate. Because the real interest rate is assumed to be stationary, shocks cannot change it permanently. Furthermore, after an initial drop, nominal interest rates start to increase and they remain at a level which is higher than the initial level. The shock behaves like a positive monetary (policy) shock which has a permanent influence on real output. As noted earlier, the shock can also be interpreted as a positive supply shock which is associated with (excessively) accommodative monetary policy. In the case of Finland, this interpretation is unnatural, however.

Figure 4. Dynamic responses to the permanent shock: output – nominal interest rate – real interest rate model



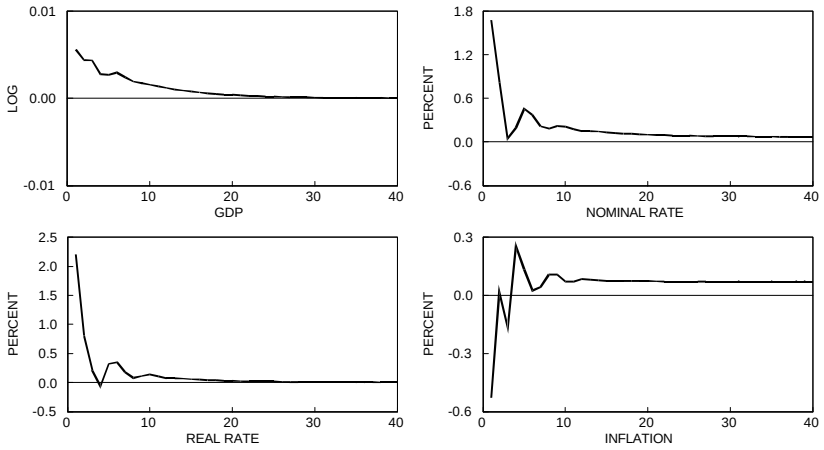
The most salient feature of the transitory shock, which was based on the assumption about outside lag, is that a rising interest rate is associated with increasing prices (Figure 5). It can be regarded as an inflation shock, which is associated with a rise in the nominal interest rate and a fall in the real interest rate. It has a slight negative effect on real output. That may not be significant statistically, however. (As noted earlier, within an open economy framework, inflationary shocks, even though they cause a fall in the real interest rate, may be contractionary if they lead to a deterioration of competitiveness.) This shock, which is similar to the transitory shock in the case of the bivariate model, can hardly be interpreted as a (monetary) policy shock.

Figure 5. Dynamic responses to the 1st transitory shock: output – nominal interest rate – real interest rate model



The other transitory shock is difficult to interpret (Figure 6). Consistent with a response to a positive aggregate-demand shock, it is associated with a rise both in the real and nominal interest rate. Yet the shock is deflationary.

Figure 6. Dynamic responses to the 2nd transitory shock: output – nominal interest rate – real interest rate model



All in all, adding one variable (a nominal interest rate) did not provide a solution to the problem which was already demonstrated by the bivariate model.[13] The shocks are very difficult to interpret within the traditional aggregate-demand – aggregate-supply framework which is based on the assumption about the vertical long-run Phillips curve. According to the impulse response functions, the permanent shock seems to be an aggregate-demand and not an aggregate-supply shock. The results are in contrast with those obtained, for instance, by *Gerlach* and *Smets* (1995) for the G-7 countries. The authors were able to get evidence which was consistent with the framework.

[13] Adding one variable did not bring about essential changes either in forecast error variance decompositions or in historical forecast error decompositions. The role of permanent shocks remained dominant. These tables are available upon request.

The results obtained so far have been so puzzling that they motivate further investigation. It is possible that, like the bivariate model, the three-variable model, too, suffers from omitted variable bias, which led to the misspecification of the model. The most unappealing feature of the results which have been reported so far is that permanent shocks behave like aggregate-demand shocks and not like aggregate-supply shocks. One can try to improve the model by using variables which, by controlling for factors affecting aggregate-demand, make a further separation of aggregate-demand shocks possible.

A four-variable model: one permanent shock

One natural candidate for the fourth variable is a monetary aggregate. Adding a monetary aggregate would enable one to conduct an investigation similar to that of *Gali* (1992). On the other hand, *Gerlach* and *Smets* (1995) report (note 5 on page 8) that in preliminary work they included monetary aggregates in the analysis but found that they were largely determined by money-demand shocks which have little impact on the economy. They interpret these findings to reflect that monetary aggregates are dominated by disturbances which are unrelated to the state of monetary policy, for instance, by financial deregulation. This leads to difficulties in the idenfication of monetary policy shocks. According to my experiments, this is the finding which applies to Finland, too. Adding a monetary aggregate will not solve the identification problem, for the reasons *Gerlach* and *Smets* (1995) presented. After the above experiments with the three-variable model, this is not surprising.

Therefore, it seems to be very difficult to find exogenous (policy) variables which would be useful in explaining the boom and the depression. Consequently, one has to rely on the use of endogenous variables, which may allow for a reasonable interpretation. For reasons already presented earlier (on page 10), and for controlling factors affecting aggregate demand, the best candidate for such a variable may be private consumption.

The estimation is based on the assumption that $(\Delta y_t, \Delta r_t, r_t - \Delta p_t, c_t - y_t)'$, where c denotes the log of private consumption, is a covariance stationary process. Because c and y are I(1) variables, this assumption means that private consumption and output are assumed to be cointegrated with (1,-1)' being the cointegration vector. This assumption is made mainly because of convenience: it makes the use of long-run identifying restrictions more straightforward. For instance, if one assumes that a shock does not affect output in the long run, the assumption implies that it will not affect private consumption either. Consequently, one can define, for instance, monetary long-run neutrality with respect to output and private consumption by using only one long-run restriction. According to the augmented Dickey-Fuller tests, the assumption is reasonable enough even though it can be questioned when standard test sizes are employed.

The presence of four variables allows for the identification of four shocks. I first attempt to identify one supply shock and three aggregate-demand shocks. In the four-variable case, the just-identification of shocks requires the use of sixteen restrictions, of which ten are provided by the orthogonality and normalization conditions. In order to separate three aggregate-demand shocks, three long-run restrictions are needed. Furthermore, the monetary disturbance is assumed not to have a contemporaneous effect either on output or consumption, and, lastly, "consumption shocks" are assumed not to contemporaneously affect nominal interest rates. This assumption is natural if one attempts to identify a monetary shock which may also be interpreted as a policy shock.[14]

Figures from 7 to 10 depict the impulse responses associated with the four shocks. The most important, and unappealing, feature of the impulse responses is that the nature of the permanent shock has remained the same as before. It is both expansionary and inflationary. Also, the transitory shocks are difficult to interpret. As before, one shock can be regarded as an inflationary (monetary) shock (Figure 10), whereas it is difficult to find satisfactory interpretations for the other two.

[14] For an analogous assumption, see *Betts, Bordo* and *Redish* (1996).

Figure 7. Dynamic responses to the permanent shock: output – consumption – nominal interest rate – real interest rate model, one permanent shock

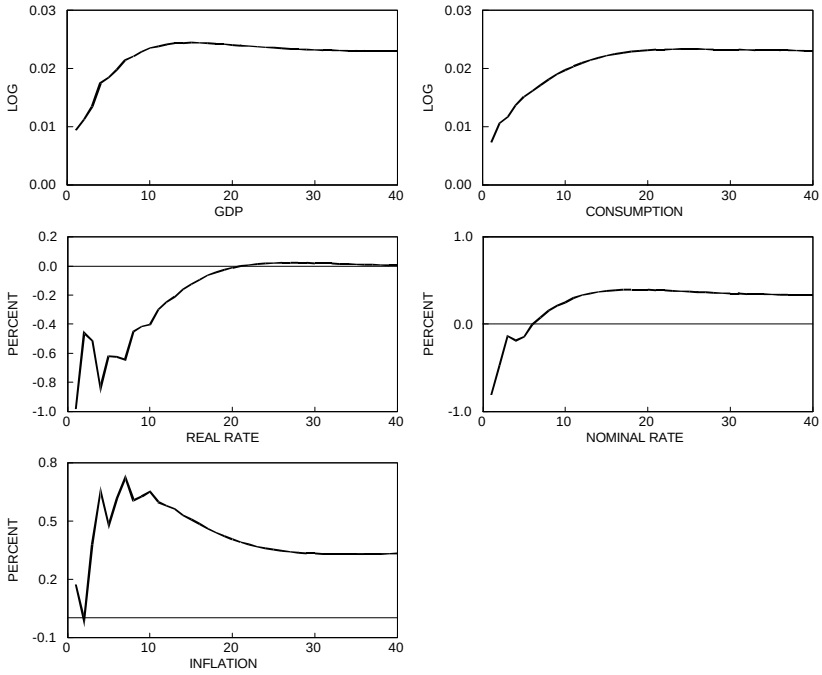


Figure 8. Dynamic responses to the 1st transitory shock: output – consumption – nominal interest rate - real interest rate model, one permanent shock

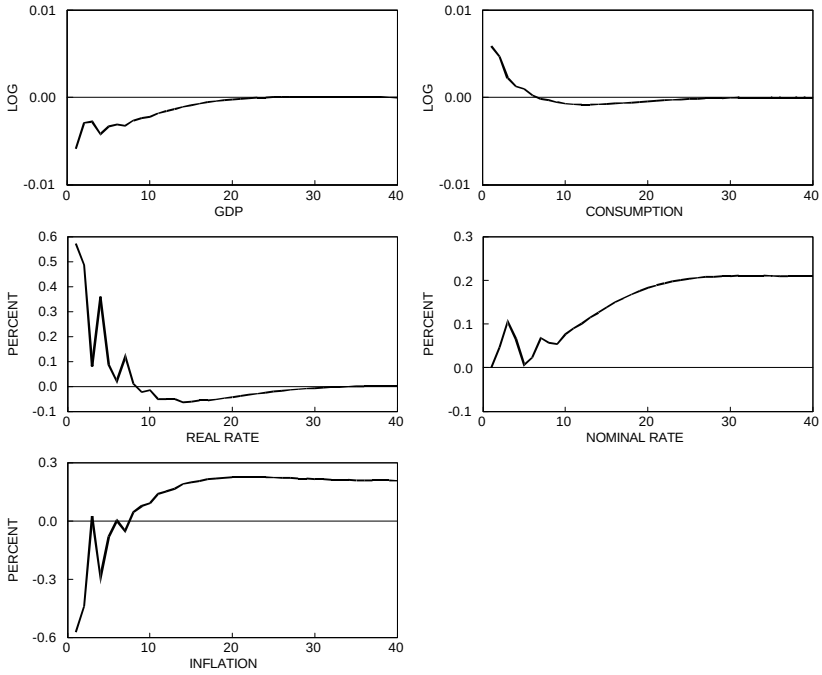


Figure 9. Dynamic responses to the 2nd transitory shock: output – consumption – nominal interest rate – real interest rate model, one permanent shock

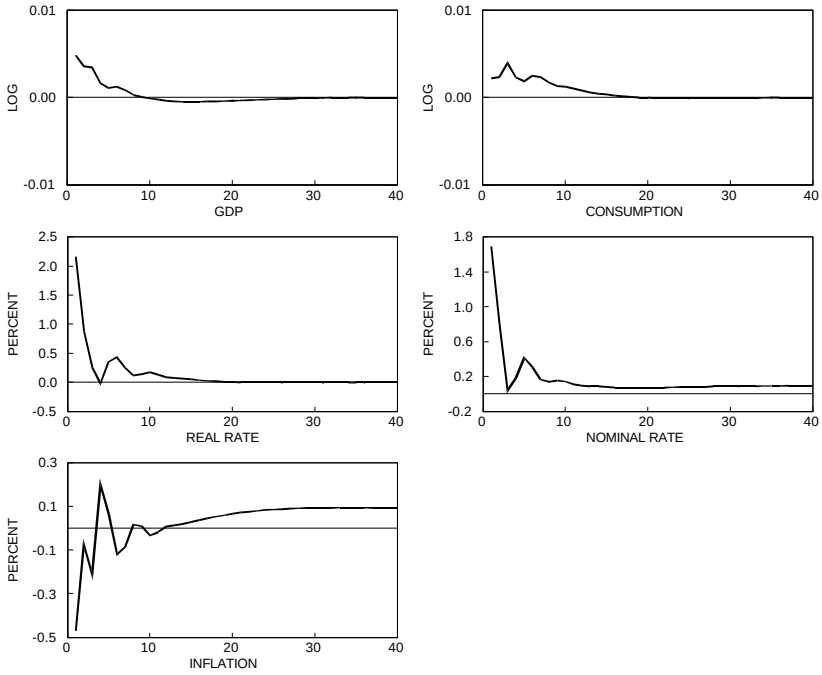


Figure 10. Dynamic responses to the 3rd transitory shock: output – consumption – nominal interest rate – real interest rate model, one permanent shock

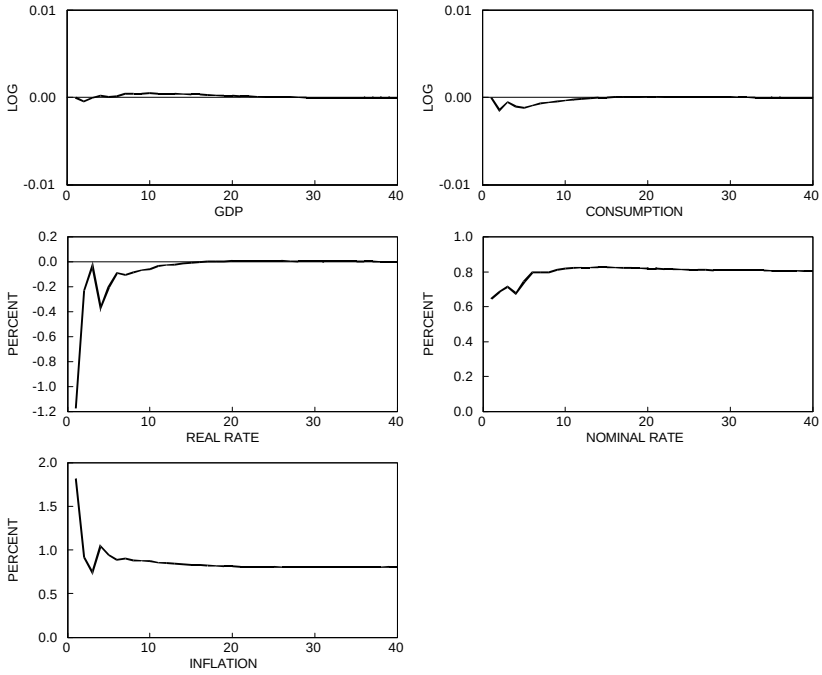


Table 3 illustrates the importance of the shocks as the sources of output fluctuations. (Without loss of any essential information, only the joint contribution of the three transitory shocks is represented.) Even though transitory shocks bear a relatively large amount of responsibilty for output fluctuations in the very short run, their importance is minor in comparison to that of permanent shocks. Permanent shocks also explain most of the fluctuations in private consumption. Even at a one-year horizon, the percentage of forecast error variance accounted for by the permanent shock is 83 per cent. (This table is available upon request.) The dominant

role of permanent shocks is also confirmed by historical forecast error decompositions (Table 4).

Table 3. Forecast-error variance decompositions for GDP: output – consumption – nominal interest rate – real interest rate model, one permanent shock

Horizon in quarters	Permanent shock	Transitory shocks
Contemporaneous	60.3	39.7
4	85.4	14.6
8	93.6	6.4
12	96.3	3.7
16	97.4	2.6
20	98.1	1.9
24	98.4	1.6
100	99.6	0.4

Note: See note in Table 1.

Table 4. Decomposition of eight-quarter forecast errors for GDP: output – consumption – nominal interest rate – real interest rate model, one permanent shock (yearly averages for 1986–1995)

Year	GDP	Permanent shock	Transitory shocks
1986	3.6	2.8	0.8
1987	3.0	3.5	-0.5
1988	4.9	6.6	-1.7
1989	3.5	4.5	-1.0
1990	-2.5	-2.5	0.0
1991	-13.9	-12.2	-1.7
1992	-12.0	-11.1	-0.9
1993	-4.8	-5.4	0.6
1994	2.0	0.8	1.2
1995	4.4	3.2	1.2

Note: See note in Table 2.

Increasing the size of the model has decreased the importance of permanent shocks somewhat, but most of the fluctuations, even at a very short-run horizon, are attributed to permanent shocks. Though this result is interesting as such, it is of little value, if we do not know what these permanent shocks are.

So far, the analysis has relied on the assumption about the vertical long-run Phillips curve, and on the assumption about one permanent shock. Yet both of these assumptions can be relaxed. One additional way of checking the robustness of the results is to drop the assumption about only one permanent shock. If two permanent shocks are allowed to exist, one may turn out be an aggregate-supply shock and the other an aggregate-demand shock. If this is the case, the assumption about the long-run vertical Phillips curve should be reconsidered.

A four-variable model: two permanent shocks

Cecchetti and *Karras* (1994) analysed the robustness of their results by allowing for the existence of an aggregate-demand shock (or another shock) which has a permanent effect on output.[15] They based their considerations on the assumption that the long-run impact of the other shock, the aggregate-demand shock, on output is smaller that that of the supply shock, the size being ρ times the magnitude of the long-run effect of the supply shock .

Within the bivariate model this assumption means that the assumption a_{yd} =0 (in equation (6)) is replaced by the assumption $a_{yd} = \rho a_{ys}$.

Cecchetti and Karras drew the conclusion that their results and conclusions were robust. Adding another permanent shock did not change their interpretation about the causes of the Great Depression. (They performed the analysis by assuming that ρ equals -0.5, -0.25, 0.25, and 0.5.)

[15] For similar considerations, see also *Fisher, Fackler* and *Orden* (1995).

I analysed the robustness of the above results in an analogous fashion. I allowed two shocks to have a permanent effect on output, and assumed that ρ equals 0.25, 0.50, 0.75, and 1. Hence, I also examined the possibility that the shocks are of equal importance.

The results can be summarized as follows. With ρ equalling 0.25 or 0.50, the results remain essentially the same as in the baseline case when ρ = 0. The patterns of impulse responses are the same, and the shock whose long-run impact on output is assumed to be larger has the dominant role in explaining fluctuations in output and consumption. However, when ρ approaches unity, the importance of the second permanent shock as a source of output fluctuations increases and the responses to this shock also change.

Figures 11 and 12 display the relevant impulse responses when ρ equals unity. (Figure 11 is analogous to Figure 7, and Figure 12 to Figure 8.) The patterns in Figures 7 and 11 are similar, even though the shock in Figure 11 seems to be more inflationary. It looks like an aggregate-demand shock, which has a permanent influence on output. The main difference between Figures 8 and 12 is that the shock in Figure 12 is expansionary. It is not impossible to interpret it as an aggregate-supply shock, because, at least initially, it has a deflationary impact on the economy. Yet in the longer run it is inflationary.

The forecast error decompositions are shown in Table 5. In comparison to Table 3, the importance of the first permanent shock decreases at the cost of the second permanent shock. At shorter horizons the first permanent shock is, however, more important than the second one. In the long run they are, by definition, of equal importance.

Furthermore, at a very short run (contemporaneously) 98.5 per cent of the forecast error variance for private consumption is accounted for by the second permanent shock. On the other hand, the first permanent shock is the most important source of fluctuations in the real interest rate both at shorter and longer horizons. (Tables of these decompositions are available upon request.)

Figure 11. Dynamic responses to the 1st permanent shock: output – consumption – nominal interest rate – real interest rate model, two permanent shocks, ρ =1

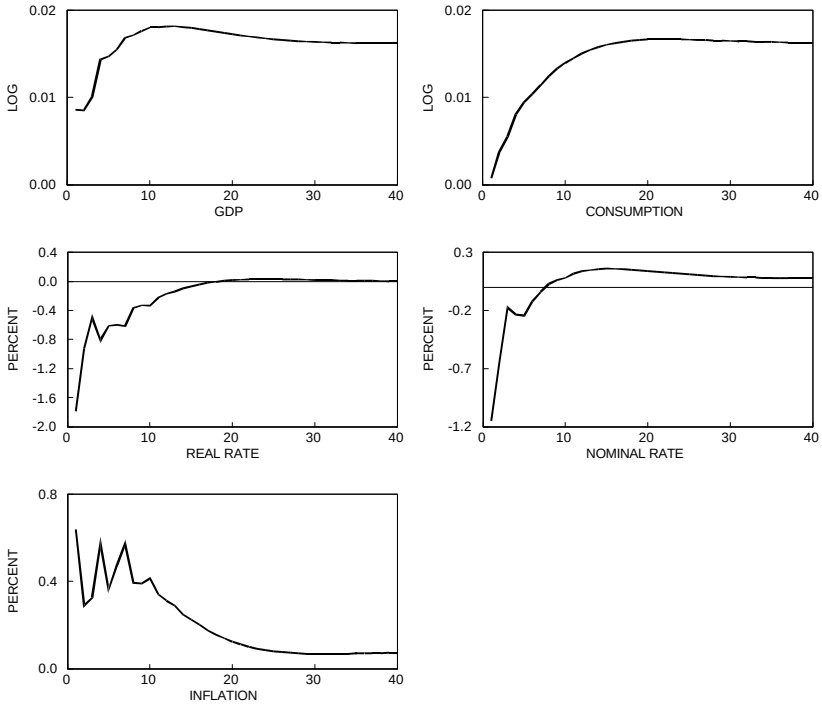


Figure 12. Dynamic responses to the 2nd permanent shock: output – consumption – nominal interest rate – real interest rate model with two permanent shocks, ρ =1

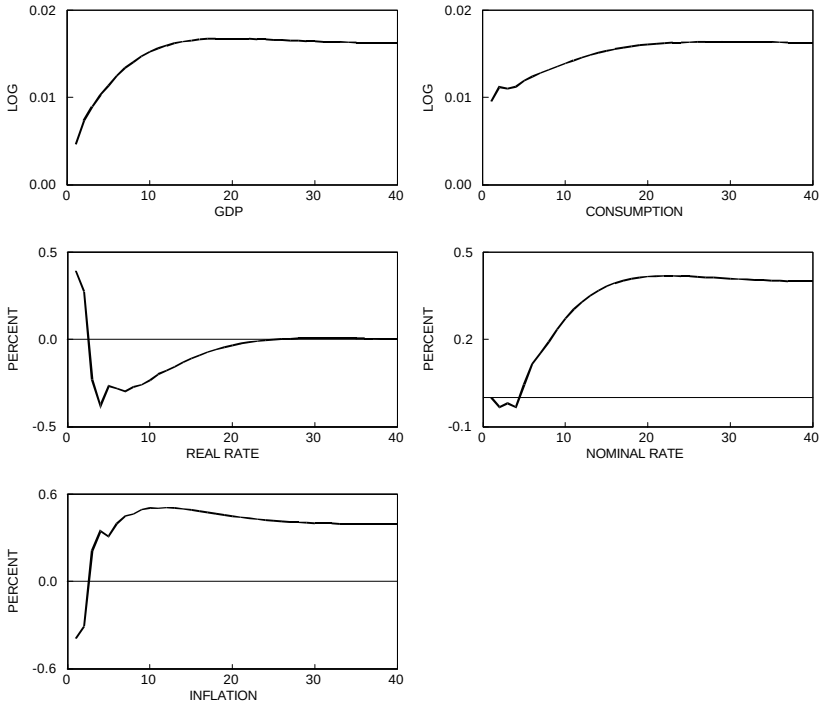


Table 5. Forecast-error variance decompositions for GDP: output – consumption – nominal interest rate – real interest rate model, two permanent shocks, $\rho = 1$

Horizon in quarters	1st permanent shock	2nd permanent shock	Transitory shocks
Contemporaneous	50.8	14.8	34.4
4	55.6	32.0	12.4
8	58.7	36.5	4.8
12	58.1	39.2	2.7
16	56.9	41.3	1.8
20	55.8	42.9	1.3
24	54.8	44.1	1.1
100	51.1	48.7	0.2

Note: See note in Table 1.

The historical forecast error decompositions are shown in Table 6. It clearly differs from Table 4 because of the important role of the second permanent shocks. According to Table 6, the boom was caused by a sequence of those shocks. During the depression both permanent shocks played a major role. The first permanent shock was the most important one at the early stage of the depression, while the second shock was the most important cause of the prolongation of the depression. Transitory shocks played only a minor role both during the boom and the depression.

Table 6 obviously, provides an alternative shock interpretation for both the boom and the depression. But what are the two permanent shocks?

If one adheres to the vertical Phillips curve paradigm, both of them should be interpreted as aggregate supply shocks. But if one takes the patterns of the impulse response functions seriously, it is impossible to regard both of them as supply shocks. The only way of proceeding, I think, is to take them seriously, and to try to construct an account of the boom and the depression which is consistent with the shocks.

Table 6. Decomposition of eight-quarter forecast errors for GDP: output – consumption – nominal interest rate – real interest rate model, two permanent shocks, $\rho = 1$ (yearly averages for 1986–1995)

Year	GDP	1st permanent shock	2nd permanent shock	Transitory shocks
1986	3.6	0.5	2.1	1.1
1987	2.9	-1.2	3.9	0.2
1988	4.9	-0.1	5.9	-0.9
1989	3.5	-1.4	5.1	-0.2
1990	-2.5	-4.5	1.3	0.7
1991	-13.9	-9.2	-3.6	-1.1
1992	-12.0	-7.7	-3.7	-0.6
1993	-4.9	-0.6	-4.1	-0.2
1994	1.9	6.4	-4.3	-0.2
1995	4.5	6.4	-2.2	0.3

Note: See note in Table 2.

The first permanent shock is best regarded as an aggregate-demand shock, which affects and operates through the real interest rate. (One transitory shock also affects the real interest rate but its role is secondary.) The positive shock is inflationary and it decreases the real interest rate. This decrease is, however, transitory because acceleration of inflation increases nominal interest rates. In the long run, the real interest rate returns to its initial level.

In addition to the effects of changes in real interest rates, the first shock may also reflect other factors affecting aggregate-demand. It is highly likely that, for instance, shocks to export demand are also reflected in this shock. Table 6 supports this kind of interpretation.

Consistent with the above interpretation, the first shock did not contribute to the boom. The rise in the real interest rate in 1989 is seen as a negative shock. The concrete cause of the downturn of the economy, therefore, was a negative aggregate demand shock operating through the real interest rate

channel. Yet GDP growth was maintained by the second permanent shock. In 1990, the first shock had a strong contractionary effect on output. The collapse of the Soviet trade is very likely one reason for the very big negative shock in 1991. The first shock had a small negative effect in 1993, but the recovery of the economy was attributed to it. This is consistent with the view that changes in the real interest rate and exports are reflected in the first permanent shock.

As has already become evident, the second permanent shock is not easily interpretable. In the very short run, at a six months horizon, it behaves like a supply shock. It is deflationary, and causes a decrease in the nominal rate and an increase in the real rate. In the longer run, the shock is inflationary, however. Except for the very short run, it is an important cause of output fluctuations. Because it is the main cause of fluctuations in private consumption in the short run, it can be called a consumption shock. Along with the first permanent shock, it is important in explaining movements in private consumption also in the long run. Unlike the first permanent shock it does not seem to be an important factor behind movements in the real interest rate.

The sequence of the second permanent shocks is consistent with the interpretation, which emphasises the role of credit and the credit channel. One can, of course, give many rationalizations for the sequence of the second permanent shocks, each highlighting the role of credit and the credit channel. If one does not want to assume irrational behaviour by private economic agents, one can attempt to utilize the economics of imperfect information and the (new Keynesian) "credit view" which is built on that literature. This is, of course, only one alternative.[16]

The "credit view" underlines the role of two channels, the balance sheet channel and the bank lending channel, in the propagation of monetary

[16] Another relevant alternative is to utilize an approach which does not adhere to the rational choice model. For such an approach, see, for example, *Minsky* (1986). *Meltzer* (1995) contains a monetarist approach to the credit channel and to the "credit view".

policy measures (see, for instance, *Bernanke* and *Gertler*, 1995). Obviously, both of these channels played an important role in the boom, which was accompanied with credit explosion. During the boom they were an essential part of the mechanism which boosted GDP growth, while during the depression the two channels played an adverse role.

The sequence of the second permanent shocks can be interpreted as mainly reflecting the expansionary and contractionary roles of these two channels first of all for the development of private consumption.[17]

Table 6 shows that the role of the second permanent shock was not important at the outset of the depression, but it contributed to the depth of the depression, and, what is most important, to the length of the depression. GDP started to rise in 1994 but the second shock had a contractionary effect as late as in 1995. For the depression years, the sequence of the second permanent shocks can be interpreted as describing the debt-deflation process during which both the balance sheet channel and bank lending channel were important.

When explaining the length of the Great Depression both *Cecchetti* and *Karras* (1994), and *Betts, Bordo* and *Redish* (1996) utilized *Bernanke's* (1983) theory of the collapse of financial intermediation. It emphasizes the role of the bank lending channel. Bernanke argues, resting on the "credit view", that the main reason for the lengthening of the Great Depression was an increase in the cost of financial intermediation, which resulted in a large number of otherwise creditworthy borrowers being denied loans. The increase was a risk premium demanded by risk-averse bankers.

In both *Cecchetti* and *Karras* (1994), and *Betts, Bordo* and *Redish* (1996) the negative supply shocks, which were associated with the prolongation of the Great Depression, are interpreted as reflecting the collapse of financial intermediation.

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[17] In this paper, the role of private consumption and households is stressed, and perhaps even exaggerated, at the cost of private investment and firms. For an analogous emphasis, see *Mishkin* (1978).

A similar interpretation can be given for the sequence of the second permanent shocks. In additon to borrowers' need to adjust their balance sheets, the Finnish banking crisis, which led to credit contraction, provides one rationalization for negative shocks in 1994 and 1995.[18]

According to the impulse response functions, it is not obvious that the second shock should be regarded as an aggregate-supply shock. This is, however, not inconsistent with the "credit view" , because the shocks which operate through the balance sheet channel and the bank loan channel may affect both aggregate-supply and aggregate-demand.

The above experiment shows that, also within the traditional aggregate-demand – aggregate-supply framework, it is possible to produce results which emphasize the role of private consumption, and the credit channel. Furthermore, they are consistent with the debt-deflation interpretation about the depression.

Yet the results are not robust. It is possible to generate shocks which are very difficult to interpret and which therefore do not support any of the various explanations of the causes of the depression

Obviously, the traditional aggregate-demand – aggregate-supply models are not necessarily very useful when the "credit view" is utilized in the interpretation of shocks, since credit and the above two channels have no explicit role in these models. Therefore, one can argue that the reasoning, for instance, in both *Cecchetti* and *Karras* (1994) and *Betts, Bordo* and *Redish* (1996) was not based on the models the authors employed. This kind of criticism applies to this paper, too.

Furthermore, Finland is a special case, because in the interpration of the shocks one should take into account, for instance, the effects of putting an end to credit rationing. *Blinder* (1987) has developed a model which

[18] *Vihriälä's* (1997) study of the Finnish banking crisis is based on the "credit view". According to *Vihriälä* (1997), the moral hazard of weak banks played a role in the expansion phase, and insufficient capital constrained lending later. Credit contraction was caused rather by 'collateral squeeze' than by 'credit crunch'.

describes an economy suffering, because of credit rationing, from "effective supply failure". In Blinder's model, firms must pay their factors of production before they receive revenues from sales, and must borrow in order to do so. But if they cannot get the credit, they must cut back their hiring. This causes effective supply failure. Blinder's model illustrates, even though one would not have confidence in its descriptive relevance, why the use of the standard aggregate-demand – aggregate-supply framework may be exceptionally problematic in the case of Finland.

External shocks provide an extra difficulty. In the Finnish debate, the importance of terms of trade shocks have been highlighted by those who regard the depression as an outcome of negative external shocks (see *Tarkka* 1994). Consequently, "consumption shocks" may reflect changes in the terms of trade. In what follows, the validity of this interpration is analysed by adding the terms of trade variable into the above four-variable model.[19]

A five-variable model: the role of the terms of trade

Even though all of the above results have not been robust, the important role of permanent shocks, whether they are aggregate-demand or aggregate-supply shocks, has been a permanent feature. One manifestation of the non-robustness of the results was that it was impossible to give a robust interpretation for the permanent shocks. Analysing the role of terms of trade can help identify these shocks, perhaps by ruling out some interpretations.

I estimate a five-variable VAR model which includes the terms of trade variable, tot, as one variable. The model is based on the assumption that $(\Delta tot_t, \Delta y_t, \Delta p_t, r_t - \Delta p_t, c_t - y_t)'$ is a stationary process. This means that the

[19] I will not discuss the effects of terms of trade shocks within an explicit model. For that kind of discussion, see, for instance, *Hoffmaister* and *Roldós* (1997).

terms of trade are assumed to be an I(1) variable. This assumption is consistent with standard ADF tests.

Furthermore, according to block exogeneity tests, there is no need to include the other variables in the autoregression for the terms of trade. It can be regarded as an exogenous variable with respect to the other variables. Therefore, the unconstrained reduced form is estimated under this assumption, which implies that the analysis is based on the estimation of a near VAR model.

The identification of shocks is a straightforward generalization of the *Blanchard-Quah* (1989) identification. Just-identification requires the use of twenty-five constraints, of which fifteen are given by the orthogonality and normalization conditions. In addition to those constraints, three long-run constraints are imposed in order to separate three transitory shocks which do not affect output in the long-run. This means that two permanent shocks, of which one is a terms of trade shock, are identified. I assume that the other four shocks do not affect the terms of trade contemporaneously. This assumption provides four short-run restrictions. The last three equations are analogous to those used within the four-variable model. One transitory shock, the “monetary shock”, does not contemporaneously affect output and consumption. This gives two restrictions. The last assumption is that one of the other two transitory shocks does not contemporaneously affect nominal interest rates.

The importance of the terms of trade shocks can be assessed by forecast-error variance decompositions and historical forecast error decompositions.

Table 7 shows that about ten per cent of the output variability is accounted for by terms of trade shocks at the business cycle frequencies. Hence, terms of trade shocks are a noteworthy source of output fluctuations but their importance should not be exaggerated. As a source of fluctuations in private consumption their importance is even somewhat greater. At business cycle frequencies about twenty per cent of the forecast error variance is accounted for by terms of trade shocks. (This table is available upon request.)

Yet according to the historical forecast-error compositions (Table 8), terms of trade shocks did not play a decisive role either during the boom or during the depression. Their relative importance was greatest at the start of the

Table 7. Forecast-error variance decompositions for GDP: terms of trade – output-consumption – nominal interest rate – real interest rate model, two permanent shocks

Horizon in quarters	Terms of trade shock	2nd permanent shock	Transitory shocks
Contemporaneous	0.6	28.0	71.4
4	8.4	55.3	36.3
8	9.2	71.8	19.0
12	9.4	78.7	11.8
16	9.8	81.8	8.3
20	10.3	83.3	6.4
24	10.8	84.0	5.2
100	13.2	85.5	1.3

Note: See note in Table 1.

Table 8. Decomposition of eight-quarter forecast errors for GDP: terms of trade – output-consumption – nominal interest rate – real interest rate model, two permanent shocks (yearly averages for 1986–1995)

Year	GDP	Terms of trade shock	2nd permanent shock	Transitory shocks
1986	3.4	0.3	2.4	0.7
1987	3.0	1.1	2.7	-0.8
1988	4.6	0.8	5.6	-1.8
1989	3.4	0.8	3.8	-1.1
1990	-2.7	0.2	-3.0	0.1
1991	-14.0	-0.5	-11.8	-1.7
1992	-11.6	-0.5	-10.1	-1.0
1993	-4.9	-0.4	-5.1	0.6
1994	1.9	-0.3	1.0	1.2
1995	4.6	0.7	2.8	1.1

Note: See note in Table 2.

boom in 1987. During the depression, the worsening of the terms of trade played only a minor role.

These results, therefore, do not support the view that terms of trade shocks were an important factor contributing both to the boom and the depression. The results are in contrast with the third interpretation of the depression. The bulk of the fluctuations is explained by other permanent shocks. Unlike most of the previous conclusions and interpretations, this conclusion is based on a model within which the shock, the terms of trade schock, was well-identified.

5. CONCLUSIONS

The main aim of this paper was to explore the boom and the depression by estimating structural VAR models which are based, first of all, on the utilization of the traditional aggregate-demand – aggregate-supply framework. Typically, these models belong to the class of IS-LM models, which have been augmented with a Phillips curve.

This paper attempted to deepen the exploration initiated in *Sauramo* (1996) by linking the econometric investigation more closely to economic theory. One can expect that the use of the aggregate-demand – aggregate-supply framework is superior to largely atheoretic frameworks such as the ones utilized in *Blanchard* (1993) or *Sauramo* (1996), since the interpretation of shocks should become easier.

However, the usefulness of that kind of investigation crucially depends on how well the framework fits the data. For Finland, finding a suitable framework is far from obvious. Until the mid eighties, the financial markets were regulated and therefore the standard textbook versions were more or less inapplicable in the description of the behaviour of the economy. The deregulation of the financial markets has brought about a drastic change, but this does not necessarily make the analysis easier: institutional changes were accompanied by shifts in the exchange rate policy and monetary policy regimes, which complicates the use of the standard IS-LM framework or the Mundell-Fleming framework.

The identification of shocks which would be compatible with the standard framework turned out to be difficult. For instance, most of the permanent shocks which were identified looked more like aggregate-demand than aggregate-supply shocks. Furthermore, identifying monetary policy shocks turned out to be impossible. In fact, if one takes into account the above

changes in the institutional environment, this is what one would expect. Endogenous changes dominate the relevant policy variables.

Despite all these difficulties, the analysis provided some noteworthy results.

The bulk of output fluctuations are explained by permanent shocks. Except for the very short run (one to four quarters), transitory shocks are of minor importance. Even though this result is related to the difficulty to identify relevant transitory shocks, the major role of permanent shocks may have been an essential characteristic of output fluctuations in Finland.

It was the identification of permanent shocks which was the most important and difficult part of the investigation. The considerations which were based on the assumption about the vertical long-run Phillips curve were largely counterproductive. If only one permanent shock was allowed to exist it looked more like an aggregate-demand than an aggregate-supply shock. Perhaps the most appealing results were obtained when, within a four-variable model, two permanent shocks were assumed to exist, and the assumption about the vertical long-run Phillips curve was relaxed. In that case, the two permanent shocks could be given reasonable interpretations. One was an aggregate-demand shock causing changes in the real interest rate and also reflecting other factors affecting aggregate-demand, in particular, export demand. The other one could be interpreted as a supply shock, even though it was inflationary in the longer run. I regarded it as a shock which operates mainly through the credit channel. It was a shock which explained the boom of the late eighties and, in particular, the length of the depression. These results were consistent with the debt-deflation interpretation of the depression.

The identification of the above two permanent shocks was, however, not robust. Therefore these results could have been more persuasive. On the other hand, the validity of the third interpretation about the causes of the depression was assessed by analysing the role of the terms of trade. The results contrasted with the view that adverse shocks to the terms of trade played a major role in the birth of the depression. This outcome was unrelated to the non-robust identification.

According to *Sauramo* (1996) the main "cause" of the boom and the depression were positive and negative "consumption shocks". The issue left unanswered was what these shocks are. In this paper this issue has been analysed within the traditional aggregate-demand – aggregate-supply framework. Even though the results do not provide a persuasive answer to this question they do support the view that it is very difficult to give a good explanation of the causes of the depression by ignoring the credit channel, and the (policy) measures which have operated through it.

The analysis of this paper has still been tentative, and it may raise more questions than it answers. Perhaps the most puzzling, and robust, feature of the results was that they could not be reconciled with the vertical long-run Phillips curve paradigm. On the contrary, they were consistent with the view that GDP growth has largely been determined by aggregate-demand. This may be the case, and there are good arguments which support this view. Yet one can make progress in identifying aggregate-supply shocks. For example, the identification of technology shocks would be a natural extension of the analysis of this paper. The identification of technology shocks may help to solve some of the puzzles raised by this paper.[20]

But it is unlikely to provide a solution to the problem associated with the interpretation and identification of "consumption shocks". *Cochrane* (1994) argues that the puzzle of "consumption shocks" may remain unsolved, if "consumption shocks" reflect news that agents see but we do not, and continues: "If this view is correct, we will forever remain ignorant of the fundamental causes of economic fluctuations." (See the abstract of the paper.) This comment strongly motivates further research. According to this paper, one should be ready to rely on the frameworks which are not based on the vertical long-run Phillips curve paradigm.[21]

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[20] For an appealing framework for estimating technology shocks, see *Gali* (1996).

[21] Furthermore, the traditional aggregate-demand – aggregate-supply framework has been criticised as being logically inconsistent. See, for instance, *Barro* (1994), *Colander* (1995), and *Hall* and *Threadgold* (1982). Even though this criticism is

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aimed at some conventional theoretical models, econometric models which utilize these models are not immune to it. This gives an additional reason for the use of frameworks other than the traditional aggregate-demand – aggregate-supply framework.

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