The 'German View' and Consumption Booms: Empirical Evidence from Denmark

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Abstract

We develop an alternative test of the 'German view'— that a reduction in government consumption may lead to an immediate private consumption boom — derived from an open–economy permanent income model. In our empirical study we find, in accordance with the 'German view', that an anticipated permanent reduction of government consumption is associated with a strong short–run (and permanent) increase in private consumption. However, the Danish experience following the fiscal contraction in 1982 suggest that this was not a dominant factor behind the private consumption boom. Our evidence shows instead that other factors increasing permanent income, including a substantial terms–of–trade improvement, were much more important.

Keywords: Expansionary fiscal contraction; German view; consumption booms; structural shocks
JEL Classification Numbers: E21, E62, E65.

1 Introduction

The prospect of a fiscal contraction typically raises well-founded fears among policymakers — based on conventional macroeconomic analysis — over the likely recessionary consequences. In theory, however, it is possible that a fiscal contraction which leads to the expectation of permanently lower future paths of government consumption and taxation could provide a powerful stimulus to the economy, and private consumption in particular, because of the anticipated rise in permanent (disposable) income. If this stimulus is

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sufficiently strong, it could in principle more than offset the effect of the reduction in government consumption expenditure in the short–run and lead to a net increase in aggregate demand and output. This non–Keynesian prediction has been termed the 'expansionary fiscal contraction hypothesis' (Barry and Devereux (1994)) and often characterized as the 'German view' in light of statements by the German Council of Economic Experts in the early 1980s that fiscal retrenchment should set the foundation for an economic expansion (Giavazzi and Pagano (1990)).

As Barry and Devereux (1994,1995) emphasize, however, there are a number of conditions which need to be met such that an immediate economic expansion follows a reduction in government consumption expenditure. In the face of overlapping contracts (Jensen and Jensen (1995)), other wage/price rigidities (Barry and Devereux (1995)), or some uncertainty over the permanence of lower government expenditures (and taxation), a fall in government consumption may lead to declining private consumption and output.

Given these theoretical ambiguities over the effects of fiscal policy, empirical evidence must be brought to bear on the issue. Indeed, Giavazzi and Pagano (1990, 1995) argue that the severe fiscal contractions in Denmark, and Ireland, and in many other countries, have led to consumption booms and economic expansions. They present empirical evidence, based primarily on unexpectedly high consumption in these countries which appears correlated with unanticipated changes in permanent government consumption, leading them to conclude that " . . . there are cases in which the German view has a serious claim to empirical relevance" (Giavazzi and Pagano (1990, p. 105)).

This view has not gone unchallenged, however. Andersen and Risager (1990) and Andersen (1994), for example, postulate another hypothesis for Denmark, based primarily on the idea that the decline in government spending was concentrated on non–tradable goods which in turn depressed real wages and increased international competitiveness. Other explanations such as lower real interest rates associated with the adoption of a 'hard currency regime' have also been put forward as alternatives to the 'German view' of the unexpected expansions in Denmark and elsewhere following fiscal contractions.

In this paper, we develop an alternative test of the expansionary fiscal contraction hypothesis which allows us to distinguish between several leading alternative explanations for the consumption booms at the time of fiscal contractions. We present a simple illustrative open economy version of the permanent income model of consumption designed to bring out the main ideas of the expectations model and the 'German' view in an empirically tractable form, rather than provide a complete explanation for consumption. In this context, current fiscal policy and other determinants of disposable income "signal" changes in permanent income and hence consumption.

Using a time–series statistical methodology, we distinguish between three shifts to "permanent" income — those arising from permanent shifts in government consumption expenditure, terms–of–trade and "other" factors including cost and productivity shocks. We are also able to identify a composite transitory disturbance on consumption, which incorporates short–run aggregate demand considerations and business cycle effects. Identifying the disturbances in this fashion, and historically decomposing the unexpected

portions of private consumption by these separate components, provides insights into the extent to which the 'German view' may be relied upon as countries introduce fiscal consolidation programs.

We estimate a "base" model and several alternatives over the post–Bretton Woods sample period (1971–95), identifying the various disturbances and testing the parameter restrictions implied by the small open economy model. The model is then used for a historical decomposition of the forces affecting consumption for the five–year period following the Danish fiscal contraction begun in the autumn of 1982. In our empirical analysis, we cannot reject the hypothesis that reductions in government consumption expenditure that are permanent tend to increase private consumption in the short–run as well as in the long–run. However, the historical decomposition of the Danish fiscal reform program begun in the autumn of 1982 does not indicate that an "expansionary fiscal contraction" working through strong expectations effects and an immediate rise in anticipated permanent income was at work. The most important factors behind the consumption boom were initially a substantial terms–of–trade improvement and cyclical upturn (after the deep recession in the years preceding the policy change), then followed by a sharp rise in expected permanent income arising from other factors. Finally, even support of the 'German view' in the general setting needs to be qualified — the results are robust to model specification but are sensitive to the identifying restrictions of the structural VAR model.

The paper is organized in the following manner. Section 2 develops the basic theoretical framework upon which the empirical tests are based. Section 3 sets out the common trends statistical methodology, and section 4 presents the results. Finally, section 5 provides some concluding comments.

2 Small Open Economy Model

2.1 The Expansionary Fiscal Contraction Hypothesis

The expansionary fiscal contraction hypothesis may be illustrated by a simple model with representative, infinitely lived, agents who smooth expected consumption over time. We postulate a model with two tradeable goods in a small open–economy framework where the terms–of–trade and interest rates are exogenous. Within this small open economy version of the standard Ramsey model, we focus on the dynamic response of private consumption from shocks to terms–of–trade, income, and government consumption expenditures. Wealth effects from changes in the terms–of–trade are easily incorporated into this framework, as in Frenkel and Razin (1992) and Obstfeld and Rogoff (1996). Familiar features of this illustrative partial equilibrium model are that it satisfies Ricardian equivalence, the terms-of-trade is determined in world markets, and that production and investment decisions are treated as exogenous for the small open economy. (Our empirical model is more general and we relax some of these assumptions).

Following most of the empirical literature in this area, we assume the linear quadratic

utility function:

$$u\left(C_s\right) = C_s - \frac{\phi}{2} C_s^2 \ . \tag{1}$$

Consumption (C_s) is the (subutility) index of real consumption at time s. Defining r as the real interest rate and θ as the representative agent's subjective rate of time preference, the quadratic utility function allows us to derive the optimal level of consumption under uncertainty similarly to the perfect foresight case and, by assuming $r = \theta$, constrains the economy to follow a stationary long–run path.

These assumption give the special form of the Euler condition for optimality derived by Hall (1978), $1 - \phi C_t = \mathrm{E}_t \left\{1 - \phi C_{t+1}\right\}$, which in this special case implies that $\mathrm{E}_t \left\{C_s\right\} = C_t$ for all $s > t$, so we can substitute current consumption for all future levels of expected consumption into the intertemporal budget constraint and derive a reduced form for the level of consumption as a function of net foreign assets (B_t), current and expected future values of labor income (Y_s), government consumption expenditures (G_s), and the current consumption–price index (P_s):

$$C_t = \left(\frac{r}{1+r}\right)\left[(1+r)\frac{B_t}{P_t} + \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t} \mathrm{E}_t\left\{\frac{Y_s - G_s}{P_t}\right\}\right] \ . \tag{2}$$

The expansionary fiscal contraction hypothesis is that a current government consumption expenditure decline may also signal a permanent reduction, causing a rise in the present discounted value of wealth and a rise in the current and permanent level of private consumption. By operating on expected future net income, this policy shift may have a net expansionary effect on aggregate demand. By contrast, if the fiscal contraction does not lead to the expectation of significantly lower permanent government consumption expenditure levels, then current private consumption will not be much affected. In this circumstance, the fiscal contraction will not be offset by a significant rise in current private consumption and will have a net contractionary effect on aggregate demand.

Another point is that factors other than expectations of government consumption expenditure may also prove a powerful influence on consumption and these may at times have coincided with government consumption expenditure shifts. A rise in real income (Y_s) due to productivity increases and other factors enhancing cost competitiveness in the export sector would increase wealth and consumption. Similarly, a permanent rise in the terms–of–trade will decrease the consumption–based price index P_t (lowering the price of obtaining a unit of the consumption index) and, correspondingly, permanently increase wealth and consumption. This is similar to a rise in consumption possibilities due to a rise in expected real income evaluated in terms of the export good (Y_s).

3 Empirical Model

Let the time series vector $x_t = \left[\begin{array}{cccc} p_{x,t} & Y_t & G_t & C_t \end{array}\right]'$, where $p_{x,t}$ is the terms–of–trade, and define a vector of structural shocks $\nu_t = \left[\begin{array}{cccc} \psi_p & \psi_y & \psi_g & \varphi_t \end{array}\right]'$ satisfying $\mathrm{E}[\nu_t] = 0$, and

$\mathrm{E}[\nu_t \nu_t']$ is diagonal, where ψ_i are permanent terms–of–trade, "other" permanent income, and permanent government consumption expenditure shocks respectively whereas φ_t is a transitory shock incorporating short–run demand and other factors affecting the time series vector in the short–run. Assume that the system linking the data to the four shocks can be represented as the following structural vector moving average, VMA, model

$$\Delta x_t = \delta + R(L)\nu_t \tag{3}$$

where δ is a constant and $R(L)$ is the impulse response function. It is well known in the literature that this VMA model can be represented as a common trends model;

$$x_t = x_0 + A\tau_t + \Phi(L)\nu_t \tag{4}$$

where x_0 is the initial condition, τ is a trivariate vector of random walks with drift, and $\Phi(L) = \sum_{j=0}^{\infty} \Phi_j L^j$ is finite for all L. The long–run multipliers collected in the 4×3 factor loading matrix A links the three permanent shocks to the four variables in x_t. Moreover, since we have assumed that there are three shocks giving permanent effects on the variables, it follows that there are three common trends and one cointegration relationship in the model.

Following King, Plosser, Stock and Watson (1991) we identify the common trends model in (4) (or the VMA model in (3)) using estimates of a standard vector autoregressive, VAR, model formed by the vector time series x_t. This approach presumes that the underlying structural shocks are linear combinations of Wold innovations and that the cointegration rank is one.[1] Under these assumptions, we estimate the following vector moving average model

$$\Delta x_t = \delta + C(L)\varepsilon_t \tag{5}$$

where $C(L) = I_4 + \sum_{j=1}^{\infty} C_j L^j$, L is the lag operator and the four dimensional vector of innovations ε_t is assumed to be a white noise sequence with $\mathrm{E}[\varepsilon_t] = 0$ and a nonsingular covariance matrix $\mathrm{E}[\varepsilon_t \varepsilon_t'] = \Sigma$.[2] The basic problem is to identify the structural innovations ν_t in (3) as linear combinations of the reduced form disturbances ε_t in (5), i.e., to find a matrix F such that $\nu_t = F^{-1}\varepsilon_t$.

To identify our system, we have to add three identifying restrictions. We assume that (i) government consumption expenditure shocks do not affect the long–run value of real income, and (ii) that domestic expenditure shocks ($\psi_{y,t}$ and $\psi_{g,t}$) do not affect the long–run value of the terms–of–trade. Note that we do not have to impose any further restrictions to identify the transitory shock. It is also noteworthy that we do not impose any restrictions on the short–term behavior of the time series other than that the limit of the impulse response of the variables to the transitory shock becomes zero when the time horizon goes to infinity. Therefore, the transitory shock may have large short–run and medium term effects.

[1] See Lippi and Reichlin (1993) for structural representations when the assumption that the structural innovations are linear combinations of Wold innovations is relaxed.

[2] See, i.a., Johansen (1991).

Table 1: Likelihood ratio tests for the number of steady–state relations in the unrestricted VAR system.

	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
$\hat{\lambda}$	0.334	0.148	0.053	0.013
LR_{trace}	60.92*	21.87	6.48	1.26

Note: (*) denotes significance at the 5 percent level, and (+) at the 10 percent level. Critical values are taken from Osterwald–Lenum (1992).

4 Empirical Results

The data consists of quarterly observations on terms–of–trade, real GNP, real government consumption and real private consumption constructed by Danmarks Nationalbank. The sample runs from 1971:1 to 1995:3. All variables are in logarithms and are seasonally adjusted.

First, we consider the cointegration properties of the data. We have assumed above that our four variable time series model contains three permanent shocks and one transitory shock. This assumption implies a cointegration rank of one, i.e., that we should find one cointegration vector among the four variables. Table 1 provides LR–trace statistics and eigenvalues from Johansen's maximum likelihood based analysis for the unrestricted VAR using 3 lags (there are 2 lags in the vector error correction representation of our model). Using a sequential procedure we find that there is one cointegration vector present in our system. Under the maintained hypothesis of one cointegration vector, we also test whether the four variables are stationary and if any variable can be excluded from the cointegration space. Both hypotheses are rejected at conventional significance levels.[3] Furhtermore, diagnostic testing suggest that there is no autocorrelation left in the residuals. We conclude, based on these tests, that our empirical model is reasonably well specified.

Next, we impose the identifying restrictions on our model, i.e., restrictions on the long–run effects on the variables from the three permanent shocks. Table 2 reports estimates of the long–run multipliers in the matrix A in equation (4). These estimates provide a measure of the long–run response of the variables in our system to orthogonal innovations in the three trends. The last column in Table 2 shows the long–run effects on private consumption arising from one standard deviation shocks to terms–of–trade, permanent income and government consumption expenditure. All of the estimated coefficients are statistically significant and have the signs predicted by our model. Terms–of–trade and permanent income shocks have positive long–run effects on private consumption and a government consumption expenditure shock has a negative long–run effect on private consumption.

These estimates are consistent with the permanent income model and the 'German

[3]These test statistics are not reported for brevity, but are avalable from the authors upon request.

Table 2: Estimates of the long–run effect of permanent shocks.

Shock	$p_{x,t}$	Y_t	G_t	C_t
ψ_p	1.615	0.631	−1.381	0.945
	(0.128)	(0.130)	(0.156)	(0.192)
ψ_y	—	1.114	0.761	1.233
	(—)	(0.084)	(0.087)	(0.145)
ψ_g	—	—	0.613	−1.060
	(—)	(—)	(0.046)	(0.079)

Note: Standard errors are reported in the parenthesis below each estimate.

view', but do not clearly distinguish the theory from more conventional alternative hypotheses. To that end, we need to investigate the dynamic behavior of the system at short– and medium–term horizons. In the next two subsections we analyze the dynamic effects of permanent and transitory shocks by examining impulse response functions, forecast error variance decompositions and historical decompositions.

4.1 Dynamic Behavior of Consumption

Some of the dynamic characteristics of the model may be seen by investigating impulse responses of private consumption to the various disturbances (Figure 1) and decompositions of the consumption forecast error variance attributable to each shock (Table 3).

The impulse responses show the response of (log level) consumption to a one unit structural shock. Two standard deviation confidence bands around the point estimates are also shown, calculated by the asymptotic method developed by Warne (1993). The effects from each disturbance have the theoretically predicted signs. Positive and permanent terms–of–trade and permanent income shocks increase private consumption in the short–run as well as the long–run. Terms–of–trade shocks gradually affect private consumption, and the latter reaches its new long–run equilibrium value (rising 0.6 percent in response to a 1 percent shock) after about four years. By contrast, private consumption in the short–run appears to overshoot its long–run equilibrium value by about 20 percent following a permanent income shock. The adjustment process again takes about four years. A transitory shock, which may be interpreted as a temporary rise in income, increases private consumption in the short–run but has a very short–lived effect.

Turning to the test of the 'German view', a permanent rise (fall) in government consumption expenditure causes a significant fall (rise) in private consumption in the short–run. The dynamic response reflects an 'undershooting' pattern, with the long–run equilibrium decline (rise) again reached in about four years. Government consumption expenditures seem to "crowd out" private consumption in both the short–run and long–run, consistent with the 'German view', i.e., we find support for the expansionary fiscal contraction hypothesis in its general form. Indeed, the magnitude of the private consumption response is larger than expected — private consumption falls more than proportionately to a rise in government consumption expenditure. This result is robust to different formu-

Figure 1: Impulse responses of private consumption to a one unit permanent and transitory shocks and the two standard deviation confidence bands.

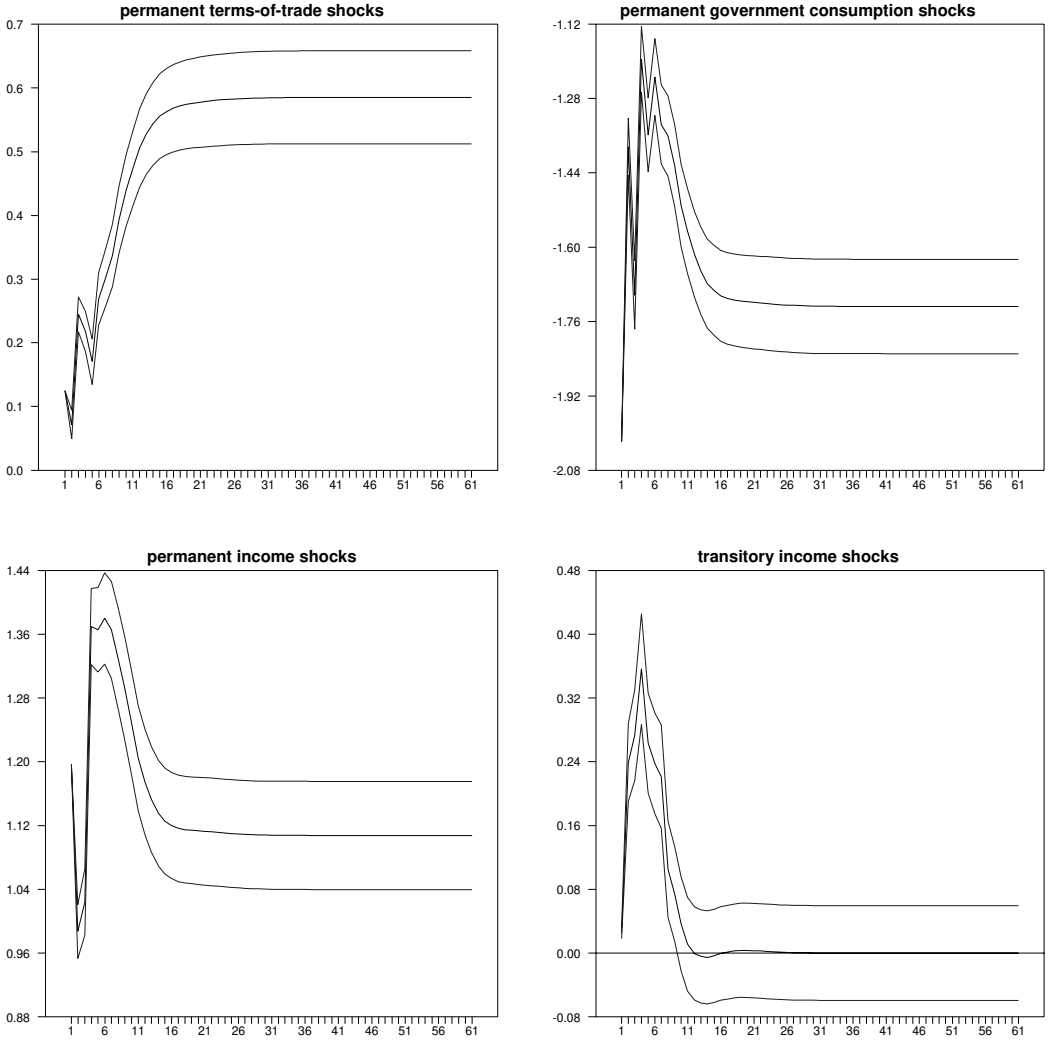


Table 3: Forecast error variance decomposition of private consumption. The fraction of the forecast error explained by permanent and transitory shocks.

shock	Quarter						
	1	4	8	16	24	32	∞
ψ_p	0.01	0.03	0.05	0.13	0.17	0.20	0.25
	(0.022)	(0.032)	(0.041)	(0.061)	(0.069)	(0.072)	(0.081)
ψ_y	0.53	0.60	0.66	0.58	0.53	0.50	0.43
	(0.072)	(0.065)	(0.060)	(0.068)	(0.072)	(0.074)	(0.076)
ψ_g	0.46	0.35	0.27	0.28	0.29	0.30	0.32
	(0.070)	(0.058)	(0.049)	(0.050)	(0.052)	(0.053)	(0.056)
φ	0.00	0.02	0.02	0.01	0.01	0.00	0.00
	(0.000)	(0.005)	(0.005)	(0.002)	(0.001)	(0.001)	$(-)$

Note: Asymptotic standard errors are reported in the parenthesis below each estimate. These standard errors are computed using the theory developed by Warne (1993).

lations of the model, including introducing variable real interest rates and trend shifts in real government consumption.[4] One possible explanation for the unexpectedly large estimated effect is that changes in government consumption expenditure may signal similar changes in other government expenditure categories, e.g., transfer payments.

The forecast error variance decomposition of consumption is shown in Table 3. This table shows, for the number of quarters ahead indicated, the fraction of the forecast error attributable to each disturbance. Asymptotic standard errors around the estimates are given in parentheses. Permanent terms–of–trade disturbances account for only a small fraction of consumption variance for short time horizons, but explain about 25 percent in the long–run. Permanent income shocks are the most important factor moving consumption for all time horizons, accounting for more than 50 percent initially, growing to over 65 percent and stabilizing at about 40 percent in the long run. Permanent government consumption disturbances explain a sizeable fraction of consumption fluctuations within the first year, around 35–45 percent, before declining to somewhat above 30 percent in the long–run.

Transitory shocks explain a surprisingly small fraction of consumption fluctuations. This also holds for other variables. The transitory shock explains only a small fraction of the variance in real output and government consumption. For example, at the one–year horizon, the transitory shock explains only 4 percent of the variance in government consumption and 7 percent of the variance in real output. By contrast, the transitory shock explains large fractions of the variance in the terms–of–trade in the short–run (over 40 percent at the 1–year horizon, 16 percent at the 3–year horizon, and 8 percent at the 5–year horizon).

The estimates of our model may be sensititve to model specification and the particular identification assumptions imposed on the long–run model (but not on the short–run

[4]These results are omitted for brevity, but are available from the authors upon request.

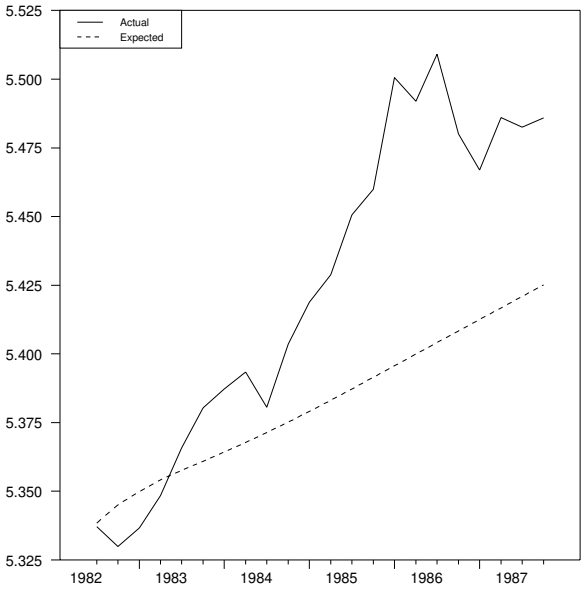
model). To check the robustness of these results we have considered one alternative model specification and two alternative model identification schemes. These results are reported in Appendix A. We find that alternative model specification (including taxes in the model) gives results which are quite similar to the base model — particularly with respect to the long–run impact of an increase in government consumption on private consumption. We find no evidence that our result is attributable to a long–run negative correlation between government consumption and real output. More generally, changing identificaton assumptions gives less plausible estimates and also provides less evidence of a long–run "crowding out" effect running from government to private consumption in Denmark.

4.2 Did Denmark Experience a Consumption–led Expansionary Fiscal Contraction?

The previous analysis suggest considerable support for the permanent income model and the expansionary fiscal contraction hypothesis, at least when one allows for some adjustment and information lags which can induce gradual adjustment to long–run equilibrium. But does the expansionary fiscal contraction hypothesis, judging by our model estimates and historical decomposition of structural disturbances, explain the consumption boom in Denmark following the 1982 fiscal contraction? The dashed line in Figure 2 shows the forecast value of consumption from our base model given all of the available information from 1982:Q2 (deterministic terms and lagged values of the four dependent variables in the system). The solid line is actual consumption and the difference between the two lines indicates "unexpected" consumption, i.e., consumption forecast errors. This figure shows that Danish consumption was unexpectedly low immediately following the announcement of the fiscal program, but soon rebounded and was above the forecast level (based on information prior to the fiscal reform) by the latter part of 1983. This initial overprediction of consumption, which is inconsistent with the 'German view' of the Danish experience, is also noted by Andersen (1994). However, the consumption boom from that point on, for the most part "unexpected", is clearly evident.

Did the permanent fall in (expected) government consumption expenditure cause the consumption boom? Figure 3 shows the historical decomposition of consumption during the five years following the Danish contraction into the various disturbances. The solid line is the unexpected part of consumption (the difference between the actual and forecasted values shown in Figure 2) and the dashed line is the effect on consumption due to the structural shock noted. The immediate downturn may be attributable to several factors, but most important for our purposes is that the permanent government consumption expenditure shock had a negative effect on consumption immediately following announcement of the fiscal reform program. Although current and lagged effects arising from the current and anticipated permanent government consumption expenditure reduction played a role in the sharp upturn in consumption at the end of 1983, the effect was short–lived and soon dominated by other factors. Only a modest stimulative effect was

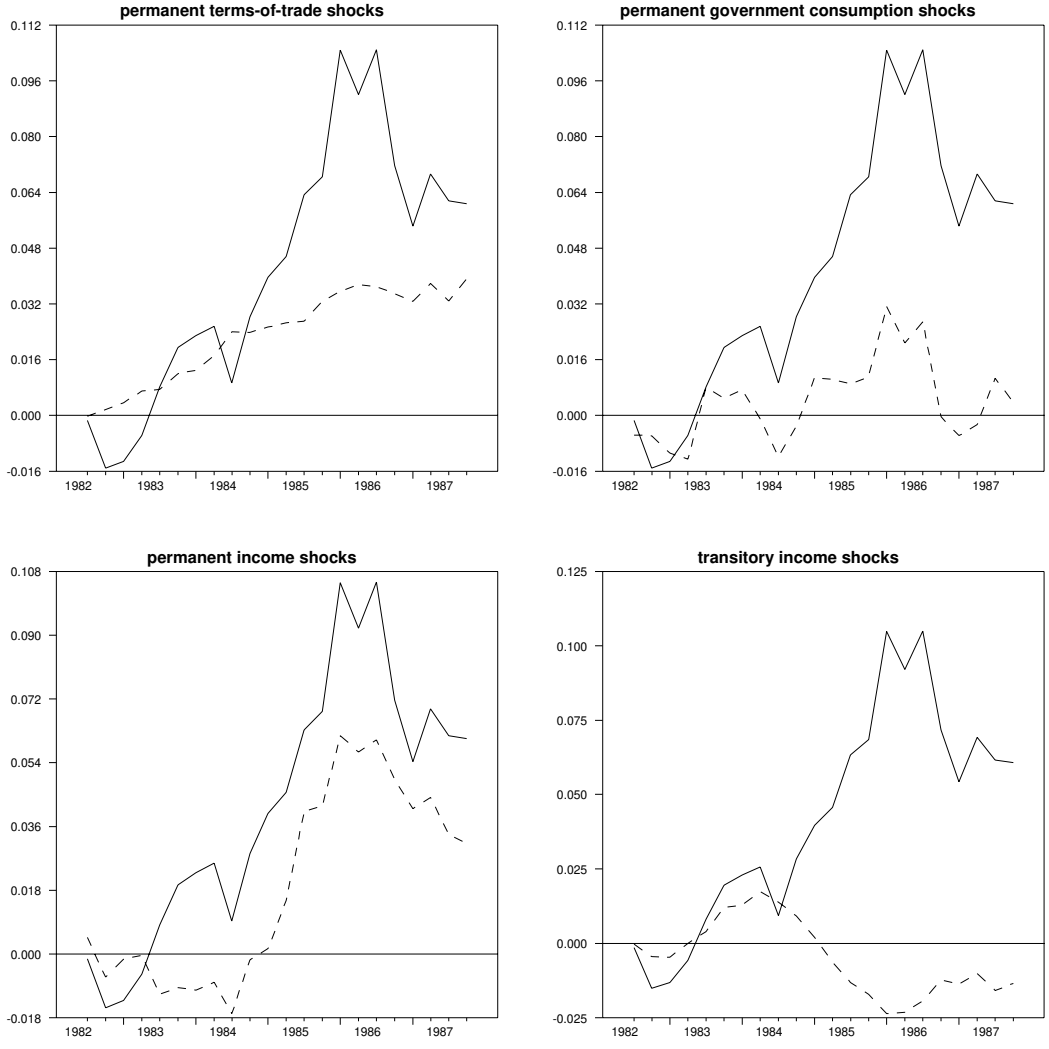
Figure 2: Actual and expected private consumption, 1982:3–1987:4.



realized despite several measures to consolidate fiscal finances on a longer term basis, including changes in budgetary practice and greater control of local fiscal authorities, which should have enhanced the credibility of the policy.

By contrast, a strong upward movement in the Danish terms–of–trade has been a strong positive force on consumption growth since the beginning of the fiscal reform program and continuously through most of the 1980s. Falling world energy prices in real terms played an important role in the terms–of–trade gain. Cyclical factors such as the upturn in world growth, led by the strong U.S. economy recovery, also played an important role in 1983 and 1984. Other permanent income shocks, by contrast, tended to dampen consumption through mid–1984, and then became the dominant force pushing up consumption for the next two years. These "other" permanent income shocks may include wealth effects associated with the interest rate decline emphasized by Christensen (1987). Interest rate decline in turn may have been attributable to the credibility of the new "hard currency" policy adopted by the government despite the historical experience of several discrete devaluations (Andersen and Risager (1988) and Andersen (1994)). Other aspects of the reform program in Denmark which would tend to boost this part of expected permanent income would include measures designed to increase efficiency in labor markets (e.g., suspension of indexation of wages and unemployment benefits) and financial markets (e.g., financial market liberalization and deregulation).

Figure 3: Historical decomposition of unexpected private consumption (solid line) attributable to structural shocks (dashed line), 1982:3–1987:4.



5 Conclusions

Our empirical evidence suggests that "permanent" (positive) shocks to real disposable income — in the form of an expected permanent terms–of–trade improvement, a decline in the equilibrium value of real government consumption expenditure, or other highly persistent factors such as an improvement in international competitiveness — have powerful effects on private consumption. Given economic structural rigidities and uncertainties over the form of the shocks, however, it is not surprising that the dynamics of private consumption are complicated and that it takes considerable time following a disturbance for new equilibrium values to be attained.

The application of the model to the Danish fiscal contraction in the autumn of 1982, however, does not provide much support for the 'German view' (expansionary fiscal contraction hypothesis) that the expectation of a permanently lower trend growth of government consumption expenditure was primarily responsible for the consumption boom. Firstly, consumption growth was below its forecast value immediately following announcement of the Danish fiscal reform. Secondly, when the consumption boom was realized it was primarily attributable to other factors, a continuous improvement in the terms–of–trade through most of the 1980s and, during 1984–86, a sharp upturn in "other" factors increasing permanent income and therefore consumption. This latter could be attributable to improving cost competitiveness and other consequences of the general package of economic reforms introduced at the time.

The model estimates suggest that a permanent reduction in the path of government consumption expenditure is associated with a climb in private consumption. This result was robust to an alternative model specification, but was sensitive to identification restrictions. Another caveat suggesting a cautious interpretation of the results is that the empirical model does not allow for non–linearities in fiscal response functions or "trigger points" associated with large stabilizations (Bertola and Drazen (1993) and Manasse (1996)). Moreover, in some sense the 1982 Danish experience studied here is not a clear test case of the 'German view'. In particular, Danish households had good reason to be skeptical of the fiscal reform program in its initial stages, however, and this may explain the delayed effects. A program with clear and credible specific objectives, and announced in advance to allow agents time to adjust in the interim period before implementation, could have a more powerful effect on consumption than the Danish case would suggest. These caveats suggest that further empirical work on this topic is necessary before stronger conclusions about the practical import of the 'German view' may be reached, and forms part of our planned future research agenda.

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Appendix A: Alternative models

Table A.1 reports estimates of the long–run response of income and private consumption to the three permanent shocks of our model (shocks to terms–of–trade, real income and government consumption). The table also shows, in parentheses below the long–run coefficients, the percentage of the long–run variance of output and private consumption explained by each of the permanent shocks.

The negative relationship between private and government consumption found in the base model could simply be picking up the effect of taxes on private consumption. The base model (permanent income model) implicitly assumes Ricardian equivalence, so that the time pattern of taxation would have no independent influence on private consumption. However, Ricardian equivalence may not hold. To take this into account, we add taxes to the model but otherwise maintain the same identifying restrictions as the base model. This alternative specification of the model is given as Model A.

The long–run estimates of Model A for consumption and income, reported in Table A.1, are very similar to the base model results. The long–run response of private consumption to permanent changes in government consumption is again negative (-1.13) and statistically significant. The positive long–run effect of a permanent income shock is also similar to the base model estimate. The only qualitatively important difference between the two models is that terms–of–trade shocks do not have significant long–run effects on consumption or income in Model A. This result is also reflected in the low proportion of long–run variance in either real output or private consumption explained by the terms–of–trade shocks. The results, however, seems to conform to our theoretical priors and the general estimates of the base model.

The long–run negative relationship between private and government consumption found in the base model could also be explained, at least in principle, by an adverse effect on output from the long–run expansion of the government sector. That is, perhaps the long-run offset we find between private and government consumption is really a "spurious correlation" which is reflecting the negative correlation between long–run government consumption and real output. The base model does not allow a long-run relationship between government consumption and real output, though government consumption may affect real output in the short- and medium-run. This restriction is one of the key identifying restrictions of the base model. We relax this identifying restriction in Model B. (An alternative identifying restriction must be imposed; Model B assumes that permanent income shocks do not affect government consumption in the long–run). In general, however, the explanatory power and plausibility of the point estimates of Model B are not satisfactory, and also suggest that there is no long–run adverse affect of government consumption on real output. Rather, the model suggests a long–run positive effect from permanent government consumption shocks on real output and no significant effect on private consumption.

Another key identifying restriction in the base model is that Denmark is a small open economy, i.e., Denmark's terms–of–trade is determined exogenously in world markets. Neither domestic output nor government consumption permanently affects the terms–of–

trade in the base model, although short–run effects are not restricted. In Model C we allow these domestic shocks to influence the terms–of–trade in the long-run as well as the short–run. (Instead, to identify the model, we assume that government consumption in the long-run is not affected either by terms–of–trade or permanent income shocks.) Again the results from this particular identifying scheme are not fully satisfactory. For example, Model C estimates suggest that an improvement in the terms–of–trade significantly lowers private consumption and that government consumption shocks do not have a significant permanent influence on either private consumption or income.

Table A.1: Estimates of the long–run effect of permanent shocks on income and private consumption.

Model	Variables	ψ_p	ψ_y	ψ_g	Model	Variables	ψ_p	ψ_y	ψ_g
Base model	Y_t	0.63*	1.11*	–	Model A	Y_t	0.24	1.02*	–
		(24%)	(76%)	(–)			(5%)	(95%)	(–)
	C_t	0.94*	1.23*	-1.06*		C_t	0.28	1.29*	-1.13*
		(25%)	(43%)	(32%)			(3%)	(55%)	(42%)
Model B	Y_t	0.60	0.72*	0.82*	Model C	Y_t	–	1.25*	0.00
		(23%)	(34%)	(43%)			(–)	(100%)	(0%)
	C_t	0.85	1.57*	0.23		C_t	-0.88*	1.48*	-0.55
		(22%)	(76%)	(2%)			(24%)	(67%)	(9%)

Note: (*) denote statistically significance at the 5 percent level.