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That Uncertain Feeling - How consumption responds to economic uncertainty in Norway

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That Uncertain Feeling

- How consumption responds to economic uncertainty in Norway*

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Abstract

Economic theory predicts that higher uncertainty motivates households to consume less. In this paper we empirically assess how household consumption in Norway responds to variation in economic uncertainty. We consider alternative measures of uncertainty, volatility indexes from financial markets and the frequency with which economic uncertainty is mentioned in the Norwegian press. We find that a one standard deviation rise in our preferred measure of uncertainty is followed by a statistically significant fall in overall consumption reaching a maximum of about 0.6% after one year. For durable consumption the fall is larger, reaching a maximum of 2% after one year. These responses are consistent with precautionary savings affecting all consumption components, and additional wait-and-see effects for durable consumption.

Keywords: Economic Uncertainty; Consumption

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1 Introduction

From time to time the future looks more uncertain than before. A popular perception has it that such movements in uncertainty may cause drops in real activity. This hypothesis may also be supported by economic theory. In this paper we explore the empirical content of it on Norwegian data. In particular, we focus on how consumption responds after movements in uncertainty.

The concept of uncertainty is challenging to quantify. In this paper we rely on two measures. First, we use stock market volatility, as considered by Bloom (2009) for the US economy. We here rely on two different volatility indices, one for the US and one for Norway. This allows us to study innovations in uncertainty that are caused by international events, and arguably are exogenous to the Norwegian economy, and to compare the effects of these international uncertainty shocks to uncertainty innovations in Norway. Second, we construct an index based on media coverage of economic uncertainty, similar to what Alexopoulos and Cohen (2009) use for the US. In a nutshell, our index covers the frequency with which the words "economy" and "uncertainty" are used in the Norwegian written press. Beyond serving as a robustness check, this latter measure has the benefit of arguably being more directly observed by households than financial market volatility itself. Or, phrased more elegantly as done by Alexopoulos and Cohen (2009): Press coverage is likely to be more important for perceptions of uncertainty on "Main Street", rather than financial volatility which primarily is directly observed on "Wall Street".

To assess the impact of uncertainty shocks, we follow Bloom (2009) and Alexopoulos and Cohen (2009) by using a structural vector auto regression model (SVAR), where the effects of uncertainty shocks are traced out after a recursive identification scheme. [1]

Bivariate SVARs, with uncertainty and consumption measures only, show that an innovation to uncertainty is followed by a fall in aggregate consumption. This fall is statistically significant, but of a moderate size, reaching a maximum of about 0.6% after one year, and thereafter reverting gradually to trend. When we consider the effect of

[1] We use a Cholesky decomposition.

uncertainty on durable consumption in isolation, we find far stronger effects. Durable consumption responds with a maximum fall of 2% to a one standard deviation increase in uncertainty. In bivariate models, the main dynamic pattern and magnitude of consumption responses are the same for shocks to both the two domestic uncertainty indices (financial volatility and press coverage of uncertainty) and for shocks to the US uncertainty index (financial volatility). When we extend the analysis to multivariate models, controlling for stock prices, interest rates and oil prices, the consumption responses to press based uncertainty measure remain unchanged, whereas the responses to market volatility are less robust.

The finding that durable consumption is particularly sensitive to uncertainty is consistent with the view that purchases of durables are particularly costly to reverse. For instance, buying a new car entails a particularly high fixed cost since its value drops massively after being used for the first time. Economic theory emphasizing the option value of postponing irreversible choices would predict that it is precisely these types of purchases that are most strongly influenced by uncertainty (Bloom (2009), Dixit and Pindyck (1994)). The response of aggregate consumption, which is greater and somewhat more protracted than can be explained by durable consumption alone, indicates that precautionary savings also might play a role here.

The rest of this paper is organized as follows. In section 2 we briefly explain 2 theoretical channels through which uncertainty is likely to affect consumption. In section 3 we discuss recent macro studies of the impact of uncertainty shocks. In section 4 we describe our data and methodology. In section 5 we give our main results. Section 6 concludes.

2 How uncertainty might affect the real economy

There are two main channels through which uncertainty is likely to affect the real economy. These are precautionary behavior and delays of irreversible decisions.

Precautionary behavior is induced as uncertainty raises agents' fear of having low consumption levels in the future. Hence, higher uncertainty will motivate households to save more. To achieve this, households must necessarily reduce their consumption or increase their income, the latter of which will cause higher labor supply. Mathematically, the condition for precautionary savings to arise is that the third derivative of utility with respect to consumption is positive. Textbook presentations of precautionary savings are given by for instance Romer (2011) or Ljungqvist and Sargent (2004).

The second effect of uncertainty arises when decisions are costly to reverse. A typical example would be the purchase of a new car, which immediately after its first usage drops discretely in value. In such instances, higher uncertainty motivates agents to postpone decisions rather than taking them immediately. The intuitive reason is that by postponing a decision, the individual agent can obtain more information about what is the correct choice to make. When passivity in the current period is possible to reverse by taking a decision in the future, whereas activity today is costly or impossible to reverse in the future, delaying a decision has an "option value". Hence, the importance of this effect will depend on the extent to which the decision in question is irreversible. Typical decisions one would expect to be influenced by such concerns are firms' investment and hiring policies, as both of these decisions entail fixed costs such as reorganization and training costs or temporary halts in production. On the household side, a typical such decision is likely to be durable consumption. The classic reference for how irreversibility affects decisions is Dixit and Pindyck (1994).

3 Recent literature on uncertainty and aggregate fluctuations

The insight that uncertainty may might affect behavior is far from new, and early studies of the phenomenon are Bernanke (1983) and Romer (1990). However, within the mainstream literature on business cycle fluctuations interest in the topic has been revived

recently. We give a brief survey of some recent studies here.

The paper that invigorated recent interest in uncertainty shocks as a driver of business cycles is Bloom (2009). His main approach was to use a theoretically based (structural) model of firms' hiring and firing decisions in an environment with uncertainty shocks. However, to motivate this analysis, Bloom used a Structural VAR to study the aggregate effects of uncertainty shocks, as measured by movements in the Chicago VIX-index. The findings from this analysis indicate that higher uncertainty gives falls in investment and employment, and that these responses were rapid and abrupt. The identification scheme used relies upon a Cholesky decomposition. We will explain this procedure in some more detail below, as we will use it in our analysis too.

The vital assumptions in Bloom's structural model are that investments and hiring entail fixed costs of adjustment, which generate a real option value of postponing decisions. When this model is estimated, it generates dynamics after a temporary uncertainty shocks characterized by rapid drop, rebound, and overshooting in employment, output and productivity growth. Hiring and investment fall dramatically in the 4 months immediately after shock because higher uncertainty increases the option value of waiting. Productivity declines because the hold-up in investments prevents capital from being reallocated in an efficient way from low productive to highly productive firms. [2] This model reflects the typical characteristic of how uncertainty influences choices that are costly to reverse due to fixed adjustment costs: Uncertainty expands the region of inaction that fixed adjustment costs imply.

Alexopoulos and Cohen (2009) follow up Bloom's study by giving a richer empirical analysis of the aggregate effects of uncertainty shocks, in particular on consumption and investment. Furthermore, they propose news paper coverage as an alternative measure of uncertainty, rather than just stock market volatility. Their main argument for this measure is that media coverage is the main channel through which households observe higher uncertainty, rather than through increased stock market volatility per se. Their

[2]Bloom (2009) also shows that fixed costs of investment generate larger effects than fixed costs of hiring.

main findings are consistent with Bloom's VAR evidence, in that output, employment, labor productivity, consumption and investment all drop significantly in response to an unanticipated rise in uncertainty. Furthermore, their results suggest that uncertainty shocks account for $10-25$ percent of the short-run variation in these variables, and that the newspaper-based index accounts for more of the swings in real activity than stock market volatility does.

One specific source of uncertainty comes from the unpredictability of future choices by politicians. An attempt to measure such policy uncertainty and its impact on the real economy is undertaken by Baker et al. (2012). They build an index for the US, which combines the frequency of references to economic uncertainty in newspapers, the number of federal tax code provisions set to expire in future years, and the extent of disagreement among professional forecasters over future government purchases and the future CPI level. Using this index in a VAR with the same recursive identification strategy as in Bloom (2009), they find a strong relationship between economic policy uncertainty and the real economy. Their main estimates imply that an increase in policy uncertainty of the magnitude observed between 2006 and 2011 is followed by a drop in real GDP of 3.2%, and an investment fall of 16%.

Sceptical views on the effects of higher uncertainty are given by Bachmann et al. (2010) (BES, hereafter), Bachmann and Bayer (2011) and Knotek and Khan (2011). BES rely on a VAR-methodology similar to the studies mentioned above, but they differ by using survey data to measure business uncertainty, and by distinguishing between *uncertainty* and *confidence*.[3] Their findings indicate that the responses of real activity to uncertainty are identical to those of confidence, being slow and protracted. When confidence is controlled for, the responses to uncertainty are mitigated, and they disappear if it is assumed that uncertainty shocks cannot affect the economy at long horizons. BES interpret this as evidence that what previous studies claim to be strong effects of

[3]Specifically, uncertainty is measured by cross-sectional disagreement in business expectations in the US and Germany. Confidence is measured as the fraction of survey respondents who expect an increase in general activity minus the fraction who expect a decrease.

uncertainty, really are effects of innovations to the long-run outlook of the economy. BES' evidence is a call for caution in interpreting VAR-evidence on the relationship between uncertainty and real activity as causal, and stemming from uncertainty shocks per se. However, this does not imply uncertainty might have real effects. In particular, variation in uncertainty that is endogenously driven by the same forces that underly long-term growth prospects, is still likely to be important.

While most theoretically leaning work on adjustment costs and uncertainty is based on partial equilibrium analysis, Bloom et al. (2011) enrich the literature by studying uncertainty shocks in a quantitative dynamic stochastic general equilibrium model. They first document the countercyclicality of uncertainty at the aggregate and cross-sectional firm level, and also give indicative evidence that there could be causation from uncertainty to industry growth, rather than causation running the other way as claimed in the aforementioned study by BES. Their DSGE model is constructed to allow for such effects, by containing heterogenous firms, time-varying uncertainty and adjustment costs. Their main finding is that a one standard deviation increase in uncertainty makes output drop by around 2%.[4]

4 Data

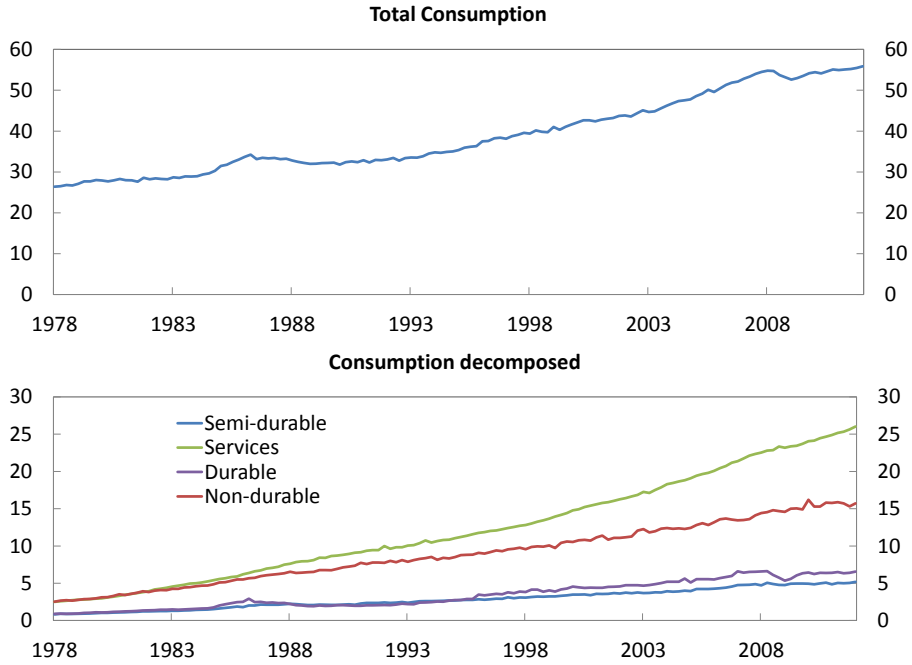
In our analysis we will primarily focus on the relationship between uncertainty and consumption. We here present the data on Norwegian consumption, and the uncertainty measures we shall employ.

4.1 Consumption

Figure 1 plots consumption per capita in Norway since 1978. The upper panel plots total consumption, while the lower panel plots its composition into durables, non-durables,

[4]There are also some studies that look at higher-moment shocks in conventional representative agent DSGE models, for example Fernández-Villaverde and Rubio-Ramírez (2010) and Fernandez-Villaverde et al. (2011). Since there are no irreversibilities in these models, the effects of volatility shocks goes mainly through precautionary behavior alone.

Figure 1: Nominal consumption expenditure per capita in Norway over time.

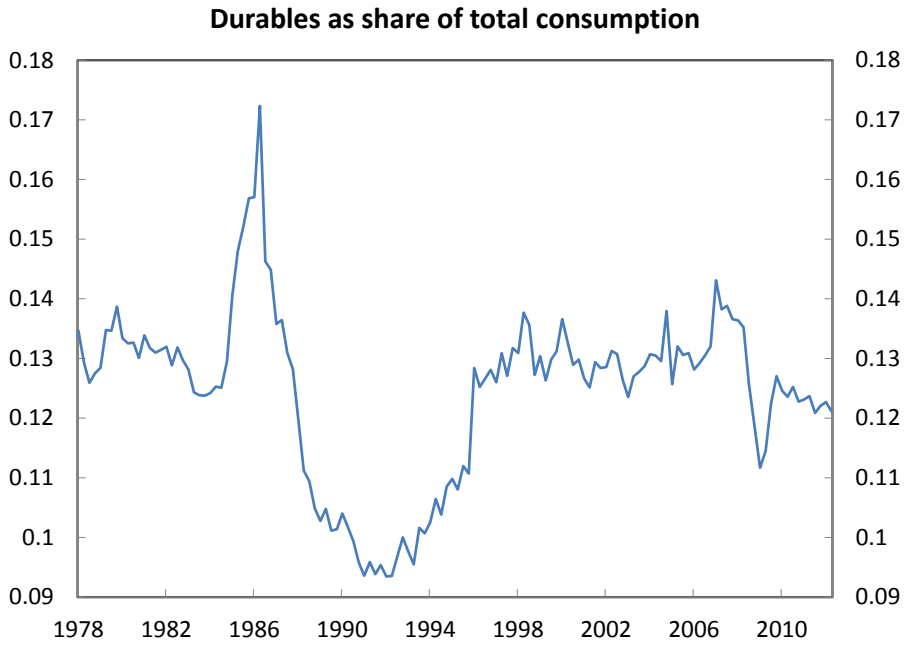


Note: Consumption in thousand NoK per capita.

semi-durables and services. We see that total consumption has grown steadily over the period. The composition of consumption has changed somewhat over the period, as services have grown stronger than the others. Furthermore, one may notice that some of the categories are more volatile than others, in particular durable consumption which drops somewhat in 2008.

Figure 2 illustrates how the consumption composition varies over time, by displaying the share of durable consumption over the period. We see how durable consumption spiked around in the fourth quarter of 1986, and thereafter dropped dramatically to its lowest level in the early 90s. Since 1995 the share of durables was relatively stable until it started falling in late 2008 reaching a trough in the third quarter of 2009. Since then it has picked up, but without quite returning to the same levels as before the fall in 2008-09.

Figure 2: The share of durable consumption over time.



4.2 Measures of uncertainty

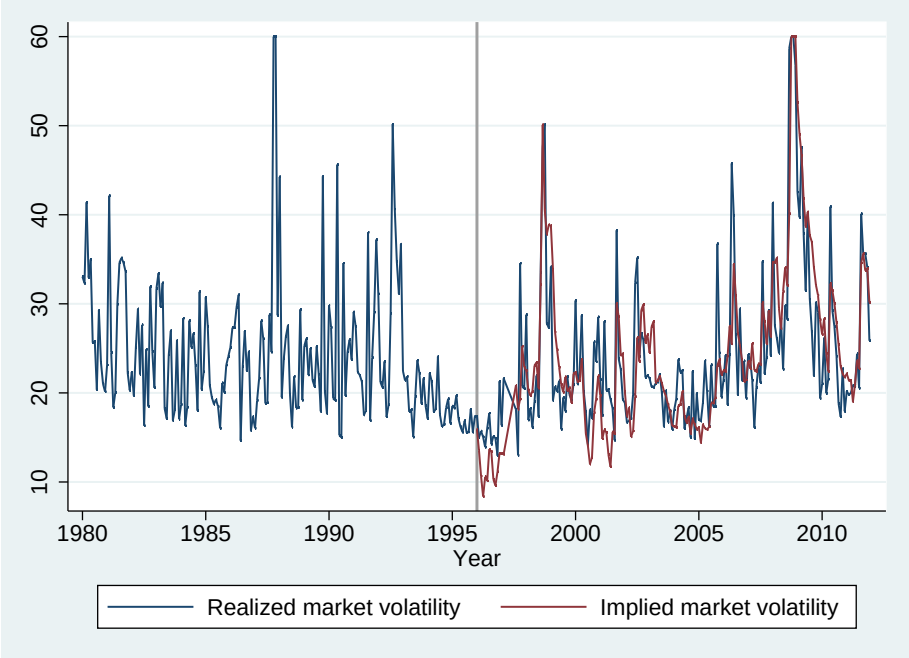
Measuring uncertainty is far from trivial, as the concept itself is somewhat vague and abstract. We shall consider two main measures of domestic uncertainty in our analysis. First, we use measures based on volatility in financial markets, which is the most widely used approach elsewhere in the literature. For Norwegian volatility, we rely on a series of implied volatility for 1996 and onward provided by Bloomberg, based on call options on the Oslo stock exchange (OBX).[5]. For the period between 1980 through 1995 we use realized return volatility at the Oslo stock exchange, as given by the monthly standard deviation of stock returns.[6] This approach is equivalent to the one used by Bloom (2009) for US market volatility.

Figure 3 displays the movements of implied and realized market volatility in Norway

[5]Implied volatility for underlying securities is calculated from a weighted average of the volatilities of the two closest options. For all securities, the contract used is the closest pricing contract month that is expiring at least 20 business days out from today.

[6]We rely on the return index constructed by Bernt Arne Ødegård, documented in Ødegård (2012) and available at http://finance.bi.no/~bernt/financial_data/ose_ asset_pricing_data/index.html

Figure 3: Realized and implied volatility Norway.



Note: Realized volatility refers to the monthly standard deviation of returns at the Oslo stock exchange as calculated Ødegård (2012) and available at http://finance.bi.no/~bernt/financial_data/ose_asset_pricing_data/index.html. Implied volatility since 1996 is based on call options on the Oslo stock exchange (OBX). Observations truncated at 60

over time. The shaded vertical line indicates the time period from which the implied volatility measure is available. We see that these two market based measures are highly volatile themselves, with pronounced spikes around certain events, such as the collapse of Lehman Brothers in the fall of 2008, the Asian crisis in 1998, the Norwegian currency turbulence in the early 90s, and the stock exchange crash of 1987. The curves also show that the two variables are closely correlated over the period when they both exist (the contemporaneous correlation coefficient is 0.85), and that the implied volatility measure is somewhat smoother than what is the case for realized volatility.

Our second domestic indicator of uncertainty is based on newspaper coverage of economic uncertainty. This indicator was constructed by counting the monthly frequency with which the words *"economy"* and *"uncertainty"* were both used in the same article by the Norwegian press.[7] The database behind this word count consists of 102 sources,

[7]The Norwegian terms are *"økonomi"* and *"usikkerhet"*.

with national, regional and local newspapers, magazines and journals, scientific press, news agencies and press releases.[8]

In addition to these two indicators of domestic uncertainty, we also consider the effect of international uncertainty. For this purpose we rely on the market based indicator constructed by Bloom (2009), which consists of the Chicago Board of Options VXO index of percentage implied volatility from 1986 onward, and realized monthly volatility of the daily S& P500 before that (before 1986).

Figure 4 below plots the alternative uncertainty measures over time. We see that the market based volatility measure for the United States (mvolUS hereafter) moves together with the market based measure for Norway (mvolNO hereafter) over the entire sample period.[9] The contemporaneous correlation between market volatility in Norway and the US is 0.76. We see that in the early part of our sample, between 1980 and ca 1985, our press based uncertainty index (PBU hereafter) lies constantly at a very low level, indicating that economic uncertainty was not given much attention by the press in the early part of our sample period. However, from then onward the PBU-indicator has increased steadily, and displays spikes at the same specific events as when market volatility surged.

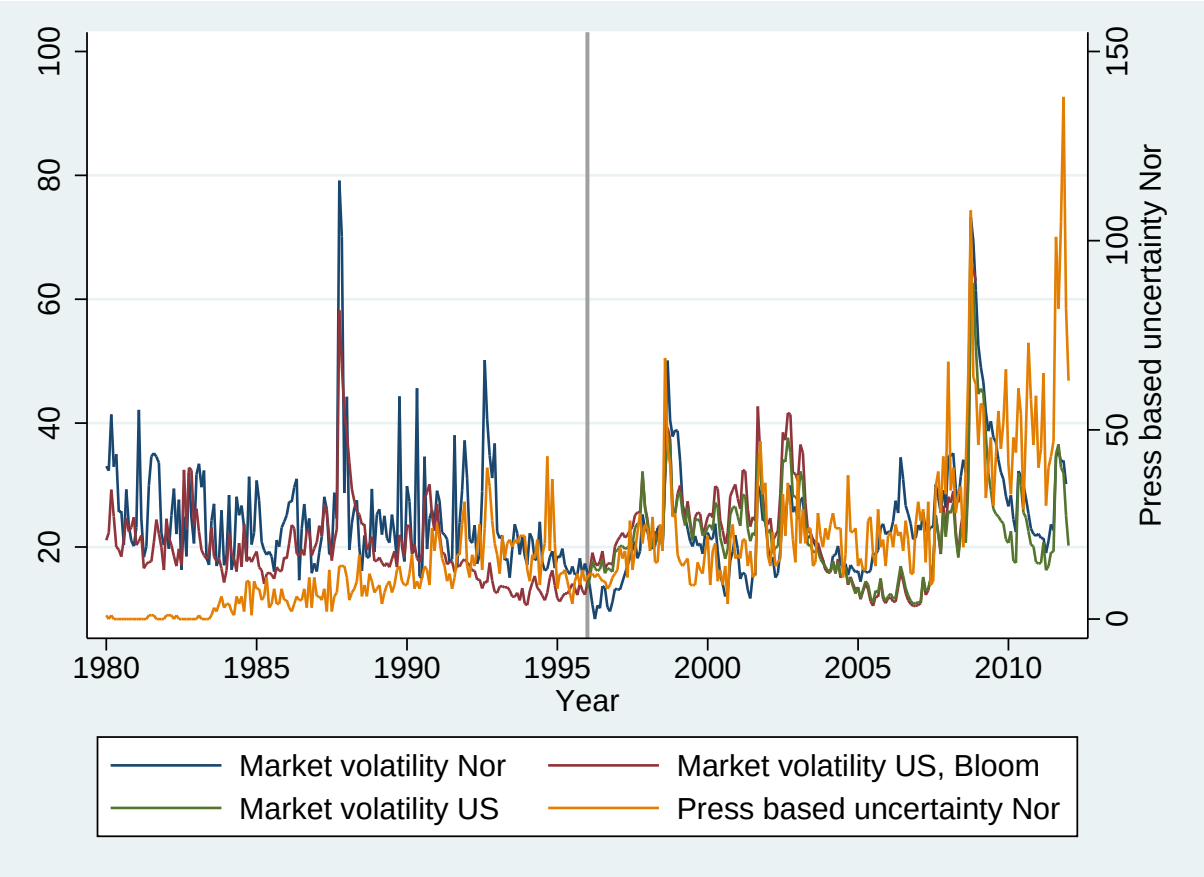
If the market and press based measures of uncertainty capture similar phenomena, they should be closely correlated. Figure 5 shows that this indeed is the case. Press quotations are counted on the vertical axes in both figures, against implied volatility in Norway and the US respectively. The upward sloping line in each figure is the result of regressing the measures on each other and a constant.

The results behind regression lines in Figures 5 are given in Table 1, which also reports results from regressing the PBU-index on realized volatility since 1980. We see that press quotations are weaker related to the market based measure than to implied

[8]Quotations from news agencies and press releases were counted only once.

[9]The Norwegian measure of market volatility consists here of realized volatility up until 1995, and implied volatility thereafter, with realized volatility re-scaled to have the same mean and variance as implied volatility in the post 1996 period where both measures existed. The procedure used for this standardization is the same as in Bloom (2009).

Figure 4: Uncertainty measures over time.

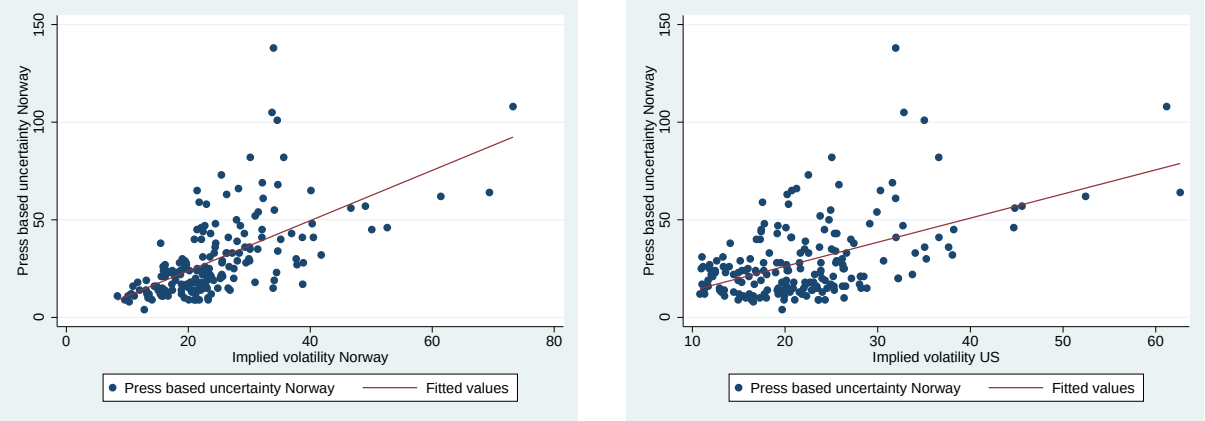


Note: Market volatility Norway equals realized volatility up until 1995, and implied volatility thereafter, with realized volatility re-scaled to have the same mean and variance as implied volatility after 1996. Market volatility for the US is reported as implied volatility as given by the VXO after 1996, and the indicator constructed by Nick Bloom (2009) which combines realized with implied volatility.

volatility. There are two reasons why. First, realized volatility covers also the 1980's, when we know from the preceding discussion and Figure 3 that the press based measure gives a stable low number of counts (that is there are many zeros). Second, even if we include only the same sample period as the one used for the implied volatility measure, the relationship with realized volatility is weaker, which probably reflects that realized volatility is a slightly more noisy measure of uncertainty.

A question to the PBU-index is whether it is correlated with the US volatility index simply because the press is covering foreign events with little relevance for the Norwegian economy. To investigate this concern, we regress PBU on both domestic and US market

Figure 5: Implied volatility Norway vs Norwegian press coverage of uncertainty (left), and Volatility index US vs Norwegian press coverage of uncertainty (right).



Note: Implied volatility in Norway is based on call options on the Oslo stock exchange since 1996. Press based uncertainty is based on coverage of economic uncertainty by the Norwegian press. Implied volatility in US as given by the Chicago Board of Options VXO index.

volatility. The results are given in Column 6 of Table 1. We see that when domestic market volatility is controlled for, the US based measure is not related to the Norwegian press coverage of economic uncertainty. Hence, it seems reasonable to interpret the PBU-index as a measure of domestic economic uncertainty.

Finally, we summarize the correlation between the PBU-index and the market volatility indices in Table 2. Each entry in the table gives the correlation between the PBU-index and variable named in column 1 j periods ahead ($corr(PBU_t, vol_{t+j}$, where vol_{t+j} is the relevant volatility index at time $t+j$).

5 Results

We now turn to our main analysis which aims to illuminate how consumption moves after changes in economic uncertainty. We will here emphasize three different measures of consumption. These are durable consumption, total household consumption, and the goods consumption index. We focus on durable consumption because this is where theory of irreversibility seems to be the most relevant. Total consumption is simply the aggregate of durable, semi-durable, non-durable, and service consumption. The goods consumption

Table 1: Press coverage of uncertainty regressed on market volatility, monthly.

	(1)	(2)	(3)	(4)	(5)	(6)
impvol_NO	1.29***					1.16***
	(0.12)					(0.18)
impvol_US		1.24***				0.20
		(0.15)				(0.21)
realvol_NO			1.15***			
			(0.13)			
mvol_NO				0.85***		
				(0.10)		
mvol_US					0.56***	
					(0.08)	
N	189	193	175	307	348	189
adj. R^2	0.384	0.255	0.302	0.204	0.119	0.383

*Note: Results from regressing PBU on a constant and market volatility. Point estimates are reported with standard errors in parentheses below. Statistical significance reported with asteriscs; *** indicates significance at the 1% level. The variable impvol_NO is the implied market volatility in Norway from 1996 and onward, realvol_NO is realized volatility from 1980 and onward, and mvol_NO is a series combining the two by using impvol_NO after 1996 and realvol_NO before. Impvol_US is implied volatility in the US since 1996 while mvol_US is a combination of implied and realized volatility as constructed by Bloom (2009). All regressions using realized volatilities start in 1986, due to few observations covered by the PBU before that. All regressions using implied volatility start in 1996.*

index is also considered because it is available at a monthly frequency, in contrast to durable and total consumption for which only quarterly data are available.

5.1 Empirical strategy

Our empirical strategy will be to use structural VARs, similar to those used elsewhere in the literature, such as Alexopoulos and Cohen (2009) and Bloom (2009) discussed above. As these studies do, we will employ a recursive scheme to identify the effects of uncertainty shocks. We will use a Choleski decomposition, where the uncertainty measures are ordered first, so that the consumption variables are allowed to respond immediately to higher uncertainty. This choice of ordering is motivated by the observation

Table 2: Correlations between PBU and market based measures of uncertainty, $corr(vol_t, PBU_{t+j})$

vol_t	$j=-4$	$j=-3$	$j=-2$	$j=-1$	$j=0$	$j=1$	$j=2$	$j=3$	$j=4$
$impvol\_NO_t$:	0.35	0.43	0.52	0.60	0.62	0.51	0.45	0.39	0.31
$realvol\_NO_t$:	0.19	0.25	0.36	0.49	0.58	0.46	0.38	0.32	0.21

that in most structural models with irreversible decisions, agents tend to respond rapidly to uncertainty shocks.[10]

5.2 Bivariate models

As a starting point, we consider two variable VARs. We use one model with the constructed Norwegian volatility index, one with the Norwegian measure of press coverage (PBU), and one with the US volatility index. The Norwegian volatility index consists of realized volatility throughout 1995, and implied volatility from 1996 and onwards. For each uncertainty measure, we estimate the effect of an increase in uncertainty on the monthly consumption index (data from 1996 throughout 2011), the quarterly measures of total consumption and durable consumption (data from 1980 an onwards).

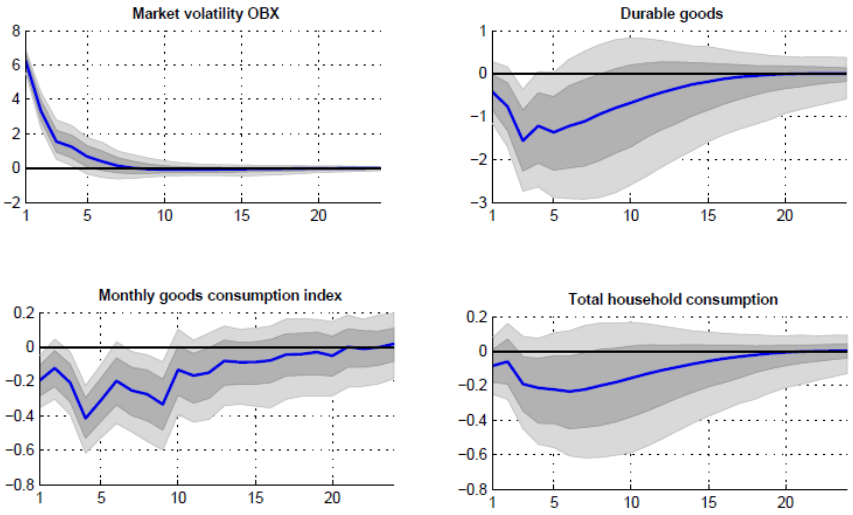
Figures 6 - 8 plot the effects of a one standard deviation increase in the uncertainty indexes. All reported responses are quarterly, apart from the consumption index for which the responses are monthly. In each figure, the upper left panel displays the movements in the uncertainty index itself, taken from the quarterly model with durable consumption.[11]

We see from Figures 6 and 8 that market volatility indexes for the US and Norway display similar patterns, as they gradually returns to their normal level over a course of

[10] While this ordering of variables is the one that is widespread in the literature, it does suffer from the caveat that that one must consequently assume that uncertainty measures react to the macro variables (here consumption) only with a lag. For a financial variable like the volatility index, this is clearly an unrealistic assumption, and we have therefore corroborated our findings with robustness analysis where we alter the ordering. The main results go through also when uncertainty is ordered last.

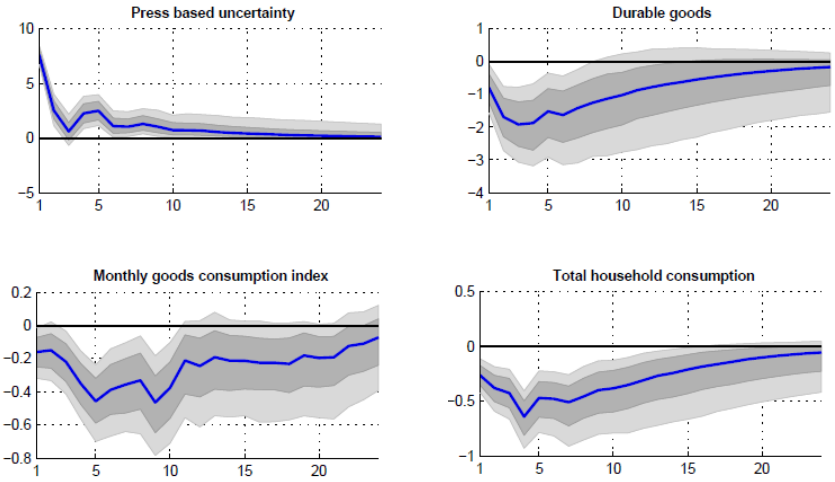
[11] In principle, the dynamics of the uncertainty measure may depend on which other variable is included in the model for which the shock is computed. However, for all the specifications considered here the movements of the uncertainty measures were almost completely unaffected by which other variables we included in the model.

Figure 6: Responses to a one standard deviation increase in Norwegian market volatility.



Note: Confidence bands of 84% *(dark grey) and* 95%*. Market volatility is an index equal to realized OBX volatility between 1980 and 1995 and implied volatility from 1996 through 2011. Consumption reported as percentage point deviations from a quadratic trend. The time frequency is quarterly over the sample period 1980 through 2011, apart from for the goods consumption index in the lower left panel for which the frequency is monthly over the period 1996 through 2011.*

Figure 7: Responses to a one standard deviation increase in press coverage of uncertainty.

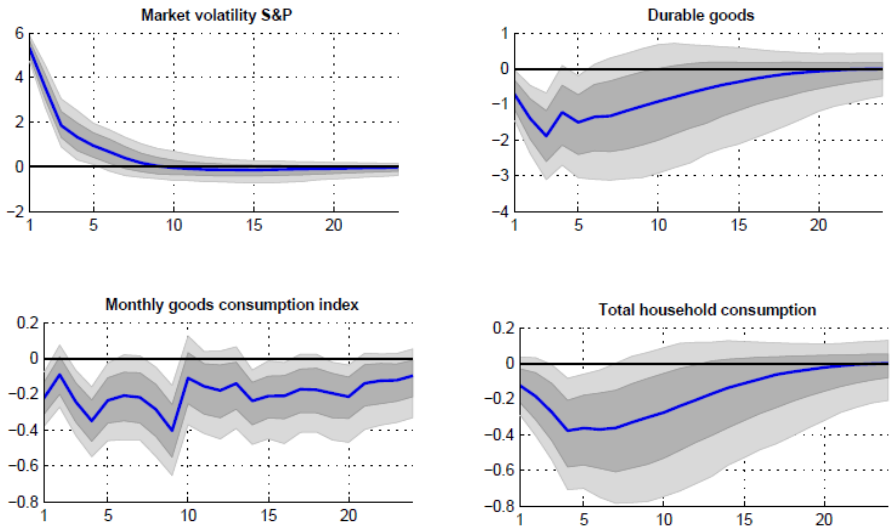


Note: Confidence bands of 84% *(dark grey) and* 95%*. Press coverage gives the frequency with which the words uncertainty and economy are used in the same article by the Norwegian written press. Consumption reported as percentage point deviations from a quadratic trend. The time frequency is quarterly over the sample period 1985 through 2011, apart from for the goods consumption index in the lower left panel for which the frequency is monthly over the period 1996 through 2011.*

five quarters, and remain on trend thereafter. The PBU-index displays slightly different dynamics, as it drops somewhat faster and is close to its trend level after 3 quarters, and hovers above trend for about 5 quarters thereafter.

The main qualitative insight from all the three Figures 6 to 8 is that hikes in uncertainty are followed by falls in consumption. This happens irrespective of which uncertainty measure we consider, and whether the source of uncertainty is domestic or originates in the US. For total consumption, as measured by either the monthly goods consumption index or by total household consumption, we see that the maximum drop is of about 0.6% below trend. The effect on durable consumption is far stronger, as the maximum point estimate of the response is a fall of about 2%. However, given the share of durable consumption of total consumption (between 10 and 15 percent over the sample period), the drop in durable consumption cannot alone explain the drop in to-

Figure 8: Responses to a one standard deviation increase in US market volatility.



Note: Confidence bands of 84% *(dark grey) and* 95%*. Market volatility is an index based on realized volatility as given by the monthly standard deviation of the S&P500 between 1980 and 1985, and implied volatility as given by the VXO index from 1986 through 2011. Volatility data up until 2008 are identical to the series constructed by Bloom (2009). Consumption reported as percentage point deviations from a quadratic trend. The time frequency is always quarterly over the sample period 1980 through 2011, apart from for the goods consumption index in the lower left panel for which the frequency is monthly over the period 1996 through 2011.*

tal consumption. It is likely that the change in durable consumption is mainly affected through delays of irreversible decisions, whereas change in total consumption is due to both precautionary behavior and delays of irreversible decisions.

The dynamics indicate that the effect grows for the first 3-4 quarters, and returns thereafter. The point estimates indicate quite persistent effects, but after approximately 6-8 quarters the responses are no longer statistically different from zero at the 84% significance level. Note that the dynamics differ slightly between durable consumption and total consumption. Durable consumption drops more rapidly and is less persistent compared to total consumption. This is in line with what we should expect from the dynamics of irreversible decisions, where, as explained in section 2, there may be a fast reversion of

the initial response as uncertainty contracts to normal levels.[12] If the remainder of total consumption primarily is affected by precautionary savings, this might explain why total consumption responds more slowly than durables.

Comparing the responses to the domestic uncertainty measures in figures 6 and 7, we see that while the point estimates are qualitatively similar, the initial responses to the market volatility index, are less precisely estimated, and hence not significantly different from zero at the 95% level. This is likely to reflect that the realized volatility used in constructing this series is highly volatile itself. Indeed, when restricting the sample to the period from 1996 and on, when the implied volatility measure for Norway is applicable, estimates become statistically different from zero also for market volatility.

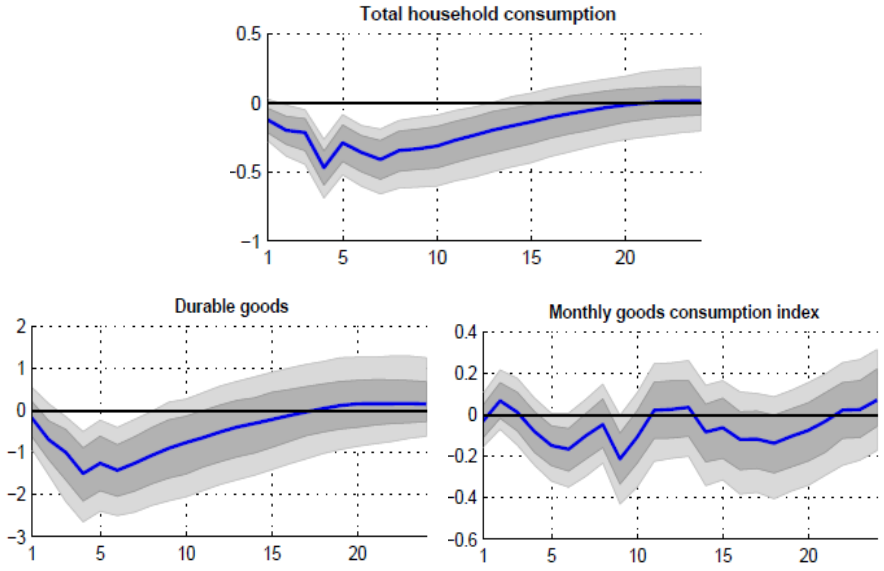
5.3 Multivariate models

The results from the bivariate model seem robust for different measures of uncertainty. However it is reasonable to question what the movement in the uncertainty indicator really captures. To address this issue we run a series of multi-variate VARs.

We extend the two variable model with the PBU-indicator to include stock prices, oil prices and interest rate. Movements in stock prices in general, and oil price in particular, give a good indication of Norwegian households' view on future income. Households' income expectations can be a proxy for the level of pessimism or optimism in the economy. Controlling for this level can help us better separate the uncertainty effect from pessimism about future income more generally. The ordering of the VAR is as follows: we place the oil price first, followed by stock prices, then the uncertainty index, followed by the interest rate and finally consumption (total and durable goods). The consumption responses for the multivariate case are presented in figure 9. The main qualitative insight still holds for the inclusion of the level of optimism or pessimism and monetary policy. Total consumption drops by 0.5% below trend and durable goods consumption drops 1.6% below trend. The dynamics remain the same, where the effect grows for the 3–4 quarters,

[12] However, in contrast to irreversibility theory, we find no sign of overshooting.

Figure 9: Responses to a one standard deviation increase in press coverage of uncertainty - multivariate model.



Note: Responses when the benchmark-model is extended with oil price stock prices and interest rate. Confidence bands of 84% *(dark grey) and* 95%*. Press coverage gives the frequency with which the words uncertainty and economy are used in the same article by the Norwegian written press. Consumption reported as percentage point deviations from a quadratic trend. The time frequency is quarterly over the sample period 1985 through 2011, apart from for the goods consumption index in the lower left panel for which the frequency is monthly over the period 1996 through 2011.*

and returns thereafter.

However, when we change the uncertainty indicator from PBU to market volatility, both OBX and S&P, the results seem less robust and become insignificant, see appendix and figure 10 for results. We also control for difference in realized and implied volatility in the Norwegian stock market. The market volatility indicator used in the bivariate model for OBX was a merged indicator between realized and implied volatility. The results are presented in figure 11. When we specify the bivariate model with only realized volatility or only implied volatility the results stays significant only for movements in durable goods.

6 Conclusion

In this paper we have explored the relationship between movements in uncertainty and consumption. The patterns we find indicate that increases in economic uncertainty are followed by significant contractions in consumption. A one standard deviation hike in uncertainty is followed by a fall in durable consumption of about 2 percent after 4 quarters, and a fall in aggregate consumption of about 0.6 percent after 4 quarters. The fall in durable consumption cannot alone explain the fall in total consumption. It is therefore plausible that the fall in total consumption is due to both precautionary behavior and delays of irreversible decisions. These responses are clearer when uncertainty is measured by press coverage of the topic, than when it is measured by financial market volatility. Uncertainty arising internationally, as measured by financial market volatility in the US, has similar effects as domestically arising uncertainty, as measured by market volatility in Norway.

While these patterns, particularly that durable consumption falls stronger than other consumption categories, aligns with what one would expect after a pure uncertainty shock, one should still be cautious in interpreting our findings as pinning down the causal effect of uncertainty alone. A specific concern with a causal interpretation, is that because uncertainty goes up when the future looks bleaker, our results reflect the impact of confidence (the first moment) rather than uncertainty (the second moment). We attempt to address this issue by adding controls such as stock returns, oil prices and monetary policy. The responses to the press based uncertainty measure is robust to these extensions, while the responses to the financial market indicators are less so. Our results are relatively consistent with what is found elsewhere in the literature, where the issue of how to identify the isolated effect of uncertainty is unresolved and controversial. One possibility is that while uncertainty is important for the macro economy, its role is more to propagate shocks to the first moment, rather than to constitute an independent influence on the economy in itself.

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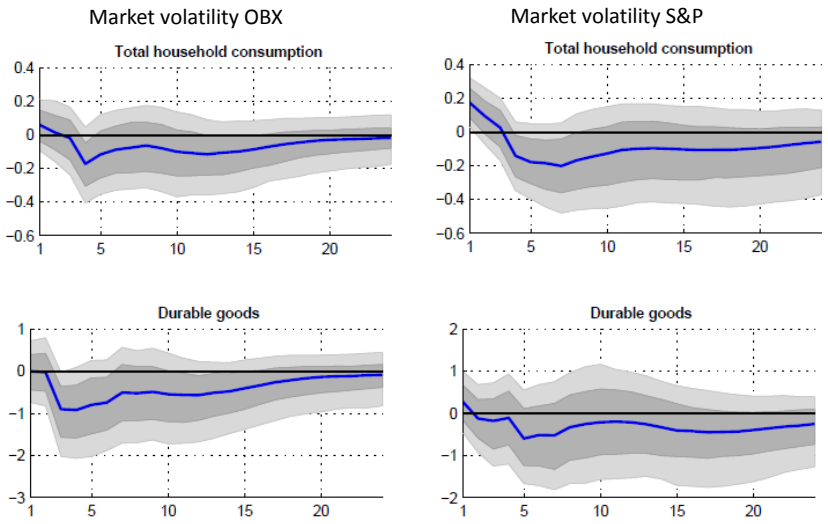
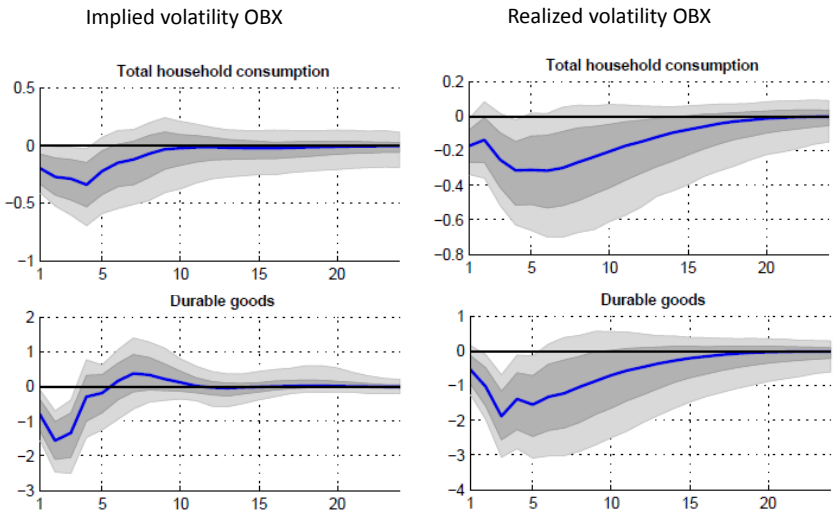
7 Appendix: Robustness

Figure 10: Responses to a one standard deviation increase in Norwegian market volatility and US market volatility - multivariate model.



Note: Responses when the benchmark-model is extended with stock and oil price and interest rate. Confidence bands of 84% *(dark grey) and* 95%*. Consumption reported as percentage point deviations from a quadratic trend. .*

Figure 11: Effects of a shock to market volatility - implied and realized volatility.



Note: Responses to a one standard deviation increase in Norwegian market volatility. Confidence bands of 84% *(dark grey) and* 95%*. Realized OBX volatility between 1980 and 2011 and implied volatility from 1996 through 2011. Consumption reported as percentage point deviations from a quadratic trend. .*