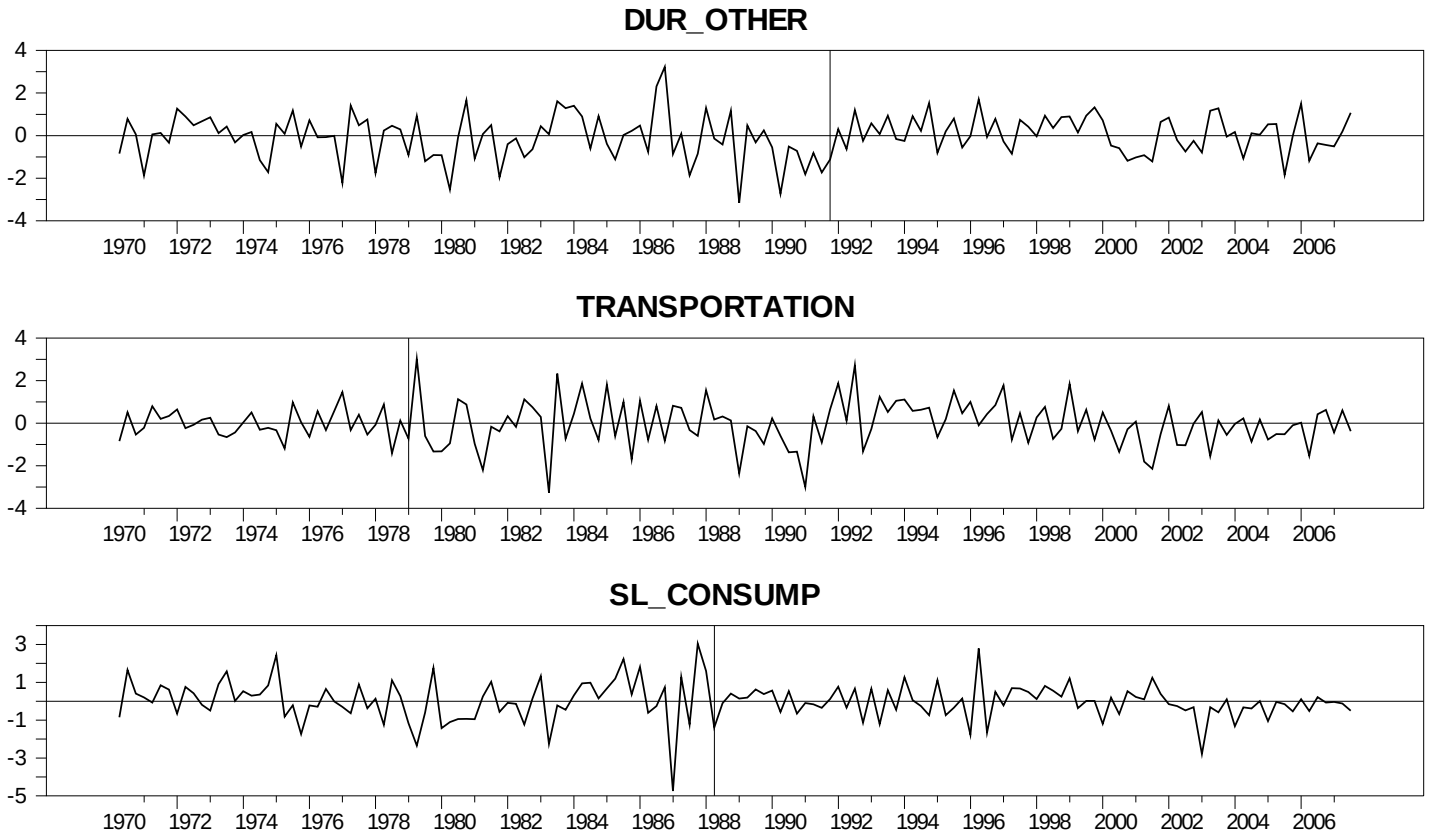
Appendix to Enders and Ma: Sources of the Great Moderation

Table A1: Diagnostic checks of Variance Breaks

Series	Date	CUSUM^2	Statistic	Series	Date	CUSUM^2	Statistic
GDP	1984Q1	2001Q3	0.062	INFORMATION	1982Q2	1987Q4	0.095
PCE	1986Q3	1992Q1	0.134	COMPUTERS	1986Q3	1975Q2	0.096
DURABLE	1986Q3	1991Q1	0.141	SOFTWARE	1983Q1	1996Q3	0.133
MOTOR	1986Q3	1991Q1	0.140	INFOR_OTHER	1982Q1	1987Q4	0.108
FURN_HOUSE_EQUIP	1981Q4	1996Q2	0.070	IND_EQUIP	1986Q1	2001Q1	0.111
DUR_OTHER**	1982Q3	1991Q4	0.152	TRANSP_EQUIP	1983Q4	1991Q4	0.065
NONDURABLE	1981Q1	1990Q3	0.081	OTHER_EQUIP	1983Q4	1991Q3	0.110
FOOD	1981Q3	1988Q1	0.072	RESIDENTIAL	1983Q1	1996Q3	0.105
CLOTHING_SHOES	1984Q3	1974Q1	0.049	EXPORTS	1982Q4	1996Q3	0.091
GAS_FUEL_ENERGY	1981Q1	2001Q4	0.097	EX_GOODS	1982Q4	1972Q1	0.069
NONDUR_OTHER	1982Q1	1999Q3	0.113	EX_SERVICES	1986Q4	1975Q3	0.097
SERVICES	1985Q1	1992Q1	0.134	IMPORTS	1984Q1	1991Q1	0.061
HOUSING	1986Q3	1994Q2	0.091	IM_GOODS	1986Q2	1975Q3	0.082
HOUSEHOLD_OPERAT	1986Q1	2001Q4	0.073	IM_SERVICES	1986Q3	1999Q4	0.097
ELECTRICITY_GAS	1986Q1	2001Q4	0.071	GOV	1986Q3	2001Q4	0.085
OTHER_HOUSE_OPER	1982Q1	1991Q2	0.140	FEDERAL	1986Q3	2000Q3	0.065
TRANSPORTATION**	1986Q1	1979Q1	0.152	NATIONAL_DEF.	1986Q3	1975Q3	0.125
MEDICAL_CARE	1981Q4	1998Q2	0.120	DEF_CONSUMP	1986Q3	1974Q3	0.086
RECREATION	1981Q2	1992Q1	0.080	DEF_INV	1981Q2	1999Q2	0.141
SER_OTHER	1985Q1	2001Q3	0.096	NONDEFENSE	1981Q1	1990Q1	0.139
GPDI	1984Q1	2001Q4	0.087	NONDEF_CONS.	1984Q2	1980Q1	0.099
FIXED_INV	1983Q4	1994Q1	0.072	NONDEF_INV	1983Q3	1993Q3	0.071
NONRES	1984Q1	1978Q1	0.066	STATE_LOCAL	1986Q1	1995Q4	0.076
STRUCTURES	1986Q4	1978Q1	0.130	**SL_CONSUMP****	1986Q1	1988Q2	0.210
EQUIP_SOFT	1984Q1	2001Q3	0.057	SL_INV	1984Q3	2001Q4	0.077

NOTE: **Date** is the break date found by our grid search method; **CUSUM^2 is** the date found by the CUSUM^2 test conditional on the presence of **Date; Statistic** is the value of the sample test statistic. Given the sample sizes used in the paper, the 5% critical value is 0.15. ** denotes statistical significance at the 5% level.

Figure A1: Standardized Residuals of the Three Series with Significant CUSUM^2 Values



The graphs show the standardized residuals of the three series with significant CUSUM^2 values. The vertical lines correspond to the break dates indicated by the CUSUM^2 test. As indicated in the graphs, the break dates for DUR_OTH and TRANSPORTATION are far from the Great Moderation. For SL_CONSUMP, the grid search method did not find a significant break; the indicated CUSUM^2 break for SL_CONSUMP comes too late to be a causal factor of the Great Moderation.

Table A2: Diagnostic Check of Mean Breaks

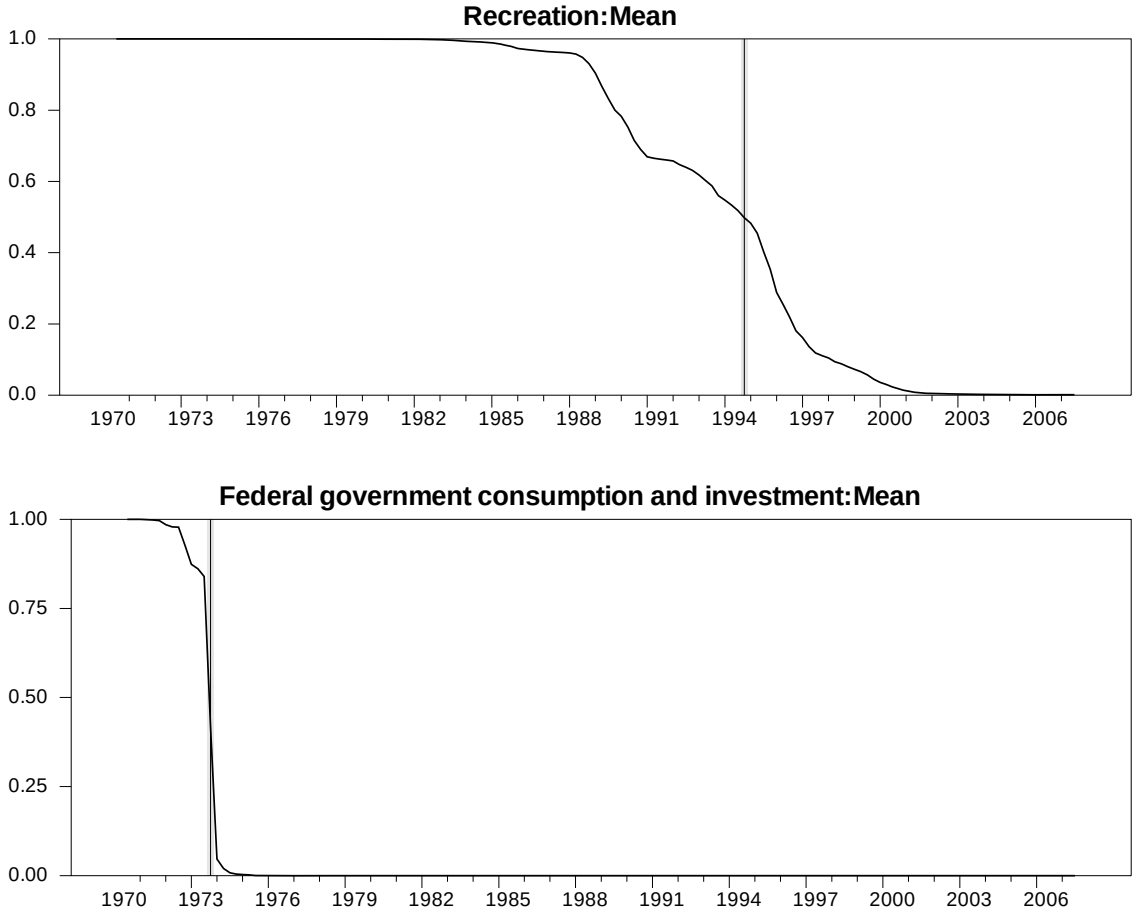
	Unrestricted Log-likelihood Value	**Restricted Log-likelihood Value**
Gross domestic product	-147.3623742	-147.41086
Personal consumption expenditures	-141.5674451	-141.56746
Durable goods	-381.3112658	-381.4497
Motor vehicles and parts	-477.8057976	-478.131
Furniture and household equip.	-270.5489411	-271.48137
Other	-322.591347	-322.60292
Nondurable goods	-142.1701714	-142.17482
Food	-164.7332098	-164.76498
Clothing and shoes	-258.3164506	-258.33358
Gasoline, fuel oil, & other energy	-291.4251886	-292.38313
Other	-180.6818348	-180.90091
Services	-74.4050109	-75.115389
Housing	-12.41799401	-13.372987
Household operation	-268.9904372	-269.76543
Electricity and gas	-375.5959836	-375.59598
Other household operation	-171.4656379	-171.74359
Transportation	-224.8275692	-224.85856
Medical care	-94.9255798	-95.810305
Recreation**	-177.72171	-179.86598
Other	-214.3886837	-214.5387
Gross private domestic investment	-423.6481177	-423.75662
Fixed investment	-295.4467233	-295.58012
Nonresidential	-304.3476994	-304.36147
Structures	-358.696457	-358.69646
Equipment and software	-329.5621341	-329.57796
Info. equipment and software	-341.4791797	-341.57135
Computers and equipment	-508.9778088	-508.97781
Software	-313.6427462	-313.64275
Other	-356.5895675	-356.58957
Industrial equipment	-346.0404487	-346.04045
Transportation equipment	-482.7958565	-482.79586
Other equipment	-395.2186568	-395.21866
Residential	-371.8408508	-372.16093
Change in Private Inventory	-689.59722	-689.58399
Exports	-347.1677205	-347.21518
Goods	-365.5873538	-365.61372
Services	-377.1960992	-377.20097
Imports	-347.6387228	-347.73055
Goods	-366.4705802	-366.54143
Services	-353.8767629	-355.45317

Govt. cons. and gross investment	-195.7969413	-195.79694
Federal**	-295.1510944	-299.01847
Nondefense	-360.630271	-360.74205
Consumption expenditures	-370.0748743	-370.14589
Gross investment	-449.1751851	-449.17519
National defense	-336.3753236	-336.37532
Consumption expenditures	-318.5495869	-318.54959
Gross investment**	-503.6393502	-513.5687
State and local	-169.566732	-170.03771
Consumption expenditures	-59.24651401	-60.55866
Gross investment	-385.1101152	-385.44368

Note: The restricted Markov regime-switching model only allows volatility to switch. The unrestricted model allows both mean and volatility to switch *separately*, i.e., they are not forced to switch at the same time. Different initial values are used to avoid local optimum. We compute the *LR* test statistics based on 2*(unrestricted log-likelihood value – restricted log-likelihood value) and note that such a test is non-standard (see, e.g., Davies(1977)). However, we report the 5% critical value of $\chi^2(1)$ to give a rough indication whether the null that only volatility switches is good enough to describe the data. Those series that have LR test statistics over 3.84 are marked with (**). Overall, the log-likelihood value improves very marginally for almost all series but three: Recreation, Federal government consumption and gross investment, and National defense gross investment. For the first two series, we do not find significant volatility break. Therefore, we only report the smoothed switching probability of their means in figures below. But for the National defense gross investment, we report the smoothed switching probability of both its mean and volatility in figures below. For the series Recreation, the mean break happens at 1994Q4, and after the break the average growth rate declined. For the series Federal government consumption and gross investment, the mean break happens at 1973Q4, and after the break the average growth rate increased. For the series National defense gross investment, the mean break happens at 1972Q4, and after the break the average growth rate increased; the volatility break happens at 1999Q2, and after the break the volatility declined.

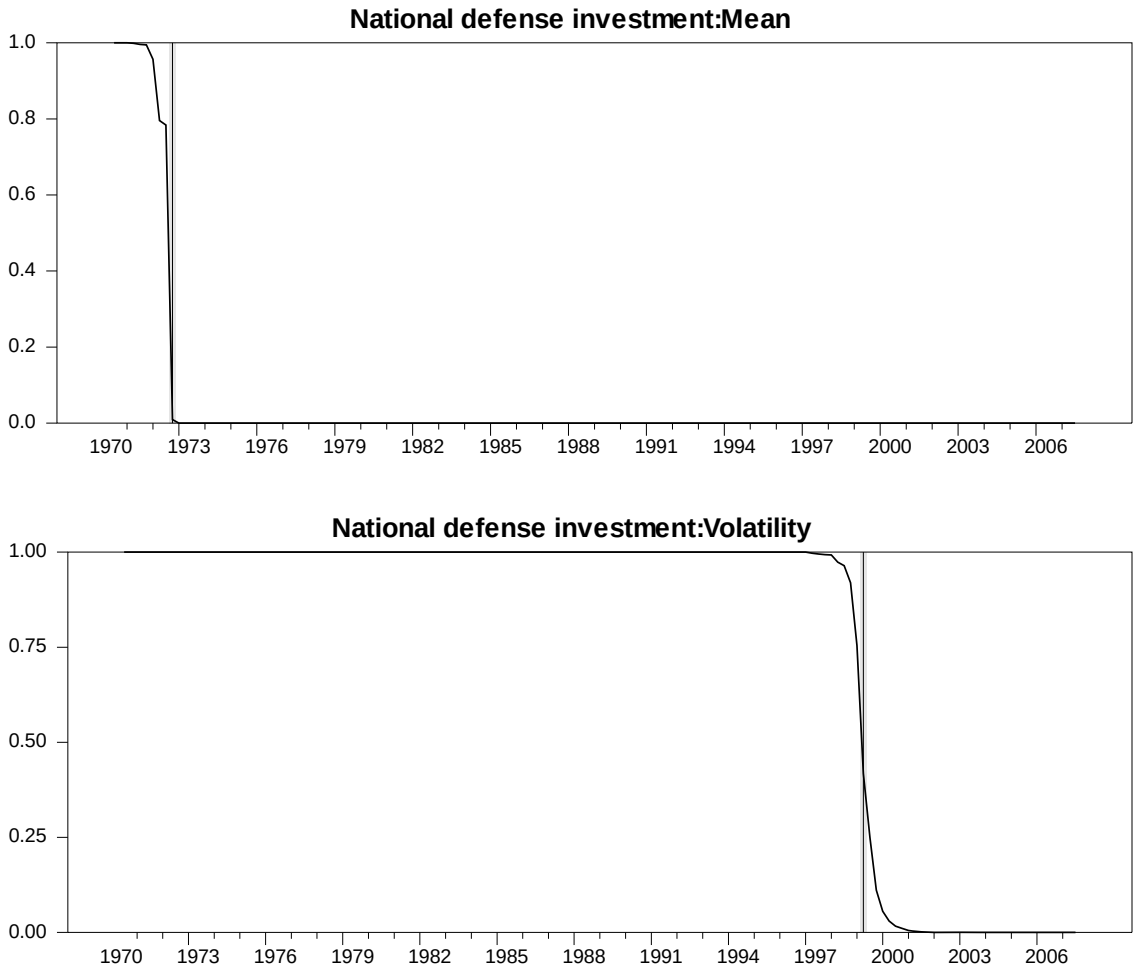
Davies, R. B. (1977): "Hypothesis testing when a nuisance parameter is present only under the alternative," *Biometrika*, 64, 247-254.

Figure A2: Smoothed Probability of Staying in the Initial Regime



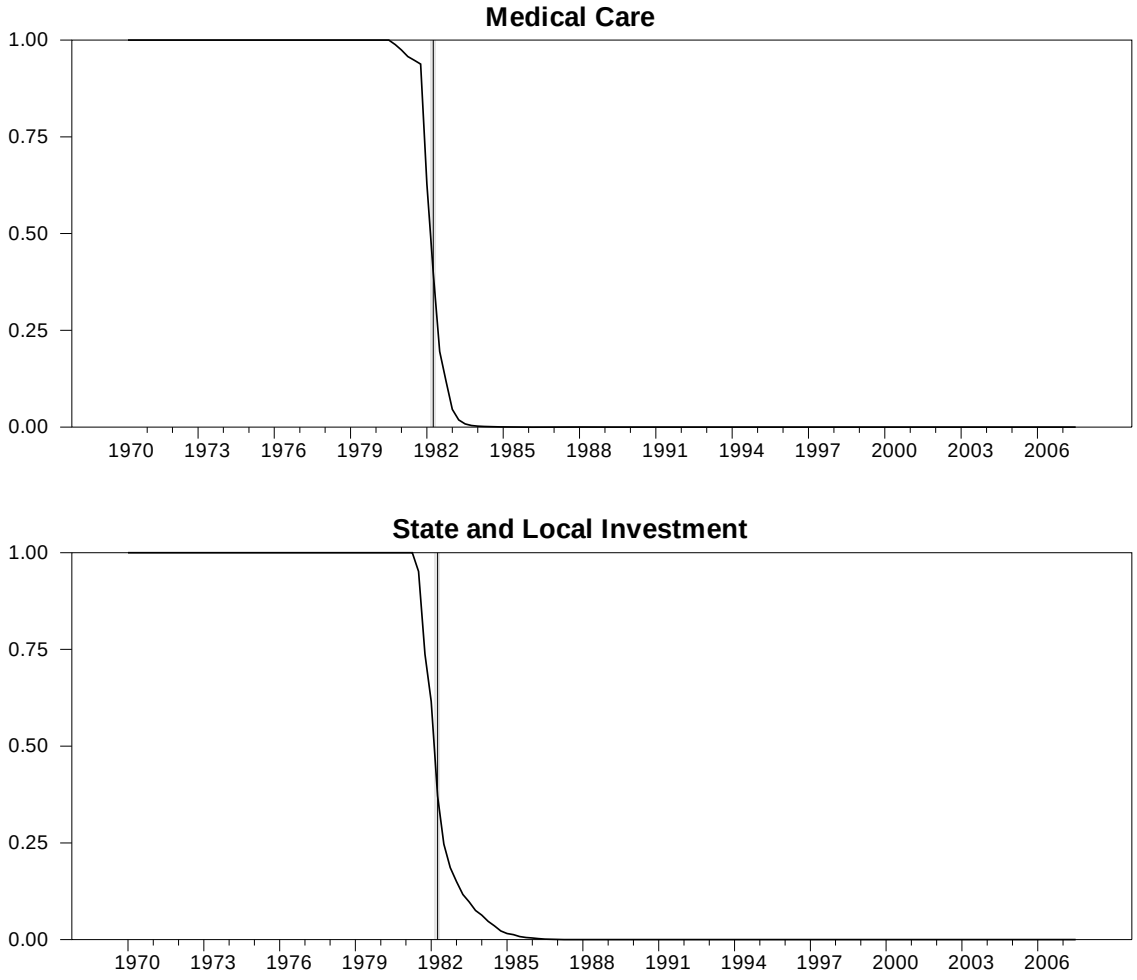
Note: The shaded gridline represents the first quarter in which the probability of staying in the initial regime drops below 0.5.

Figure A3: Smoothed Probability of Staying in the Initial Regime



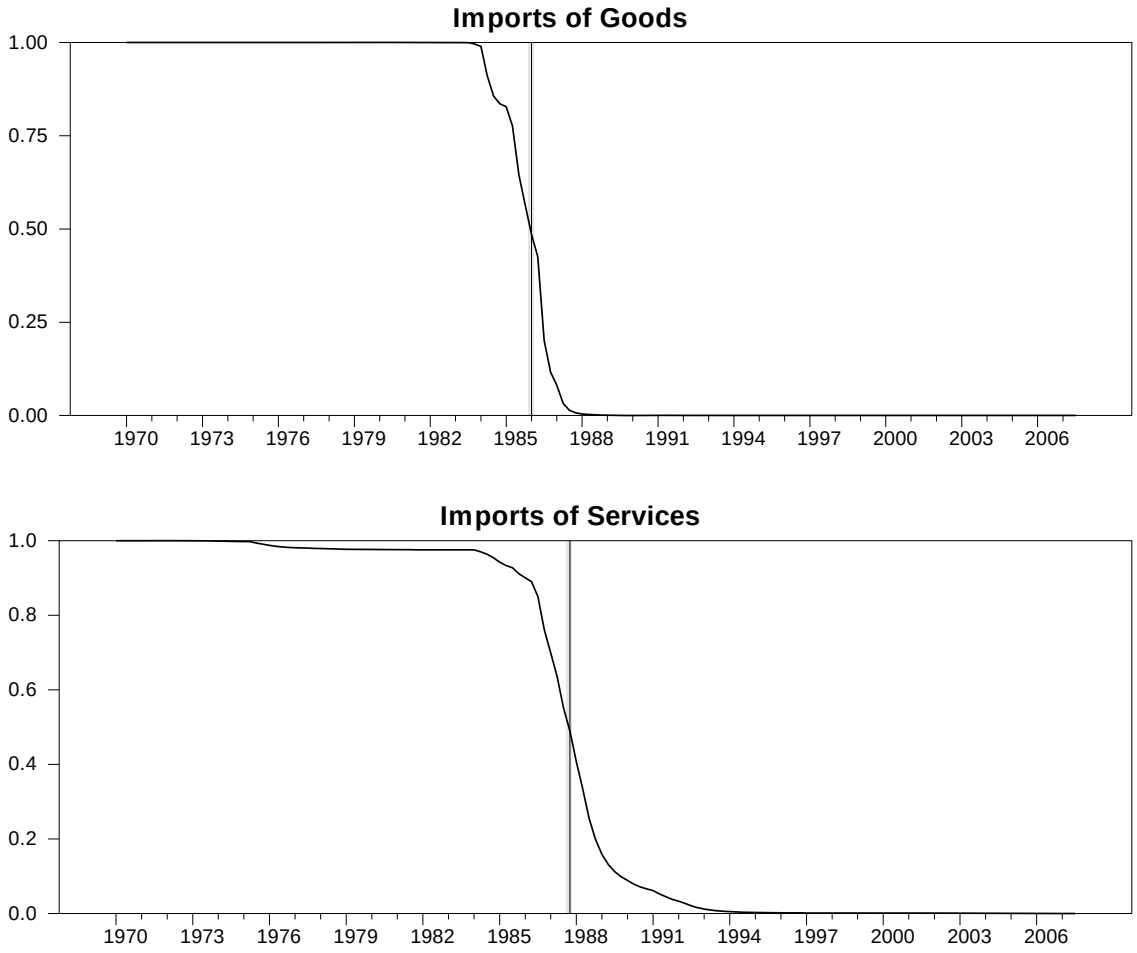
Note: The shaded gridline represents the first quarter in which the probability of staying in the initial regime drops below 0.5.

Figure A4: Smoothed Probability of Staying in the High Volatility Regime



Note: The shaded gridline represents the first quarter in which the probability of staying in the initial regime drops below 0.5.

Figure A5: Smoothed Probability of Staying in the High Volatility Regime



Note: The shaded gridline represents the first quarter in which the probability of staying in the initial regime drops below 0.5.

Also note that we report the smoothed switching probabilities of all sectors in the attached Excel file.