The Two Greatest. Great Moderation vs Great Recession

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Federal Reserve Bank of San Francisco

Where Danger Lurks

- "Where Danger Lurks", Olivier Blanchard, IMF Finance and Development (September, 2014)
- Until 2008, mainstream U.S. macroeconomics had a benign view of economic fluctuations in output and employment. The crisis has made it clear that this view was wrong and that there is a need for a deep reassessment.

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- From the early 1980s on, most advanced economies experienced what has been dubbed the "Great Moderation". Whatever caused the Great Moderation, for a quarter century the benign, linear view of fluctuations looked fine.
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- "Dark corners". Situations in which the economy could badly malfunction. We thought we were far away from those corners, and could for the most part ignore them.
- Measuring systemic risk, can be used to give warning signals that we are getting too close to dark corners, and that steps must be taken to reduce risk and increase distance.

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One lesson and one assumption

- Dark corners should be seen in advance and can be seen in advance. Early warning systems.
- Great Moderation is over (otherwise we would be still fooled). Thanks to its end, we can observe the dark corners
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Searching for dark corners

1. Early warning systems.
   - "The failure to predict the Great Recession. The failure of Academic Economics? A view through the role of credit" (Gadea and Perez-Quiros, JEEA 2014)
2. Great Moderation is over
   - "Great Moderation and Great Recession: From plain sailing to stormy seas?" (Gadea, Gomez-Loscos and Perez-Quiros, Documento de Trabajo Banco de España, 1423, Working Paper CEPR DP10092)
   - The Great Moderation in historical perspective. Is it that great? (Gadea, Gomez-Loscos and Perez-Quiros)

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Outline

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Searching for dark corners

- IMF Global Financial Stability Report. September 2011
- "Credit to GDP growth is a particularly reliable indicator of recession when the experiences of both advanced and emerging economies are considered together"

Searching for dark corners

Why nobody saw the credit crunch coming? LSE, Nov 2008

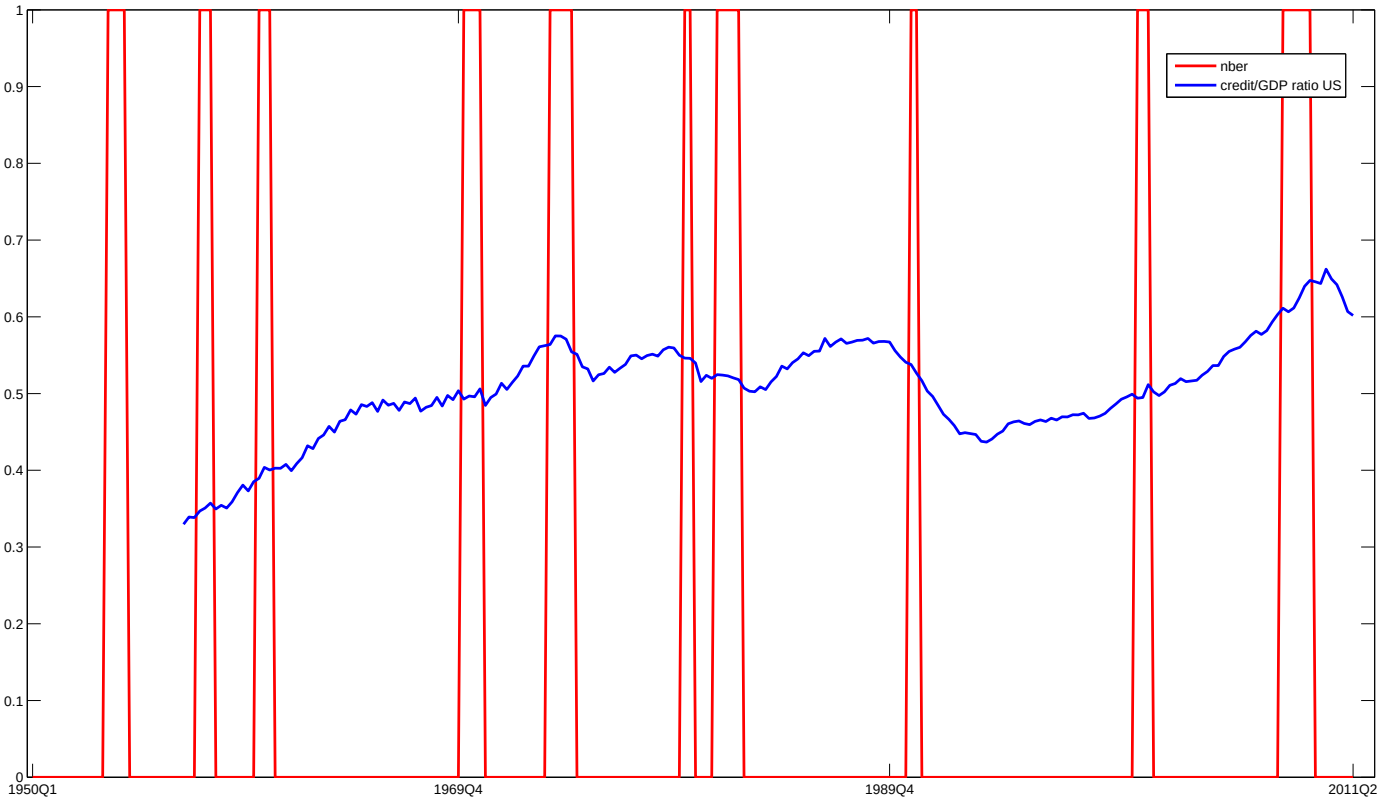
Why nobody saw the credit crunch coming?

The failure of economists to foresee the Great Recession has been globally commented... and has been widely criticized

- Olivier Blanchard (2014). Fooling of the Great Moderation
- Paul Krugman (2009) "Profession blindness to the possibility of catastrophic failures in the market economy"
- Colander et al (2009) "Misallocation of research efforts in economics"..."an insistence on constructing models that disregard the key elements driving output in the real world"
- Smets and Wouter (2007) and others do not incorporate any financial accelerator mechanism

Credit to GDP. Reliable indicator of recessions

IMF Global Financial Stability Report (September, 2011)



Credit to GDP. Reliable indicator of recessions

- IMF Global Financial Stability Report. September 2011
  - Kaminsky y Reinhart (1999)
  - Alesi and Detken (2009)
  - Jorda et al (2011)
  - Gourinchas and Obsfeld (2011)
    - Logit model
  - Terrones and Mendoza (2011)
    - Threshold models

Credit to GDP. Reliable indicator of recessions

- These papers are so clear that economists must have been blind not to see the crisis coming.
- More importantly, they have dramatically changed the way in which monetary policy is conducted because they all indicate that price stability does not guarantee macroeconomic stability and that monetary policy should coordinate with macroprudential policy. The combination of these two policies by controlling financial imbalances, should reach a new objective, financial stability (IMF 2013 and FSB, IMF and BIS 2011).

Credit to GDP. Reliable indicator of recessions

- Stylized facts
  - GREAT PAPERS but badly read by policymakers
  - They provide considerable evidence that financial markets, credit in particular, play an important role in shaping the economic cycle, in the probability of financial crises, in the intensity of recessions and in the rhythm of recoveries

Credit to GDP. Reliable indicator of recessions

- Econometric approach
  - All of them consider that recessions are known a priori, either by using historical records or by pinpointing them with non-parametric techniques
  - Crises are usually treated as exogenous to the model and the behaviour of some financial and macroeconomic variables are analysed in their environment

Credit to GDP. Reliable indicator of recessions? Some caveats

Standard analytical approach

$$Z_{ti} = \alpha + \beta Y_{ti} + \gamma X_{ti} + \epsilon it \tag{1}$$

where

- Z_{ti} is a dummy that takes value of 1 if there is a recession in period $t + i$, where i=1,2,3
- Y_{ti} is the credit to GDP ratio
- X_{ti} are the control variables
- β is positive and significant in a logit model and that is evidence that credit is a reliable indicator of recession

Credit to GDP. Reliable indicator of recessions? Some caveats

Four main concerns

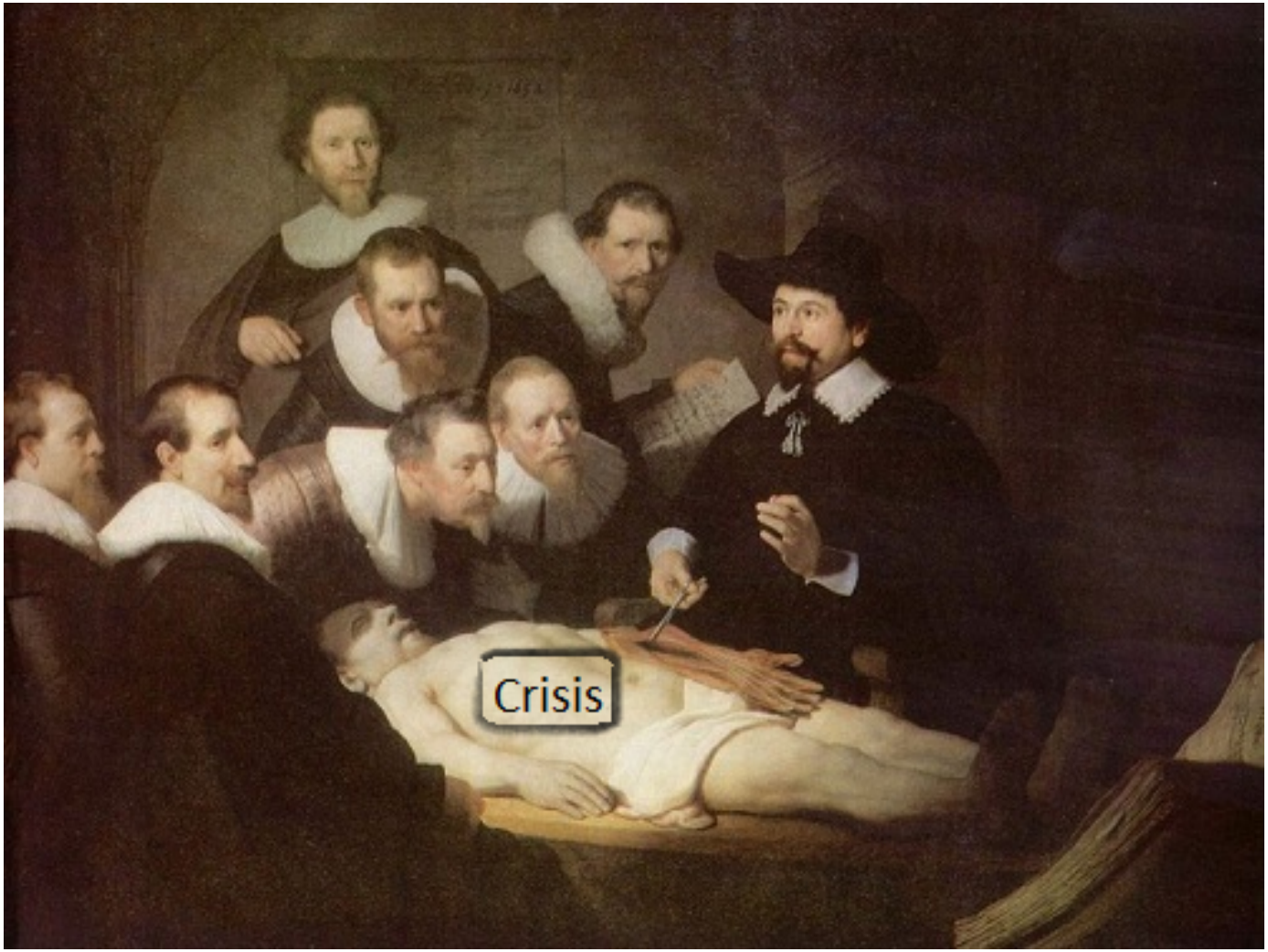
1. Uncertainty
2. Cumulation effect of credit
3. Endogeneity
4. Financial crises, real crises and the Great Recession

Credit to GDP. Reliable indicator of recessions? Some caveats

1. Uncertainty of the recession periods
   - The results are only descriptive. Basically, the previous literature is more interested in the "anatomy" of financial crises, once these have occurred, than in "clinical medicine", that is, diagnosis from the symptoms
   - This literature is not designed to make inference.

Anatomy of the crisis

Forensic medicine

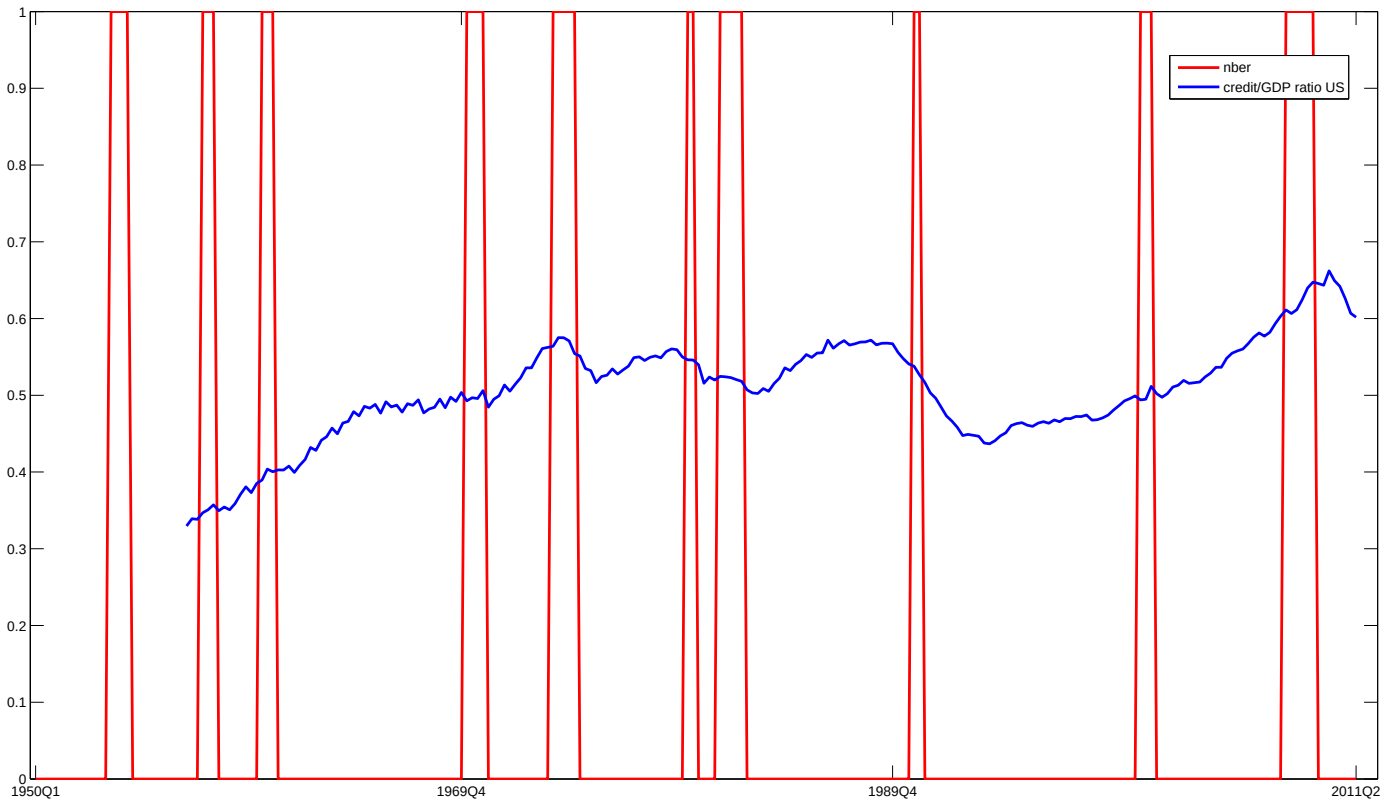


Symptons of the Crisis

Clinical medicine

Credit to GDP. Reliable indicator of recessions? Some caveats

2. Cumulation effect of credit



Credit to GDP. Reliable indicator of recessions? Some caveats

2. Cumulation effect of credit
   - Credit is a variable that increases during expansion periods
   - Credit to GDP accumulates over time endogenously in different theoretical models, as in Gertler and Karadi (2011), Gertler and Kiyotaki (2010), Christiano, Motto and Rostagno (2010) or Nuño and Thomas (2012), and, therefore, it is endogenously high when the expansions are long
   - But does this behaviour...imply any predictive power of this ratio on the turning points?

Credit to GDP. Reliable indicator of recessions? Some caveats

TABLE 1

REGRESSION ON TRENDING EXPANSIONS

	β	t_ratio
US DATA		
ratio	0.0010	3.8428
variation in ratio	0.0087	2.6282
credit intensity	0.0147	2.2028
OECD 39 COUNTRIES		
ratio	0.0530	17.0298
variation in ratio	0.0224	8.9129
credit intensity	0.0210	5.1895
JORDÁ ET AL. (2011)'S DATA		
ratio	0.0030	6.2066
variation in ratio	0.0259	4.1160
credit intensity	0.0444	3.0135

Credit to GDP. Reliable indicator of recessions? Some caveats

3. Endogeneity
   - In the literature, crises, both their location and their typology, are treated as exogenous variables
   - In the definition of turning points, credit is one of the variables which is considered
   - A fall in credit in period "$t, t+1....t+k$" contributes to the definition of a turning point in period "t"
   - Credit is strongly autocorrelated

$$z_t = \alpha + \beta * credit_t + \epsilon_t$$

   - Then $E(\epsilon_t, credit_t) \neq 0$ and, therefore, β is upwardly-biased and no conclusions can be drawn from its estimation

Credit to GDP. Reliable indicator of recessions? Some caveats

4. Financial, real crisis and the Great Recession
   a) For the sample of 39 OECD countries, between 1950.q1 and 2011.q2, we identify 149 recession periods. Out of these, only 45 coincide financial crises documented by Gourinchas and Obstfeld (2011), and 31 of them correspond to the recent crisis
   b) For this sample Gourinchas and Obstfeld (2011) identify 143 financial crises, of which only 45 correspond to a real crisis
   c) Eliminating the last 31 recent crises out of the 230 financial or real crises (143-31 financial, 149-31 real), we find that only 14 cases (6%) are both financial and real

Credit to GDP. Reliable indicator of recessions? CONCLUSIONS

Previous literature is not design to make inference. If we read those papers properly, you do not have tools to provide the policymakers the rules that they are demanding. Because they do not want to be blindfolded when looking at credit

A policymaker looking at credit

Credit (which should be?). The relevant question

- Does the level of credit to GDP (or its variation) observed in period "t" increase the probability of being in a recession in "$t+1$"?
- Does that level affect the characteristics of future cyclical phases?
- If the answer to this questions is YES...credit is a variable to control...otherwise, the policymakers could cut good and healthy expansions in order to avoid a not-forthcoming recession...

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- If the answer to this questions is YES...credit is a variable to control...otherwise, the policymakers could cut good and healthy expansions in order to avoid a not-forthcoming recession...as they have done with the level of debt and future growth

Credit. Providing solutions

- We need a methodology that does not just describe the past.
- We need to provide a tool that allows policymakers to infer, in real time, future probabilities of recession (or characteristics of the cycles).
- Credit will matter if, when we include this variable in our analysis, it changes the inferences about the future in a statistically significant way

Credit. Providing solutions

On standard method very successful in the literature of business cycle to infer in real time the probability of recessions is the estimation of Markov Switching models (Hamilton, 1989)

$$dy_{ti} = \mu_{S_j} + \epsilon_{ti} \tag{2}$$

where μ_{S_j} is the vector of Markov switching intercepts $\epsilon_{tc}|_{S_j} \sim N(0, \sigma_{S_j})$.

$$dy_{ti} = \mu_1 + \epsilon_{ti} \text{ for state 1} \tag{3}$$

$$dy_{ti} = \mu_2 + \epsilon_{ti} \text{ for state 2} \tag{4}$$

$$P(S_t = j|S_{t-1} = i, \Omega_{t-1}) = P(S_t = j|S_{t-1} = i) = \begin{bmatrix} p_{11} & \dots & p_{1m} \\ \dots & \dots & \dots \\ p_{m1} & \dots & p_{mm} \end{bmatrix} \tag{5}$$

where p_{ij} controls the probability of a switch from state j to state i.

Credit. Providing solutions

- This is definitely better methodology than a logit with credit in sample. Because the Root Mean Squared Error of the forecast:

TABLE 5. Credit Performance with Logit Model.

	Logit	GM	GM_prob_credit
		In sample	
QPS	0.12	0.08	0.08
		Out-of-sample	
FQPS	0.14	0.11	0.12
DM test		5.80 (0.000)	4.31 (0.000)

Credit. Providing solutions

- An alternative model, where credit matters would be: Credit can affect the dynamics of the business cycle by modifying :
  1. the means of the states, μ_1 and μ_2

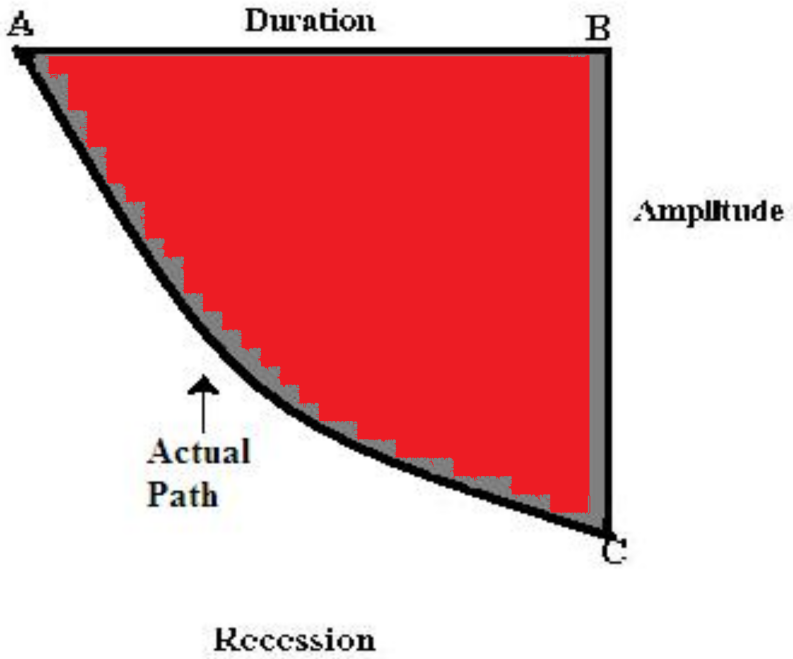
$$\begin{aligned} d\widetilde{Y}_t &= \mu_1 + \alpha_1 * CR_{t-1} + \epsilon_i \text{ for state i=1} \\ d\widetilde{Y}_t &= \mu_2 + \alpha_2 * CR_{k,t-1} + \epsilon_i \text{ for state i=2} \\ \mu_{1t} &= \mu_1 + \alpha_1 * CR_{t-1} \\ \mu_{2t} &= \mu_2 + \alpha_2 * CR_{t-1} \end{aligned} \tag{6}$$

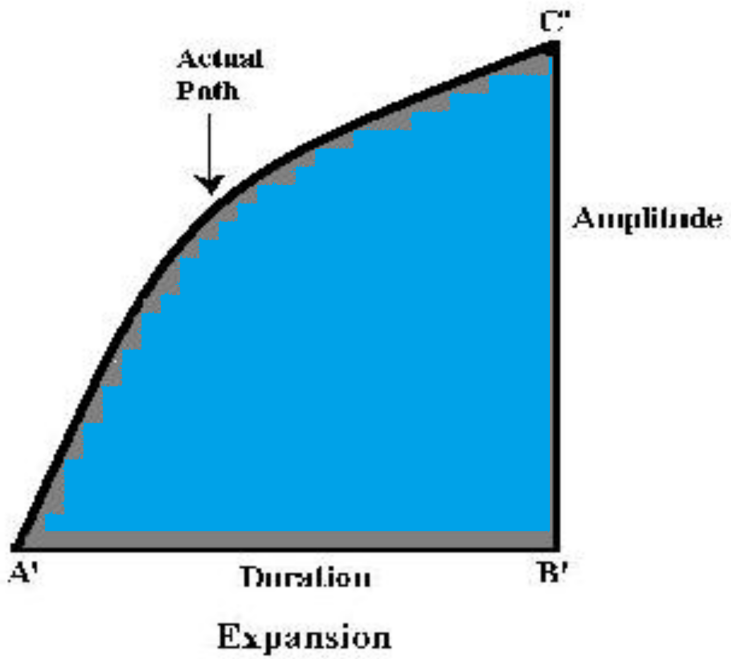
  2. the transition probabilities, p and q.

$$\begin{aligned} \Pr(St &= j/S_{t-1} = i, \Omega_{t-1}) = f/CR_{t-1}) \\ \Pr(St &= 1/S_{t-1} = 1, \Omega_{t-1}) = p + \delta_1 CR_{t-1} \\ \Pr(St &= 0/S_{t-1} = 0, \Omega_{t-1}) = q + \delta_2 CR_{t-1} \\ p_t &= p + \delta_1 * CR_{t-1} \\ q_t &= q + \delta_1 * CR_{t-1} \end{aligned} \tag{7}$$

Credit. Providing solutions

Some implications of the two models:
μ_1, μ_2, p and q contain all the information on the main business cycle characteristics, amplitude, duration, cumulation and excess (Harding and Pagan, 2002)





Credit. Providing solutions

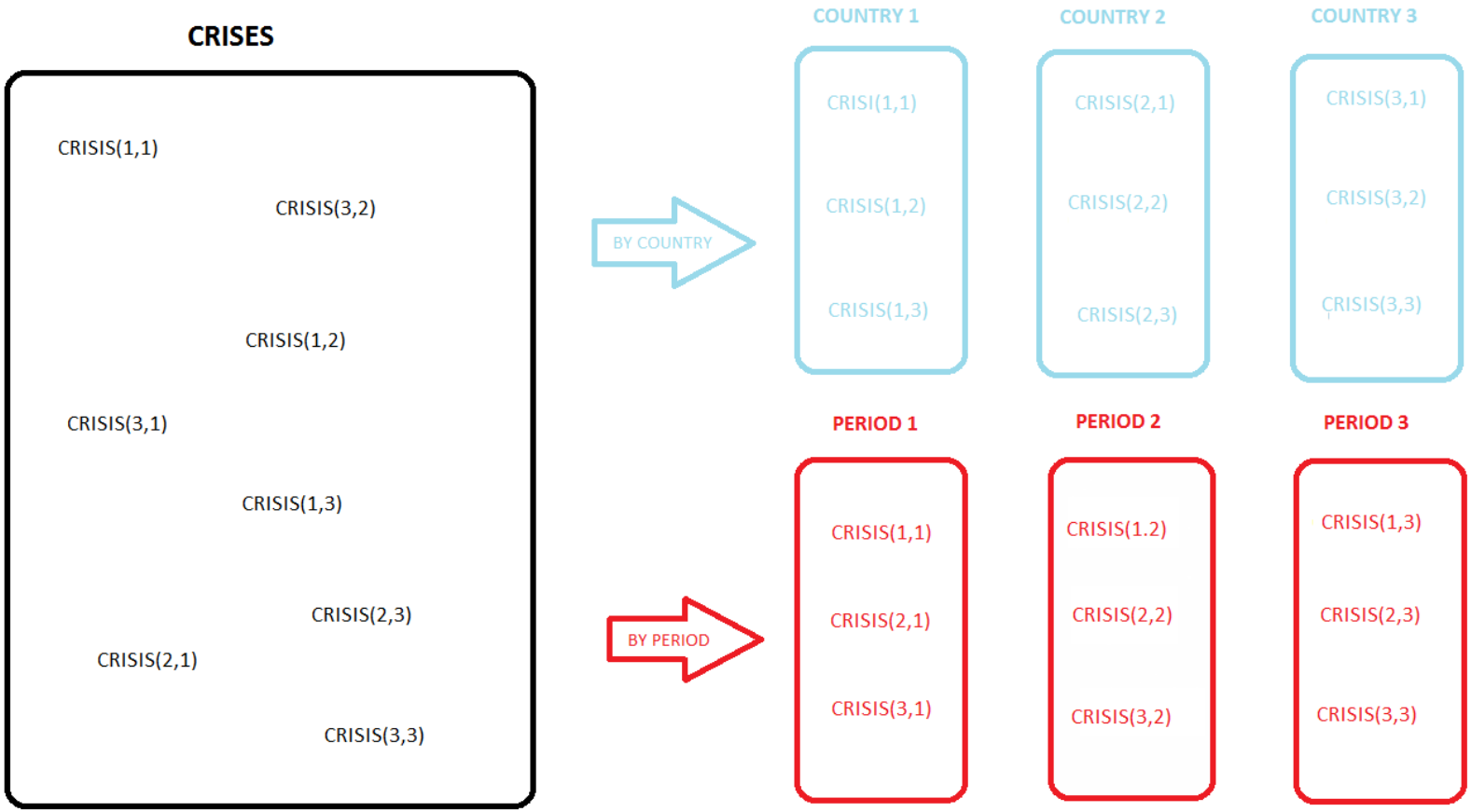
TABLE 2
MS MODEL ESTIMATION

	μ_1	μ_2	σ^2	p	q		μ_1	μ_2	σ^2	p	q
AG	1.84 (0.21)	−1.41 (0.40)	1.69 (0.33)	0.95 (0.02)	0.84 (0.08)	IS	1.30 (0.15)	−0.19 (0.27)	0.62 (0.15)	0.94 (0.03)	0.77 (0.13)
AU	0.95 (0.08)	−0.33 (0.60)	1.12 (0.13)	0.98 (0.01)	0.60 (0.25)	IT	1.64 (0.13)	0.28 (0.07	0.59 (0.07)	0.87 (0.05)	0.95 (0.01)
BD	0.70 (0.06)	−2.96 (0.26)	1.00 (0.11)	0.98 (0.00)	0.23 (0.23)	JP	2.26 (0.02)	0.57 (0.09	1.24 (0.13)	0.99 (0.00)	0.99 (0.00)
BG	1.17 (0.07)	0.33 (0.06)	0.24 (0.03)	0.91 (0.03)	0.94 (0.02)	LX	1.20 (0.24)	−2.26 (0.07)	2.69 (0.63)	0.95 (0.02)	0.46 (0.31)
BR	1.02 (0.18)	−3.31 (0.79)	2.03 (0.40)	0.94 (0.02)	0.29 (0.24)	MX	1.08 (0.07)	−5.90 (0.61)	1.08 (0.11)	0.99 (0.01)	0.33 (0.27)
CL	1.57 (0.14)	−1.11 (0.62)	1.55 (0.27)	0.96 (0.01)	0.55 (0.21)	NL	0.69 (0.08)	−2.43 (0.50)	0.75 (0.11)	0.96 (0.01)	0.19 (0.23)
CN	0.97 (0.06)	−0.50 (0.31)	0.56 (0.06)	0.98 (0.00)	0.79 (0.10)	OE	0.78 (0.06)	−2.07 (0.52)	0.79 (0.08)	0.99 (0.00)	0.43 (0.26)
CZ	0.83 (0.14)	−1.31 (1.00)	0.71 (0.15)	0.97 (0.00)	0.58 (0.33)	PT	1.42 (0.07)	0.01 (0.09)	0.48 (0.06)	0.96 (0.01)	0.94 (0.02)
DK	0.52 (0.14)	−1.51 (0.77)	1.32 (0.23)	0.98 (0.00)	0.71 (0.24)	RS	1.59 (0.20)	−3.06 (0.70)	1.10 (0.29)	0.97 (0.01)	0.69 (0.23)
EO	1.53 (0.20)	−4.31 (0.87)	2.51 (0.47)	0.97 (0.00)	0.64 (0.20)	SA	1.09 (0.09)	−0.27 (0.22)	0.84 (0.11)	0.95 (0.02)	0.81 (0.07)
ES	0.91 (0.05)	−0.04 (0.10)	0.21 (0.03)	0.97 (0.00)	0.91 (0.04)	SD	0.73 (0.09)	−3.59 (0.82)	1.48 (0.16)	0.99 (0.00)	0.25 (0.25)
FN	1.00 (0.10)	−1.98 (0.40)	1.51 (0.18)	0.97 (0.00)	0.66 (0.14)	SJ	0.96 (0.09)	−4.80 (0.49)	0.47 (0.09)	0.98 (0.00)	0.49 (0.35)
FR	1.33 (0.08)	0.40 (0.07)	0.33 (0.04)	0.96 (0.01)	0.97 (0.00)	SW	0.62 (0.07)	−1.93 (0.54)	0.99 (0.10)	0.99 (0.01)	0.77 (0.18)
GR	2.18 (0.14)	0.32 (0.09)	0.88 (0.10)	0.93 (0.03)	0.97 (0.00)	TK	1.44 (0.25)	−5.43 (1.04)	2.81 (0.59)	0.95 (0.01)	0.43 (0.26)
HN	0.76 (0.07)	−1.67 (0.28)	0.31 (0.06)	0.98 (0.00)	0.79 (0.16)	UK	0.73 (0.07)	−1.05 (0.36)	0.79 (0.09)	0.97 (0.00)	0.65 (0.15)
ID	1.40 (0.13)	−8.08 (0.84)	1.42 (0.23)	0.99 (0.01)	0.49 (0.35)	US	1.01 (0.07)	−0.54 (0.29)	0.65 (0.07)	0.95 (0.01)	0.69 (0.11)
IR	1.19 (0.09)	−1.56 (0.61)	1.43 (0.15)	0.99 (0.00)	0.86 (0.11)	**Mean**	1.16 (0.11)	−1.87 (0.48)	1.10 (0.17)	0.96 (0.01)	0.66 (0.17)

Credit. Providing solutions

- The main problem is that we only have a few recessions in the sample for each country (8 at most...which imply those huge standard errors.
- We would like to pool the information in a panel when we will have different recessions for different countries...but that is definitely mixing apples and orange...isn´t it?

Credit. Providing solutions



Credit. Providing solutions

We test this hypothesis more formally in two ways:

1. We apply the Kruskal-Wallis test that compares samples from two or more groups and tests the null hypothesis that all samples are drawn from the same populations
2. We mix the features of all the recessions, make clusters with similar characteristics and analyse the concentration of periods and countries in each cluster using the Herfhindal index

Credit. Providing solutions

TABLE 3

KRUSKAL-WALLIS TEST

	DURATION	AMPLITUDE	CUMULATION	EXCESS
By country	29.09	42.85	38.35	41.97
	(0.6146)	(0.0953)	(0.2035)	(0.117)
By periods	50.39	64.62	59.08	43.40
	(0.0082)	(0.0002)	(0.0008)	(0.0418)

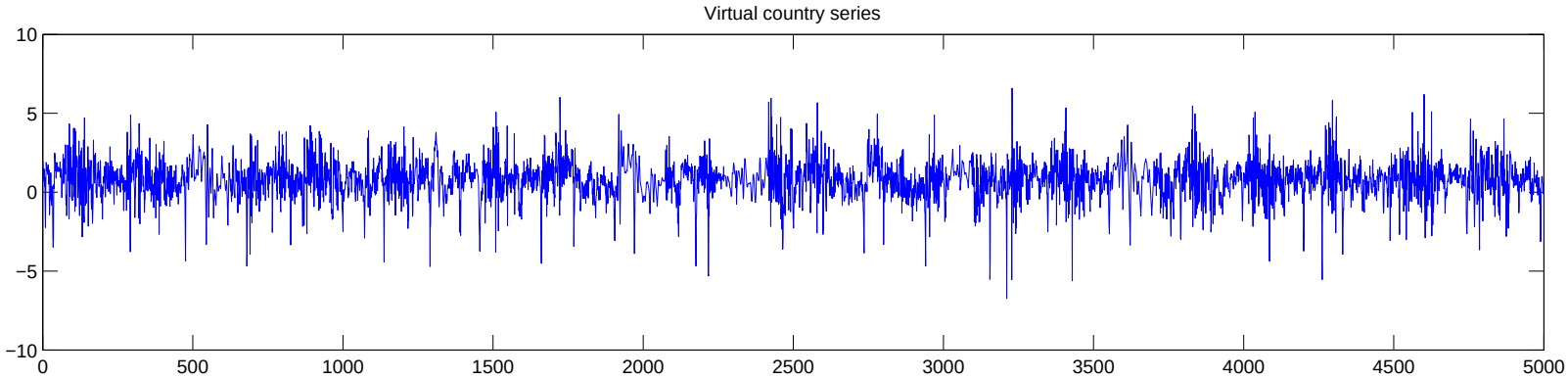
Credit. Providing solutions

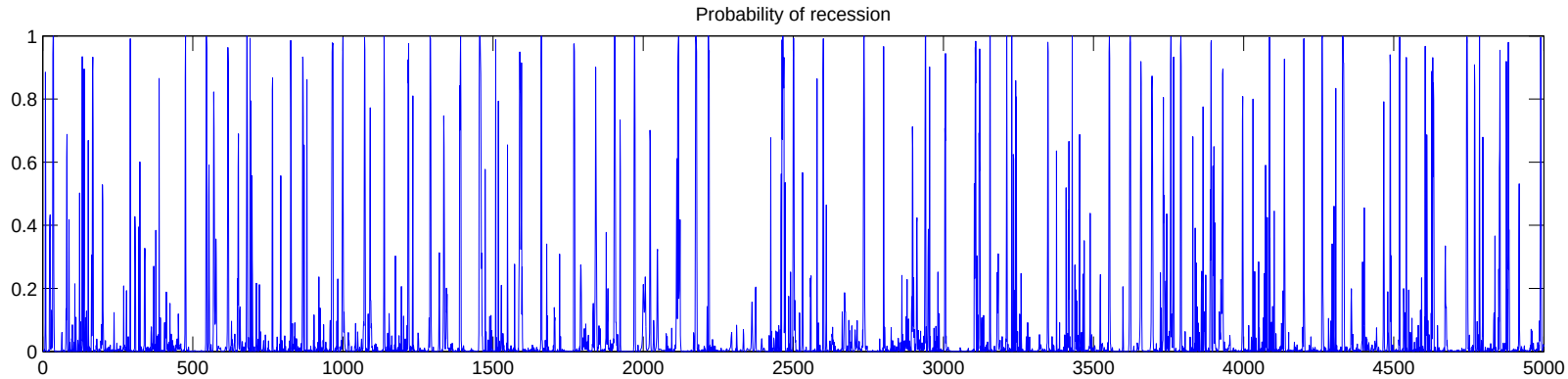
- We know that there is information in combining the evidence form different countries

$$Y = (Y_{1t}, Y_{2t}, ..., Y_{Nt}) \tag{8}$$

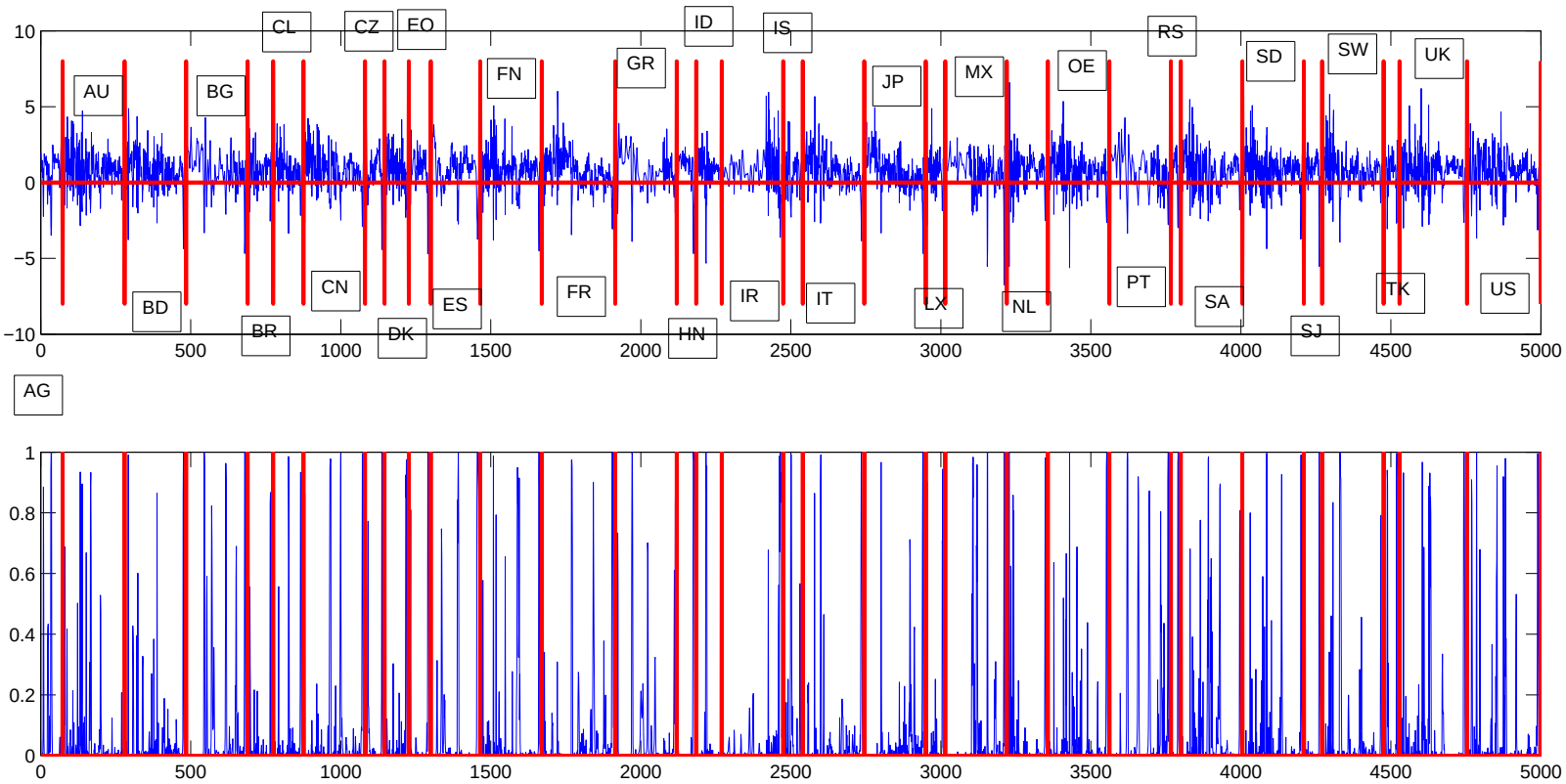
- Where Y_{it} is the normalized growth rate of country i

30-countries GDP growth





30-countries GDP growth



Credit. Providing solutions

TABLE 5

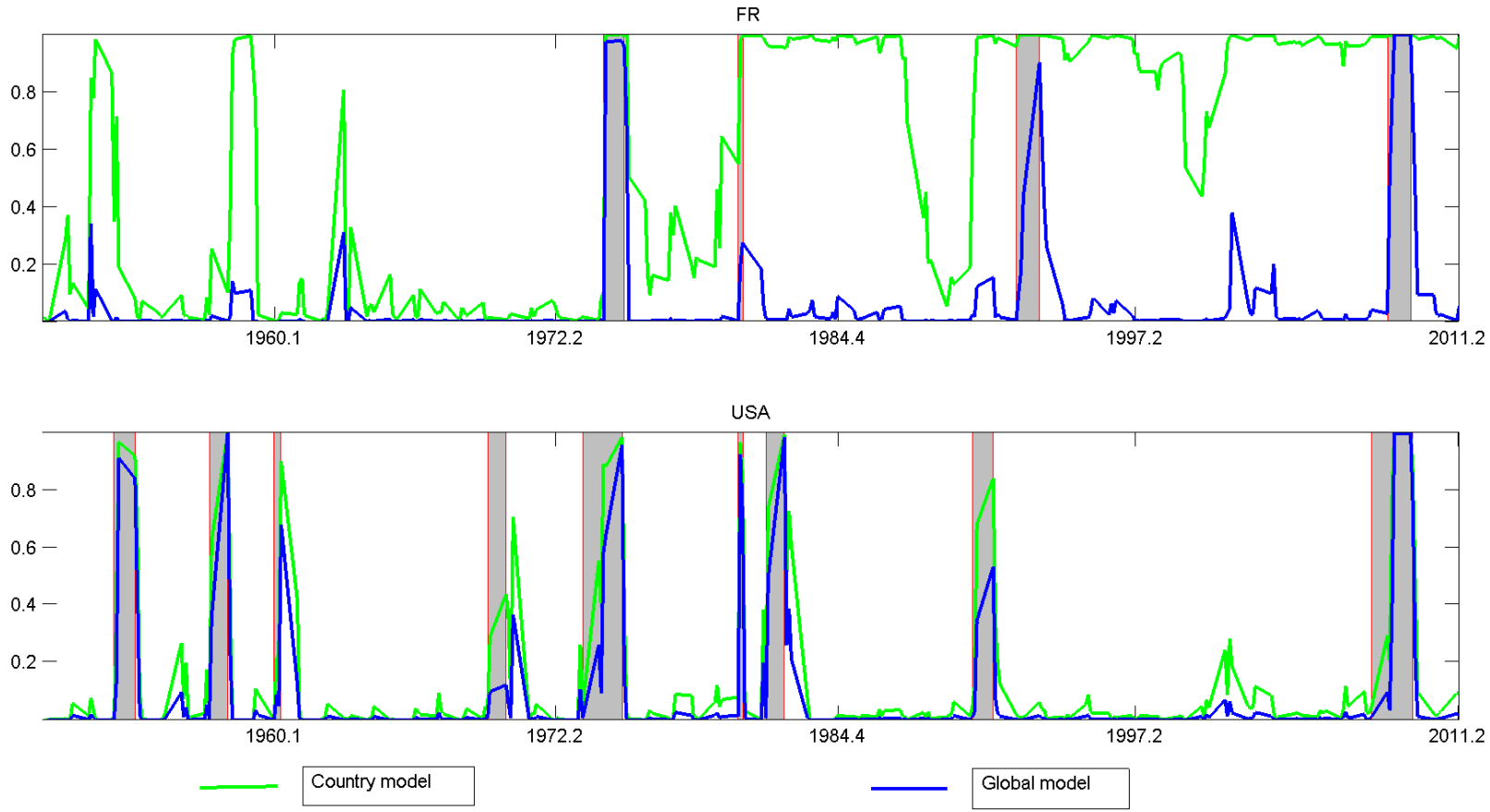
GLOBAL MODEL ESTIMATION

μ_1	μ_2	σ^2	p	q	δ_1	δ_2
MS MODEL						
0.97 (0.018)	−1.46 (0.122)	1.09 (0.025)	0.97 (0.001)	0.65 (0.035)		

Credit. Providing solutions

- We compare the forecast that we obtain with the country model (CM) with the result of using the global model (GM) forecast details
- As our benchmark model representing the true state of the business cycle, we use the results of applying the BB algorithm
- We apply the Diebold and Mariano (1995) test for predictive ability (DM)
- Probabilities of recession estimated with the global model match the BB states better than country estimates The results of the DM test show that this difference is significant when we compare the CM with GM (9.16) with a pvalue of 0.000.
- Bayesian interpretation of the analysis

Credit. Providing solutions



Credit. Providing solutions

- Comovements?
- Our model:

$$d\widetilde{y}_{t,c} = \mu_{S_{t,c}} + \epsilon_{t,c} \tag{9}$$

- Taking into account comovements of the shocks

$$d\widetilde{y}_{t,c} = \mu_{S_{t,c}} + \lambda F_t + \epsilon_{t,c} \tag{10}$$

- Where F_t represents time varying comovements of the shocks Stock and Watson (2002) and Pesaran (2008)
- Correlation of 0.92 of the probabilities estimated with and without comovements.

Credit. Final analysis

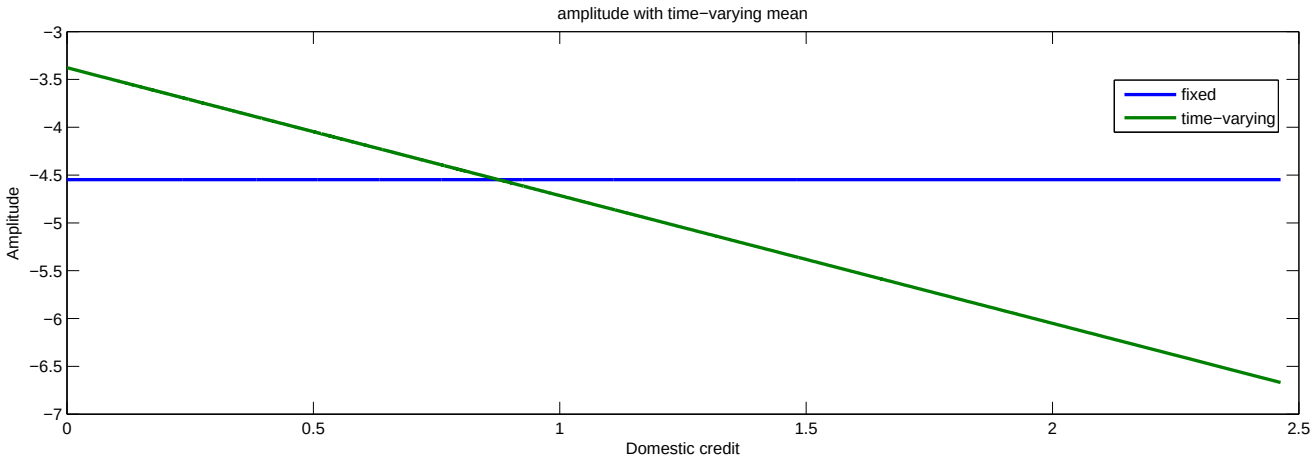
We introduce credit in the global model

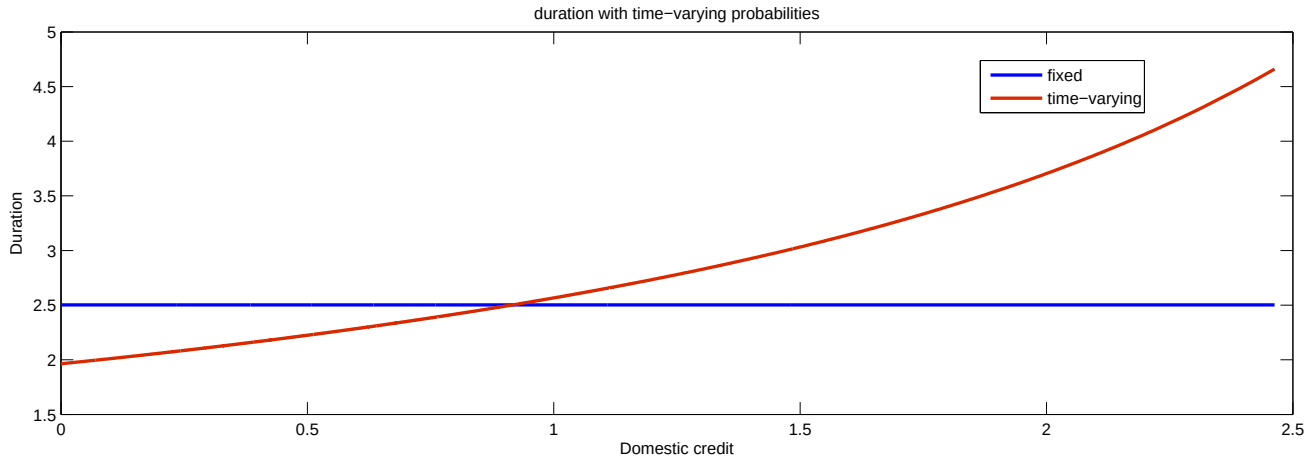
TABLE 8

μ_1	μ_2	σ^2	p	q	δ_1	δ_2	α_1	α_2	θ
MS MODEL WITH FIXED MEANS AND PROBABILITIES									
0.87 (0.02)	−1.84 (0.11)	1.01 (0.03)	0.97 (0.00)	0.60 (0.04)					
MS MODEL WITH FIXED PROBABILITIES AND TIME-VARYING MEANS									
1.15 (0.04)	−1.41 (0.19)	0.99 (0.03)	0.97 (0.00)	0.60 (0.04)			−0.37 (0.04)	−0.50 (0.22)	
MS MODEL WITH FIXED MEANS AND TIME-VARYING PROBABILITIES									
0.87 (0.02)	−1.84 (0.12)	1.01 (0.03)	0.97 (0.00)	0.50 (0.07)	−0.04 (0.00)	0.11 (0.06)			
MS MODEL WITH TIME-VARYING MEANS AND PROBABILITIES									
1.17 (0.03)	−1.26 (0.18)	0.99 (0.03)	0.96 (0.00)	0.55 (0.07)	0.02 (0.00)	0.06 (0.08)	−0.40 (0.04)	−0.73 (0.21)	
MS MODEL WITH DURATION DEPENDENCE									
0.87 (0.02)	−1.81 (0.19)	1.02 (0.04)	0.97 (0.00)	0.69 (0.04)					−0.09 (0.04)
MS MODEL WITH DURATION DEPENDENCE AND TIME-VARYING MEANS									
1.16 (0.01)	−1.28 (0.10)	0.99 (0.02)	0.97 (0.00)	0.69 (0.04)			−0.39 (0.02)	−0.65 (0.08)	−0.09 (0.04)

Credit. Final analysis

We introduce credit in the global model





Credit. Final analysis

Out of sample. Probability Recession

	GM	GM_credit_μ	GM_credit_prob	GM_dd	GM_dd_credit_μ
GM		FQPS1=0.1110 FQPS2=0.1140 DM_test=-1.4507 (0.2786)	FQPS1=0.1110 FQPS2=0.1168 DM_test=-2.6116 (0.0264)	FQPS1=0.1110 FQPS2=0.1058 DM_test=3.7780 (0.0006)	FQPS1=0.1110 FQPS2=0.1068 DM_test=2.1192 (0.0845)
GM_credit_μ			FQPS1=0.1140 FQPS2=0.1168 DM_test=-0.7690 (0.5933)	FQPS1=0.1140 FQPS2=0.1058 DM_test=3.5593 (0.0004)	FQPS1=0.1140 FQPS2=0.1068 DM_test=5.3019 (0.0000)
GM_credit_prob				FQPS1=0.1168 FQPS2=0.1058 DM_test=4.4121 (0.0000)	FQPS1=0.1168 FQPS2=0.1068 DM_test=2.7186 (0.0198)
GM_dd					FQPS1=0.1058 FQPS2=0.1068 DM_test=0.5499 (0.6859)
GM_dd_credit_μ					

Notes: The first value corresponds with rows and the second with columns. The third values display the Diabold and Mariano test and its associated p-values of the null hypotheiss that the predictive performance of model in row and model in column is equal.

Credit. Final analysis

Our of sample. Probability Recession and other characteristics

TABLE A0.4

FORECASTING BUSINESS CYCLE CHARACTERISTICS

	GM	GM_credit_μ	GM_credit_*prob*	GM_dd	GM_dd_credit_μ
FQPS	0.11	0.11	0.11	0.11	0.11
FQPS at turning points (1,2.period, total)	0.45	0.44	0.44	0.43	0.43
MSE duration recessions at first point	9.84	10.36	11.14	8.74	9.23
MSE amplitude recessions at first point	20.47	22.60	21.47	19.52	20.69
MSE cumulation recessions at first point	494.14	505.78	511.65	473.72	482.92

Credit. Final analysis

TABLE 3

GLOBAL MODEL ESTIMATION

μ_1	μ_2	σ^2	p	q	δ_1	δ_2	α_1	α_2	θ
MS MODEL WITH FIXED MEANS AND PROBABILITIES (FULL SAMPLE)									
0.97 (0.019)	−1.46 (0.122)	1.09 (0.025)	0.97 (0.001)	0.65 (0.035)					
MS MODEL WITH FIXED MEANS AND PROBABILITIES (SAMPLE RESTRICTED TO CREDIT DATA)									
0.87 (0.019)	−1.84 (0.112)	1.01 (0.026)	0.97 (0.010)	0.60 (0.038)					
MS MODEL WITH FIXED PROBABILITIES AND TIME-VARYING MEANS DEPENDING ON CREDIT									
1.15 (0.037)	−1.41 (0.194)	0.99 (0.026)	0.97 (0.001)	0.60 (0.037)			−0.37 (0.043)	−0.50 (0.215)	
MS MODEL WITH FIXED MEANS AND TIME-VARYING PROBABILITIES DEPENDING ON CREDIT									
0.87 (0.019)	−1.84 (0.12)1	1.01 (0.027)	0.97 (0.00)	0.50 (0.068)	−0.04 (0.003)	0.11 (0.057)			
MS MODEL WITH TIME-VARYING MEANS AND PROBABILITIES DEPENDING ON CREDIT									
1.17 (0.035)	−1.26 (0.183)	0.99 (0.026)	0.96 (0.000)	0.55 (0.069)	0.02 (0.003)	0.06 (0.076)	−0.40 (0.039)	−0.73 (0.210)	
MS MODEL WITH FIXED PROBABILITIES AND TIME-VARYING MEANS DEPENDING ON CREDIT (2008.3)									
1.19 (0.041)	−1.04 (0.152)	0.93 (0.027)	0.96 (0.000)	0.69 (0.035)			−0.34 (0.048)	0.35 (0.196)	
MS MODEL WITH FIXED MEANS AND TIME-VARYING PROBABILITIES DEPENDING ON CREDIT (2008.3)									
0.97 (0.026)	−0.73 (0.129)	0.95 (0.028)	0.96 (0.000)	0.64 (0.053)	−0.00 (0.008)	0.10 (0.063)			
MS MODEL WITH DURATION DEPENDENCE									
0.87 (0.023)	−1.81 (0.187)	1.02 (0.036)	0.97 (0.001)	0.69 (0.044)					−0.09 (0.044)
MS MODEL WITH DURATION DEPENDENCE AND TIME-VARYING MEANS DEPENDING ON CREDIT									
1.16 (0.013)	−1.28 (0.101)	0.99 (0.021)	0.97 (0.004)	0.69 (0.045)			−0.38 (0.025)	−0.65 (0.084)	−0.09 (0.042)

Credit. Final analysis

Last robustness check:Control for the accumulation effect. Duration dependence MS models of Diebold and Rudebusch (1990), Durland and McCurdy (1994) and Filardo and Gordon (1998)

TABLE 8

μ_1	μ_2	σ^2	p	q	δ_1	δ_2	α_1	α_2	θ
MS MODEL WITH FIXED MEANS AND PROBABILITIES									
0.87 (0.02)	−1.84 (0.11)	1.01 (0.03)	0.97 (0.00)	0.60 (0.04)					
MS MODEL WITH FIXED PROBABILITIES AND TIME-VARYING MEANS									
1.15 (0.04)	−1.41 (0.19)	0.99 (0.03)	0.97 (0.00)	0.60 (0.04)			−0.37 (0.04)	−0.50 (0.22)	
MS MODEL WITH FIXED MEANS AND TIME-VARYING PROBABILITIES									
0.87 (0.02)	−1.84 (0.12)	1.01 (0.03)	0.97 (0.00)	0.50 (0.07)	−0.04 (0.00)	0.11 (0.06)			
MS MODEL WITH TIME-VARYING MEANS AND PROBABILITIES									
1.17 (0.03)	−1.26 (0.18)	0.99 (0.03)	0.96 (0.00)	0.55 (0.07)	0.02 (0.00)	0.06 (0.08)	−0.40 (0.04)	−0.73 (0.21)	
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MS MODEL WITH DURATION DEPENDENCE AND TIME-VARYING MEANS									
1.16 (0.01)	−1.28 (0.10)	0.99 (0.02)	0.97 (0.00)	0.69 (0.04)			−0.39 (0.02)	−0.65 (0.08)	−0.09 (0.04)

Credit. Final analysis

Out of sample. Probability Recession

	GM	GM_credit_μ	GM_credit_prob	GM_dd	GM_dd_credit_μ
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GM_dd					FQPS1=0.1058 FQPS2=0.1068 DM_test=0.5499 (0.6859)
GM_dd_credit_μ					

Notes: The first value corresponds with rows and the second with columns. The third values display the Diabold and Mariano test and its associated p-values of the null hypotheiss that the predictive performance of model in row and model in column is equal.

Looking for Dark Corners. Conclusion

- Dark corners are difficult to find. We may find ones and the next recession could come associated to new ones.
- But definitely, we need to revise the methods that we are currently using for the search of early warning indicators.
- We review the results of previous literature with an empirical exercise and obtain a controversial finding: "Credit does not help to forecast recessions or business cycle characteristics"
- There was no empirical evidence to support that a policymaker decide to cut credit in the middle of an expansion to prevent future recessions

Looking for Dark Corners. Conclusion

- Dear Queen, nobody saw the credit crunch coming because credit was not so closely related to business cycle. This is a new feature of the data associated with just one particular period.
- Macroeconomics did not include credit in their models because other features of the data (stickiness in wages and prices, for example) explained better the business cycle features than anything else

One lesson and one assumption

- Dark corners should be seen in advance and can be seen in advance. Early warning systems.
- Great Moderation is over (otherwise we would be still fooled). Thanks to its end, we can observe the dark corners

One lesson and one assumption

- Dark corners should be seen in advance and can be seen in advance. Early warning systems.

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Outline

Outline

The Great Domination

The Great Domination

UEFA EURO2008
Austria-Switzerland

The Great Domination

UEFA EURO2008 Austria-Switzerland

SOUTH AFRICA 2010 FIFA WORLD CUP

The Great Domination

UEFA
EURO2008
Austria-Switzerland

UEFA
EURO2012
POLAND-UKRAINE

The Great Humiliation

The Great Humiliation

A structural break for Spain?

- The Spanish team closes a cycle
- Failure and end of cycle for the Spanish team
- Xabi Alonso says that cycles come to an end after a defeat, pointing to an unavoidable loss of hunger
- Fernando Torres: "One day this cycle had to end"
- Editorial in the news. Theoretical models:
  - The effects of ageing on soccer
  - The effect of lack of motivation in soccer
  - The effect of competitive leagues on the national team

But we are econometricians

- Definitely...too soon to say:
- We need more observations. Lack of power at the end of the sample
- Too few observations. Wait until Euro 2016

- ... by the way... why we did not see this thing coming up earlier?

The Great Moderation (GM)

- The period of significant decline macroeconomic volatility that began in the mid-1980s. Kim and Nelson (1999) and McConnell and Perez-Quiros (2000)

- Consensus before the Great Recession that the GM was a permanent phenomenon
  - Blanchard and Simon (2001): "The decrease in output volatility appears sufficiently steady and broad based that a major reversal appears unlikely"
  - Bernanke (2004): "The reduction in the volatility of output is also closely associated with the fact that recessions have become less frequent and severe"
  - Robert Lucas (2003). Presidential address to the AEA: "the central problem of depression-prevention has been solved, for all practical purposes".

The Great Recession (GR)

- The global economic decline in the late 2000 decade
- GDP growth in US negative between 2008Q3 to 2009Q2
- Worst recession since WWII

Great Moderation vs Great Recession

- John Taylor blog: Sunday, December 23, 2012 Five-Year Anniversary of the End of the Great Moderation

- "Five years ago this month the GM ENDED. To be precise Dec 2007 is the month in which the NBER designed the peak and it was the end of the Great Moderation and the beginning of the Great Recession".

Great Moderation vs Great Recession

GR ended the GM because:

- Balance Sheet Recessions. Excess confidence implied excess leverage. Vulnerability. Brunnermeier (2014)
- Misperception of risk. Bean (2010)
- Great Deviation. Wrong measures of the FED between 2003 and 2009. Williams and Taylor (2009)
- Financial accelerator. Gourinchas and Obstfeld (2012) and many others, IMF, BIS, FSB...the effect of credit

Great Moderation vs Great Recession

GR ended the GM. Empirical evidence:

- Ng and Tambalotti (2012): DSGE model with parameters of the GM make impossible to describe the GR
- Ng and Wright (2013): the financial origin of this recession makes it more explosive, killing the stability of the GM
- Keating and Valcarcel (2012), Cannarella et al. (2008)

Great Moderation vs Great Recession

On the opposite side. GR did not end GM:

- Clark (2009): the volatility rise was not widespread across sectors; the economy undergoes occasional shifts while low volatility is the norm
- Coubion and Gorodnichenko (2011, AER): the GM continues as it is determined by improved policy rather than luck

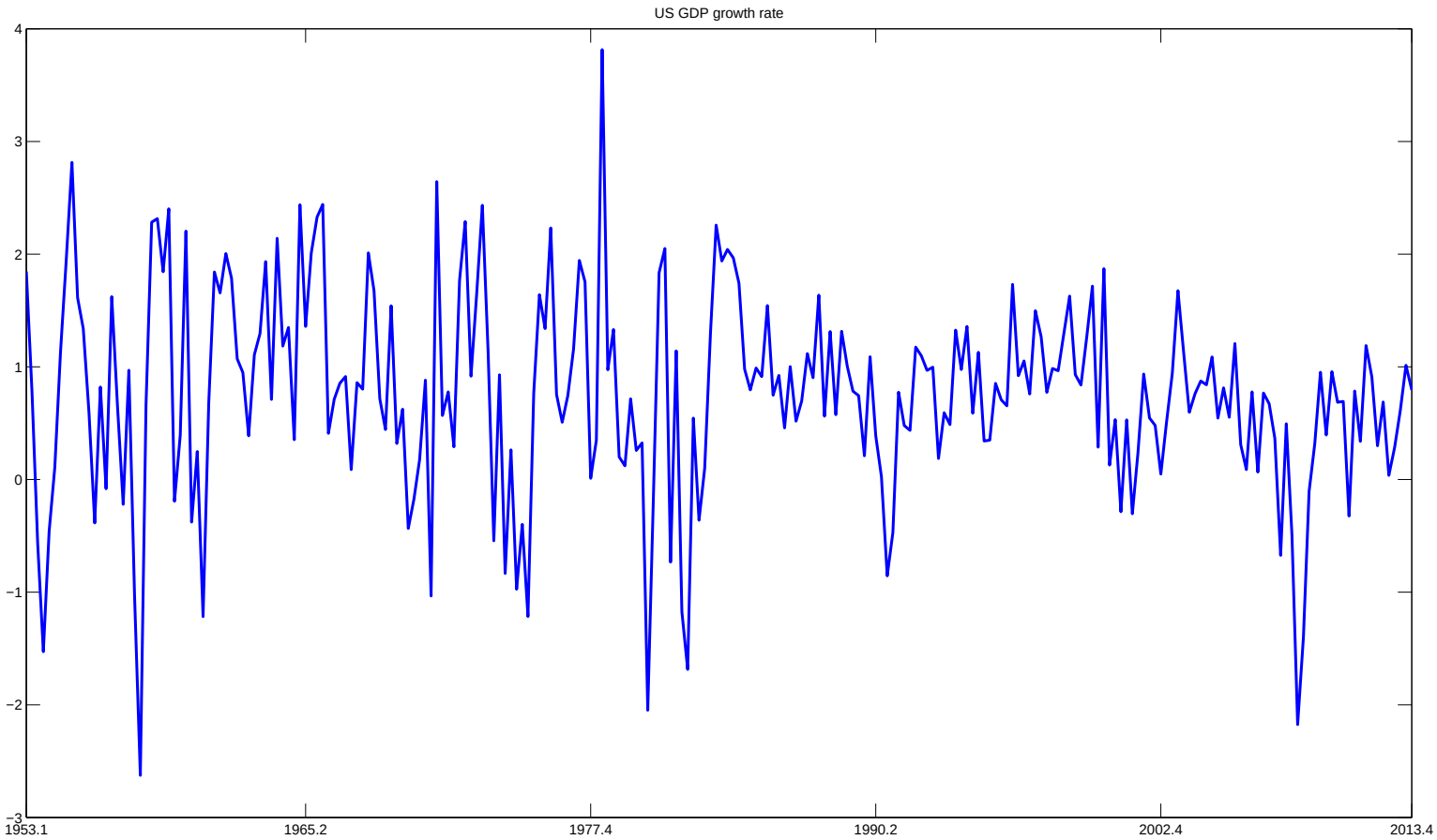
Great Moderation vs Great Recession

GM vs GR. Policymakers looking for answers:

- Jason Furman. April 10th 2014. "Whatever happened to the Great Moderation?" Annual Hyman P. Minsky Conference
- If the GM still holds... shed light on the possible explanations

Great Moderation Revisited

US GDP Growth 1953.1 - 2013.4



Great Moderation Revisited

Andrews (1993) and Andrews and Ploberger (1994)

$$y_t = \mu + \rho y_{t-1} + \epsilon_t$$

$$\sqrt{\frac{\pi}{2}}\,|\epsilon_t| = \alpha_1 D_{1t} + \alpha_2 D_{2t} + u_t$$

$$D_{1t} = \left\{ \begin{array}{l} 1 \; if \; t \leqslant T \\ 0 \; if \; t > T \end{array} \right\}$$

$$D_{2t} = \left\{ \begin{array}{l} 1 \; if \; t \geqslant T \\ 0 \; if \; t < T \end{array} \right\}$$

where y_t, growth rate of GDP; T, break point; α_1 and α_2, the corresponding estimators of the standard deviation

Great Moderation Revisited

Andrews (1993) and Andrews and Ploberger (1994)

STRUCTURAL BREAKS IN VARIANCE

Null	Sup	Exp	Ave
$\sigma_1^2 = \sigma_2^2$	15.70	5.28	7.05
	(0.003)	(0.000)	(0.003)
Estimated break data 1984.2			

Great Moderation Revisited

Andrews (1993) and Andrews and Ploberger (1994)

- Only one break
- As usual... first we need to re-test for the possibility of a change in mean
- At the end of the sample. Trimming of the data
- Too few observations of the new post GR period

Testing for multiple breaks in the mean

Bai and Perron (1998, 2003a and 2003b):

- They consider m breaks in a general model:

$$y_t = x_t'\beta + z_t'\delta_j + u_t$$

  - y_t is the dependent variable
  - $x_t(px1)$ and $z_t(qx1)$ are vectors of independent variables, the first is univariate and the second can change
  - β and δ_j $(j = 1, ..., m+1)$ are the vectors of coefficients
  - $T_i, ..., T_m$ are the break points considered endogenous
  - Number of breaks: use the *UDmax* and *WDmax* double maximum tests and the $supF_{(l+1/l)}$ sequential procedure

Testing for multiple breaks in the mean

Multiple structural breaks (Bai-Perron methodology)

	Model 1	Model 2	Critical values	
			5%	1%
supF_(k)				
k=1	5.98	6.30	9.10	13.00
k=2	7.55	6.58	7.92	10.14
k=3	6.80	3.12	6.84	8.42
supF_(l+1/l)				
l=1	0.99	0.88	9.10	9.10
l=2	4.70	5.31	10.55	10.55
UDmax	7.55	6.57	9.52	9.52
WDmax	9.04	8.15	13.07	13.07
T(SBIC)	0	0		
T(LWZ)	0	0		
T(sequential)	0	0		

Notes: We look for changes in the mean in a pure structural model (Model 1) and including an autoregressive (Model 2). The trimming parameter is $\epsilon = 0.10$ and the maximum number breaks is 3. Serial correlation and heterogeneity in the errors are allowed. The consistent covariance matrix is constructed using the Andrews (1991) method.

- All the tests agree that ΔGDP does not have any structural change in mean

Testing for multiple breaks in variance

Inclan and Tiao (1994) Sanso *et al.* (2004). CUSUM-type test

$$IT = \sup_k \left| \sqrt{T/2} D_k \right| \text{ where } C_k = \sum_{t=1}^{k} \varepsilon_t^2 \; D_k = \frac{C_k}{C_t} - \frac{k}{t} \text{ with } D_o = D_T = 0$$

Big size distortions when the assumption of normally distributed innovations fails in the fourth order moment or for heteroskedastic conditional variance processes. Proposed corrections:

- hight kurtosis

$$IIT(\kappa_1) = \sup_k \left| \sqrt{T/B_k} \right|$$

$$B_k = \frac{Ck - \frac{k}{T} C_T}{\sqrt{\widehat{\eta}_4 - \widehat{\sigma}^4}}$$

- persistence

$$\widehat{\eta}_4 = T^{-1} \sum_{t=1}^{T} y_t^4, \; \widehat{\sigma}^4 = T^{-1} C_T$$

$$IT(\kappa_2) = \sup_k \left| \sqrt{T/G_k} \right|$$

$$G_k = \widehat{\varpi}_4^{-1/2} (C_k - \tfrac{k}{T} C_T)$$

where $\widehat{\varpi}_4$ is a consistent estimator of $\varpi_4 = \lim_{T \to \infty} E(T^{-1} (\sum_{t=1}^{k} (\varepsilon_t^2 - \sigma^2))^2)$

Testing for multiple breaks in variance

Other alternative approaches:

- Adapting the Bai and Perron (1998, 2003) method for changes in the mean of the absolute value of the estimated residuals.
  - Zhou and Perron (2008) prove the suitability of this procedure when there are no changes in mean
  - See Herrera and Pesavento (2005) and Stock and Watson (2002)
- Extending the McConnell and Perez-Quiros (2000) [Andrews test (1993) and critical values correction of Hansen (1997)] to more than one break

Testing for multiple breaks in variance

DETECTING CHANGES IN VARIANCE

ICSS algorithm		Bai-Perron		McConnell-Perez-Quiros
$IT(\kappa_1)$	$IT(\kappa_2)$	Model 1	Model 2	
1984.2	1984.2	1984.2	1983.4	1984.2

- Only one break in volatility. 1984.2... even when we allow for more than one break. But still...
  - At the end of the sample. Trimming of the data
  - Too few observations of the new post GR period

Experiments 1 and 2. Dealing with the end of the sample

Experiment 1. Introduce the GR at each point of the GM

Experiment 2. Randomly mix the observations of the GM and the GR

DETECTING CHANGES IN VARIANCE (BAI-PERRON)

	GM SB	No SB	Random SB(s)	GM SB		GM SB + GR SB
				+ 1 random SB	+ 2 random SB	
Experiment 1	92.6		7.4			
Experiment 2	90.9	8.9		0.1		

Experiments 3 and 4. Dealing with the short sample

Experiment 3: enlarge the duration after 2007.4 with the GR data (5, 10 and 15 years)

Experiment 4: enlarge the period after 2007.4 with the pre-GM data (5, 10 and 15 years)

Detecting changes in variance (Bai-Perron)

	GM SB	No SB	Random SB(s)	GM SB		GM SB + GR SB
				+ 1 random SB	+ 2 random SB	
Experiment 3						
5 years	100.0			0.0		
10 years	100.0			0.0		
15 years	100.0			0.0		
Experiment 4				GR		
5 years	68.0	1.4		1.4		29.2
10 years	24.2	17.3		10.0	0.0	48.5
15 years	5.6	41.4	0.0	12.8	0.1	40.1

Experiments 3 and 4. Dealing with the short sample

Experiment 3: enlarge the duration after 2007.4 with the GR data (5, 10 and 15 years)

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DETECTING CHANGES IN VARIANCE (BAI-PERRON)

	GM SB	No SB	Random SB(s)	GM SB		GM SB + GR SB
				+ 1 random SB	+ 2 random SB	
Experiment 3						
5 years	100.0			0.0		
10 years	100.0			0.0		
15 years	100.0			0.0		
Experiment 4				GR		
5 years	68.0	1.4		1.4		29.2
10 years	24.2	17.3		10.0	0.0	48.5
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DETECTING CHANGES IN VARIANCE (BAI-PERRON)

	GM SB	No SB	Random SB(s)	GM SB		GM SB + GR SB
				+ 1 random SB	+ 2 random SB	
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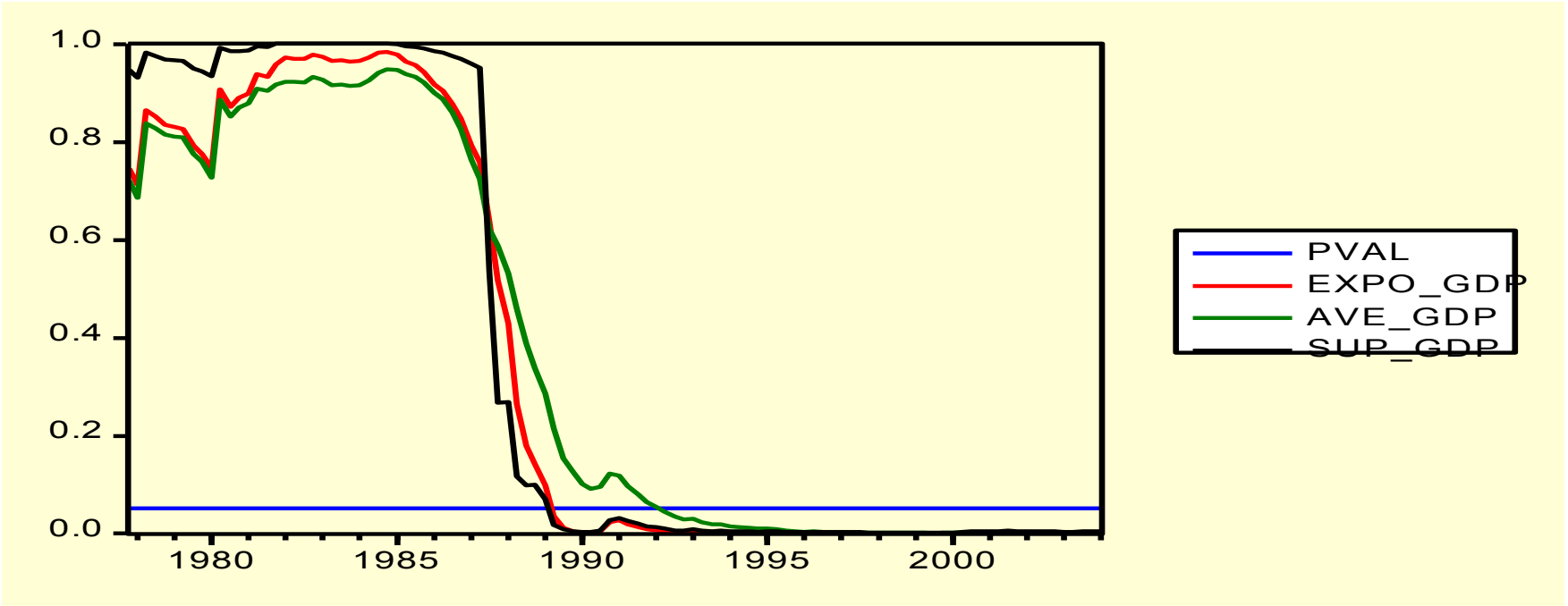
15 years	5.6	41.4	0.0	12.8	0.1	40.1

Experiments 3 and 4. Dealing with the short sample

One little thing... why does it take so long to capture the structural break?



Camacho and Perez-Quiros (2007, SNDE)

Experiment 5

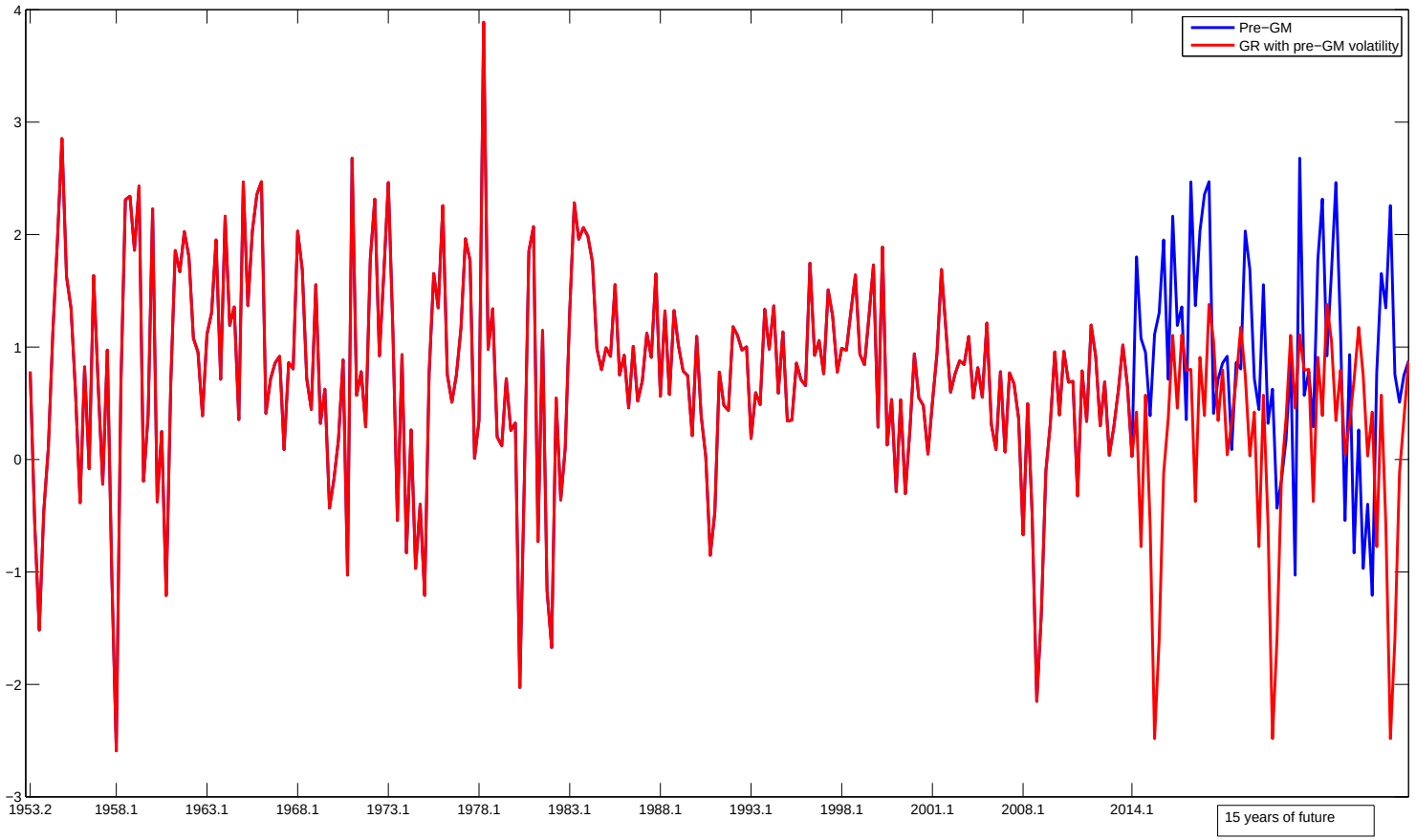
Perhaps the key is that the pre-GM volatility is 1.12, and the GR volatility is 0.80 $\Rightarrow$ Experiment 5: Enlarge the duration after 2007.4 with the GR data (5, 10 and 15 years) and the pre-GM volatility

DETECTING CHANGES IN VARIANCE (BAI-PERRON)

	GM SB	No SB	Random SB(s)	GM SB		GM SB + GR SB
				+ 1 random SB	+ 2 random SB	
Experiment 5						
5 years	96.9	3.0		0.0		0.0
10 years	91.8	8.1		0.0		0.1
15 years	77.8	19.1		0.5		2.7

Data features

Ilustration:



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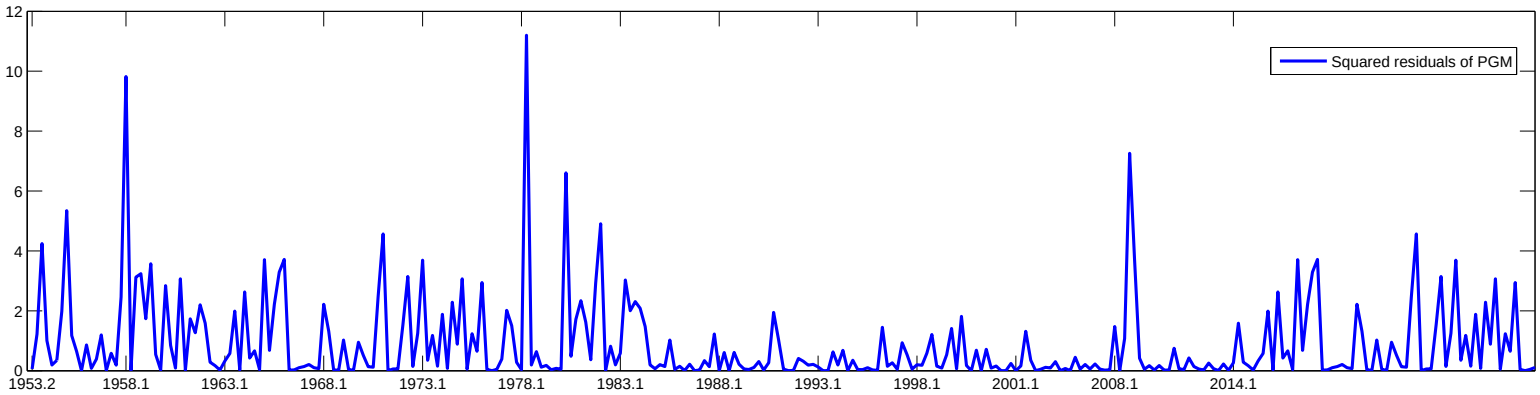
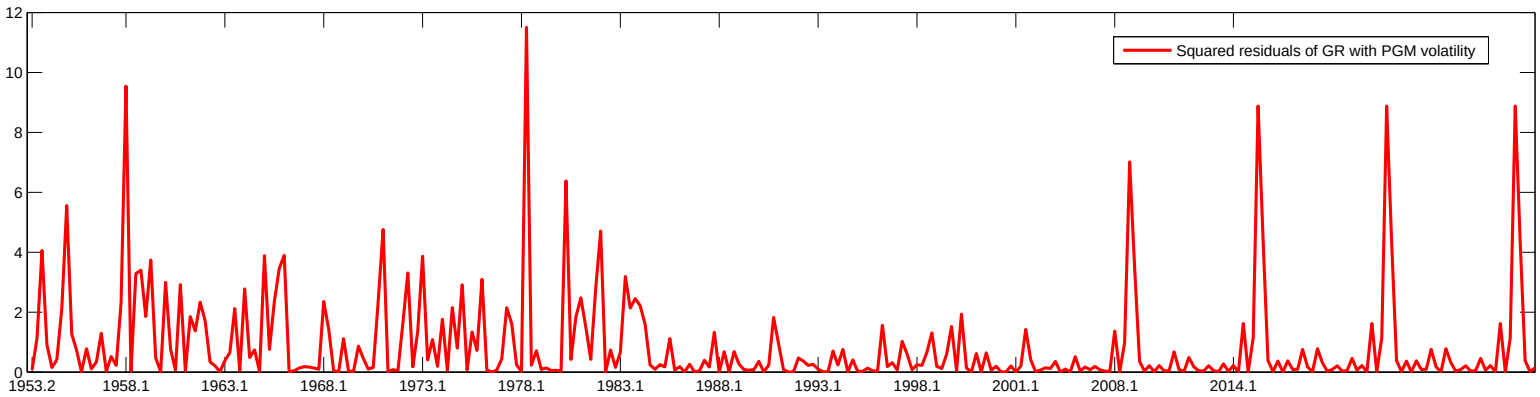
Ilustration:





What is in the post GR data?

- Good luck?? There is GM even if we have 4 recessions in the next 15 years even bigger that the one we have recently live
- Good policy?? What kind of good policy allows for 4 recessions in the next 15 years
- Good practices?? Ramey and Vine (2006), Gali and Gambetti (2013), Camacho et al (2008), etc...

What do the pre-GM data have that is not present in the post GR data?

Wilcoxon test:

- Recessions before the GM are equal to the recession of the GR $\Rightarrow$ Wilcoxon test, p-value 0.61
- First year of expansions before the GM are different from the first year of expansion of the GR $\Rightarrow$ Wilcoxon test, p-value 0.02
- Second and third year of expansions. Statistically equal before and after the GM

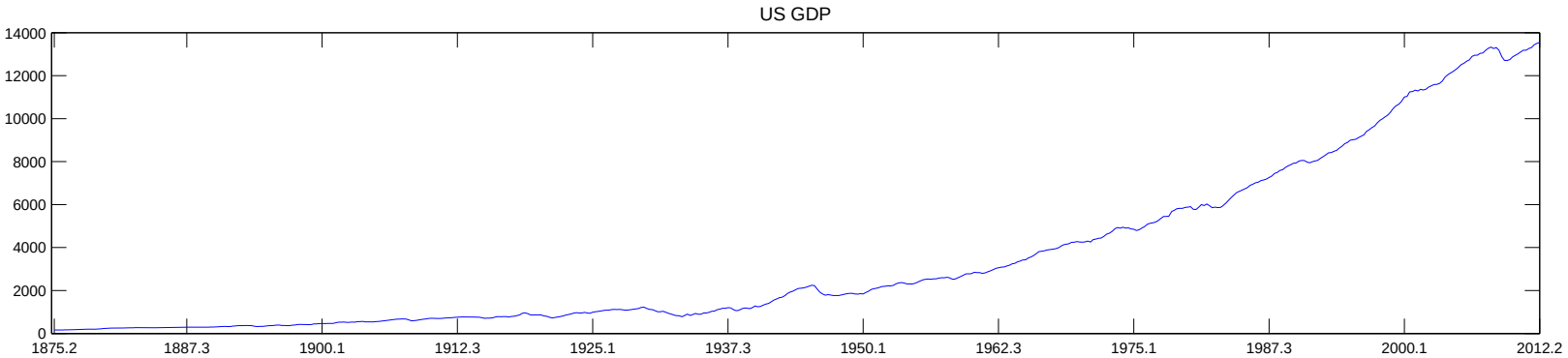
Experiment 6

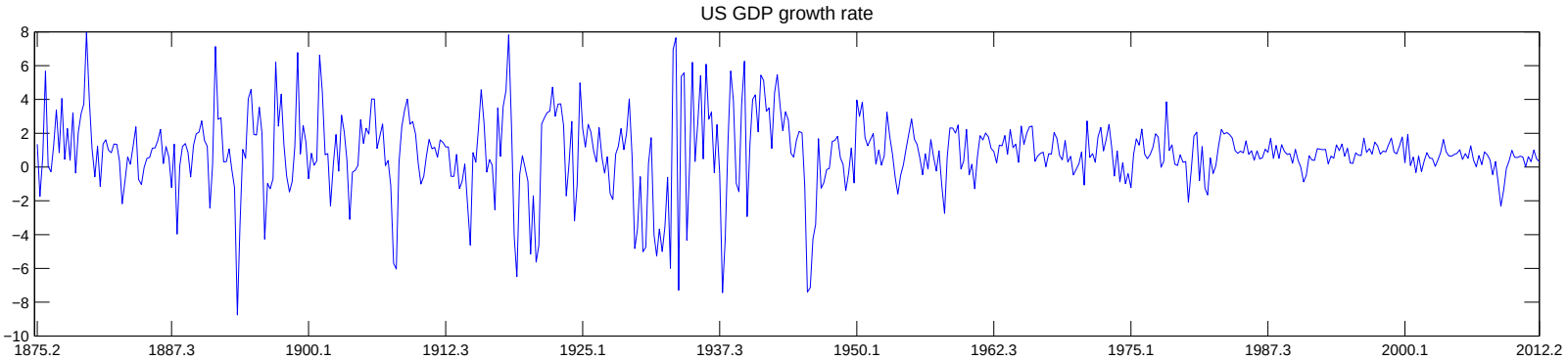
- Experiment 6 enlarge the post GR period with changes in the first year of the expansion

EXPERIMENT 6 (15 YEARS)

	GM SB	No SB	Random SB(s)	GM SB		GM SB + GR SB
				+ 1 random SB	+ 2 random SB	
Detecting changes in variance (Bai-Perron)						
				GR and recovery		
GR (Exp 3)	100.0					
GR+vol (Exp 5)	77.3	18.7		0.5		3.5
GR+Hrec	48.8	4.6		25.0	0.5	21.1
GR+Hrec+vol	9.6	74.0	0.1	10.2		6.1

How big is the GM?





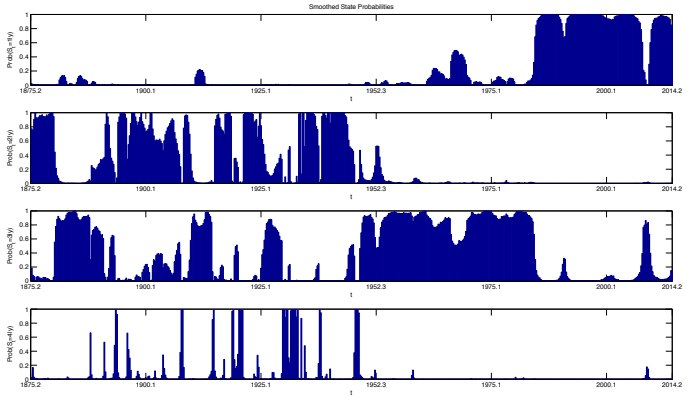
How big is the GM?

DETECTING CHANGES IN VARIANCE

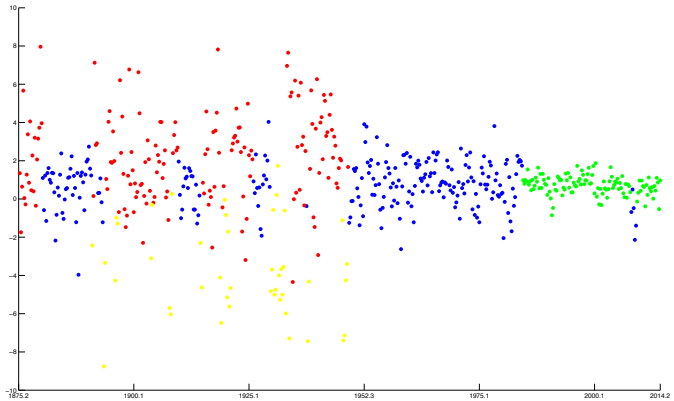
ICSS algorithm	Bai-Perron	McConnell-Perez-Quiros
$IT(\kappa_2)$	Model 1	
1917.4	1917.3	1951.1
1946.2	1947.1	1984.3
1984.1	1984.2	

The first break found in the recursive analysis is 1984.2

How big is the GM?



(b) Smoothed states probabilities



(c) Time series segmentation based on smoothed states probabilities

Conclusions GM vs GR

- The GM still holds
- Papers that assume the end of the GM contradict the empirical evidence. They obtain conclusions before testing. As the sport press
- The fact that the GM still holds puts a question mark on the papers that postulate good luck or good policy
- The GM is not necessarily a good feature. It implies slower recoveries

Outline

One lesson and one assumption

- Dark corners should be seen in advance and can be seen in avance. Early warning systems

- Great Moderation is over (otherwise we would be still fooled). Thanks to its end, we can observe the dark corners

FINAL CONCLUSIONS

- What recent crisis has brought to economics is the pressure to provide policymakers with solutions
- Policymakers need stable rules that can support their policy decisions
- We should be careful in explaining which evidence is descriptive and which can be used for normative purposes
- The Great Moderation has not been killed by the Great Recession