Dating Business Cycles in Emerging Market Economies: The Case of Brazil

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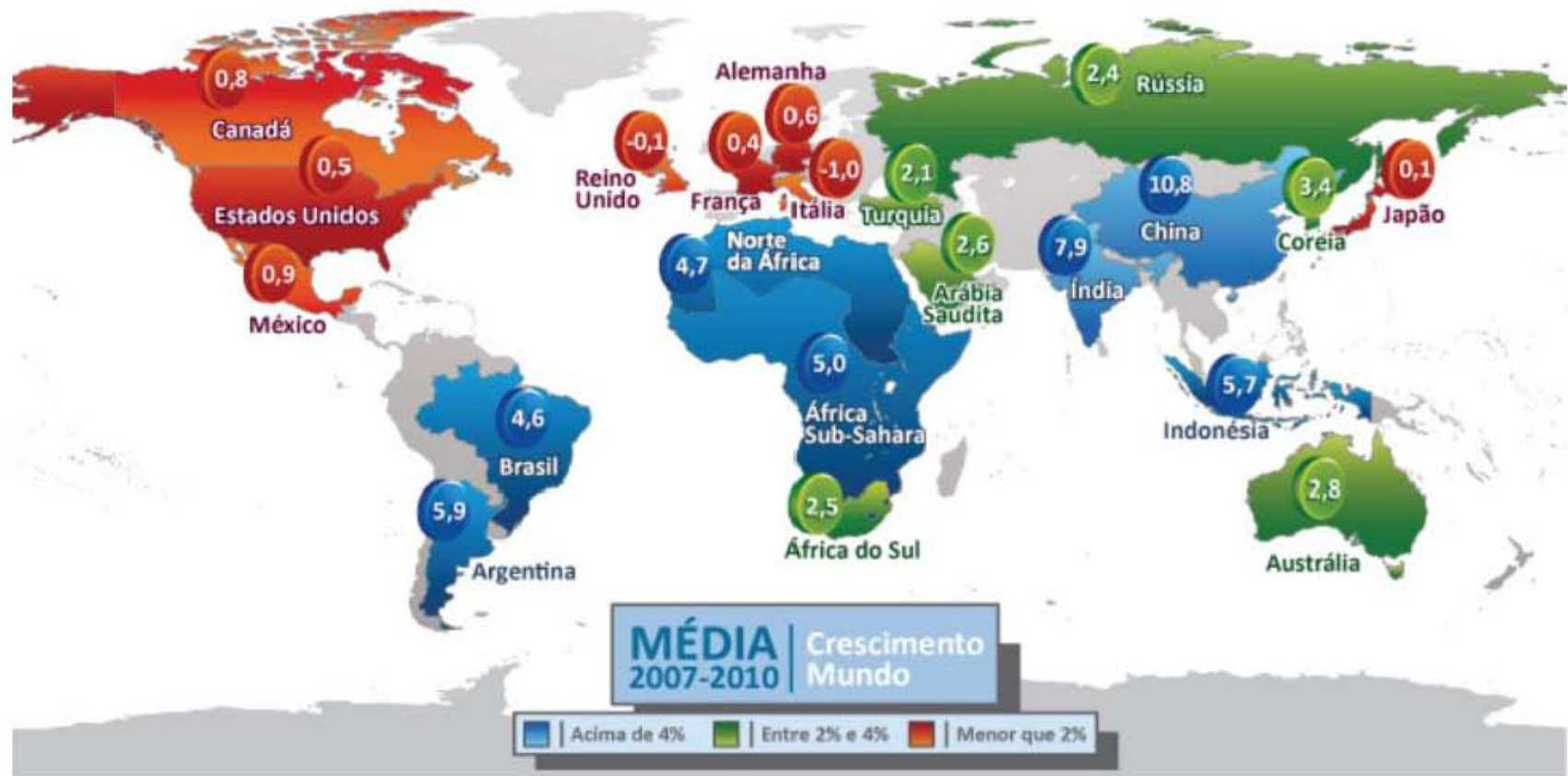
June 2011

Motivation

- There is an increasingly vast interest on characterizing and predicting business cycles in emerging market economies, particularly the BRICTS (Brazil, Russia, India, China, Turkey, and South Africa)

- Most of these countries have been experiencing fast pace growth and stability since mid 1990s. Recessions have been mild and expansions characterized by strong growth.

- Recent financial crisis in the U.S. spread globally, but with different intensity across countries. These countries experienced an abrupt but very short recession limited to only some sectors of the economy

- These countries' economic potential is historically well-known, but this potential seems to be realizing now

Global projected growth 2007-2010

GDP growth, in % annual average

Alemanha 0,6
Canadá 0,8
Estados Unidos 0,5
México 0,9
Reino Unido -0,1
França 0,4
Itália -1,0
Turquia 2,1
Rússia 2,4
China 10,8
Coreia 3,4
Japão 0,1
Índia 7,9
Norte da África 4,7
Arábia Saudita 2,6
África Sub-Sahara 5,0
África do Sul 2,5
Brasil 4,6
Argentina 5,9
Indonésia 5,7
Austrália 2,8

MÉDIA 2007-2010 | Crescimento Mundo

Acima de 4% | Entre 2% e 4% | Menor que 2%

Source: IMF

2011: Global imbalances
Predictions of GDP growth, in %

Canadá 2,6
Estados Unidos 3,3
México 3,9
Brasil 4,5
Argentina 5,3
Alemanha 2,6
Reino Unido 1,6
França 1,7
Itália 1,1
Turquia 5,1
Egito 4,1
Arábia Saudita 5,5
Índia 9,0
Rússia 4,3
China 9,0
Coreia 4,6
Japão 1,7
Indonésia 6,1
África do Sul 3,7
Austrália 3,1

2011 | Crescimento Mundo

Acima de 4%   Entre 2% e 4%   Menor que 2%

Fonte: The Economist

Investment Growth in emerging markets

In % of GDP 2010
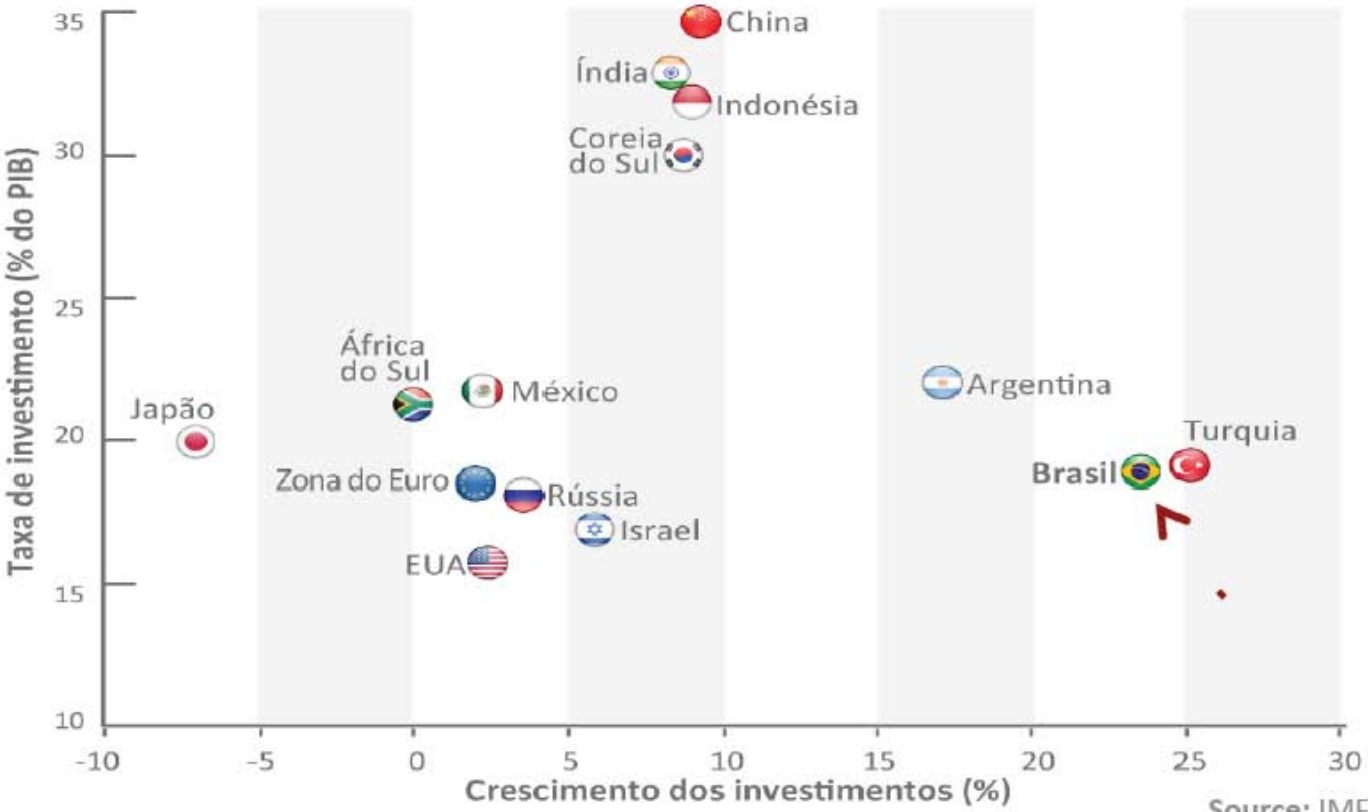
Dating Business Cycles

Goal

- Identification of turning points – beginning and end of recessions. To obtain a chronology of business cycle that can be used as a reference point for economic analysis and policy.

Motivation

- Timely identification of economic contraction and its severity allows policy intervention that may reduce its amplitude and duration.

- In addition, firms can re-evaluate projections of sales and profits, and consumers their purchasing and investment plans based on information on transitions to new business cycle phases.

Dating Business Cycles

- Analysis of Brazilian economy according to the current economic stage. Transparency with respect to the information of the state and strength of the economy. Key economic variables may have different dynamics before, during, and after recessions.

- Turning points as reference point for the construction of coincident and leading indicators of the economy.

- In the U.S., the National Bureau of Economic Research (NBER) business cycle dating is regarded as authoritative by both academic researchers and the public at large. Dates as outcome of NBER's qualitative judgment about the state of the economy.

  ➢Policy and planning decisions by government bodies, private firms, and individual households.

Dating Business Cycles in Brazil

Brazilian Business Cycle Dating Committee – CODACE

- CODACE was found in 2005 mirroring the experience of the NBER Business Cycle Dating Committee in the US and the CEPR in Europe. The committee is composed of seven members, who are renowned economists with practical and technical knowledge of the Brazilian economy and business cycles.

- CODACE was founded by a research institution and its members are independent scholars.   The decisions regarding business cycles are, therefore, not political. They are independent and essentially technical, and result from a consensus from discussions among the members about the economic situation for each one of the business cycle observed in Brazil in the last 30 years.

Brazilian Business Cycle Dating Committee – CODACE

- Committee met for the first time in May 2009:

  ➢ Dating of quarterly business cycle for Brazil since 1980. Announcement of the peak of 2008-2009 recession (July 2008).

- Committee met again in January 2010:

  ➢ Dating of monthly business cycle for Brazil since 1980. Announcement of the trough of 2008-2009 recession (January 2009).

Definition of Business Cycles – NBER

- The classical business cycle is characterized by a decrease in the level of economic activity and a subsequent recovery:

  > "A cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle. This sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximately their own." (Burns e Mitchell 1946)

- Burns and Mitchell's business cycle definition is considered institutional, since it explains economic fluctuations per se, instead of developing an abstract model to explain cyclical behavior. The advantage of this approach is that it yields a benchmark analytic tool for business cycles that is independent on a theory or particular model.
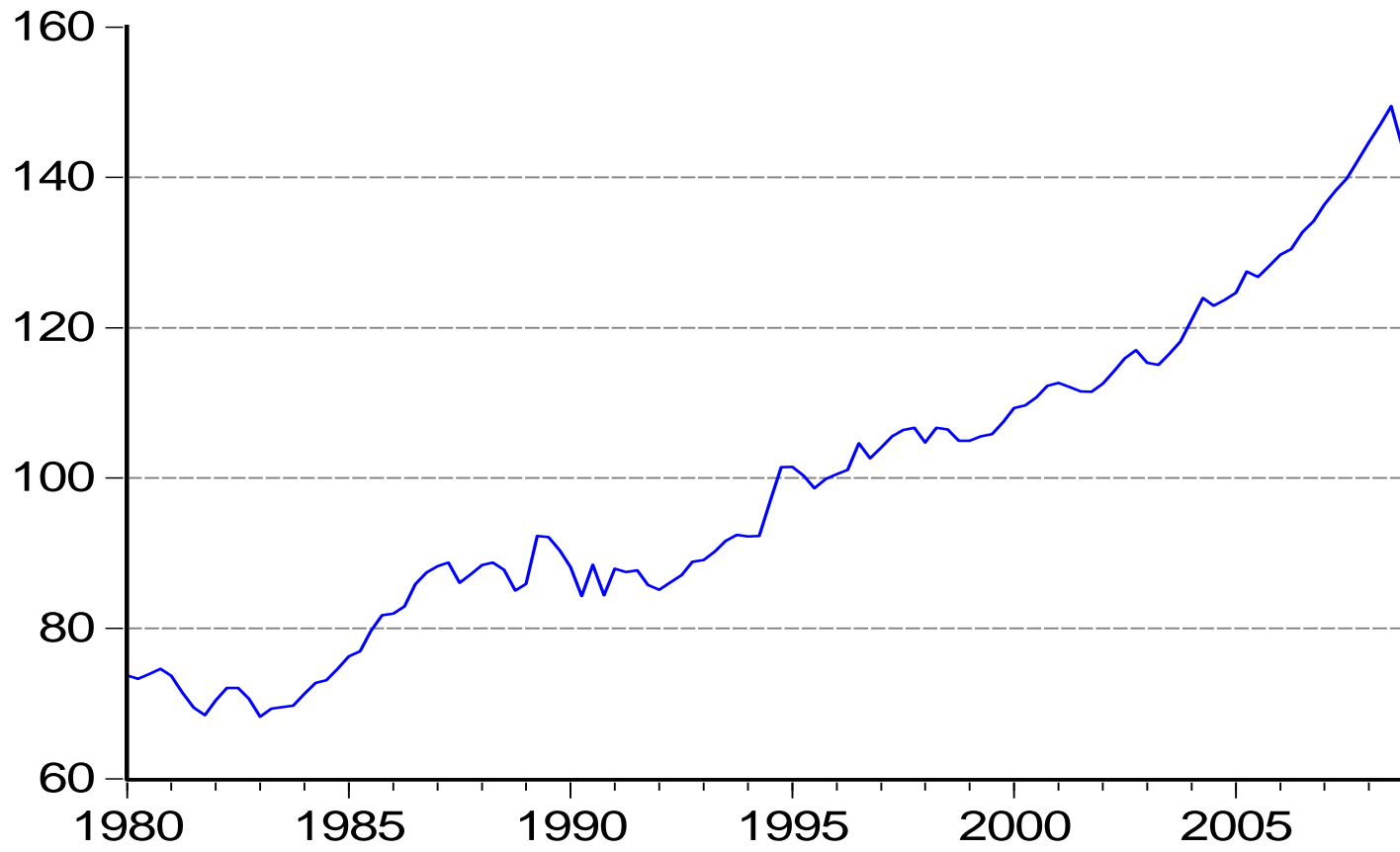
Analysis of the Brazilian Business Cycle

Reference cycle: fundamental cycle that characterize the general economic activity, representing aggregate income, production and employment.

Chronology of turning points

- First Step: determination of Reference Cycle

- Find turning points in the quarterly frequency using the same traditional method by the NBER and adopted worldwide.

  o Quarterly GDP: 1980:1 a 2008:1
  o Several monthly serices were used to support the decision

- Second Step: Models to date and to predict the reference business cycle

Produto Interno Bruto

Brazilian GDP
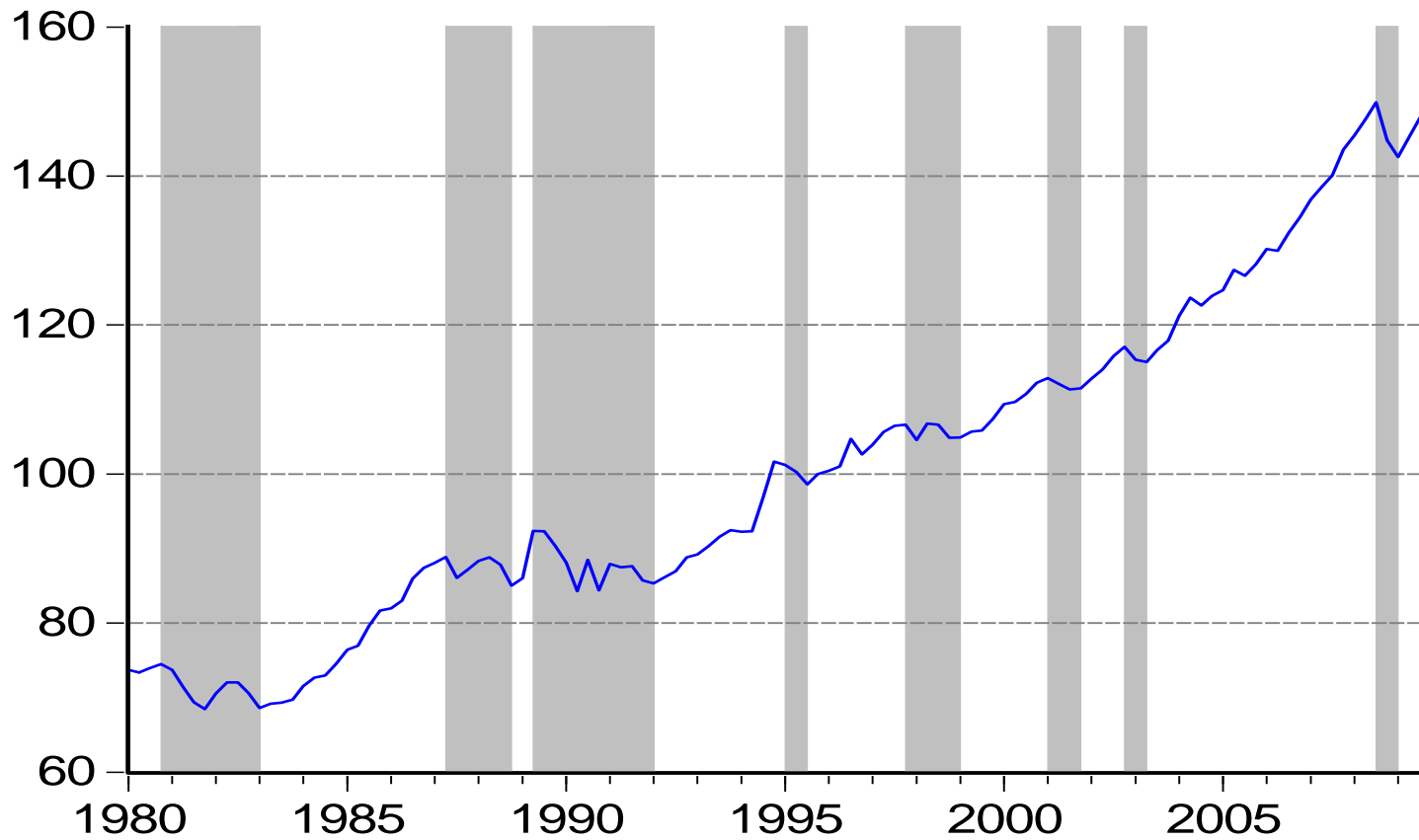
GDP - Dating of Brazilian Business Cycles
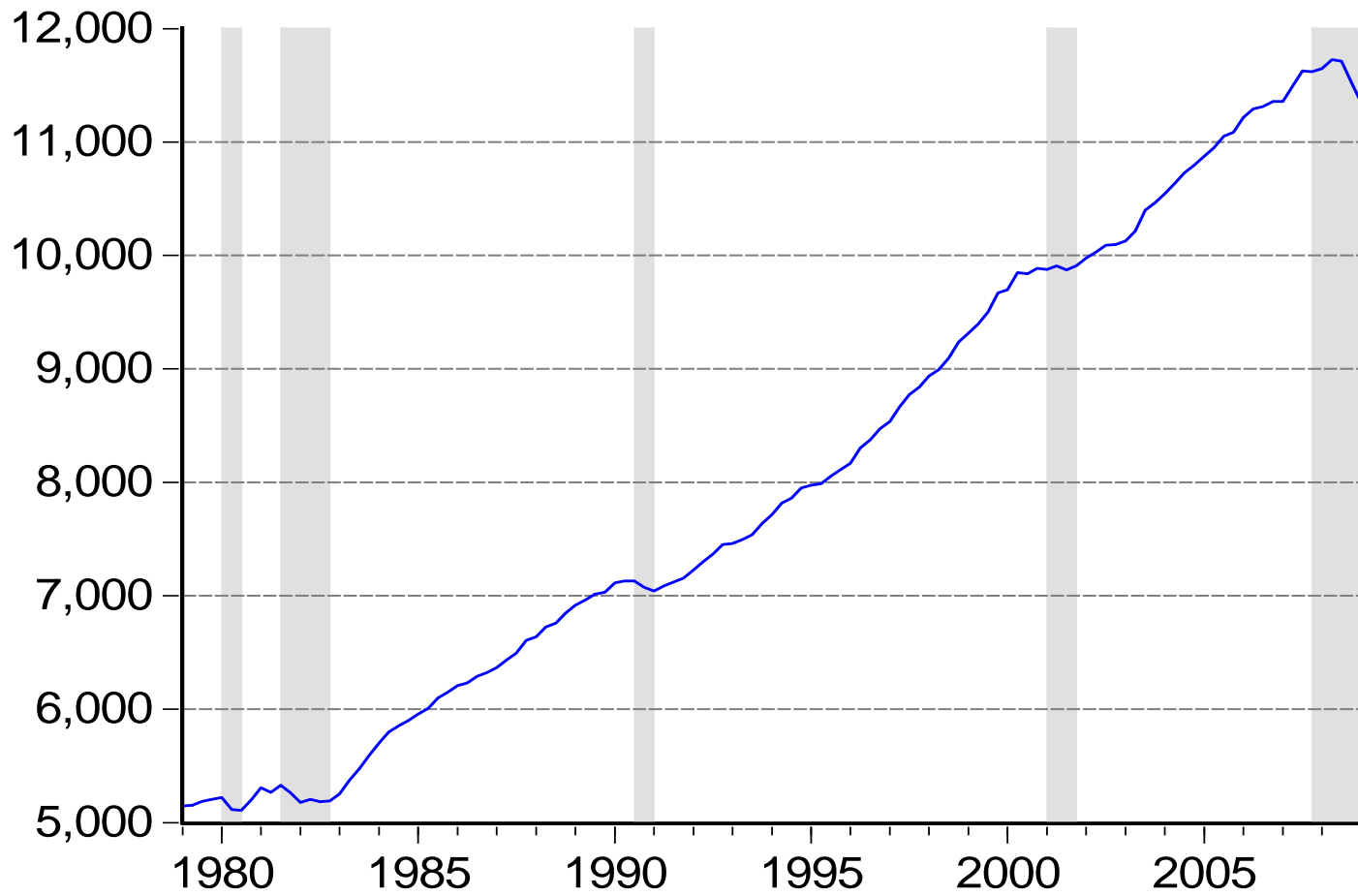
GDP – Dating of the US Business Cycle

CODACE Dating

Recession Period	Duration (quarters)	Absolute Variation %	Average Variation %
1980:Q4 – 1983:Q1	9	-8.5%	-1.0%
1987:Q2 – 1988:Q4	6	-4.2%	-0.7%
1989:Q2 – 1992:Q1	11	-0.9%	-0.1%
1995:Q1 – 1995:Q3	2	-2.8%	-1.4%
1997:Q4 – 1999:Q1	5	-1.6%	-0.3%
2001:Q1 – 2001:Q4	3	-1.0%	-0.3%
2002:Q4 – 2003:Q2	2	-1.7%	-0.8%
2008:Q3 – 2009:Q1	2	-3.6%	-

Traditional Method - NBER

The description of the classical business cycle can be summarized in 4 factors:

1) **Amplitude** (depth and recovery): to be considered a cycle, economic activity has to present a pronounced declined followed by a recovery.

2) **Duration** (length): the duration of a business cycle – which includes the length of expansions, recoveries and recessions – is of at least 1 year. The maximum extension observed is 12 years. This definition excludes seasonal fluctuations and fixed cycles.

3) **Diffusion** (impact): a business cycle has to be broad and affect several industries and economic activities simultaneously.

4) **Displacement** (severity): it measures the degree of economic deterioration during recessions, and the degree of utilization during expansions. The level of displacement can help in the classification of cycles by the analysis of its degree of severity. Two common measures of displacement are employment and capacity utilization.

- Once the cycle features are defined, one can distinguish the phases of the cycle. Burns and Mitchell distinguish two critical points in the cycle: **peak and trough**. These references measures define periods of growth and deceleration in economic activity, based on two hypotheses:

  1) Economic cycles are continuous – an expansion is followed by a recession, which, by its turn, is followed by a contraction and a period of recovery;
  2) The peaks and trough measures are enough to delineate the economic turning points.

- The popular terminology maintain three segments of Burns and Mitchel's proposition: recession, recovery and expansion:
  o **Recession** refers to the period from peak to trough.
  o **Recovery** refers to the period from trough to the point in which the level of economic activity returns to the previous peak.
  o **Expansion** refers to the period in which the level of economic activity growth beyond the previous peak.

Rules of the Dating Committee

- The duration of each cycle phase should be at least 6 months and the complete cycle should be at least 15 months, measured peak to peak or trough to trough.

- Strikes and other special factors that generate outliers are generally ignored if their effects are temporary and completely reversible.

Models for Dating and Predicting Business Cycles

- Construct models of coincident and leading indicators of business cycles and inflation in emerging market economies

  - Models that produce forecasts of recession probabilities are most valuable around the beginning and end of recessions, and during economic recoveries

  - Inflation turning point signals direction change in monetary policy with consequent impact on exchange rates.

Models for Dating and Predicting Business Cycles (cont.)

- However, real time turning point prediction is difficult to attain:

  ➤ Structural breaks

  ➤ Parameter instability

- Probability of recessions and probabilities of high and low inflation phases are affected by both the presence and location of breaks.

- Potential impact on reliability of prediction is large, and examining its importance is one of the main goals of this research.

Goal: real-time monitoring of economic conditions - formal framework that accounts for breaks and instabilities and predict business cycles at the time the events are occurring.

Economic Trends and Fluctuations in Emerging Economies

- Possible interrelation between trends and cyclical fluctuations: business cycles influenced by major secular changes and/or the long-term trend of the economy influenced by the short-term business cycle.

- Presence of potential breaks could be important in the analysis of cycles in particular (business cycles, housing market cycles, financial cycles, inflation cycles, etc.) and in the functioning of the economy in general.

- Chauvet and Senyuz (2011) model long run economic trends and business cycles of some emerging market economies.

- Instability and abrupt changes of regimes that are typical of these economies are explicitly captured with nonlinear frameworks. In particular, models that incorporate the possibility of multiple breaks are used to characterize economic activity.

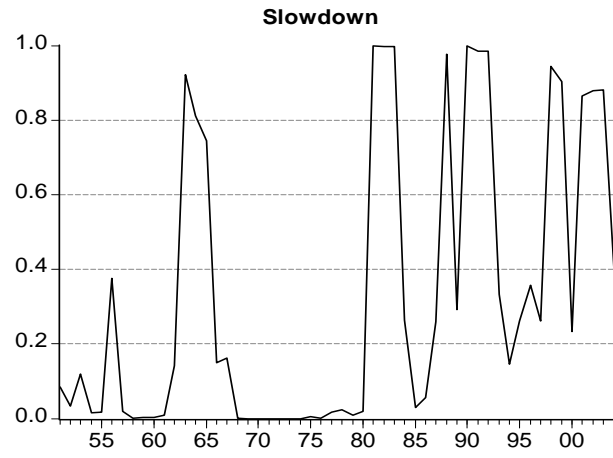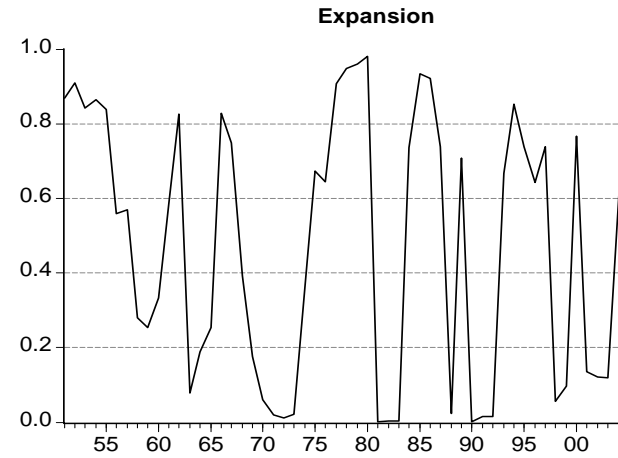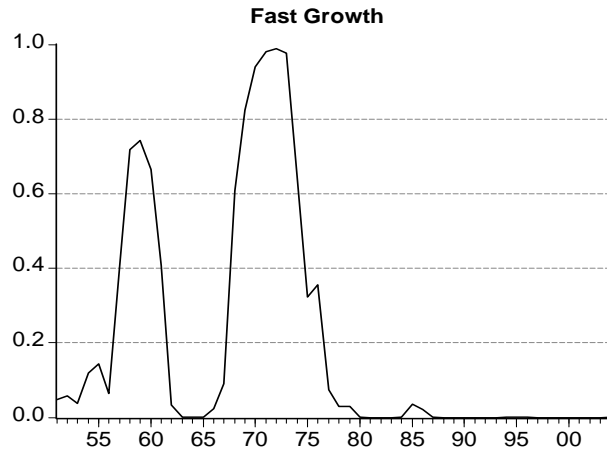# Brazil – Trend and Cycles

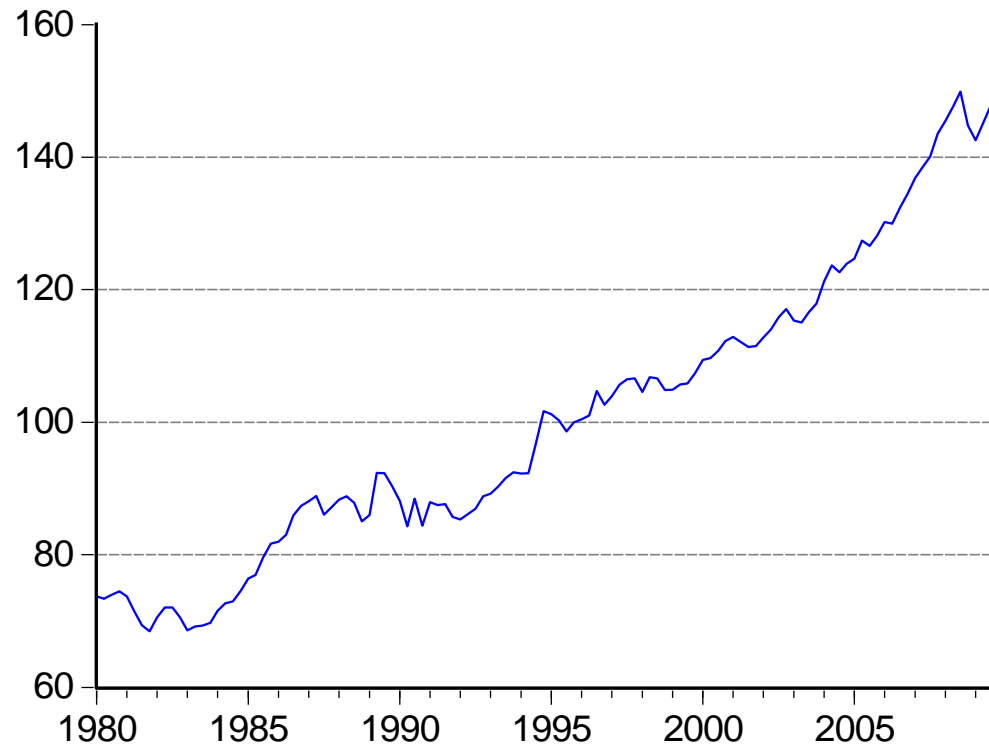**Brazil – Breaks in GDP Trend**
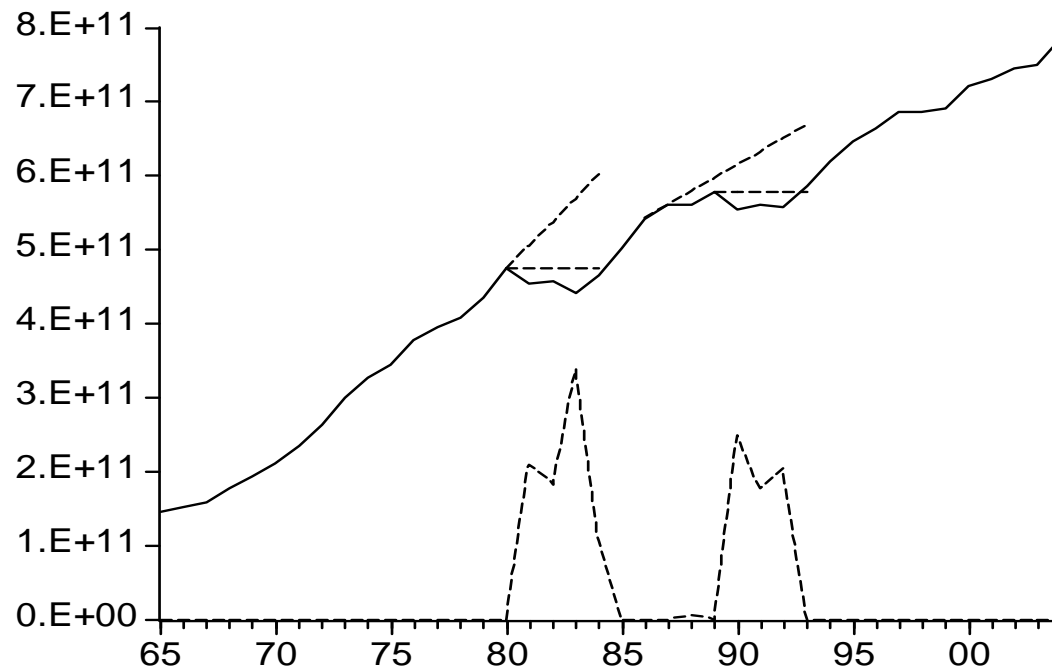
Brazil – Cycles (GDP growth)
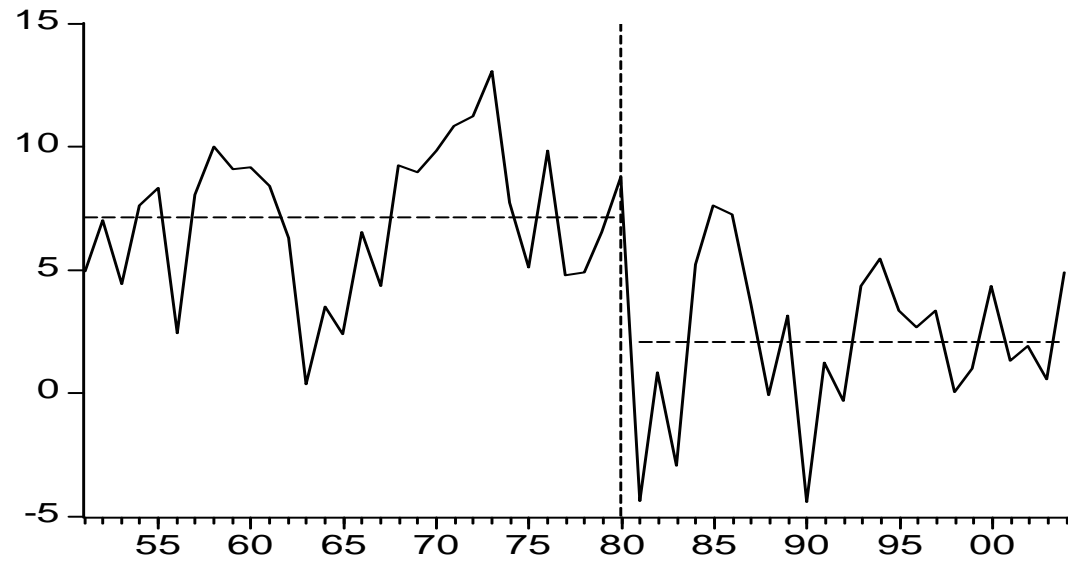
Brazil – Cycle Phases

BRAZIL

Fast Growth

Expansion
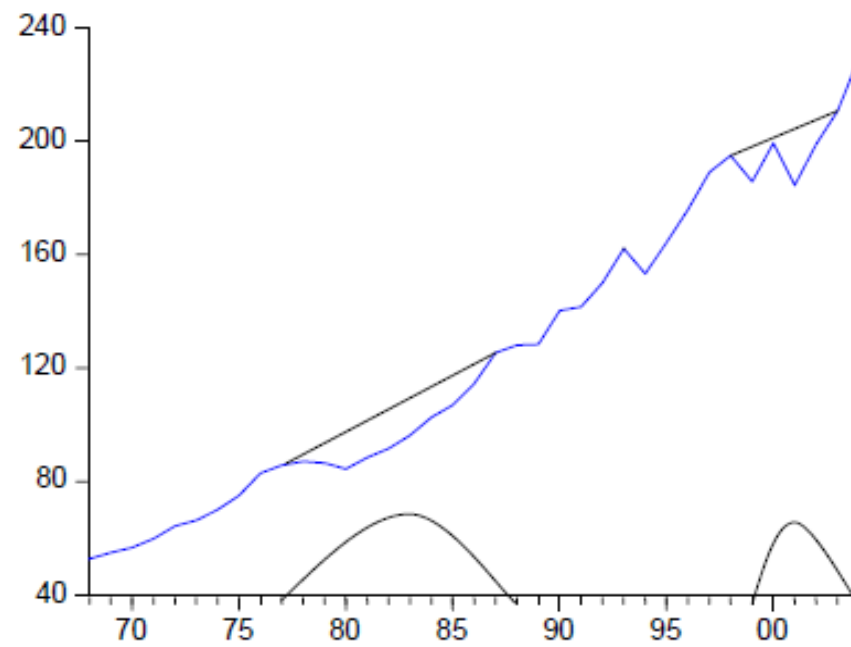

Slowdown
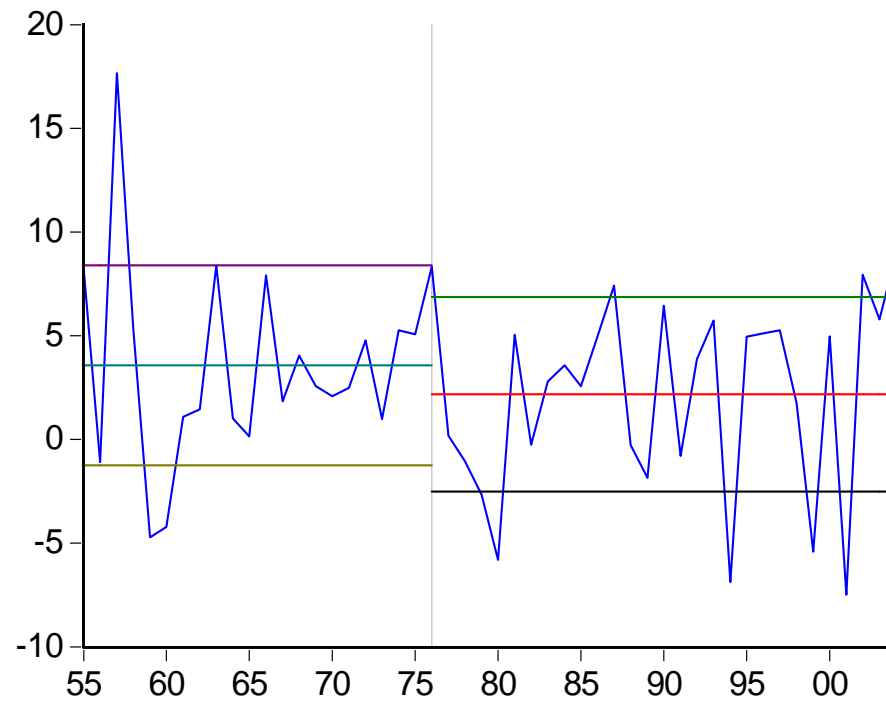
Brazil – Recent Trend

Turkey – Trend and Cycles
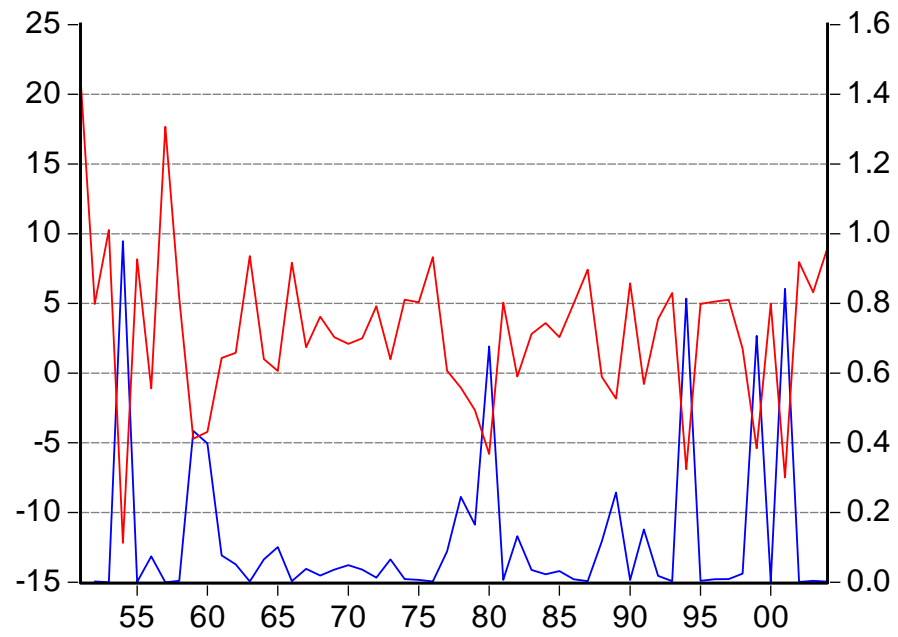
Turkey – Breaks in GDP Trend

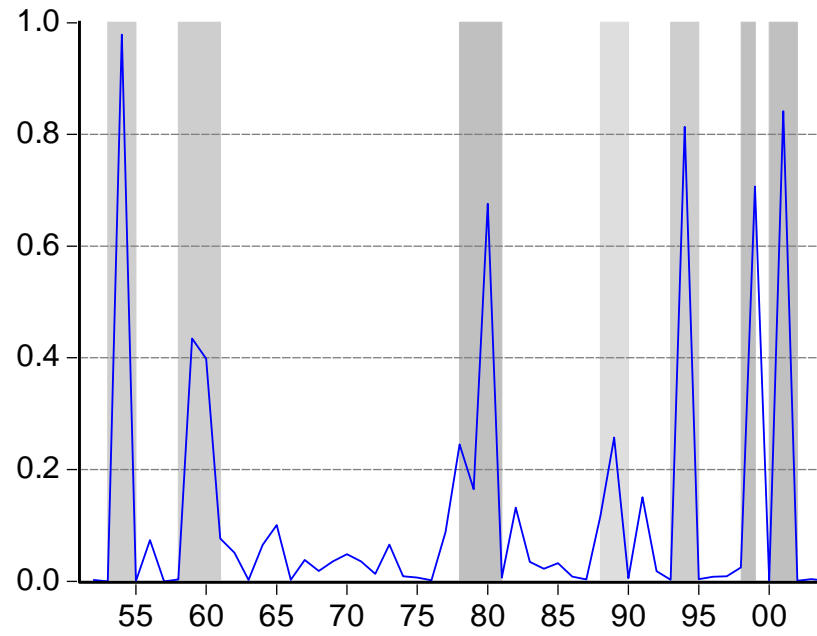## Turkey – Cycles (GDP growth)

Pre-Break: Mean growth 3.6%, stdv: 4.8
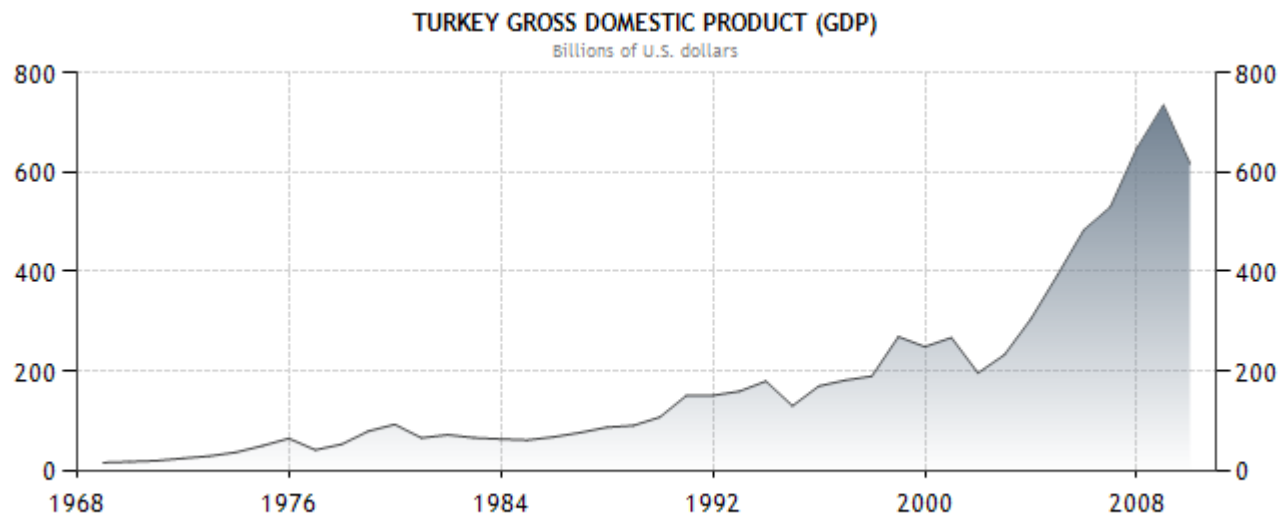
Post-Break: Mean growth 2.2%, stdv: 4.7

Turkey – Business Cycle

Turkey – Probabilities of Recession

Turkey - GDP

TURKEY GROSS DOMESTIC PRODUCT (GDP)
Billions of U.S. dollars
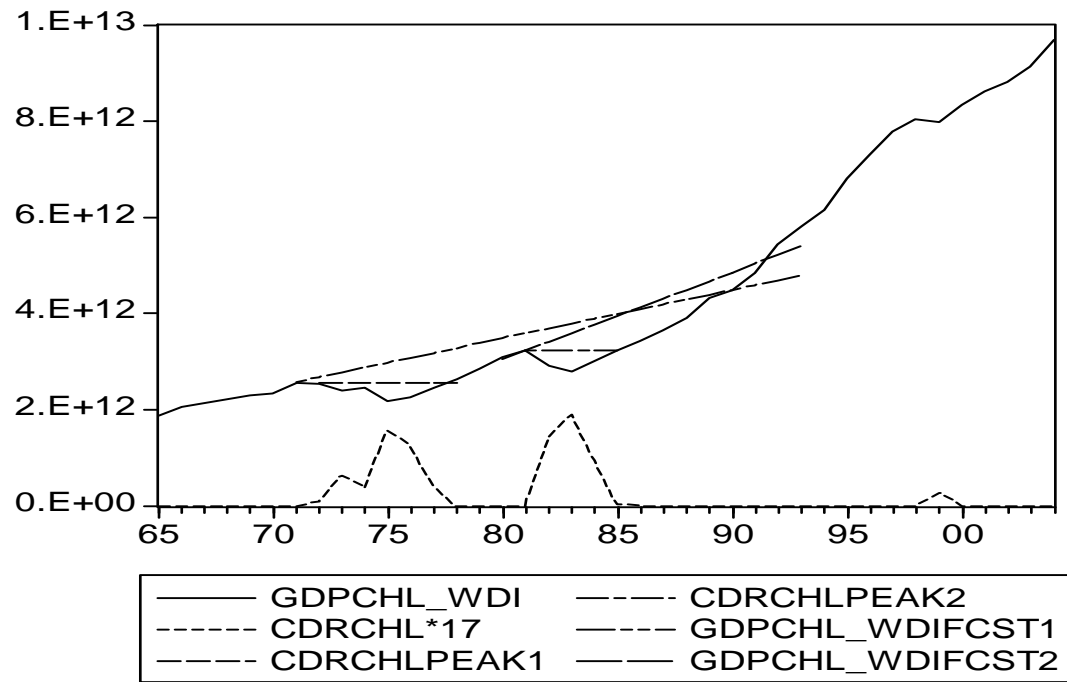
source: TradingEconomics.com; The World Bank Group

Chile

—— GDPCHL_WDI	—·—· CDRCHLPEAK2
----- CDRCHL*17	---- GDPCHL_WDIFCST1
— — CDRCHLPEAK1	—— GDPCHL_WDIFCST2

CHILE

Fast Growth

Expansion

Slowdown

Mexico

Legend:
- —— GDPMEX_WDI
- —·—· GDPMEX_WDIFCST1
- ---- 45*CDRMEX
- —— GDPMEX_WDIFCST2
- ——— CDRMEXPEAK1

MEXICO

Fast Growth

Expansion

Slowdwon

Argentina

ARGENTINA

Fast Growth

Expansion

Slowdown
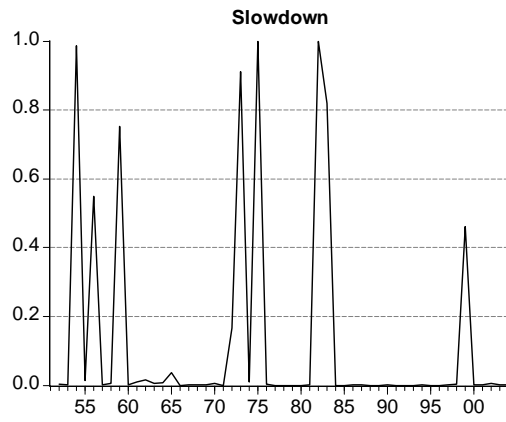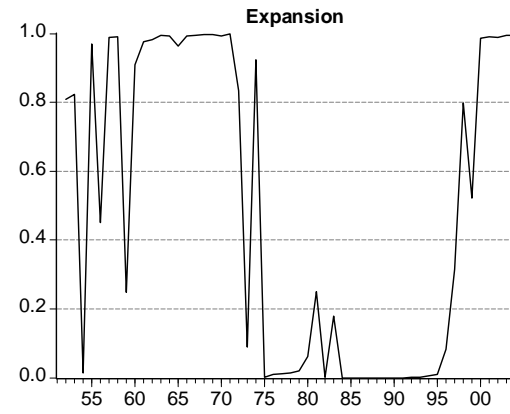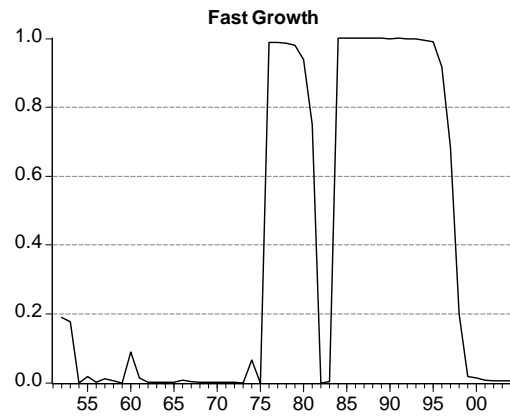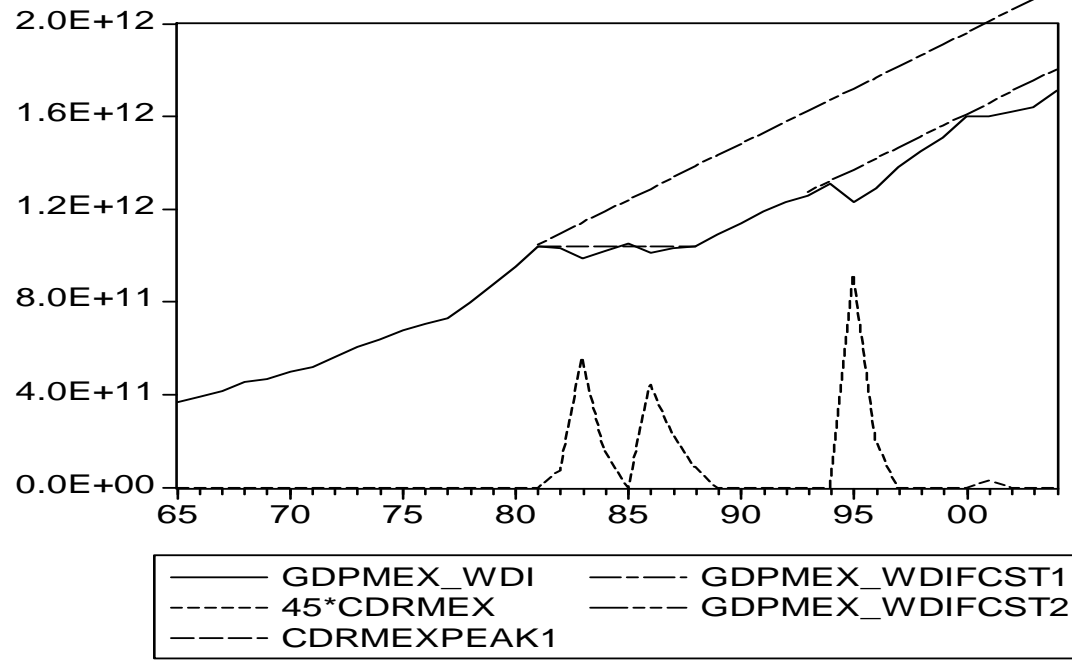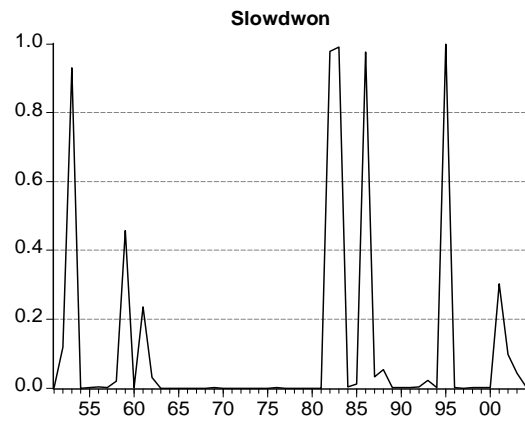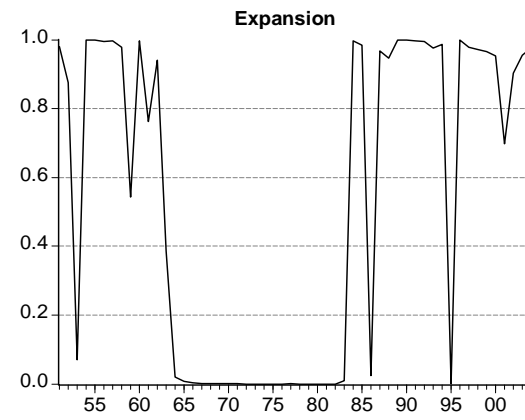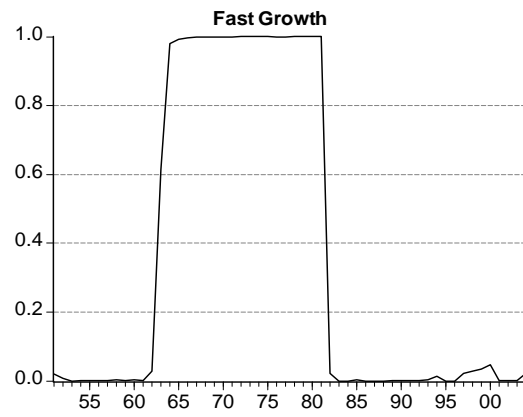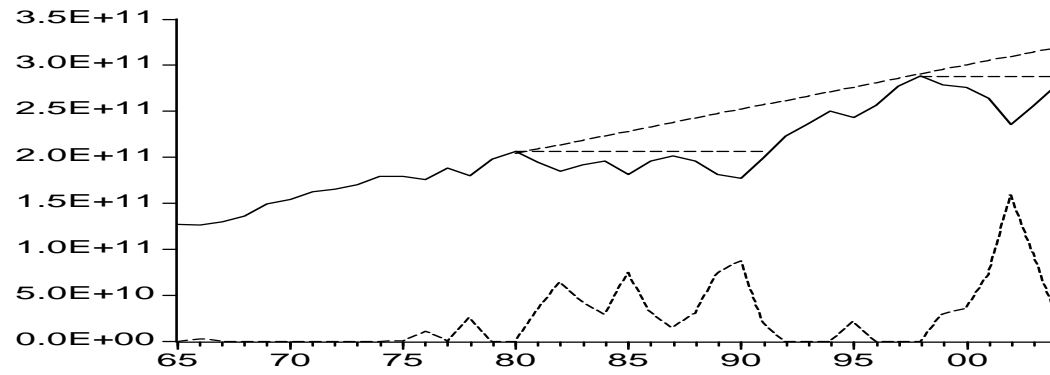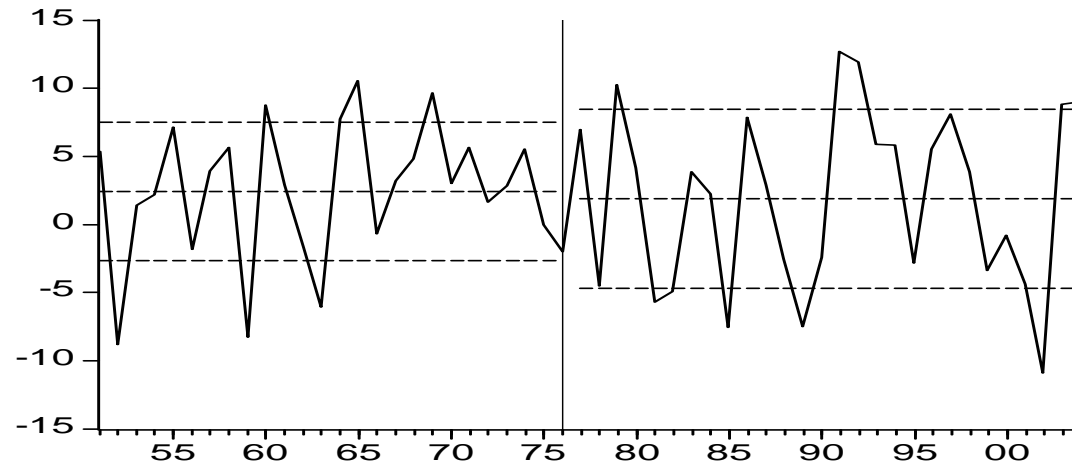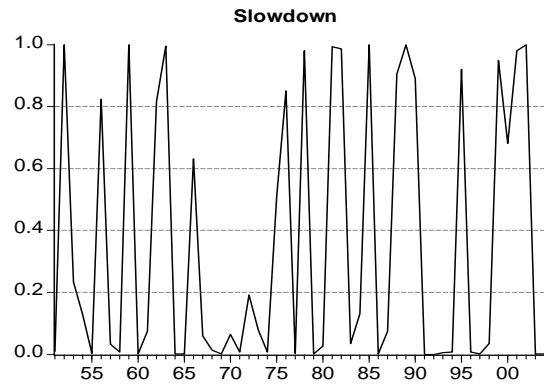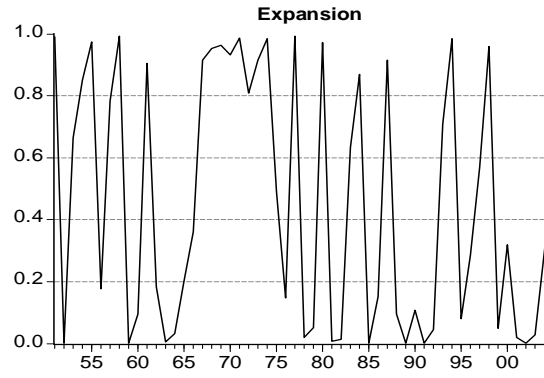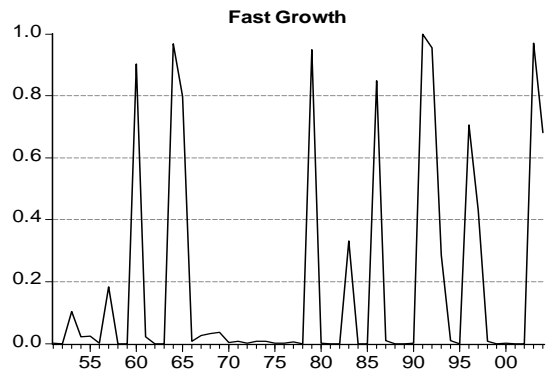
Results

- Emerging Economies have quite different dynamics compared to the U.S. or European countries.

- Although models identify expansion and contraction phases, in most cases an additional state is the best representation of their business cycle.

- On the other hand, we find evidence of several structural breaks in their mean growth rate and volatility, which are closely related to financial, banking or currency crises.

- There have also been gradual shifts, which are related to long run changes in the growth and stability of these economies.

Challenges and Goal – Nonstationarities

- Long-term trend exhibits multiple structural breaks and/or time-varying parameters.

- Based on these results, build leading indicators that take into account:

  ➢ Impact of these breaks on duration and frequency of business cycle phases, and on recession forecasts.

  ➢ Potential asymmetries underlying economic and financial series across different stages of the business cycle or financial markets.

  o Many studies have shown that the largest errors in characterizing and predicting some series occur around turning points (i.e., the beginning or end of a cycle).

CODACE - Tools for Dating Business Cycles

- Traditional method described above as reference

- Probabilities of quarterly recessions and reference turning points obtained from Markov switching model adjusted to GDP

- Several empirical representations of business cycles using series measuring production, sales, employment, and income.

- Coincident indicators of the economy built from:

  1) Weighted average of monthly coincident series

  2) Dynamic factor model with Markov switching applied to several coincident series (8): probabilities of monthly recessions and business cycle turning points

CODACE - Tools for Dating Business Cycles

3) Common features model

4) Principal component and dynamic factor adjusted to 36 monthly series representing sectors that compose GDP: construction of monthly GDP series

5) MIDAS Kalman filter: construction of monthly GDP series

Tools for <u>Predicting</u> Business Cycles

- Probit models: Chauvet and Morais (2008, 2001)

- Uses a time-varying autoregressive probit model that allows for potential recurrent breakpoints.

- Proposed methodology is especially suited for the Brazilian economy, since it takes into consideration potential structural breaks, changes in parameters, and their peculiar short business cycle phases.

- Model composed of several economic series that display predictive power to anticipate the beginning or end of recessions.

- Two different specifications for comparison:
    - **Model 1**: Standard probit with no break

    - **Model 2**: Dynamic probit model with recurrent breaks - business cycle specific variance and autoregressive latent process.

Tools for <u>Predicting</u> Business Cycles (cont.)

- In addition to traditional recession probabilities period by period, the paper constructs probabilities that a given quarter is the first one in a recession phase

  ➢ Probabilities of `first occurrence' or hitting probabilities take into consideration information regarding the duration of cycle phases, which can potentially improve performance in predicting turning points.

  ➢ Method is applied for real time forecasting:

    o The uncertainty is taken into consideration in the posterior distribution of the first hitting recession probability in a real time out-of-sample exercise for the period between 2008-2010.

The Models

Model 1: Standard Probit Model

$$Y_t = \begin{cases} 0 & if \quad Y_t^* < 0 \ expansion \\ 1 & if \quad Y_t^* \geq 0 \ recession \end{cases}$$

$$Y_t^* = \beta_0 + \beta' \mathbf{X_{t\text{-}k}} + \varepsilon_t \qquad \varepsilon_t|\mathbf{X_t} \sim \textit{i.i.d.} \ \mathbf{N(0,1)}$$

$$\mathbf{P}(Y_t^* \geq 0| \mathbf{X_t}, \boldsymbol{\beta}) = \Phi (\beta_0 + \beta\mathbf{X_{t\text{-}k}})$$

where
- $\mathbf{X_{t\text{-}k}}$ are the leading macroeconomic variables
- $\beta = \{\beta_0, \beta'\}$
- Y_t^* - latent variable representing the state of business cycle, dummy 0/1 with 1 for recessions
- Φ - cumulative distribution function of the standard normal distribution

Model 2: Probit model with recurrent breaks and serial correlation

$$Y_t^* = \beta_0 + \beta'X_{t\text{-}k} + \theta Y_{t-1}^* + \sigma(t)\varepsilon_t$$

$$\mathbf{P}(Y_t^* \geq 0 | \mathbf{X_{t\text{-}k}}, \beta) = \Phi_n[\beta_0 + \beta'X_{t\text{-}k}] = \Phi[(\beta_0 + \beta'X_{t\text{-}k})/\sigma_\mathbf{n}\}$$

where $\sigma_n = \sigma(t)$ if $t_{n-1} < t \leq t_n$, n = 1, …, N, and $|\theta| < 1$.

- Scale of innovation and coefficients can not be separately identified: model can be interpreted as a time-varying parameter specification, in which σ_n normalized to 1 across all business cycles, but each cycle has unique coefficients $\beta_{n0} = \beta_0/\sigma_n$ and $\beta_{ni} = \beta_i/\sigma_n$

- Another interpretation: shocks change across business cycles – possibility that size of innovation variance may change depending on the duration of the business cycle.

  ➢ Since this specification allows for recurrent breakpoints across business cycles, it can capture long run trends on the variance such as whether it has been decreasing over time.

Selected Leading Variables

- We use the simple and extended probit models, linear regressions, and turning point analysis to rank and select top leading indicators of recession from hundreds of variables (two types: short run:1-2 quarters; medium run: 3-6 quarters).

- Among the best leading indicators there are:

  o Measures of early stages of the production process

  o Measures of demand and supply pressures, changes in fiscal and monetary policy

  o Changes in expectations of the private sector

    ▪ Stock market index

    ▪ Business Tendency Surveys
      ➢ Industrial Tendency Surveys (FGV and CNI)
      ➢ Consumer Survey (FGV)

DATA

- <u>In-Sample</u>: 1994:Q3 to 2008:Q2
- <u>Out-of-Sample</u>: 2008:Q3 to 2009:Q4

Table 1 – Description of selected leading variables

Short Run (1-2 quarters)		Medium Run (3-6 quarters)	
Code	Variable	Code	Variable
SA7	Physical Production in the Mineral Sector – PIM-PF/IBGE	SA5	Residential Consumption of Electrical Energy
SA21	Production of Natural Gas in millions/m^3	SA39	Stock of Light Commercial Vehicles in Dealers
SA33	Total Production of Agricultural Machines (quantum)	SA41	Stock of Buses in Dealers
SA42	Total Stock of Vehicles in Dealers	SA46	Total Import Price Index
SA43	Total Export – SECEX	SA52	Personal Bankruptcy Index
SA55	Stock Return Ibovespa (% a.m)	SA60	Changes in the Trade Balance
GDP	Quarterly series at market prices, chained index, 1995=100. Source: Ipeadata		

Figure 3 – Short Run Leading Variables

Industrial Production in the Mineral Sector

Production of Natural Gas

Production of Agricultural Machines

Total Stock of Vehicles in Dealers

Exports

Ibovespa Stock Return (% a.m)

47
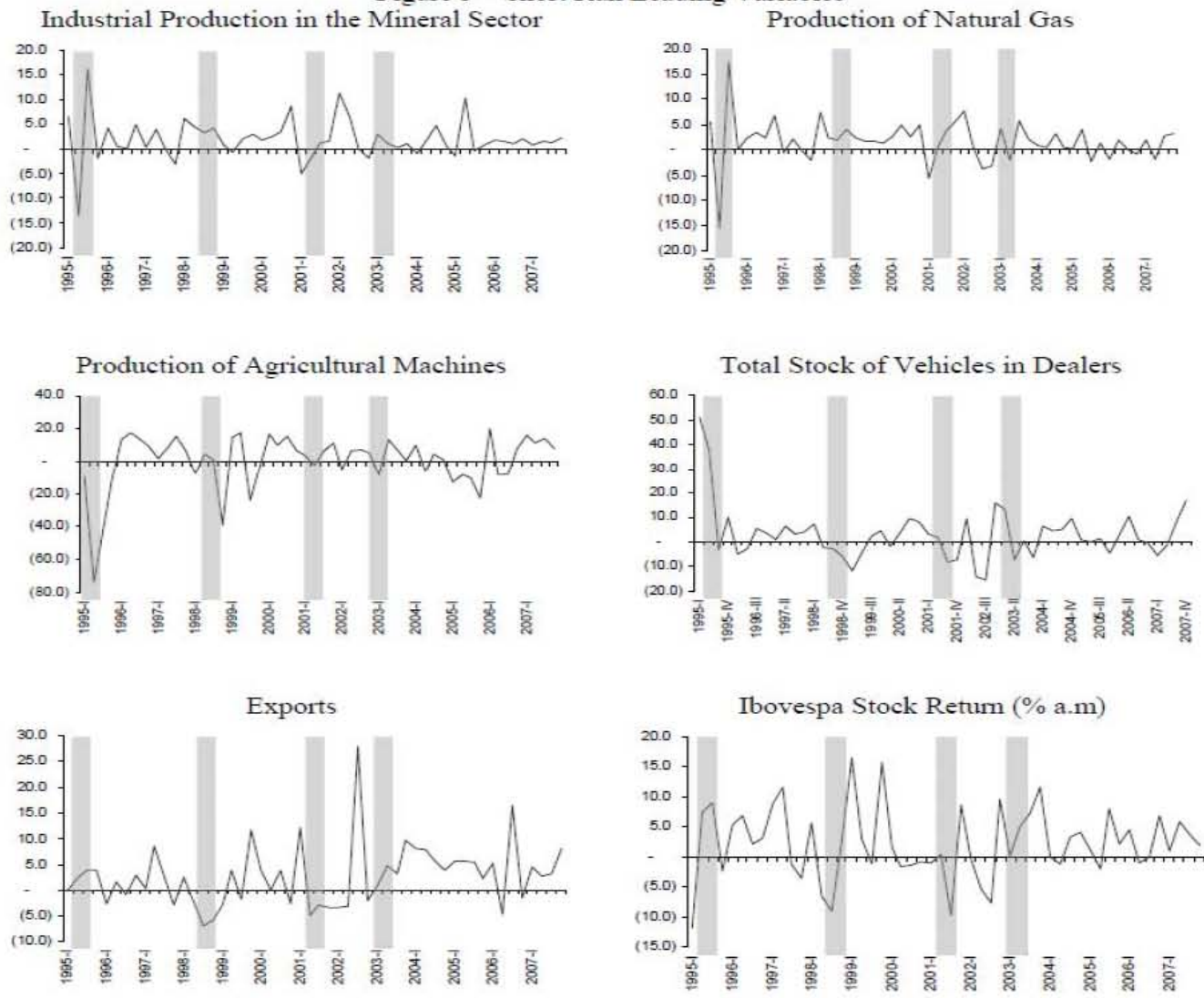
Figure 4 – Medium Run Leading Variables

Residential Consumption of Electrical Energy

Stock of Light Commercial Vehicles in Dealers

Stock of Buses in Dealers

Import Price Index – Total

Bankrupcy Index

Trade Balance – Absolute Change

48
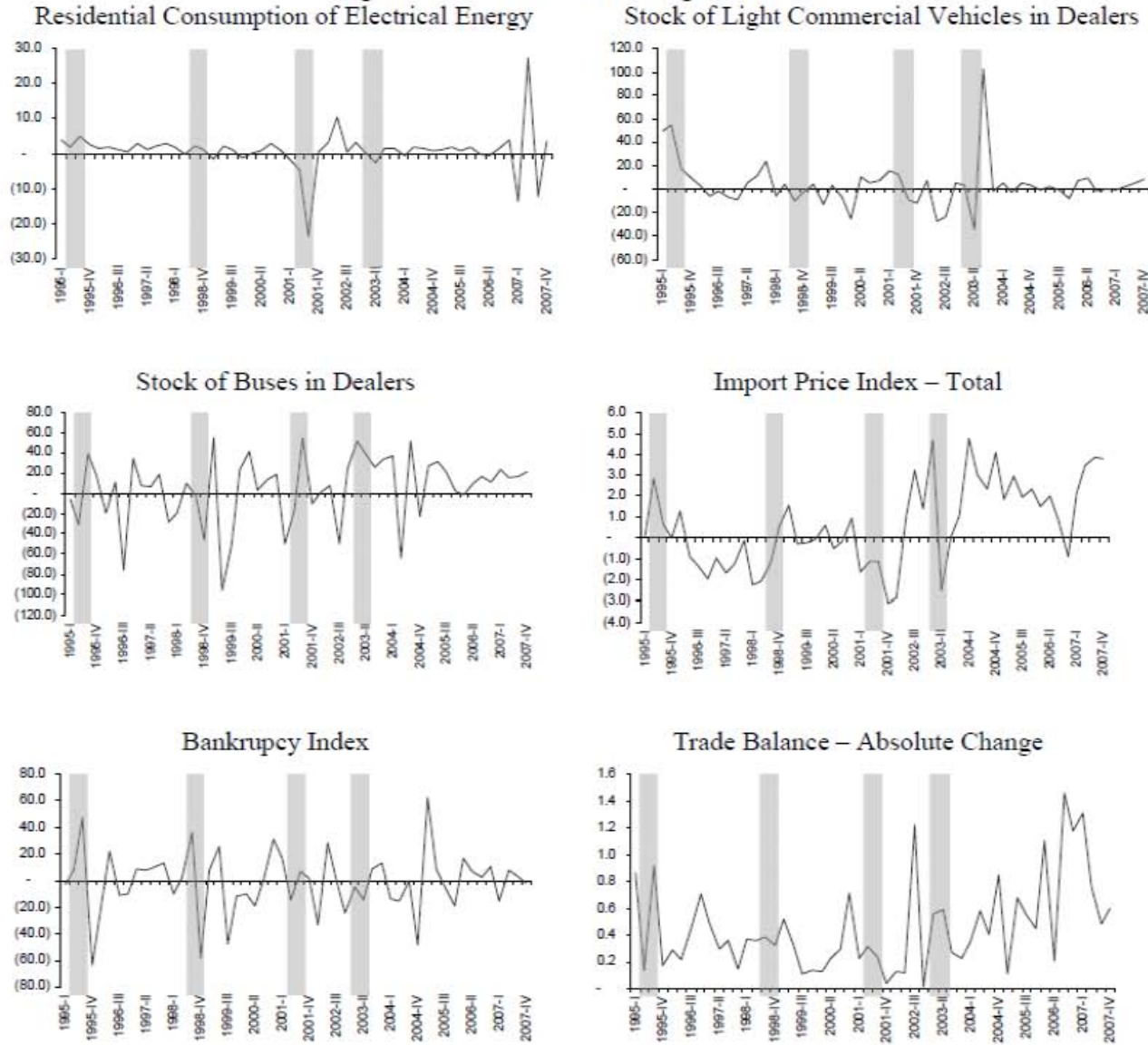
Empirical Results

Posterior Mean Parameters across Models

Parameters	Model 1 Short Run	Model 2 Short Run	Parameters	Model 1 Medium Run	Model 2 Medium Run
β_0^{sr}	-2.43	-2.40	β_0^{mr}	-3.57	-2.52
β_1^{sr}	0.05	-0.65	β_1^{mr}	-0.04	-0.05
β_2^{sr}	-0.49	-1.59	β_2^{mr}	-1.39	-1.17
β_3^{sr}	0.29	0.48	β_3^{mr}	-1.21	-0.75
β_4^{sr}	-0.55	-0.82	β_4^{mr}	-1.60	-1.38
-	-	-	β_5^{mr}	-0.06	-0.04
θ^{sr}	-	0.2	θ^{mr}	-	0.30
Innovation Variance	1	-	Innovation Variance	1	-
1995:I-1995:III	-	7.98	1995:I-1995:III	-	-
1995:IV-1998:IV	-	3.84	1995:IV-1998:IV	-	1.64
1999:I-2001:III	-	2.56	1999:I-2001:III	-	0.71
2001:IV-2003:II	-	1.23	2001:IV-2003:II	-	0.65

Empirical Results

- Estimated variances reflect similar findings across different business cycles:

  ➢ Highest variance occurring in the earlier business cycles (trough to trough)

  ➢ Innovation variance shows a declining trend over time.

- Strong evidence of structural breaks in the relationship between series and business cycles. Bayes factor:

     Model 2 vs Model 1:   -128.2

Jeffrey's rule
      $lnBF > 0$ evidence supports null
      $-1.15 < lnBF < 0$ very slight evidence against null
      $-2.3 < lnBF < -1.15$ slight evidence against the null
      $-4.6 < lnBF < -2.3$ strong to very strong evidence against null
      $lnBF < -4.6$ decisive evidence against null (Model 1).

Empirical Results (cont.)

- Consideration of recurrent breaks is important as parameters change substantially, as seen in Table 1:

  ➢ Imposing constant parameters across business cycles can yield misleading results.

- In addition, where the break occurs is important in determining the probabilities of recession.

  ➢ Uncertainty over the breakpoints implies very different signal to noise ratio regarding prediction of recessions.
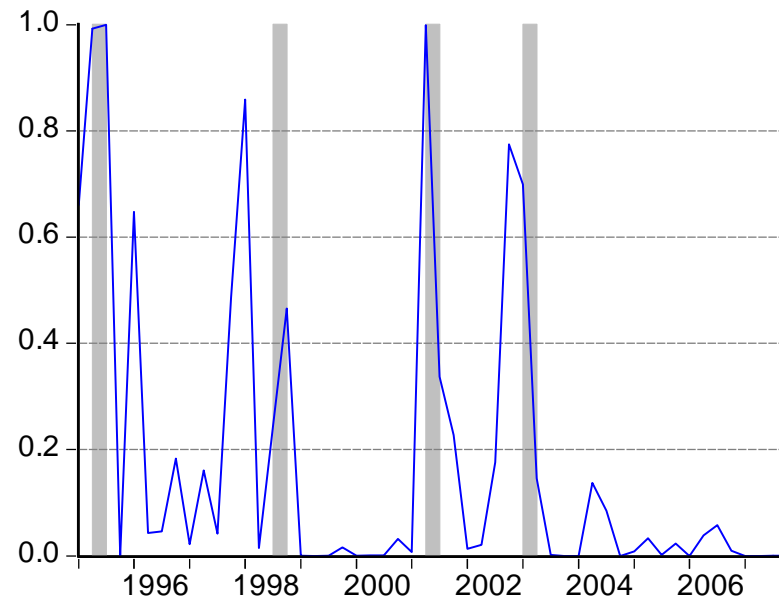
Posterior Mean Probabilities of Recession

- Probabilities consistently rise before each of the four recessions.

- However, marked differences in the signal to noise ratios of each model. Proposed extended probit model has a better ability to predict recessions compared to standard probit on several dimensions:

  ➤ Model 1 (simple probit no break) noisy during expansions. It signals recessions with relatively low probability values.

  ➤ Model 2 (extended probit recurrent breaks) show much clearer dichotomy between recessions and expansions and, therefore, less uncertainty regarding interpretation of the probabilities of recessions (smoother, low noise during expansions, leading signals of recession).

  ➤ Model 2 correctly signals all recessions, with no missed call and very few false peaks (1 in sr, 0 in mr). Model 1 SR, on the other hand, misses one recession and yields several false recession alarms (3 in sr, 2 in mr).

Mean Posterior Probabilities of Recession from the Short Run Simple Probit Model (Model1_sr) and the Extended Probit Model (Model2_sr)
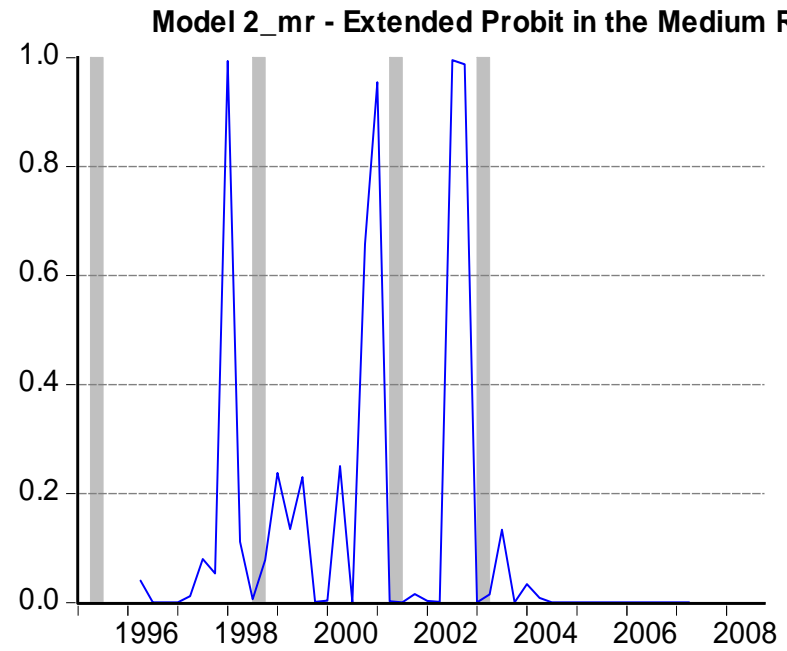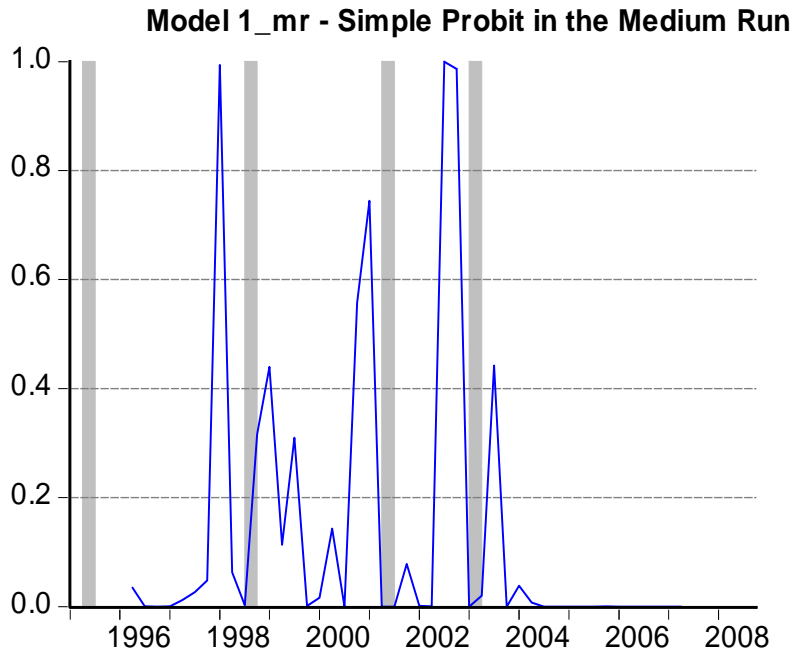

Model 1_sr - Simple Probit in the Short Run
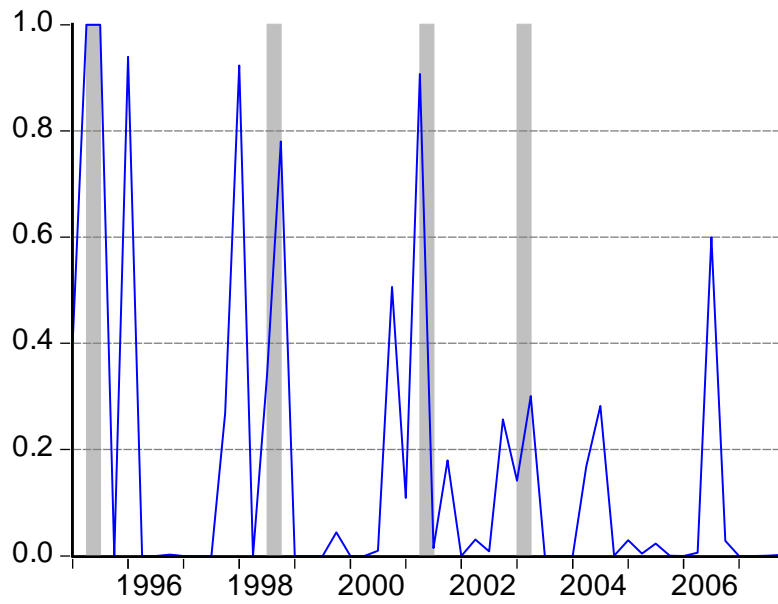
Model 2_sr - Extended Probit in the Short Run

Mean Posterior Probabilities of Recession from the Medium Run Simple Probit Model (Model1_mr) and the Proposed Probit Model (Model2_mr)

Model 1_mr - Simple Probit in the Medium Run

Model 2_mr - Extended Probit in the Medium Run

Real Time Forecast – Hitting Probabilities

First Hitting Time to a Recession:

$$H_R(t) = \{H: Y^*_{t+H} > 0,\ Y^*_{t+H-1} < 0, \ldots, Y^*_{t+1} < 0\},$$

Hitting Probabilities:

$$\pi_R(k, t) = P[H_R(t) = k]$$

$$= P[Y^*_{t+k} > 0 \mid Y^*_{t+k-1} < 0, \ldots, Y^*_{t+1} < 0](1 - \pi_R(k-1, t))$$

Conditional on $X^k_{t+K} = \{X_{t-K+1}, X_{t-K+2}, \ldots, X_{t-K+k}\}$:

$$\pi_R(k, t) = \Phi[\beta_0 + \beta_1 X_{t-K+k}] \prod_{s=1}^{k-1} \{1 - \Phi[\beta_0 + \beta_1 X_{t-K+s}]\}$$

$$l(Y^T \mid X^{T-K}, \beta) = \prod_{t \in R} \Phi[\beta_0 + \beta_1 X_{t-K}] \prod_{t \in E} \{1 - \Phi[\beta_0 + \beta_1 X_{t-K}]\}$$

$$\text{where } \beta = [\beta_0, \beta_1\ ]'$$

Real Time Predictive Ability - Recent Economic Situation

Real Time Probabilities

	Model 1sr 2008:III Peak	Model 1sr 2009:II trough+1	Model 2sr 2008:III peak	Model 2sr 2009:II trough+1	Model1mr 2008:III peak	Model1mr 2009:II trough+1	Model2mr 2008:III peak	Model2mr 2009:II trough+1
Probability of Continued Expansion	98.0%	8.2%	42.6%	65.4%	84.8%	22.1%	31.3%	78.1%
Hitting Probability of Recession	0.2%	91.8%	57.4%	34.6%	15.2%	77.9%	68.7%	21.9%
Lower 2.5th percentile	0.04%	43.2%	48.9%	0.06%	0%	48.6%	56.8%	0.02%
Upper 97.5th percentile	9.6%	99.0%	68.2%	46.2%	43.1%	92.0%	81.4%	35.6%

Real Time Recession Forecasts for 2008-2009

- Paper updated: in-sample 1994:III to 2008:II; out-of-sample: 2008:III to 2009:IV

- Model 2 in the short run and medium run has the best overall ability to forecast Brazilian recessions.

➢ Model medium run – Hitting probability of recession for 2008:III (Codace peak):

    ➢ Model 1: 15.2%   (0%, 43.1%)   misses peak

    ➢ Model 2: 68.7%   (56.8%, 81.4%)   signals peak

➢ Model medium run – Hitting probability of recession for 2009:II (Codace trough in 2009:I):

    ➢ Model 1: 77.9%   (48.6%, 92.0%)   misses trough

    ➢ Model 2: 21.9%   (0.02%, 35.6%)   signals trough

Recession Forecasts for 2008-2009: Uncertainty

Posterior cumulative distribution function of the probability of a recession state in 2008-2009 indicates that uncertainty regarding the recession probability is larger for the standard probit model.

Medium Run Model – Probability of recession in 2008:III

➢ Model 1 – standard probit model:

   95% of the posterior on the probability of recession is between 0% and 43.1%

➢ Model 2 – Extended probit model with recurrent breaks:

   95% of the posterior on the probability of recession is between 56.8% and 81.4%

Medium Run Model – Probability of recession in 2009:II

➢ Model 1 – standard probit model:

   95% of the posterior on the probability of recession is between 48.6% and 92.0%

➢ Model 2 – Extended probit model with recurrent breaks:

   95% of the posterior on the probability of recession is between 0.02% and 35.6%

Real Time Forecasting

- We use the hitting probabilities in a real-time forecasting exercise to assess the probability of a recession occurring in 2008:III and ending before 2009:II.

  - Uncertainty with respect to a recession probability is reduced when time-varying parameters and serial correlation in the conditional mean of the leading variables are considered.

  - Extended probit model yields a higher probability of recession with less uncertainty than the standard probit model for the recession peak in 2008:III

  - Extended probit model yields a lower probability of recession with less uncertainty than the standard probit model for the quarter after the recession trough in 2009:I

Conclusions

- Misspecification of standard probit model

- Evidence of recurrent breakpoints: Bayes factors strongly favor Model 2

- Recession forecasts differ substantially across specifications

- Both models signal weaker economic activity but with different strength. Uncertainty decreases with more sophisticated model

- Better in-sample and out of sample real time prediction
  - ➢ Probit model with recurrent breaks (business cycle specific innovation variance)