MSc DOFIN

Financial and Business Cycles. Worldwide Correlations and Determinants

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1. MOTIVATION

- A common feature of the recent crises was that they also had various types of financial disruptions
 - an intensive debate about the links between macroeconomics and finance
 - the study of interactions between business cycles and financial cycles have been propelled to the forefront of research
- It is not possible to understand economic fluctuations without understanding the co-movement between financial and business cycles

2. OBJECTIVES

- What are the financial and business cycles and why are they so important in the economy?
- How do we observe the financial and business cycles?
- What methods are used for dating the cycles?
- What are the main characteristics of the financial and business cycles in Romania?
- How do business and financial cycles interact?

What are the financial and business cycles and why are they so important in the economy?

- Persistent fluctuations of the economy, that do not have a seasonal nature and that generate the transitions from booms to busts
- Cycles are important factors for all the market participants
 - the central authorities use their expectations in the process of establishing policies
 - agents and households use their expectations in shaping their behaviour of consumption and saving.

How do we observe the financial and business cycles?

- Business cycles the fluctuations of the production (GDP, industrial production)
- Financial cycles ?
 - A consensus has not been reached
 - Studying the cycles of credit, property prices and financial assets
 - Constructing a Financial Conditions Index which aims to capture the information from a very large set of financial variables

- Principal Component Analysis
 - Pearson (1901) & Hotelling (1933)
 - Transforming a large number of variables into a smaller set of uncorrelated (orthogonal) factors, the principal components
 - The principal components account for much of the variance among the set of original variables
 - > Each component is a linear combination of the initial variables.
 - \blacktriangleright Let **X** be the initial set of data series and **A** the correlation matrix for **X**.

A = WAW' and P = XW

where Λ is the diagonal matrix of the eigenvalues, **W** is the orthogonal matrix of the corresponding eigenvectors and **P** is the matrix of principal components

- Constructing a FCI using Principal Component Analysis
 - The Index is computed as the common component of several financial variables it captures the greatest common variation in the variables
 - Matheson (2012) FCIs for the USA and Euro Area, Hatzius et al. (2010) – FCI for USA, Angelopoulou et al. (2010) – FCIs for Euro Area and selected Euro Area countries
 - Chicago Fed National Financial Conditions Index
 - St. Louis Fed's Financial Stress Index
- The purpose of this section: constructing a FCI for Romania, covering the period January 2005 December 2014 a measure for the financial conditions.

| Data series | First difference | The sign of the series | Standardised |
|-------------------------------------|------------------|------------------------|--------------|
| Total loans to private sector/ GDP | \checkmark | + | \checkmark |
| Loans to private sector in RON/ GDP | \checkmark | + | \checkmark |
| Variation of ROBOR3M | | - | \checkmark |
| Variation of EURIBOR3M | | - | \checkmark |
| EURIBOR3M – EONIA spread | | - | \checkmark |
| Lending rates** - ROBOR3M spread | | - | \checkmark |
| Lending rates** - EURIBOR3M spread | | - | \checkmark |
| Variation of the lending rates | | - | \checkmark |
| Variation of VSTOXX | | - | \checkmark |

Source: NBR, INS, EUROSTAT, GLOBAL-RATES, STOXX, Author's computation

 Considering the way the index is constructed, a decrease of the index will signal a tightening of the financial conditions, while an increase in the index will indicate an easing of the financial conditions in Romania.

| Eigenvalues: (Sum = 9, Average = 1) | | | | | |
|-------------------------------------|----------|------------|------------|---------------------|--------------------------|
| Number | Value | Difference | Proportion | Cumulative Value | Cumulative Proportion |
| 1 | 3.247883 | 1.414832 | 0.3609 | 3.247883 | 0.3609 |
| 2 | 1.833050 | 0.167183 | 0.2037 | 5.080933 | 0.5645 |
| 3 | 1.665867 | 0.793049 | 0.1851 | 6.746800 | 0.7496 |
| 4 | 0.872819 | 0.297668 | 0.0970 | 7.619619 | 0.8466 |
| 5 | 0.575150 | 0.115891 | 0.0639 | 8.194770 | 0.9105 |
| 6 | 0.459260 | 0.249902 | 0.0510 | 8.654029 | 0.9616 |
| 7 | 0.209358 | 0.126198 | 0.0233 | 8.863387 | 0.9848 |
| 8 | 0.083160 | 0.029706 | 0.0092 | 8.946546 | 0.9941 |
| 9 | 0.053454 | | 0.0059 | 9.000000 | 1.0000 |

The results of Principal Component Analysis applied on the initial data set

Source: Eviews, Author's computation

Kaiser's criterion and minimum 70% variance



 $FCI = \frac{PC1 * 0.3609 + PC2 * 0.2037 + PC3 * 0.1851}{0.7496}$

Figure 2.3.1: The Evolution of the Financial Conditions Index



Source: Eviews, Author's computation





Source: Author's computation

Figure 2.3.2: A Comparison Between the FCI and the Growth Rate of the Real GDP



Source: Author's computation

Each financial variable is purged from its response to the economic activity

$$X_{it} = A_i(\mathbf{L})Y_t + v_{it}$$

where X_{it} the *i*-th financial variable and Y_t represents the present value and the t - 1 lag of the real GDP

 $FCI_res = \frac{PC1_res * 0.3801 + PC2_res * 0.1875 + PC3_res * 0.1152}{0.6829}$

What methods are used for dating the cycles?

Dating vs. Detecting the cycles

- Dating the cycles of a series is a difficult and important concept
- Two different approaches in the literature:
 - Non-parametric models translate the graphical inspection approach into an algorithm, flexible, transparent
 - Parametric models more complex, involve a mathematical approach, provide more qualitative and quantitative information

What methods are used for dating the cycles? – A non-parametric approach

- Burns and Mitchell (1946)
- Bry and Boschan (1971) The BB Algorithm (NBER)
- Harding and Pagan (2002) *The BBQ Algorithm*
- *The BBQ Algorithm 3 steps:*
 - 1. Determination of a potential set of turning points, i.e. the peaks and troughs in a series.
 - 2. A procedure for ensuring that peaks and troughs alternate.
 - 3. A set of rules that re-combine the turning points established after steps one and two in order to satisfy pre-determined criteria concerning the duration and amplitudes of phases and complete cycles; what we will refer to as ,,censoring rules".
- Dating the business and financial cycles using the BBQ Algorithm Claessens et al. (2011); Harding (2008)

What methods are used for dating the cycles? – A non-parametric approach

Identifying the Turning Point of the GDP

Identifying the Turning Points of the FCI

Censoring Rules (Pagan&Harding):

- a phase at least 2 quarters
- a full cycle at least 4 quarters

Censoring Rules:

- a phase at least 4 quarters
- a full cycle at least 8 quarters

- Claessens et al. (2011)
- The FCI constructed for Romania captures much of the banking sector characteristics

What methods are used for dating the cycles? – A non-parametric approach

Identifying the Turning Point of the GDP

Identifying the Turning Point of the FCI

| Gross Domestic Product | | |
|------------------------|-------------|--|
| Peak 2008 – Q3 | | |
| Trough | 2010 – Q3 ! | |

The Turning Points of the Real GDP Series Identified by the BBQ Algorithm



The Turning Points of the FCI Series Identified by the BBQ Algorithm





Source: Author's computation

Source: Author's computation

What methods are used for dating the cycles? – A parametric approach

- Markov Switching Models
 - Developed by James Hamilton (1989)
 - More complex, popular and efficient in dating and detecting the cycle -Anas et al. (2002); Franses et al. (2001); Artis et al. (2002)
 - Able to provide a lot of qualitative and quantitative information
 - Assume that the evolution of a series is ruled by an unobservable variable which in turn follows a first order K-state Markov chain
- The purpose of this section:
 - Identifying two regimens for each of the variables GDP and FCI What are the main characteristics of the financial and business cycles in Romania?

Identifying the joint phases of the two variables – How do business and financial cycles interact?

What methods are used for dating the cycles? – A parametric approach

Are the two variables subject to structural breaks?

Results of Chow Test

| CHOW TEST (H0: No breaks at specified breakpoints) | | | |
|----------------------------------------------------|--------------------|---------|--|
| The variable | F-statistic | p-value | |
| The real GDP | 3.4537 | 0.0428 | |
| Financial Conditions Index | 5.9933 | 0.0058 | |

Source: Author's computation, Eviews

• AMS(2) - AR(p) model for identifying two phases for each variable:

- ➢ For the GDP: the expansion phase and the contraction phase
- For the Financial Conditions Index: the relaxation phase of the financial conditions and the tightening phase of the financial conditions.

$$y_t = \alpha_{S_t} + \sum_{i=1}^p \beta_{S_t}^i y_{t-i} + \sigma_{S_t} \varepsilon_t$$

Choosing the number of lags – log-likelihood criterion:

| Log-likelihood | FCI | GDP |
|----------------|-------|-------|
| MS-AR(1) | 140.6 | 117.6 |
| MS-AR(2) | 138.5 | 116.9 |
| MS-AR(3) | 151.6 | 119.9 |

Source: Matlab, Author's computation

I. Filtered and Smoothed Probabilities







II. Characteristics of the phases

GDP

- State 1
 ➤ mean 0.035
- State 2
 ➤ mean -0.176

- FCI
- State 1
 - ➤ mean 0.003
 - ➤ standard deviation 0.0032

• *State 2*

- ≻ mean -0.006
- ➤ standard deviation 0.0053

III. Transitions Probability Matrix

| G | DP | FO | CI |
|----------------------|-----------------|-----------------------|-----------------|
| (<mark>93.2%</mark> | 25.11% | (<mark>96.35%</mark> | 11.51%) |
| 6.8% | 74.89%) | 3.65% | 88.49%) |

The phases of the FCI are more persistent than the phases of the GDP is we expect them to have a longer duration

IV. The duration of the phases

$$D_{S_i} = \frac{1}{1 - p_{ii}}$$

| | Gross Domestic Product | Financial Conditions Index |
|-------------|----------------------------------|--------------------------------|
| State 1 | 14.7 quarters | 27.4 quarters |
| State 2 | 3.9 quarters | 8.7 quarters |
| TOTAL Cycle | 18.6 quarters = 4.7 years | 36.1 quarters = 9 years |

Source: Matlab, Author's computation

V. Coefficients

| Lag | Financial Conditions Index | Gross Domestic Product | |
|-----|----------------------------|-------------------------------|--|
| | State 1 (p-value) | | |
| 1 | 0.3997 (0.08)*** | 0.0029 (0.00)* | |
| 2 | 0.3418 (0.08)*** | 0.4630 (0.00)* | |
| 3 | 0.0041 (0.98) | 0.0273 (0.00)* | |
| | State 2 (p-value) | | |
| 1 | -0.3493 (0.00)* | -0.6869 (0.00)* | |
| 2 | -0.0219 (0.81) | -1.6856 (0.00)* | |
| 3 | -0.1968 (0.04)** | -1.9256 (0.04)** | |

*significance level of 1%, **significance level of 5%, ***significance level of 10% *Source: Matlab, Author's computation*

- A MS(k) VAR(p) model
- 2 individual phases for each variable => 4 joint phases
- Estimating a model with 3 phases:
 - State 1: Both the real GDP and the Financial Conditions Index are growing
 - State 2: The real GDP grows and the Financial Conditions Index decreases
 - State 3: Both the real GDP and the Financial Conditions Index decrease
- Choosing the number of lags

| | AIC | BIC |
|----------------|-----------|-----------|
| MS(3) - VAR(1) | -434.7128 | -313.7240 |
| MS(3) - VAR(2) | -451.5912 | -343.1028 |
| MS(3) - VAR(3) | -463.4379 | -349.1006 |

Source: Matlab, Author's computation





Are the phases correctly defined?

II. Transition probability matrix

| /95.50 % | 45.50 % | 11.48% \ |
|-----------------|----------------|----------------|
| 0.50% | 49.50 % | 26.52 % |
| 4.00% | 5.00% | 62.00%/ |

III. Duration of the phases

| TOTAL | 26.83 quarters – 6.7 years |
|------------------------------------------------------------------|----------------------------|
| Both the real GDP and the Financial Conditions Index decrease | 2.63 quarters |
| The real GDP grows and the Financial Conditions Index decreases | 1.98 quarters |
| Both the real GDP and the Financial Conditions Index are growing | 22.22 quarters |

Source: Matlab, Author's computation

IV. Coefficients

| | GDP equation | FCI equation |
|----------------|----------------|-----------------|
| State 1, Lag 1 | 0.35 (0.09)*** | 0.20 (0.07)*** |
| State 1, Lag 2 | 0.03 (0.04)** | 0.08 (0.08)*** |
| State 1, Lag 3 | 0.16 (0.28) | -0.06 (0.05)** |
| State 2, Lag 1 | 0.07 (0.00)* | -0.39 (0.03)** |
| State 2, Lag 2 | 0.46 (0.12) | -0.10 (0.08)*** |
| State 2, Lag 3 | -0.09 (0.04)** | 0.09 (0.04)** |
| State 3, Lag 1 | 0.98 (0.00)* | 1.06 (0.00)* |
| State 3, Lag 2 | 0.16 (0.08)*** | 0.08 (0.04)** |
| State 3, Lag 3 | -0.05 (0.03)** | 0.07 (0.36) |

* significance level of 1%, **significance level of 5%, ***significance level of 10% *Source: Matlab, Author's computation*

CONCLUSIONS

- A **Financial Conditions Index** is useful in studying the financial cycles
- The financial sector tends to response at least as quickly to shock as the GDP
- The **parametric models** are much more complex and provide a lot more qualitative information about the cycles than the **non-parametric ones**
- The financial cycle has more **persistent** and **longer phases** than the business cycle
- There are three joint phases for Romania's business and financial cycles
- Disruptions of the financial sector affect the entire economy and hampers the recovery after the crisis
- The business and financial cycles interact with each other the most in state 3, mutually feeding their decline
- Why should we use such a model?
- Future research: dynamic FCI, detecting the cycles, comparisons between Romania and other economies

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THANK YOU!