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This paper introduces a new composite index - the financial supply index (FSI), which measures the level of supply of foreign capital to 11 EU new member states (NMS). We aim to fill the gap in the literature, which has so far focused on creating indices that measure the financial conditions only, while the economic factors, also important determinants of capital flows, have been overlooked. FSI includes both the financial and economic determinants of capital flows and is estimated using Kalman filtering, principal components and variance-equal weights approach. Three financial supply cycles in NMS could be extracted based on the analysis of FSI dy-namics. The results indicated that the main drivers of financial supply to NMS are externally determined, with economic sentiment and business climate in the Eurozone carrying the highest weight. In addition, we create a new indicator - the Refinancing Risk Ratio (RRR), which relates the supply and demand for foreign capital, to quantify the external refinancing conditions and risk faced by the government. We are able to distinguish two main episodes of high refinancing risk faced recently by the EU NMS - one during the global financial crisis, and the other during the European sovereign debt crisis, but the episodes significantly differ in nature.

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financial cycles, financial supply, EU new member states, capital flows, refinancing conditions

**JEL classification**
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November 1, 2016

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# 1 Introduction

This paper introduces a new composite index, i.e. the financial supply index (FSI), which measures the level of supply of foreign capital to 11 EU new member states (NMS). FSIs are estimated using three different methodological approaches and then applied to extract financial supply cycles, and to create a new indicator, i.e. the *Refinancing Risk Ratio* (RRR). This ratio relates the supply and demand for foreign capital to quantify the external refinancing conditions and risk faced by the governments.

Recent global financial and European sovereign debt crises highlighted the importance of macro-financial linkages and emphasized how severe financial stress can translate into real economic activity. Financial conditions are important because they reflect not only current and past economic conditions, but also the markets' expectations about the future, which is why they are a subject of interest to policy makers, investors, regulators, researchers, etc. It is, thus, not surprising that the number of financial conditions indices (FCIs) that capture the co-movement of vast arrays of financial variables in a given country (or group of countries) has risen exponentially over the recent period. Most notably, FCIs have been created by large institutions like the OECD (Guichard and Turner, 2008), Deutsche Bank (Hooper et al., 2010), Goldman Sachs (Dudley et al., 2005), Bloomberg (Rosenberg, 2009), Federal Reserve Bank of Kansas City (Hakkio and Keeton, 2009), but also by individual researchers and academics (Hatzius et al., 2010; Brave and Butters 2011; Matheson 2011; Gumata et al., 2012, etc.).

However, there is a considerable gap in the literature concerning indices that would capture the full scope of the financial supply, i.e. the supply of foreign capital in the market. Financial conditions indices do not answer the question of how much capital is really available to a country, as they ignore the economic determinants of capital flows, both in the source and destination countries. Two different countries may face the same financial environment, but this does not necessarily imply that the actual supply of capital to these countries is equal. As the literature has shown, investors may be more prone to invest into a country with better economic fundamentals, better business climate and/or more favourable economic sentiment.

The importance of economic variables as determinants of cross-border capital flows has been well documented in the literature. Ever since the seminal paper by Calvo et al. (1993), who analysed the determinants of

capital flows as combinations of "push" (external) and "pull" (domestic) factors, the vast majority of papers dealing with the topic has highlighted the importance of economic factors for cross-border capital flows. Specifically, rising economic activity and improving economic sentiment in the source and destination country have been found as important drivers that increase the volume of international capital flows, i.e. increase the supply of capital (see Chuhan et al., 1993; Kim, 2000; Ying and Kim, 2001; Taylor and Sarno, 2007; De Vita and Kyaw, 2008; IMF, 2011; Globan, 2014, 2015a, 2015b; etc.). Other important factors that influence the volume of capital flows include interest rates, indicators of liquidity and risk, macro-financial volatilities, price and exchange rate movements, indicators of financial openness, stock market indices, fiscal indicators, etc. (see e.g. Calvo et al., 1993; Fernández-Arias, 1996; Montiel and Reinhart, 1999; Fiess, 2003; Fratzscher, 2011).

Thus, the aim of this research is not to measure the mere state of internal and external financial conditions, but to create an index that would comprehensively capture all main factors that influence the volumes of foreign capital offered in the market to a given country. This index we title the financial supply index.[1] The inclusion of economic variables into the creation of such an index is essential. In contrast, economic variables (e.g. GDP or industrial production) are usually omitted from the creation of FCIs. In fact, these indices are most often purged from all economic feedback that could be contained within financial indicators (Hatzius et al., 2010). That is why, in a sense, an FCI could be viewed as a subset of an FSI.

Concerning financial supply, the literature so far has focused more on quantifying the relative importance of supply and demand forces for the dynamics in credit flows (Everaert et al., 2015), bond and loan flows (Felices and Orskaug, 2008) and sudden stop episodes in total capital flows (Mody and Taylor, 2003). To our knowledge, this is the first attempt at creating a composite index that captures the scope of financial supply to a given country over different points in time, which is based on a large number of domestic and foreign financial and economic variables. Such an index provides more information than the common FCI, as it reveals the current and historical levels of supply of capital to each country individually, which can be

[1] It should be noted that the notion of financial supply is not equal to realized capital inflows recorded by a country. FSI measures the volumes of foreign capital that are supplied to a country based on domestic and external economic and financial conditions, while recorded capital inflows measure only what has been realized, which again depends on the interactions between the supply and demand for capital.

used to determine the phase of the financial supply cycle a country is currently in. In turn, this could provide useful information to policy makers and corporate executives in determining the appropriate timing of issuing debt, the risk premium they might face, the riskiness of their refinancing position, and to form realistic expectations about near-term capital inflows.

To estimate FSIs for 11 EU new member states, we employ three methodological approaches - Kalman filtering, principal components analysis and variance-equal weights approach. Estimated indices turned out robust across specifications and lead to very similar conclusions. Based on the estimated average FSI for the NMS group it is possible to extract three financial supply cycles over the last 17 years, and the beginning of the fourth one, i.e. the one we are currently in. Furthermore, there is a trend in the higher comovement of domestic components of FSIs across EU NMS, possibly indicating rising financial integration within the group.

In the second part of the analysis we introduce a new indicator (RRR) which relates the demand for foreign funds by the government to the supply of capital available at a given point of time. We are able to distinguish two main episodes of high refinancing risk faced by the EU NMS - one during the global financial crisis, and the other during the European sovereign debt crisis. We test whether spikes in RRR across countries had been supply- or demand-induced, and find that the second spike was much different in nature than the first one. The results have shown that the main drivers of financial supply for EU NMS are externally determined, with economic sentiment and business climate in the Eurozone carrying, on average, the highest weight in FSI dynamics of individual countries.

The paper is structured as follows. Section 2 describes the variable selection and data used for the creation of FSIs. Section 3 discusses the three methodological approaches employed in the estimation. Section 4 brings forward the results of FSI and RRR estimations and their applications, while robustness checks are carried out in Section 5. Section 6 concludes the paper.

## 2 Data and variable selection

To construct a financial supply index we collected data for 21 variables, capturing external and domestic movements in market risk and liquidity, financial stability, monetary conditions, business climate and economic activity. External variables should capture the dynamics out of the scope of

domestic policy makers, which have been recognized in the literature[2] as important "push" factors of capital flows for small open economies. Likewise, domestic variables should capture the dynamics that can be influenced by domestic policy authorities, also known as "pull" factors, i.e. domestic factors that attract capital from abroad. Although in reality there is certainly much more than 21 variables that influence the supply of foreign capital, the variable selection was influenced by several objective limitations concerning data availability, lengths of time series, data frequencies, time variance, missing values and extreme outliers, especially for the period of early-2000s. Therefore, it was not possible to include all variables that the literature has found as potential determinants of financial supply.

The data is of monthly frequencies, covering the period from 1999:12 to 2016:6. Main sources of data were the IMF's International Financial Statistics (IFS) database, Eurostat and European Commission databases, but other sources were used as well. For more details on data sources consult the Data appendix. FSIs have been estimated for 11 EU new member states: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.

The total variable pool comprises 13 external and 8 domestic variables. The emphasis of external variables is on financial and economic conditions in the European Union and the Eurozone, which are main sources of capital inflows for EU NMS. However, due to their importance for global macro-financial dynamics, several US variables have also been included into the sample. The variables that measure conditions that impact the financial supply adversely (e.g. market uncertainty, risk, volatilities, etc.) have been multiplied by -1. This way, an increase in all variables represent improving financial supply conditions, and vice versa. For details consult the Data appendix.

## 2.1 External variables

The first group of external variables deals mainly with risk. It includes the European economic policy uncertainty index ($ext\_uncert_t$) constructed by Baker et al. (2016) as a measure of risk aversion in Europe; the volatility of S&P 500 index, i.e. the VIX index ($ext\_vix_t$) as a measure of global risk aversion, market expectations and investment sentiment; average sovereign

[2] See the introductory section for literature review.

bond spreads for EU NMS vis-à-vis the German bond ($ext\_spread_t$) as a measure of regional risk premium for the country group. We also include the EU consumer confidence index ($ext\_conf_t$) as one of the measures of external risk aversion; and LIBOR-T-Bill spread ($ext\_libor_t$) as a measure of perceived credit risk, global liquidity conditions and uncertainty about future US monetary policy stance.

The second group of external variables takes into consideration monetary conditions and liquidity in the Eurozone. Namely, we include short- ($ext\_strate_t$) and long-term ($ext\_ltrate_t$) Eurozone interest rates, as well as monetary conditions index ($ext\_mci_t$) as an indicator of Eurosystem's monetary policy stance.

The third group of variables measures the macro-financial sentiment, business climate and economic activity. We include the stock market indices, namely the Eurostoxx 50 ($ext\_estoxx_t$) and S&P 500 ($ext\_sp500_t$) indices, to measure investment sentiment and expectations about future growth in Europe and United States, respectively. Furthermore, to measure the state of economic activity in the Eurozone we include the industrial production index ($ext\_ind_t$). Finally, we include the Eurozone economic sentiment indicator ($ext\_esi_t$) and the Eurozone business climate indicator ($ext\_bci_t$).

## 2.2 Domestic variables

To account for domestic risk, the sample includes domestic sovereign bond spreads vis-à-vis the German bond ($dom\_spread_t$). Domestic riskiness and financial stability are captured by measuring the volatilities of the nominal effective exchange rate ($dom\_neer_t$) and prices ($dom\_price_t$). Domestic monetary conditions are captured by the average lending rates ($dom\_lend_t$) and money market rates ($dom\_strate_t$). To measure domestic investment sentiment and economic activity, industrial production index ($dom\_ind_t$) and stock market index ($dom\_stocks_t$) have been included into the sample. Finally, consumer sentiment and expectations about future growth are captured by the consumer confidence index ($dom\_conf_t$).

# 3 Methodology

The estimation objective is to identify an unobservable common factor from a group of external and domestic financial and economic indicators. Thus, three methodological approaches are employed in the estimation of

the financial supply index: the Kalman filter, principal components analysis (PCA), and variance-equal weights (VEW) approach. Using three separate methodological approaches also serves the purpose of robustness checks.

## 3.1 Kalman filter

In their seminal work, Stock and Watson (1988, 1989, 1991) proposed using state-space models and Kalman filtering to extract business cycle indicators from a large number of observable variables. This approach is utilized here to extract a financial supply index from a series of external and domestic financial and economic variables. The following state-space form is implemented:

$$X_t = \gamma FSI_t + u_t \tag{1}$$

$$FSI_t = \alpha FSI_{t-1} + \beta FSI_{t-2} + e_t \tag{2}$$

where (1) is the signal equation, including the vector of observable variables, $X_t$, and the estimated common factor, $FSI_t$. Each observable is assumed to have a linear loading on the index. The state equation is given by (2), where it is assumed that the index follows a stationary AR(2) process. The error terms, $u_t$ and $e_t$, are independent disturbances with zero mean. One of the main advantages of using this approach is that it is able to estimate the index in full time span of the sample period, regardless of the potential shorter series or missing data points in one or more series. Prior to estimation, all variables were transformed to I(0) and standardized to have zero mean and unit standard deviation.

## 3.2 Principal components analysis

The objective of the principal components analysis is to extract a common factor ($FSI_t$) that captures the largest common variation in a group of observable variables (vector $X_t$). The model is defined as follows:

$$X_t = \delta FSI_t + \vartheta_t \tag{3}$$

where $\delta$ is a $p \times n$ matrix of coefficients, $p$ is a number of variables in $X_t$, $FSI_t$ is a vector of $n \times 1$ unobserved common factors, and $\vartheta_t$ is a $p \times 1$ vector of errors. The assumption is that the common factors have zero mean,

and that the errors are orthogonal to common factors. Financial supply index is defined as the first principal component estimated by the PCA. All variables were transformed to I(0) and standardized to have zero mean and unit standard deviation. Unlike with the Kalman filter approach, the problem with PCA is that it does not solve the missing data issue, meaning that it estimates the index only for the period in which data for all variables are available.

### 3.3 Variance-equal weights

Finally, variance-equal weights approach aggregates standardized variables into a composite index ($FSI_t$) where each observable is given an equal weight:

$$FSI_t = \sum_{i=1}^{p} \frac{X_{i,t} - \overline{X}_i}{\sigma_i} * \frac{1}{p} \tag{4}$$

where $p$ is a number of observable variables, $\overline{X_i}$ is a sample mean of variable $X_i$, and $\sigma_i$ is a sample standard deviation of variable $X_i$.

## 4 Results

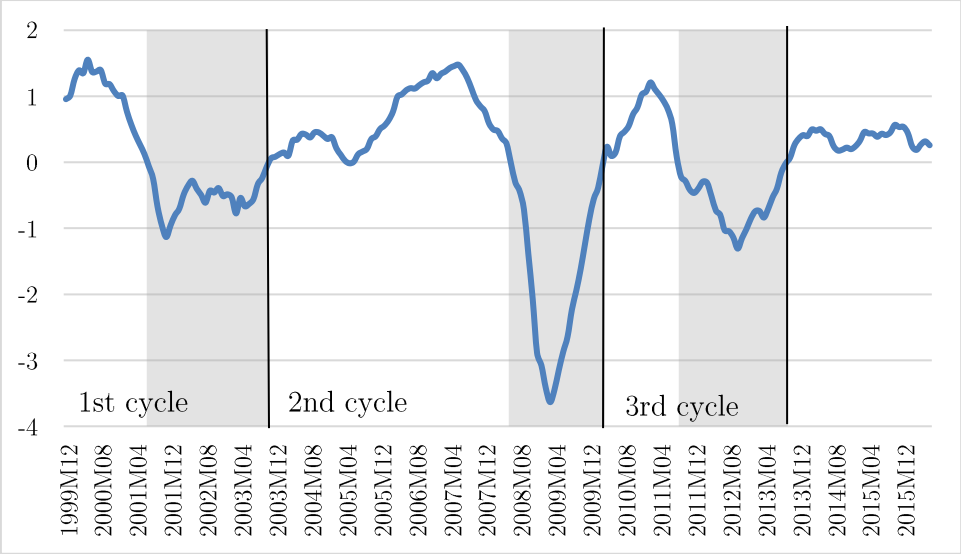
### 4.1 Estimated financial supply indices and cycles

For the sake of clarity and parsimony in presenting the results, only the indices estimated by the Kalman filter approach will be reported in this section. Kalman filter was chosen as the principal methodological tool due to its aforementioned advantages in dealing with missing data and uneven lengths of available time series across analysed countries. This enables us to obtain the longest possible time series of the indices. FSIs resulting from the PCA and VEW approaches are reported in Section 5 to assess the robustness of obtained results.

Given that the index is estimated based on year-on-year growth rates of observable variables, the FSI itself should be viewed as a year-on-year growth rate in financial supply. FSI is standardized to have zero mean and unit standard deviation. Upward movements in FSI indicate increasing financial supply, and vice versa.

Figure 1 presents the average values of FSI for 11 EU NMS. By observing the dynamics of the index, it is possible to distinguish between three (almost) full financial supply cycles (FSCs) in the analysed period, and the beginning of the fourth one, i.e. the one we are currently in. The cycles are characterized by recognizable sinusoidal patterns, with upswings with peaks exceeding one standard deviation above the sample mean of FSI, followed by downswings with troughs more than one standard deviation below the sample mean.

Figure 1: Average FSI values for EU NMS




Note: Shaded areas denote periods of negative values of FSI. Vertical lines represent the end of the financial cycle, i.e. the period in which the negative FSI value turns positive.

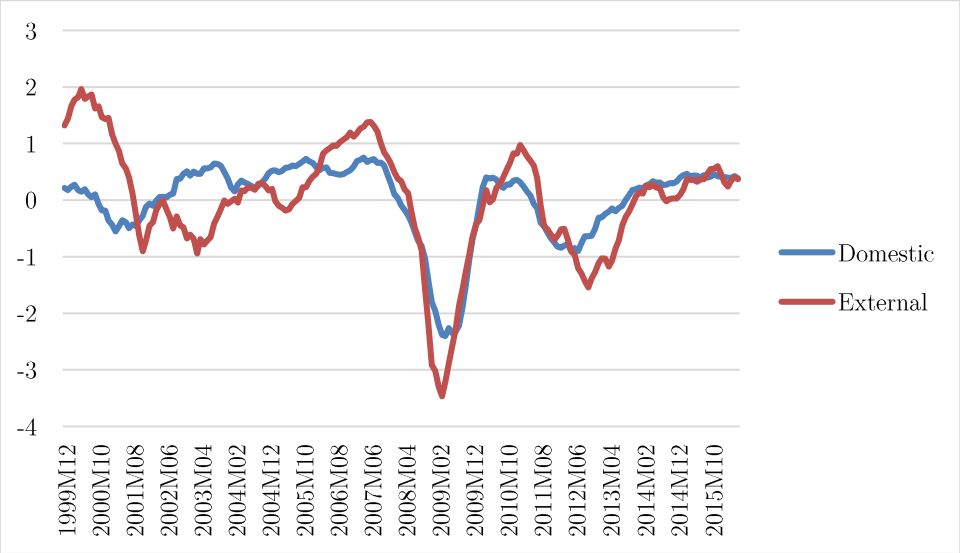
It is evident that domestic and external components of FSI follow similar trajectories throughout the sample period (Figure 2). However, the external component is noticeably more volatile, reaching higher highs and lower lows than the domestic component, indicating that the bulk of volatility in financial supply to EU NMS is externally driven.

### 4.1.1 First financial supply cycle (approx. late 1998 – Oct 2003)

The beginning of the first financial supply cycle (FSC_1) is not captured by the index, due to short time series of available datasets. One could assume that the starting point of this cycle was probably sometime during 1998, after the end of turmoil in global financial markets caused by the Asian crisis. FSC_1 reached a peak in May 2000, after which the growth rate of

FSI started to decrease, finally reaching the negative growth territory in July 2001. The trough of FSC_1 was recorded in November 2001, reflecting the financial and economic turmoil caused by the dot-com bubble burst and 9/11 terrorist attacks.

Figure 2: Average values of domestic and external components of FSI for EU NMS




Financial supply index assumed negative values for more than two years, also due to worsening economic conditions in core EU countries, which also translated to the financial markets through higher risk aversion and lower business and consumer sentiments. Figure 2 confirms that it was the external component that drove the FSI in that period, while the average domestic component relatively quickly rebounded after the 2001 slump.

### 4.1.2 Second financial supply cycle (Nov 2003 – Mar 2010)

Financial supply index finally reached positive territory in November 2003, which is the beginning of the second financial supply cycle (FSC_2). This marked the start of the longest upswing[3] in financial supply, which lasted for 55 consecutive months. This period was characterized by high global liquidity, improving economic and business sentiment and low risk aversion, both domestically and externally, as evidenced by Figure 2.

[3] In this context, an upswing denotes consecutive periods of positive values of FSI, while a downswing represents consecutive periods of negative FSI values.

High financial supply translated into high capital flows to EU NMS (both debt and equity) and high rates of GDP growth. FSI reached its peak in June 2007, after which the index growth started to decrease reflecting the first signs of economic slowdown, but more importantly, because of higher uncertainty, risk aversion and deteriorating business confidence due to the increasingly evident problems in the US subprime mortgage market.

Decreasing rates of still positive FSI values lasted for one year after the peak, before FSI turned to negative territory in June 2008, and then plummeting unprecedently quickly after the Lehman Brothers bankruptcy in September. Fuelled by the now global financial crisis, FSI reached its historical low in March 2009 when it was 3.63 standard deviations below the sample average, reflecting the credit crunch and a sudden stop in capital flows throughout most of the world.

The level of financial supply of more than one standard deviation below the sample mean continued for 14 consecutive months (October 2008 – November 2009), but it wasn't until April 2010 that FSI returned to positive values. Figure 2 reveals that both the domestic and the external component of FSI contracted severely in that period, but the stronger impetus, just like in the pre-crisis period, came from external markets.

#### 4.1.3 Third financial supply cycle (Apr 2010 – Sep 2013)

The worst part of the global financial crisis was over by the end of 2009, and by April 2010 FSI returned to positive territory, indicating the start of the third financial supply cycle (FSC_3). Monetary conditions improved and economic recovery started as both the European and the global economy rebounded from the worst recession since the Great Depression. However, risk aversion remained relatively high and business sentiment was still well below pre-crisis growth rates, reflecting the still toxically contaminated balance sheets of European banks and soaring sovereign debt levels in the Eurozone periphery. FSC_3 reached its peak in February 2011, with an FSI value below the peak values of the previous two cycles. Moreover, this time the upswing was short-lived. It took less than a year and a half (17 months) before a new downswing started.

This time the problem was mainly a European one, as the Eurozone went into a double-dip recession, while the sovereign debt crisis swept through the periphery of the monetary union. High uncertainty about the future of the Eurozone increased the risk aversion to levels similar to those of late

2008, which resulted in a sharp drop of financial supply, but not as sharp as during the global financial crisis. Although both the domestic and the external component decreased in 2011/2012, again it was the dynamics in the European market that dominantly determined the movement of FSI (Figure 2).

Mario Draghi's "whatever it takes" speech in the second half of 2012 helped calm the financial markets, and by October 2013 the financial supply index was back to positive territory, indicating the beginning of the fourth financial supply cycle (FSC_4) – the one which we are currently in. By the time of writing of this manuscript, FSI has continuously marked positive values for 33 consecutive months, surviving another wave of the Greek debt crisis and the Brexit vote. FSI growth has been supported by the ECB's quantitative easing programme and modest economic recovery in the Eurozone, with still no visible peak in sight as the values of FSI have mainly coasted below 0.5 standard deviations above the sample mean.

The summary diagnostics of all three FSCs with its peaks and troughs are given in Table 1.

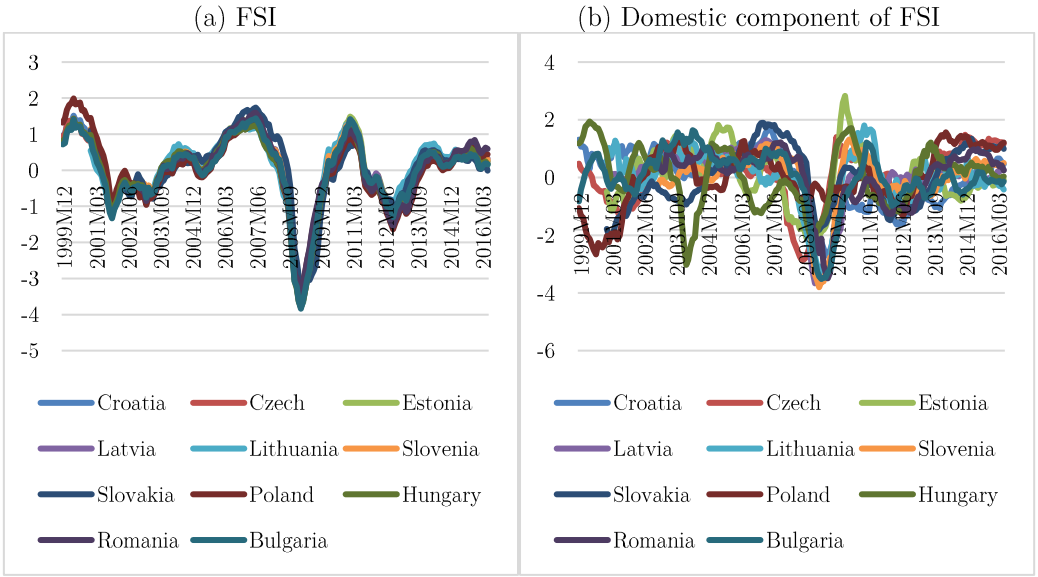
Table 1: Diagnostics of financial supply cycles in EU NMS

| WHOLE CYCLE | 1st cycle | 2nd cycle | 3rd cycle |
|---|---|---|---|
| **Period** | ? – Oct 2003 | Nov 2003 – Mar 2010 | Apr 2010 – Sep 2013 |
| **Number of months** | >47 (>3y 11m) | 77 (6y 5m) | 42 (3y 6m) |
| **Peak** | May 2000 | Jun 2007 | Feb 2011 |
| **Trough** | Nov 2001 | Mar 2009 | Oct 2012 |
| **Peak value of FSI** | 1.56 | 1.48 | 1.21 |
| **Trough value of FSI** | -1.13 | -3.63 | -1.31 |
| **Months from peak to trough** | 18 (1y 6m) | 21 (1y 9m) | 20 (1y 8m) |
| **Months from prev. trough to peak** | ? | 67 (5y 7m) | 23 (1y 11m) |
| UPSWING | 1st cycle | 2nd cycle | 3rd cycle |
| **Period** | ? – Jun 2001 | Nov 2003 – May 2008 | Apr 2010 – Aug 2011 |
| **Number of months** | >19 (>1y 7m) | 55 (4y 7m) | 17 (1y 5m) |
| DOWNSWING | 1st cycle | 2nd cycle | 3rd cycle |
| **Period** | Jul 2001 – Oct 2003 | Jun 2008 – Mar 2010 | Sep 2011 – Sep 2013 |
| **Number of months** | 27 (2y 3m) | 22 (1y 10m) | 25 (2y 1m) |

The analysis above was made based on the average FSI values for the 11 EU NMS. Figure 3a reveals individual FSIs for each country. It is evident that index dynamics are very similar in all countries, indicating the appropriateness of the average-value approach taken above to evaluate common financial supply cycles in EU NMS.

All countries share the common external component (the one indicated in Figure 2), since they all face the same macro-financial conditions in European and global markets. However, the domestic (idiosyncratic) component of FSI is unique for each country, as evident from Figure 3b. This heterogeneity is the reason why FSI values differ across countries (Figure 3a). However, the fact that all countries share a very similar trend in FSI dynamics speaks to the fact that it is the external component that is dominantly driving financial supply cycles in EU NMS.

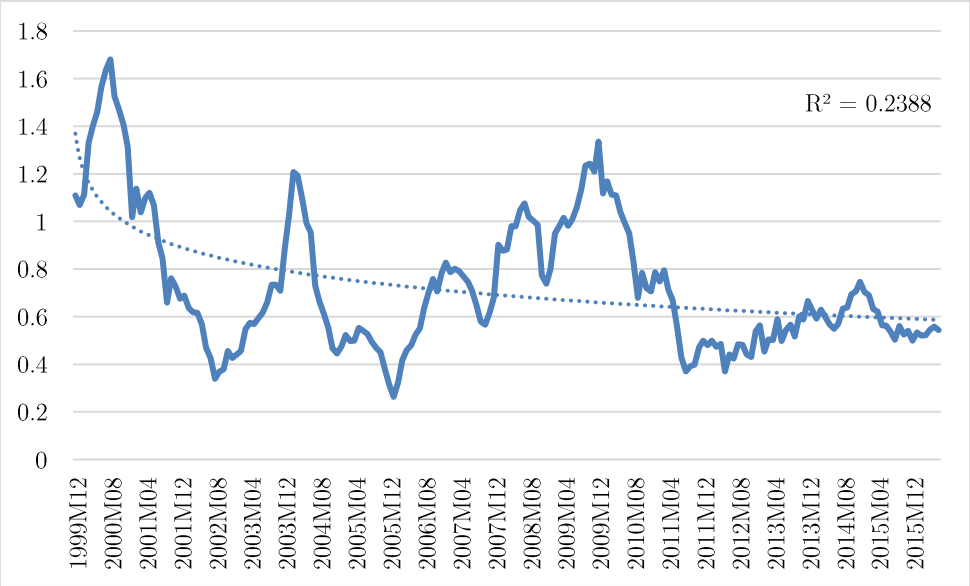
Figure 3: FSIs of individual EU NMS




Although the heterogeneity in the dynamics of domestic components of national FSIs is blatantly evident from Figure 3b, it is still noticeable that there are some common movements, especially over the last two financial supply cycles. To test whether there is indeed a trend in the co-movement of domestic components across EU NMS, we calculated the standard deviations of these 11 components for each point in time. Figure 4 reveals that the standard deviation has been decreasing throughout the analysed period, with a statistically significant logarithmic trend and an $R^2$ of 0.24. This could be an indication of a higher financial integration amongst this group

of EU countries, although a more formal test (which is beyond the scope of this paper) should be done before reaching any conclusions in that regard.

Figure 4: Standard deviation of domestic components of FSI across EU NMS



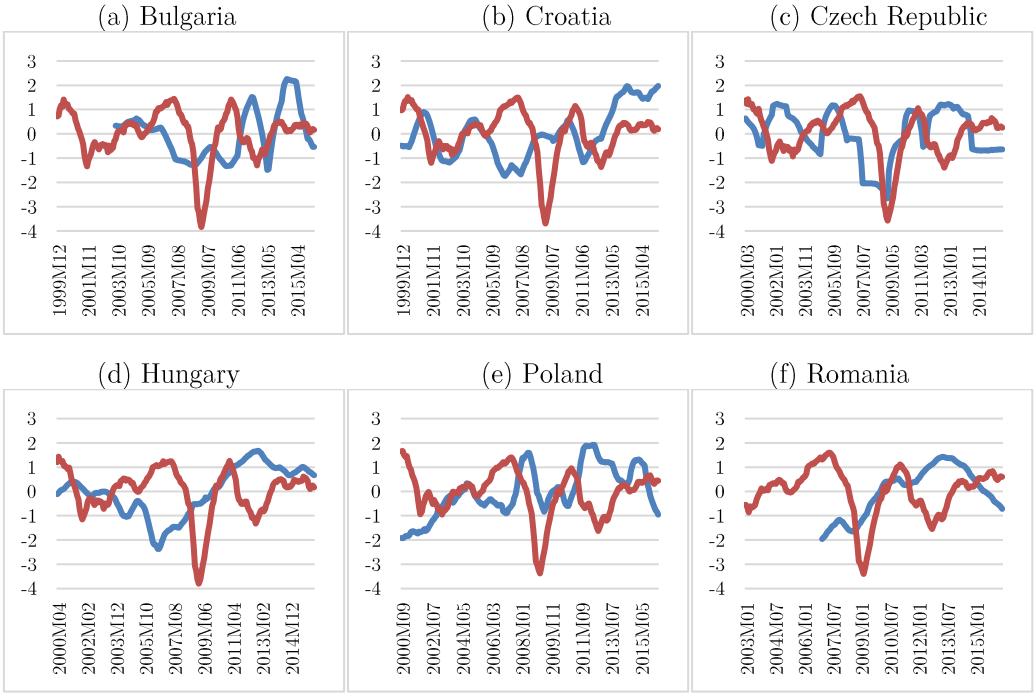

## 4.2 Supply vs. demand - introducing the *Refinancing Risk Ratio*

The first part of the analysis dealt with the financial supply dynamics, i.e. the cycles in the supply of foreign capital available for investing into EU NMS. In this section we examine the supply simultaneously with the demand for foreign capital and introduce a new indicator called *Refinancing Risk Ratio* (RRR) which relates the demand for foreign funds to the supply of capital available at a given point of time. RRR thus aims to quantify the conditions and riskiness of external refinancing of the maturing sovereign debt.

As a proxy for the demand for foreign capital we use short-term net drains on foreign currency, obtained from the IMF's International Reserves and Foreign Currency Liquidity database. This variable represents the level of foreign currency debt repayments (loans, securities, deposits) that need to be made by the government, and mature within the next 12 months. A 12-month horizon was taken instead of a 1-month horizon due to the assumption that the government does not necessarily wait until the last moment (month) to refinance the near-maturing debt.

Net foreign currency drains are normalized by the level of economic activity[4] and then standardized to zero mean and unit standard deviation. One problem that arises with foreign currency drains data series is the occurrence of a structural break at the point when a country enters the Eurozone. There is a sharp drop in the amount of net foreign currency drains, given that what was once a foreign currency (euro) is now statistically treated as a domestic one. Thus, all further analysis will be made on a subsample of six EU NMS that have not yet adopted the euro. Figure 5 displays the simultaneous movements of supply (FSI) and demand for foreign capital throughout the analysed period of time.

Figure 5: Supply (red) and demand (blue) for foreign capital in EU NMS




It is evident that almost all countries experienced a historical spike in demand for foreign capital during the second wave of the recent crisis, i.e. the Eurozone sovereign debt crisis. This was precisely during the downswing of the third financial cycle which meant that there was a lower supply of capital on the market, indicating potential problems for the governments in refinancing their debt.

[4] Given that GDP series are available only in quarterly frequencies, industrial production was used as a proxy for economic activity.

In order to quantify this, we introduce the aforementioned *Refinancing Risk Ratio* that essentially normalizes the demand for foreign capital by the supply of capital to a given country. RRR is defined as:

$$RRR_t = \frac{demand_t}{supply_t} \tag{5}$$

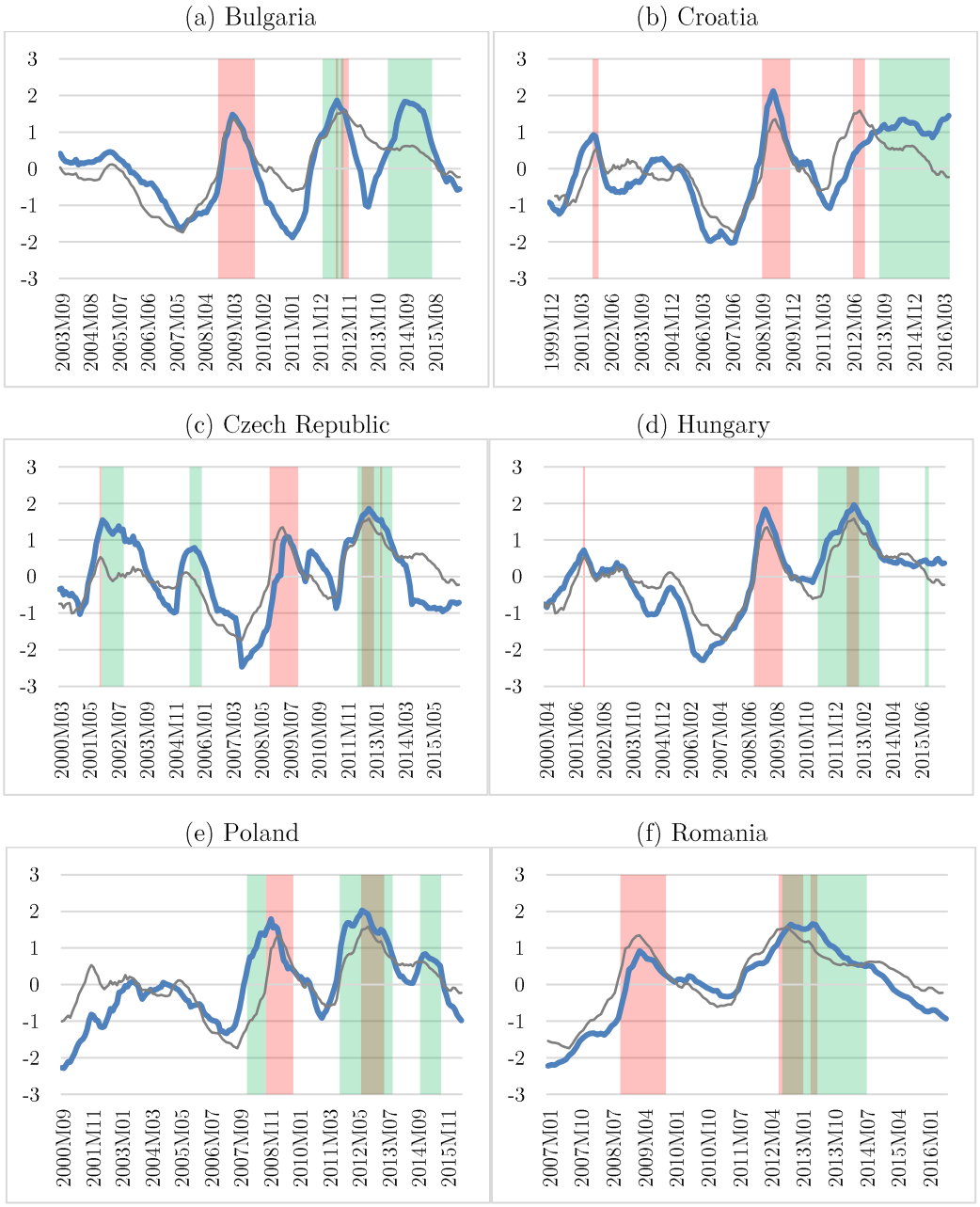
where $demand_t$ is represented by short-term net drains of foreign currency as explained earlier, and $supply_t$ is a financial supply index (FSI) for a given country. Given that both variables had been standardized to zero mean, in order to avoid problems with dividing by values equal to or close to zero, both $demand_t$ and $supply_t$ have been rebased so that the minimum value of the series equals 10. An increase in the value of RRR indicates a higher refinancing risk for a country, which can stem from an increase in the demand for capital, a decrease in the supply of capital, or both things simultaneously.

Figure 6 displays the standardized values of RRR in six non-Eurozone countries, as well as the average RRR values for the group as a whole. In order to determine whether the spikes in RRR are supply- or demand-induced (or both), shaded areas denote extreme episodes of either low supply or high demand. A low supply episode (red-shaded areas) is defined as a period in which the value of $supply_t$ (i.e. FSI) before rebasing is below -1, meaning that the financial supply is more than one standard deviation below the sample average.

A high demand episode (green-shaded areas) is defined as a period in which the value of $demand_t$ before rebasing is above 1, indicating that the demand for capital is more than one standard deviation above the sample average. The least desirable scenario for a country is the one where a low supply and a high demand episode happen simultaneously (dark-red-shaded areas), because it indicates potential problems in refinancing the maturing debt.

Several interesting findings could be inferred based on Figure 6. By observing the group average values of RRR (thin grey lines in Figure 6), two spikes in RRR values can be singled out. In both of them the standardized values of RRR were above 1, indicating that the refinancing risk was more than one standard deviation above the sample average for the group.

Figure 6: Refinancing risk ratio in EU NMS




Note: Thin grey lines indicate the average RRR for six analysed countries. Areas shaded in red denote low supply episodes, areas shaded in green denote high demand episodes, while areas shaded in darker shades of red denote both episodes simultaneously. Time spans vary across countries due to data (in)availability of net foreign currency drains series.

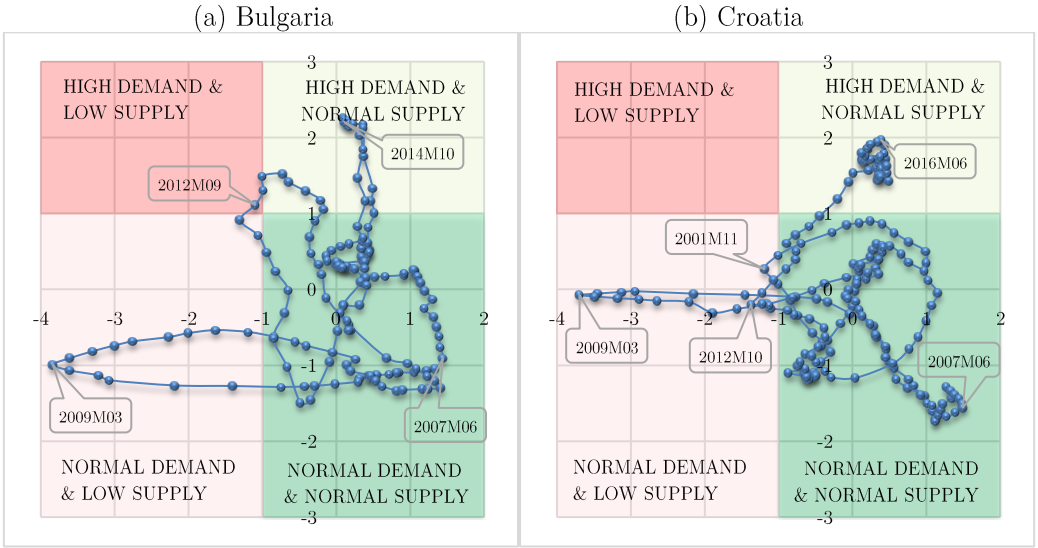
The first RRR spike happened during the downswing of FSC_2, when it was under severe influence of the global financial crisis and the credit crunch in global markets. This happened only months after the average RRR for

the group reached a sample minimum in August 2007, with values almost two standard deviations below the sample mean. The fact that this episode was heavily driven by supply conditions is confirmed by the fact that local spikes in RRRs of individual countries for that period are coinciding with red-shaded low supply episodes.

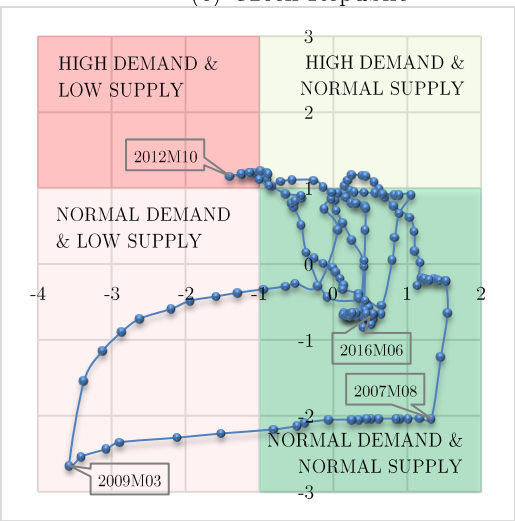
Furthermore, Figure 7 shows the values of financial supply and demand simultaneously for each point in time. Based on the values of $demand_t$ and $supply_t$, we can distinguish between four regimes: (1) high demand & normal supply, (2) normal demand & normal supply, (3) normal demand & low supply, (4) high demand & low supply. Low supply and high demand episodes are defined as before, while all other values of $demand_t$ and $supply_t$ that are not defined as high demand or low supply constitute normal demand and normal supply, respectively.

It is evident that during FSC_2 all countries experienced an RRR spike in the lower left quadrant, meaning that the low supply episode was accompanied by normal demand. Only in Poland was there a sign of high demand for foreign capital around this period, but that episode finished just before the onset of the global crisis. Net foreign currency drains during that time were below average in all countries. They were particularly low in Romania and Czech Republic, where RRR failed to reach or barely reached the value of one standard deviation above the sample mean, all in midst of the worst financial crisis in decades.

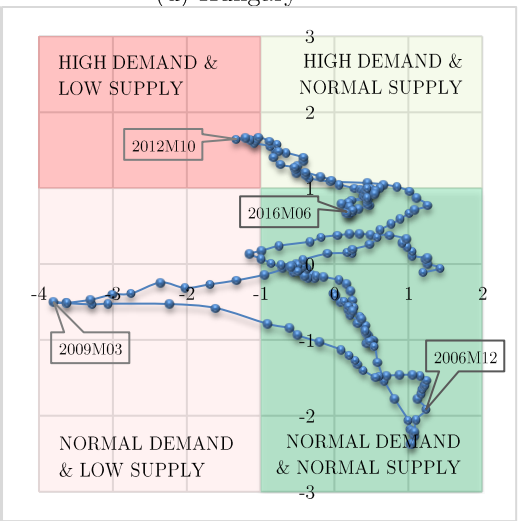
Figure 7: Evolution of the joint movement of supply and demand through four regimes



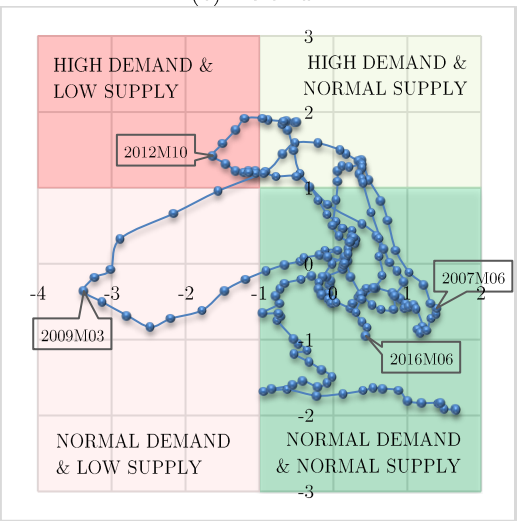
(c) Czech Republic



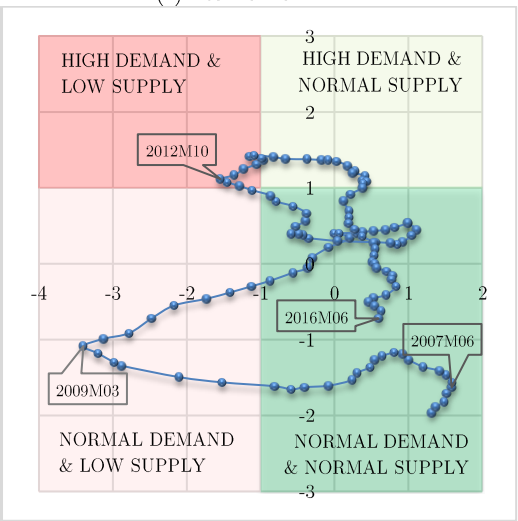

(d) Hungary




(e) Poland




(f) Romania




Note: Interactive charts with month-by-month dynamics can be found online: http://sendvid.com/gkfmgogq

The second spike in RRR that occurred during 2012 (FSC_3) was much different in nature. Although the low supply episode during the European sovereign debt crisis was not nearly as intensive as the one during the global financial crisis (see Figure 1), average RRR values spiked and surpassed the amounts from the previous episode. The reason is that this time a low supply episode was simultaneously accompanied by a high demand episode, resulting in high refinancing risk. Figure 7 confirms this finding, as during that time almost all countries were positioned in the upper left quadrant, where high demand meets low supply.

High demand was a result of large volumes of maturing loans and securities issued during the "golden" supply period (early and mid-2000s) and deteriorating economic conditions[5]. Figure 6 and Figure 7 reveal that this RRR spike began with a high demand episode, when the supply conditions were still normal in most countries. Only after that, the sovereign debt crisis culminated and normal financial supply conditions morphed into a low supply episode. As a result, RRR peaked across the board, with dark-red-shaded areas in Figure 6 denoting simultaneous low supply and high demand episodes.

The only country which managed to avoid adverse episodes happening simultaneously was Croatia. The high demand episode in Croatia started after the low supply episode had already ended, reflecting the fact that Croatian government issued the bulk of its debt later in the pre-crisis period and then during the financial crisis itself. However, this only delayed the emergence of high demand. Namely, the value of $demand_t$ for Croatia has consistently been higher than one standard deviation above the sample mean since August 2013. At the time of writing, this period has extended to 35 consecutive months.

In June 2016, the last period in the time sample, the size of the demand for foreign capital all but reached two standard deviations above the sample mean. This reflects an unusually long (6-year) recession that other countries in the sample did not experience, but also high interest payments, as Croatia decided to issue non-negligible amounts of debt during adverse crisis conditions to finance the budget deficit (Figure 8), instead of undertaking a notable fiscal consolidation. A part of that debt is maturing in 2017 and it's already visible in the demand values for 2016.[6]

This is why the second RRR spike[7] in Croatia extended to the current financial cycle (FSC_4), unlike in any other analysed country except Bulgaria. Fortunately for Croatia, the values of the financial supply index have been fairly high throughout the whole high demand episode so far, reflecting very favourable financial conditions in the Eurozone. This keeps the RRR still below the values recorded during the first spike (global financial crisis), though the refinancing risk in Croatia is currently extreme when compared

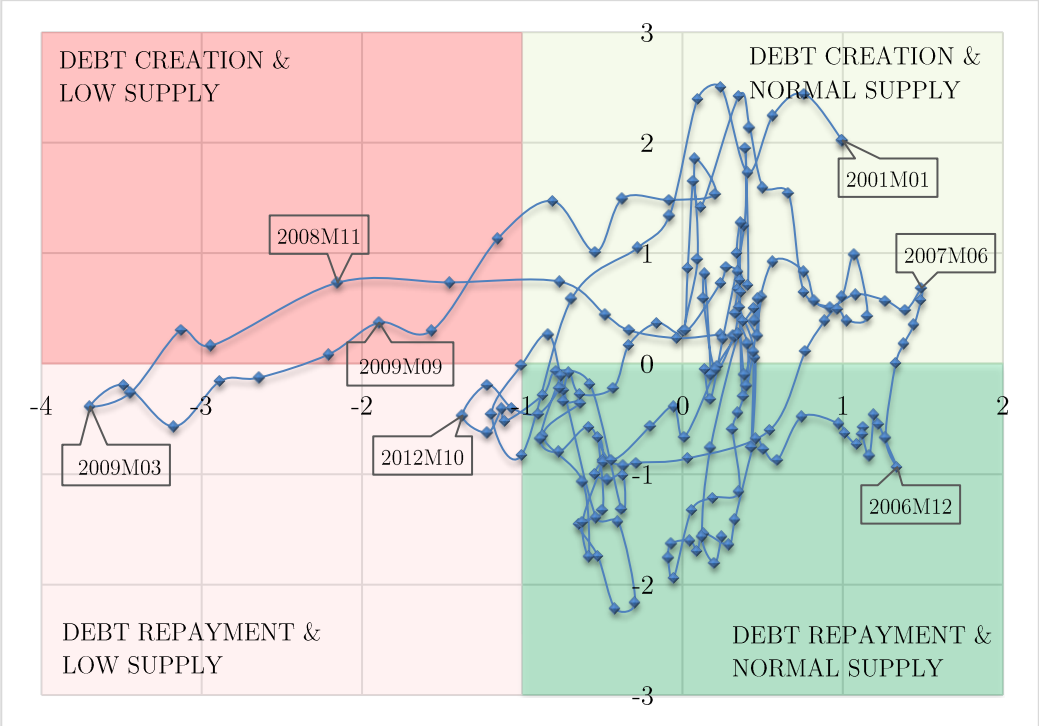
[5] Remember that net foreign currency drains were normalized by economic activity.

[6] The majority of that debt will however mature in the upcoming years, which is why it is expected that RRR will remain high for Croatia for quite some time.

[7] It is debatable should this even be called a spike, due to the protracted period of high RRR values. Perhaps a "bulge" would be a more appropriate term.

to other countries in the sample. Namely, all other countries, except Hungary, recorded negative values of RRR in the most recent period. However, even in Hungary the values of RRR are considerably lower than in Croatia.

Figure 8: Evolution of the joint movement of government foreign debt creation/repayments and financial supply in Croatia through four regimes



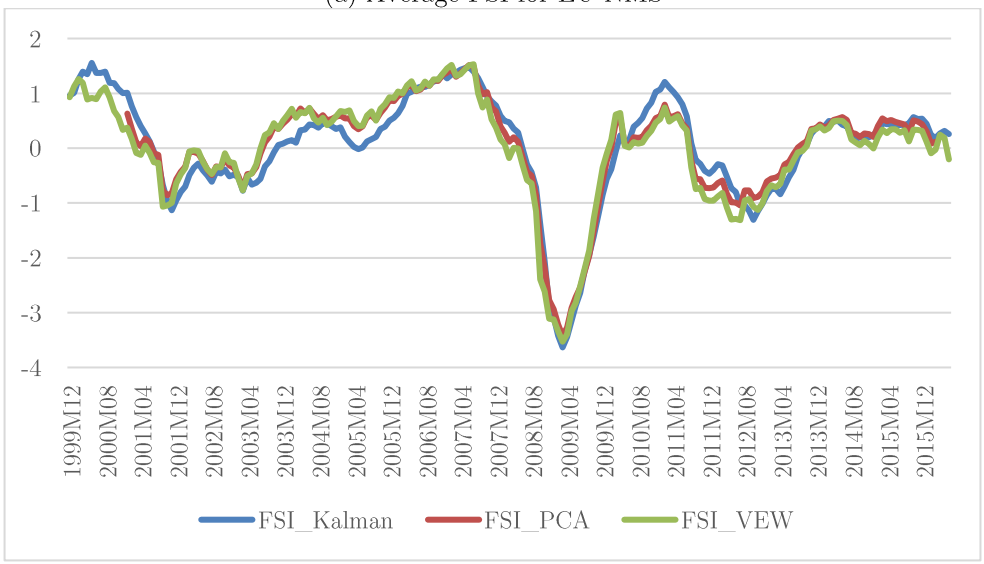

Note: An interactive chart with month-by-month dynamics can be found online: http://sendvid.com/sy0ytvcc

# 5 Robustness checks

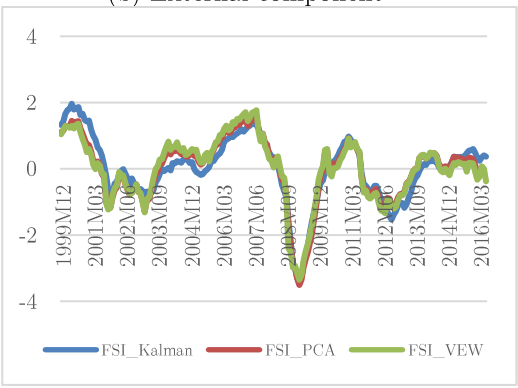
In this section we report the estimations of the financial supply index using the principal components analysis (FSI_PCA), and variance-equal weights (FSI_VEW) approach and compare them to Kalman filter estimations (FSI_Kalman). For easier comparison, all three versions of the FSI are standardized to zero mean and unit standard deviation. Figure 9 reveals that the choice of the estimation method does not significantly influence the results, i.e. dynamics of the index and its components are very similar across specifications.

Figure 9: FSI estimations using three methodological approaches

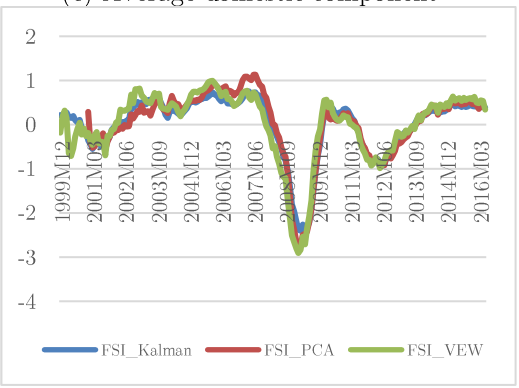
(a) Average FSI for EU NMS




(b) External component




(c) Average domestic component




This is confirmed by taking the correlation coefficients between the three FSIs. Table 2 reveals that the correlation values are very high, with the lowest coefficient being equal to 0.839 (between FSI_Kalman and FSI_VEW for Poland). All other correlation coefficients are above 0.9, which confirms that the results presented in Section 4 are indeed robust.

Table 2: Correlation coefficients between indices estimated by three different approaches

| | Kalman vs. PCA | Kalman vs. VEW | PCA vs. VEW |
|---|---|---|---|
| **Average FSI for EU NMS** | 0.943 | 0.968 | 0.992 |
| **External component** | 0.954 | 0.927 | 0.992 |
| **Average domestic component** | 0.960 | 0.979 | 0.953 |
| **FSI_Bulgaria** | 0.939 | 0.924 | 0.971 |

| | | | |
|---|---|---|---|
| **FSI_Croatia** | 0.970 | 0.948 | 0.996 |
| **FSI_Czech Republic** | 0.971 | 0.953 | 0.994 |
| **FSI_Estonia** | 0.939 | 0.902 | 0.987 |
| **FSI_Hungary** | 0.953 | 0.931 | 0.993 |
| **FSI_Latvia** | 0.943 | 0.929 | 0.989 |
| **FSI_Lithuania** | 0.972 | 0.942 | 0.979 |
| **FSI_Poland** | 0.971 | 0.839 | 0.985 |
| **FSI_Romania** | 0.939 | 0.927 | 0.997 |
| **FSI_Slovakia** | 0.940 | 0.907 | 0.987 |
| **FSI_Slovenia** | 0.970 | 0.904 | 0.972 |

In order to determine which variables are the main drivers of financial supply in analysed countries, Table 3 presents factor loadings obtained by the principal components analysis, which reveal the signs and magnitudes of variables included in the index. It is evident that the main drivers of financial supply for EU NMS are externally determined. Namely, economic sentiment and business climate in the Eurozone seem to, on average, carry the highest weight in FSI dynamics of individual countries. Other variables of high importance are industrial production, consumer confidence and short-term interest rates in the Eurozone, followed by the Emerging Europe long-term government bond spread and stock market indicators (Eurostoxx 50, S&P 500 and the volatility index VIX).

Domestic variables have, on average, lower factor loadings. However, domestic economic activity (proxied by industrial production), consumer confidence, long-term government bond spreads and stock market indices appear to be very important determinants of the financial supply.

Eurozone monetary condition index, LIBOR-T-Bill spreads and domestic short and long term interest rates are, on average, less important drivers of FSI. It should be noted that the first component explains between 39 and 53 percent of common variation between variables.

In order to further test the robustness of obtained results, we estimated the principal components without the variables whose factor loadings are below 0.15 and 0.20, respectively. The visuals of FSIs and their dynamics change very little. The only thing that does change are higher values of proportions explained by the first component and higher values of factor loadings of variables included. This is all expected due to the lower number of variables entering the estimation.

Table 3: Factor loadings for FSIs (principal components analysis)

| | BUL | CRO | CZE | EST | HUN | LAT | LIT | POL | ROM | SVK | SVN | average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Proportion explained by first component** | 0.40 | 0.47 | 0.41 | 0.44 | 0.39 | 0.41 | 0.49 | 0.45 | 0.45 | 0.41 | 0.53 | - |
| **Factor loadings** | | | | | | | | | | | | |
| **ext_uncert** | 0.16 | 0.13 | 0.14 | 0.15 | 0.12 | 0.13 | 0.15 | 0.14 | 0.11 | 0.22 | 0.17 | **0.15** |
| **ext_vix** | 0.23 | 0.22 | 0.23 | 0.27 | 0.24 | 0.23 | 0.24 | 0.21 | 0.25 | 0.22 | 0.23 | **0.23** |
| **ext_spread** | 0.29 | 0.27 | 0.25 | 0.25 | 0.26 | 0.24 | 0.27 | 0.27 | 0.26 | 0.23 | 0.27 | **0.26** |
| **ext_conf** | 0.28 | 0.28 | 0.27 | 0.26 | 0.29 | 0.27 | 0.27 | 0.28 | 0.28 | 0.17 | 0.27 | **0.27** |
| **ext_strate** | 0.28 | 0.25 | 0.26 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 | 0.24 | 0.28 | 0.26 | **0.26** |
| **ext_ltrate** | 0.12 | 0.10 | 0.10 | 0.13 | 0.06 | 0.12 | 0.14 | 0.10 | 0.06 | 0.24 | 0.16 | **0.12** |
| **ext_libor** | 0.03 | 0.07 | 0.08 | 0.11 | 0.11 | 0.11 | 0.05 | 0.05 | 0.11 | 0.07 | 0.04 | **0.08** |
| **ext_ind** | 0.29 | 0.28 | 0.30 | 0.29 | 0.31 | 0.31 | 0.28 | 0.28 | 0.29 | 0.28 | 0.28 | **0.29** |
| **ext_sp500** | 0.21 | 0.22 | 0.23 | 0.26 | 0.23 | 0.24 | 0.22 | 0.20 | 0.24 | 0.24 | 0.26 | **0.23** |
| **ext_estoxx** | 0.23 | 0.24 | 0.25 | 0.26 | 0.25 | 0.23 | 0.23 | 0.23 | 0.27 | 0.26 | 0.25 | **0.25** |
| **ext_esi** | 0.32 | 0.30 | 0.32 | 0.30 | 0.32 | 0.31 | 0.30 | 0.31 | 0.30 | 0.29 | 0.29 | **0.31** |
| **ext_bci** | 0.32 | 0.30 | 0.32 | 0.33 | 0.31 | 0.31 | 0.30 | 0.31 | 0.30 | 0.32 | 0.29 | **0.31** |
| **ext_mci** | 0.08 | 0.04 | 0.04 | 0.00 | 0.00 | 0.01 | 0.03 | 0.06 | 0.00 | 0.22 | 0.07 | **0.05** |
| **dom_conf** | 0.24 | 0.20 | 0.13 | 0.26 | 0.19 | 0.30 | 0.28 | 0.20 | 0.18 | 0.27 | 0.25 | **0.23** |
| **dom_price** | 0.07 | 0.18 | 0.20 | 0.20 | 0.13 | 0.18 | 0.19 | 0.21 | 0.12 | 0.12 | 0.16 | **0.16** |
| **dom_spread** | 0.28 | 0.23 | 0.18 | 0.23 | 0.23 | 0.21 | 0.28 | 0.20 | 0.25 | 0.21 | 0.14 | **0.22** |
| **dom_lend** | -0.03 | 0.25 | -0.03 | 0.07 | 0.11 | 0.08 | -0.03 | -0.23 | 0.24 | -0.20 | 0.02 | **0.12** |
| **dom_strate** | -0.13 | 0.10 | -0.17 | 0.01 | 0.07 | -0.01 | -0.23 | -0.05 | 0.13 | -0.15 | -0.18 | **0.11** |
| **dom_stocks** | 0.19 | 0.27 | 0.21 | 0.22 | 0.20 | 0.26 | 0.19 | 0.22 | 0.21 | -0.09 | 0.22 | **0.21** |
| **dom_ind** | 0.27 | 0.24 | 0.30 | 0.25 | 0.31 | 0.26 | 0.17 | 0.25 | 0.24 | 0.16 | 0.27 | **0.25** |
| **dom_neer** | 0.05 | 0.09 | 0.22 | 0.14 | 0.20 | 0.04 | 0.13 | 0.18 | 0.15 | 0.13 | 0.19 | **0.14** |

# 6 Conclusion

This paper introduced a new composite index, which measures the level of supply of foreign capital to 11 EU new member states, titled the financial supply index. By doing so, the paper fills the gap in the literature, which has so far focused more on creating financial conditions indices that capture the dynamics of financial variables exclusively, while the economic factors, whose importance as determinants of capital flows is well documented in the literature, have been overlooked.

To estimate FSIs, three methodological approaches have been employed - Kalman filtering, principal components analysis and variance-equal weights approach. Estimated indices turned out robust across specifications and lead to very similar conclusions. Three financial supply cycles in the NMS, and

the beginning of the fourth one, were extracted based on estimated FSIs over the last 17 years. The analysis also showed a trend in the higher co-movement of domestic components of FSIs across EU NMS, possibly indicating rising financial integration within the group. The results have shown that the main drivers of financial supply for EU NMS are externally determined, with economic sentiment and business climate in the Eurozone carrying, on average, the highest weight in FSI dynamics of individual countries. This confirms the findings of the strand of literature that emphasized the role of "push" factors for capital flow dynamics.

The paper also introduced a new indicator (*Refinancing Risk Ratio*), which relates the demand for foreign funds by the government to the supply of capital available at a given point of time, to quantify the external refinancing conditions and risk faced by the government. We are able to distinguish between two main episodes of high refinancing risk faced by the EU NMS - one during the global financial crisis, and the other during the European sovereign debt crisis. We find that the first spike in RRR was supply-driven, while the second one was characterized by simultaneous low supply and high demand episodes, which made the refinancing conditions much more unfavourable. The recent periods were marked by a significant drop in RRR values in most NMS, with an exception of Croatia whose government currently faces unprecedented levels of demand for foreign capital.

The usefulness of FSI and RRR for economic policy is multifaceted. FSI provides more information than the common FCI, as it reveals the current and historical levels of supply of foreign capital to each country individually, which can be used to determine the phase of the financial supply cycle a country is currently in. In turn, FSI and RRR could provide useful information to policy makers and corporate executives in determining the appropriate timing of issuing debt, the risk premium they might face, the riskiness of their refinancing position, and to form realistic expectations about near-term capital inflows.

This research has opened several new questions and avenues for future research. Namely, how does the timing of debt issuance by governments and corporate sectors correspond with the phases of financial cycles? Have the governments been able to avoid debt creation during the unfavourable financial supply conditions? Is there a connection between the level of RRR and the fiscal discipline of sovereign governments and what is the nature of

this relationship? Is RRR a good predictor of sovereign debt crises? All these questions remain a potentially fruitful topic for future research.

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# Data appendix

Table 4: Variables and data sources

| Variable | Explanation | Transformation | Source |
|---|---|---|---|
| External variables | | | |
| $ext\_uncert_t$ | European economic policy uncertainty index | Natural logarithms, multiplied by -1 | Baker et al. (2016) |
| $ext\_vix_t$ | Volatility of S&P 500 (VIX) | Natural logarithms, multiplied by -1 | FRED |
| $ext\_spread_t$ | Difference between average EU NMS and German 10y sovereign bond yields | Multiplied by -1 | Eurostat, author's calculations |
| $ext\_conf_t$ | EU consumer confidence indicator | - | European Commission |
| $ext\_libor_t$ | Difference between 3-month LIBOR and T-Bill rates | Multiplied by -1 | IFS |
| $ext\_strate_t$ | 3-month Eurozone money market rate | Y-o-y difference, multiplied by -1 | Eurostat |
| $ext\_ltrate_t$ | Eurozone EMU convergence criterion yield | Y-o-y difference, multiplied by -1 | Eurostat |
| $ext\_mci_t$ | Eurozone Monetary Conditions Index | - | European Commission |
| $ext\_ind_t$ | Eurozone industrial production index | Y-o-y growth rate | Eurostat |
| $ext\_sp500_t$ | S&P 500 stock index | Natural logarithms, y-o-y growth rate | IFS |
| $ext\_estoxx_t$ | Eurostoxx 50 stock index | Natural logarithms, y-o-y growth rate | ECB |

| | | | |
|---|---|---|---|
| $ext\_esi_t$ | Euro area Economic Sentiment Indicator | - | European Commission |
| $ext\_bci_t$ | Euro area Business Climate Indicator | - | European Commission |
| Domestic variables | | | |
| $dom\_conf_t$ | Consumer confidence indicator | - | Eurostat |
| $dom\_price_t$ | Volatility of HICP | 24m rolling standard deviations, multiplied by -1 | Eurostat |
| $dom\_spread_t$ | Difference between domestic and German 10y sovereign bond yield | Multiplied by -1 | Eurostat |
| $dom\_lend_t$ | Average lending rate | Y-o-y difference, multiplied by -1 | IFS |
| $dom\_strate_t$ | 3-month money market rate | Y-o-y difference, multiplied by -1 | Eurostat |
| $dom\_stocks_t$ | Stock market indices | Y-o-y growth rate | IFS |
| $dom\_ind_t$ | Industrial production indices | Y-o-y growth rate | Eurostat |
| $dom\_neer_t$ | Volatility of nominal effective exchange rate | 24m rolling standard deviations, multiplied by -1 | IFS |