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Alternative Measures for the Global Financial Cycle: Do They Make a Difference?

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Alternative Measures for the Global Financial Cycle: Do They Make a Difference?

Abstract

We construct several measures for the global financial cycle using dynamic factor models and data for 25 advanced and emerging countries over 1980-2019. Our results suggest that global cycles in asset prices and capital flows are highly similar and synchronized, especially during crisis episodes. Our measures for asset-specific global cycles suggest that cycles in credit and house prices are less volatile and have a longer duration than cycles in equity and bond prices. Finally, we find significant co-movement of our global financial cycle measures and two measures as suggested in the literature that are based on top-down and bottom-up approaches.

JEL-Codes: E440, F320, F360.

Keywords: global financial cycle, national financial cycle, dynamic factor analysis, capital flows, asset prices.

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1. Introduction

Increasing integration of financial markets stimulated research on the global financial cycle (GFCy), i.e., the co-movement of financial market prices and capital flows across countries (Davis et al., 2021; Scheubel et al., 2019).¹ The presence of a GFCy may have important policy implications, such as the choice among the objectives of a fixed exchange rate, autonomous monetary policy, and capital mobility. According to the well-known “trilemma”, countries can pursue two out of these three objectives simultaneously (Mundell, 1963), but Rey (2015) argues that the existence of the GFCy changes the “trilemma” into a “dilemma”. Countries have to choose between monetary policy autonomy and full capital mobility. However, other recent studies suggest that individual countries are still able to manage domestic financial conditions in response to global shocks (IMF, 2017; Cerutti et al., 2019).

The question of what drives the global financial cycle (GFCy) has received considerable attention in the literature. U.S. monetary policy has often been identified as one of the main drivers of the GFCy due to the crucial role of the U.S. dollar (USD) in global financial markets (e.g., Boehm and Kroner, 2020; Cerutti et al., 2019; Davis et al., 2021; Déés and Galesi, 2021; Miranda-Agrippino and Rey, 2020, hereafter MA-R).

The studies referred to above use different methods to identify the GFCy. For instance, MA-R and Aldasoro et al. (2020) identify a GFCy in asset prices and capital flows, but do not consider the global co-movement of individual variables. Ha et al. (2020) and Potjagailo and Wolters (2019) find evidence for a GFCy in asset-specific variables, like equity prices, commodity prices, and credit, but do not consider GFCys in capital flows and asset prices.

These differences reflect that there is no consensus regarding the concept and measurement of the GFCy. Different methodologies have been applied to construct the GFCy.

¹ Appendix A provides a detailed overview of research on the GFCy.

The first strand of the literature identifies the GFCy by summarizing the co-movement of financial variables (like asset prices, capital flows, and credit) around the world, following a top-down approach (Bonciani and Ricci, 2020; Davis et al., 2021; Meller and Metiu, 2017), but differences exist as to which variables are included to construct the GFCy. The second strand of literature documents the existence of the GFCy from the co-movement of national financial cycles (Oman, 2019), following a bottom-up approach.

Against this background, we construct new measures for the GFCy in capital flows, asset prices, and asset-specific variables.² We try to answer the following three questions: first, how strong is the coherence of these different GFCy measures (all determined following a top-down approach)?³ Second, do these different GFCy measures have different cyclical properties? Third, do our GFCy measures differ from other GFCy measures suggested in the literature following a top-down or bottom-up approach? These issues are relevant, also from a policy perspective; after all, if different methodologies yield very different global financial cycles, the policy implications as discussed above may not hold in general.

Our analysis is based on data for 25 advanced and emerging countries over the 1980-2019 period. The data used fall into three groups: (i) asset prices and credit; (ii) capital flows; and (iii) asset-specific variables, including the prices of commodities, equity, bonds, real residential property, and real credit and the credit ratio.

We adopt dynamic factor models (DFMs) to measure GFCys. DFMs capture common fluctuations across data sets using a few common factors. DFMs have several advantages compared to alternative methods for measuring the GFCy. For instance, some studies identify

² In our paper, a GFCy in asset prices refers to a global factor estimated from equity indices, bonds, and commodities. A GFCy in capital flows refers to a global factor estimated from both inward and outward foreign direct investment, equity and debt flows, and other investments (all expressed as a percentage of GDP).

³ There are some related papers comparing different measures for the GFCy (cf. Aldasoro et al., 2020; Miranda-Agrippino and Rey, 2020; Potjagailo and Wolters, 2019; Scheubel et al., 2019). These studies are discussed in more detail in Section 2.

the GFCy as the GDP weighted average of national financial cycles, which implies that large countries dominate the GFCy and could mask the co-movement across a subset of the data (Oman, 2019). Instead, the DFM computes “weights” as part of the estimation, which capture the largest dynamic global factor across countries. Besides, if the global financial cycle is dominated by one large country or variable, a DFM would identify the dynamic factor that contains the most significant information of that country or variable.

We analyze coherence of the extracted GFCys using the synchronicity and similarity measures suggested by Mink et al. (2012). These authors show that the correlation coefficient of output gaps, i.e., a widely used approach to examine business cycle coherence, does not properly take differences between the sign and the amplitude of the output gap into account. For instance, two output gap series may have very different amplitudes while the correlation between both series equals one. The same criticism holds for the correlation of GFCy measures. Mink et al. (2012) propose two simple measures to analyze coherence of cycles that can be used as an alternative for the correlation coefficient. These measures examine whether cycle measures have the same sign (synchronicity), and whether they have the same amplitude (which is taken into account by the similarity measure). For comparing the cyclical characteristics of GFCys, we apply the BBQ method of Harding and Pagan (2002) to identify peaks and troughs which we use to determine the length and depth of the cycles.

Our analysis leads to three new findings. First, we find that the global financial cycles in asset prices and capital flows are highly similar and synchronized, especially during crisis episodes. Second, we document that the volatilities and durations of GFCys differ across asset prices. The GFCys in credit and house prices are less volatile and have a longer duration than GFCys in equity and bond prices. Third, we find significant co-movement of our GFCy measures and two alternatives based on top-down and bottom-up approaches.

The remainder of the paper is organized as follows. Section 2 provides a brief review of the literature. Section 3 describes the datasets used, while section 4 introduces our methodology. Section 5 presents the empirical outcomes. Finally, section 6 concludes.

2. Literature Review

Table A1 in the online Appendix lists recent relevant studies, showing how they measure GFCys and documenting their properties. These studies can be grouped together as follows.

First, several studies focus on the co-movement of asset prices and credit. A global factor affects individual countries' financial conditions through the cross-border lending channel: international financial intermediaries transmit liquidity and financial conditions globally through their interaction with local banks (Bruno and Shin, 2015). Rising asset prices in the home country expand financial institutions' balance sheet, which triggers a vicious circle of rising asset prices and balance sheet expansion across countries (Krugman, 2008). This loop increases financial institutions' net worth, which affects their lending capacity (Drehmann et al., 2012; Schüler et al., 2020).

Second, several studies identify a GFCy in capital flows, analyzing the factors driving capital flows. This issue plays an important role in the “dilemma vs. trilemma” debate. According to proponents of the dilemma, capital flows are driven by factors independently of the exchange rate regime. Opponents of this view argue that the GFCy plays a limited role in explaining capital flows. Thus, the trilemma does not morph into a dilemma, and countries have more freedom in managing policies to immunize themselves from undesirable global shocks (Cerutti et al., 2019). In addition, some authors take an intermediate position arguing that the extent to which countries are exposed to the GFCy is related to their financial openness, financial depth, and exchange rate regimes (Barrot and Serven, 2018), and the presence of global investors and global players (Ligonniere, 2018). Countries adjust their policies

accordingly, using, for instance, partial capital controls and limited exchange rate flexibility instead of strict capital controls and fully floating exchange rates (Aizenman et al., 2013; Klein and Shambaugh, 2015).

The first and second strand of literature have in common that they are based on a top-down approach, in contrast to the third strand of literature which investigates GFCys based on national financial cycles and thus follows a bottom-up approach. Under this approach, a GFCy exists if financial cycles across countries are highly similar and synchronized. Claessens et al. (2011) find highly synchronized credit cycles across countries. Relatedly, Meller and Metiu (2017) combine phase synchronization and cluster analysis, and conclude that a synchronized credit cycle exists within a limited number of countries. In this literature, studies are typically based on medium-term financial cycles, and scholars commonly adapt univariate filters with a frequency band of 32–120 quarters to measure these medium-term fluctuations (Claessens et al., 2012; Drehmann et al., 2012; Oman, 2019). They capture the GFCy as GDP-weighted national financial cycles.

Little is known about the similarity of global financial cycle measures constructed using these different methodologies. The study that comes closest to our work is Aldasoro et al. (2020). These authors compare national financial cycles (NFCys), constructed by calculating a composite medium-term index of credit and property prices, with the GFCy estimated by MA-R and the GFCys in gross capital inflows. They find that NFCys and the GFCy are not strongly associated.

Although studies discussed above measure the GFCy as the co-movement among asset prices, credit, and/or capital flows around the globe using a static or dynamic global factor model (Aldasoro et al., 2020; MA-R, 2020; Potjagailo and Wolters, 2019; Scheubel et al., 2019), they use different samples of countries, time periods, and variables. Some analyze a cycle among several financial variables, while others identify a GFCy in individual financial variables.

Only few papers measure the GFCy using both capital flows and asset prices on the one hand, and asset-specific GFCys on the other, and compare them as we do.

3. Data

We use an unbalanced panel dataset from 1980 to 2019 for 25 countries. Our sample contains the major advanced and emerging countries. Small emerging countries are excluded as their financial markets are relatively closed and they have limited cross-border capital flows. The countries in our sample are listed in Table 1.

Table 1. List of countries

Full sample (25)		Advanced (14)	Emerging (11)	G20 (19)*	G7 (7)	BRICS (5)
Australia (AU)	Argentina (AR)	Australia	Argentina	Argentina	Canada	Brazil
Austria (AT)**	Brazil (BR)	Austria	Brazil	Australia	France	China
Belgium (BE)**	China (CN)	Belgium	China	Brazil	Germany	India
Canada (CA)	India (IN)	Canada	India	Canada	Italy	Russia
France (FR)**	Indonesia (ID)	France	Indonesia	China	Japan	South Africa
Germany (DE)**	Mexico (MX)	Germany	Mexico	France	UK	
Italy (IT)**	Republic of Korea (KR)	Italy	Korea	Germany	US	
Japan (JP)	Russia (RU)	Japan	Russia	India		
Netherlands (NL)**	Saudi Arabia (SA)	Netherlands	Saudi Arabia	Indonesia		
Poland (PL)**	South Africa (ZA)	Poland	South Africa	Italy		
Spain (ES)**	Turkey (TR)	Spain	Turkey	Japan		
Sweden (SE)**		Sweden		Korea		
United Kingdom (UK)		UK		Mexico		
United States (US)		US		Russia		
				Saudi Arabia		
				South Africa		
				Turkey		
				UK		
				US		

Notes: This table lists the full sample of countries, which covers advanced, emerging, G20, G7, and BRICS countries. Numbers in parentheses are the number of countries in the full sample or subgroups. G7 = Group of Seven; G20 = Group of Twenty. *Does not include European Union aggregate. ** Largest European Union countries.

Data for capital flows come from the IMF International Financial Statistics (IFS), covering both inward and outward foreign direct investment, equity and debt flows, and other investments. These data are sourced at the quarterly frequency. We control for the economy's size by taking the capital flows as a percentage of GDP. GDP is obtained from the IMF's World Economic Outlook database. As for some countries GDP is only available at a yearly frequency, we disaggregate annual GDP data into quarterly figures using the Chow and Lin (1971) approach.

Furthermore, we take monthly commodity prices from the Commodity Research Bureau (Cmdty). The monthly commodity futures are the price of the nearest- or next nearest-to-delivery contract. For equity price indices, we pick representative indices of five sectors for each country: information technology, financials, health care, consumer discretionary, and industrials.⁴ Bond indices contain 18 corporate bonds for Euro markets, 24 for Sterling markets, and 36 for USD markets. In total, we include 39 commonly used commodities, 122 sectoral equity indices, and 78 bond indices.⁵

National financial cycles are identified using credit and housing prices. Following Drehmann et al. (2012) and Oman (2019), we use (i) the real residential property price as indicator of housing prices, (ii) real credit from banks to the private non-financial sector, and (iii) the ratio of credit to GDP. These variables are sourced from the BIS and available at the quarterly frequency from 1980Q1-2019Q4. We convert the quarterly series of capital flows, credit, and housing prices into monthly data via shape-preserving piecewise cubic interpolation, which gives very smooth and accurate interpolating curves (Dougherty et al., 1989).

⁴ The sector classification is based on <https://www.spglobal.com/spdji/en/indices/equity/sp-global-1200/#data>.

⁵ The online Appendix B describes the detailed series used to estimate global factors.

4. Dynamic Factor Analysis

4.1 Dynamic Factor Model

Let x_t be an n -dimensional vector of monthly observed variables $x_{i,t}$, where $x_{i,t}$ is the series i at date t . The DFM takes the following form:

$$x_t = \Lambda F_t + \xi_t, \quad (1)$$

where $F_t = [f_{1,t}, \dots, f_{r,t}]'$ is an $(r \times 1)$ vector of common factors, Λ is the vector of factor loadings and ξ_t is a $(n \times 1)$ vector of idiosyncratic errors. The factors are assumed to follow a VAR process of order p , which allows parameters to vary over time as functions of lagged dependent variables

$$F_t = \Phi_1 F_{t-1} + \dots + \Phi_p F_{t-p} + \varepsilon_t. \quad (2)$$

We distinguish common fluctuations at different levels. Therefore, each series $x_{i,t}$ is the sum of a global factor (f_t^{global}), a regional specific factor (f_t^{region}) and an idiosyncratic term

$$\begin{aligned} x_{i,t} &= \lambda_i^g f_t^{global} + \lambda_i^r f_t^{region} + \xi_{i,t} \\ &= (\lambda_i^g \quad \lambda_i^r) \begin{pmatrix} f_t^{global} \\ f_t^{region} \end{pmatrix} + \xi_{i,t}, \end{aligned} \quad (3)$$

where f_t^{global} captures fluctuations in all series and f_t^{region} captures commonalities of series that belong to a region or group. Such DFM with hierarchical structure is imposed via zero restrictions on some of the elements in Λ . The entire DFM with all R blocks (regions) can be written as:

$$x_t = \begin{pmatrix} \Lambda_1^g & \Lambda_1^1 & 0 & \dots & 0 \\ \Lambda_2^g & 0 & \Lambda_2^2 & \dots & 0 \\ \vdots & 0 & 0 & \ddots & \vdots \\ \Lambda_R^g & 0 & 0 & \dots & \Lambda_R^R \end{pmatrix} \begin{pmatrix} f_t^{global} \\ f_t^{region,1} \\ f_t^{region,2} \\ \vdots \\ f_t^{region,R} \end{pmatrix} + \xi_t. \quad (4)$$

We apply this DFM with blocks to our dataset. Since the DFM requires stationary data, the variables are transformed accordingly. The global factor in capital flows is extracted from

capital inflows and outflows as a percentage of GDP in levels while asset prices as well as housing prices and credit are included in log-differenced form. Before estimation, we standardize each series to have a zero mean and unit variance. The global factors on log-differenced time series are obtained via cumulating, as cumulating the factors estimated from the log-differenced model gives a consistent estimate of the data before the log-differenced transformation. To obtain the proper sign of the comparable global factor, we follow Bai and Ng (2004)'s normalization.⁶ Next, we fit each dataset to the DFM with one global factor and one factor for each region/block. That is, we estimate a 'global factor', which is a common factor covering all variables, with regional factors, which capture the fluctuations of variables in blocks. The data are divided into the following seven blocks based on their geographical location: North America, Latin America, Western Europe (Euro Area, UK, and the Scandinavian countries), Central and Eastern Europe, Emerging Asia, Asia Pacific, and Africa.

To determine the number of dynamic factors, we employ the criterion suggested by Bai and Ng (2007) and Hallin and Liška (2007). Zhao et al. (2017) compare the performance of five methods and conclude that the methods developed by Bai and Ng (2007) and Hallin and Liška (2007) for estimating the number of dynamic factors outperform the others.

We first show the number of dynamic factors, and then display the outcomes of global factors and discuss the nature of the global factors that we estimate. Table 2 reports the number of dynamic factors in capital flows and asset prices, respectively, while Table 3 reports the explained variance of the first q common factors. Since the availability of data differs across countries, we employ four different time periods: 1980-2019; 1990-2019; 2000-2019; and 2010-2019. Table 2 suggests that the number of dynamic factors in capital flows or in asset

⁶ Bai and Ng (2004) begin with a $T \times N$ matrix X . In order to make the variables stationary, they first-differenced data and get a $(T - 1) \times N$ matrix \tilde{X} . The principal component estimator of f , denoted \hat{f} , is $\sqrt{T - 1}$ times the r eigenvectors corresponding to the first r largest eigenvalues of the $(T - 1) \times (T - 1)$ matrix $\tilde{X}\tilde{X}'$. They normalize the factor using $\hat{f}\hat{f}'/(T - 1) = I_r$.

prices range between 2 and 5, while the first common factor can explain 30% of the variation on average as shown in Table 3.

Table 2. Estimated number of dynamic global factors in capital flows and asset prices

Sample	Bai & Ng (2007)	Hallin & Liška (2007)
<i>Capital flows</i>		
(a) 1980M1:2019M12, 13 countries, cross section n=104, T=480 months, 49920 observations	3	4
(b) 1990M1:2019M12, 16 countries, cross section n=128, T=360 months, 46080 observations	3	4
(c) 2000M1:2019M12, 22 countries, cross section n=174, T=240 months, 41760 observations	5	3
(d) 2010M1:2019M12, 25 countries, cross section n=196, T=120 months, 23520 observations	5	2
<i>Asset prices</i>		
(a) 1980M2:2019M12, cross section n=121, T=479 months, 57959 observations	2	4
(b) 1990M1:2019M12, cross section n=157, T=360 months, 56520 observations	3	4
(c) 2000M1:2019M12, cross section n=260, T=240 months, 62400 observations	5	3
(d) 2010M1:2019M12, cross section n=305, T=212 months, 36600 observations	5	2

Notes: The methodology for selecting the number of dynamic factors is based on balanced panels. The asset prices from 1980M1 to 2019M12 include 19 commodities, 54 equity indices, 17 credit ratios, 17 real credit series, and 14 housing prices. The asset prices from 1990M1 to 2019M12 include 25 commodities, 78 equity indices, 21 credit ratios, 19 real credit series, and 14 housing prices. The asset prices from 2000M1 to 2019M12 include 29 commodities, 112 equity indices, 55 bond indices, 25 credit ratios, 25 real credit series, and 14 housing prices. The asset prices from 2010M1 to 2019M12 include 37 commodities, 119 equity indices, 78 bond indices, 25 credit ratios, 25 real credit series, and 21 housing prices.

Table 3. Covariance matrix of capital flows and asset prices

q	(a) 1980M1:2019M12	(b) 1990M1:2019M12	(c) 2000M1:2019M12	(d) 2010M1:2019M12	Average
Capital flows					
1	0.3290	0.2958	0.2464	0.3290	0.3001
2	0.2212	0.2472	0.1981	0.2212	0.2219
3	0.1854	0.1975	0.1518	0.1854	0.1800
4	0.0951	0.1287	0.1227	0.0951	0.1104
5	0.0892	0.0778	0.0943	0.0892	0.0876
6	0.0401	0.053	0.0748	0.0401	0.0520
Asset prices					
1	0.4612	0.3151	0.229	0.1983	0.3009
2	0.4329	0.3074	0.2254	0.1928	0.2896
3	0.0786	0.2855	0.2166	0.1815	0.1906
4	0.0273	0.0726	0.163	0.1733	0.1091
5		0.0195	0.1395	0.1305	0.0965
6			0.0265	0.1017	0.0641

Notes: The methodology for selecting the number of dynamic factors is based on balanced panels. The asset prices from 1980M1 to 2019M12 include 19 commodities, 54 equity indices, 17 credit ratios, 17 real credit series, and 14 housing prices. The asset prices from 1990M1 to 2019M12 include 25 commodities, 78 equity indices, 21 credit ratios, 19 real credit series, and 14 housing prices. The asset prices from 2000M1 to 2019M12 include 29 commodities, 112 equity indices, 55 bond indices, 25 credit ratios, 25 real credit series, and 14 housing prices. The asset prices from 2010M1 to 2019M12 include 37 commodities, 119 equity indices, 78 bond indices, 25 credit ratios, 25 real credit series, and 21 housing prices.

4.2 Synchronicity and similarity

We analyze the coherence of different GFCys using the synchronicity and similarity measures proposed by Mink et al. (2012), which compare the sign and the magnitude of those GFCys with those of a reference cycle.⁷ The synchronicity among n cycles considers the sign differences more adequately than the correlation coefficient, and captures whether the positive or negative phases of a cycle coincide with those of a reference cycle, regardless of their amplitudes. Denoting some measure of the global financial cycle at time t by $g_i(t)$ and the reference cycle at time t by $g_r(t)$, we calculate synchronicity between this global financial cycle measure and the reference cycle in period t as

$$\varphi_{ir}(t) = \frac{g_i(t)g_r(t)}{|g_i(t)g_r(t)|} \quad (5)$$

⁷ The next part heavily draws on Mink et al. (2012).

The similarity measure is based on the absolute differences between two cycles. While GFCy correlations do not accurately reflect to what extent GFCys have the same sign, they also do not consider whether GFCys have the same amplitude. The correlation between two series can be equal to one even when both series have different standard deviations. To take amplitude differences between GFCys into account, we calculate overall similarity of the n countries with the reference as

$$\varphi_{ir}(t) = 1 - \frac{\sum_{i=1}^n |g_i(t) - g_r(t)|}{\sum_{i=1}^n |g_i(t)|}. \quad (6)$$

Having defined our synchronicity and similarity measures, we need to specify the reference cycle. We select the reference that maximizes synchronicity and similarity simultaneously, i.e., the median of all individual GFCys observed at time t (Joag-Dev, 1989). Our reference GFCy maximizes synchronicity and similarity not only for the full sample period for which it is calculated, but also for all possible sub-samples. This property reflects the fact that the reference GFCy and the synchronicity and similarity measures are calculated on a per-observation basis without being affected by GFCys observed at earlier or later dates.

4.3 Turning-point algorithm

We use the Harding and Pagan (2002) turning-point algorithm to examine cyclical characteristic of GFCys. This method first establishes candidate dates of peaks and troughs by calculating local minimum and maximum values of the individual series:

a peak occurs at time t if $y_{t-2} - y_t < 0$; $y_{t-1} - y_t < 0$; $y_{t+1} - y_t < 0$; $y_{t+2} - y_t < 0$; and

a trough occurs at time t if $y_{t-2} - y_t > 0$; $y_{t-1} - y_t > 0$; $y_{t+1} - y_t > 0$; $y_{t+2} - y_t > 0$.

Next, turning points are censored to ensure that peaks and troughs alternate. Finally, censoring the turning points ensures that each phase lasts a minimum of 2 quarters, and each complete financial cycle lasts a minimum of 5 quarters. As much of the previous work in this line of

research uses quarterly data (Drehmann et al., 2012; Hiebert et al., 2018), we convert GFCys into quarterly series and set the minimum phase at two quarters.

5. Empirical results

5.1 GFCy in asset prices and capital flows and asset-specific GFCy

Here we present our GFCy estimates obtained following a top-down approach. We start by identifying the GFCys in asset prices and credit. Next, we extract the GFCy in capital flows, followed by our estimates of GFCys in asset-specific variables. We analyze the synchronicity and similarity of these GFCys and examine their cyclical characteristics.

GFCys in asset prices and credit

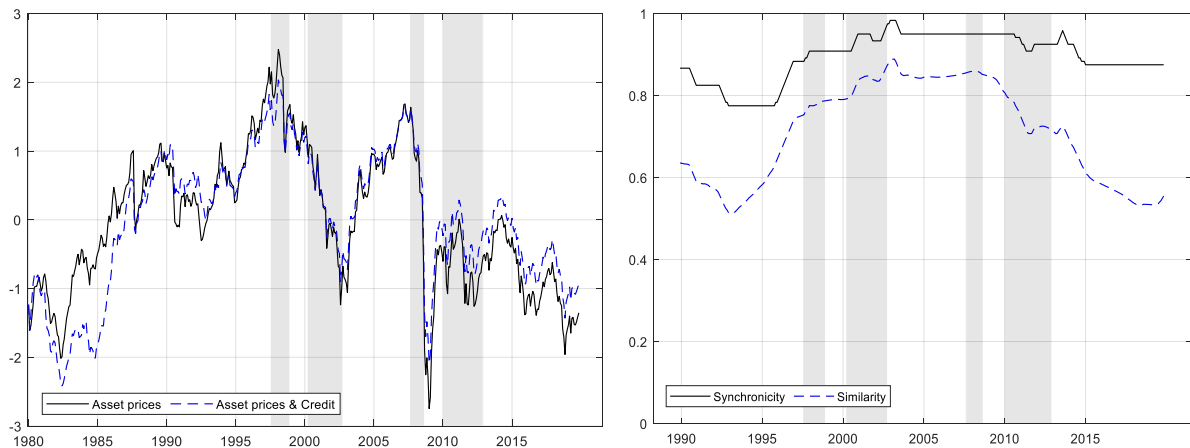
The black solid line in the left-hand side panel of Figure 1 shows the GFCy in asset prices for the period 1980-2019. The blue dashed line displays the estimated GFCy in asset prices and credit together, which shows only minor differences with the GFCy in asset prices. These GFCys decreased around 1997-2000, which may be associated with events like the Russian default crisis, the LTCM bailout, and the Asian financial crisis. The trough after 2000 may be related to the dot-com crash. The subprime market's collapse and the Global Financial Crisis around 2007-2008 are captured by the sharp decline associated with this crisis episode.

We analyze these GFCys using the synchronicity and similarity measures as explained in the previous section. The right-hand side panel of Figure 1 depicts 10-year moving averages of the synchronicity and similarity measures.⁸ Synchronicity and similarity of the GFCys in asset prices and the GFCy in asset prices and credit jointly are relatively high. The overall

⁸ The first observation for 1990.1 is the average of the synchronicity and similarity over the period 1980.1-1990.1. The second observation for 1990.2 is the average of 1980.2-1990.2, etc.

synchronicity measure is usually higher than 0.8, and the overall similarity measure is higher than 0.5. Furthermore, synchronicity and similarity display similar patterns.

Figure 1. GFCys in asset prices and asset prices and real credit

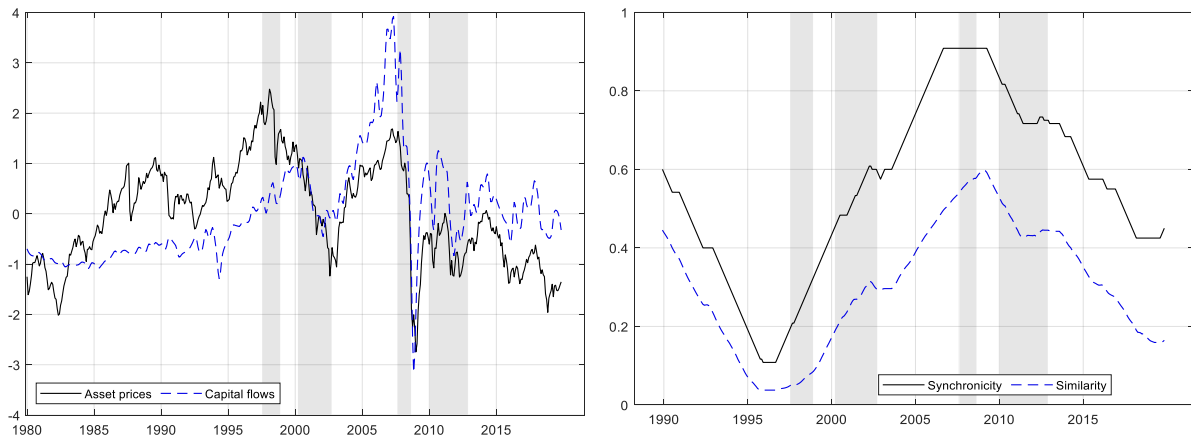


Notes: The left-hand side panel of Figure 1 plots the GFCy estimated from all asset prices (black solid line) and the GFCy estimated from all asset prices and real credit (blue dashed line) for the sample period of 1980M1:2019M12. We standardize the GFCy series with a zero mean and unit variance to compare different GFCys. The block matrix is based on the geographical location. The right-hand side panel of Figure 1 plots the synchronicity (black solid line) and similarity (blue dashed line) measures that are transformed to 10-year moving averages. Shaded areas denote the Asia financial crisis of 1997-1998, the dot-com crash of 2000-2002, the Global Financial Crisis of 2007-2008, and the European debt crisis of 2010-2012, respectively.

GFCy in capital flows

Figure 2 shows that the GFCy in capital flows and the GFCy in asset prices are very similar. The similarity and synchronicity of the two cycles are relatively high, with the exception of the 1990s (Mexican and Asian financial crisis). This finding is consistent with the conclusions of Miranda-Agrippino et al. (2020), who report a high correlation between GFCys in asset prices and in capital flows. Between 1995-2010, the similarity and synchronicity measures increased, with temporary peaks corresponding with periods of crisis. This probably reflects that global risks in financial markets are associated with extreme capital flow episodes (Forbes and Warnock, 2012).

Figure 2. GFCys in asset prices and capital flows



Notes: The left-hand side panel of Figure 2 plots the GFCy in capital flows of 25 countries for the sample period of 1980M1:2019M12 (black solid line) together with the GFCy in asset prices (blue dashed line). We convert the quarterly capital flows to monthly flows via interpolation. The block matrix is based on the geographical location. The right-hand side panel of Figure 2 plots the synchronicity (black solid line) and similarity (blue dashed line) measures that are transformed to 10-year moving averages. Shaded areas denote the Asia financial crisis of 1997-1998, the dot-com crash of 2000-2002, the Global Financial Crisis of 2007-2008, and the European debt crisis of 2010-2012, respectively.

Asset-specific GFCys

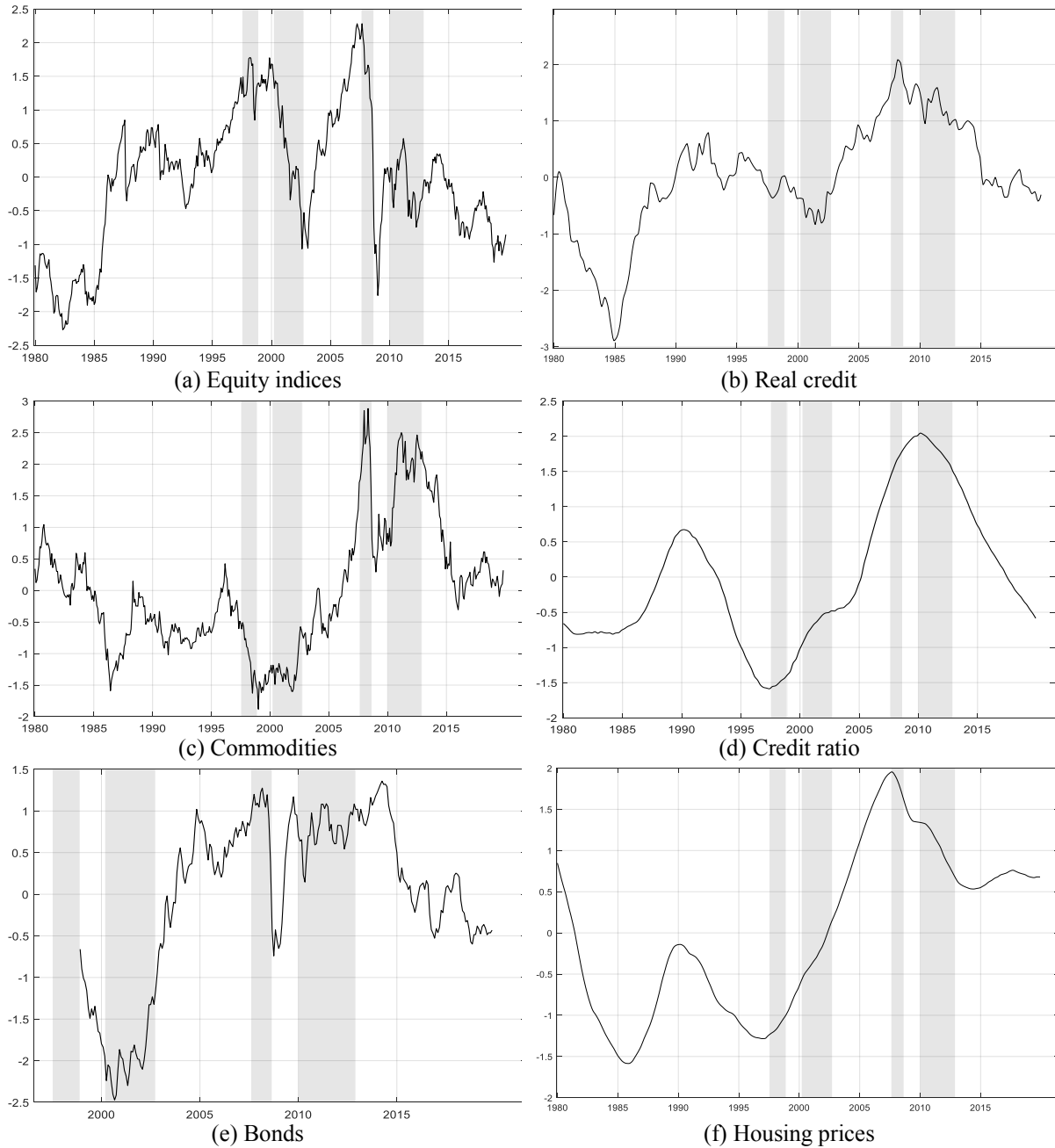
Figures 3(a) to (g) show GFCys in equity, bonds, and commodity indices, credit, and house prices, respectively. The graphs lead to several observations. First, the volatilities of GFCys in credit and house prices (Figures 3b, 3d, 3f) differ substantially from the volatility of the GFCys in asset prices (Figures 3a, 3c, 3e). The standard deviations of the GFCys in equity and bond prices over the whole sample period are more than twice as high as the standard deviation of the other GFCys.⁹

Furthermore, durations across these GFCys vary. Previous research has suggested that national financial cycles constructed using credit and housing prices have a longer duration than

⁹ The standard deviations of the GFCys in equity and bond prices are 5.97 and 7.93, respectively. The standard deviations of the GFCys in commodities, real credit, credit ratio, and housing prices are 2.54, 3.02, 1.86, and 1.79, respectively.

financial cycles in equity prices (Drehmann et al., 2012). Likewise, we find that the durations of GFCys in credit and house prices are longer than GFCys in risky asset prices.¹⁰

Figure 3. Asset-specific GFCys

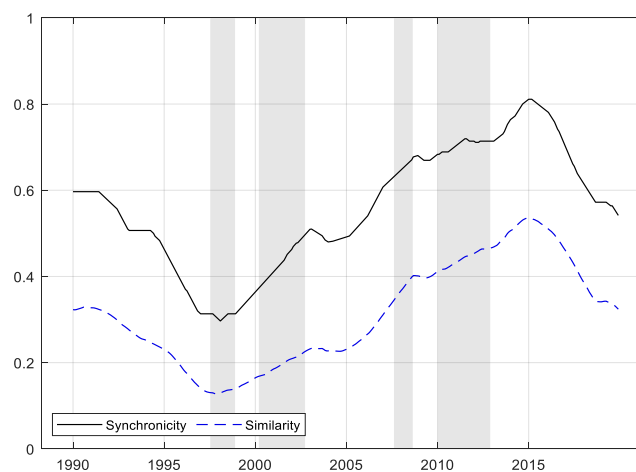


Notes: Figure 3a plots the GFCy estimated from equity indices of 25 countries for the sample period of 1980M1:2019M12. Figure 3c plots the GFCy estimated from 39 commonly used commodity prices. Figure 3e plots the GFCy estimated from 110 bond indices. Figures 3b, 3d, and 3f plot the GFCy estimated from the real credit, credit ratio, and housing prices for the sample period of 1980M1:2019M12, respectively. Shaded areas denote the Asia financial crisis of 1997-1998, the dot-com crash of 2000-2002, the Global Financial Crisis of 2007-2008, and the European debt crisis of 2010-2012, respectively.

¹⁰ Note that Drehmann et al. (2012) impose a restriction on the length of the financial cycles, while we do not set such a restriction before estimation.

Figure 4 shows 10-year moving averages of the synchronicity and similarity measures for asset-specific GFCys in equity indices, bonds, commodities, real credit, the credit ratio, and housing prices for the period 1980:01–2019:12. Synchronicity is generally higher than similarity. Both measures declined from about 1991 until the late 1990s and exhibited a significant upward trend during 2000-2015 and a downward trend after 2015.

Figure 4. Synchronicity and similarity of asset-specific GFCys



Notes: Figure 4 plots the synchronicity (black solid line) and similarity (blue dashed line) measures of equity indices, bonds, commodities, real credit, the credit ratio, and housing prices (10-year moving averages). The reference cycle is the median of all individual GFCys in equity indices, bonds, commodities, real credit, the credit ratio, and housing prices. Shaded areas denote the Asia financial crisis of 1997-1998, the dot-com crash of 2000-2002, the Global Financial Crisis of 2007-2008, and the European debt crisis of 2010-2012, respectively.

Finally, the resemblance between the GFCy in asset prices (shown in Figure 2) and the GFCy in equity prices is much higher than the resemblance with the GFCy in commodity and bond prices. This suggests that equity indices play a more prominent role in determining the GFCy in asset prices.

Cyclical properties of GFCys

Table 4 presents cyclical characteristics of our GFCys in asset prices and capital flows, and in asset-specific GFCy measures. The last column in the table shows that the duration of our GFCys varies quite substantially. The GFCy in residential property prices and the credit ratio

have the longest duration (56.5 quarters on average), while the duration of the GFCy in bond indices is shortest (9.5 quarters). In addition, the other GFCys take intermediate time to reach their peak, around 14 quarters on average. Furthermore, the table shows that the expansion and contraction phases are similar for different GFCys; the contraction phase is usually slightly shorter than the expansion phase (shown in columns 3 and 5). The GFCys in commodities and residential property prices are exceptions; they have a longer contraction phase and a shorter expansion phase.

Table 4. Characteristics of asset-specific GFCys: individual series

	Amplitude		Duration		Cycle*
	Expansions	Contractions	Expansions	Contractions	
GFCy in asset prices	1.38	-1.36	7.64	5.58	12.50
GFCy in capital flows	1.79	-1.55	13.50	5.00	18.50
Equity	1.25	-1.16	6.50	5.77	13.3
Commodities	1.07	-1.10	6.17	6.25	12.4
Bonds	1.08	-0.86	5.13	4.00	9.5
Real credit	0.94	-0.74	6.73	5.90	13.6
Credit ratio	1.72	-1.15	27.67	16.50	55.0
RPP**	0.89	-1.64	20.33	24.33	58.0

Notes: * The duration of the full cycle is measured (in quarters) from peak to peak. ** Residential property prices. We regard GFCys as quarterly series and set the minimum phase at two quarters.

5.2 Comparison with other GFCys

In this section, we ask how our GFCy measures relate to other GFCy measures. Table 5 lists studies using either the top-down or bottom-up approach. We select two representative studies for comparison purposes: MA-R, which is also based on a DFM, and Oman (2019), who adopts a bottom-up approach. We first describe how these alternative GFCys measures have been constructed, and then compare them with our GFCy measures using their similarity and synchronicity, and cyclical characteristics.

Table 5. Global financial cycle measures

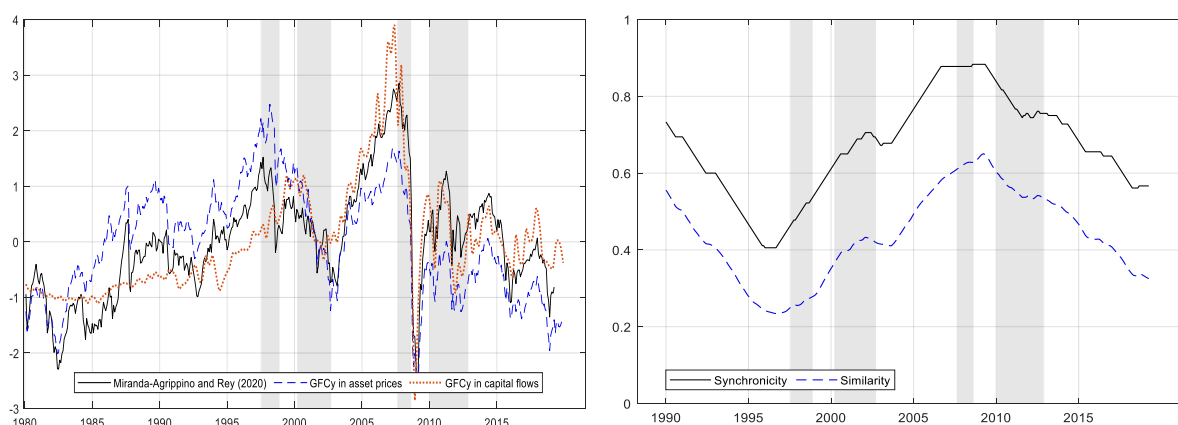
GFCy	References	Methodology
Global factor in asset prices; capital flows; credit	Miranda-Agrippino and Rey (2020)	Dynamic factor model
	Aldasoro et al. (2020)	Principle component analysis
	Cerutti et al. (2019)	Dynamic factor model
	Scheubel et al. (2019)	HP filter & Sign restricted factor model
	Potjagailo and Wolters (2019)	Dynamic factor model
	Breitung and Eickmeier (2016)	Three-level factor model
Co-movement of medium-term national financial cycles in credit and housing prices	Ha et al. (2020)	Dynamic factor model
	Oman (2019)	GDP-weighted EA11 financial cycle
	Meller and Metiu (2017)	Band-pass filter and Synchronization
	Rünstler et al. (2018)	Band pass filter & Synchronization; Principal component analysis.
	De Winter et al. (2022)	Multivariate UCTSM; Synchronization
	Strohsal et al. (2019)	Univariate and multivariate spectral analysis.
	Aikman et al. (2015)	Band-pass filter and correlation across countries.
	Jordà et al. (2019)	Baxter-King band-pass filter and rolling window Spearman rank correlation coefficients
Schüler et al. (2020)	Power cohesion; Constructing a composite financial cycle for G7; Synchronization	

Note: Detailed information about these studies is provided in online Appendix A.

Comparison with MA-R

MA-R document the existence of a GFCy in risky asset prices using DFM. Figure 5 shows their GFCy measure (solid black line) and compares it to our GFCys in asset prices (blue dashed line) and capital flows (orange dotted line), respectively. The left-hand side panel of Figure 5 suggests that our GFCys in asset prices and capital flows are remarkably similar to the one of MA-R. The right-hand side panel of Figure 5 shows 10-year moving averages of synchronicity and similarity of our GFCys in asset prices and in capital flows and the GFCy of MA-R. The synchronicity and similarity measures show similar patterns. Both declined during the 1990-1995 period, and show a significant upward trend until around 2009 and a downward trend thereafter.

Figure 5. Comparison of GFCys



Notes: The left-hand side panel of Figure 5 plots the GFCys obtained by MA-R (black solid line), our GFCy in asset prices (blue dashed line), and our GFCy in capital flows (orange dotted line). The right-hand side panel of Figure 5 plots the synchronicity (black solid line) and similarity (blue dashed line) of these three GFCy measures (10-year moving averages). The reference cycle is the median of three GFCy measures. Shaded areas denote the Asia financial crisis of 1997-1998, the dot-com crash of 2000-2002, the Global Financial Crisis of 2007-2008, and the European debt crisis of 2010-2012, respectively.

We document the cyclical characteristics of the GFCy from MA-R and compare them with our GFCy measures in asset prices and capital flows (shown in Table 4 above). The amplitude of the expansion and contraction phases in the GFCy from MA-R are 1.52 and 1.46 quarters, respectively, and the duration of the expansion and contraction phases are 8.36 and 5 quarters, respectively. These numbers suggest the same pattern as in our GFCys in asset prices and capital flows, namely that expansions are longer than contractions. This holds especially for the duration of GFCy in capital flows, which has a contraction phase of 5 quarters and an expansion phase of 13.50 quarters. Meanwhile, there are no significant differences with respect to the length of these GFCys, which generally are around 3 to 5 years.¹¹

¹¹ Turning points of our GFCys and the GFCy of MA-R (2020) are compared in online Appendix C.1.

Comparison with Oman (2019)

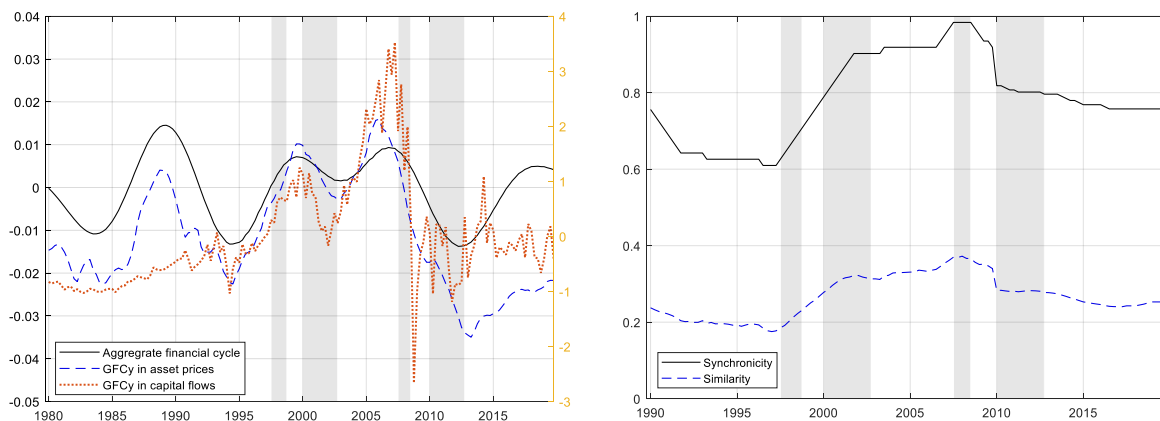
Some scholars identify the GFCy by focusing on the co-movement of national financial cycles. A representative study is Oman (2019), which measures the GFCy as an aggregate of national financial cycles for 11 Euro Area (EA) countries. This author captures potential fluctuations of credit to the non-financial private sector, the ratio of credit to GDP, and residential property prices (RPP). Credit and residential property prices are in real terms and in logs. All series are standardized and normalized to 1985:Q1.

For comparison purposes, we first reproduce the outcomes of Oman (2019) in three steps. First, we use the band-pass filter proposed by Christiano and Fitzgerald (2003) to extract the medium-term cycle in annual growth rates by setting the upper bound parameter at 120 quarters and the lower bound parameter at 32 quarters. Then, the national composite financial cycle is calculated by taking the simple average of three filtered time series of each country. Finally, the composite EA11 financial cycle is computed as the GDP-weighted average of the national financial cycles.

The left-hand side panel of Figure 6 shows that the GDP-weighted average of national financial cycles and GFCys in asset prices move upwards or downwards around the same time for EA11 countries. However, the GFCy in capital flows show more variations. The GFCys and the aggregated national financial cycles diverge especially after 2015. The right-hand side panel of Figure 6 shows 10-year moving averages of synchronicity and similarity for the aggregated national financial cycles and our GFCys in asset prices and capital flows for the EA11 countries. Several main results emerge. First, the synchronicity measures are relatively high, while the similarity measures are relatively low. The synchronicity measures are mostly higher than 0.6, and the similarity measures are usually lower than 0.3. This means that the aggregate financial cycles usually have the same sign but different amplitude than our GFCys. Second, the fluctuations in the synchronicity and similarity measures are very similar. In particular, the

synchronicity and similarity measures rise before and during the 1997-1998 Asian financial crisis, reaching a peak before the 2008 global financial crisis. After that, synchronicity and similarity decrease slightly.¹²

Figure 6. Euro-area financial cycles and GFCys



Notes: The left-hand side panels of Figure 6 plot the aggregate financials (black solid line), GFCys in asset prices (blue dashed line), and GFCys in capital flows (orange dotted line) for EA11 countries. The right-hand side panel of Figure 6 plots the synchronicity (black solid line) and similarity (blue dashed line) for EA11 countries (10-year moving averages). The reference cycle is the median of aggregate financials, GFCy in asset prices, and GFCy in capital flows for EA11 countries. Shaded areas denote the Asia financial crisis of 1997-1998, the dot-com crash of 2000-2002, the Global Financial Crisis of 2007-2008, and the European debt crisis of 2010-2012, respectively.

Table 6 lists and compares cyclical features of the aggregated and our GFCys. The amplitudes of aggregate financial cycles and GFCys in asset prices and capital flows are similar. However, the durations of GFCys in asset prices and capital flows are much shorter than those of the aggregate financial cycle (Table 6, last column), which has more peaks and troughs.¹³

¹² Following Oman (2019), we also calculated the measures of aggregate financial cycles, GFCys in asset prices, and GFCys in capital flows for high-amplitude and low-amplitude EA11 countries, and their synchronicity and similarity. Main results hold for high-amplitude and low-amplitude countries. The results are provided in online Appendix C.2.

¹³ The detailed cyclical characteristics and turning points analysis for the aggregate national financial cycle and the GFCys in asset prices and capital flows are displayed in online Appendix C.3.

Table 6. Characteristics of the aggregated financial cycle and GFCys in EA11 countries

	Amplitude		Duration		Cycle*
	Expansion	Contraction	Expansion	Contraction	
FC**	0.02	-0.02	21	18.67	40
GFCy in asset prices	1.09	-1.06	11.00	9.13	21.86
GFCy in capital flows	1.24	-1.12	8.82	4.58	13.45

Notes: *The duration of the full cycle is measured from peak to peak. **The aggregated financial cycle.

6. Conclusion

This paper constructs different measures of the GFCy and compares their synchronicity and similarity, and cyclical characteristics. Using dynamic factor models and data for the 1980-2019 period, we identify global financial cycles in asset prices and capital flows, and in asset-specific variables. We also compare our measures with those of MA-R and Oman (2019).

We reach three main conclusions. First, our GFCys in asset prices and capital flows are highly similar and synchronized. Meanwhile, equity indices play a prominent role in determining the GFCy in asset prices. Second, we find that volatilities and durations of GFCys based on different asset prices vary. The GFCys in equity and bond prices are more volatile than GFCys in credit and housing prices. In addition, the GFCys in credit and house prices have a longer duration than GFCys in risky asset prices. Third, we find a high coherence between our GFCys in capital flows and asset prices and the financial cycles proposed by MA-R and Oman (2019). The GFCys obtained from aggregating national financial cycles and ours obtained from a DFM are highly synchronized.

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Table A.1 Global Financial Cycle: Overview of the literature

Study	Cycle	Variable	Sample	Definition	Level versus Growth rate	Method	Conclusion
Aikman et al. (2015)	Global credit cycle	Bank loans and bank assets.	14 developed countries from 1880-2008. Yearly.	The fluctuations in credit to output operating over the medium term.	Growth rate	Spectral density, bandpass filter, pairwise correlation across countries.	(i) The medium-term credit cycles. (ii) The synchronization of credit cycles across countries has increased.
Bruno and Shin (2015)	Global financial cycle	Global Leverage; Global Leverage growth; Global Equity growth.	46 countries from 1995-2011. Quarterly.	Global factors are associated with bank capital flows.	Level & Growth rate	None	Global factors in the leverage cycle of the global banks are the key determinants of global liquidity before 2008.
Rey (2015)	Global financial cycle	(i) Capital inflows and outflows. (ii) VIX. (iii) 858 Risky asset prices.	53 countries from 1990-2012. Quarterly.	GFCy are associated with surges and retrenchments in capital flows, booms and busts in asset prices and crises.	Log-level for VIX. Growth rate for risky asset prices.	Correlation analysis and dynamic factor model (Miranda-Agrippino and Rey, 2015).	(i) There is a potent GFCy in gross capital flows, credit creation and asset prices, which has tight connections with VIX. (ii) credit flows are connected to the GFCy.
Breitung and Eickmeier (2016)	Global business and financial cycles	Financial: Stock and house prices, domestic and cross-border credit, interest rates, monetary aggregates M0 and M2, and implied stock market volatility. Business: GDP, consumption, investment.	11 advanced and 13 emerging economies from 1995 to 2011. Quarterly.	Financial variables co-move internationally.	Growth rate apart from interest rates and implied stock market volatility in level.	Three-level factor model.	(i) Financial variables co-move worldwide. (ii) The financial synchronization is similar to the degree of macroeconomic synchronization. (iii) The commonality is particularly high for stock prices and interest rates and considerably lower for monetary and credit aggregates as well as house prices.
IMF (2017)	Global financial cycle	Corporate spreads, term spreads, interbank spreads, sovereign spreads, the change in long-term interest rates, equity and house price returns, equity return volatility, the change in the market share of the financial sector, and credit growth.	43 advanced and emerging economies from 1990-2016. Monthly.	GFCy is a single factor that summarizes the dynamics of a significant share of financial conditions around the world well.	Level	Dynamic factor models	A GFCy accounts for about 20 to 40 percent of the variation in countries' domestic financial conditions.
Meller and Metiu (2017)	Global credit cycle	Bank loans (the end-of-year amount of outstanding domestic currency lending by domestic banks to domestic households and nonfinancial corporations).	14 advanced economies from 1906 to 2008. Yearly.	Credit cycles are the transitory fluctuations in the real credit around its long-run trend level.	Log-level	(i) Bandpass filter. (ii) A binary credit cycle variable.	(i) There is significant positive international synchronization between credit cycle phases. (ii) The results against the existence of a global credit cycle.
Barrot and Serven (2018)	Global financial cycle	Scaled capital inflows and outflows by trend GDP.	85 countries from 1979-2015. Yearly.	GFCy is the commonality of capital inflows and outflows.	Level	Two-level latent factor model	GFCy dominate advanced-country capital flows, while idiosyncratic factors dominate emerging- and developing-country capital flows.
Ligonniere (2018)	Global financial cycle	VIX & the ratio of international debt securities to GDP.	Unbalanced panel, including 161 countries from 1970 to 2013. Yearly.	GFCy is the high level of co-movement in asset prices, credit, and risk aversion around the world.	Log-level	(i) Binary measure: the dummy variable is equal to 1 if the VIX is higher than its 75th percentile of the distribution (ii) Continuous measure: log VIX.	(i) The GFCy worsens trilemma but does not disappear. (ii) The sensitivity to the GFCy depends more on the presence of global investors and global banks than on the fluctuations of these financial forces.

A1. (continued): Global Financial Cycle: Overview of the literature

Rünstler and Vlekke (2018)	Financial and business cycles and GFCy	(i) Real total credit to the private sector. (ii) Real residential property prices. (iii) Real GDP.	The US, the UK, Germany, France, Italy, and Spain. 1973-2014. Quarterly.	Relevant to macro-prudential policies.	Level	Univariate and extended multivariate structural time series models (STSM) to investigate the interactions at different frequencies.	(i) The medium-term cycles in real credit volumes, real house prices, and real GDP. (ii) GDP cycles are correlated with credit and house price cycles at the medium-term frequency.
Rünstler et al. (2018)	Financial and business cycles and GFCy	(i) Real GDP. (ii) Real total credit to the private non-financial sector. (iii) Real house prices. (iv) Equity price index. (v) Nominal long-term rates. (vi) Interest rates.	10 EU countries start prior to 1988. 7 EU countries start between 1990 and 1998. All data end in 2015. Quarterly.	The co-movement between financial series.	Log-level apart from interest rate.	(i) Band pass filter. (ii) Wavelet analysis. (iii) Multivariate STSM. (iv) Principal component analysis.	(i) The medium-term cycles in credit volumes and house prices are related. (ii) Cycles in GDP are related to cycles in credit and house prices at the medium-term. (iii) Cycles in equity prices and interest rates are shorter and weakly correlated with cycles in GDP, house prices, or credit volumes. (iv) The synchronicity of house price and credit cycles across EU countries is lower than it is for GDP. (v) No evidence of a common cycle in Europe.
Akdi et al. (2020)	Global financial cycle	(i) The Chicago Board Options Exchange Volatility Index (VIX). (ii) The TED spread. (iii) The London Interbank Offered Rate-the Overnight Index Swap spread (LIBOR-OIS spread).	TED spread and the LIBOR-EFF spread start from 1986 to 2018. VIX starts from 1990 to 2018. Monthly.	GFCy is the changes in the global financial environment and depicts the changes in global risk appetite, global volatility and uncertainty; as well as global liquidity and global systemic risk.	Level	Periodogram-based analysis.	The similar duration, 43-month common cycle, which are observed for these three series.
Avdjiev et al. (2019)	Global financial cycle	VIX	34 emerging market economies from 2000-2016. Quarterly.	VIX	Log-level	None	None
Cerutti et al. (2019)	Global financial cycle	(i) VIX. (ii) Capital flows: foreign direct investment, portfolio equity investment, portfolio debt investments, and bank credit.	Unbalanced panel database consists of 161 countries from 1990 to 2015. Quarterly.	GFCy is the (high) commonality in financial conditions.	Level	Dynamic factor model	(i) The factors extracted from capital flows are not strongly related with the VIX. (ii) Most variation in capital flows does not result of the GFCy nor stem from observables in a central country.
Cunha et al. (2019)	Global financial cycle	VIX monthly average	Brazil from 1996 to 2016. Monthly.	VIX (a measure of risk aversion and uncertainty in the global financial market. A low level of global financial volatility characterizes periods of expansion of the GFCy)	Log-level	None	(i) An increase in the degree of financial integration generates deeper effects in downward periods of the GFCy. (ii) a decline in GFCy generates greater impacts when a higher degree of financial integration is present.
Jordà et al. (2019)	Global financial cycle	Credit aggregates, house prices, and equity prices.	17 advanced countries from 1870 to 2013. Yearly.	The international co-movement in credit aggregates, house prices, and equity prices.	Log-level & Growth rate	(i) Baxter-King bandpass filter. (ii) Nonparametric detrending method. (iii) 15-year rolling window Spearman rank correlation coefficients. (iv) The average of bilateral correlations.	The global financial synchronization over the past two decades increase.

A1. (continued): Global Financial Cycle: Overview of the literature

Oman (2019)	Financial and business cycles and GFCy	Financial Cycle: credit to the non-financial private sector, the ratio of credit to GDP, and residential property prices. Business cycle: real GDP. Leverage Cycle: the medium-term cyclical fluctuations in the credit-to-GDP ratio.	EA11 from 1971Q1–2015. Quarterly.	The co-movement of credit and asset prices.	Growth rates	(i) Bandpass filter. (ii) Composite financial cycle by taking the simple average of the three filtered time series.	(i) Financial cycles are less synchronized than business cycles. (ii) Business cycle synchronization increased while financial cycle synchronization decreased. (iii) Financial cycles desynchronization was more pronounced between high-amplitude and low-amplitude countries, especially Germany. (iv) high-amplitude countries and Germany experienced divergent leverage dynamics after 2002.
Potjagailo and Wolters (2019)	Global financial cycle	GDP, credit, house prices, equity prices, and long-term interest rates	17 advanced economies from 1880 to 2013. Yearly.	Global co-movement of financial variables.	Growth rate (log-diff apart from interest rate).	Time-varying multi-level dynamic factor model	(i) The importance of the GFCy has increased for some variables since the 1980s. (ii) The global cycles in equity prices explain more than half of the fluctuations in the data. (iii) The global cycles in credit and housing become more pronounced and longer, but their importance in explaining dynamics only increased for the US, the UK and Nordic European countries.
Scheubel et al. (2019)	Global financial cycle	Leverage of Global Banks; Exchange Market Pressure for EME; Total Credit to Non-Financial Sector; Portfolio Inflows to EME; USD nominal effective exchange rate; EMBI Spread; VIX; Datastream World Total Shares Price; Datastream Bank Total Share Price	25 EME and G7 countries. Most dataset range from 1980 to 2017. Quarterly	The GFC is closely related to capital flows to, and financial stress in, emerging markets.	Level	HP filter & Structural factor approach	(i) The GFCy measure are significantly correlated with other existing measures of the GFCy, with the expected signs. (ii) The GFCy has a statistically significant effect on the frequency of all capital flow episodes and currency crises.
Strohsal et al. (2019)	Financial and business cycles and GFCy	Financial cycles: credit volume, credit to GDP ratio, house prices, and equity price. Business cycle: real GDP.	The US and the UK from 1960-2013. Germany from 1970-2013. Quarterly.	Financial cycles are well captured by the three distinct market segments of credit, housing and equity.	Growth rate apart from the credit to GDP ratio.	Univariate and multivariate spectral analysis.	(i) The growth rates of credit and house prices feature longer cycles and larger amplitudes than the business cycle in the US and the UK. (ii) Global financial cycle is found at low frequencies.
Akdi et al. (2020)	Global financial cycle	(i) The Chicago Board Options Exchange Volatility Index (VIX). (ii) The TED spread. (iii) The London Interbank Offered Rate-the Overnight Index Swap spread (LIBOR-OIS spread).	TED spread and the LIBOR-EFF spread start from 1986 to 2018. VIX starts from 1990 to 2018. Monthly.	GFCy is the changes in the global financial environment and depicts the changes in global risk appetite, global volatility and uncertainty; as well as global liquidity and global systemic risk.	Level	Periodogram-based analysis.	The similar duration, 43-month common cycle, which are observed for these three series.
Aldasoro et al. (2020)	Financial and business cycles and GFCy	Financial: (i) annual growth rates of credit to the non-financial private sector; (ii) the ratio of credit to GDP, and (iii) the annual growth of residential property prices. GFCy: (i) MA-R; (ii) The ratio of gross capital inflows to GDP	49 countries from 1995-2018; Longer dataset from 1981-2018. Quarterly.	GFCy is the first principal component of the ratio of gross capital inflows to GDP.	Level	Principle component analysis	The GFCy measures do not depend on whether asset prices or capital flows are used.
Bonciani and Ricci (2020)	Global financial cycle	A large panel of around 1000 series of financial stock prices from around the world	44 countries; 1990-2018. Daily.	GFCy is a global factor extracted from the realized volatilities of risky asset returns.	Growth rate (log-diff)	Sequential principal component	GFCy explains 38% of the variation in global asset returns.

A1: (continued): Global Financial Cycle: overview of the literature

Boehm and Kroner (2020)	Global financial cycle	International stock indexes, the VIX, and commodity prices	27 countries. 30-minute	Global co-movement of high-frequency risky asset prices.	Log-diff	Principal component analysis	US macroeconomic news are the more important driver of the global financial cycle than US monetary policy shocks.
Ha et al. (2020)	Global business and financial cycles	Financial: Equity prices, house prices, interest rates, and credit. Business: output, consumption, and investment	G7 countries from 1985-2016. Quarterly.	GFCy captures common cyclical fluctuations across multiple financial markets.	Growth rate	Dynamic factor model	(i) There are common business cycles, as reflected in the comovement of macroeconomic aggregates among the G7 countries. (i) GFCy exist in certain financial variables, especially equity prices and interest rates.
Miranda-Agrippino and Rey (2020)	Global financial cycle	Asset prices, commodities prices, and corporate bond indices.	(i) 858 series from 1990 to 2012 for North America, Latin America, Europe, Asia, Pacific, and Australia. (ii) 303 series from 1975 to 2012 for only the US, Europe, Japan. Monthly.	GFCy is the fluctuations in financial activity on a global scale	Growth rate (log-diff)	Dynamic factor model	(i) There is the global factor in risky assets prices. (iii) The global factor is consistent with both the US recession periods as identified by the NBER and with major worldwide events. (iii) The global factor in risky asset prices goes down, spreads go up, global domestic and cross-border credit go down very significantly, and leverage decreases.
Schüler et al. (2020)	Financial and business cycles and GFCy	Financial cycles: Credit, house price, equity price, and bond price; Business cycles: output, consumption, investment, and hours worked.	G7 countries from 1970-2018. Quarterly.	Financial cycles are identified via the balance sheet channel, which are measured as the co-movement of credit and asset prices.	Growth rate	Power cohesion (the linear combination of normalized absolute cross-spectra for all pairwise combinations of variables in the set considered)	(i) The durations of financial cycles differ across G7 countries. (ii) Financial cycles are longer and have a larger amplitude than business cycles. (iii) Composite financial cycles synchronize strongly across countries. (iv) Composite financial cycles outperform the Basel III credit-to-GDP gap in predicting financial crises.
Davis et al.(2021)	Global financial cycle	Gross outflows, gross inflows, and net flows.	58 countries from 1996–2015. Annual or quarterly.	Global financial cycle is identified as global latent factors that are drivers on both gross and net capital flows.	Level	Static factor model	The GFCy factor and the energy price factor account for half the variance of gross flows in advanced countries and 40% of the variance of gross flows in emerging markets.
Dées and Galesi (2021)	Global financial cycle	Real equity prices, gross capital inflows over GDP	33 countries from 1994 to 2016. Quarterly.	Global co-movement of international financial variables.	Level	None	Hegemon economy's monetary policy generate a global synchronization of financial variables across all countries.
De Winter et al. (2022)	Financial and business cycles and GFCy	(i) Domestic bank credit to the private non-financial sector. (ii) house prices. (iii) Real GDP. (iv) Real industrial production.	G7 countries and the Netherlands from 1970-2015. Quarterly data on real GDP, credit volumes and house prices. Monthly data on real industrial production.	The short-term and medium-term fluctuations of financial variables.	Log-level	Multivariate unobserved components time series model (UCTSM).	(i) The cyclicity of credit and house prices are driven by the medium-term cycle. (ii) The co-movement between financial and business cycles is medium-term. (iii) The medium-term cycles of credit and house price have no strong concordance in four of the eight countries. (iv) There is a strong concordance between medium-term cycles of credit and GDP in three countries and the 'indirect' concordance in three other countries. (v) The cross-country concordance of both the short-term and medium-term cycles of GDP, house prices, and credit is low.

Appendix B: Data Description

B.1 Asset Prices

Table B1. Commodity prices

Type	Markets	Source	Tcode	Date	Frequency
Corn	US	CBOT	3	1980:01-2020:07	M
Soybean	US	CBOT	3	1980:01-2020:07	M
Soybean Oil	US	CBOT	3	1980:01-2020:07	M
Soybean Meal	US	CBOT	3	1980:01-2020:07	M
Wheat	US	CBOT	3	1980:01-2020:07	M
Oats	US	CBOT	3	1980:01-2020:07	M
Rough Rice	US	CBOT	3	1987:01-2020:07	M
Hard Red Wheat	US	KCBOT	3	1980:01-2020:07	M
Spring Wheat	US	MGEX	3	1980:01-2020:07	M
Canola	CA	ICE CANADA	3	1980:01-2020:07	M
Rapeseed	EURO	EURONEXT	3	2001:09-2020:07	M
Milling Wheat	EURO	EURONEXT	3	2001:09-2020:07	M
Feed Wheat	EURO	ICE EURO	3	1994:01-2020:07	M
Live Cattle	US	CME	3	1980:01-2020:07	M
Feeder Cattle	US	CME	3	1980:01-2020:07	M
Lean Hogs	US	CME	3	1980:01-2020:07	M
Class III Milk	US	CME	3	1996:01-2020:07	M
Cotton #2	US	ICE US	3	1980:01-2020:07	M
Coffee	US	ICE US	3	1980:01-2020:07	M
Cocoa	US	ICE US	3	1980:01-2020:07	M
Sugar #11	US	ICE US	3	1980:01-2020:07	M
Sugar #16	US	ICE US	3	2008:09-2020:07	M
Orange Juice	US	ICE US	3	1980:01-2020:07	M
Robusta Coffee 10	EURO	ICE EURO	3	2008:07-2020:07	M
Cocoa #7	EURO	ICE EURO	3	1989:01-2020:07	M
Crude Oil WTI	US	NYMEX	3	1983:03-2020:07	M
ULSD NY Harbor	US	NYMEX	3	1980:01-2020:07	M
Gasoline RBOB	US	NYMEX	3	1984:12-2020:07	M
Natural Gas	US	NYMEX	3	1990:04-2020:07	M
Crude Oil Brent (F)	US	NYMEX	3	2001:01-2020:07	M
Ethanol Futures	US	CBOT	3	2005:03-2020:07	M
Crude Oil Brent	EURO	ICE EURO	3	1989:07-2020:07	M
Crude Oil WTI ICE	EURO	ICE EURO	3	2006:02-2020:07	M
ICE Gas Oil LS	EURO	ICE EURO	3	1986:06-2020:07	M
ICE UK Natural Gas	EURO	ICE EURO	3	1997:02-2020:07	M
ICE RBOB Blendstock	EURO	ICE EURO	3	2006:04-2020:07	M
High Grade Copper	US	COMEX	3	1980:01-2020:07	M
Steel Scrap	UK	LME	3	2015:12-2020:07	M
Steel Rebar	UK	LME	3	2015:12-2020:07	M

Notes: From Cmdty. Tcode means the transformation types, 1: SA, in levels. 2: Interpolation, SA, in levels. 3: log-differences.

Table B2. Equity price indices

Country	IT	Financials	Health Care	Cons. Discretionary	Industrials	Tcode	Frequency
Argentina	1992:01-	1991:09-	NA	1988:01-	1988:01-	3	M
Australia	1980:01-	1980:01-	1980:01-	1980:01-	1980:01-	3	M
Austria	1980:01-	1980:01-	2019:02-	1995:02-	1980:01-	3	M
Belgium	1985:06-	1980:01-	1980:01-	1998:12-	1980:01-	3	M
Brazil	1994:07-	1994:07-	2007:10-	1994:07-	1994:07-	3	M
Canada	1980:01-	1980:01-	1980:01-	1980:01-	1980:01-	3	M
China	1996:11-	1991:08-	1994:11-	1994:01-	1994:02-	3	M
France	1980:01-	1980:01-	1980:01-	1980:01-	1980:01-	3	M
Germany	1980:01-	1980:01-	1980:01-	1980:01-	1980:01-	3	M
India	1990:01-	1990:01-	1990:01-	1990:01-	1990:01-	3	M
Indonesia	1994:10-	1990:04-	1990:04-	1990:04-	1993:03-	3	M
Italy	1980:01-	1980:01-	1986:01-	1980:01-	1980:01-	3	M
Japan	1980:01-	1980:01-	1980:01-	1980:01-	1980:01-	3	M
Korea	1989:11-	1987:09-	1987:09-	1987:04-	1987:09-	3	M
Mexico	1990:06-	1998:04-	1998:07-	NA	1998:04-	3	M
Netherlands	1980:01-	1980:01-	1980:01-	1980:01-	1980:01-	3	M
Poland	1998:02-	1994:03-	2016:12-	1996:07-	1996:09-	3	M
Russia	1998:01-	1998:04-	NA	1999:08-	2007:11-	3	M
Saudi Arabia	2005:10-	2005:10-	2009:09-	2005:10-	2005:10-	3	M
South Africa	1994:10-	1980:01-	1980:01-	1980:01-	1980:01-	3	M
Spain	1987:03-	1987:03-	1987:03-	1987:03-	1987:03-	3	M
Sweden	1982:04-	1982:04-	1991:07-	1982:04-	1982:04-	3	M
Turkey	1988:03-	1988:01-	2018:02-	1988:01-	1988:01-	3	M
UK	1980:01-	1980:01-	1980:01-	1980:01-	1980:01-	3	M
US	1980:01-	1980:01-	1980:01-	1980:01-	1980:01-	3	M

Notes: From Eikon. Tcode means the transformation types, 1: SA, in levels. 2: Interpolation, SA, in levels. 3: log-differences. All series end in 2019:12.

Table B3. Bond price indices

Type	Markets	Tcode	Date	Frequency
18 corporate bonds for Euro markets				
iBoxx EUR Corporates	EUR	3	1998:12-2020:07	M
iBoxx EUR Financials	EUR	3	1998:12-2020:07	M
iBoxx EUR Banks	EUR	3	1998:12-2020:07	M
iBoxxEUR Financial services	EUR	3	1998:12-2020:07	M
iBoxx EUR Insurance Index	EUR	3	1998:12-2020:07	M
iBoxx EUR Non-Financials Index	EUR	3	1998:12-2020:07	M
iBoxx EUR Automobiles & Parts	EUR	3	1998:12-2020:07	M
Iboxx EER Basic Resources	EUR	3	1998:12-2020:07	M
iBoxx EUR Chemicals	EUR	3	1998:12-2020:07	M
iBoxx EUR Construction & Materials	EUR	3	1998:12-2020:07	M
iBoxx EUR Food & Bev	EUR	3	1998:12-2020:07	M
iBoxx EUR Health Car	EUR	3	1998:12-2020:07	M
iBoxx EUR Industrial	EUR	3	1998:12-2020:07	M
iBoxx EUR Media	EUR	3	1998:12-2020:07	M
iBoxx EUR Oil & Gas	EUR	3	1998:12-2020:07	M
iBoxx EUR Technology	EUR	3	1998:12-2020:07	M
iBoxx EUR Telecommunications	EUR	3	1998:12-2020:07	M
iBoxx EUR Utilities	EUR	3	1998:12-2020:07	M
24 corporate bonds for Sterling markets				
iBoxx GBP Corporates	UK	3	1999-01-2020:07	M
iBoxx GBP Financials	UK	3	2002:04-2020:07	M
iBoxx GBP Banks	UK	3	2002:04-2020:07	M
iBoxx GBP Financial Services	UK	3	2002:04-2020:07	M
iBoxx GBP Insurance	UK	3	2002:04-2020:07	M
iBoxx GBP Non-Financials	UK	3	2002:04-2020:07	M
iBoxx GBP Basic Materials	UK	3	2002:04-2020:07	M
iBoxx GBP Basic Resources	UK	3	2002:04-2020:07	M
iBoxx GBP Chemicals	UK	3	2002:04-2020:07	M
iBoxx GBP Consumer Goods	UK	3	2004-12-2020:07	M
iBoxx GBP Automobiles & Parts	UK	3	2002:04-2020:07	M
iBoxx GBP Food & Bev	UK	3	2002:04-2020:07	M
iBoxx GBP Personal & Household Goods	UK	3	2004-12-2020:07	M
iBoxx GBP Consumer Services	UK	3	2004-12-2020:07	M
iBoxx GBP Media	UK	3	2002:04-2020:07	M
iBoxx GBP Retail	UK	3	2004-12-2020:07	M
iBoxx GBP Travel & Leisure	UK	3	2004-12-2020:07	M
iBoxx GBP Health Care	UK	3	2002:04-2020:07	M
iBoxx GBP Industrial	UK	3	2002:04-2020:07	M
iBoxx GBP Construction & Materials	UK	3	2002:04-2020:07	M
iBoxx GBP Oil & Gas	UK	3	2002:04-2020:07	M
iBoxx GBP Technology	UK	3	2002:04-2020:07	M
iBoxx GBP Telecommunications	UK	3	2002:04-2020:07	M
iBoxx GBP Utilities	UK	3	2002:04-2020:07	M
36 corporate bonds for USD markets				
iBoxx USD Corporates	US	3	1999-01-2020:07	M
iBoxx USD Financials	US	3	1999-01-2020:07	M
iBoxx USD Banks	US	3	1999-01-2020:07	M
iBoxx USD Financial Services	US	3	1999-01-2020:07	M
iBoxx USD General Financial	US	3	1999-01-2020:07	M
iBoxx USD Real Estate	US	3	1999-01-2020:07	M
iBoxx USD Insurance	US	3	1999-01-2020:07	M
iBoxx USD Non-Financials	US	3	1999-01-2020:07	M
iBoxx USD Basic Materials	US	3	1999-01-2020:07	M
iBoxx USD Basic Resources	US	3	1999-01-2020:07	M
iBoxx USD Forestry & paper	US	3	1999-01-2020:07	M
iBoxx USD Industrial Metals	US	3	1999-01-2020:07	M
iBoxx USD Mining	US	3	1999-01-2020:07	M
iBoxx USD Chemicals	US	3	1999-01-2020:07	M
iBoxx USD Consumer Goods	US	3	1999-01-2020:07	M
iBoxx USD Automobile & Parts	US	3	1999-01-2020:07	M
iBoxx USD Food & Beverage	US	3	1999-01-2020:07	M
iBoxx USD Personal & Household Goods	US	3	1999-01-2020:07	M
iBoxx USD Tobacco	US	3	1999-01-2020:07	M
iBoxx USD Consumer Services	US	3	1999-01-2020:07	M
iBoxx USD Media	US	3	1999-01-2020:07	M
iBoxx USD General Retailers	US	3	1999-01-2020:07	M
iBoxx USD Travel & Leisure	US	3	1999-01-2020:07	M
iBoxx USD Health Care Equipment & Services	US	3	1999-01-2020:07	M
iBoxx USD Industrials	US	3	1999-01-2020:07	M
iBoxx USD Construction & Materials	US	3	1999-01-2020:07	M
iBoxx USD Industrial Goods & Services	US	3	1999-01-2020:07	M
iBoxx USD Aerospace & Defense	US	3	1999-01-2020:07	M
iBoxx USD Electronic & Elec	US	3	1999-01-2020:07	M
iBoxx USD Support Services	US	3	1999-01-2020:07	M
iBoxx USD Oil & Gas	US	3	1999-01-2020:07	M
iBoxx USD Technology	US	3	1999-01-2020:07	M
iBoxx USD Software & Computer Svcs	US	3	1999-01-2020:07	M
iBoxx USD Technology & Equip	US	3	1999-01-2020:07	M
iBoxx USD Telecommunications	US	3	1999-01-2020:07	M
iBoxx USD Utilities	US	3	1999-01-2020:07	M

Notes: From iBoxx Eikon. Tcode means the transformation types, 1: SA, in levels. 2: Interpolation, SA, in levels. 3: log-differences.

Table B4. Credit and housing prices

Country	Housing price	Credit	Ratio of credit to GDP	CPI, 2010=100	Tcode
Argentina	NA	1990Q1-2019Q4	1984Q4-2019Q4	1980Q1-2019Q4	3
Australia	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
Austria	2000Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
Belgium	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
Brazil	2001Q1-2019Q4	1993Q4-2019Q4	1996Q1-2019Q4	1980Q1-2019Q4	3
Canada	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
China	2005Q2-2019Q4	1985Q4-2019Q4	1985Q4-2019Q4	1993Q1-2019Q4, OECD	3
France	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
Germany	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
India	2009Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
Indonesia	2002Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
Italy	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
Japan	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
Korea	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
Mexico	2005Q1-2019Q4	1980Q4-2019Q4	1980Q4-2019Q4	1980Q1-2019Q4	3
Netherlands	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
Poland	2010Q1-2019Q4	1992Q1-2019Q4	1992Q1-2019Q4	1989Q1-2019Q4	3
Russia	2001Q1-2019Q4	1995Q2-2019Q4	1995Q2-2019Q4	1992Q1-2019Q4, OECD	3
Saudi Arabia	NA	1993Q1-2019Q4	1993Q1-2019Q4	1990Q1-2019Q4	3
South Africa	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
Spain	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
Sweden	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
Turkey	1980Q1-2019Q4	1986Q1-2019Q4	1986Q1-2019Q4	1980Q1-2019Q4	3
UK	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3
US	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	1980Q1-2019Q4	3

Notes: Sourced from BIS, except for the CPI in China and Russia. Housing price is represented by residential property prices selected in real term 2010=100. Credit is represented by the credit to private non-financial sector from banks in market value. Ratio of credit to GDP is represented by the credit to private non-financial sector from banks as a percentage of GDP. Tcode means the transformation types, 1: SA, in levels. 2: Interpolation, SA, in levels. 3: log-differences.

B.2 Capital Flows

Table B5. Country and type list for capital flows

Country	Time	In_FDI	In_FPID	In_FPIE	In_FOI	O_FDI	O_FPID	O_FPIE	O_FOI	Tcode
Argentina	1980Q1-2019Q4	√	√	√	√	√	√	√	√	1
Australia	1989Q1-2019Q4	√	√	√	√	√	√	√	√	1
Austria	2005Q1-2019Q4	√	√	√	√	√	√	√	√	1
Belgium	2002Q1-2019Q4	√	√	√	√	√	√	√	√	1
Brazil	1980Q1-2019Q4	√	√	√	√	√	√	√	√	1
Canada	1980Q1-2019Q4	√	√	√	√	√	√	√	√	1
China	2005Q1-2019Q4	√	√	√	√	√	√	√	√	1
France	1980Q1-2019Q4	√	√	√	√	√	√	√	√	1
Germany	1980Q1-2019Q4	√	√	√	√	√	√	√	√	1
India	1993Q1-2019Q4	√	√	√	√	√	NA	NA	√	1
Indonesia	1996Q1-2019Q4	√	√	√	√	√	√	√	√	1
Italy	1980Q1-2019Q4	√	√	√	√	√	√	√	√	1
Japan	1996Q1-2019Q4	√	√	√	√	√	√	√	√	1
Korea	1988Q1-2019Q4	√	√	√	√	√	√	√	√	1
Mexico	1980Q1-2019Q4	√	√	√	√	√	√	√	√	1
Netherlands	1980Q1-2019Q4	√	√	√	√	√	√	√	√	1
Poland	2000Q1-2019Q4	√	√	√	√	√	√	√	√	1
Russian	1994Q1-2019Q4	√	√	√	√	√	√	√	√	1
Saudi Arabia	2008Q1-2019Q4	√	NA	NA	√	√	√	√	√	1
South Africa	1980Q1-2019Q4	√	√	√	√	√	√	√	√	1
Spain	1980Q1-2019Q4	√	√	√	√	√	√	√	√	1
Sweden	1980Q1-2019Q4	√	√	√	√	√	√	√	√	1
Turkey	1990Q1-2019Q4	√	√	√	√	√	√	√	√	1
UK	1980Q1-2019Q4	√	√	√	√	√	√	√	√	1
US	1980Q1-2019Q4	√	√	√	√	√	√	√	√	1

Notes: FDI is the abbreviation of foreign direct investment, FPID is the abbreviation of foreign portfolio debt investment, FPIE is the abbreviation of portfolio equity investment, FOI is the abbreviation of other investment. The prefix *In_* stands for inward capital flows, the prefix *O_* stands for outward capital flows. Capital flows come from IMF IIP BMP6. Following the order of the first row, the code for each capital flows is: BFDL_BP6_USD, BFPLD_BP6_USD, BFPLE_BP6_USD, BFOL_BP6_USD, BFDA_BP6_USD, BFPAD_BP6_USD, BFPAE_BP6_USD, BFOA_BP6_USD respectively. Tcode means the transformation types, 1: SA, in levels. 2: Interpolation, SA, in levels. 3: log-differences.

Table B6. GDP and exchange rate

Country	GDP, Quarterly	GDP, Yearly	Exchange rate	Tcode
Argentina	Argentine Peso, millions, NSA, 2004Q1-2019Q4	1980-2003, Eikon	BIS, Q	2
Australia	Australian Dollar, millions, NSA, 1959Q3-2019Q4	/	FRB, Q	1
Austria	Euro, millions, NSA, 1995Q1-2019Q4	1980-1994, Euro, millions	FRB, Q	2
Belgium	Euro, millions, NSA, 1995Q1-2019Q4	/	FRB, Q	1
Brazil	Brazilian Real, millions, NSA, 1996Q1-2019Q4	1980-1995, Eikon	BIS:1980Q1-1994Q4; FRB: 1995Q1-2019Q4;	2
Canada	Canadian Dollar, millions, NSA, 1980Q1-2019Q4	/	FRB, Q	1
China	Yuan RMB, millions, NSA, 1992Q1-2019Q4	/	FRB, Q	1
France	Euro, millions, NSA, 1980Q1-2019Q4	/	FRB, Q	1
Germany	Euro, millions, NSA, 1991Q1-2019Q4	1980-1990	FRB, Q	2
India	Indian Rupee, billions, NSA, 2004Q2-2019Q4	1993-2004, Indian Rupee, millions,	FRB, Q	2
Indonesia	Rupiah, billions, NSA, 2008Q1-2019Q4	1996-2007, Rupiah, millions	BIS, Q	2
Italy	Euro, millions, NSA, 1995Q1-2019Q4	1980-1994, Euro, millions	FRB, Q	2
Japan	Yen, millions, NSA, 1994Q1-2019Q4	/	FRB, Q	1
Korea	Won, millions, NSA, 1980Q1-2019Q4	/	FRB, Q	1
Mexico	Mexican Peso, millions, NSA, 1993Q1-2019Q4	1980-1992, Mexican Peso, millions	BIS:1980Q1-1993Q3; FRB:1993Q4-2019Q4	2
Netherlands	Euro, millions, NSA, 1995Q1-2019Q4	1980-1994, Euro, millions	FRB, Q	2
Poland	Zloty, millions, NSA, 1995Q1-2019Q4	/	BIS, Q	1
Russia	Russian Ruble, millions, NSA, 2003Q1-2019Q4	1994-2002, Russian Ruble, millions	BIS, Q	2
Saudi Arabia	Saudi Riyal, millions, NSA, 2010Q1-2019Q4	2008-2009, Saudi Riyal, millions	BIS, Q	2
South Africa	Rand, millions, NSA, 2010Q1-2019Q4	1980-2009, Rand, millions	FRB, Q	2
Spain	Euro, millions, NSA, 1995Q1-2019Q4	1980-1994, Euro, millions	FRB, Q	2
Sweden	Swedish Krona, millions, NSA, 1993Q1-2019Q4	1980-1992, Swedish Krona, millions	FRB, Q	2
Turkey	Turkish Lira, millions, NSA, 1998Q1-2019Q4	1990-1997, Turkish Lira, millions	BIS, Q	2
UK	Pound Sterling, millions, NSA, 1995Q1-2019Q4	1980-1994, Pound Sterling, millions	FRB, Q	2
US	US Dollar, millions, NSA, 1980Q1-2019Q4	/	/	1

Notes: Most quarterly and yearly GDP are sourced from OECD except for yearly GDP of Argentina and Belgium, which come from Eikon. Tcode means the transformation types, 1: SA, in levels. 2, Interpolation, SA, in levels. 3, log-differences.

Appendix C: Additional results

C.1 Turning points analysis for GFCys

Table C1 shows the turning points of our GFCys and the GFCy of MA-R. Three findings stand out. First, turning points of our GFCys and the one of MA-R are close, around 1.5 quarters on average. Second, the link between the peaks and troughs in our GFCys and the MA-R GFCy is tight. Between 67% and 83% of the peaks and troughs are covered in both our GFCys and the MA-R GFCy. Third, the distance between peaks of our GFCys and the MA-R GFCy tends to be larger than the distance between troughs of our GFCys and the MA-R GFCy.

Table C1. Estimated turning points for GFCys

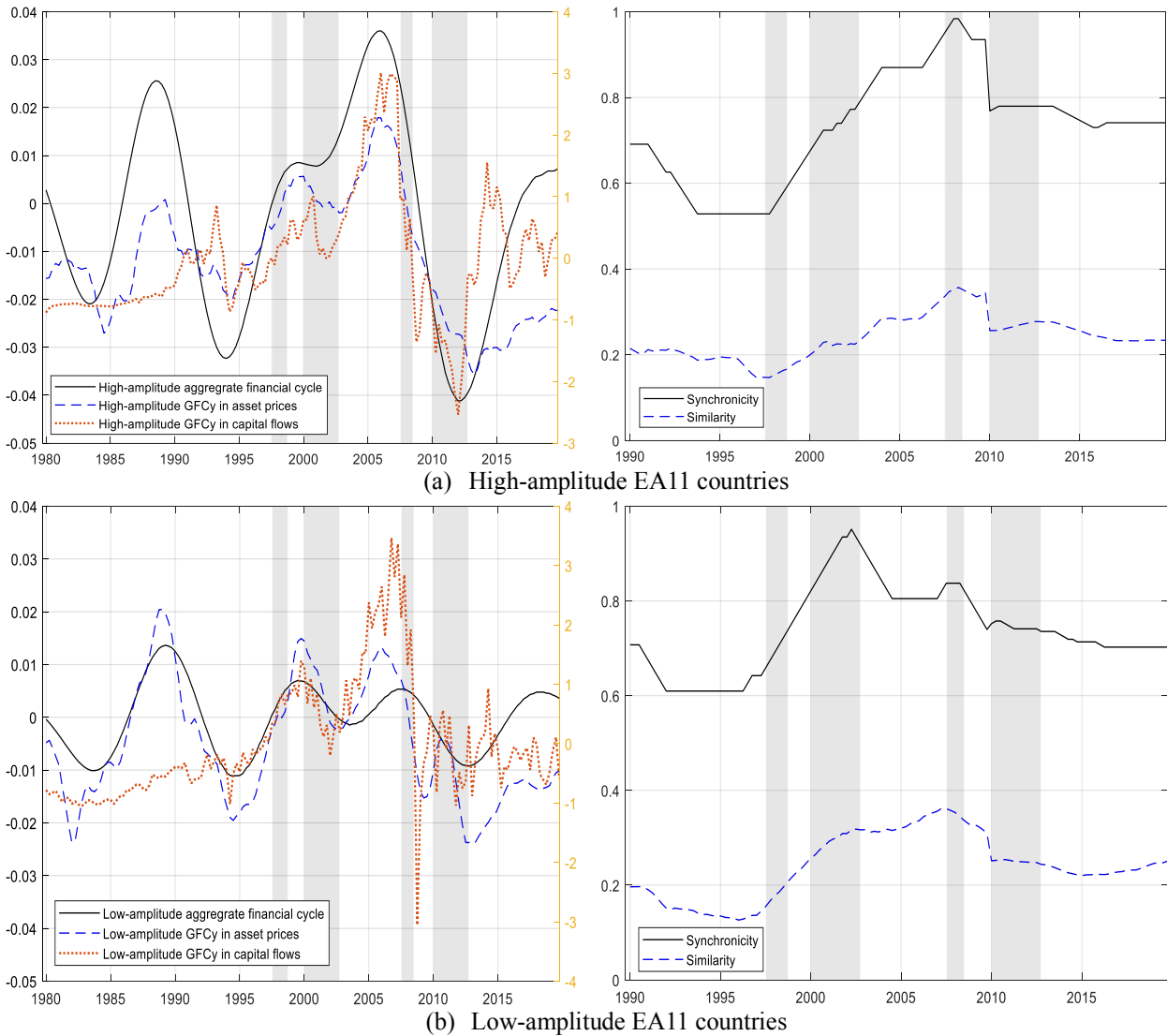
GFCy in asset prices	GFCy in capital flows	Miranda-Agrippino and Rey (2020)
Peaks	Peaks	Peaks
1981Q1	1980Q4(+1)	1980Q4(+1)
1983Q4		1984Q1(-1)
1986Q1		1987Q3(-6)
1989Q3	1990Q3(-4)	
1992Q1		1992Q2(-1)
1993Q4	1993Q4(0)	1993Q4(0)
1998Q1	1996Q4(+5)	1997Q3(+2)
	2000Q3	1999Q4
		2002Q1
2007Q2	2007Q2(0)	2007Q3(-1)
2009Q4		
2011Q1	2010Q4(+1)	2011Q1(0)
2014Q1	2014Q2(-1)	2014Q2(-1)
2017Q3	2017Q4(-1)	2017Q4(-1)
Troughs	Troughs	Troughs
1982Q2	1982Q4(-2)	1982Q2(0)
1984Q2		1984Q4(-2)
1986Q3		
1990Q4	1991Q2(-2)	1990Q3(+1)
1992Q3		1992Q4(-1)
1995Q1	1994Q2(+3)	1994Q2(+3)
	1997Q4	1998Q3
		2001Q3
2002Q3	2002Q1(+2)	2003Q1(-2)
2009Q1	2008Q4(+1)	2009Q1(0)
2010Q2		
2011Q4	2011Q4(0)	2011Q3(+1)
2016Q4	2016Q1(+3)	2016Q2(+2)
2018Q4	2019Q1(-1)	2018Q4(0)
Average	1.69Q	1.3Q

Notes: The numbers in parentheses refer to the distance between a peak or trough in our GFCy in capital flows and the one of MA-R to the nearest peak or trough of our GFCy in asset prices. Positive (negative) numbers indicate by how many quarters the GFCys precede (follow) the peak or trough of our GFCy in asset prices.

C.2 Aggregated financial cycle and GFCys for high- and the low-amplitude EA11 countries

The left-hand side panels of Figure C1 show that the resulting measures of the aggregated national financial cycle and GFCys in asset prices and capital flows for high-amplitude and low-amplitude EA11 countries. The right-hand side panels of Figure C1 shows 10-year moving averages of synchronicity and similarity for the high-amplitude EA11 countries and the low-amplitude EA11 countries.

Figure C1 Aggregated financial cycle and GFCys for high-amplitude and low-amplitude EA11 countries



Notes: High-amplitude EA11 countries include Spain, Ireland, and Greece; low-amplitude EA11 countries include Germany, France, Italy, Netherlands, Belgium, Austria, Finland, and Portugal. The left-hand side panels of (a) and (b) in Figure C1 plot the aggregate financials (black solid line), GFCys in asset prices (blue dashed line), and GFCys in capital flows (orange dotted line) for high-amplitude and low-amplitude EA11 countries. The right-hand side panels of (a) and (b) in Figure C1 plot the synchronicity (black solid line) and similarity (blue dashed line) for high-amplitude and low-amplitude EA11 countries (10-year moving averages). Reference cycle is the median of aggregate financial cycles, GFCy in asset prices, and GFCy in capital flows for high-amplitude and low-amplitude EA11 countries, respectively. Shaded areas denote the Asia financial crisis of 1997-1998, the dot-com crash of 2000-2002, the Global Financial Crisis of 2007-2008, and the European debt crisis of 2010-2012, respectively.

C.3 Cyclical characteristics of aggregate financial cycles and GFCys

Table C2 lists cyclical features of the aggregated financial cycle and our GFCys for high-amplitude and low-amplitude EA11 countries. Table C3 compares the turning points among the aggregated

national financial cycles and GFCys in asset prices and capital flows, respectively. We observe that most peaks and troughs of the aggregated financial cycle are close to the turning points of the related GFCys. For EA11 and high-amplitude countries, the average differences are around 3 quarters, the difference for low-amplitude countries is a bit long (3.44 quarters). In addition, the BBQ algorithm identifies more turning points in GFCys asset prices and in capital flows than in the aggregate financial cycles for either country group.

Table C2. Characteristics of financial cycles and GFCys

	Amplitude		Duration		Cycle*
	Expansion	Contraction	Expansion	Contraction	
High-amplitude FC**	0.04	-0.05	20.67	17.33	36.00
High-amplitude GFCy in AP	0.81	-0.90	9.67	7.22	10.40
High-amplitude GFCy in CF	1.39	-1.22	8.30	5.73	14.20
Low-amplitude FC**	0.02	-0.02	20.50	19.00	40.00
Low-amplitude GFCy in AP	1.52	-1.40	11.57	9.14	23.50
Low-amplitude GFCy in CF	1.29	-1.17	8.55	4.83	13.45

Notes: The duration of the full cycle is measured from peak to peak. **The aggregated financial cycle. AP is the abbreviation of asset prices. CF is the abbreviation of capital flow.

Table C3. Estimated turning points for aggregate financial cycles and GFCys in EA11 countries

EA11			High-amplitude EA11			Low-amplitude EA11		
FC*	GFCy in AP	GFCy in CF	FC*	GFCy in AP	GFCy in CF	FC*	GFCy in AP	GFCy in CF
Peaks	Peaks	Peaks	Peaks	Peaks	Peaks	Peaks	Peaks	Peaks
	1980Q4	1980Q4		1981Q2	1982Q2		1983Q2	1980Q4
	1983Q2	1983Q2		1983Q2			1984Q4	1983Q2
		1984Q4		1985Q3				1984Q4
		1987Q1	1988Q3	1989Q2(-3)	1988Q3			1987Q1
1989Q2	1988Q4(+2)	1990Q4(-6)		1991Q4	1991Q1	1989Q2	1989Q1(+1)	1990Q4(-6)
	1991Q3	1993Q2		1993Q1	1993Q2			1992Q3
	1993Q1	1998Q2			1995Q2	1999Q3	1999Q4(-1)	1999Q4(-1)
1999Q3	1999Q3	1999Q4(-1)	1999Q3	2000Q1(-2)	1999Q1(+2)			2003Q2
2006Q4	2006Q1(+3)	2007Q2(-2)		2002Q1	2000Q1	2007Q4	2006Q1(+8)	2006Q4(+4)
		2009Q4	2006Q1	2005Q4(+1)	2006Q4		2010Q4	2010Q4
		2014Q2			2009Q3			2014Q2
2018Q3	2017Q2(+5)	2017Q4(+3)			2014Q2	2018Q3	2017Q1(+6)	2017Q4(+3)
				2019Q2	2017Q4			
Troughs	Troughs	Troughs	Troughs	Troughs	Troughs	Troughs	Troughs	Troughs
	1982Q2	1982Q4		1982Q2			1982Q1	1982Q4
1983Q3	1984Q2(-3)	1984Q1(-2)	1983Q3	1984Q3(-4)	1984Q4(-5)	1983Q4	1983Q4	1984Q1(-1)
	1990Q4	1985Q2		1986Q2	1989Q1		1985Q3	1985Q2
	1992Q2	1987Q4		1990Q4	1992Q2			1987Q4
		1991Q2		1992Q2				1991Q2
1994Q2	1994Q3(-1)	1994Q2	1994Q1	1994Q3(-2)	1994Q2(+2)	1994Q3	1994Q3	1994Q2(+1)
		1998Q4			1996Q2			2002Q1
2003Q1	2002Q4(+1)	2002Q1(+4)			1999Q3	2003Q3	2002Q3(+4)	2004Q2(-3)
		2008Q4	2001Q1	2001Q3(-2)	2001Q4(-3)		2009Q2	2008Q4
2012Q2	2013Q2(-4)	2011Q4(+2)		2002Q4	2008Q4	2012Q4	2012Q4	2011Q4(+4)
		2015Q2	2012Q1	2013Q2(-6)	2012Q1			2015Q2
	2018Q2	2018Q4			2016Q1		2018Q2	2018Q4
					2018Q4			
Average	2.71	2.86		2.86	3		4	2.88

Notes: The numbers in parentheses refer to the distance between a peak or trough in the aggregated national financial cycles to the nearest peak or trough in GFCy. Positive (negative) numbers indicates that the aggregated national financial cycles precede (follow) the peak or trough in GFCy quarter dates. *The aggregated financial cycle. AP is the abbreviation of asset prices. CF is the abbreviation of capital flows.