

**Bank of Israel**



**Research Department**

**Synchronization of financial cycles and  
financial integration**

**Michael Gurkov\***

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Bank of Israel– <http://www.boi.org.il>

\* Michael Gurkov, Research Department – [Michael.Gurkov@boi.org.il](mailto:Michael.Gurkov@boi.org.il)

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חטיבת המחקר, בנק ישראל ת"ד 780 ירושלים 91007  
Research Department, Bank of Israel. POB 780, 91007 Jerusalem, Israel

# **Synchronization of financial cycles and financial integration**

**Michael Gurkov**

## **Abstract**

This paper studies the relationship between the synchronization of financial cycles and financial integration using data on 30 OECD countries. The results suggest that the relationship is state-dependent: While financial integration acts as a “shock absorber” during normal times, the findings indicate that it facilitates “shock propagation” during financial crises. Overall, the findings show that while financial integration may be desired because it may facilitate risk diversification, additional macroprudential measures may be warranted to account for the risk exposure during times of crisis.

## **תזמון של מחזורים פיננסיים ואינטגרציה פיננסית**

**מיכאל גורקוב**

### **תקציר**

הנייר בוחן את הקשר בין תזמון מחזורים פיננסיים לבין מידת האינטגרציה הפיננסית בנתוני פאנל של 30 מדינות OECD. נמצא כי הקשר הינו תלוי מצב – בזמנים רגילים אינטגרציה פיננסית עוזרת להחליק תנודות במערכת הפיננסית אבל בזמנים של משברים פיננסיים אינטגרציה גבוהה עלולה להגביר את התנודות במערכת הפיננסית. הממצאים מראים שבעוד שאינטגרציה פיננסית הינה רצויה בגלל שהיא מקדמת פיזור סיכונים, בזמני משבר עשוי להתעורר צורך בנקיטת אמצעי מדיניות מאקרו יציבותית נוספים.

# Synchronization of financial cycles and financial integration

Michael Gurkov

## 1 Introduction

This work analyzes the relationship between financial integration and financial cycles synchronization. Financial integration refers to the linkage of different financial markets, while financial cycles synchronization refers to the comovement of the main components of the financial cycle (credit, home and share prices). I identify the synchronization between cross-border banking flows of 30 OECD countries, and find that the level of the synchronization generally decreases with the increase in banking linkages between the countries.

The theory provides ambiguous predictions regarding the effect of financial integration on financial cycles synchronization. Financial integration can help diversify risk, redirect capital to more profitable investment opportunities and act as a country-specific “shock absorber” (Kose et al. 2009). In that case, the association between banking integration and financial synchronization should be negative. In contrast banking integration can induce contagion effects and act as a global “shock propagator” (Degryse, Elahi, and Penas 2010; Popov and Udell 2012). In that case, a positive association should be observed. This paper examines which effect dominates by studying the connection between banking integration and financial cycles synchronization.

A recent line of research studies the relationship between business synchronization and financial integration. For example, Kalemli-Ozcan, Papaioannou, and Peydro (2013) find that output synchronization is negatively affected by financial integration. The authors explain the connection as follows: if a country is hit with a negative productivity shock, global banks will reduce credit to that country and increase credit to another country, thus, exacerbating the negative output effect in the former country and facilitating positive output effect in the latter. This paper tests whether the same mechanism applies to financial synchronization. To this end, I follow the methodology suggested by Kalemli-Ozcan, Papaioannou, and Peydro (2013). Specifically, I use their measures of cycles synchronization and banking linkages and run a panel regression controlling for common and time invariant unobservable factors. I also control for other economic factors that can affect both financial cycles synchronization and banking integration. Since the theory is ambiguous on the issue of the effect of banking integration on financial synchronization, the question becomes an empirical one. The theory does provide predictions with respect to the direction of the association between cycles synchronization and banking linkages in more specific setups, such as during finan-

cial crises as well as in highly developed markets. I analyze those setups in addition to a baseline analysis.

I find evidence that financial integration is negatively associated with cycles synchronization, thus on average it acts as a shock absorber. However, the results show that the relationship is state-dependent: I find that during financial crises financial integration is associated with more synchronized financial cycles relative to normal times, indicating that during crises synchronization propagates shocks. In a highly developed financial market, integration is also associated with more synchronized cycles relative to a low level of financial development.

This paper contributes to the literature in several ways: first, I contribute to the literature on financial cycles by identifying the situations in which financial cycles become more synchronized. Second, I contribute to the strand of literature that studies financial integration. The literature stresses that financial integration can function as “shock absorber” or “shock propagator,” I identify the conditions that characterize each of the effects.

The paper is structured as follows. In Section 2, I review the relevant literature and theoretical considerations. Section 3 provides a description of the data. Empirical specification are formulated in Section 4. Estimation results are presented in section 5 and robustness tests in Section 6. Section 7 concludes the paper.

## 2 Literature review

This paper is related to both the financial cycles and financial integration strands of the literature.

The literature on financial cycles defines the components of the financial cycle and attempts to study the interactions between business and financial cycles. Borio (2014) stresses the role of the financial cycle in macroeconomics and suggests that the most parsimonious description of the financial cycle can be made in terms of credit and property prices. Claessens, Kose, and Terrones (2012) analyzes the interaction between business and financial cycles. They show that recessions in the business cycle that are related to financial cycle contraction tend to be deeper and longer relative to other recessions. Meller and Metiu (2017) study the synchronization of credit cycles. They look at 14 advanced countries in 1906 - 2008 years using cluster analysis and find that there are several clusters with different synchronization patterns. They also find positive synchronization of the business and credit cycle. Unfortunately, cluster analysis is unable to provide insight into the factors that affect the synchronization of credit cycles. I attempt to make some progress in this direction.

Financial integration is a phenomenon in which financial markets in neighboring, regional or global economies are closely linked together. The literature in this field discusses the benefits and dangers of financial integration (see Kose et al. (2009) for survey and summary). Potential benefits of financial integration include efficient capital allocation, better governance, higher investment and growth,

and risk-sharing. At the same time, financial integration can also have adverse effects. A higher degree of financial integration can generate severe financial contagion in integrated economies. Popov and Udell (2012) study banking integration and identify a mechanism by which financial shocks propagate through cross-border linkages. The authors show that a negative shock to a parent (foreign) bank leads to a reduction in lending provided by its subsidiaries abroad. Degryse, Elahi, and Penas (2010) analyze the extent of contagion risk through banking linkages. They focus on the 1999 - 2006 period and ran a simulation based on cross-border bank linkages and bank equity. The authors conclude that contagion risk had increased during that period. They also find that contagion is more widespread in geographical proximity. Avdjiev, Aysun, and Hepp (2019) study the factors that affect the lending behavior of global banks' subsidiaries throughout the world. The authors divide the influencing factors into two groups: "push" (global drivers) factors and "pull" factors such as macroeconomic conditions that measure the local cost of funding and the strength of the borrowers' balance sheets and the financial conditions of the global bank's subsidiaries. They find that the lending behavior of the subsidiaries is more closely related to local macroeconomic conditions and financial conditions than to those of their owner-specific counterparts, namely that the "pull" factors are more important relative to "push" factors. From a financial stability point of view, the "push" factors increase synchronization (the contagion or propagation effect) while the "pull" factors should reduce synchronization (absorption effect) due to idiosyncratic shocks. Cerutti, Hale, and Minoiu (2015) analyze the composition and drivers of cross-border bank lending between 1995 and 2012, distinguishing between syndicated and non-syndicated loans. They find (among other results) that banking integration (cross-border credit) is closely related to the level of development and sophistication of the banking system, strength of balance sheets and regulation. Kalemli-Ozcan, Papaioannou, and Peydro (2013) find that output cycle synchronization is negatively affected by financial integration. They suggest that banking integration magnifies productivity shocks (to regions or countries), making output growth among integrated economies diverge. I use their methodology to analyze financial cycles synchronization.

## 3 Data

### 3.1 Bank linkages

I use data on bilateral cross-border bank positions gathered from the Bank for International Settlements (BIS) data on the residence-based locational banking statistics (LBS). The LBS details at the country level, the geographical composition of banks' balance sheets and capture outstanding claims and liabilities of banking offices located in the BIS reporting countries, including intragroup positions, and excludes local claims of foreign branches and subsidiaries.

The BIS statistics have possibly the most extensive time coverage of all similar databases on cross-border investment holdings (as a comparison to the IMF CPIS database that reports bilateral

cross-border financial flows and stocks after 1999). The main limitation of the data set is that it reports the aggregate international exposure only of the banking system. Yet, cross-border banking activities continue to be a very significant component of cross-border investment. As long as there is a high correlation between international banking and other forms of portfolio investment (equity flows, FDI, and debt flows), my estimates will not be systematically biased. The BIS data are expressed originally in current US dollars (millions). I convert the data into constant US dollars by deflating the series with the US Consumer Price Index (CPI). Then I use the total stock of external assets and liabilities to construct a quantity-based measure of financial integration.<sup>1</sup> Following Kalemli-Ozcan, Papaioannou, and Peydro (2013), my main measure is the average of (the logs of) real bilateral asset and liability holdings as a share of the two countries' GDP.

$$B_{i,j,t} = \frac{1}{4} \left[ \ln \left( \frac{A_{i,j,t}}{G_{i,t} + G_{j,t}} \right) + \ln \left( \frac{L_{i,j,t}}{G_{i,t} + G_{j,t}} \right) + \ln \left( \frac{A_{j,i,t}}{G_{i,t} + G_{j,t}} \right) + \ln \left( \frac{L_{j,i,t}}{G_{i,t} + G_{j,t}} \right) \right] \quad (1)$$

where:

$B_{i,j,t}$  - bank linkages between bank  $i$  and bank  $j$  in year  $t$

$A_{i,j,t}$  - total assets of banks in country  $i$  in country  $j$

$L_{i,j,t}$  - total liabilities of banks in country  $j$  in country  $i$

$G_{i,t}$  - gross domestic product of country  $j$  in year  $t$

$i, j$  - country index

This measure captures the financial integration between two countries at an annual frequency. An increase in bank linkages means that more capital is moving between the countries.

### 3.2 Financial cycles synchronization

Credit and asset prices are considered the most fundamental components of the financial cycle and are extensively used in the literature (Drehmann, Borio, and Tsatsaronis (2012), Grinderslev et al. (2017)). Borio (2014) argues that the most parsimonious description of the financial cycle can be made in terms of credit and property prices. Rey (2015) and Miranda-Agrippino and Rey (2015a) expand the definition of the financial cycle to include both home and share prices. Following this literature, I use total credit and assets (property and shares) price data to estimate the financial cycle. Importantly, total credit accounts for credit from all sources, namely credit from financial accounts, domestic bank credit, and cross-border bank credit are the three main building blocks underlying the construction of the total credit series. The credit data come from the BIS database while property and shares prices come from OECD database.

I calculate the logarithmic change of each variable and then take a simple average to obtain the growth of the financial cycle.

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<sup>1</sup>Stocks seem to be better measurements than flows for financial integration, see Prasad et al. (2003)

$$R_{i,t} = \frac{1}{3} \cdot \ln \left( \frac{C_{i,t}}{C_{i,t-1}} \right) + \frac{1}{3} \cdot \ln \left( \frac{H_{i,t}}{H_{i,t-1}} \right) + \frac{1}{3} \cdot \ln \left( \frac{S_{i,t}}{S_{i,t-1}} \right)$$

where:

$C_t$  - total credit to private sector in year  $t$ .

$H_t$  - index of prices of residential property in country  $i$  in year  $t$ .

$S_t$  - index of common shares traded in country  $i$  in year  $t$ .

$i, j$  - country index

As a measure of synchronization of financial cycles, I use the negative of divergence in growth rates defined as the absolute value of financial cycle growth differences between country  $i$  and country  $j$  in period  $t$ .

$$FinSynch_{i,j,i} = - |R_{i,t} - R_{j,t}| \quad (2)$$

This index is simple and quite popular (Kalemli-Ozcan, Papaioannou, and Perri (2013), Giannone, Lenza, and Reichlin (2010)). In contrast to the correlation measures, it is not sensitive to the various filtering methods that have been criticized on many grounds (e.g., Canova (1998)). It also does not contain an estimation error that emerges, for example, from self-selecting a rolling estimating window. Nevertheless, in order to test the robustness of the results in Section 6, I use a rolling (5 year) correlation as the synchronization measure. The results are similar to the main results of the paper.

### 3.3 Descriptive Statistics

Summary statistics of the data are presented in Table 1. The sample includes 5,756 country pair-year observations for 1980 - 2013 period. The average divergence in financial cycle growth over the sample period is -7.02 (Fin cycles synch), with significant variation (the standard deviation is 6.24). Banking linkages are characterized by similiar average level (-6.88) with much smaller variation (the stadandard deviation is 1.99). About 21.8 percent of the observations in the sample refer to crisis periods (where at least one country in the country pair undergoes a financial crisis during this year).

Figure 1 shows the average cross-border (bilateral) bank linkages of the countries in my sample. We can see that financial integration had increased since the 1980s until 2007 - 2008 (the Global Financial Crisis) and then a sharp decline followed, dropping below initial levels. The shaded area in the figure refer to the dates of banking crises (which comes from an updated version of Laeven and Valencia (2013) and includes the start and end year of banking crises in the OECD countries for the entire sample period) in the sample countries and it seems that those are associated with a decrease in financial integration.

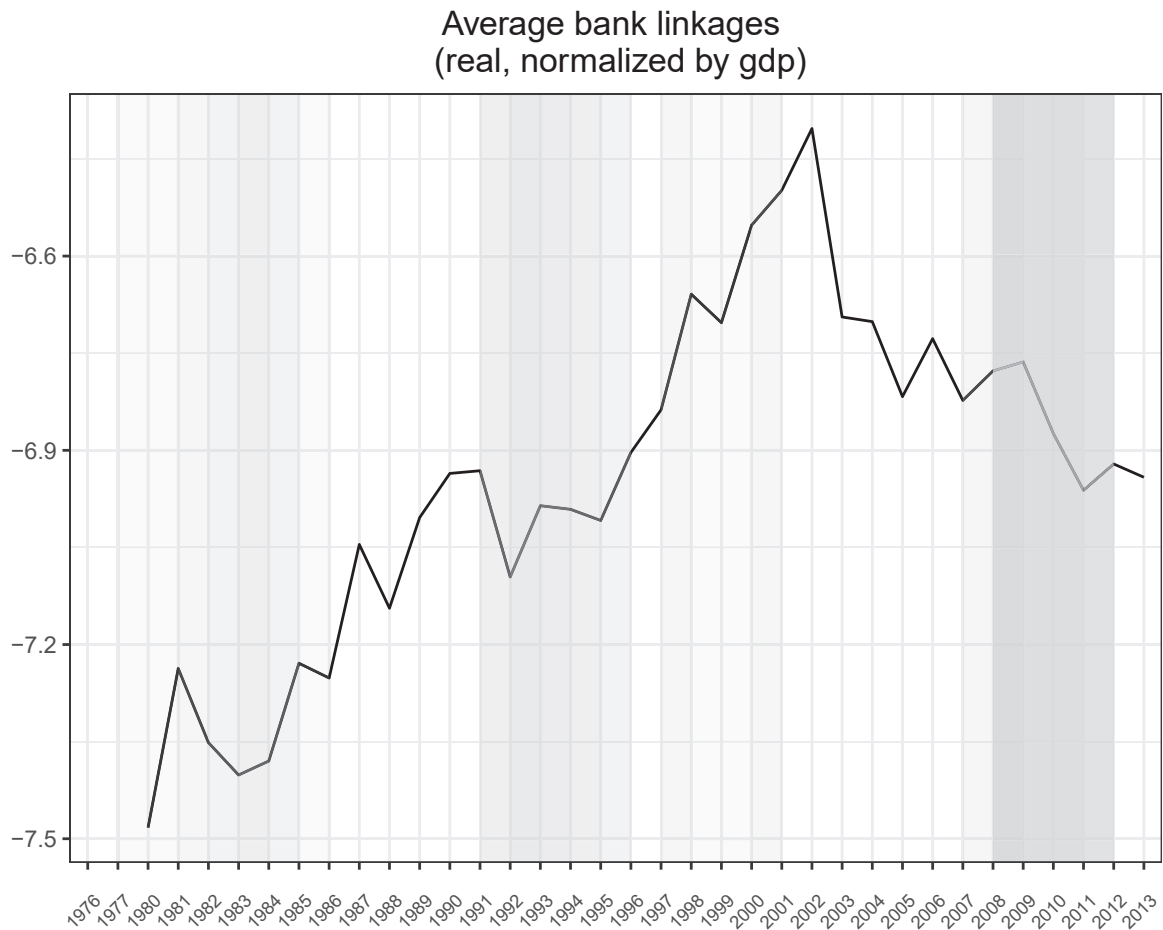


Figure 1: Cross-border bank claims over time. This figure plots the evolution of the average value of logs of bilateral stocks of assets and liabilities normalized by the sum of the two countries' GDP. For each year, the average is estimated across 338 country pairs (the sample spans 30 countries). Shaded areas are banking crisis periods.



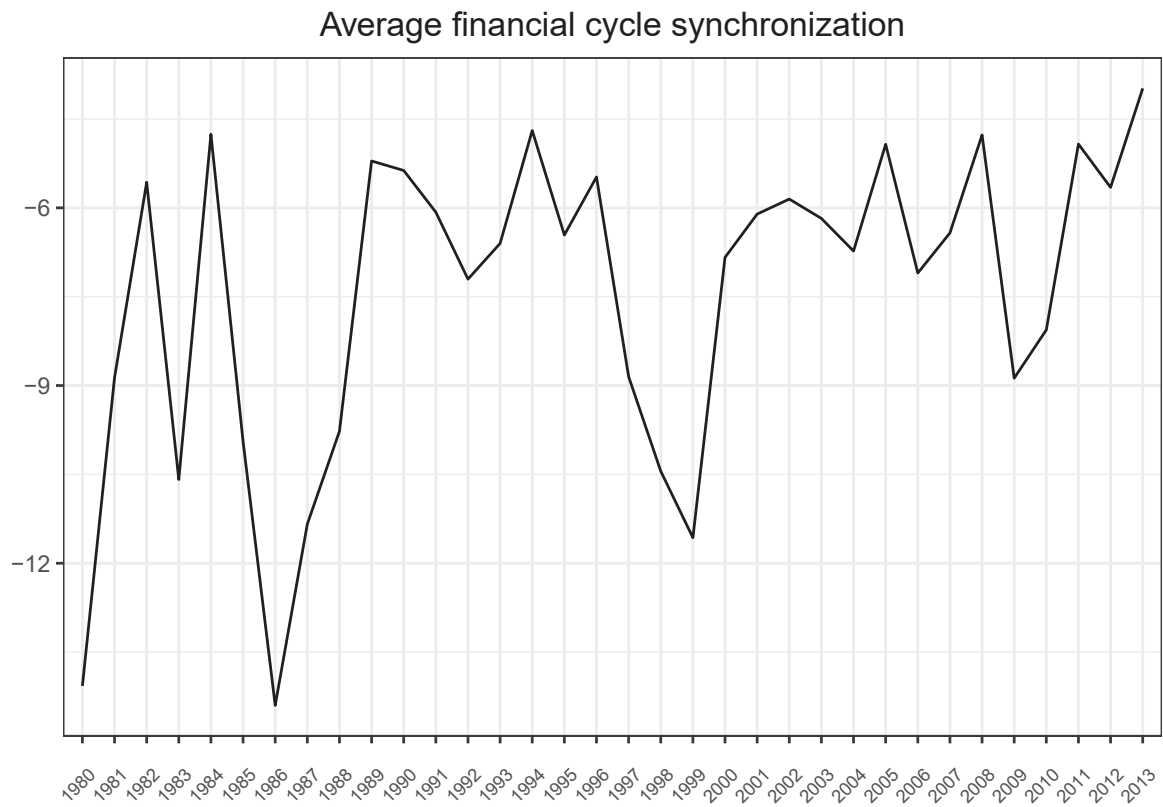


Figure 2: Financial cycle synchronization over time. This figure plots the evolution of the average value of the negative absolute difference in financial cycle rate of change between country  $i$  and country  $j$  in year  $t$ . For each year, the average is estimated across 338 country pairs (the sample spans 30 countries).

Table 1: Summary statistics of the main variables

Statistic	Max	Min	Mean	Median	St. Dev.	N
Financial synchronization	0	-56.87	-7.02	-5.49	6.24	5,756
Banking linkages	-2.75	-11.34	-6.88	-6.80	1.99	5,756
Crises	1	0	0.22	0	0.41	5,756
FD	1.95	0.28	1.29	1.36	0.32	5,756
Trade linkages	-2.25	-13.23	-6.05	-6.06	1.37	5,756
FX stability	2.00	0.12	1.10	1.08	0.49	5,756
Financial openness	2.00	0	1.66	1.94	0.46	5,756
GDP total	41.35	30.59	36.07	36.02	1.83	5,756

Note: The table reports summary statistics of the main variables used in the empirical analysis. Financial cycles synchronization is the negative of the absolute difference of financial cycle growth between country  $i$  and country  $j$  in year  $t$ . Bank linkages is the log of total bilateral cross-border banking claims as a share of the two countries' GDP. Crises is an indicator variable that equals 1 if at least one country undergoes a banking crisis at that year. FD is the sum of the level of each country's financial development index. Trade linkages is the log of bilateral real exports and imports as a share of the two countries' GDP. FX stability is a measure of exchange rate stability. Financial openness is a measure of capital account openness. GDP total is the sum of GDP of both countries.

Figure 2 shows the average synchronization (measured as the difference between credit and home price growth rates for each country pair). The synchronization seems to be quite volatile with no specific trend until 2007 - 2008 (the Great Financial Crisis) and trending upward since.

## 4 Empirical specification

The baseline specification (following along the lines of Kalemli-Ozcan, Papaioannou, and Peydro (2013)) is

$$FinSynch_{i,j,t} = \alpha_{i,j} + \delta_t + \beta BankLinkages_{i,j,t-1} + Controls_{i,j,t} + \varepsilon_{i,j,t} \quad (3)$$

where:

*FinSynch* - a measure of synchronization of financial cycles.

*BankLinkages* - a measure of banking integration between two countries.

This specification includes time and country pair fixed effect to control for unobservable time and country pair specific factors (such as cultural difference or turmoil years). The time fixed effects account for the effect of global shocks and other common time varying factors that affect both financial cycle patterns and banking integration. The country pair effects account for hard to measure factors such as cultural ties and similarities, informational frictions, and other time invariant unobservable factors that affect both financial integration and financial cycle patterns.

To account for the trend and the non-stationary nature of banking integration (see Figure 1), I add a country pair specific linear time trend<sup>2</sup>. It should be noted that it may be the case that the trend picks up the effect of some other omitted variable. Since I'm only interested in estimating the bank linkage effect in the regression (as opposed to explicitly modeling all the factors that affect financial synchronization), controlling for other variables (trend or another omitted variable) seems required.

The estimation results can be subject to an endogeneity problem for reasons of omitting relevant variables or reverse causality. In order to address this issue, I take several steps: first, the specified regression is augmented with a set of variables to control for other economic factors that can affect both financial cycle synchronization and banking integration. As control variables I use measures of foreign exchange stability, and financial (capital account) openness (see Chinn and Ito (2010)). I also include trading linkages to control for cross-country trading activity.<sup>3</sup> Second, bank linkages enter in my specification in a lagged form, which should attenuate the reverse causality problem.

#### 4.1 Crisis effect

Several papers (see Kalemli-Ozcan, Papaioannou, and Perri (2013), Aysun and Hepp (2016), and Fratzscher (2012)) find that during financial crises times the effect of global (“push”) factors in cross-border bank lending increases. If during financial crises times common (global) shocks are prevalent, that should induce more synchronized financial cycles. That means that the crisis effect should be positive and the “shock propagator” role of banking integration should increase during crisis times. Stremmel and Zsámboki (2015) analyze financial cycles of 21 EU economies and find that during stress periods the similarity of financial cycles increases.

To test the role of crises I introduce an indicator variable for a bank crisis period. The indicator equals 1 if at least one country of the country pair is going through banking crises at period  $t$ . The data comes from an updated version of Laeven and Valencia (2013) and includes the start and end year of banking crises in the OECD countries for the entire sample period. I expect that the effect of banking integration will be different in crises vs normal times and to capture this difference I add an interaction variable between bank linkages and crisis indicator to the estimation equation.

#### 4.2 Financial development

Mendoza, Ríos-Rull, and Quadrini (2009) study the relationship between financial development and global imbalances. The authors show that financial development varies widely even among industrial countries, and that financial integration can have different effects when countries differ

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<sup>2</sup>I choose a linear trend for reasons of simplicity and comparability with Kalemli-Ozcan, Papaioannou, and Peydro (2013); see Bouvatier, Vincent and Delatte and Anne-Laure (2015) for use of trends in banking integration measures.

<sup>3</sup>All the variables are explained in the Appendix.

in financial markets development. Countries with deeper financial markets react to financial integration by borrowing from abroad and investing in high return foreign risky assets while countries that are less financially developed accumulate positions in safer assets.

Bahadir and Valev (2015) show that financial development convergence takes place. Countries with a high level of financial development exhibit lower credit growth rates in comparison to countries with a low level of financial development. Kılınc, Seven, and Yetkiner (2017) confirm the financial development convergence for 15 EU countries. They find that both credit and stock markets exhibit convergence, meaning that growth rates of these markets decrease at high levels of development.

Fisman and Love (2004) analyze the role of financial development in allocating resources. They argue that global (productivity) shocks will induce comovement of growth rates among countries with a high level of financial development, since undeveloped countries will not be able to react to the shocks of other countries. Thus, financial development at a high level can transmit global shocks and induce comovement in economic activity.

I hypothesize that this phenomenon (comovement induced by a high level of financial development) holds with respect to financial activity as well. An example is given in Acharya and Schnabl (2010). The authors analyze an investment strategy of large commercial banks that set up asset-backed commercial paper (ABCP) conduits. This strategy involved selling to investors short-term asset-backed commercial paper and investing the proceeds mainly in US asset-backed longer-term securities. Once negative news about US assets emerged, all the banks suffered significant losses, thus inducing comovement. This investment strategy required a highly developed domestic financial market (financing through commercial paper instruments), and it is not surprising that the list of countries whose banks were pursuing this strategy includes the US, UK, Germany, France, Belgium, and Portugal - highly developed countries.

To account for the fact that the effect of financial integration depends on the level of domestic financial development, I include an index of financial development (the sum of the financial development index of each country in the country pair) and an interaction term between financial development and banking integration. Data on financial development index comes from Svirydzenka (2016) and includes an index of financial development of all the countries in my sample for 1980 - 2013 period.

## 5 Estimation and results

Estimation results are shown in Table 2. The table starts with the baseline specification and then interaction variables are added going left to right.

Banking linkages enter the equation with a negative sign, meaning that integration is associated with less synchronized cycles. However, in baseline specification this result is not statistically significant, suggesting that in my sample the “risk absorber” feature is similar in magnitude to the “risk propagator” feature, thus rendering the final result inconclusive.

Table 2: Financial synchronization and banking integration:panel specification

	Fin cycles synch		
Bank linkages (lag)	-0.22 (0.17)	-0.33* (0.17)	-1.16*** (0.42)
Crises		0.32 (0.78)	0.42 (0.79)
FD			3.14 (2.32)
Bank linkages (lag) * Crises		0.35*** (0.11)	0.38*** (0.12)
Bank linkages (lag) * FD			0.62** (0.29)
Trade linkages	0.75 (0.68)	0.47 (0.67)	0.55 (0.67)
FX stability	4.37*** (0.62)	3.77*** (0.63)	3.81*** (0.64)
Financial openness	1.27* (0.71)	0.84 (0.69)	0.89 (0.69)
GDP total	1.19* (0.70)	1.18* (0.69)	1.04 (0.68)
Country pair FE	Yes		
Year FE	Yes		
Country pair linear trend	Yes		
Observations	5,358	5,358	5,358
R <sup>2</sup>	0.11	0.12	0.12

*Note:* The table presents panel estimation that includes two-way fixed effects and country pair specific linear time trend. Financial cycles synchronization is the negative of the absolute difference of financial cycle growth between country  $i$  and country  $j$  in year  $t$ . Bank linkages is the log of total bilateral cross-border banking claims as a share of the two countries' GDP. Crises is an indicator variable that equals 1 if at least one country undergoes a banking crisis at that year. FD is the sum of the level of each country's financial development index. Trade linkages is the log of bilateral real exports and imports as a share of the two countries' GDP. FX stability is a measure of exchange rate stability. Financial openness is a measure of capital account openness. GDP total is the sum of GDP of both countries.

Introduction of the crisis indicator variable make it possible to disentangle the opposite effects. We see that during banking crisis periods integration is associated with higher synchronization relative to the baseline case (the overall effect remains negative). Banking (and financial) crises are often contagious events that are being hard to contain locally, and thus produce common shocks that result in higher synchronization. Addition of the financial development indicators further enhances the results. In highly developed financial markets, integration is also associated with higher synchronization relative to the baseline case.

The findings with respect to crisis periods as well as highly developed financial markets are in line with the theory that suggests that the “risk propagator” feature is present in these settings and thus the synchronization should increase relative to the baseline.

Coefficient analysis shows that the banking integration effect is economically significant. A change of one standard deviation in banking linkages is associated with a change of 0.37 standard deviations in financial synchronization. During banking crises one standard deviation change in integration contributes 0.12 standard deviations to the synchronization. In highly developed financial markets, one standard deviation change in integration contributes 0.2 standard deviations to the synchronization of financial cycles.

Looking at the control variables, we see that FX stability contributes to the synchronization of financial cycles, possibly because stable FX facilitates cross-border financial transactions. Financial openness works in the same direction, however it is statistically significant only in the baseline specification. The economic size of the country pair measured by the sum of GDP also promotes the synchronization of financial cycles.

## 5.1 Graphical results

For illustration purpose, This section presents the result of the analysis for two big financial centers (the United States and the United Kingdom), as well as a small open market country (Israel). The distribution of the bilateral cross border credit is shown in Figure 3. The United States and United Kingdom are the largest counterparties to each other, the Unites States is also the largest cross-border credit counterparty for Israel.

Figure 5 shows the correlation between financial synchronization and banking integration for United Kingdom-United States and Israel-United States pairs. To obtain the correlation estimate I first regress financial synchronization and banking integration on a control variables set (including fixed effect) in an attempt to “clean out” the effect of other factors. The figure plots the residuals of these first step regressions, the trend line shows the (slightly) negative association between financial synchronization and banking integration in the all country pair.

The effect of banking linkages in the Israel subsample is similar to the effect in the total sample. A one standard deviation change in banking linkages reduces the synchronization by 0.31 standard deviations.

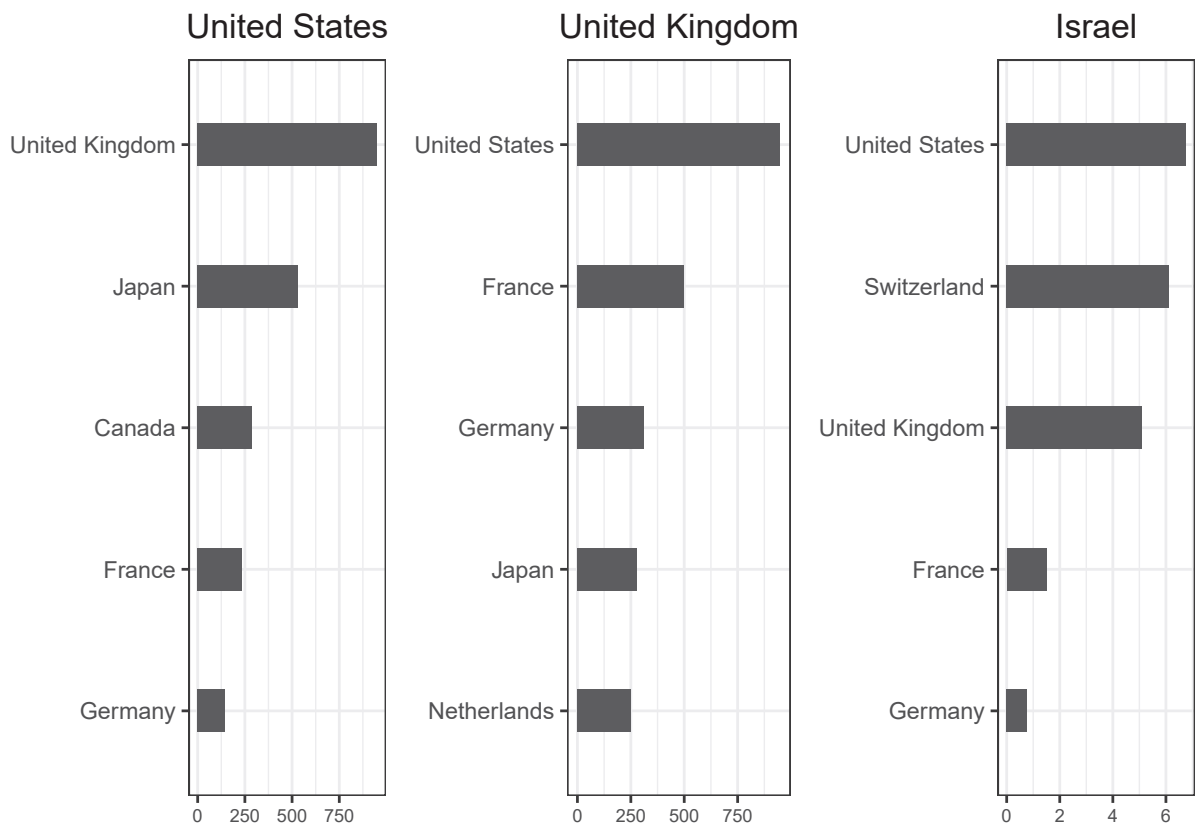


Figure 3: The cross border credit (USD millions) for top 5 counter-parties of two big financial centers (United States and United Kingdom), and a small open market country (Israel).

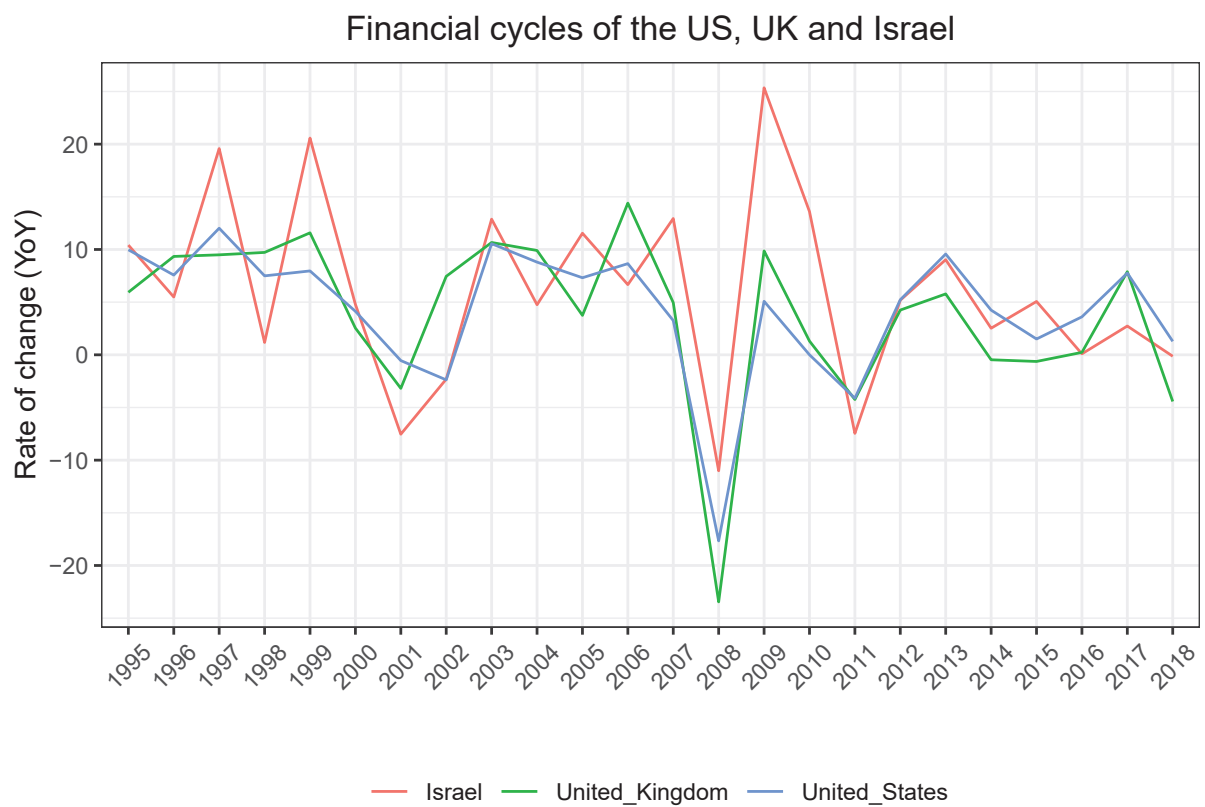


Figure 4: This figure plots the financial cycles of the US, UK and Israel. The financial cycle is defined as the simple average of log returns of the three cycle components (total credit, home prices and share prices).



### Correlation of banking integration and financial synchronization (netting fixed effects and controls)

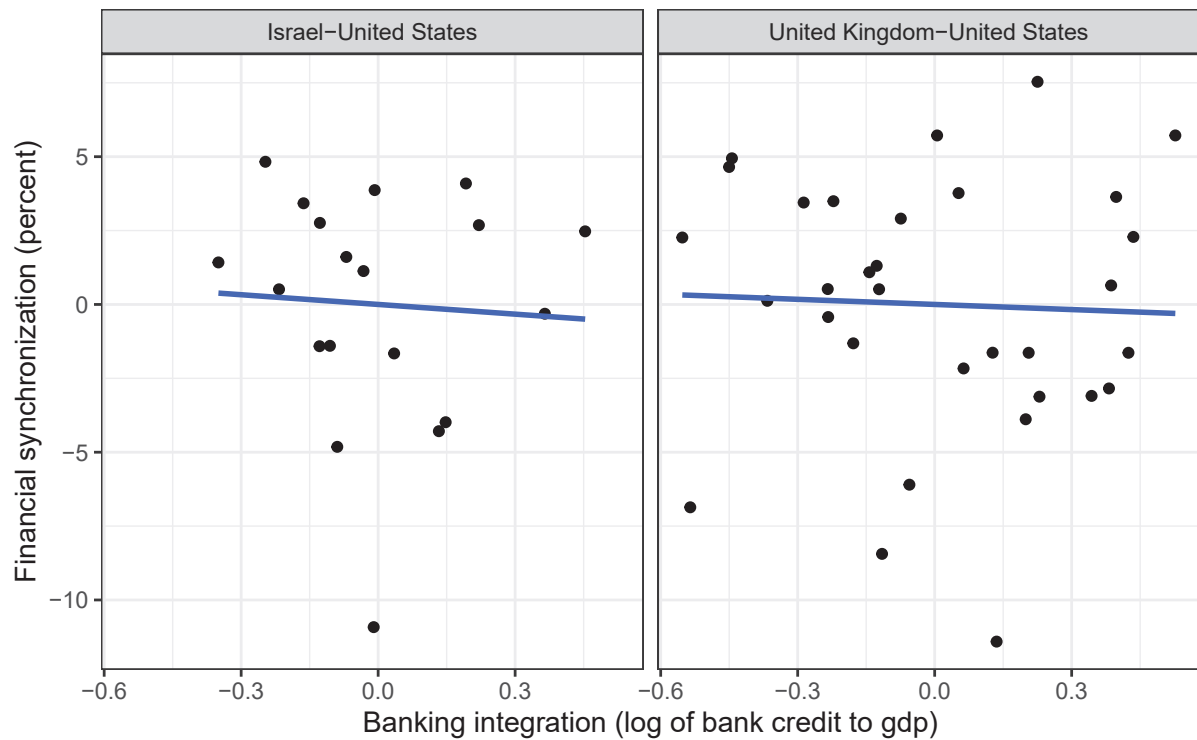


Figure 5: The figure plots the within-country pair and within-year correlation between financial synchronization. (Fin Synch) on the vertical axis and banking integration (Bank Linkages) on the horizontal axis. Each observation corresponds to a particular country pair in each year. To generate the figure I first regress output synchronization and banking integration on country-pair fixed effects and year fixed effects. Then the residuals of the synchronization regression on the vertical axis are plotted against the residuals from the banking integration regression on the horizontal axis.

## 6 Robustness

### 6.1 Excluding GFC

The Great Financial Crisis was an extraordinary event that significantly affected the synchronization of financial activity all over the world. To ensure that my results are not driven by this effect I exclude the period of the GFC (2008 - 2009) from my sample. The results are presented in column 1 in Table 3. This exercise leaves all the results practically unchanged (concerning coefficients and statistical significance).

### 6.2 Rolling correlation

In this section, I use a rolling window correlation as the synchronization measure to test the robustness of my analysis. The results are presented in column 2 in Table 3. I find that the main result (negative association of banking integration and financial activity) holds as well as the effect of financial development. However, the crisis effect becomes insignificant in this setting.

### 6.3 Flow vs, Stock measures

My measure of banking integration is a stock measure (the balance of normalized cross border credit). It may be that the flow measures will capture a different aspect of the banking integration, for example during crises the credit flows will presumably drop due to a credit crunch while the credit balance will stay the same. To capture this aspect of banking integration I change my measure of integration to credit flows instead of credit stocks by differencing the cross-border credit balance. Column 3 in Table 3 shows the results of this exercise. Similarly to the case of rolling correlation test I find that the main result holds as well as the effect of financial development. The crisis effect is insignificant in this setting as well.

Table 3: Robustness specifications

	GFC	Roll	Delta
	(1)	(2)	(3)
Bank linkages (lag)	-1.17*** (0.44)	-0.09** (0.04)	-1.85** (0.93)
Crises	0.03 (1.29)	-0.12** (0.06)	-2.13*** (0.33)
FD	4.44* (2.37)	0.23 (0.20)	-0.90 (1.33)
Bank linkages (lag) * Crises	0.39** (0.18)	-0.01 (0.01)	0.01 (0.43)
Bank linkages (lag) * FD	0.79** (0.31)	0.07** (0.03)	1.31* (0.68)
Trade linkages	-0.05 (0.70)	-0.03 (0.05)	0.18 (0.72)
FX stability	3.17*** (0.67)	0.05 (0.04)	3.07*** (0.58)
Financial openness	0.34 (0.68)	0.01 (0.06)	-0.37 (0.71)
GDP total	-0.58 (0.71)	0.17*** (0.05)	0.99 (0.71)
Country pair FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Country pair linear trend	Yes	Yes	Yes
Observations	4,371	4,828	5,041
R <sup>2</sup>	0.12	0.17	0.11

*Note:* The table presents three robustness specifications. Column 1 is the baseline specification excluding Global Financial Crisis (2007 - 2009). Column 2 presents a specification which uses rolling correlation as an alternative measure of financial synchronization, and Column 3 uses differenced bank linkages in order to capture flow nature of cross border credit instead of stock.

Overall the robustness tests show that the main result (negative association of banking linkages and financial synchronization) holds. The financial development effect is also consistent across all

the specifications. However, the crisis effect turns insignificant in specifications that use alternative variable definitions (rolling correlation as a measure of financial synchronization or differenced banking linkages).

## 7 Summary and conclusions

This paper studies the effect of banking integration on the synchronization of financial cycles. Theory posits that there may be opposite effects (“shock absorption” vs. “shock propagation”) that make the identification of this effect difficult. In a real business cycle setting, Kalemli-Ozcan, Papaioannou, and Peydro (2013) find that banking integration causes business cycles divergence, and they suggest that credit flows from low to high return investments may be the mechanism that causes the divergence.

I hypothesize that the same credit flow will cause financial cycles divergence as well. I find corroborating evidence of a negative association between banking integration and financial cycles synchronization. Moreover, my results suggest that there are other factors that contribute to financial cycle synchronization and make the relationship state dependent.

I find that financial crises increase the “shock propagation” feature of banking integration relative to a baseline setting. This is an important result for policymakers. It suggests that while banking integration may be desired, additional macro-prudential measures may be warranted to account for the risk exposure during crisis times.

Additional factors that contribute to financial cycle synchronization are the high development of financial markets, which means that policy makers should take the structural characteristics of their financial markets into account as well.

## 8 Appendix

### 8.1 Explanatory variables

**Total credit** Importantly, the data account for credit from all sources, not only that extended by domestic banks. Total credit from financial accounts, domestic bank credit, and cross-border bank credit are the three main building blocks underlying the construction of the total credit series. Trade credit (as well as other accounts payable and receivable) is excluded from the new total credit series because the quality of the underlying data is globally poor. In principle, nominal values are used for loans, corresponding to the origination price (historical cost) plus the interest that has accrued but not been paid if there has not been a default. All other financial assets, including debt securities, are in principle valued at market prices. In practice, though, debt securities are often reported at nominal value. This may affect international comparability in cases of large volumes

of debt securities and large price swings but it is impossible to adjust for it. As a rule, the total credit series are not adjusted for exchange rate movements. This correction is only possible for the international banking statistics where a currency breakdown is available but would be highly artificial for the long-run series.

**Bank linkages** This variable is based on bilateral cross-border holdings (stocks) of banks. Data on banks' cross-border bilateral stocks of assets and liabilities come from BIS's Locational Banking Statistics. For each country pair and year there are up to four observations: i) asset holdings (stocks) of banks located in country i in all sectors of the economy in country j, ii) asset holdings (stocks) of banks located in country j in all sectors of the economy in country i, iii) liabilities (stocks) of banks located in country i to country j, and iv) liabilities (stocks) of banks located in country j to country i. The data are originally expressed in (millions) current U.S. dollars. I normalize the data with the following steps:

1. Deflate the four series by the U.S. CPI index
2. Standardize the series by dividing assets and liabilities by the sum of the two countries' GDP in each year (using data from World Bank's World Development Indicators).
3. Take the average of the log value of real bilateral assets and liabilities in each year.

### House Prices

The housing prices indicator shows indices of residential property prices over time. The real house price is given by the ratio of nominal price to the consumers' expenditure deflator in each country, both seasonally adjusted, from the OECD national accounts database. This indicator is an index with base year 2015. The source is OECD (2019), Housing prices (indicator).

**Share Prices** Share price indices are calculated from the prices of common shares of companies traded on national or foreign stock exchanges. They are usually determined by the stock exchange, using the closing daily values for the monthly data, and normally expressed as simple arithmetic averages of the daily data. The source is OECD (2019), Share prices (indicator).

**Trading linkages** The measure is the log of bilateral real (deflated with the U.S. CPI) exports and imports as a share of the two countries' GDP. Source: IMF Direction of Trade Database (2008).

**Financial openness** and **Exchange Rate Stability** measures are based on the work of Chinn and Ito (2010).

### Exchange Rate Stability

To measure exchange rate stability, annual standard deviations of the monthly exchange rate between the home country and the base country are calculated and included in the following formula to normalize the index between 0 and 1:

$$ERS = \frac{0.01}{0.01 + SD(\Delta(\ln(FX)))}$$

Merely applying this formula can easily create a downward bias in the index. That is, it would exaggerate the “flexibility” of the exchange rate especially when the rate usually follows a narrow band, but is de- or revalued infrequently. To avoid such downward bias, a threshold to the exchange rate movement is applied. That is, if the rate of monthly change in the exchange rate stayed within +/-0.33 percent bands, the exchange rate is considered “fixed” and the value of one is assigned for the ERS index. Furthermore, single year pegs are dropped because they are quite possibly not intentional ones. Higher values of this index indicate more stable movement of the exchange rate against the currency of the base country.

### **Financial openness**

The financial openness measure is based on the index of capital account openness or KAOPEN, by Chinn and Ito (2006). KAOPEN is the first standardized principal component of the variables that indicate the presence of multiple exchange rates, restrictions on current account transactions, on capital account transactions, and the requirement of the surrender of export proceeds. The index is normalized between zero and one. Higher values of this index indicate that a country is more open to cross-border capital transactions.

**Asset prices** I use data about house and share prices from OECD database.

**GDP** - Source: World Development Index. Current US dollars

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