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What drives shadow banking? A dynamic panel evidence[1]

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[1] This paper was prepared for the meeting. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the meeting.

What Drives Shadow Banking?:[1]

A dynamic panel evidence

SungJun, Kim[2]

Abstract

This paper examines what drives shadow banking by employing dynamic panel estimation. Utilising annual data from mainly G20 countries for 2002~2013 periods, we provide empirical evidence which suggests that long-term institutional investors including pension funds, insurance companies play a pivotal role in the growth of shadow banking. Our findings also indicate that the size of banks' assets has a statistically significant effect on the growth of shadow banking as the Originate-to-Distribute Model implies. This result reveals that the growth of shadow banking is accompanied with the growth in traditional banking. In the long-run, one percentage point increase in pension funds to GDP ratio can lead to the increase in the broad shadow banking by 4.5~7.0%p which is measured by OFI as a % of GDP. One percentage point increase in the size of traditional banking to GDP attributes to the growth of shadow banking by 0.51~0.66%p in the long run.

Keywords: Shadow banking, dynamic panel

1 The views expressed in this paper are those of the author and are not necessarily reflective of views at the Bank of Korea. Any errors or omissions are the responsibility of the author.

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1. Introduction

In the wake of global financial crisis, many studies have focused on the role of the shadow banking[3] in the financial crisis and the meaning on macro-prudential policies. See Adrian and Shin (2009), Pozsar et al (2010), Claessens et al (2012), Claessens and Ratnovski (2014), etc. Adrian and Ashcraft (2012) provide a literature review on the shadow banking.

According to these literatures, the shadow banking system can raise the systemic risk in the financial markets via reinforcing interconnectedness between financial institutions, even though it has contributed to enhancing the efficiency in the financial markets and improving the credit availability in the real sector. Shadow banks are financed mainly by market-based funds rather than retail funds, whereas they manage long-term illiquid assets. As a result, it is vulnerable to runs or sudden stops, and likely to cause fire sales of assets when the financial market confidence drops. Luttrell et al (2012) deal with intrinsic risks of shadow banking.

The studies highlight that shadow banks have faced weak regulation comparing to the traditional banks. They call for stronger regulation to prevent excessive leverage and maturity mismatch to achieve financial stability.

However, there have not been that many studies that provide empirical evidence due to the lack of statistics on the shadow banking and the ambiguity on its definition[4] of the shadow banking (IMF, 2014)[5]. IMF (2014) and Duca (2014) can be illustrated as the recent empirical studies on the determinants of the shadow banking. IMF (2014) demonstrates cross-country panel estimation on the growth rate of shadow banking using Non-core debt, flow of funds measure, and FSB measure as a dependent variable. IMF (2014) suggests that a search for yield, regulatory arbitrage, institutional cash pools and financial developments contribute to the growth of the shadow banking. They mainly provide Pooled OLS estimation which requires strong assumptions for consistency, though they employ partially a static panel estimation with fixed effects. They did not employ a dynamic model. In the following we illustrate the estimation method for more details.

Duca (2014) implements the time series analysis for the long-term time series data based on the Flow of Funds Statistics in the United States. Duca (2014) indicates that the shadow share was affected by the deposit rate ceilings, the economic outlook, and the risk premia in the short-run, but over the long-run it was affected by the changing information and reserve requirement costs, and the shifts in the impact of regulations on bank.

Recently, more than 10 years of cross-country panel data for mainly G20 countries following the definition and the methodology of FSB can be available after FSB has published the Global Shadow Banking Monitoring Report in the line with the G20 DGI(Data Gaps Initiative). This paper provides empirical evidence on the

3 Shadow banking system is defined as credit intermediation involving entities and activities outside th e regular banking system (FSB, 2015).

4 The term of shadow banking is firstly used by PIMCO managing director, Paul McCulley. (McCulley(2007)). He describes shadow banking as "Unlike regulated real banks, who fund themselve s with insured deposits, back-stopped by access to the Fed's discount window, unregulated shadow b anks fund themselves with un-insured commercial paper, which may or may not be backstopped by li quidity lines from real banks."

5 Shadow banking has been measured in different ways depending on researchers and institutions. IMF(2014) provides a summary of the different definitions of and perspectives on shadow banking.

determinants of the shadow banking using these new data series. Also, we provide more rigorous empirical analysis using not only a static model with fixed effects estimation, but also a dynamic panel model.

The estimation results indicate that the size of long-term institutional investors including pension funds and insurance companies promotes the growth of shadow banking. It implies that the demand of long-term institutional investors for instruments issued by shadow banking sectors plays a crucial role in the growth of shadow banking.

In addition, long-term market interest rates(10 year Treasury Bond yields) have a negative impact on the shadow banking growth as expected, even with weak statistical significance. This is because the high long-term interest rate discourages the incentive to a search for higher yield. As the Originate-to Distribute Model implies, the estimation results indicate that the growth in the size of traditional banking has a significant effect on the growth of shadow banking. It shows that the growth of the shadow banking is accompanied with the growth of traditional bank. In a dynamic panel model, a 1%p increase in pension funds to GDP ratio can lead to 4.5~7.0%p increase in the broad shadow banking which is measured by OFI as a % of GDP. A 1%p increase in the size of traditional banking has a 0.51~0.66%p effect on the growth of the shadow banking in the long run.

The paper is organised as follows. Section 2 provides a brief literature review of the determinants that affect the growth of the shadow banking. Section 3 and 4 describe our data sets, outline estimation method, and present the estimated results. Finally, Section 5 summarizes and concludes.

2. Literature review

This section provides a brief literature review of the determinants of the shadow banking growth. As shown in IMF(2014) and Duca (2014), the existing literatures suggest various factors including the demand of institutional investors, regulatory arbitrages, and a search for yield, financial innovations, etc, as a determinant. Here, we focus on the demand factors and regulatory arbitrages.

Regarding the demand, Adrian and Shin(2009) suggest that institutional investors which include pension funds, mutual funds and insurance companies as well as foreign central banks outside the banking system play an important role as a new funding source of banks. These investors buy those securitized claims, which are issued in the process of credit creation.

Banks originate loans and sell them to broker and dealers, hedge funds. The buyers pool and securitize them as types of ABS, CDO, etc, then distribute them to investors with different risk appetites including SIVs, hedge funds, asset managers, and insurance companies. Pozsar(2008) and Pozsar et al(2010) illustrate this Originate-to-Distribute model in more detail.

Next, looking at the regulatory arbitrage, deposit-insurance scheme, reserve requirements, and capital requirement rules are mentioned as representative examples of regulatory arbitrages of shadow banking compared to traditional banks. While bank deposits cost insurance fees for deposit protections, shadow banking without insurance fees has a room for providing higher return. See Pozsar et al (2010)

for the absence of deposit insurance of shadow banking which differentiates it from deposits of traditional banks.

Reserve requirements imposed on the traditional banks can decrease their revenue because the amount of credit supply would shrink as banks piled up reserves at the central bank. Meanwhile, shadow banking such as MMF has no reserve requirement, resulting in offering higher return (Duca, 2014).

Shadow banks can expand their activities by taking advantage of loose capital requirement or employing evasive behaviours. As an example, securitization can be noted in that because the transfer of assets is recognized as true sale, originators can not only book off securitized assets in the balance sheet, but also originators don't have to record funds raised by securitization in a borrowing. Moreover, originators such as banks can have an advantage in improving the capital requirement ratio through securitizing non-performing loans(FSS, 2013). Adrian and Ashcraft(2012) also introduces that regulatory changes to ABCP played a significant role in the growth of the shadow banking system.

3. Data and Empirical models

3.1 Data

The data for shadow banking are obtained from FSB '2015 Global Shadow Banking Monitoring Report'. These datasets are compiled based on the financial accounts, called the Flow of funds in each country. See FSB(2011a), FSB(2011b), FSB(2015) for detail on the definition and the compilation method led by FSB. While the raw data are available for 26 countries for the 2002-2014 period, we use datasets excluding a few countries including Argentina and Brazil which are assumed to be outliers or to contain missings in covariates[6]. Due to missing values, unbalanced panel data are used to estimate.

OFI(Other Financial Institutions) as a % of GDP, a dependent variable, is drawn from FSB. This is called "broad shadow banking".[7] The definition of shadow banking led by FSB can be divided into the broad shadow banking and the narrow shadow banking. Broad shadow banking is measured as the asset size of OFI(Other Financial Institutions) which denotes financial sector except banks, pension funds and insurance companies, public financial institutions, and financial auxiliaries.

On the other hand, the narrow shadow banking is limited to the institutions with high systemic risks after classifying financial institutions into five groups based on their functions[8]. <Box> illustrates how to derive shadow banking statistics from the Flow of Funds statistics.

6 Due to missing values in variables, the number of observations which are used in estimation depends on model specifications.
7 In narrow measure, just data for 5 time periods are available, it is not easy to get significant results from them.
8 Economic Function classifications(EF1~5) are as follows. EF1 is management of collective investment vehicles with features that make them susceptible to runs. EF2 is loan provision that is dependent on short-term funding, EF3 is intermediation of market activities that is dependent on short-term funding or on secured funding of client assets. EF4 is facilitation of credit creation. EF5 is securitization-based credit intermediation and funding of financial entities.

For covariates, we want to classify the determinants into 3 categories, that is, the demand factor of institutional investors on instruments issued by shadow banking sectors, regulatory arbitrages, and a search for yield.

For the demand factor, we use the asset size of pension funds and insurance companies as a % of GDP. The data on asset size of banks are calculated as a % of GDP, and is drawn from FSB to verify the Originate-to-Distribute model.

For the data on regulatory arbitrages, we use long-term interest rates as a proxy of reserve requirements tax following Duca(2014). Long-term interest rates can indicate a search for yield together with term spread(10yr-3M). Besides, net interest margin(NIM) and bank capital ratio are included in control variables.

We include income, stock market size, and financial development index to capture the financial innovations or financial developments. Financial development index is drawn from Svirydzenka(2016) who compiled it considering the depth, access, efficiency in financial institutions or financial markets in a comprehensive manner.

Chart1 plots the relationship between broad measure of shadow banking and covariates. It shows that pension funds, insurance companies, and banks are positively correlated with the broad measure of shadow banking. On the other hand, it indicates that the long-term interest rates, the bank capital ratio, and the bank net interest margin are negatively correlated with the shadow banking system. Chart2 with the narrow definition also shows similar relationships between them.

Table 1 provides descriptive statistics of variables, and Table 2 presents correlation coefficients.

Summary Statistics

Table 1

	Source	Unit of Measurement	Mean	Overall S.D	Between S.D	Within S.D	Min	Max
OFI	FSB	as a % of GDP	87.584	132.210	127.545	39.878	0.519	828.198
Treasury Bond yield(10Yr)	Bloomberg	%	4.483	2.461	2.440	1.056	0.509	13.624
Spread (10yr-3M)	Bloomberg	%	1.652	1.178	0.838	0.999	-1.544	4.890
Bank Capital Ratio	World Bank	%	7.563	2.895	2.796	0.979	3.000	14.600
Bank Net Interest Margin	World Bank	%	3.211	2.185	1.849	1.216	0.140	14.636
Log(GDP per capita)	World Bank	lagged by one time period	9.739	1.169	1.073	0.510	6.175	11.385
Pension Fund	FSB	as a % of GDP	36.431	36.569	36.736	6.591	0.001	156.708
Insurance	FSB	as a % of GDP	38.997	28.299	28.512	6.109	1.254	105.315
Bank	FSB	as a % of GDP	237.070	186.769	184.419	45.026	29.112	815.767
Stock Market	World Bank	as a % of GDP	101.438	85.354	82.743	26.659	14.154	570.155
Financial Development Index	IMF	index	0.685	0.200	0.200	0.040	0.281	1.000

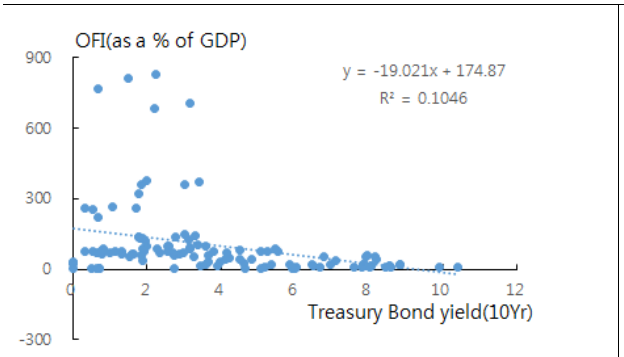
Correlation Matrix

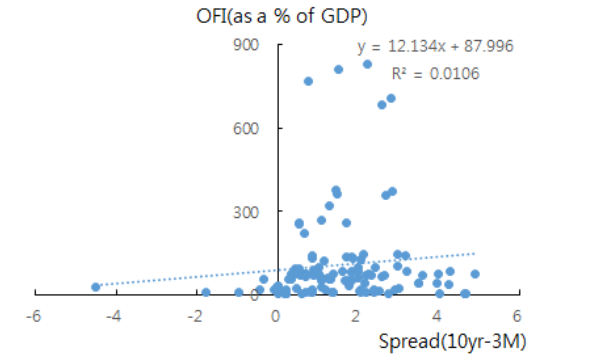
Table 2

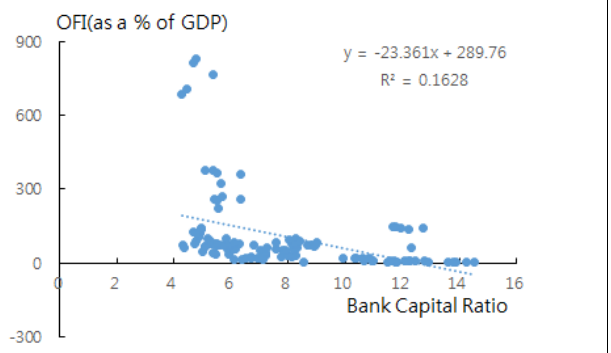
	OFI (as a % of GDP)	Treasury Bond yield (10Yr)	Spread (10yr-3M)	Bank Capital Ratio	Bank Net Interest Margin	Log (GDP per capita)	Pension Fund (as a % of GDP)	Insurance (as a % of GDP)	Bank (as a % of GDP)	Stock Market (as a % of GDP)
OFI(as a % of GDP)	1									
Treasury Bond yield(10Yr)	-0.2830	1								
Spread (10yr-3M)	0.0619	0.0052	1							
Bank Capital Ratio	-0.3377	0.3411	0.0718	1						
Bank Net Interest Margin	-0.3658	0.6266	-0.0419	0.5155	1					
Log(GDP per capita)	0.3722	-0.6979	0.1186	-0.2829	-0.4906	1				
Pension Fund(as a % of GDP)	0.7946	-0.3047	-0.0963	-0.1490	-0.2614	0.4289	1			
Insurance(as a % of GDP)	0.4676	-0.5952	0.0030	-0.5105	-0.5467	0.5835	0.4083	1		
Bank(as a % of GDP)	0.2766	-0.5687	0.0896	-0.1446	-0.4922	0.4469	0.3178	0.5752	1	
Stock Market(as a % of GDP)	-0.0207	-0.2346	-0.0916	0.3240	-0.0440	0.1355	0.2185	0.1429	0.5209	1
Financial Development Index	0.3236	-0.7215	0.1019	-0.3671	-0.5896	0.8031	0.3977	0.6093	0.4848	0.2263

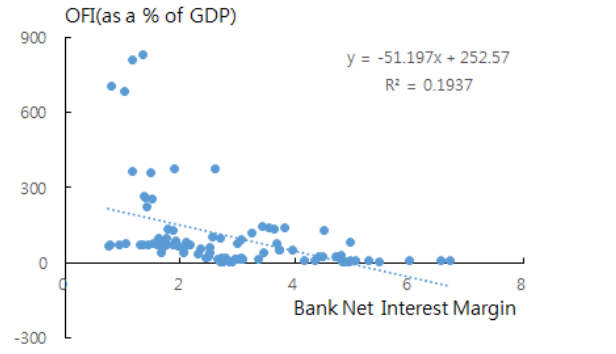
Shadow banking in broad measure

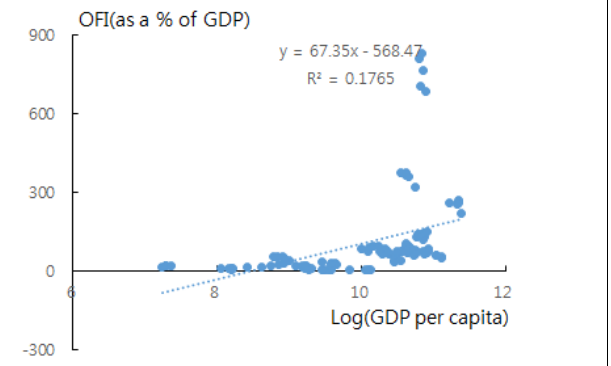
Chart 1

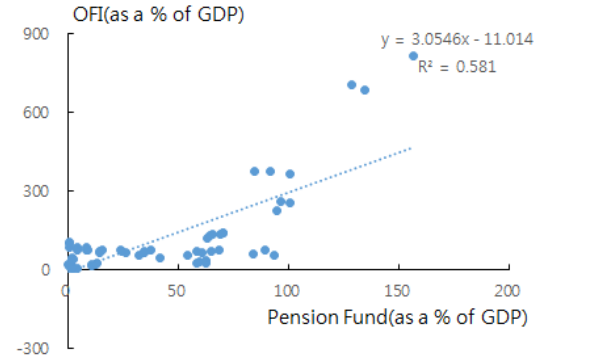


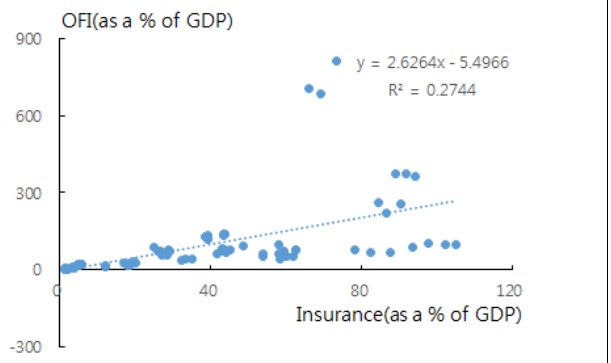


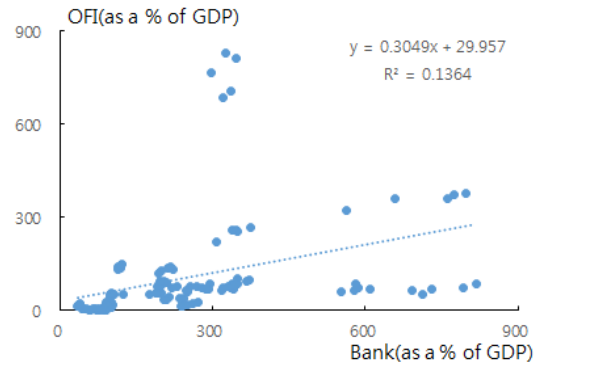












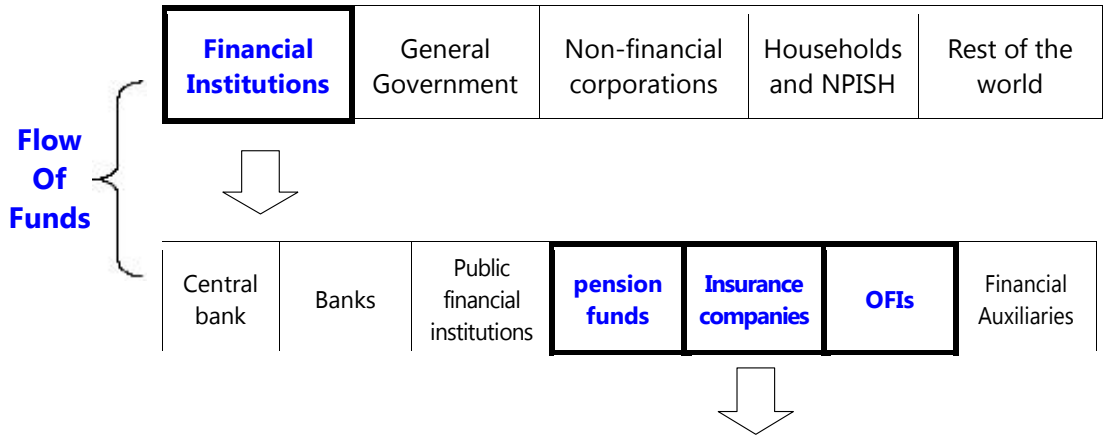
Shadow banking in narrow measure

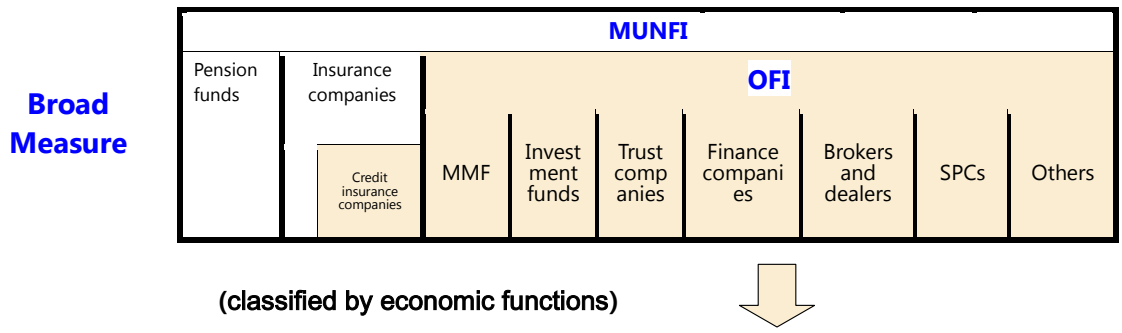
Chart 2

Box 1

How to derive shadow banking statistics from Flow of Funds statistics

Shadow banking system monitoring exercise led by FSB takes two-step approach to measure shadow banking system. First, authorities cast the net wide to cover all areas where shadow banking-related risks to the financial system might potentially arise. Second, authorities narrow the focus to the subset of non-bank credit intermediation by classifying broad measure into 5 economic functions. In the second step, the narrow measure of shadow banking is measured by excluding self-securitization, absence of credit intermediation, prudential consolidation into a banking group from the broad measure





(classified by economic functions)

Narrow Measure	EF1	EF2	EF3	EF4	EF5	Others
	Collective investment vehicles(MMF, investment funds, trusts)	Finance companies	Brokers and dealers	Credit insurance companies	SPC	Not classified
(excluded)	(absence of credit intermediation)	(prudentially consolidated into a banking group)	(prudentially consolidated into a banking group)	-	(self-securitization)	

3.2 Empirical models

We first use the static panel linear model as a preliminary model. Our empirical model is as follows.

$$y_{it} = x'_{it}\,\beta + \tau_t + \delta_i + e_{it} \quad (1)$$

i and t are the indices of countries and years, respectively. τ_t's denote time effects to capture macroeconomic circumstances. δ_i's are called unobserved country fixed effects, and e_{it}'s are all unobserved idiosyncratic errors(i.i.d). y_{it}'s are the broad measure of shadow banking as a % of GDP of country i in period t. x_{it}'s contain control variables, β is the coefficient vector that we are interested in. Pooled OLS assumes that δ_i is not correlated with x_{it}, that is, $\mathrm{cov}(\delta_i, x_{it}) = 0$, which is quite a strong assumption, to get consistent coefficients. Thus, we estimate models with fixed effects estimator allowing for the correlation between δ_i and x_{it}. While there are two fixed effects estimators including LSDV(Least Squares Dummy Variable estimator), Within-group estimator which are numerically identical(Baltagi, 2013), we use LSDV[9]. Also, time effects and country fixed effects are included in all regressions. We estimate various models which are specified in different ways.

Next, we employ the dynamic panel estimation as follows.

$$y_{it} = \sum_{j=1}^{p} \alpha_j y_{i,t-j} + x'_{it}\,\beta + \tau_t + \delta_i + e_{it} \quad (2)$$

The dynamic model includes lagged dependent variables, $y_{i,t-j}$. It also allows for the correlation between δ_i and x_{it} ($\mathrm{cov}(\delta_i, x_{it}) \neq 0$). We use the generalized method of moments estimator (GMM) developed by Arellano-Bond(1991). We first-difference the model (2) to get rid of country specific effects or any time-invariant country specific variable. Then, we obtain

$$\Delta y_{it} = \sum_{j=1}^{p} \alpha_j \Delta y_{i,t-j} + \Delta x'_{it}\,\beta + \Delta\tau_t + \Delta e_{it} \quad (3)$$

In the differenced model (3), there still exists a correlation[10] between lagged values of dependent variable $\Delta y_{i,t-j}$ and the differenced errors, Δe_{it}. Due to this correlation, standard fixed effects estimator is not consistent, causing the bias (Nickell, 1981). To eliminate the endogeneity problem due to this correlation, the difference GMM by Arellano-Bond(1991) employs instrumental estimation which utilizes the orthogonality conditions between the differenced errors and lagged terms of dependent variable, $\Delta y_{i,t-j}$.[11] The difference idiosyncratic errors, Δe_{it} may show serial

9 In unbalanced panel data, LSDV may suffer from less losses of data compared to Within-Group Fixed effects estimator.
10 Δe_{it} is a function of $e_{i,t-j}$, which causes the correlation with $\Delta y_{i,t-j}$.
11 As T is getting larger, moment conditions also increase. Too many moment conditions can improve the efficiency, but, introduce bias. So it is suggested that a subset of moment conditions be used to take

correlation which can be addressed by adjusting the AR order p. We can test for serial correlation. In $p = 1$, AR(1) model, α should be a positive value[12] with less than 1 to converge to the steady state. If α is close to 1, System GMM(Blundell and Bond, 1998) would be more desirable. In a dynamic model, time effects and country fixed effects are included in all regressions.

4. Empirical results

4.1 Static panel model

The results in Table 4 display the estimates of the static linear model. The estimated results indicate that the size of long-term institutional investors like pension funds and insurance companies contributes to promoting the growth of shadow banking. It implies that the demand of long-term institutional investors for instruments of shadow banking plays a crucial role in the growth of shadow banking.

In addition, long-term market interest rates(10 year Treasury Bond yields) have a negative impact on the shadow banking growth as anticipated, even though they have weak statistical significance. It is because high long-term interest rate discourages a search for high yield. The coefficients of financial crisis dummies are negative, which means that after the financial crisis, shadow banking activities have remained sluggish.

However, the stock market capitalization and the financial development index have a negative impact on the shadow banking growth counter-intuitively, even though income has a positive effect. It would be possible if the big sized stock market means that there are alternatives for high yield. Financial development index relies on Svirydzenka(2016) who creates indices considering the depth, accessibility, and the efficiency of financial markets and the financial institutions in a more comprehensive manner. Though, the index can be insufficient to represent financial innovations favourable to shadow banks over traditional banks. The depth, the accessibility, and the efficiency are measured by mixing stock market size to GDP, net interest margin, stock market turnover ratio, return on equity, and return on assets.

4.2 Dynamic panel model

Table 5 reports the estimates of dynamic panel estimation. The coefficients of lagged dependent variable produce around 0.5, which displays considerable persistence. It is because the instruments with more-than-one-year maturities issued by shadow banking sectors are considerable, while the size of shadow banking is measured as the size of assets of shadow banking sectors.

Looking at the effects which we are interested in, the size of pension funds that represents the demand has a substantial effect on the growth of shadow banking. An additional increase in pension funds as a % of GDP leads to 2.168~2.459%p increase

advantage of this trade-off (Baltagi et al, 2009)

12 Larger than 1 value of alpha means that it goes to infinity without converging to the steady state.

in OFI to GDP ratio. Insurance companies also have a significant effect on shadow banking in interaction term with financial crisis dummies.

Interestingly, as the Originate-to-Distribute model implies, the estimated coefficients of bank size indicates that the growth in asset size of banks has a positive effect on the growth of shadow banking. A 1%p increase in the size of banks as a % of GDP leads to 0.222~0.289%p increase in OFI to GDP ratio. This provides the evidence that the shadow banking growth is accompanied with the growth of the traditional bank.

Meanwhile, the estimates imply that the long-term effect[13] of a 1%p increase in pension funds to GDP ratio leads to 4.5~7.0%p increase in OFI to GDP ratio. In the long run, a 1 %p increase in the bank size as a %p of GDP leads to 0.51~0.66%p increase in the "steady-state" value of shadow banking. It seems quite a reasonable magnitude relative to the sample means, which are 87.6, 36.4, 277.1 for the size of OFI, pension funds, banks as a % of GDP respectively.

Long-run effects on the size of shadow banking Table 3

	Dif-GMM1	Dif-GMM2	Dif-GMM3	Dif-GMM4	Dif-GMM5
Pension Fund (as a % of GDP)	4.504	4.483	4.519	5.461	6.991
Bank (as a % of GDP)	0.507	0.543	0.519	0.660	0.663

The AR(2) test and Hansen test indicate that the over-identifying restrictions implied by GMM procedure are not rejected. If the coefficient of lagged dependent variable is close to unity, difference GMM estimator may suffer from weak identification, in that case, a system GMM(Blundell and Bond, 1998) can be a desirable estimation method. However, in our case, the autoregressive coefficient is far from unity. Table 6 and Table 7 report the estimated results in various Model specifications. These results show by and large similar results as before.

4.3 Comparison with earlier studies

Our results can be compared with those of earlier studies. Aramonte et al(2015) suggest that insurance companies, pension funds, in particular, structured-finance vehicles take higher credit risk when investors expect interest rates to remain low. Banks originate riskier loans that they tend to divest shortly after origination, thus appearing to accommodate other lenders' investment choices. This mechanism is supported by our results that the shadow banking growth is accompanied with the growth of the traditional bank as Originate-to-Distribute model implies. These results are also consistent with the presence of a risk-taking channel of monetary policy as Aramonte et al(2015) mention.

13 In dynamic model, β means short-term effects, long-term effects are calculated from $\frac{\beta_k}{1-\alpha}$ in p = 1, AR(1) model.

Estimation results

LSDV estimates

Table 4

OFI(as a % of GDP)	LSDV1	LSDV2	LSDV3	LSDV4	LSDV5
Crisis dummy(1 if since 2008)	-36.44***	-32.18**	-38.45***	-32.36***	-17.97**
	(11.32)	(13.11)	(11.11)	(9.191)	(8.955)
Treasury Bond yield(10Yr)	-3.296*	-2.136	-3.201*	-1.603	0.144
	(1.936)	(1.917)	(1.909)	(1.747)	(1.828)
Spread(10yr-3M)	1.66	2.622	1.334	0.0465	0.832
	(2.427)	(2.593)	(2.467)	(2.055)	(1.99)
Bank Capital Ratio	2.874	0.559	2.795		
	(3.326)	(2.994)	(3.37)		
Bank Net Interest Margin	1.593				
	(1.322)				
Pension Fund(as a % of GDP)	3.882***	3.755***	3.851***	3.762***	4.249***
	(0.581)	(0.655)	(0.596)	(0.608)	(0.735)
Insurance(as a % of GDP)	1.163***	0.772*	1.104***	1.190***	0.683*
	(0.384)	(0.393)	(0.373)	(0.376)	(0.377)
Bank(as a % of GDP)	0.041	-0.00898	0.0555	0.0732	0.0126
	(0.0764)	(0.067)	(0.0755)	(0.0785)	(0.0768)
Stock Market(as a % of GDP)	-0.288***		-0.282***	-0.265***	-0.248***
	(0.0993)		(0.1)	(0.0874)	(0.0913)
Financial Development Index	-181.9*	-201.0*	-196.2*	-319.9***	
	(102.3)	(108.4)	(105.1)	(111.4)	
log(GDP per capita)	12.30**	14.44**	11.74**	6.22	9.654**
	(5.258)	(5.67)	(4.971)	(5.156)	(4.326)
Time effect	Yes	Yes	Yes	Yes	Yes
Country effect	Yes	Yes	Yes	Yes	Yes
Observations	140	143	141	168	168
Number of Countries	20	20	20	20	20

1 All regressions include country fixed effects and time fixed effects. Robust standard errors in parentheses.

2 significant levels : *** p<0.01, ** p<0.05, * p<0.1

Estimation results

Difference GMM estimates Table 5

OFI(as a % of GDP)	Dif-GMM1	Dif-GMM2	Dif-GMM3	Dif-GMM4	Dif-GMM5
OFI(t-1)	0.454***	0.468***	0.468***	0.603***	0.665***
	(0.056)	(0.066)	(0.062)	(0.068)	(0.046)
Crisis dummy				-39.43**	
				(18.490)	
Treasury Bond yield(10Yr)	-0.34	-0.779	-0.915	0.887	1.86
	(1.518)	(1.733)	(1.724)	(1.268)	(1.353)
Spread(10yr-3M)	-0.767	0.00223	-0.604	-0.652	-0.891
	(1.911)	(2.290)	(2.147)	(2.239)	(1.846)
Bank Capital Ratio	5.481	4.755	5.724		
	(3.534)	(3.347)	(3.721)		
Bank Net Interest Margin	3.694*				
	(1.964)				
Pension Fund(as a % of GDP)	2.459***	2.385***	2.404***	2.168***	2.342***
	(0.605)	(0.634)	(0.624)	(0.487)	(0.646)
Insurance(as a % of GDP)	-0.725	-0.932	-0.591	-1.257	-1.311
	(0.924)	(0.983)	(0.926)	(1.030)	(1.084)
Insurance×Crisis dummy	0.535	0.683	0.584	0.620**	0.715**
	(0.386)	(0.484)	(0.410)	(0.275)	(0.340)
Bank(as a % of GDP)	0.277**	0.289**	0.276**	0.262*	0.222*
	(0.123)	(0.135)	(0.128)	(0.146)	(0.118)
Stock Market(as a % of GDP)	-0.136*		-0.108	-0.0263	-0.038
	(0.080)		(0.080)	(0.048)	(0.042)
Financial Development Index	-64.29	-50.8	-45.66	-193.6	
	(100.6)	(101.7)	(96.8)	(156.9)	
log(GDP per capita)	42.25	45.5	37.31	36.05**	37.87*
	(28.210)	(28.100)	(26.030)	(17.750)	(19.620)
AR(2) (p-value)	0.196	0.632	0.396	0.346	0.221
Time effect	YES	YES	YES	YES	YES
Country effect	YES	YES	YES	YES	YES
Observations	94	97	95	134	134
Number of Countries	20	20	20	20	20

1 All regressions include country fixed effects and time fixed effects. Robust standard errors in parentheses.

2 Difference Hansen tests(Null H : Instruments are valid) are conducted for model 1~5, and all of them are not rejected at 5% significant level.

3 significant levels : *** p<0.01, ** p<0.05, * p<0.1

Estimation results

Difference GMM estimates - 1 Table 6

OFI(as a % of GDP)	Dif-GMM1	Dif-GMM2	Dif-GMM3	Dif-GMM4	Dif-GMM5
OFI(t-1)	0.333***	0.349***	0.348***	0.526***	0.585***
	(0.022)	(0.025)	(0.025)	(0.060)	(0.031)
OFI(t-2)	0.298***	0.317***	0.301***	0.240***	0.268***
	(0.077)	(0.085)	(0.082)	(0.078)	(0.104)
Crisis dummy		-27.16*			-15.15*
		(16.040)			(8.285)
Treasury Bond yield(10Yr)	1.275*	0.629	0.462	1.478	2.619
	(0.741)	(0.922)	(0.945)	(1.071)	(1.666)
Spread(10yr-3M)	-3.164	-2.136	-2.569	-1.785	-1.876
	(2.003)	(2.124)	(2.150)	(2.101)	(1.753)
Bank Capital Ratio	4.554	3.911	4.827		
	(3.168)	(2.893)	(3.344)		
Bank Net Interest Margin	4.307*				
	(2.242)				
Pension Fund(as a % of GDP)	1.777***	1.666***	1.726***	1.767***	1.881***
	(0.372)	(0.363)	(0.376)	(0.463)	(0.552)
Insurance(as a % of GDP)	-0.882	-1.008	-0.723	-1.114	-1.093
	(0.869)	(0.930)	(0.892)	(1.261)	(1.318)
Bank(as a % of GDP)	0.312**	0.314**	0.304**	0.309*	0.256*
	(0.141)	(0.149)	(0.144)	(0.178)	(0.148)
Stock Market(as a % of GDP)	-0.124		-0.0968	-0.0378	-0.0535
	(0.079)		(0.079)	(0.045)	(0.053)
Financial Development Index	-58.1	-45.9	-39.39	-210.7	
	(68.550)	(70.040)	(63.990)	(155.800)	
log(GDP per capita)	35.98	38.58	31.49	40.15*	41.98
	(26.730)	(25.840)	(24.490)	(23.910)	(25.760)
AR(2) (p-value)	0.243	0.276	0.245	0.287	0.237
Time effect	YES	YES	YES	YES	YES
Country effect	YES	YES	YES	YES	YES
Observations	94	97	95	120	120
Number of Countries	20	20	20	20	20

1 All regressions include country fixed effects and time fixed effects. Robust standard errors in parentheses.

2 Difference Hansen tests(Null H : Instruments are valid) are conducted for model 1~5, and all of them are not rejected at 5% significant level.

3 significant levels : *** p<0.01, ** p<0.05, * p<0.1

Estimation results

Difference GMM estimates - 2 Table 7

OFI(as a % of GDP)	Dif-GMM1	Dif-GMM2	Dif-GMM3	Dif-GMM4	Dif-GMM5
OFI(t-1)	0.482***	0.513***	0.503***	0.640***	0.727***
	(0.083)	(0.080)	(0.082)	(0.079)	(0.071)
Treasury Bond yield(10Yr)	-0.935	-0.616	-1.466	0.767	1.569
	(3.149)	(2.978)	(3.075)	(2.796)	(2.827)
Spread(10yr-3M)	-1.073	0.299	-0.731	-0.351	-0.414
	(3.669)	(3.523)	(3.608)	(3.090)	(3.144)
Bank Capital Ratio	5.181	3.688	5.645		
	(3.425)	(3.166)	(3.437)		
Bank Net Interest Margin	3.698				
	(2.735)				
Pension Fund(as a % of GDP)	2.229***	2.110***	2.212***	2.018***	2.244***
	(0.440)	(0.428)	(0.439)	(0.411)	(0.407)
Bank(as a % of GDP)	0.254**	0.204*	0.253**	0.194*	0.143
	(0.120)	(0.111)	(0.120)	(0.105)	(0.105)
Stock Market(as a % of GDP)	-0.196*		-0.165	-0.118	-0.139
	(0.110)		(0.109)	(0.092)	(0.093)
Financial Development Index	-77.43	-52.46	-63.13	-225.2**	
	(112.9)	(107.5)	(112.7)	(94.6)	
log(GDP per capita)	21.63	30.25	21.6	21.07	22.08
	(25.18)	(23.76)	(25.21)	(21.77)	(22.17)
AR(2) (p-value)	0.544	0.735	0.652	0.246	0.213
Time effect	YES	YES	YES	YES	YES
Country effect	YES	YES	YES	YES	YES
Observations	98	103	99	138	138
Number of Countries	20	20	20	20	20

1 All regressions include country fixed effects and time fixed effects. Robust standard errors in parentheses.

2 Difference Hansen tests (Null H : Instruments are valid) are conducted for model 1~5, and all of them are not rejected at 5% significant level.

3 significant levels : *** p<0.01, ** p<0.05, * p<0.1

5. Conclusion

This paper investigates what determines the shadow banking growth using the shadow banking statistics which are recently published in FSB Global Shadow Banking Monitoring Report. Utilizing unbalanced panel data for mainly G20 countries for 2002-2013 periods, we provide the empirical evidence of the static model with fixed effects estimation as well as dynamic panel estimation.

The estimated results imply that the size of pension funds, which represents the demand, has a considerable effect on the growth of shadow banking. Marginal increase in pension funds as a % of GDP leads to 2.168~2.459%p increase in OFI to GDP ratio.

Interestingly, as the Originate-to-Distribute model implies, the estimate of the bank size indicates that the growth in the asset size of banks has a positive effect on the growth of shadow banking. A 1%p increase in the size of banks as a % of GDP leads to 0.222~0.289%p increase in OFI to GDP ratio. This provides the evidence that the shadow banking growth is accompanied with the growth of the traditional bank.

Meanwhile, the estimates imply that the long-term effect of a 1%p increase in pension funds to GDP ratio lead to 4.5~7.0%p increase in OFI to GDP ratio. In the long run, a 1 %p increase in the bank size as a %p of GDP leads to 0.51~0.66%p increase in the "steady-state" value of shadow banking. It is quite a reasonable magnitude relative to the sample means, which are 87.6, 36.4, 277.1 for the size of OFI, pension funds, banks as a % of GDP respectively.

However, we cannot help pointing out some limitations of our empirical analysis. It falls short of the impact analysis of regulatory arbitrages on the shadow banking. We have difficulties in finding indicators or variables to indicate regulatory arbitrages appropriately, while we should admit that our variables used in estimation are exposed to substantial measurement errors. For example, in case of reserve requirements which are referred as an example of regulatory arbitrages, it is not easy to create the variable to indicate advantages of shadow banking relative to deposits of traditional banks. In addition, the reserve requirement ratio depends on the types of deposits, and has little variation to identify the coefficients in the fixed effects estimation. As one can see, a measurement error causes attenuation bias: then it is necessary to pay attention in interpreting the estimates in the panel fixed effects estimation(Angrist and Pischke, 2009). Griliches and Hausman(1986) provide the measurement error in panel data.

Hereafter, there still remain additional work to investigate how effective reserve requirements ratio, appropriate estimates for deposit insurance burden and proxy for financial innovations have an impact on shadow banking growth if we get them.

In addition, if narrow measure data of shadow banking which is measured by following FSB methodology are accumulated in longer term series, it is thought that additional analysis on the determinants of shadow banking can be experimented in various perspectives.

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BANK FOR INTERNATIONAL SETTLEMENTS

Eighth IFC Conference on *"Statistical implications of the new financial landscape"*

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What drives shadow banking? A dynamic panel evidence[1]

SungJun Kim, Bank of Korea

[1] This presentation was prepared for the meeting. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the meeting.

What Drives Shadow Banking?

- A dynamic panel evidence -

SungJun, Kim

The Bank of Korea

Sep.8, 2016

Overview

- Introduction
- Literature review
- Data and Empirical models
- Estimation results
- Conclusion

Introduction

- In the wake of global financial crisis, many studies have focused on the role of the shadow banking in the financial crisis and the meaning on macro-prudential policies.
- However, there have not been that many studies that provide empirical evidence due to the lack of statistics on the shadow banking and the ambiguity on its definition of the shadow banking.
- Recently, more than 10 years of cross-country panel data for mainly G20 countries following the definition and the methodology of FSB can be available after FSB has published the Global Shadow Banking Monitoring Report in the line with the G20 DGI(Data Gaps Initiative).
- This paper provides empirical evidence on the determinants of the shadow banking using these new data series. Also, we provide more rigorous empirical analysis using not only a static model with fixed effects estimation, but also a dynamic panel model.

Literature review

a brief literature review of the determinants of the shadow banking growth.

- As shown in IMF(2014) and Duca (2014), the existing literatures suggest various factors including the demand of institutional investors, regulatory arbitrages, and a search for yield, financial innovations, etc, as a determinant.
- Adrian and Shin(2009) suggest that institutional investors which include pension funds, mutual funds and insurance companies as well as foreign central banks outside the banking system play an important role in shadow banking activities.
  - Banks originate loans and sell them to broker and dealers, hedge funds. The buyers pool and securitize them as types of ABS, CDO, etc, then distribute them to investors with different risk appetites including SIVs, hedge funds, and insurance companies.
- Next, looking at the regulatory arbitrage, deposit-insurance scheme, reserve requirements, and capital requirement rules are mentioned as representative examples of regulatory arbitrages of shadow banking compared to traditional banks.

Data

	Source	Unit of Measurement	Mean	Overall S.D	Between S.D	Within S.D	Min	Max
OFI	FSB	as a % of GDP	87.584	132.210	127.545	39.878	0.519	828.198
Treasury Bond yield(10Yr)	Bloomberg	%	4.483	2.461	2.440	1.056	0.509	13.624
Spread (10yr-3M)	Bloomberg	%	1.652	1.178	0.838	0.999	-1.544	4.890
Bank Capital Ratio	World Bank	%	7.563	2.895	2.796	0.979	3.000	14.600
Bank Net Interest Margin	World Bank	%	3.211	2.185	1.849	1.216	0.140	14.636
Log(GDP per capita)	World Bank	lagged by one time period	9.739	1.169	1.073	0.510	6.175	11.385
Pension Fund	FSB	as a % of GDP	36.431	36.569	36.736	6.591	0.001	156.708
Insurance	FSB	as a % of GDP	38.997	28.299	28.512	6.109	1.254	105.315
Bank	FSB	as a % of GDP	237.070	186.769	184.419	45.026	29.112	815.767
Stock Market	World Bank	as a % of GDP	101.438	85.354	82.743	26.659	14.154	570.155
Financial Development Index	IMF	index	0.685	0.200	0.200	0.040	0.281	1.000

Empirical models

Dynamic Panel Linear model

$$y_{it} = \sum_{j=1}^{p} \alpha_j y_{it-j} + x_{it}'\beta + \tau_t + \delta_i + e_{it} \qquad (1)$$

$$\triangle y_{it} = \sum_{j=1}^{p} \alpha_j \triangle y_{it-j} + \triangle x_{it}'\beta + \triangle \tau_t + \triangle e_{it}$$

- Arellano and Bond(1991) Difference GMM estimator
  - first-difference the model (1) to get rid of country-specific effects
  - employ instrumental estimation which utilizes the orthogonality conditions between the differenced errors and lagged terms of dependent variable

Estimation results in Static panel model

- the size of long-term institutional investors like pension funds and insurance companies contributes to promoting the growth of shadow banking
  - It implies that the demand of long-term institutional investors for instruments of shadow banking plays a crucial role in the growth of shadow banking.
- long-term market interest rates(10 year Treasury Bond yields) have a negative impact on the shadow banking growth as anticipated, even though they have weak statistical significance.
  - It is because high long-term interest rate discourages a search for high yield.
- The coefficients of financial crisis dummies are negative, which means that after the financial crisis, shadow banking activities have remained sluggish.

Estimation results in Static panel model

OFI(as a % of GDP)	LSDV1	LSDV2	LSDV3	LSDV4	LSDV5
Crisis dummy(1 if since 2008)	-36.44***	-32.18**	-38.45***	-32.36***	-17.97**
	(11.32)	(13.11)	(11.11)	(9.191)	(8.955)
Treasury Bond yield(10Yr)	-3.296*	-2.136	-3.201*	-1.603	0.144
	(1.936)	(1.917)	(1.909)	(1.747)	(1.828)
Spread(10yr-3M)	1.66	2.622	1.334	0.0465	0.832
	(2.427)	(2.593)	(2.467)	(2.055)	(1.99)
Bank Capital Ratio	2.874	0.559	2.795		
	(3.326)	(2.994)	(3.37)		
Bank Net Interest Margin	1.593				
	(1.322)				
Pension Fund(as a % of GDP)	3.882***	3.755***	3.851***	3.762***	4.249***
	(0.581)	(0.655)	(0.596)	(0.608)	(0.735)
Insurance(as a % of GDP)	1.163***	0.772*	1.104***	1.190***	0.683*
	(0.384)	(0.393)	(0.373)	(0.376)	(0.377)
Bank(as a % of GDP)	0.041	-0.00898	0.0555	0.0732	0.0126
	(0.0764)	(0.067)	(0.0755)	(0.0785)	(0.0768)
Stock Market(as a % of GDP)	-0.288***		-0.282***	-0.265***	-0.248***
	(0.0993)		(0.1)	(0.0874)	(0.0913)
Financial Development Index	-181.9*	-201.0*	-196.2*	-319.9***	
	(102.3)	(108.4)	(105.1)	(111.4)	
log(GDP per capita)	12.30**	14.44**	11.74**	6.22	9.654**
	(5.258)	(5.67)	(4.971)	(5.156)	(4.326)
Time effect	Yes	Yes	Yes	Yes	Yes
Country effect	Yes	Yes	Yes	Yes	Yes
Observations	140	143	141	168	168
Number of Countries	20	20	20	20	20

1 All regressions include country fixed effects and time fixed effects. Robust standard errors in parentheses.

2 significant levels : *** p<0.01, ** p<0.05, * p<0.1

Estimation results in Dynamic panel model

- The coefficients of lagged dependent variable produce around 0.5, which displays considerable persistence.
  - It is because the instruments with more-than-one-year maturities issued by shadow banking sectors are considerable, while the size of shadow banking is measured as the size of assets of shadow banking sectors.
- the size of pension funds that represents the demand has a substantial effect on the growth of shadow banking.
  - An additional increase in pension funds as a % of GDP leads to 2.168~2.459%p increase in OFI to GDP ratio.
- Insurance companies also have a significant effect on shadow banking in interaction term with financial crisis dummies.

Estimation results in Dynamic panel model

- As the Originate-to-Distribute model implies, the estimated coefficients of bank size indicates that the growth in asset size of banks has a positive effect on the growth of shadow banking.
  - A 1%p increase in the size of banks as a % of GDP leads to 0.222~0.289%p increase in OFI to GDP ratio.
  - This provides the evidence that the shadow banking growth is accompanied with the growth of the traditional bank.
- long-term effect13 of a 1%p increase in pension funds to GDP ratio leads to 4.5~7.0%p increase in OFI to GDP ratio.
  - In the long run, a 1 %p increase in the bank size as a %p of GDP leads to 0.51~0.66%p increase in the "steady-state" value of shadow banking.

Estimation results in Dynamicl panel model

OFI(as a % of GDP)	Dif-GMM1	Dif-GMM2	Dif-GMM3	Dif-GMM4	Dif-GMM5
OFI(t-1)	0.454***	0.468***	0.468***	0.603***	0.665***
	(0.056)	(0.066)	(0.062)	(0.068)	(0.046)
Crisis dummy				-39.43**	
				(18.490)	
Treasury Bond yield(10Yr)	-0.34	-0.779	-0.915	0.887	1.86
	(1.518)	(1.733)	(1.724)	(1.268)	(1.353)
Spread(10yr-3M)	-0.767	0.00223	-0.604	-0.652	-0.891
	(1.911)	(2.290)	(2.147)	(2.239)	(1.846)
Bank Capital Ratio	5.481	4.755	5.724		
	(3.534)	(3.347)	(3.721)		
Bank Net Interest Margin	3.694*				
	(1.964)				
Pension Fund(as a % of GDP)	2.459***	2.385***	2.404***	2.168***	2.342***
	(0.605)	(0.634)	(0.624)	(0.487)	(0.646)
Insurance(as a % of GDP)	-0.725	-0.932	-0.591	-1.257	-1.311
	(0.924)	(0.983)	(0.926)	(1.030)	(1.084)
Insurance×Crisis dummy	0.535	0.683	0.584	0.620**	0.715**
	(0.386)	(0.484)	(0.410)	(0.275)	(0.340)
Bank(as a % of GDP)	0.277**	0.289**	0.276**	0.262*	0.222*
	(0.123)	(0.135)	(0.128)	(0.146)	(0.118)
Stock Market(as a % of GDP)	-0.136*		-0.108	-0.0263	-0.038
	(0.080)		(0.080)	(0.048)	(0.042)
Financial Development Index	-64.29	-50.8	-45.66	-193.6	
	(100.6)	(101.7)	(96.8)	(156.9)	
log(GDP per capita)	42.25	45.5	37.31	36.05**	37.87*
	(28.210)	(28.100)	(26.030)	(17.750)	(19.620)
AR(1) (p-value)	0.197	0.187	0.196	0.139	0.181
AR(2) (p-value)	0.196	0.632	0.396	0.346	0.221
Time effect	YES	YES	YES	YES	YES
Country effect	YES	YES	YES	YES	YES
Observations	94	97	95	134	134
Number of Countries	20	20	20	20	20

1 All regressions include country fixed effects and time fixed effects. Robust standard errors in parentheses.

2 Difference Hansen tests(Null H : Instruments are valid) are conducted for model 1~5, and all of them are not rejected at 5% significant level.

3 significant levels : *** p<0.01, ** p<0.05, * p<0.1

Conclusion

- This paper investigates what determines the shadow banking growth using unbalanced panel data for mainly G20 countries for 2002-2013 periods.
- we provide empirical evidence which suggests that long-term institutional investors including pension funds, insurance companies play a pivotal role in the growth of shadow banking. Our findings also indicate that the size of banks' assets has a statistically significant effect on the growth of shadow banking as the Originate-to-Distribute Model implies.
- some limitations of our empirical analysis
  - It falls short of the impact analysis of regulatory arbitrages on the shadow banking.
  - We have difficulties in finding indicators or variables to indicate regulatory arbitrages appropriately

Conclusion

Thank you