Based on GSADF model - To study the impact of surging cross-border capital flows and their internal structure on economic growth

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Abstract. This paper measures surges using the Generalized Supremum Augmented Dickey-Fuller (GSADF) model based on capital flows data for 64 economies from 2003:Q1 to 2020:Q4. Then, this paper examines the impact of surges and the internal structure (abnormal liability flows and abnormal asset flows) on economic growth in the recipient economy, and further investigate the heterogeneity among economies with different levels of economic development. This paper finds that surges can positively contribute to economic growth in the recipient economy. In terms of the internal structure of surges, overall, abnormal liability flows have a significant positive effect on economic growth, while abnormal asset flows have no significant effect. Emerging economies perform in line with the overall, while economic growth in developed economies is positively boosted by both abnormal liability flows and abnormal asset flows together. Our research has important reference value for China to prevent risks of surges and their inherent structural changes.

Keywords: capital flow surges, economic growth, heterogeneity.

1. Introduction

With the deepening of globalization, international financial exchanges have become more frequent and the scale of cross-border capital flows has been constantly growing. Since the 1997 Asian financial crisis, there has been a sharp increase in extreme capital flows movements, so the topic of abnormal capital flows has been studied widely. As a type of abnormal flows, the capital flow surges refer to the abnormally sharp increase in net capital inflows (Borio and Disyatat, 2010, 2015; Broner et al., 2013)[1-3]. If a country experiences surges, its macroeconomy may experience changes unrelated to domestic fundamentals. Converse (2018)[4] also suggests that surges would lead to uncertainty in domestic financial markets and trigger changes in economic growth rates. From the pathway of occurrence, the surge in net capital flows is driven by either a sharp increase in total capital inflows or a sharp decrease in total capital outflows, so this is expressed as the difference between total capital outflows and total capital inflows (Davis et al., 2021)[5]. The former represents abnormal liability flows, defined as the behavior of foreign investors who increase investment in the recipient economy. The latter represents abnormal asset flows, defined as the behavior of domestic investors who repatriate large amounts of foreign assets and send revenues back to their home countries. Thus, the internal structure of surges consists of abnormal liability flows and abnormal asset flows, and both of them would affect the macro economic.

Moreover, there may be heterogeneity in the magnitude of macroeconomic shocks from surges for different types of economies. And with the continuous development of China's economy and financial market, studying the impact of surges on different types of economies can help provide long-term recommendations for China to guard against the risks of surges. Reinhart and Reinhart (2008)[6] find that banking, currency, and inflation crises caused by surges are significantly more likely to occur in emerging economies than in developed economies.

Currently, existing literature has explored the impact of surges on economic growth of the recipient economy, but seldom studies the impact of the internal structure, namely the abnormal liability flows and abnormal asset flows, on economic growth. For the measurement of surges, most literature depends on pre-setting thresholds, which cannot guarantee objectivity. In addition, most scholars have

only studied the impact of surges on emerging economies, ignoring the heterogeneity among economies with different levels of economic development.

Considering this, this paper first applies the GSADF model to detect surges and the internal structure during the periods of 2003:Q1–2020:Q4 for 64 economies. The GSADF model is completely data-driven and can effectively remove volatility and identify real surges (bubble behavior) without the need of setting a threshold in advance (Cheung et al., 2015)[7]. Second, this paper develops a linear model to investigate how surges and the internal structure affect economic growth of the recipient economy. Finally, this paper discusses the differences in the above effects between emerging and developed economies.

2. Theoretical Analysis and Hypothesis

Abnormal capital flows usually will affect economic growth of the recipient economy (Cheng and Li, 2020)[8]. For example, abnormal capital flows may lead to uncertainty in financial markets and cause investment reallocation among production departments, thus affecting economic growth rate (Converse, 2018)[4]. As an important type of abnormal capital flows, surges are driven by one or both of the abnormal liability flows and abnormal asset flows (Ghosh et al., 2014)[5]. Some scholars found that the abnormal liability flows will positively contribute to economic growth of the recipient economy (Fu, 2012)[9]. Besides, abnormal asset flows will positively contribute to economic growth in the recipient economy (Gou et al., 2018)[10].When the above hypotheses hold, surges will also positively affect economic growth of the recipient economy, due to the positive contribution of abnormal liability flows and abnormal asset flows. This leads to hypothesis 1.

Hypothesis 1: Surges, abnormal liability flows, and abnormal asset flows all have a positive effect on economic growth of the recipient economy.

3. Data and Empirical Strategy

3.1. Measurement of surges, abnormal liability flows, and abnormal asset flows

This paper utilizes quarterly data on net capital inflows, gross capital inflows, and gross capital outflows for 64 economies[1] from 2003:Q1 to 2020:Q4. Then, this paper detect surges, abnormal liability flows, and abnormal asset flows using the Generalized Supremum Augmented Dickey-Fuller (GSADF) model proposed by Philips et al. (2015)[11].

3.1.1 Data

This paper uses the financial account (excluding international reserves) taken from the Balance of Payments (BOP) database of the International Monetary Fund (IMF). It includes four items: direct investments, portfolio investments, financial derivatives, and other investments. Gross capital inflows and outflows are the sums of liabilities and assets of the four items, respectively. And net capital inflows are the difference between gross capital inflows minus gross capital outflows.

[1] Based on the representativeness of the sample and the availability of data, this paper select 64 economies for empirical study and divides them into emerging and developed economies based on 2015 World Economic Outlook (WEO) proposed by IMF. Thus, this paper obtain 27 developed economies and 37 emerging economies. Among them, developed economies include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, China, Iceland, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Panama, Portugal, Singapore, Slovenia, Spain, Sweden, Switzerland, United Kingdom, and United States. Emerging economies include: Argentina, Armenia, Bangladesh, Bolivia, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Ecuador, Georgia, Guatemala, Hungary, India, Indonesia, Kazakhstan, Korea, Kyrgyz Republic, Latvia, Lithuania, Malaysia, Mexico, Nicaragua The following countries are also represented in the list of countries that are members of the United Nations, such as: China, Peru, Philippines, Poland, Romania, Russia, Slovakia, South Africa, Sri Lanka, Thailand, Ukraine, Vietnam.

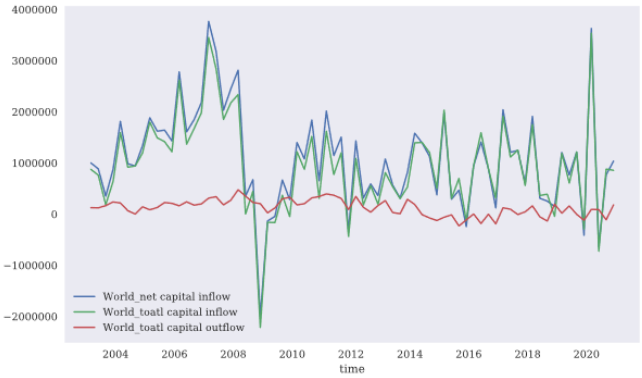

Figure 1 Surges, abnormal liability flows, and abnormal asset flows for 64 economies

Source: IMF Balance of Payments Database

Figure 1 shows the gross capital outflows, gross capital inflows, and net capital inflows for 64 economies. As can be seen, they all increased sharply and then decreased rapidly around the 2008 financial crisis. It implies that surges, abnormal liability flows, and abnormal asset flows may have occurred in that period. Additionally, during the 2019-2020 COVID-19, net capital inflows and gross capital inflows fluctuated drastically, which implies surges and abnormal liability flows may also have happened.

3.1.2 Methodology for detecting surges

Take the measurement of surges as an example. First, this paper takes the 4-quarter moving sum of net capital inflows to reduce the seasonality effect. Second, based on the GSADF model, this paper assumes that the net capital inflows obey a stochastic process with a drift term. To obtain the GSADF statistic, this paper applies a series of unit root tests by rolling and expanding the sample sequence. To be more specific, this paper recursively changes the initial point of the estimation window forward, and recursively expand the sample size forward. If the GSADF statistic is greater than the critical value of 90% confidence obtained by Monte Carlo Simulation, an explosive process is considered to have occurred. Then, this paper uses the Backward Supremum Augmented Dickey-Fuller (BSADF) model to determine the occurrence and termination points of the explosion. Finally, this paper applies the HP Filter to eliminate negative explosive processes and retain only positive ones as surges. Similarly, the abnormal liability flows and abnormal asset flows are detected using gross capital inflows and gross capital outflows data, respectively.

3.1.3 Measurement results

Results show that 64 economies experienced 1,193 surges, 1,360 abnormal liability flows, and 1,474 abnormal asset flows during the period from 2003:Q1 to 2020:Q4.

Figures 2-4 respectively show the percentages of economies experiencing abnormal asset flows, abnormal liability flows, and surges in each period.

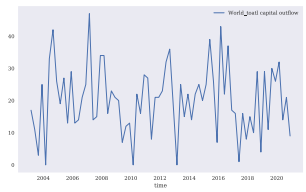

Figure 2 Proportion of economies experiencing abnormal asset flows

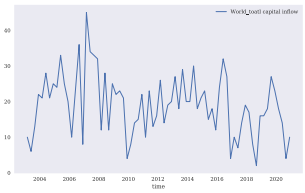

Figure 3 Proportion of economies experiencing abnormal liability flows

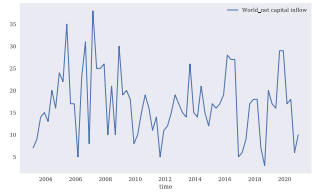

Figure 4 Proportion of economies experiencing surges

3.2. Model

To investigate the impact of surges and the internal structure on economic growth of the recipient economy, this paper constructs the following models.

$$GROW_{it} = \beta_{net1} Xnet_{it} + \beta_2 Z_{it} + \lambda_i + \mu_t + \varepsilon_{it} \quad (1)$$

$$GROW_{it} = \beta_{in1} Xin_{it} + \beta_2 Z_{it} + \lambda_i + \mu_t + \varepsilon_{it} \quad (2)$$

$$GROW_{it} = \beta_{out1} Xout_{it} + \beta_2 Z_{it} + \lambda_i + \mu_t + \varepsilon_{it} \quad (3)$$

Where i and t denote economy and time, respectively. GROW is GDP growth rate. Z is a vector of control variables, including foreign direct investment level (FDI), government expenditure rate (GER), capital formation rate (CFR), trade openness degree (TOD), and inflation rate (CPI). λ_i is the individual effect. μ_t is the time effect. ε_{it} is the residual term.

X is a dummy variable for whether the event occurs, taking 1 if it occurs and 0 otherwise. Xnet corresponds to surges, measured by net capital inflows. Xin corresponds to the abnormal liability flows, measured by gross capital inflows. And Xout corresponds to the abnormal asset flows, measured by gross capital outflows.

3.3. Variables

The dependent variable is the economic growth rate (GROW), which is obtained by differencing the logarithmic form of the seasonally adjusted GDP data. It represents the growth of a country's economy to a certain extent.

The core independent variable is the dummy variable (X) indicating whether the event occurs or not, which is measured by the GSADF model. If the event occurs, X takes 1, otherwise, it takes 0. This paper uses Xnet, Xin, and Xout to denote whether surges, abnormal liability flows and abnormal asset flows happen, respectively.

Referring to the studies of Li (2018)[12] and Cheng (2020)[8], this paper screened and selected the following control variables: Foreign direct investment level (FDI), Government expenditure rate (GER), Capital formation rate (CFR), Trade openness degree (TOD), and Inflation rate (CPI).

3.4. Data and Descriptive Statistics

This paper applies quarterly balance panel data for 64 economies from 2003:Q1 to 2020:Q4, including 37 emerging economies and 27 developed economies. Data sources and specific measurement methods of the variables are shown in Table 1.

Table 1 Data sources

Variable	Data Source	Measurement Methods and Indicators Used
GDP growth rate ($GROW$)	IMF`s IFS database	Difference of the logarithmic form of the seasonally adjusted GDP in real domestic currency.
Dummy variable indicating whether an event occurs or not (X)	IMF`s BOP database	Gross capital inflows and gross capital outflows are total liabilities and assets under the financial account (excluding international reserves). Based on the above data, X is measured by the GSADF model.
Foreign direct investment level (FDI)	UNCTAD	Difference between foreign direct investment inflows and outflows as a share of GDP in the BOP.
Government expenditure rate (GER)	IMF`s IFS database	Seasonally adjusted public sector (generally government and public corporations) final consumption expenditure in real domestic currency as a share of GDP.
Capital formation rate (CFR)	IMF`s IFS database	Seasonally adjusted gross fixed capital formation in real domestic currency as a share of GDP.
Trade openness degree (TOD)	IMF`s IFS database	Seasonally adjusted total import and export of goods and services in real domestic currency as a share of GDP.
Inflation rate (CPI)	IMF`s IFS database	Difference of the logarithmic form of CPI.

To avoid the interference of outliers, all variables were winsorized at the 1% level. The descriptive statistics of the variables after winsorization are shown in Table 2.

Table 2 Descriptive statistics of variables

Variable	Observations	Mean	Standard deviation	Minimum Value	Maximum Value
$GROW$	4,536	0.702	1.554	-6.697	5.505
FD	4,284	0.430	0.285	0.003	0.923
FDI	4,388	-1.323	4.653	-28.310	5.953
GER	4,536	0.168	0.053	0.053	0.273
CFR	4,464	0.244	0.105	0.127	0.982
TOD	4,392	0.901	0.532	0.259	3.279
CPI	4,392	0.008	0.011	-0.017	0.050

For regressions (1)-(6), the Hausman test shows that the two-way fixed effect model is more appropriate. The variance inflation factors (*VIF*) are all less than 2.5, so there is no serious problem of multicollinearity. Moreover, the stationarity test shows that the government expenditure rate (*GER*) and capital formation rate (*CFR*) are first-order unit root processes and other variables are stationary. Therefore, this paper takes first-order differences for *GER* and *CFR*, and leave the rest of the variables untreated.

4. Empirical Results

4.1. Impact of surges and the internal structure on economic growth

Based on the two-way fixed effect model and the IV-GMM model, this paper explores the impact of surges and the internal structure (abnormal liability flows and abnormal asset flows) on economic growth of the recipient economy. And results of the baseline regressions are shown in Table 3.

Columns (1)-(3) are the estimation using the two-way fixed effect model. Results show that the effect of surges on economic growth is positive at the 10% significance level. It indicates that the influx of capital flows can effectively supplement domestic capital and improve the financial market operation efficiency, thus promoting economic growth. Moreover, the estimated coefficient of abnormal liability flows on economic growth is positive at the 1% significance level, while the corresponding coefficient of abnormal asset flows is insignificant. It implies that as for the internal structure, abnormal liability flows can significantly and positively promote economic growth, but abnormal asset flows have no significant effect.

Considering the possible two-way causality between surges and economic growth, this paper further applies the IV-GMM model for estimation to correct the endogeneity problem. Columns (4)-(6) and (7)-(9) are results of IV-GMM estimation using the first order lag term and the first and second order lag terms of the dummy variable as instrumental variables, respectively. With the endogeneity problem considered, the baseline findings do not change significantly.

Table 3 Overall impact of surges and the internal structure on economic growth

Model	FE			IV-GMM(1)			IV-GMM(1-2)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Xnet$	0.069*			0.098*			0.075*		
	(1.87)			(1.67)			(1.65)		
Xin		0.110***			0.339***			0.308***	
		(2.80)			(5.83)			(5.26)	
$Xout$			-0.014			-0.032			-0.055
			(-0.45)			(-0.54)			(-0.91)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observation	3709	3709	3709	3704	3704	3704	3650	3650	3650
R^2	0.356	0.357	0.340	0.112	0.123	0.108	0.095	0.118	0.104

Note: Numbers in parentheses are the t value. ***, ** and * indicate significant at the 1%, 5% and 10% levels, respectively. The same is below.

4.2. Robustness test

This paper conducts robustness tests by expanding the sample, i.e., using raw data without winsorization for the above regressions. Table 4 are results of using raw data to explore the impact of surges and the internal structure on economic growth.

Table 4 Overall impact of surges and the internal structure on economic growth: based on raw data

Model	FE			IV-GMM(1)			IV-GMM(1-2)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Xnet$	0.124**			0.176**			0.158**		
	(2.34)			(2.25)			(2.02)		
Xin		0.124**			0.356***			0.309***	
		(2.20)			(4.60)			(3.93)	
$Xout$			-0.089			-0.051			-0.077
			(-1.61)			(-0.64)			(-0.95)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observation	3709	3709	3709	3704	3704	3704	3650	3650	3650
R^2	0.256	0.256	0.253	0.113	0.119	0.110	0.110	0.115	0.107

5. Comparison Between Emerging and Developed Economies

Generally, developed economies are capital exporters while emerging economies are capital importers (Chen, 2018)[13], and they differ in the level of economic development and financial market openness, so the above effects may be different in the two types of economies. Thus, this paper divide 64 economies into 37 emerging economies and 27 developed economies and explore similarities and differences between them by grouped regressions.

Table 5 shows the estimation for emerging economies, where findings of the two-way fixed effect model and the IV-GMM model are consistent. Taking columns (4)-(6) as examples, the coefficient denoting the impact of surges on economic growth is positive at the 5% significance level, the coefficient corresponding to abnormal liability flows is positive at the 1% significance level, and the coefficient corresponding to abnormal asset flows is insignificant.

This suggests that for emerging economies, surges can mitigate the inefficiency of domestic capital flows, thereby contributing to economic growth. Moreover, the investment capacity of domestic residents in emerging economies is relatively weak, and the volume of funds repatriated by domestic residents is smaller than that invested by foreign investors. Thus, abnormal liability flows contribute significantly and positively to economic growth, while abnormal asset flows have no significant impact.

Table 5 Impact of surges and internal structure on economic growth: based on emerging economies sample

Model	FE			IV-GMM(1)			IV-GMM(1-2)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Xnet$	0.124**			0.250**			0.220*		
	(2.38)			(1.98)			(1.76)		
Xin		0.191***			0.354***			0.324***	
		(3.38)			(4.21)			(3.77)	
$Xout$			-0.074			-0.105			-0.219
			(-1.34)			(-1.62)			(-1.55)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observation	2078	2078	2078	2077	2077	2077	2048	2048	2048
R^2	0.367	0.369	0.366	0.084	0.136	0.115	0.084	0.134	0.081

Table 6 shows the results for developed economies. Columns (1)-(2) denote that based on the two-way fixed effect model, core coefficients in regressions (1)-(2) are insignificant, which may be due to the endogeneity problem. Therefore, further estimation is performed using the IV-GMM model. As shown in columns (4)-(6) and (7)-(9), the corresponding coefficients of surges, abnormal liability

flows, and abnormal assets flow are positive at the 10%, 1%, and 1% significance levels, respectively, regardless of whether the first order lag term or the first and second order lag terms are used as the instrumental variables.

This suggests that surges also have a positive impact on economic growth for developed economies. In terms of the internal structure, both abnormal liability flows caused by foreign investors and abnormal asset flows caused by domestic investors contribute positively to economic growth.

Table 6 Impact of surges and internal structure on economic growth: based on developed economies sample

Model	FE			IV-GMM(1)			IV-GMM(1-2)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Xnet$	0.020			0.140*			0.129*		
	(0.41)			(1.87)			(1.72)		
Xin		0.074			0.398***			0.371***	
		(1.43)			(5.58)			(5.19)	
$Xout$			0.081			0.270***			0.271***
			(1.49)			(3.50)			(3.54)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observation	1631	1631	1631	1627	1627	1627	1602	1602	1602
R^2	0.447	0.447	0.447	0.233	0.279	0.283	0.218	0.265	0.270

The similarity between emerging and developed economies lies in the significant positive effect of surges on economic growth, while the difference is reflected in the manifestation of internal structural affecting economic growth: (1) economic growth in emerging economies is positively boosted by abnormal liability flows, but not significantly affected by abnormal asset flows, (2) economic growth in developed economies is positively influenced by both abnormal liability flows and abnormal asset flows. This suggests that both emerging and developed economies are highly dependent on foreign investors` behaviors, while developed economies are also significantly influenced by domestic investors` behaviors due to their high investment literacy.

6. Conclusion and Policy Suggestions

Our findings show that there is a positive effect of surges on economic growth of the recipient economy. Although both emerging and developed economies are highly dependent on cross-border capital flows, they differ in the manifestation of the internal structure of surges affecting economic growth. Economic growth in emerging economies is positively boosted by abnormal liability flows only, while developed economies are positively affected by both abnormal liability flows and abnormal asset flows.

Based on our findings, and taking into account the current financial openness of China, this paper proposes the following policy suggestions: First, as China's economy develops and financial openness increases, China will gradually transform from an emerging economy to a developed economy. In the process of transformation, its economic growth will gradually convert from being significantly affected by only abnormal liability flows to both abnormal liability flows and abnormal asset flows. Since the impact of abnormal asset flows on China's economic growth will grow significantly, the government should strengthen the supervision of domestic investors` behaviors, thereby preventing financial risks arising from abnormal asset flows.

In addition, as an emerging economy, China depends highly on abnormal liability flows led by foreign investors, which makes it hard to withstand the potential risk of sudden withdrawal of foreign divestment. Therefore, the government should reduce the dependence on capital flows by deepening the financial system reform, encouraging the innovation of domestic financial products, etc.

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