Research on the Mitigating Effect of Supply Chain Finance on Financing Constraints of SMEs
—Empirical Analysis Based on GEM Listed Companies

Zijing Huang[1,*]

[1] School of Economics and Management, Shanghai Maritime University, Shanghai, China
*Corresponding author. Email: zz2266718@163.com

ABSTRACT

This paper studies the mitigating effect of supply chain finance on SMEs' financing constraints using data of GEM-listed companies from 2013 to 2020 for empirical analysis. Furthermore, SMEs are grouped based on their regions, and the quality of information disclosed to investigate the differences in the mitigating effects of supply chain finance on the financing constraints. The study results demonstrate that SMEs' financing constraints in China are widespread, especially in the non-eastern region and SMEs with lower disclosure quality. Supply chain finance can mitigate the financing constraints of SMEs, which is more significant among SMEs in the eastern region of China and SMEs with lower information disclosure quality. Finally, some suggestions are proposed based on the research conclusions to mitigate the financing constraints of enterprises.

Keywords: Supply Chain Finance, Financing Constraints, SME, GEM.

1. INTRODUCTION

SMEs play a vital role in China's economic development and improve China's national income, increase employment, promote industrial upgrading, and maintain social stability. However, China's SMEs generally have problems such as small asset scale, high operation risk, opaque information disclosure, and poor reputation, which leads to the current situation of financing difficulties and becomes a significant obstacle to the development of SMEs. Relevant state departments have taken many measures to solve the financing difficulties of SMEs. As a new financial service mainly for the financing of SMEs, supply chain finance came into being and developed rapidly. In this context, it is critical to investigate if supply chain finance may help SMEs mitigate their financing constraints.

Supply chain finance has been studied by scholars worldwide in relation to enterprise financing constraints. Based on a qualitative examination of supply chain finance, Berger and Udell (2006) proposed that supply chain finance could be used to mitigate financing difficulties for SMEs [1]. Several SMEs face financing limitations, which can be mitigated by supply chain finance according to Zhang Weibin and Liu Ke (2012) [2]. The research subject for Gu Qun (2016) was technology-based SMEs. According to the findings, supply chain finance is able to significantly mitigate the financing limitations of technology-based SMEs. A greater mitigating effect can be observed in areas with a high level of financial development and for non-state-owned enterprises [3]. Wang Liqing and Hu Ying (2018) argued that combining industry and finance, along with strategic commitment, can positively regulate the impact of supply chain finance on corporate financing limitations [4]. Zhu Weidong and Li Heyong (2021) used the life cycle theory to show that companies' degree of financing limitations in different life cycles is quite varied. Supply chain finance may help SMEs overcome their financing challenges in both growth and recession.

After referring to the relevant literature at home and abroad, this research uses the companies listed on the GEM from 2013 to 2020 as an empirical sample to investigate the mitigating effect of supply chain finance on SMEs' financing constraints. Further, it compares the financing constraints of SMEs in diverse regions and with different information disclosure quality, as well as the effect of supply chain finance on the financing constraints. The possible contribution of this research is to select the data from GEM-listed companies and test the differences in the mitigating effect of supply chain finance on enterprises' financing constraints in different

regions and with different levels of information disclosure, which will add to the research findings in this field.

2. THEORETICAL ANALYSIS AND RESEARCH HYPOTHESIS

2.1. Financing Constraints of SMEs

On the one hand, commercial banks usually set higher loan standards for SMEs and raise loan interest rates to compensate for potential risks and losses in order to reduce their debt risk. This is due to SMEs' common problems of small operation scale, high operation risk, poor credit level, low quality and transparency of information disclosure, and fewer physical assets available for a mortgage. On the other hand, SMEs cooperate less with large enterprises, so few large enterprises can provide strong loan guarantees for SMEs. Besides, due to the non-standard mortgage transfer market in China, it is difficult for SMEs to realize the collateral that can be used for loans, which makes commercial banks more cautious and stricter in the examination of loan applications of SMEs. Moreover, due to the low bargaining power of SMEs, they often delay the collection or prepayment when dealing with large enterprises, so the demand for funds from SMEs is also more robust. This paper proposes hypothesis 1 based on the above analysis:

H_1: Financing constraints are prevalent in China's SMEs.

2.2. The Mitigating Effect of Supply Chain Finance on Financing Constraints of SMEs

For one thing, supply chain finance can revitalize the current assets of SMEs. The loan collateral of SMEs has changed from physical assets to prepayment, inventory, and accounts receivable under the mode of supply chain finance, which solves the problem of SMEs' lack of collateral. Furthermore, supply chain finance can reduce borrowing costs by alleviating the information asymmetry between SMEs and financial institutions. Zhou Hui et al. (2017) proposed that supply chain finance alleviates corporate financing constraints by reducing information asymmetry [6]. According to Fu Weiqiong and Bai Shizhen. (2021), supply chain finance can compensate for agricultural SMEs' lack of credit, decrease the information asymmetry between commercial banks and companies, and alleviate the financing difficulties of enterprises [7]. Through the above analysis, this paper puts forward hypothesis 2:

H_2: Supply chain finance can significantly mitigate the financing constraints of SMEs.

The eastern region of China has a more developed economy, a higher level of financial development, a perfect credit market, and the enterprise financing methods in the eastern region are more prosperous than those in the non-eastern region. Therefore, the financing constraints of SMEs in the eastern region may be less than those in the non-eastern region. In addition, Li Baobao et al. (2016) proposed that the level of financial development has a positive regulatory effect on supply chain finance to mitigate corporate financing constraints [8]. Financial development will moderate the impact of information asymmetry, improve the capital allocation rate, expand the scale effect, revitalize enterprise funds and increase enterprise financing channels. Therefore, supply chain finance may play a more vital role in mitigating the financing limitations in the eastern region of China. Through the above analysis, this paper puts forward hypothesis 3:

H_3: Compared with the eastern region, SMEs in the non-eastern region of China face more serious financing constraints. Supply chain finance plays a more significant role in mitigating the financing constraints of SMEs in the eastern region.

High-quality information disclosure can make the credit channels of enterprises unobstructed. From the perspective of information asymmetry, the quality of enterprise information disclosure changes inversely with the information asymmetry in the credit market. As long as enterprise information disclosure is good, the degree of information asymmetry in the credit market will be low. At this time, enterprises are easy to obtain external financing. However, obtaining external finance is difficult and costly when the information disclosure quality of enterprises is poor. Companies in this situation are more likely to develop supply chain finance and finance with a high credit level across the entire supply chain and core enterprises. At this juncture, the mitigating effect of supply chain finance on enterprise financing limitations can better function. Through the above analysis, this paper puts forward hypothesis 4:

H_4: Compared with SMEs with higher information disclosure quality, SMEs with lower information disclosure quality face more severe financing constraints. Supply chain finance plays a more significant role in mitigating the financing constraints of enterprises with lower information disclosure quality.

3. RESEARCH DESIGN

3.1. Model Setting

The cash-cash flow sensitivity model introduced by Almeida, Campello, and Weisbach (2004) is used to assess the degree of financing constraints [9]. The model shows that enterprises with financing constraints tend to withdraw part of their cash flow for future investment needs. Therefore, enterprises with financing constraints show cash-cash flow sensitivity.

Build the following model to measure the financing constraints of enterprises:

$$\Delta Cash_{i,t}=\alpha_0+\alpha_1 CF_{i,t}+\alpha_2 Size_{i,t}+\alpha_3 Growth_{i,t}+\alpha_4 CE_{i,t}+\alpha_5 \Delta NWC_{i,t}+\Sigma Year+\Sigma Industry+\varepsilon_{i,t} \tag{1}$$

Based on the model (1), add SCF and CF×SCF to model (2) to measure the mitigating effect of supply chain finance on financing constraints of enterprises:

$$\Delta Cash_{i,t}=\alpha_0+\alpha_1 CF_{i,t}+\alpha_2 SCF_{i,t}+\alpha_3 CF_{i,t}\times SCF_{i,t}+\alpha_4 Size_{i,t}+\alpha_5 Growth_{i,t}+\alpha_6 CE_{i,t}+\alpha_7 \Delta NWC_{i,t}+\Sigma Year+\Sigma Industry+\varepsilon_{i,t} \tag{2}$$

The measurement of supply chain financial indicators refers to Yao Wangxin et al. (2017), measured by the ratio of the sum of short-term borrowing and notes payable to total assets [10].

3.2. variable Description

Table 1. Variable description

Variable name	Variable symbol	Variable definition
Changes in cash holding	ΔCash	Net changes in cash and cash equivalents / Total assets at the end of the year
Cash flow	CF	Net cash generated from operating activities / Total assets at the end of the year
Supply chain finance development level	SCF	(Short-term borrowing + Notes payable) / Total assets at the end of the year
Scale of enterprise	Size	Natural logarithm of the total assets at the end of the year
Growth of enterprise	Growth	Growth rate of operating income
Capital expenditure	CE	(Cash paid for construction of fixed assets, intangible assets and other long-term assets - Cash received from disposal) / Total assets at the end of the year
Changes in non-cash operating capital	ΔNWC	Changes in Non-cash operation capital / Total assets at the end of the year

3.3. Data sources and sample selection

Companies listed on the GEM of Shenzhen Stock Exchange from 2013 to 2020 are used as the sample in this article. The financial data comes from CSMAR, and the data on the quality of information disclosure comes from the website of the Shenzhen Stock Exchange. In data consolidation, the samples of incomplete data, financial, ST/*ST, and companies listed after December 31, 2012, were excluded, and all continuous variables were undergone 1% Winsor processing. Eventually, the panel data of 331 GEM listed companies for eight years were obtained, with 2648 sample observations.

4. ANALYSIS OF EMPIRICAL RESULTS

4.1. Descriptive Statistical Analysis

According to the descriptive statistical results in Table 2, the mean value of ΔCash is -0.005, and the standard deviation is 0.085. There is a clear distinction between the maximum and the minimum. The mean value of CF is 0.038, and the standard deviation is 0.059, demonstrating significant variances in how different companies on the GEM operate and develop. The mean value of SCF is 0.111, the standard deviation is 0.104, and the gap between the maximum and the minimum is 0.419, demonstrating that the degree of supply chain finance development of different GEM-listed companies

varies greatly. There are some differences between other variable data, but there are no extreme values.

Table 2. Descriptive statistical analysis

Variable	Obs	Mean	Std. Dev	Min	Max
ΔCash	2648	-0.005	0.085	-0.284	0.259
CF	2648	0.038	0.059	-0.129	0.206
SCF	2648	0.111	0.104	0.0000	0.419
Size	2648	21.562	0.819	19.907	23.662
Growth	2648	0.210	0.397	-0.535	2.079
CE	2648	0.043	0.041	-0.015	0.208
ΔNWC	2468	0.009	0.092	-0.263	0.309

4.2. Correlation Analysis

According to the results of variable correlation analysis in Table 3, the correlation coefficient between ΔCash and CF is significantly positive at the level of 1%, which can preliminarily prove the rationality of H1. Moreover, the correlation coefficient between ΔCash and Size and between ΔCash and Growth is significantly positive at 1%. Besides, the correlation coefficient between ΔCash and CE and between ΔCash and ΔNWC is significantly negative at 1%, which is in line with the theoretical expectation. There is no substantial multicollinearity if the correlation coefficient between variables is less than 0.5.

Table 3. Correlation analysis

	ΔCash	CF	SCF	Size	Growth	CE	ΔNWC
ΔCash	1.000						
CF	0.208***	1.000					
SCF	0.081***	-0.203***	1.000				
Size	0.222***	-0.011	0.293***	1.000			
Growth	0.137***	-0.029	-0.017	0.100***	1.000		
CE	-0.184***	0.140***	0.010	-0.026	0.039**	1.000	
ΔNWC	-0.348***	-0.101***	-0.228***	-0.075***	0.069***	-0.076***	1.000

Note: *, **, *** represent significant at the 10%, 5%, and 1% levels, respectively, similarly hereinafter.

4.3. Regression Analysis

As shown in Table 4, the total sample regression coefficient of the explanatory variable CF in model (1) is 0.305, which is significantly positive at the 1% level. Besides, the coefficients of other control variables are significant at the 1% level as well. The above results prove that China's SMEs have a high cash-cash flow sensitivity, that is, they face severe financing limitations. H_1 is verified. After adding quantitative indicators of supply chain finance to the model, the coefficient of CF in model (2) is significantly positive at the 1% level, showing that SMEs still face considerable financing difficulties. The coefficient of the interaction term between cash flow and supply chain financial development level (CF×SCF) is -0.725, which is significantly negative at the 1% level, demonstrating that supply chain finance is able to significantly mitigate the financing limitations of SMEs. H_2 is verified.

The regression results grouped by region in Table 4 show that the coefficient of CF in model (1) is significantly positive at the 1% level in both eastern and non-eastern regions, indicating severe financing constraints for SMEs in both regions. However, the coefficient of CF in the non-eastern region is more significant than that in the eastern region, indicating that SMEs face more serious financing constraints in the non-eastern region than in the eastern region. The coefficient of the interaction term between cash flow and supply chain financial development level (CF×SCF) in model (2)

is -0.808 in the eastern region group, which is significantly negative at the 1% level, but not in the non-eastern region group. The above results indicate that supply chain finance can significantly mitigate the financing constraints of SMEs in the eastern region, but cannot significantly mitigate the financing constraints of SMEs in the non-eastern region. H_3 is verified.

The regression results grouped by the quality of information disclosure in Table 4 show that the coefficient of CF in model (1) is significantly positive at the 1% level no matter whether the quality of information disclosure is high or low. In contrast, the coefficient of CF in the group with low quality of information disclosure is more significant than that in the group with high quality of information disclosure. The findings demonstrate that there are obvious financing constraints no matter whether the information disclosure quality of SMEs is high or low, and enterprises with low quality of information disclosure face more serious financing constraints. Moreover, the coefficient of the interaction term between cash flow and supply chain financial development level (CF×SCF) in model (2) is -0.819 in the low information disclosure quality group, which is significantly negative at the 1% level not in the high information disclosure quality group. It proves that supply chain finance has abilities to significantly mitigate SMEs' financing constraints with low information disclosure quality but cannot significantly mitigate the financing constraints of SMEs with high information disclosure quality. H_4 is verified.

Table 4. regression results

Variable	Total sample		Eastern region group		Non-eastern region group		High information disclosure quality group		Low information disclosure quality group	
	Model (1)	Model (2)	Model (1)	Model (2)	Model (1)	Model (2)	Model (1)	Model (2)	Model (1)	Model (2)
CF	0.305***	0.388***	0.291***	0.380***	0.377***	0.467***	0.246***	0.304***	0.309***	0.410***
	(11.481)	(9.960)	(9.419)	(8.167)	(6.471)	(5.621)	(3.763)	(2.881)	(10.283)	(9.313)
SCF		0.027*		0.026		0.022		-0.050		0.037**
		(1.680)		(1.340)		(0.666)		(-0.740)		(2.275)
CF×SCF		-0.725***		-0.808***		-0.716		-0.877		-0.819***
		(-3.064)		(-2.877)		(-1.442)		(-1.402)		(-3.147)

Size	0.019***	0.019***	0.019***	0.019***	0.018***	0.018***	0.029***	0.035***	0.018***	0.017***
	(10.054)	(9.212)	(8.649)	(8.087)	(5.148)	(4.794)	(4.104)	(3.424)	(9.676)	(8.812)
Growth	0.031***	0.031***	0.030***	0.030***	0.034***	0.034***	0.017	0.018	0.031***	0.030***
	(7.776)	(7.726)	(5.760)	(5.737)	(5.870)	(5.906)	(1.478)	(1.592)	(7.173)	(7.137)
CE	-0.499***	-0.496***	-0.512***	-0.508***	-0.455***	-0.452***	-0.521***	-0.483***	-0.508***	-0.506***
	(-12.544)	(-12.476)	(-11.075)	(-10.982)	(-5.631)	(-5.605)	(-5.835)	(-5.037)	(-11.800)	(-11.733)
ΔNWC	-0.322***	-0.318***	-0.329***	-0.326***	-0.305***	-0.300***	-0.579***	-0.590***	-0.281***	-0.274***
	(-11.888)	(-11.278)	(-10.431)	(-10.019)	(-5.744)	(-5.202)	(-7.820)	(-7.812)	(-10.421)	(-9.865)
Constant	-0.429***	-0.429***	-0.449***	-0.456***	-0.399***	-0.399***	-0.628***	-0.745***	-0.421***	-0.414***
	(-10.977)	(-10.265)	(-9.813)	(-9.311)	(-5.733)	(-5.476)	(-4.367)	(-3.626)	(-11.074)	(-10.334)
Year FE	YES									
Industry FE	YES									
Adjust r²	0.282	0.284	0.287	0.289	0.249	0.249	0.430	0.433	0.263	0.266
Observations	2648	2648	2040	2,040	608	608	392	392	2256	2256

4.4. Robustness Test

To further test the robustness of the results, this paper regresses model (1) and model (2) using the total asset growth rate (TAGR) instead of the operating income growth rate (Growth) as the measuring index of future investment opportunities. The total sample robustness test results show that the regression coefficient of CF in model (1) is significantly positive at the 1% level, and the coefficient of the interaction between cash flow and supply chain financial development (CF×SCF) in model (2) is significantly negative at the level of 1%, which is basically consistent with the original regression results. The coefficient significance level of the interaction term between cash flow and supply chain financial development level (CF×SCF) of model (2) in the eastern region group decreased from 1% to 5% in the group regression results in Table 5. In contrast, other variables' coefficient symbols and significance levels are roughly consistent with the original regression results. The research conclusions do not change substantially, indicating that the empirical results are stable.

Table 5. Robustness test results

Variable	Total sample		Eastern region group		Non-eastern region group		High information disclosure quality group		Low information disclosure quality group	
	Model (1)	Model (2)	Model (1)	Model (2)	Model (1)	Model (2)	Model (1)	Model (2)	Model (1)	Model (2)
CF	0.323***	0.404***	0.311***	0.391***	0.386***	0.488***	0.268***	0.291***	0.329***	0.428***
	(12.874)	(11.193)	(10.940)	(9.307)	(6.412)	(5.515)	(4.433)	(2.936)	(11.514)	(10.428)
SCF		0.047***		0.042**		0.050		-0.074		0.059***
		(3.105)		(2.416)		(1.441)		(-1.288)		(3.793)
CF×SCF		-0.640***		-0.658**		-0.743		-0.522		-0.733***
		(-2.891)		(-2.590)		(-1.421)		(-0.936)		(-2.984)
Size	0.010***	0.009***	0.010***	0.009***	0.010***	0.008**	0.012***	0.017**	0.010***	0.009***
	(5.963)	(5.038)	(5.069)	(4.522)	(2.946)	(2.305)	(2.729)	(2.579)	(5.750)	(4.669)
Growth	0.083***	0.083***	0.086***	0.086***	0.079***	0.079***	0.132***	0.132***	0.077***	0.078***
	(14.516)	(14.687)	(13.147)	(13.295)	(7.125)	(7.163)	(7.175)	(6.985)	(13.123)	(13.325)
CE	-0.493***	-0.492***	-0.507***	-0.506***	-0.445***	-0.439***	-0.542***	-0.504***	-0.498***	-0.497***
	(-13.580)	(-13.572)	(-11.970)	(-11.951)	(-5.934)	(-5.874)	(-7.691)	(-6.414)	(-12.188)	(-12.133)
ΔNWC	-0.307***	-0.298***	-0.318***	-0.310***	-0.271***	-0.258***	-0.575***	-0.589***	-0.264***	-0.251***
	(-11.692)	(-10.758)	(-10.430)	(-9.769)	(-5.220)	(-4.489)	(-7.757)	(-7.975)	(-10.224)	(-9.311)
Constant	-0.245***	-0.229***	-0.247***	-0.239***	-0.239***	-0.215***	-0.273***	-0.394***	-0.253***	-0.230***
	(-7.100)	(-6.290)	(-6.222)	(-5.744)	(-3.483)	(-2.938)	(-3.083)	(-2.833)	(-7.034)	(-6.055)
Year FE	YES									
Industry FE	YES									
Adjust r²	0.366	0.368	0.374	0.376	0.329	0.329	0.548	0.551	0.342	0.345
Observations	2648	2648	2040	2,040	608	608	392	392	2256	2256

5. CONCLUSIONS

5.1. Research Conclusions

Based on the data of Shenzhen Stock Exchange GEM listed companies, this paper studies the mitigating effect of supply chain finance on the financing constraints of SMEs. The results indicate that financing constraints are typical in China's SMEs, and supply chain finance can mitigate the financing constraints of SMEs. Furthermore, due to disparities in the regions where enterprises are located and the quality of information disclosed, SMEs in the non-eastern region of China and those with lower quality of information disclosure suffer more severe financing constraints. Supply chain finance plays a more significant role in mitigating the financing constraints of SMEs in the eastern region of China and with lower quality of information disclosure. At the same time, it is less significant in mitigating the financing constraints of SMEs in the non-eastern region of China and with high quality of information disclosure.

5.2. Suggestions

Firstly, enterprises and financial institutions should be encouraged to participate in the supply chain financial system by the government. Furthermore, the government should improve relevant laws and regulations and standardize SMEs', financial institutions', and other supply chain members' behavior. Moreover, the government should improve the supervision mechanism and supervise the legitimacy of the behavior of enterprises, financial institutions, and other subjects to prevent all kinds of risks and ensure the efficient operation and development of supply chain finance.

Secondly, SMEs should improve their business conditions and the quality of information disclosure, minimize information asymmetry with financial institutions and improve their credit level. In addition, SMEs can secure funding guarantees and strengthen their creditability by keeping long-term and solid cooperative relationships with key firms and supply chain partners.

Thirdly, different policies should be implemented in different regions. It is imperative to speed up China's economic development, especially in the non-eastern region, as well as the construction and improvement of the credit market. It is also necessary to develop supply chain finance further in the eastern region. In addition, due to the small number of SMEs in the non-eastern region, financing is more complex, and the mitigating effect of supply chain finance is not significant. So the government should increase support for SMEs in the non-eastern region to improve their financing difficulties.

REFERENCES

[1] Allen N. Berger, Gregory F. Udell. A More Complete Conceptual Framework for SME Finance[J]. Journal of Banking & Finance, 2006, 30(11): 2945-2966. DOI: 10.1016/j.jbankfin.2006.05.008

[2] Zhang Weibin, Liu Ke. Can the Development of Supply Chain Finance Reduce Financing Constraints of SMEs ——Empirical Analysis Based on SMEs [J]. Economic Science,2012(03):108-118. DOI: 10.19523/j.jjkx.2012.03.010

[3] Gu Qun. An Empirical Study on the Relationship between Supply-Chain Finance and Financial Constraints: The Evidence from Technology-Based SMEs [J]. Collected Essays on Finance and Economics,2016(05):28-34.   DOI: 10.13762/j.cnki.cjlc.20151223.001

[4] Wang Liqing, Hu Ying. Supply Chain Finance and Corporate Financing Constraints ——An Adjusting Role Analysis Based on the Combination of Industry and Finance and Strategic Commitment [J]. China Business and Market, 2018,32(06):122-128. DOI: 10.14089/j.cnki.cn11-3664/f.2018.06.013

[5] Zhu Weidong, Li Heyong. Supply Chain Finance and Financing Constraints of SMEs——From the Perspective of Enterprise Life Cycle [J]. Commercial   Accounting,2021(09):4-8.   DOI: 10.3969/j.issn.1002-5812.2021.09.002

[6] Zhou Hui, Tan Yue, Yan Bo. Supply Chain Finance and Enterprise Financing Constraints: Effect , Mechanisms and Mediation Factors [J]. Commercial Research,2017(09):163-169. DOI: 10.13902/j.cnki.syyj.2017.09.022

[7] Fu Weiqiong, Bai Shizhen. Effect of Supply Chain Finance on Easing Financing Constraints of Small and Medium-sized Agricultural Enterprises[J]. Journal of Northwest A&F University (Social Science Edition),2021,21(02):140-151. DOI: 10.13968/j.cnki.1009-9107.2021.02.17

[8] Li Baobao, Li Tingting, Geng Chengxuan. Supply Chain Finance and Financing Constraints of SMEs — Evidence from Small and Medium-Sized Listed Manufacturing Companies [J]. East China Economic Management,2016,30(11):174-179. DOI: 10.3969/j.issn.1007-5097.2016.11.025

[9] Heitor Almeida, Murillo Campello, Michael S. Weisbach. The Cash Flow Sensitivity of Cash[J]. The journal of finance,2004, 59(4): 1777-1804. DOI: 10.2139/ssrn.345840

[10] Yao Wangxin, Xia Juan, Sun Tingting. A Study on Financing Constraint and its Mitigation in Hi-Tec SMEs in the View of Supply Chain Financing[J].

Science   &   Technology   Progress   and
Policy,2017,34(04):105-110.   DOI:
10.6049/kjjbydc.2016050181