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INTERCONNECTIONS AND INTERDEPENDENCIES OF ECONOMIC DEVELOPMENT AND SHADOW BANKING SECTOR IN DEVELOPING AND TRANSITIONAL ECONOMIES

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Abstract. The research objective is defined as the identification and confirmation of empirical relationships between shadow banking activities and economic development in developing and transitional economies to establish a theoretical basis for minimizing potential risks associated with shadow banking. The methodological design is based on a quantitative approach, implemented through correlation-regression analysis and ARIMA forecasting methods. The research findings confirm Hypothesis 1: China's shadow banking is closely interconnected with the country's economic development. However, Hypothesis 2 (the reduction of shadow banking in China contributes to per capita GDP growth) is only supported for specific structural elements of shadow banking that contribute to economic overheating. In contrast, for other structural elements, such as entrusted loans, a strong direct correlation exists, promoting a positive impact of shadow banking on the country's economic development. This highlights the need for a highly balanced state policy to minimize shadow banking risks. The research results can be valuable for professionals in public administration and academic researchers, particularly in terms of shaping future research directions.

Keywords: banking system, correlation, entrusted loans, regression, shadow banking.

JEL Classification: C53, E59, F63.

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1. Introduction

At the beginning of the third millennium, the rapid growth of information technology, which became a powerful driver of globalization, brought about significant changes in nearly all spheres of human activity. In the financial market, these processes have led to an exceptionally swift expansion of a distinct form of financial intermediation known as shadow banking (Claessens et al., 2012). Shadow banking has rapidly gained global significance and the capability to influence various aspects of the global and national economies. By the start of the third decade of the 21st century, there has been a noticeable trend where, in many countries, the scale of the shadow banking sector has reached comparability with that of the traditional banking system (Fong et al., 2021). This can be attributed to the considerably greater flexibility of non-bank financial intermediaries, which are not bound by stringent regulatory frameworks. The reduction of government regulation, on the one hand, provides

the shadow banking sector with additional advantages for rapid growth in comparison to the conventional banking system (Anagnostopoulos, 2018). Notably, the most profitable and risky services of non-bank financial institutions are often associated with asset securitization, derivatives markets, and to some extent, "virtual finance" (Milic, 2021). On the other hand, the absence of government regulation significantly elevates the risks posed by the shadow banking sector, both for the financial system and the economy, especially during periods of economic downturn, as central banks lack mechanisms to influence the operations of various non-bank financial institutions (Sever, 2022).

The shadow banking sector holds particular significance for developing and transitional economies, primarily due to the underdeveloped state of their conventional banking systems and their heightened vulnerability to financial shocks. This underscores the heightened attention of financial market practitioners and academic researchers towards the formation of the banking system and shadow banking sector in the People's Republic of China. China's national economy combines elements of both planned and market economies, and the scale of its national economy can create significant risks for the global financial market (Allen & Gu, 2021). Furthermore, some researchers have noted that the shadow banking sector in China imposes less stringent requirements, facilitating specific financial operations for economic entities that may not access certain financial services within the regulated banking segment (Elliott et al., 2015). However, several scholars, both within and outside China, are concerned about the potential negative consequences of a shadow banking crisis, as they observe tendencies within the Chinese economy towards overheating, characterized by the emergence of "bubbles" in stock and real estate markets (Hou et al., 2018).

The heightened relevance and urgency of the issue of shadow banking sector growth in developing and transitional economies became particularly pronounced following the COVID-19 pandemic and the subsequent global economic crisis. This crisis can be seen as a groundbreaking exogenous global economic event unprecedented in human history. The profound impacts of the COVID-19 pandemic on individual national economies and the worldwide economic landscape have spurred a clear societal call for the pursuit of sustainable development. Sustainability has taken on a paramount role, both on a micro-level, encompassing individual enterprises and their specific operations, and on a macro-level, spanning industries, national economies, and intergovernmental economic alliances. This has led to increased attention directed towards the least regulated and least predictable segment of the financial market – shadow banking.

However, despite the significant importance of the shadow banking sector, there are several gaps in the academic literature, primarily stemming from the very nature of shadow banking. Its inherent characteristics restrict the accessibility of objective and precise statistical information, and the industry is relatively closed off to research activities. Consequently, this study aims to address these academic gaps concerning the fundamental relationships and interdependencies between the shadow banking sector and the economic development of countries with transitional and developing economies. This research aims to provide an empirically grounded foundation for the minimization of significant risks associated with shadow banking and the sustainable development of the financial sector amidst turbulent economic conditions.

2. Literature review

An analysis of theoretical sources reveals that the significance and particular relevance of shadow banking issues in turbulent economic conditions have led to a substantial body of scientific research dedicated to shadow banking (Arora & Zhang, 2019; Hachem, 2018; Shah et al., 2023). Despite the de facto existence of the shadow banking sector for some time, the active conceptualization of this term began only in the 21st century, when economic globalization created conditions for the exponential growth of shadow banking. This has given rise to several distinctive features, including significant gaps in academic research, an underdeveloped theoretical foundation, and a somewhat nascent conceptual framework. Indeed, the accelerated growth of the shadow banking sector has spurred a social demand for applied research, while the theoretical basis remains insufficiently developed (Avgouleas & Xu, 2017; Gabor, 2018; Liu, 2019). Thus, despite increased academic interest, at the time of this study, there was still no universally accepted definition of shadow banking (Claessens et al., 2012; Elliott et al., 2015). In contemporary scholarly literature, the most frequently used definition is the one put forth by the Financial Stability Board in its 2011 Recommendations, which defines shadow banking as "credit intermediation involving entities and activities outside the regular banking system" (Financial Stability Board, 2011). However, this definition has been subject to deserved criticism for its overly broad approach and lack of precision (Claessens et al., 2012; Elliott et al., 2015). The rising research interest in issues about the shadow banking sector of the People's Republic of China has led to an increasing global popularity of the definition put forth by the People's Bank of China. This definition offers clarification on the local characteristics of shadow banking development in China. According to this definition, the Chinese shadow banking system is understood as "credit intermediation involving entities and activities outside the regular banking system, serving to provide liquidity and credit transformation, and capable of generating sources of systemic risk or regulatory arbitrage" (People's Bank of China, 2013). While this definition provides more specificity, it does so in a narrow context, considering the intricacies of the formation of China's shadow banking system, and may not remain applicable to other shadow banking systems.

A widely accepted definition defines the shadow banking sector as "financial intermediaries that engage in maturity transformation, credit intermediation, and liquidity provision without direct access to central bank liquidity or public sector credit guarantees" (Pozsar et al., 2012). However, the authors of this definition have repeatedly noted its narrow focus and the need for further development of the conceptual framework of shadow banking (Claessens et al., 2012; Pozsar et al., 2012). In this article, the shadow banking sector is understood as financial, including credit, intermediation conducted outside the conventional banking system, with the potential to pose a systemic risk to the financial system.

The principal methodologies and tools of shadow banking are depicted in Figure 1.

As we observe, the shadow banking sector is formed by a diverse array of non-bank financial institutions, including credit agencies, hedge funds, investment funds, and trusts. These institutions offer various financial services to clients. Additionally, the shadow banking sector encompasses financial institutions associated with underground criminal organizations, facilitating illicit financial activities, including money laundering, terrorism financing, and illegal drug trafficking (Lin et al., 2018; Alqodsi, 2021).

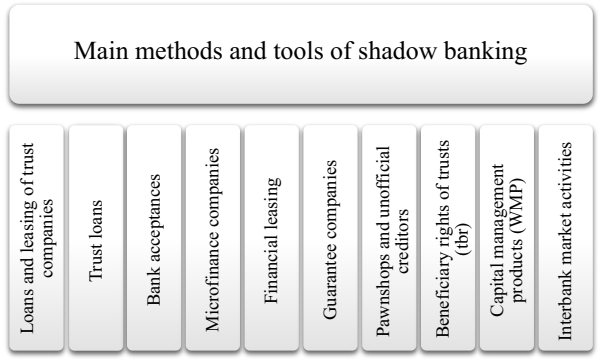


Figure 1. Main methods and instruments of shadow banking (source: developed by the authors based on Elliott et al., 2015)

The distinct features of China's banking sector have been underscored by contemporary academic researchers on numerous occasions. These include a high level of state monopoly, limiting the share of private and foreign banks (Chen et al., 2020), and an extremely high level of non-performing loans, which is a specific characteristic of the Chinese banking sector (Łasak et al., 2019). By the tradition of state capitalism and party-directed governance, China's largest state-owned banks serve state-owned enterprises, conglomerates, and major private businesses (Tan, 2017). This allows capital-intensive Chinese enterprises to enhance their international competitiveness and continue their foreign expansion (Le et al., 2021). However, the distortion of market competition in the capital market over the years has led to the emergence of shadow financing mechanisms, which are not only utilized by the private sector but also by state-owned enterprises. Small and medium-sized enterprises, facing difficulties in obtaining funds for development, have relied on informal financing and various non-bank financial institutions, thus contributing to the rapid growth of the private sector, despite the limited availability of financial resources (Tsai, 2017; Woyames Dreher, 2020).

One of the most distinctive features of the Chinese banking system is the development of the shadow banking system, a collective of non-bank financial institutions that intermediate in the financing of households and businesses in the real economy. This system operates outside the direct control and regulation of official supervisory authorities (Vasudevan, 2021; Yang et al., 2019). The specific characteristics of the formation of China's banking system have also shaped the traits of the shadow banking sector. The shadow banking sector in China is relatively simple, with limited prevalence of instruments such as securitized assets and derivatives. Furthermore, while not being a part of the formal banking system, the shadow banking sector is subject to oversight by regulatory bodies that have demonstrated both susceptibility to significant risks and the ability to effectively mitigate these risks (Elliott et al., 2015). The main players in the shadow sector in China are informal lenders: trust companies, investment funds, and leasing firms. Banks act as intermediaries which act mainly through the off-balance-sheet operations (Wu, 2023).

Shadow banking in China shares many features with other countries, such as credit creation and regulatory arbitrage, while some of them are unique to the Chinese financial and regulatory system. Taking into account the different credit creation processes (credit money

and non-monetary mechanisms), the Chinese shadow banking system should be divided into two categories: shadow banking and traditional shadow banking (Sun, 2019). China's shadow banking: Bank's shadow and traditional shadow banking). The shadow banking system in China is fundamentally different from the shadow banking system in developed economies (such as Europe and America) in terms of its origin, mechanisms, and risk profile (Shah et al., 2023). The main source of funding for shadow banking in advanced economies is mutual funds, and the underlying assets are subprime loans and other illiquid financial claims, as well as products such as asset securitization and repo (Nath & Chowdhury, 2021). In advanced economies, shadow banking refers mainly to traditional shadow banking, which transfers credit money. In contrast, shadow banking in China refers mainly to shadow banks, which are based on credit money created by expanding liabilities with loan-like assets (Sun, 2019; Wang et al., 2022).

At the moment, there is no unequivocal attitude towards the shadow banking sphere either at the level of the government or financial market actors in China. Many politicians refer to shadow banks as a product of strict state control over lending to Chinese enterprises (Zhang & Wan, 2017). Some studies highlight the ability of the shadow banking industry to transform free cash into investment resources characterized by high returns and efficiency. Now, at a time when China's economy is transitioning to a domestic consumption growth model, the need for huge amounts of investment comes to the fore (Wu et al., 2021).

It is worth noting that the authorities in China initially supported the development of shadow banking, recognizing its role in sustaining high economic growth rates, enhancing investment potential, and expanding the real estate market. However, in recent times, the Chinese government has initiated measures to reduce the share of shadow banking (Jiang & Fang, 2022; Pellegrini et al., 2022). Nevertheless, as evidenced by the analysis of literature sources, contemporary economic literature lacks a sufficient amount of empirically confirmed information regarding the relationships between shadow banking and a country's economic growth.

Therefore, the primary motivation for this research stems from the established societal demand for establishing empirically confirmed relationships and interdependencies between shadow banking and a country's economic development, combined with the insufficient development of this issue in contemporary scientific literature. Nevertheless, the analysis of literature sources has allowed the formulation of the following scientific hypotheses: (H1) shadow banking in China is closely interconnected with the country's economic development; (H2) a reduction in shadow banking in China contributes to an increase in GDP per capita.

This research aims to establish and empirically confirm the fundamental relationships between shadow banking and economic development in countries with developing and transitional economies to provide a theoretical basis for minimizing potential risks associated with shadow banking. The achievement of this aim became possible through the systematic resolution of the following research objectives: (1) analyze theoretical sources on the research issue; (2) develop the methodological design of the research and determine its primary information sources; (3) pilot the proposed methodological design using the example of shadow banking in China; (4) process and interpret the results.

3. Materials and methods

The research relies on the methods of correlation regression analysis and scenario modelling. The data on shadow banking in China is taken for the last 21 years (2001–2021). The study includes several stages.

In the first stage, a correlation analysis of the components of China's shadow banking sector was conducted based on the data provided in the reports of Moody's Investors Service (Moody's Investors Service, 2022). The calculation was performed in the RStudio software, the computing environment used to build a correlation matrix and visualize the elements. The initial data for the correlation analysis is shown in Table 1.

Table 1. Baseline data for the study (source: formed by the authors based on data from Macrotrends LLC, 2022; Moody's Investors Service, 2022)

Period	Trust loans, RMB trillion	Entrusted loans, RMB trillion	Undiscounted bankers' acceptances, RMB trillion	Assets funded by WMPs/AMPs, RMB trillion	Loans by finance companies, RMB trillion	Informal lending, RMB trillion	Others, RMB trillion	Shadow banking, RMB trillion	GDP per capita, USD
2001	0.3	0.9	0.6	0.1	0.2	0.4	0.1	2.6	1.053
2002	0.4	1.1	0.8	0.3	0.2	0.4	0.1	3.3	1.149
2003	0.5	1.1	0.9	0.3	0.2	0.4	0.2	3.6	1.289
2004	0.6	1.3	1.1	0.3	0.4	0.4	0.2	4.3	1.509
2005	0.7	1.5	1.3	0.5	0.4	0.5	0.3	5.2	1.753
2006	0.8	1.6	1.6	0.6	0.4	0.5	0.3	5.8	2.099
2007	0.8	1.9	1.6	1	0.6	0.7	0.3	6.9	2.694
2008	1	2.3	1.9	1.1	0.6	0.7	0.3	7.9	3.468
2009	1.3	3.3	1.7	0.9	0.7	0.7	0.3	8.9	3.832
2010	1.6	4.3	2.9	1.2	1.1	0.8	0.6	12.5	4.55
2011	1.7	5	3.4	2.8	1.9	0.9	0.9	16.6	5.614
2012	3	5.2	6.1	4	1	3.4	1.3	23.9	6.301
2013	4.9	7.2	6.9	6.7	2.2	3.4	1.8	33.1	7.02
2014	5.3	9.3	6.8	11	2.4	3.4	2.8	40.8	7.636
2015	5.4	10.9	5.9	21.4	2.6	3.4	3.8	53.4	8.016
2016	6.2	13.2	3.9	30.3	2.9	3.4	4.6	64.5	8.094
2017	8.5	14	4.4	26.5	3.1	3.4	5.8	65.6	8.817
2018	7.9	12.4	3.8	24.4	3.2	3.4	6.3	61.3	9.905
2019	7.4	11.4	3.3	23.4	3.3	3.4	6.8	59	10.144
2020	6.3	11.1	3.5	24.7	3.4	3.4	6.8	59.2	10.409
2021	6	11	3.8	24.15	3.55	3.4	6.8	58.7	12.556

The second stage of the study involved regression analysis of the relationships between the components of shadow banking and GDP per capita in China, which resulted in a multiple regression model represented by the following equation:

$$GDPpc = \beta_1 \cdot TL + \beta_2 \cdot EL + \beta_3 \cdot UBA + \beta_4 \cdot AF + \beta_5 \cdot LFC + \beta_6 \cdot IL + \beta_7 \cdot Oth, \quad (1)$$

where *GDPpc* is per capita gross domestic product (in USD); TL is Trust loans (RMB trillion); EL is Entrusted loans (RMB trillion); UBA is Undiscounted bankers' acceptances (RMB trillion); AF is Assets funded by WMPs/AMPs (RMB trillion); LFC – loans by finance companies; IL – informal lending; Oth is Others (RMB trillion).

The regression model has several assumptions. If m experimental points (X_1, Y_1); (X_2, Y_2); ..., (X_m, Y_m), where m denotes pairs of observation, are obtained for *Y*, which depends randomly on *X*, then to find a functional dependence of *Y* from *X* in the polynomial regression analysis one can use the following polynomial equation for Y_r:

$$Y_r = f(X) = C_0 + C_1 \cdot X + C_2 \cdot X^2 + \ldots + C_n \cdot X_n^n, \quad (2)$$

where C_0, C_1, C_2, ..., C_n are constant coefficients and n is the degree of the polynomial.

The coefficients C_0, C_1, C_2, ..., C_n were defined by the method of least squares (LOS) (Hadigol & Doostan, 2018).

The quality of the model was assessed by the determination index (determination coefficient when $n = 1$) R^2 and the average approximation error *ME*. They are determined by the following formulas:

$$R^2 = 1 - \frac{\sum_{i=1}^{m} (Y_i - Y_{ri})^2}{\sum_{i=1}^{m} (Y_i - \overline{Y})^2}; \quad (3)$$

$$ME = \frac{1}{m} \sum_{i=1}^{m} \left| \frac{(Y_i - Y_{ri})}{Y_i} \right| \cdot 100(\%), \quad (4)$$

where Y_i are experimental values of *Y* at X_i; Y_{ri} – the value of the polynomial (1) at X_i; $\overline{Y}$ – average for Y_1, Y_2, ..., Y_m. The closer the value of R^2 is to one, the better the regression model, while the value $ME \leq 7\%$ also indicates a satisfactory choice of model with the initial data. Meanwhile, to assess the significance of the regression model for data from *m* pairs of numbers, the authors compare the actual value of Fisher's criterion *F* and the theoretical value of F_a at a certain level of significance (*a*). If *F* is greater than F_a, the regression model is considered significant for this level of significance, otherwise, it is not significant.

The actual *F*-ratio is determined as follows:

$$F = \frac{R^2}{(1 - R^2)} \cdot \frac{m - n - 1}{n}. \quad (5)$$

The parameter *n* in (4) is the number of degrees of freedom v_1 for the factor sum of squares and ($m - n - 1$) is the number of degrees of freedom v_2 for the residual sum of squares. The theoretical values of the *F*-criterion can be calculated using the beta distribution function:

$$I_x(a,b) = \frac{1}{B(a,b)} \int_0^x t^{a-1} (1-t)^{b-1} dt, \quad (6)$$

where $0 \le x \le 1$, the segment in which $I_x(a, b)$ is defined; a and b are parameters; $B(a, b)$ is Euler beta function (Bock et al., 2020):

$$B(a,b) = \int_0^1 t^{a-1}(1-t)^{b-1}\,dt. \tag{7}$$

The theoretical value of F_a for the significance level of a at v_1 and v_2 is defined using the beta distribution function, which has the following form:

$$I_x\left(\frac{v_1}{2}, \frac{v_2}{2}\right) = 1-a, \tag{8}$$

where x has the value of

$$x = \frac{v_1 F_a}{v_2 + v_1 F_a}. \tag{9}$$

The quality of the regression model was assessed by the average error of approximation and the determination index (determination coefficient when $n = 1$) in Rstudio. The model's significance was assessed using the actual (F) and theoretical Fisher criteria (F_a) at $a = 0.05$.

In the third stage, the authors forecast the components of shadow banking and GDP per capita in China. The RStudio software was used to conduct this stage. This allowed analyzing time series and visualize the predicted volumes of the studied indicators, as well as confidence intervals. The Box-Jenkins ARIMA model was used to make the forecasts. The ARIMA model of nonstationary time series X_t is as follows:

$$\Delta^d X_t = c + \sum_{i=1}^{p} a_i \Delta^d X_{t-i} + \sum_{j=1}^{q} b_j \varepsilon_{t-j} + \varepsilon_t, \tag{10}$$

ε_t – stationary time series; c, a_i, b_j – model parameters; Δ^d – mathematical operator of time series differences of order d (successive selection of d-fold first-order differences – first from the time series, then from the obtained first-order differences, and so on). Also, the model under study is interpreted as ARIMA (p, d, q) – model with d unit roots. At $d = 0$, one has the usual ARIMA (p, d, q) models. With the lag operator L: $Lx_t = x_{t-1}$ these models can be calculated using the following formulas (11)–(14):

$$(1-L)^d X_t = c + \left(\sum_{i=1}^{p} a_i L^i\right)(1-L)^d X_t + \left(1 + \sum_{i=1}^{p} a_i L^i\right)\varepsilon_t, \tag{11}$$

or short:

$$a(L)(1-L)^d X_t = c + b(L)\varepsilon_t; \tag{12}$$

$$a(L) = 1 - \sum_{i=1}^{p} a_i L^i; \tag{13}$$

$$b(L) = 1 - \sum_{j=1}^{q} b_j L^j. \tag{14}$$

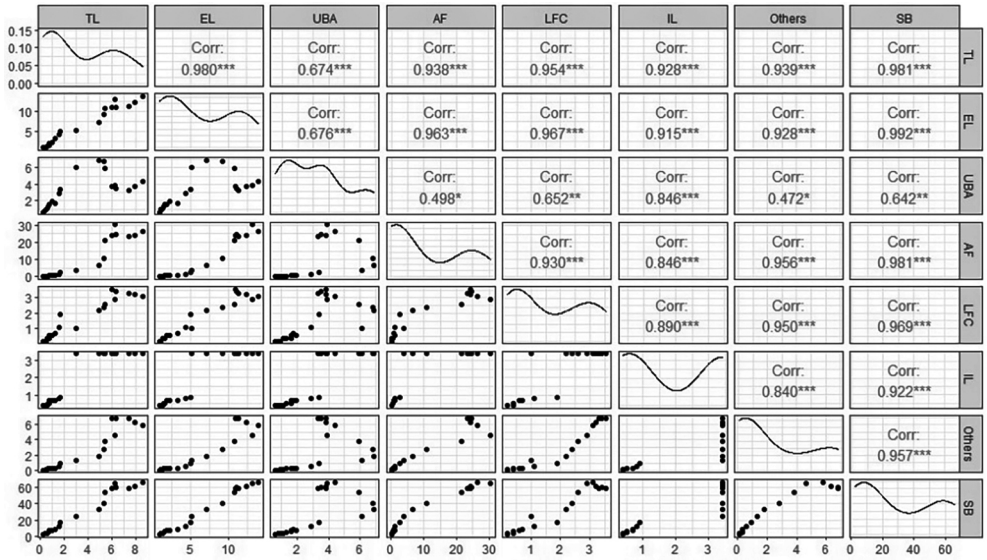
The final step involved comparing the level of correlation between the shadow banking sector and GDP per capita, which allows for an assessment of the relationship between the dynamics of shadow banking and the economic development of China.

4. Results

Throughout the period under study, several changes in the components of the shadow banking sector were revealed. The sector's volume has been increasing until 2017, when it amounted to 65.6 RMB trillion, but then it decreased to 59.2 RMB trillion by 2020. To ascertain the relationship between the structural components of China's shadow banking sector, a correlation analysis was conducted. The results are presented as a correlation matrix in Figure 2.

As evident from the correlation matrix, all structural components of the shadow banking sector exhibit signs of strong (|Corr| > 0.4) and very strong (|Corr| > 0.85) positive (Corr > 0) relationships. A very strong correlation (0.98 ≤ Corr ≤ 0.99) is observed among entrusted loans, trust loans, and assets financed by WMP/AMP, aligning with the specific nature of shadow banking development in China and confirming the findings of previous researchers. Bankers' acceptances demonstrate a strong level of correlation (0.64), affirming the presence of a significant influence of changes in bankers' acceptances on the overall dynamics of China's shadow banking.

However, there is virtually no correlation between China's shadow banking sector and other shadow banking assets. Other major shadow banking assets, including trust and fiduciary loans, shrank by 700 billion RBM in 2020. Furthermore, shadow banking assets classified as "Others" also shrank by 300 billion RMB, mainly due to the discontinuation of P2P lending activities and strict regulatory oversight. Meanwhile, the decision by Chinese financial regulators to delay the implementation of new asset management rules until the end of 2021 could lead to a moderate short-term increase in shadow lending. In the medium term, however, the government's policy of reforming the asset management sector remains unchanged.



Note: TL – trust loans; EL – entrusted loans; UBA – undiscounted bankers' acceptances; AF – assets funded by WMPs/AMPs; LFC – loans by finance companies; IL – informal lending; SB – shadow banking.

Figure 2. Correlation matrix of shadow banking components in China (source: formed by the authors)

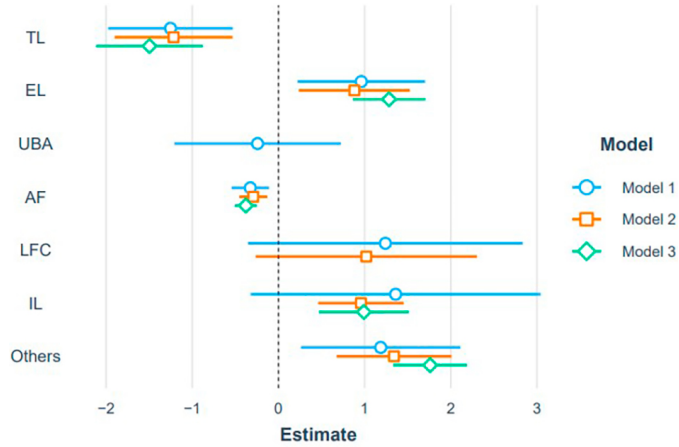
To model the relationship between the components of shadow banking and GDP per capita in China, the authors conducted a factor analysis, the criteria indicators of which are shown in Table 2. During the formation of the first model, the p-value for UBA, exceeding the normative value of 0.05, was recorded. Therefore, to build the second model, this factor was excluded as insignificant. When forming the second model, a p-value exceeding the normative value of 0.05 was determined for the LFC, so this factor was similarly excluded.

The third model is built with the exclusion of insignificant factors and demonstrates the compliance of the p-value with the norm, not exceeding 0.05. This characterizes the factors included in the model as significant and allows one to determine the key characteristics of the models (Figure 3).

Table 2. Modelling the relationship between shadow banking and GDP per capita in China (source: formed by the authors)

Factor	Model 1				Model 2				Model 3			
	Est.	S.E.	t val.	p	Est.	S.E.	t val.	p	Est.	S.E.	t val.	p
(Intercept)	0.33	0.31	1.08	0.30	0.38	0.29	1.30	0.22	0.27	0.30	0.89	0.39
TL	–1.25	0.33	–3.74	0.00	–1.22	0.32	–3.81	0.00	–1.50	0.29	–5.15	0.00
EL	0.96	0.34	2.81	0.01	0.88	0.30	2.93	0.01	1.28	0.20	6.51	0.00
UBA	–0.24	0.45	–0.54	0.60	–	–	–	–	–	–	–	–
AF	–0.33	0.10	–3.24	0.01	–0.29	0.08	–3.84	0.00	–0.38	0.06	–6.29	0.00
LFC	1.24	0.74	1.68	0.12	1.02	0.60	1.70	0.11	–	–	–	–
IL	1.36	0.78	1.75	0.10	0.96	0.23	4.14	0.00	0.99	0.24	4.05	0.00
Others	1.19	0.43	2.77	0.02	1.34	0.31	4.31	0.00	1.76	0.20	8.74	0.00

Note: TL – trust loans; EL – entrusted loans; UBA – undiscounted bankers' acceptances; AF – assets funded by WMPs/AMPs; LFC – loans by finance companies; IL – informal lending; SB – shadow banking.



Note: TL – trust loans; EL – entrusted loans; UBA – undiscounted bankers' acceptances; AF – assets funded by WMPs/AMPs; LFC – loans by finance companies; IL – informal lending; SB – shadow banking.

Figure 3. Key estimation characteristics of the generated models, taking into account the components of shadow banking in China (source: formed by the authors)

Based on the regression analysis, models were formed, the latter of which is the most adequate to current conditions, as it is cleared from the insignificant components of shadow banking in the context of GDP per capita (Table 3).

All presented models are characterized by relatively high correlation values between independent variables and the dependent variable, as confirmed by extremely high coefficients of determination (0.98–0.99). Notably, the third model is applicable in contemporary conditions as it includes only significant independent variables.

The results of the conducted modelling indicate that there is a strong positive relationship with the most significant impact established for the entrusted loans segment, signifying the positive influence of entrusted loans' growth on the economic development of the Chinese economy. Conversely, the study revealed an inverse relationship between the GDP per capita and the segments of trust loans and assets financed by WMP/AMP, suggesting high risks generated by these structural components of shadow banking activities.

The results of the conducted analysis reveal a strong interrelation both among various components of shadow banking and between individual elements of shadow banking and the economic development of the country. The identified characteristics indicate that changes in shadow banking, including structural changes, can have significant consequences for the Chinese economy, both positive and negative.

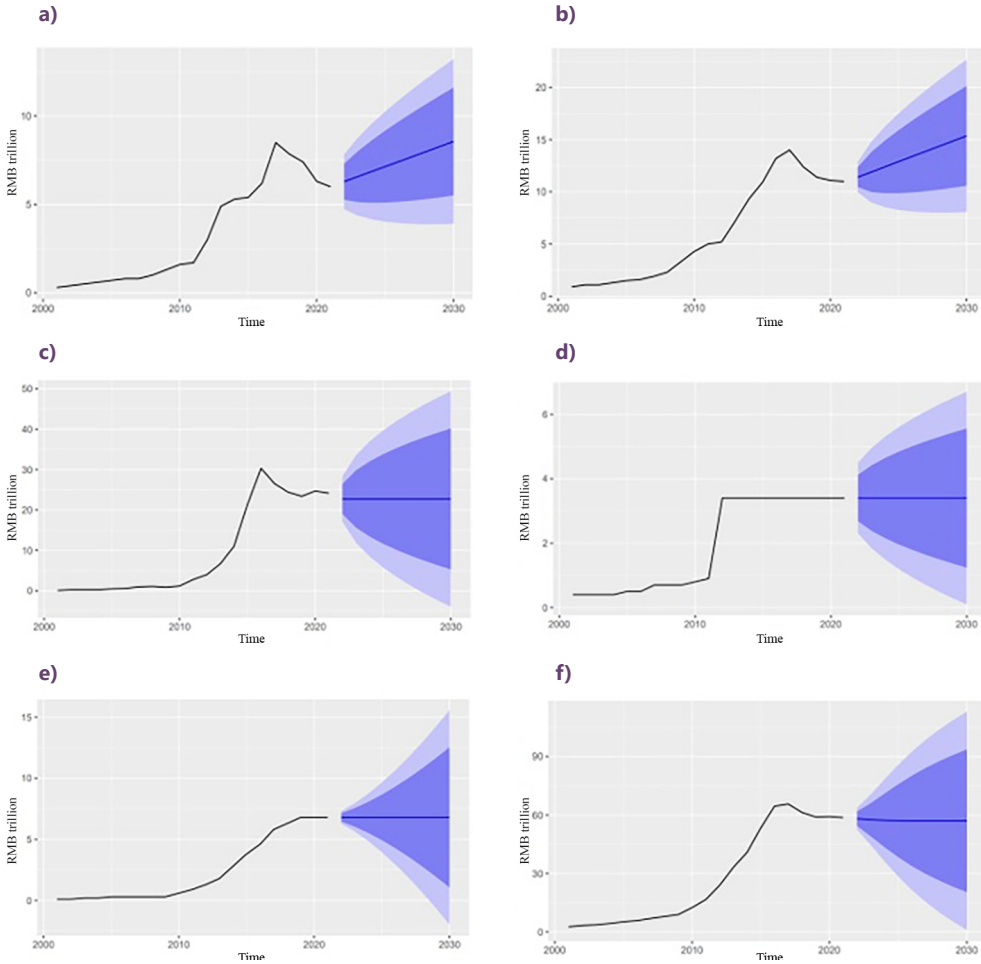
Table 3. Regression analysis of the relationship between shadow banking and GDP per capita in China (source: formed by the authors)

Factor	Model 1	Model 2	Model 3
(Intercept)	5.61 ***	5.61 ***	5.61 ***
	(0.12)	(0.11)	(0.12)
TL	–3.62 **	–3.51 **	–4.32 ***
	(0.97)	(0.92)	(0.84)
EL	4.57 *	4.18 *	6.09 ***
	(1.63)	(1.43)	(0.94)
UBA	–0.49		
	(0.90)		
AF	–3.72 **	–3.33 **	–4.31 ***
	(1.15)	(0.87)	(0.69)
LFC	1.57	1.29	
	(0.94)	(0.76)	
IL	1.97	1.39 **	1.44 **
	(1.13)	(0.33)	(0.35)
Others	3.15 *	3.56 ***	4.68 ***
	(1.14)	(0.83)	(0.53)
N	21	21	21
R2	0.99	0.99	0.98

Note: (1) All continuous predictors are mean-centered and scaled by 1 standard deviation. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$. (2) TL – trust loans; EL – entrusted loans; UBA – undiscounted bankers' acceptances; AF – assets funded by WMPs/AMPs; LFC – loans by finance companies; IL – informal lending; SB – shadow banking.

The forecast results for the consequences of structural changes in China's shadow banking sector when altering the most significant components of China's shadow banking, performed using ARIMA, are presented in Figure 4.

Based on forecast results, one can note that the structure of shadow banking in China may change in the coming years. This may have a significant impact on the Chinese economy in the context of the impact on GDP per capita. Entrusted loans are projected to increase, the volume of which, based on the previous modelling stage, may contribute to a positive effect on the economic indicator. However, there is also a possible increase in Trust loans, which, on the contrary, may reduce the value of GDP per capita. For the other components of shadow banking, no significant changes until 2030 are projected, but significant deviations in their values are possible (Table 4).



Note: a – trust loans; b – entrusted loans; c – assets funded by WMPs/AMPs; d – informal lending; e – others; f – shadow banking.

Figure 4. Forecast of key shadow banking components that have a link to GDP per capita in China until 2030 (source: formed by the authors)

Table 4. Forecast indicators of key shadow banking components until 2030 (source: formed by the authors)

Indicator	Period	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Trust loans	2022	6.29	5.27	7.30	4.73	7.84
	2023	6.57	5.13	8.01	4.37	8.77
	2024	6.86	5.09	8.62	4.16	9.55
	2025	7.14	5.10	9.18	4.03	10.25
	2026	7.43	5.15	9.70	3.94	10.91
	2027	7.71	5.22	10.20	3.90	11.52
	2028	8.00	5.30	10.69	3.88	12.11
	2029	8.28	5.40	11.16	3.88	12.68
	2030	8.57	5.51	11.62	3.90	13.23
Entrusted loans	2022	11.40	10.46	12.35	9.95	12.85
	2023	11.90	9.99	13.80	8.98	14.81
	2024	12.39	9.87	14.91	8.53	16.25
	2025	12.89	9.87	15.90	8.28	17.50
	2026	13.38	9.94	16.82	8.12	18.64
	2027	13.88	10.06	17.69	8.04	19.71
	2028	14.37	10.21	18.53	8.01	20.73
	2029	14.87	10.39	19.34	8.03	21.71
	2030	15.36	10.59	20.13	8.07	22.66
Assets funded by WMPs/AMPs	2022	22.73	19.05	26.41	17.10	28.36
	2023	22.73	15.66	29.80	11.92	33.54
	2024	22.73	13.44	32.02	8.52	36.94
	2025	22.73	11.65	33.81	5.78	39.67
	2026	22.73	10.11	35.34	3.44	42.02
	2027	22.73	8.74	36.71	1.34	44.11
	2028	22.73	7.50	37.96	–.56	46.02
	2029	22.73	6.35	39.11	–2.32	47.78
	2030	22.73	5.27	40.19	–3.97	49.43
Informal lending	2022	3.40	2.68	4.12	2.30	4.50
	2023	3.40	2.38	4.42	1.84	4.96
	2024	3.40	2.15	4.65	1.49	5.31
	2025	3.40	1.96	4.84	1.20	5.60
	2026	3.40	1.79	5.01	0.94	5.86
	2027	3.40	1.64	5.16	0.70	6.10
	2028	3.40	1.49	5.31	0.48	6.32
	2029	3.40	1.36	5.44	0.28	6.52
	2030	3.40	1.24	5.56	0.09	6.71
Others	2022	6.80	6.46	7.14	6.28	7.32
	2023	6.80	6.04	7.56	5.64	7.96
	2024	6.80	5.53	8.07	4.85	8.75
	2025	6.80	4.94	8.66	3.95	9.65
	2026	6.80	4.28	9.32	2.94	10.66
	2027	6.80	3.55	10.05	1.83	11.77
	2028	6.80	2.77	10.83	0.64	12.96
	2029	6.80	1.94	11.66	–.63	14.23
	2030	6.80	1.05	12.55	–1.99	15.59

In China's shadow banking industry, Entrusted loans could increase by 34% by 2030. Even though Trust loans are projected to increase by 36%, the effect on GDP per capita will be positive, based on the model ratios. Given that these are just two key components of shadow banking in China, GDP per capita was modelled in a similar way to obtain the total amount of shadow banking. Based on the obtained indicators, a comparison of the level of correlation between these two indicators in 2011–2021 and 2022–2030 was made (Figure 5).

The forecast results lead to the conclusion that the direct relationship between shadow banking and GDP per capita will intensify until 2030, reaffirming the high dependency of China's economy on shadow banking financing. Consequently, government policies aimed at minimizing shadow banking risks should consider the real sector's need for shadow banking financing. Simultaneously, specific structural components of the shadow banking sector exhibit a negative correlation with the GDP per capita, primarily affecting components that generate overheating effects in the economy and the emergence of "financial bubbles" in the most sensitive markets.

Therefore, the research results confirm Hypothesis 1: China's shadow banking is closely linked to the country's economic development. However, Hypothesis 2 (reduction in China's shadow banking leads to an increase in GDP per capita) holds only for specific structural elements of shadow banking that induce economic overheating. In contrast, for other structural components, such as entrusted loans, a significant direct correlation exists, contributing to the positive impact of shadow banking on the country's economic development. This underscores the necessity for an exceedingly balanced and cautious regulatory policy regarding shadow banking, as, amid a turbulent economy, substantial structural shifts in China's shadow banking can lead to significant alterations in achieving the sustainable development of the Chinese economy.

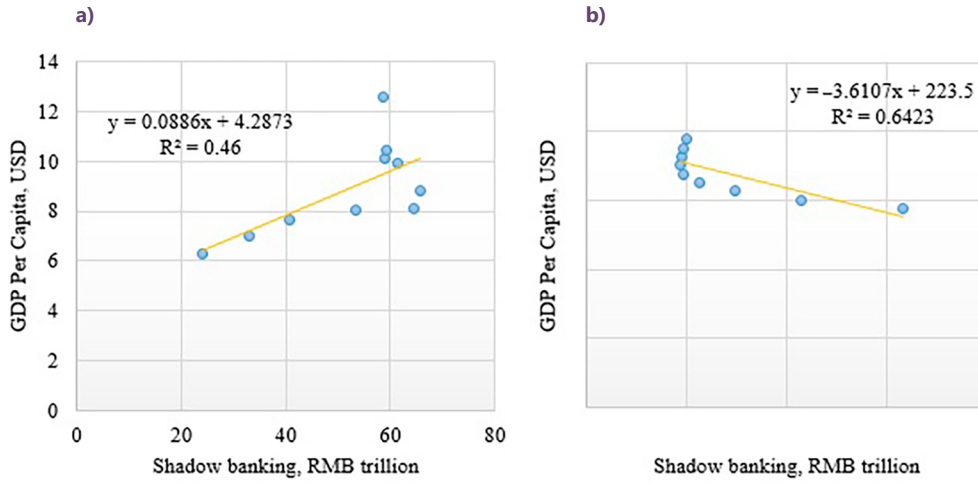


Figure 5. Relationship between shadow banking and GDP per capita in 2011–2021: (a) and 2022–2030 (b) (source: formed by the authors)

5. Discussion

The results of this research indicate that regulatory government policies concerning shadow banking must be highly balanced and grounded in empirically confirmed findings from current economic research. Negligent regulation of shadow banking can lead to not only a slowdown in GDP growth but also trigger a severe financial crisis. Thus, our research corroborates the dual impact of the shadow banking sector on China's economy, as noted by Wang et al. (2021). On the one hand, informal financial institutions significantly influence the development of the real economic sector and represent a valuable addition to the Chinese banking system (Łasak et al., 2019). On the other hand, shadow banking can catalyze various crises and cause dissatisfaction among a huge number of depositors who will lose their own money if China's financial system collapses (Le et al., 2021). The study also demonstrated the duality of the effectiveness of reducing shadow banking activity. Indeed, it is possible to reduce the shadow sector's share in nominal GDP (Petry, 2020). However, this leads to an inhibition of the banking sector's digitalization process, as exemplified by the reduction in the number of e-payment users (Omotubora & Basu, 2018; Rahman & Islam, 2022).

Thus, the study demonstrates that the main measures to combat the shadow banking sphere are yet to come. Because the study period covered the last 21 years (from 2001 to 2021), it could confirm that the Chinese government policies focused on limiting bank deposit rates had contributed to the rapid growth of the shadow banking sphere, blurring the boundaries between formal and informal financial institutions (Carvalho, 2021; Yang et al., 2019). This situation was advantageous to all in the short term; however, it has the potential to generate additional risks for China's economy in the long term (Fang et al., 2020).

A limitation of this study lies in its narrow focus on the impact assessment, as it employs GDP per capita as the sole indicator of economic growth, whereas the range of indicators could be much broader. To mitigate this limitation, expanding the range of indicators reflecting the influence of shadow banking on the banking sector and other sectors of the economy, including the transformation of financial and credit relations in China and their global implications (Baumgärtner & Klose, 2021; Wu & Shen, 2019) could be considered. This would contribute to broadening the results of prior researchers on the influence of shadow banking on the banking sector, monetary policy, and the overall economy (Chen et al., 2018, Zhu et al., 2019).

Thus, this study not only corroborates the findings of predecessors (Le et al., 2021; Wang et al., 2021) but also offers empirical evidence for hypotheses previously unexplored in the academic literature, contributing to a better understanding of shadow banking issues in developing and transitional economies. Furthermore, the scholarly contribution of the authors should be recognized in shaping future research directions, including those focused on investigating the intricacies of shadow banking activities from both institutional (the study of financial market institutions) and instrumental (the study of financial market participants' tools and operations, including banks) standpoints. Additionally, a promising avenue for future research could involve a comparative analysis of shadow banking to assess the influence of national differences on shadow banking formation.

6. Conclusions

This research aimed to establish and empirically confirm the fundamental relationships between shadow banking and economic development in countries with developing and transitional economies to provide a theoretical basis for minimizing potential risks associated with shadow banking. The analysis of the literature sources resulted in the formulation of the primary scientific hypotheses: (H1) Shadow banking in China is closely interconnected with the country's economic development; (H2) Reducing shadow banking in China contributes to an increase in GDP per capita.

The developed research project is based on the utilization of a quantitative approach, implemented through methods of correlation-regression analysis and scenario modelling. The temporal model is limited to the period from 2001 to 2021. Correlation analysis revealed strong relationships between the level of shadow banking and its components, with the strongest correlation demonstrated by entrusted loans, trust loans, and assets financed by WMP/AMP.

The results of the modelling demonstrate a strong positive relationship, with the most significant impact observed in the entrusted loans segment, indicating a favourable influence of the growth of entrusted loans on the economic development of the Chinese economy. Furthermore, the study unveiled an opposing connection between GDP per capita and the categories of entrusted loans, along with assets funded through WMP/AMP, underscoring the elevated risks emanating from these fundamental components of shadow banking within the contemporary economic landscape.

The results of the forecasting indicate an intensification of the direct correlation between shadow banking and GDP per capita until 2030, confirming the profound interdependence of China's economy on shadow banking financing. Simultaneously, certain structural components of the shadow banking sector exhibit a negative relationship with GDP per capita, particularly concerning elements that contribute to overheating the economy and the emergence of financial bubbles in the most susceptible markets.

In this way, the study validates hypothesis H1, affirming the close link between China's shadow banking and the country's economic development. However, hypothesis H2 (reducing shadow banking in China leads to an increase in GDP per capita) holds only for specific structural facets of shadow banking, those that provoke economic overheating. In contrast, other elements, such as entrusted loans, display a substantial direct relationship, fostering a positive impact of shadow banking on the country's economic development.

Therefore, this research not only corroborates the findings of previous studies but also introduces empirical evidence for hypotheses that have not been previously addressed in the scientific literature. This contribution by the authors enhances the understanding of shadow banking issues in developing and transitioning economies. Furthermore, the scholarly contribution of the authors extends to the formulation of prospective avenues for future research. These avenues include an investigation into the operational peculiarities of shadow banking from both institutional aspects (examining financial market institutions) and instrumental perspectives (studying the tools and transactions of financial market participants, including banks). Additionally, it encompasses a comparative analysis of shadow banking, which allows an assessment of the impact of national disparities on the formation of shadow banking.

7. Political recommendations

Hence, the state's policy regarding the mitigation of shadow banking risks should consider both the real economy's need for shadow banking financing and the negative impact on the economy of structural elements of shadow banking that trigger the creation of "financial bubbles". The findings of this study underscore the necessity for an extremely balanced and cautious regulatory policy concerning shadow banking, as significant structural shifts in China's shadow banking could lead to substantial changes in achieving sustainable development in the Chinese economy, especially in the backdrop of a turbulent economic environment.

Author contributions

All authors contributed to the study conception and design. Conceptualization: YL. Material preparation, data collection and analysis were performed by AJA and YL. The first draft of the manuscript was written by XJ and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Disclosure statement

Authors declare that they have no conflict of interest.

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