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Study on the Monetary Policy of PBOC --- During and After the Crises

Kangyu Ren
Beijing Foreign Studies University, Beijing, China
Email: renkangyu@bfsu.edu.cn

Abstract

This paper focuses on the central bank. Firstly, we review the operations of China's central bank (the People's Bank of China, PBOC) during the 2008 international financial crisis and the 2020 coronavirus pandemic, by comparing the characteristics of its balance sheet changes. Secondly, we establish a time-varying parametric vector autoregressive model (TVP-VAR) to explore the different impacts of total asset changes on the real economy and financial markets. It was found that there were large differences in the operation of PBOC in the two crises and changes in its total assets have different knock-on effects on the real economy and financial markets. Thirdly, we further observe the new characteristics of China's macroeconomic and financial environment after the pandemic, and put forward the options of the central bank to optimize monetary policy, including actively promoting financial restructuring at the macro-financial level, planning to deal with various potential liquidity risks as soon as possible, guiding the change of social concepts and enhancing the independence of the central bank, etc.

Keywords: Central Bank; Monetary Policy; Crisis; Fiscal Dominance

1. Instruction

In 2022, many economies around the world faced the highest inflation during the past four decades, coupled with recessionary risk and rising public debt, adding new problems to the coronavirus pandemic, which has been going on for quite some time. In 2020, the COVID-19 pandemic swept the world, bringing a huge impact on the economy and society of various countries, such as global production stagnation and economic downturn. Earlier, in 2008, it's the international financial crisis that shocked the world.

Usually, during or after the crisis, the central bank will actively act to hedge risks and control inflation by monetary policy operations, trying to alleviate the negative effects of the crisis. For example, in 2022, the Fed raised interest rates sharply in a row. On March 3rd and 15th 2020, the Fed urgently cut interest rates by 50 basis points and 100 basis points, respectively. And on March 19th 2020, the ECB announced the implementation of an emergency asset purchase program of 750 billion euros. Of course, similar large-scale bailouts also occurred during the 2008 international financial crisis.

So how does China's central bank respond during and after the crisis? How effective is its policy implementation? How to understand the new characteristics of China's economic and financial environment, so as to optimize monetary policy? These issues deserve our in-depth study and discussion.

During the 2008 international financial crisis, most central banks firstly chose to adjust their benchmark interest rates. From September 2007 to the end of December 2008, the Fed cut interest rates nine times, lowering the federal funds rate by a total of 500 basis points. The Bank of England and the Bank of Japan have also cut interest rates several times, reducing them to near zero. However, a zero-interest rate policy may introduce a "liquidity trap" and lead to problems such as low consumer confidence (Liu Shenghui, 2010). Therefore, central banks actively explored unconventional monetary policy. For example, after September 2008, the Fed and the ECB frequently introduced new rescue measures, injecting a large amount of funds into the financial system and triggering significant changes in the central bank's balance sheet. Although these unconventional monetary policies have problems such as imperfect development (Liu Yuanchun et al., 2017) and fail to solve the deep-seated problems that triggered the financial crisis (Zhu Min and Bian Weihong, 2009), central banks are still exploring different monetary policy tools.

In 2020, during the coronavirus pandemic, United States, Japan and the European Central Bank once again exercised many expansionary policies such as balance sheet expansion, making global liquidity extremely

abundant to cope with the impact of the epidemic. Gao Jie (2020) found that during the epidemic, the PBOC used tools such as RRR reduction, relending and rediscounting, but the total asset scale remained basically stable. Guo Lu and Wang Jin (2020) pointed out that the balance sheets of central banks in other major economies have shown a sharp and rapid expansion trend, but there are significant differences in the balance sheet structure of different central banks. Wei Ting (2020) compared the expansion of the balance sheets of Chinese and US central banks from January to May 2020, arguing that the goal of the two central banks is to provide liquidity to the market, but there are significant differences in the speed of expansion and constraints.

In 2022, as the epidemic gradually eased, the global economy began to recover, but new challenges followed, such as the Russian-Ukrainian war. Central banks in the United States, Europe and other economies are facing new challenges and are actively acting. However, due to time constraints, there are relatively few in-depth studies on central bank operations under the coronavirus pandemic in 2020 and since 2022, and there are few comparative studies linking several crises and the post-crisis era. Although the causes of the international financial crisis in 2008 and the coronavirus pandemic in 2020 are completely different, the macro-financial environment after 2022 is also very different, and the respond measures of different central banks are different, it is valuable to deeply study the changes in the balance sheet of China's central bank under the two crises to understand the actions of central banks in special periods; Coupled with the observation of changes in the current macro environment and the thinking of optimizing monetary policy, it will help deepen our understanding of the actions of central banks and monetary policy.

2. PBOC's Monetary Policy during the Two Crises

Observing a central bank's balance sheet is an important angle in understanding its monetary policy. Therefore, let's start with a balance sheet observation of the PBOC.

Central bank balance sheets consist of assets, liabilities, and owner's equity. Assets include foreign assets and domestic assets. The former is mainly composed of foreign exchange reserves held by the central bank, and the latter includes credit arrangements provided to governments, financial institutions or other departments. Liabilities consist mainly of currency in circulation and reserve deposits of the banking system, i.e. the monetary base, as well as other items such as central bank bills.

From 2007 to 2020, the balance sheet of the PBOC has undergone major changes. In terms of total volume, from the beginning of 2007 to the end of 2020, its total assets rose from 13.25 trillion yuan to 38.76 trillion yuan, an increase of nearly 2 times (see Figure 1). The dotted line above in Figure 1 is the logarithmic value of the total assets, reflecting the magnitude of the change. The curve has been smooth, indicating steady growth of its assets. The solid line below shows the monthly growth rate of total assets, which is relatively stable and basically remains within 5%。

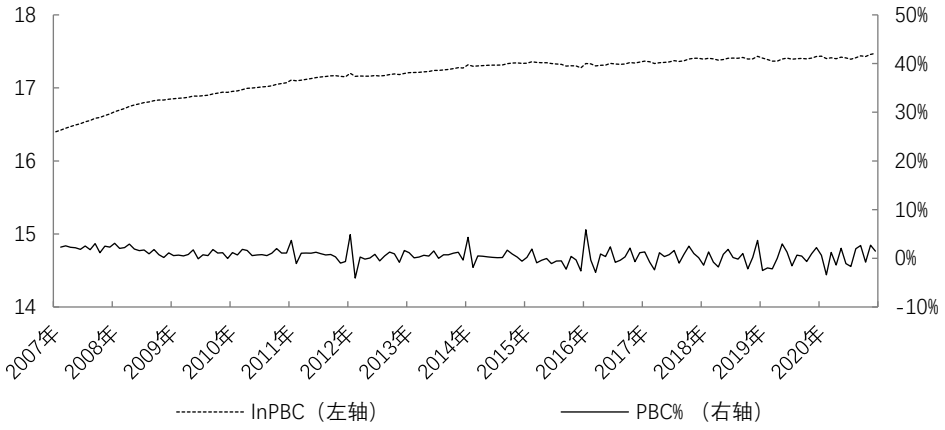

Figure 1 PBOC's total assets and the growth rate from 2007 to 2020

Central bank's liabilities are mainly composed of monetary base (MB), which changes along with the scale of assets. The dotted line in Figure 2 is the logarithmic value of the PBOC's monetary base. The curve fluctuates slightly. The solid line below is the month-on-month growth rate of it, which is large and fluctuating significantly.

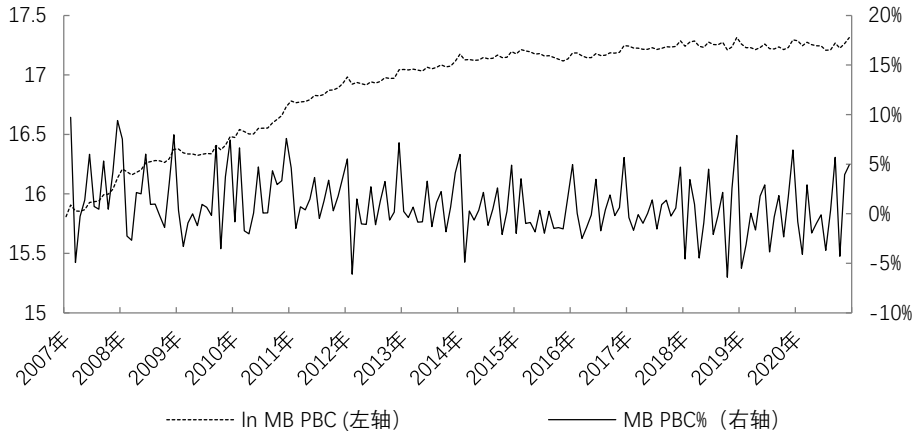

Figure 2 PBOC's MB and month-on-month growth rate from 2007 to 2020

Specifically, foreign assets have always been the largest asset item of PBOC. As can be seen from Figure 3, the proportion of foreign assets has been rising from 67.51% at the beginning of 2007 to 84% around 2012. But it dropped significantly around 2016 and has been fluctuating around 60% ever since. Relending and rediscounting of domestic assets (claims on other depository companies) are formed through the central bank's provision of liquidity to commercial banks. As it is shown in Figure 3, before September 2014, the proportion of these items to total assets was small and unchanged (basically fluctuating between 3% and 6%), but then began to grow rapidly. Especially in January 2016, this proportion jumped to 15.43%, followed by lower growth rate; In December 2020, this proportion was already greater than 30%, and there is still an upward trend. The proportion of government claims formed through open market operations has remained below 10%, rising significantly twice in August 2007 and December 2007, from 1.86% to 5.7% and from 5.34% to 9.65% respectively, and the proportion has slowly declined after December 2007, accounting for about 4% at the end of 2020, and then its absolute amount has remained unchanged for more than two years.

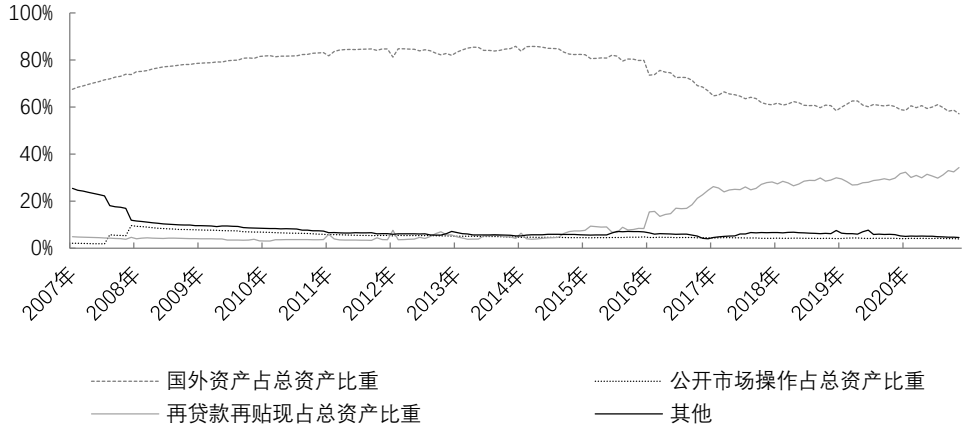

Figure 3 Changes in the proportion of PBOC's assets from 2007 to 2020

On the liability side, in addition to the MB which is already observed above, the issuance of bonds has also changed significantly. From 2007 to 2020, the proportion of MB in total liabilities was the largest and continued to rise, while the proportion of bonds issued has been declining. As can be seen from Figure 4, the proportion of base currency in total liabilities has increased year by year from 55.38% in January 2007 to basically remained around 85% from 2013 to 2020. The proportion of bonds issued as a percentage of total liabilities in January 2007 was 25.91%, which began to decline in September 2007, and as of the 2020 observation period, this proportion was only 0.27%, which is almost negligible.

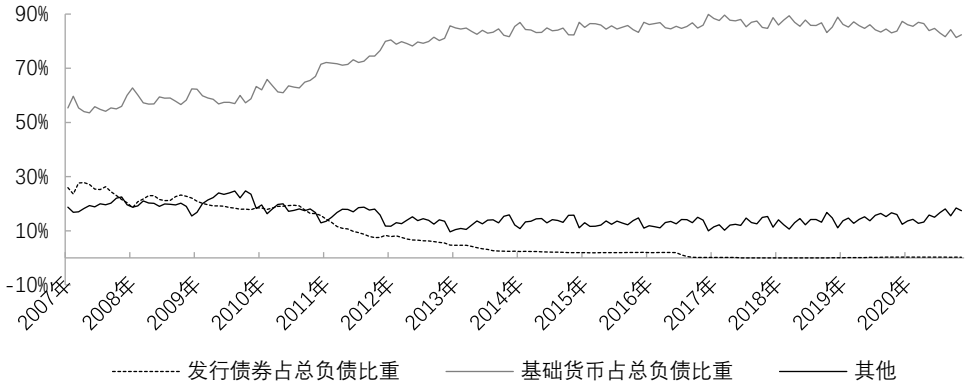

Figure 4 Changes in the proportion of PBOC's liabilities from 2007 to 2020

3. Comparative Analysis of PBOC Policies under the Two Crises

In general, the PBOC's balance sheet changes were clearly different during the 2008 international financial crisis and the 2020 coronavirus pandemic. (Table 1).

Table 1 PBOC's balance sheet changes during the two crises

Main change in items	the People's Bank of China
Open market operations	Compared with the financial crisis, the total volume increased and the proportion decreased during the epidemic, with little fluctuation.
Relending and rediscounting	Both the total amount and the proportion increased significantly, and the fluctuation intensified.
Foreign assets	The total volume kept stable from rising during the financial crisis to the epidemic period, and the proportion decreased.
Base currency	The total amount and proportion during the epidemic period are larger than those during the financial crisis, but both are relatively stable.
Bonds issued	During the epidemic period, both the total amount and the proportion decreased significantly, almost zero.

The differences in PBOC's response to the two crises are mainly reflected in the following aspects:

Firstly, the total volume of open market operations jumped significantly before and after the 2008 international financial crisis, but remained basically stable during the epidemic, because the purpose and method of these operations in the two crises were different. In 2007, PBOC indirectly purchased 155 million yuan of 10-year "special Treasury bonds" issued by the Ministry of Finance from financial institutions such as the Agricultural Bank of China to establish the China Investment Corporation Limited, increasing "claims on the government." Since then, PBOC has mainly used repurchase agreement to regulate liquidity, which is basically not reflected in the balance sheet due to the short operation time.

Secondly, the total amount and proportion of relending and rediscounting increased, mainly due to its innovation of structural monetary policy tools and transformation of liquidity delivery methods since 2013, which increased the volatility of this subject during the coronavirus pandemic in 2020.

Thirdly, foreign assets have also undergone major changes. After China's accession to WTO in 2001, both current account and financial account showed surplus, and the stock of foreign exchange reserves continued to rise. Although its growth rate declined during the 2008 international financial crisis, the total volume of foreign exchange reserves still maintained increasing. In recent years, the growth rate has declined, and so did the proportion of it.

Fourthly, corresponding to the increase in foreign exchange reserves, PBOC has sterilized partly through the issuance of central bank bills. The proportion of bonds issued to total debt remained above 5% before 2013, and

even as high as 25% before and after the 2008 international financial crisis. However, with the slowdown in the growth of foreign assets, the scale of central bank bills has declined significantly, and a small number of central bank bills are no longer used to hedge foreign exchange accounts, but play a role in optimizing the yield curve of government bonds and supporting commercial banks to issue subordinated bonds to supplement capital.

In general, PBOC's balance sheet expanded during the 2008 international financial crisis, but there was no significant expansion during the 2020 pandemic, as summarized below (Table 2).

Table 2 Balance sheet comparison of PBOC in the two crises

Main change subjects		**the 2008 international financial crisis**	**the 2020 coronavirus pandemic**
Open market operations	sum	Jumped twice	Remained almost unchanged
	proportion	Rising slightly twice	Remained almost unchanged
Relending and rediscounting	sum	Remained almost unchanged	Fluctuate violently within a certain range
	proportion	Remained almost unchanged	No significant fluctuations
Total assets		The line remained original upward trend	Fluctuate within a certain range
Base currency	sum	remained upward trend	Fluctuate frequently within a certain range
	proportion	Fluctuate within a certain range	Fluctuate within a certain range

In contrast, changes of PBOC's balance sheet during the 2008 international financial crisis were more "passive", mainly through the issuance of notes and other operations to hedge excessive liquidity (Ren Kangyu, 2009). The monetary policy report for the third quarter of 2020 also confirmed this view, and pointed out that this expansion actually began at the beginning of this century. In addition, due to the limited development of China's financial market, the lack of ability to actively manage the balance sheet at that time, and the relatively strict capital control, the impact of the world financial crisis on the domestic economy was mild so that the PBOC's balance sheet could basically maintain the previous' level (Wang Zhifeng, 2009).

In 2020, the PBOC's selection of monetary policy tools and monetary policy ideas are mainly manifested as follows: First, it mainly uses RRR reduction and relending tools to hedge the impact of the coronavirus pandemic. In terms of RRR reduction, in the first quarter of 2020, the PBOC released 1.75 trillion yuan of long-term funds by reducing the reserve requirement ratio; for the use of relending and rediscounting tools, three batches of relending and rediscounting for different economic entities of 300 billion yuan, 500 billion yuan and 1 trillion yuan respectively played a positive role in supporting the economy from epidemic prevention and control. Although the RRR reduction may only bring about the structural adjustment of the PBOC's assets, in the context of the outbreak, the long-term funds released are mainly used to issue loans in the field of inclusive finance, which will cause the tightening of the balance sheet. The relending and rediscounting policy will lead to the expansion of the PBOC's balance sheet, thus ultimately causing the PBOC's total assets to decline in the first quarter of 2020 while maintaining reasonable liquidity. The PBOC also pointed out in its monetary policy report for the third quarter of 2020 that the balance sheet reduction brought about by the RRR cut and the expansion of the balance sheet brought about by the increase in relending offset each other on the balance sheet, keeping the total scale basically stable.

Secondly, the PBOC is implementing a prudent monetary policy, and proposing to "give full play to the precise drip irrigation role of relending and rediscounting to support the development of the real economy". The PBOC's innovative structural monetary policy tools have changed liquidity delivery from passive to active, improving the accuracy of liquidity delivery, so relending and rediscounting have fluctuated greatly.

It can be seen that due to the large differences in the macroeconomic environment it faces, the PBOC's actions during the two crises are more obvious, which is mainly reflected in the changes in subjects and overall scale. During the 2008 international financial crisis, the PBOC mainly responded passively, and the balance sheet basically continued the previous trend. During the 2020 pandemic, the PBOC adopted a more proactive and prudent monetary policy to stabilize its balance sheet and economic development mainly in accordance with the domestic economic situation. In addition, since 2013, the PBOC has innovated structural monetary policy tools and changed the way of delivering liquidity, so that the total assets and specific accounts of the PBOC's balance sheet have changed differently in the two crises.

4. Analysis of the policy effect

Central bank's balance sheet is a window for its behavior. The changes reflect differences in the macroeconomic environment and monetary policy operations, which ultimately have an impact on the real economy and financial markets. Traditional monetary policy theory generally establishes a model of the mechanism for the operation on the real economy and tests the effect. However, in recent years, with the deepening of the study of the balance sheet of central banks, some scholars tried to directly establish and test the relationship between the size of the balance sheet and the actual economic indicators. Based on the above research, this paper conducts an empirical analysis of the policy effects of PBOC's total assets during the 2008 international financial crisis and the 2020 pandemic, so as to increase the understanding on the policy effects of central bank behavior.

The impact of central bank's balance sheet could be reflected in prices, income, expenditure, employment and other aspects (Ireland, 2019). According to the actual situation, the model variables selected in this paper include the month-on-month consumer price index (CPI), the gross domestic product (GDP) and the Shanghai Composite Index(financial market). The macroeconomic data come from the official website of the National Bureau of Statistics of China, and the financial data come from the Wind database. GDP is a total of 56 quarterly data from January 2007 to December 2020, and the rest is a total of 168 monthly data for the same period.

As to the analysis method we adopt the time-varying parameter vector autoregressive model (TVP-VAR model), which has no assumption of homo-variance and is more realistic than the vector autoregressive model. Its most significant feature is that it allows the variance-covariance and coefficients to adjust over time to capture nonlinear structural changes (Sun Yanlin and Zhang Qianting, 2016). The TVP-VAR model is defined as follows:

$$y_t = X_t\beta_t + A_t^{-1}\sum_t \varepsilon_t \qquad \text{t=s+1,…,n} \tag{1}$$

Among them, there are total assets of the PBOC, month-on-month CPI, GDP and Shanghai Composite Index; The explanatory variable uses the first-order lag term of the itself, which is the correlation coefficient. And time-varying parameters used in the TVP-VAR model are perturbation terms. For specific model settings, please refer to Nakajima J. (2011) and the research group of People's Bank of China Guangzhou Branch (2016).

In order to be fit for the study, it is also necessary to process the data: refer to the data processing methods of Lu Wei, Liu Chenhui (2012) and Zou Xiaomei (2021), we convert the quarterly GDP data into monthly data with EViews software, and unify the frequency with other variables; Then we take a first-order logarithmic difference for the total assets of the central bank, and a first-order difference for CPI, GDP and the Shanghai Composite Index. The above processed variables all pass the root of unity test, and their descriptive statistics are shown in Table 3.

Table 3 Variable descriptive statistics

Country	variable	definition	mean	standard deviation	Max	Min	Observations
China	r-lnSIZE	Total Assets Growth Rate	0.0013	0.0798	0.1877	-0.2828	167
	rCPI	CPI Variation	-0.0120	0.6045	1.6	-2.6	167
	rGDP	GDP Variation	50.9979	327.8297	1179.8870	-1832.4	167
	rSZ	SSE Index Variation	4.1122	264.4280	747.8	-1082.99	167

Next, we established the TVP-VAR model by using OxMetrics6 software. First, we used the VAR model of EViews to determine the order 2 of lag period, based on the five indicators such as AIC and SC. Second, we used the four variable data of r-lnSIZE, rCPI, rGDP, and rSZ for the TVP-VAR model. Third, the MCMC (Montakaro Method and Markov Chain) algorithm was used to sample 10,000 times. The parameter estimation results of the model are shown in Table 4. The means, standard deviations, confidence intervals and Geweke values obtained by the parameter test results prove that the test conforms to the posterior distribution, and the invalid factors are much less than 10000, which meets the assumption of modeling.

Table 4 TVP-VAR Model parameter estimation

parameter	Estimated	Standard error	95% CI	Geweke	Invalid factor

	value		Lower	Upper		
sb1	0.0228	0.0027	0.0184	0.0287	0.056	9.81
sb2	0.0228	0.0027	0.0183	0.0286	0.534	9.98
sa1	3.7512	59.3706	0.0507	20.7616	0.028	5.39
sa2	0.0922	0.0650	0.0421	0.2553	0.364	93.16
sh1	1.2486	0.2125	0.8873	1.6571	0.000	235.16
sh2	1.2763	0.2887	0.6063	1.9565	0.524	157.89

Note: SB1/2, SA1/2, SH1/2 are the parameters of A_t, Σ_t, ε_t in the model, respectively, and have nothing to do with the number of variables selected by the explanatory variable. For details, please refer to Nakajima (2011), Sun Yanlin and Zhang Qianting (2016), Xu Ying and Sun Yuhao (2019).

Next, both the equal interval pulse and different time point pulse response analysis are available in the TVP-VAR model. The former is to observe the amplitude of the dependent variable in the equal interval period (periods 2, 4 and 6 are selected to indicate very short-term, short-term and medium-term periods, respectively) after giving the independent variable a positive impact, while the latter can dynamically observe the changes of the dependent variable at several specified time points.

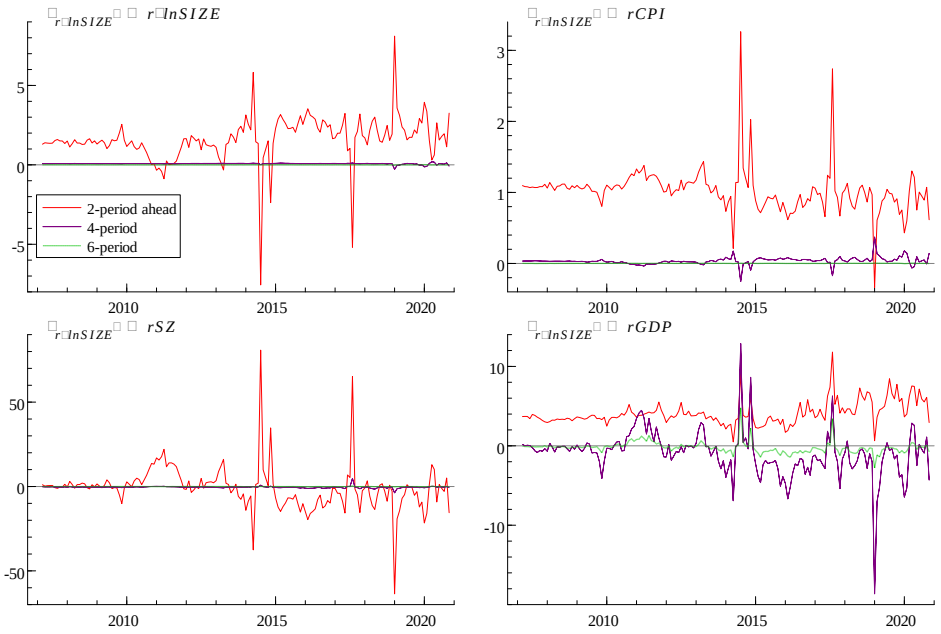

Figure 5 Equispaced pulse diagram of each variable of the total assets of the PBOC

Firstly, the equispaced impulse response of PBOC's total assets to several variables is shown in Figure 5. As it shows, total assets have a time-varying impact on various economic variables with different lags: the impulse response to CPI growth in lag 2 is positive in most periods, while lag 4 and 6 are close to no effect. It has basically no impact on the growth rate of the Shanghai Composite Index lagging 2, 4 and 6; It has a positive impact on GDP growth in lag 2 for most periods, relatively negative in lag 4, and close to no effect on lag 6. In general, the impact of PBOC's total assets on the economic variables studied in this paper has a significant impact in the short term, and there are stronger fluctuations in the market in more abnormal periods such as 2015, 2018 and 2019. And the impact on financial markets is not very obvious.

Secondly, because the central bank responded most strongly to the crisis in September 2008 and March 2020, this paper selects these two times as the representative points of the 2008 international financial crisis and the 2020 new crown pneumonia epidemic to analyze the time-point impulse response of the central bank's expansion. From Figure 6, it can be seen that the PBOC's total asset changes have different impulse responses to China's CPI growth

rate at two time points: the pulse function of CPI growth rate during the 2008 international financial crisis gradually weakened from positive value in the current period, and then gradually decreased and converged; However, during the 2020 covid-19 epidemic, it turned from negative to positive in the first phase and converged. The impact of total asset changes on the growth rate of the Shanghai Composite Index differed in the two crises, but eventually converged; The impulse response to GDP growth rate is quite different: the impulse function during the 2008 international financial crisis gradually turns positive from negative value and gradually converges in the current period; In 2020, the pulse function during epidemic turned from positive to negative, and then turned positive and then converge.

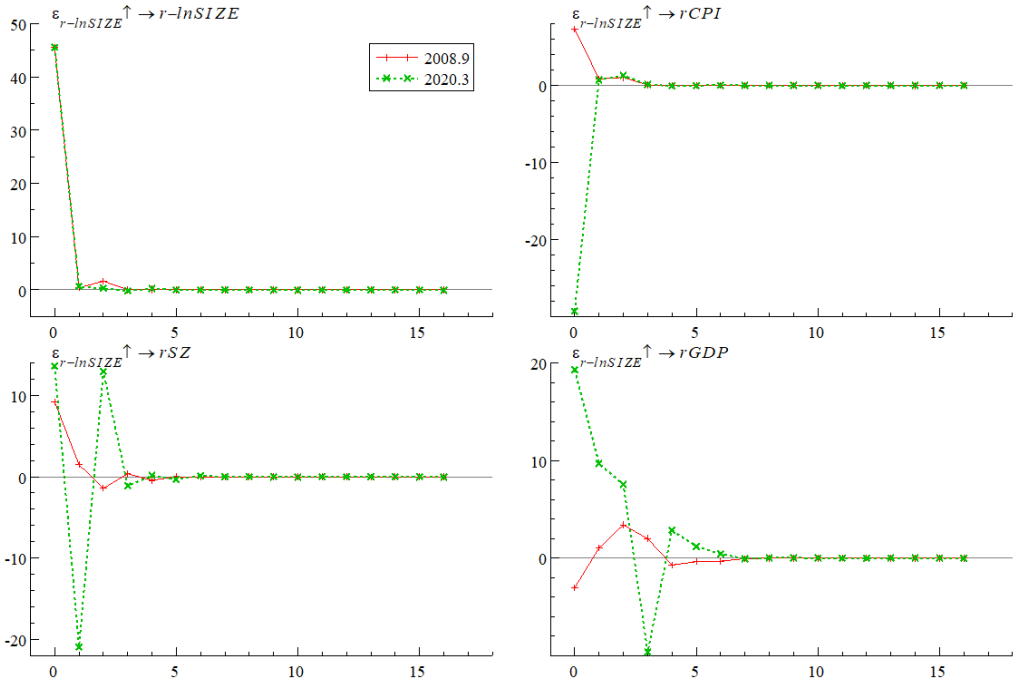

Figure 6 Time-point impulse response of PBOC's total assets to each variable

Comparing the time-point impulse response results in the two crises, it can be found that the current impact of the change of total assets of the PBOC on various economic variables in China is significantly different from the international financial crisis in 2008 and the new crown epidemic in 2020, which is consistent with the previous analysis found that there are great differences in the PBOC's actions in the two crises.

5. Optimal choices for post-crisis monetary policy

Central banks were active during crisis, influencing specific economic variables. However, as the epidemic gradually enters into the new period of normalization, the macroeconomy has begun to take on new characteristics, which require close attention from the PBOC. Since 2022, many countries around the world have faced high debt and economic "stagflation", and fiscal dominance is more popular (IMF, 2021). China's fiscal revenue and expenditure, especially local fiscal revenue and expenditure pressure, is also relatively large, and fiscal-led scenarios are frequent. The importance of improving the overall efficiency of the use of public sector funds has become increasingly prominent. In this context, the central bank needs to guide the change of social concepts, take the establishment of a modern central banking system as an opportunity, consciously and actively withdraw from some quasi-fiscal functions, and accelerate the establishment of a monetary policy framework suitable for China's economic and financial conditions, so as to improve the effect of monetary policy.

Firstly, we should clarify relevant cognition and guide the change of social concepts. At present, that "the Ministry of Finance cannot directly overdraft at the central bank" has become the mainstream of cognition, but there are still some misunderstandings in terms of the relationship between MOF and the central bank. So, we need a clear boundary between Finance and the central bank under the consideration of overall interests. Indeed, the Ministry of Finance and the Central Bank are most efficient when their functions are clear and perform their

respective functions. The central bank is responsible for implementing monetary and exchange rate policies, maintaining financial stability, etc., and if losses occur in the performance of duties, the Ministry of Finance will make up for them; Profits generated in the course of operation shall also be handed over to the Ministry of Finance in accordance with the law. The central bank independently operates in the open market, and does not implement special monetary policies for specific groups, industries and sectors, so as to prevent the transmission of interests.

Secondly, both MOF and the central bank should perform their respective duties, which can effectively avoid the moral hazard or misuse of central bank, improve the ability of the central bank to stabilize prices and maintain macro-financial stability as a lender of last resort; Moreover, the budget constraint of fiscal funds should be strengthened, the use of funds that are not subject to social supervision such as people's congresses in broad government funds should be avoided, and then the overall efficiency of the use of public funds can be improved. The People's Bank of China should intentionally guide all sectors of society to correctly understand and evaluate the coordination and cooperation between fiscal policy and monetary policy, and try to avoid the Ministry of Finance from overdrawing or borrowing from the central bank in a disguised way of evasion, or adding the central bank to assume quasi-fiscal functions. It is not appropriate to pass on some fiscal expenditures to commercial financial institutions in the name of the real economy of financial services.

Thirdly, improve the independence of the central bank. According to the experiences of many central banks, the improvement of central bank independence can significantly reduce inflation. This is also reflected in the practice of the central bank after China's reform and opening up.

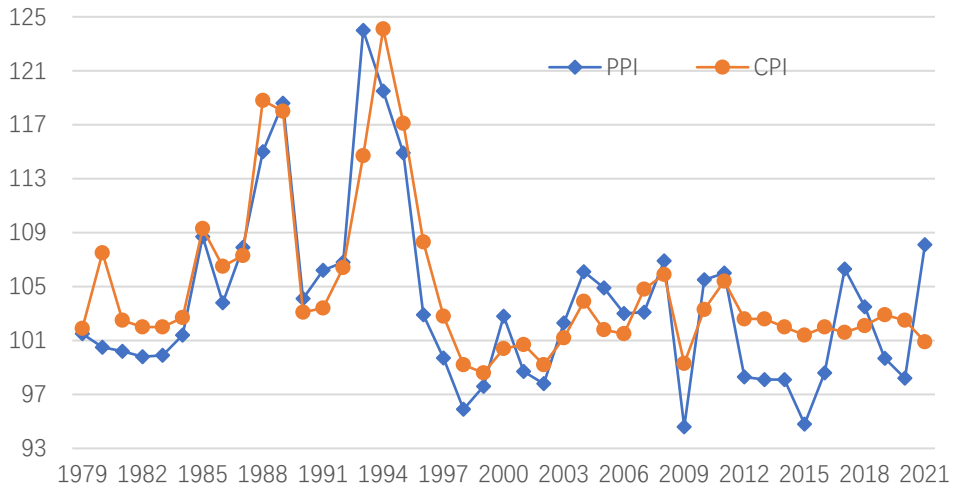

Figure 7 Price level trends from 1979 to the present

Source: Wind

After the promulgation of the People's Bank of China Law in 1995, the number of direct overdrafts from the Ministry of Finance to the central bank was significantly reduced, but the phenomenon of indirect overdraft and transfer of fiscal expenditure responsibilities came into being. First, the number of policies reloan is huge, with the nature of fiscal overdraft, and the losses that should be borne by the Finance are finally undertaken in the central bank's balance sheet. Second, the loan losses in the process of economic transformation that the finance is unwilling to bear or unable to bear are digested by the central bank, such as state-owned commercial banks and rural credit cooperatives and other financial institutions. Third, the pass-through of fiscal expenditure has always existed. If there are problems in state-owned enterprises and large private enterprises, commercial banks are required to help them; Problems in financial institutions and financial markets should be solved by the central bank. For example, the recent problems of real estate development enterprises mainly rely on commercial banks and central banks to alleviate them.

At present, affected by the impact of the epidemic, the downturn in real estate, and tax and fee reductions, the recent fiscal revenue and expenditure, the fiscal revenue and expenditure of local governments are relatively tight. In the medium and long term, on the one hand, under the situation of slowing down the growth of disposable income and continuous insufficient consumption, the pressure to adjust the income share of government departments and residential sectors in national income will increase; On the other hand, in the future, China's space for relying on high economic growth to alleviate the contradiction between fiscal revenue and expenditure is

getting smaller and smaller. Under the circumstance that the contradiction between fiscal revenue and expenditure increases, the pressure to require commercial banks and central banks to bear part of fiscal expenditure in various ways will increase. For example, transferring foreign exchange reserves to government agencies, requiring commercial banks to yield profits, and handing over profits by the central bank. According to the classification of the IMF (2021), transferring foreign exchange reserves to government agencies and handing over profits by the central bank are typical fiscal-led behaviors and so on. In such an environment, the central bank should consciously take the initiative to reduce the quasi-fiscal behavior it bears and continuously enhance its independence.

6. **Summary**

This paper first reviews and compares the actions and effects of the PBOC under the international financial crisis in 2008 and the global covid-19 pandemic in 2020, based on the perspective of its balance sheet. First, the changes in the total assets of the PBOC basically continue the trend before the crisis, to expand during the international financial crisis in 2008 and to fluctuate in 2020 without significant expansion. Second, there are obvious differences in the actions of the PBOC's balance sheet during the two crises, due to macroeconomic and monetary policy stances. Third, the impact of the PBOC's expansion on China's economic variables is obvious in the short term, and the impact on the financial market is not large.

This article also focuses on the main challenges faced by China's central bank and the optimization of monetary policy choices due to the great changes in the domestic and foreign financial environment since 2022.

The impact of the pandemic on the economies of various countries continues, and central banks are still actively responding through monetary policy means. Based on the above research, this paper makes the following recommendations:

Firstly, focus on the size of the central bank's balance sheet. Changes in the total size of the central bank's balance sheet and important accounts can reflect the general trend of China's monetary policy to a certain extent; According to the point-in-time impulse response chart, the impact of central bank balance sheet scale and money supply on the real economy and financial system during the crisis is similar, but in reality, the data statistics of the former are more timely and accurate than the latter, so they can be used as an effective supplement to observe monetary policy.

Secondly, actively use monetary policy tools in a crisis to keep markets reasonably liquid, and direct relief measures can be used. Innovative monetary policy tools have enabled balance sheet changes while maintaining the stability of the base currency, which in turn has a more positive impact on the real economy and the financial system; However, the impulse response results show that monetary policy has a certain time lag and limited effect, and some direct rescue measures may be more rapid and effective.

Thirdly, improve the independence of central banks, but be wary of the negative effects of innovative monetary policy operations such as structural monetary policy when making full use of them. Structural monetary policy is relatively less constrained by laws and financial markets, and may largely subsidize a small number of financial institutions, specific industries and groups, with obvious distributional effects. Moreover, this is partly due to the fact that the central bank's public fund spending (rather than fiscal money expenditure) is largely unconstrained by the fiscal budget system.

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Appendix: Impulse Response Results of Money Supply as Independent Variables

Figure 8 Equispaced impulse response of China's money supply

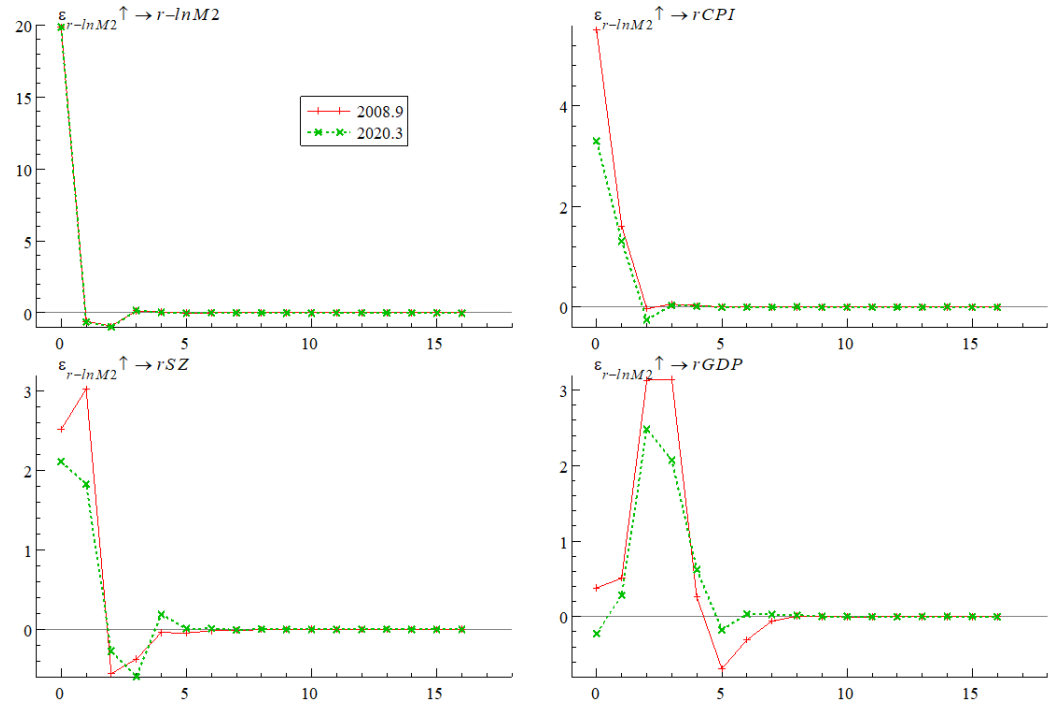

Figure 9 Time-point impulse response of China's money supply

The applicability of the Technology Acceptance Model in the usage of African language radio stations: A study of South Africa's Generation Y consumers

Mr. N.W Ntuli

Dr. A Katrodia

ABSTRACT

Keywords: Generation Y, SABC, African language radio stations, ALS, intention to use, perception, consumer behaviour, actual usage, Technology Acceptance Model, TAM, theory of reasoned action, TRA, South Africa.

While conventional literature accurates postulates that the penetration of new forms of media is a potential threat to traditional ones, the positing of the competition presented by digital media as implying an instantaneous and unavoidable abandonment of traditional media such as radio and African language radio stations (ALS) is an oversimplification of the percularities pertaining to the consumption of technological media products by consumers such as Generation Y in developing economies that include South Africa. The rise of newer media has not resulted in the automatic desertion of preceding ones and with only 54% of South Africa having access to the internet – an enabling factor in the penetration of newer media forms – the adoption rate of new media technology remains slow, and traditional ones that include ALSs continue to be dominant. Of the 35 million average South African weekly radio listeners, 26 million, which is more than 70% of the market, prefer listening to ALSs, however these indigenous language radio media have hardly been studied from a marketing, consumer behaviour and technology acceptance perspective. The applicability of the Technology Acceptance Model (TAM) in the usage of traditional media such as ALS, within an environment of digital media adoption, is a literature gap to be filled. A sample of 500 Generation Y South Africans of all genders, as a result, was drawn using convenience sampling to participate in this study and 494 responded. A self-administered questionnaire was used to collect data from Generation Y individuals who are between the ages of 18 and 36, and the process of data cleaning resulted in 350 questionnaires regarded as usable, which is a total response rate of 70.8%. Data analysis was performed using frequencies, custom tables, means, standard deviations, confirmatory factor analysis (CFA), reliability analysis, independent t-test, correlation analysis and structural equation modelling (SEM). The outcome of the study indicates that the Technology Acceptance Model is applicable in the actual usage of ALS by Generation Y in South Africa. This study further provides recommendations that would ensure that traditional media such as ALS intergrate with new digital ones as part of having ALS remain relevant within a digital technology-driven environment.

Introduction

The discovery and subsequent penetration of the latest media is creating a perception that traditional ones such as radio broadcasting in South Africa and globally automatically become redundant. Koenderman's (2011:1) assertion that "every time a new medium is introduced the obituary of some older one is invariably written" could be some of the major contributors to the development of this

perception. However, while global digital media penetration is gaining momentum, the radio medium's three billion weekly consumers indicate that traditional media are not immediately fading as radio broadcasting remains the highest consumed form of broadcast media in the world (Deloitte, 2019). Radio broadcasting in South Africa is dominated by the South African Broadcasting Corporation's (SABC) African language radio stations (ALS), which command an average of 29 million consumers (BRC, 2022). While these radio mediums enjoy almost 75% of South Africa's market, their digital media presence remains low and this results in newer media being seen as competition than modes to use in enhancing ALSs' prowess. This environment of digital media migration warrants for an exploration of traditional media in a manner that appreciates their coexistence with newer ones. The usage of ALSs together with revenue potential these media possess within an environment of digital migration may be better understood through the inculcation of the Technology Acceptance Model (TAM) (Davis *et al.*, 1989).

Literature review

African Language Stations (ALSs) in South Africa

More than 35 million South Africans currently listen to radio media regularly (Bischoff, 2019), and 74% of the market share belongs to the SABC's African language radio stations (ALS) (SABC, 2018). While ALS have a combined listenership of 26.3 million people of different age groupings (BRC, 2023), these radio stations – which are part of the African language media network - have not been fully studied in South Africa (Gunner, 2017). The need to explore these radio media from marketing and consumer behaviour perspective is immeasurable, given that ALSs constitute an ensemble of radio stations that are targeting young and old South Africans from all backgrounds who speak and understand any South African official language that was previously disadvantaged (SABC, 2021).

History has shown that colonial and apartheid South Africa's media policies were formulated with the aim to promote division among individuals on the basis of language and culture in order for the state to use separatism and racism to subdue African people (Moyo, 2010). The establishment of a broadcasting system in South Africa was followed by the broadcast of the first programmes by the South African Broadcasting Corporation (SABC) in the 1930s wherein only English and Afrikaans, as the only recognised official languages in South Africa, were used (Nyamnjoh, 2005). Mhlambi (2019) hinted that the colonial government's idea behind developing a broadcasting system that would be in African languages in South Africa came about because of the need to 'encourage' Black Africans to participate in the Second World War (WWII) while also influencing the type of content Africans consumed about the warfare.

This politically charged rationale paved the way for the launch of the loudspeaker system of broadcast in July of 1940, reaching Black African audiences that were based in mining areas, hostels and townships (Wiederroth, 2012). K.E Masinga, popularly known as 'King Edward', then presented a proposal to the SABC in December of 1941 to be given permission to present news in the indigenous language of isiZulu, which would be the first African language broadcast (Gunner, 2017). Masinga's request was granted because it presented a solution to the officials' concerns about the Black population's support and loyalty towards WWII. This decision was influenced by the fact that Zambia's Radio Lusaka, which was the first vernacular African radio station, had just been established with the objective to position the warfare favourably in Black people's minds. Even though the SABC started broadcasting in the African languages of isiZulu, with Southern Sotho and isiXhosa following later on, these radio stations were establishment on the basis of separatism that was deemed by the government as a fair representation of the tribal groupings in the country (Carver & Naughton, 1995). In 1960, with the adoption of the Broadcasting Amendment Act No. 49 of 1960, the SABC brought to the airwaves a more structured African language broadcasting system through a vernacular radio service called Radio Bantu, the role of which was to be an instrument of the government of the day to entrench apartheid policies (Lekgoathi, 2009). As a result, the Afrikaner Broederbond was indirectly given powers by the government through the SABC Board of Governors to oversee the corporation and make decisions that were to the benefit of the regime (Lekgoathi, 2012), with the Afrikaan language that was spoken by the White minority of the population being given an unfair advantage. This government-driven agenda has been found to be consistent with the principles that founded the BBC, which were to establish a monopoly in the broadcasting environment whose sustainability would not be reliant on consumer-oriented content, but on providing consumers strictly with what was deemed appropriate by the founders (Jenks, 2017). Nkiru Nwammuo and Salawu (2018) argue that the majority of African languages have been subjected to abuse, ridicule and belittlement in the global environment and, as a result, have remained unused in a similar manner to English, German and French. As such, for the public broadcaster in South Africa, multilingualism has gained importance in order to redress the effects of the past. South Africa's public broadcaster, in line with the resolution of the *Jabulani – Freedom of the Airwaves Conference* that took place in the Netherlands in 1991, has purposefully realigned in a manner that compels the corporation to adopt a multilingual approach in executing its duties and ensure that the nine (9) other indigenous official African languages, which include IsiNdebele, SiSwati, IsiXhosa, SePedi, SeTswana, TshiVenda, XiTsonga, IsiZulu and SeSotho, are afforded similar elevation in importance as English and Afrikaans, which have been enjoying preferential status (Horwitz, 2001). Apart from XK FM which was established in the year 2000, South Africa's ALSs were founded prior to 1994, during the apartheid period, and were given names that are in line with their languages of broadcast that include Radio Zulu, Radio Ndebele, Radio Xhosa, Radio Tsonga, Radio Venda, Radio Sesotho, Radio Swazi and Radio Tswana. According to Lekgoathi (2012:60):

> "After 1994, as a result of the new reconfigurations which were intended to indicate a turning point away from the separatist ethnic politics propounded by the apartheid government and realignment with the new values of a unitary South Africa, vernacular radio stations came up with new names and logos. Radio Ndebele was re-christened 'Ikwekwezi FM'; Radio Zulu became 'Ukhozi FM'; Radio Xhosa adopted the name 'Umhlobo Wenene'; Radio Sesotho was re-launched as 'Lesedi FM'; Radio Tswana was renamed 'Motsweding FM'; Radio Venda changed to 'Phalaphala FM'; Radio Tsonga identified as 'Munghana Lonene'; and Radio Swazi chose the name 'Ligwalagwala FM'."

According to the Broadcast Research Council of South Africa (BRC), by the end of February 2023, ALSs which are within the control of the SABC commanded the following listenership:

Table 1: Listenership of African language stations of the SABC

Source: (BRC, 2023)

RADIO STATION (ALSs)	**LANGUAGE**	**LISTENERSHIP ('000s)**
Ukhozi FM	IsiZulu	7,686
Umhlobo Wenene FM	IsiXhosa	4,219
Lesedi FM	SeSotho	3,611
Motsweding FM	SeTswana	3,114
Thobela FM	SePedi	2,628
Ikwekwezi FM	IsiNdebele	1,193
Ligwalagwala FM	SiSwati	1,284
Phalaphala FM	TshiVenda	1,239
Munghana Lonene FM	XiTsonga	1,412
XK FM	Xǔntali (!Xǔ), Khwedam (Khwe) and Afrikaans	0.006
TOTAL		**26,386**

The South African radio landscape is currently regulated by ICASA and radio stations operate within stipulated guidelines which are imbedded in their licence conditions that prescribe the language of broadcast to be used, the type of content to be broadcast, and the quotas of local and international music to be played (Boshoff & Jaarsveld, 2019). ALSs currently reach more than 70% of South Africa's radio consumers, and more than 10 million radio sets are currently being used to access the radio media in the country (Teer-Tomaselli, 2017).

Technology Acceptance Model (TAM)

The origin of the Technology Acceptance Model (TAM) is located in Fishbein and Ajzen's 1975 Theory of Reasoned Action (TRA) (Rafdinal & Senalasari, 2021). The conceptualisation of this model comes from the need to predict how individuals accept technological innovation within a work environment (Schiffman *et al.*, 2014). Even though the connection between attitude, intention to use and behaviour has been known to exist in TRA, TAM has also been found to be a better model to use when this relationship transcends to the prediction of behaviour and the actual usage of technological products (Alsaleh, 2017). Fishbein and Ajzen's TAM hypothesis posits that actual usage is influenced by the combination of the attitude of an individual towards acting in a particular manner, beliefs associated with acting out in line with the said beliefs and the assessment of the results (Bianchi & Andrews, 2018). With TAM, individuals' intention to use and actual usage of technological products are factors of the perceived ease of use and perceived usefulness of the product (Roy *et al.*, 2018).

Regarding the exploration of these constructs in the context of the consumption of mass communication media technology, factors that are uniquely shaping each individual market need to be fully appreciated (Balbi & Winterhalter, 2013). Through this approach it is appreciated that even though consumers may be driven by the human or psychographic-oriented influences in deciding in their consumption decisions, they may equally be be swayed by demographic ones (Krajina & Karalić, 2017). TAM's accuracy in explaining actual usage and intention to use was evident in Schepers & Wetzel's (2007) meta-analytical model; in Chen & Huang (2016) *Domestic Technology Adoption: Comparison of Innovation Adoption Models and Moderators*; and in Lim *et al.*, (2021) *How digital natives perceive and react toward online advertising? Implications for SMEs* where it was integrated with the Uses and Gratification theory and Theory of Planned Behaviour (TPB) (Fishbein & Ajzen, 2011). This theory, however, has hardly been put to the test within the context of mass communication media such as radio even though its continued enhancement has aided in the better understanding of the functioning of its constructs (Davis *et al.*, 1989) in technological media adoption. Literature that has been found to be leaning towards demonstrating TAM and communication technology has largely been around the adoption of health-related information and communication technology (Kang & An, 2020). With that, it has become necessary to understand TAM from a media consumption perspective and develop an understanding of

the effects of external variables that manifest in subjective norms (SN) on both perceived usefulness (PU) and perceived ease of use (PEOU), which in turn have an effect on consumer attitude (AT) and result in the development of intention to use (IU) and ultimately in the actual usage (AU) of technological products. This study, therefore, aims to explore the evolutionary adaptation of TAM, as refelected in Figure 1, within consumer behaviour in a manner that contextualises its applicability in the usage of African language radio stations by the Generation Y consumer cohort in South Africa.

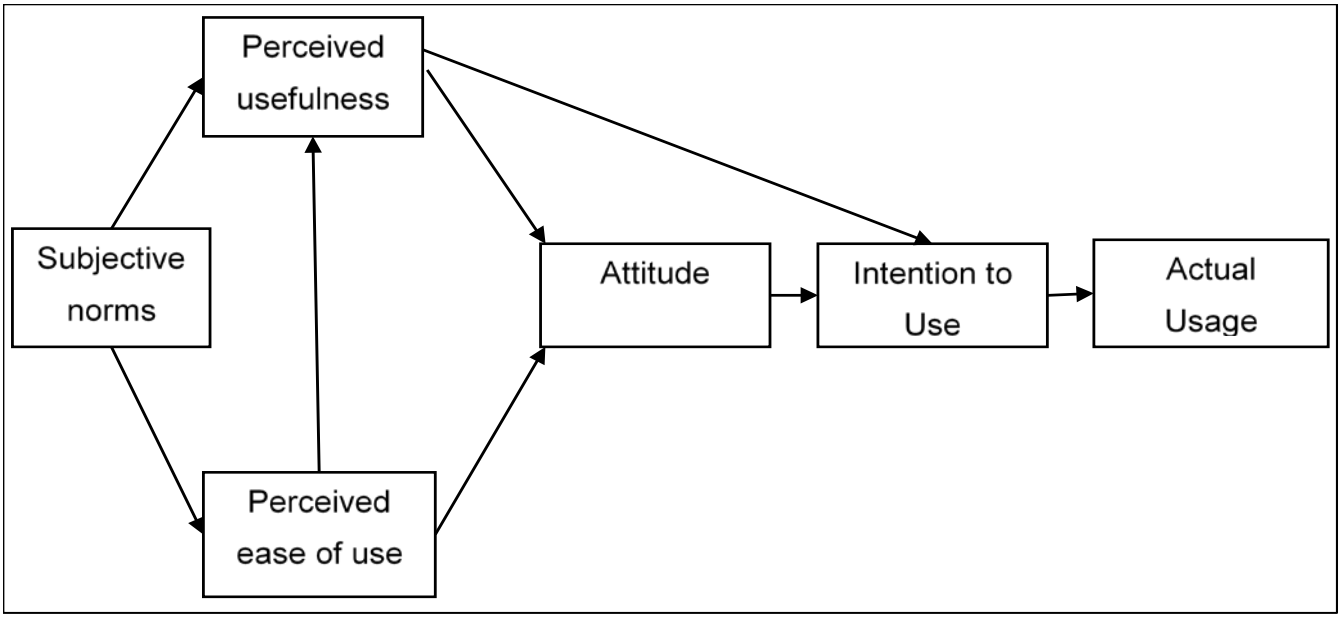

Figure 2.3: Technology Acceptance Model (TAM)

Source: (Davis *et al.,* 1989)

The hypothesised TAM framework for this study, therefore, puts to the test the convergence of subjective norms (SN), perceived ease of use (PEOU), perceived usefulness (PU), attitude (AT) and intention to use (IU) as factors that influence the actual usage (AU) of technological media that include ALS in South Africa. Based on the the presented literature, this study presents the following hypothesis:

$H_0$1 - The usage of African language radio stations is not driven by a six-factor TAM structure comprising of actual usage, intention to use, attitude, perceived usefulness, perceived ease of use and subjective norms.

H_a1 - The usage of African language radio stations is driven by a six-factor TAM structure comprising of actual usage, intention to use, attitude, perceived usefulness, perceived ease of use and subjective norms.

Generational theory and South Africa's Generation Y market

Generational theory is premised on developing an understanding of the differences between one generation of individuals and another (Wolf *et al.*, 2005). Using demographics as a basis for segmentation, marketers break down consumer markets using shared commonalities such as age (Holbrook & Schindler, 1996) to develop knowledge into generational groupings. The segmentation of markets based on generational groupings is stereotypical in nature, due to the camaraderie that is perceived to be shared by members of each particular segment (Jones *et al.*, 2018). Stereotypes are founded on the assumption that by being born within a particular period, individuals would have innate similarities in their beliefs, attitudes, ideas and values (Brosdahl & Carpenter, 2011). These internal common traits would be a product of external influences that emanate from political, economic, social and technological macro-environmental factors (Özkan, 2017). However, it becomes both impractical and unfeasible to expect external macro-environmental features to connect individuals of the world into "neat, homogenous groups" (Lappeman *et al.*, 2020:7). With globalisation, migration and the dilution of homogenous societies on the rise, more now than ever before (International Organisation for Migration, 2010), generational markets are clearly becoming diverse.

A deeper understanding of generational theory shows that although consistencies and common traits may be shared by individuals belonging to a particular generational grouping, the distinctiveness of societies also develops potential differences among subdivisions of global intergenerational cohorts (van der Walt, 2016). To this end, scholars have since introduced region-specific terminology such as "Apartheid Generation", "Struggle Generation" and "Transition Generation" in an attempt to curate contextualised equivalents of Baby Boomers, Generation X and Generation Y cohorts respectively with a South African-specific lens (Lappeman *et al.*, 2020). Some scholars have further argued that the psychological effects of geo-political events that took place in some countries have shown to have a propensity to result in those countries' generational cohorts displaying different profiles from the ones presented by other cohorts in the rest of the world (Bauer *et al.*, 2017). This exemplifies that while generational cohorts are globally regarded as being formed by individuals who share similarities in characteristics, elements such as multiculturalism and socialisation (Arsenault, 2004) also play a role in shaping unique markets. With van der Walt (2016) further using the end of apartheid as an example of a major event that would have socialised generational cohorts in a unique manner, it is apparent that South Africa's generational markets, being by-products of such a historical episode, are likely to have attributes that are different from those that are noticeable from their generational cohort counterparts in the rest of the world.

South Africa's Generation Y constitute thirty-five percent (35%) of the total population of the country and form fifty-four percent (54%) of the country's working populace, in a country with a population of almost 60 million individuals (Statistics South Africa, 2018). Statistics South Africa further revealed that almost fifty percent (50%) of the Generation Y market in the country were employed and 16 million of these

individuals had access to credit funding (Statistics South Africa, 2018; Transunion, 2019). The magnitude of Generation Y makes this one market that is more than twice the size of the generational groupings that precede it and this, by extension, presents this cohort as an attractive prospect to marketers (Huntley, 2006). Considering that seventy percent (70%) of this market's income is said to be consumed on satisfying personal wants and needs through the purchase of commodities such as travels and food (Albarran *et al.*, 2007) Generation Y renders itself a fertile market to marketers. While some scholars have argued that Generation Y continues to prefer the radio medium for music and information, common Generation Y literature emphasises that this market prefers to engage through non-traditional digital media such as Twitter and Facebook, therefore, marketers would also need to follow them to those platforms (Ave *et al.*, 2015). However, considering Van Schalkwyk's (2019:56) assertion that "South African Generation Y also grew up in one of the most unequal societies in the world and they are not yet free from poverty and inequality", it requires scholars to recognise that this market's unavoidable exposure to ALSs and their usage of media that are as easily available and richly supported in this manner, presents a dichotomy worth exploring.

Research design and methodology

A quantitative research approach was adopted for this study and a survey was the preferred method of data collection. The target population for this study was South African of all genders who were born in the period between 1986 and 2005 who are exposed to radio media. A non-probability convenience sample of 500 Generation Y South Africans that are between the ages of 18 and 36 years was performed, and self-administered questionnaires were sent to respondents using social media and connectivity platforms that include Facebook, Twitter and WhatsApp. The research instrument was then distributed as an online link amongst sampled respondents who were then afforded an opportunity to complete the survey electronically. The furnished questionnaire was automatically returned to the researcher through the online-based data collection platform called SurveyMonkey. From the 494 completed questionnaires, 350 were found to be usable.

The structure of the questionnaire ensured that different elements of data would be collected using the multi-item Linkert scale that has questions with responses ranging from strongly disagree (1) to strongly agree (5). Demographic information that included the respondent's province of origin, gender, race, age, first language and highest educational qualification was gathered using Section A. This data ensured that the study would have a wider representation and data analysis became enriched. The TAM constructs were measured using Section B to Section G. Section B collected data on actual usage in AU1 – AU4 (Al-Rahmi *et al.*, 2022), Section C focused on intention to use through IU1 – IU4 (Nysveen, 2005; Shin, 2009), attitude was measured in Section D from AT1 – AT4 (Marakarkandy *et al.*, 2017), Section E assessed perceived usefulness on PU1 – PU4 (Liu & Luo, 2022; Nysveen, 2005; Wang,

2015), Section F was used for perceived ease of use with PEOU1 – PEOU4 (Marakarkandy *et al.*, 2017; Venter *et al.*, 2012) and subjective norms were measured in Section G through SN1 – SN4 (Jin, 2014; Yoon & Rolland, 2015).

Reliability and validity of the measurements

Reliability analysis

Reliability analysis was conducted to ascertain the quality of the measurement model through the testing of its stability and consistency using the Cronbach alpha and composite reliability. The results are presented in Table 2.

Table 2. Reliability analysis and Composite reliability analysis

Items	Number of items	Cronbach's Alpha	Composite reliability (rho_a)
Actual usage	4	0.928	0.930
Intention to use	4	0.939	0.940
Attitude	4	0.914	0.918
Perceived usefulness	4	0.911	0.919
Perceived ease of use	3	0.602	0.827
Subjective norms	4	0.885	0.888
Statistically significant at p<0.05			

All the scales indicate reliability by presenting Cronbach's alpha values that are above Wiid and Diggines' (2013) 0.60 minimum. Recommended composite reliability values need to be higher than 0.70, however to avoid redundancy values should not be above 0.95, while satisfactory to good internal consistency is derived from composite reliability values that are above 0.7 but below 0.95 (Hair et al., 2011; Hair *et al.,* 2019). Composite reliability (rho_a) is presented in Table 2 wherein its calculation with respect to all constructs returned values that are below 0.95. Internal consistency and the reliability of the measurement model were thus asscertained.

Validity analysis

Convergent validity and discriminant validity were used to assess the effectiveness of the measurement instrument in measuring what it intends to (Souza *et al.*, 2017). Convergent validity was presented as an analysis method that compared similarities of the test to other ones that measure with similar constructs (Saunders *et al.*, 2015). This validity test was conducted using the Average Variance Extracted (AVE), wherein only values that are above 0.50 were considered as acceptable (Hair *et al.*, 2014). AVE tends to be regarded as a more conformist estimator of validity as it reflects the amount of

variance in suppressed constructs (Fornell & Larcker, 1981). This study's convergent validity analysis of this study returned above average AVE values for actual usage (0.824), intention to use (0.846), attitude (0.796), perceived usefulness (0.789), and subjective norms (0.744). The analysis produced a lower AVE value for one of the constructs, which is perceived ease of use (0.389). However, according to Fornell and Larcker (1981), even though a minority of constructs may have an AVE that is lower than 0.5, for as long as all the Cronbach's alpha and the composite reliability values of the measures are above the acceptable minimum levels, the measurement items should be seen as having strong internal reliability. Given this together with the results reflected above it was deduced that the measurement model passed the convergent validity test.

Correlation analysis

The performance of correlation analysis was used to test the strength and direction of the relationship between variables (Saunders *et al.*, 2015). Correlation coefficient values are considered adequate when they lie between -1 and 1, and a positive correlation between two variables signifies that as the value of one variable increase, so does the value of another (Wiid & Diggines, 2013). The Pearson's Product-Moment correlation coefficient was applied in constructing the correlation matrix and the results are outlined in Table 3.

Table 3. Correlation analysis and discriminant validity

Construct	1	2	3	4	5	6
1. Actual usage	0.907					
2. Intention to use	0.754**	0.919				
3. Attitude	0.641**	0.798**	0.892			
4. Perceived usefulness	0.678**	0.713**	0.784**	0.888		
5. Perceived ease of use	0.162**	0.233**	0.159**	0.133**	0.623	
6. Subjective norms	0.647**	0.681**	0.688**	0.712**	0.192**	0.862
****Correlation is significant at the 0.05 level (2-tailed)**						

Correlation coefficient values which are greater or equal to (≥) 0.5 indicate a strong to perfect correlation, withi those that returned values that are smaller than 0.5 demonstrating medium to small correlations. The results of the study, as presented in Table 3, demonstrate the existence of positive correlations between all the TAM sets of constructs that were tested at a significance level of 0.05. The outcome of the correlation analysis test between tested variables was thus proven, and that rendered the model as fit for the performance of structural equation modelling (SEM). Furthermore, the discriminant validity test was performed to establish the extent to which latent variables differ from one another (Rönkkö & Cho, 2022). In order to attain discriminant validity, a latent variable ought to account for bigger variance when placed against associated indicator variables, more than it accounts when placed against any other

construct within the same model (Fornell & Larcker, 1981). Table 3 presents the discriminant validity; and with all variables accounting for the sought variances, the measurement model's discriminant validity was proven.

Results

Data analysis

Characteristics of the respondents are presented in Table 4, and these contain the respondents' gender, age, race, first language, province of origin and highest level of education. The frequency and percentages of the participats' responses to questions presented with respect to individual constructs are also outlined.

Characteristics of the respondents

Table 4. Respondent characteristics (n = 350)

Variables		Frequency (n)	Percentage (%)
What is your gender?	Male	107	30.6
	Female	240	68.6
	Other	3	0.9
What is your age?	18-24	151	43.1
	25-29	101	28.9
	30-36	98	28.0
What is your race?	Black	272	77.7
	Coloured	15	4.3
	Indian/Asian	34	9.7
	White	29	8.3
	Other	3	0.3
What is your first language?	Afrikaans	8	2.3
	English	85	24.3
	IisNdebele	72	20.6
	IsiXhosa	20	5.7
	IsiZulu	43	12.3
	Sepedi	44	12.6
	Sesotho	10	2.9
	Setswana	18	5.1
	SiSwati	21	6.0
	Tshivenda	10	2.9
	Xitsonga	19	5.4
	Other	3	0,3

What is your province of origin?	Eastern Cape	17	4.9
	Free State	11	3.2
	Gauteng	118	33.7
	KwaZulu Natal	31	8.9
	Limpopo	59	16.9
	Mpumalanga	100	28.6
	Northern Cape	2	0.6
	North West	4	1.1
	Western Cape	8	2.3
What is your highest level of education?	Did not complete high school	4	1.1
	High school	120	34.3
	College graduate	41	11.7
	University Diploma	28	8.0
	University degree	95	27.1
	Postgraduate degree	62	17.1

The study's gender representation was unevenly split: more females (68.6%) than males (30.6%) participated, and participants who fall under the 'other' catergory being in the minority (0.9%). The collected data revealed that participants' ages ranged from between 18 to 24 (43.1%), 25 to 29 (28.9%) and 30 to 36 (28%). The study had a wide representation in race, with Black at 77.7%, Coloured at 4.3%, Indian/Asian at 9.7% and White at 8.3%. All eleven official languages of South Africa had a form of representation in the study, and participats' first languages included English (24.29%), isiNdebele (20.57%), Sepedi (12.57%) and isiZulu with (12.29%) in the majority. Participation was also drawn from first language speakers of SiSwati (6.00%), isiXhosa (5.71%), Xitsonga (5.43%), Setswana (5.14%), Sesotho (2.86%), Tshivenda (2.86%) and Afrikaans (2.29%). A bigger proportion of participants originated from the provinces of Gauteng (33.7%) and Mpumalanga (28.6%), with a minority originating from Limpopo (16.9%), Kwazulu-Natal (8.9%), Eastern Cape (4.9%), Free State (3.1%), Western Cape (2.3%), North-West (1.1%) and Northern Cape (0.6%). All Generation Y respondents in the study had some form of basic formal education, with high school education being something that almost 90% of them possessd. Participants indicated that they had completed high school (34.3%), some possessed a university degree (27.1%) and a significant proportion having completed a postgraduate degree (17.7%). Some respondents completed a college diploma (11.7%), a university diploma (8.0%), and a minority did not complete high school (1.1%). The actual usage (AU) construct was measured from AU1 – AU4 (Al-Rahmi *et al.*, 2022) in Section B, Section C determined intention to use (IU) through the usage of questions IU1 – IU4 (Nysveen, 2005; Shin, 2009), attitude (AT) was measured on Section D using AT1 – AT4 (Marakarkandy *et al.*, 2017), while Section E measured perceived usefulness (PU) with questions PU1 – PU4 (Liu & Luo, 2022; Nysveen, 2005; Wang, 2015), perceived ease of use (PEOU) on Section F with PEOU1 – PEOU4 (Marakarkandy *et al.*, 2017; Venter *et al.*, 2012) and subjective norms measured in Section G with SN1 – SN4 (Jin, 2014; Yoon & Rolland, 2015).

Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis (CFA) is necessary in confirming the theoretical model (Alavi *et al.*, 2020) and in the context of this study, it was performed through construct validity and model fit indices. This exercise is perfomed in order to ensure that inferences that are made based on the study's results are not founded on models that have a poor fit (Field, 2013). IBM Analysis of Moment Structure (AMOS) version 28 was used to conduct CFA and the CFA model fit indices are presented in Table 5. Model fit indices are used to determine the overall model fit while also establishing how it compared to a given theoretical model (Schermelleh-Engel *et al.*, 2003). Indices that were tested include the Chi-square, root mean square error and approximation (RMSEA), standardised root mean square residual (SRMR), goodness-of-fit, Tucker-Lewis index (TLI), comparative fit index (CFI), normed fit index (NFI), relative fit index (RFI) and incremental fit index (IFI).

Table 5. Model fit indices

Absolute and Relative Fit Indices	**Recommended Values**	**References**	**Actual Usage**	**Intention to Use**	**Attitude**	**Perceived Usefulness**	**Perceived Ease of Use**	**Subjective Norms**
Chi-Square p-value	>0.05	(Barret, 2007)	0.805	0.957	0.540	0.664	0.011	0.096
Root Mean Square Error of Approximation (RMSEA)	<0.07	(Steiger, 2007)	0.000	0.000	0.000	0.000	0.125	0.062
Standardised Root Mean Square Residual (SRMR)	<0.08	(Hooper *et al.,* 2008)	0.002	0.000	0.002	0.004	0.035	0.017
Goodness-of-Fit Statistic (GFI)	>0.95	(Shevlin & Miles, 1998)	1.000	1.000	0.999	0.999	0.991	0.993
Tucker-Lewis Index (TLI)	>0.90	(Schumaker & Lomax, 2004)	1.005	1.005	1.004	1.004	0.894	0.989
Comparative Fit Index (CFI)	≥ 0.95	(Hu & Bentler, 1999; West *at al.,* 2012)	1.000	1.000	1.000	1.000	0.982	0.996
Normed Fit Index (NFI)	≥0.95	(Hu & Bentler, 1999)	1.000	1.000	1.000	0.999	0.980	0.994
Relative Fit Index (RFI)	>0.90	(Bollen, 1989)	1.000	1.000	0.998	0.997	0.877	0.981
Incremental Fit Index (IFI)	>0.90	(Bollen, 1989)	1.001	1.001	1.001	1.001	0.983	0.996

The chi-square test requires that a construct attains a p-value statistic that is higher than 0.05 for a good model fit to be achieved (Barrett, 2007).. A chi-square value that is close to zero together with a p-value

that is greater than 0.05 are indicative of a minimal difference between expected and observed covariance matrices (Holtzman & Vezzu, 2011). This study's measure for actual usage had a p-value > 0.05 (p = 0.805), intention to use achieved p > 0.05 (p = 0.957), attitude computed a p-value >0.05 (p = 0.540), and perceived usefulness returned a p-value > 0.05 (p = 0.096). The chi-square for the perceived ease of use construct demonstrated a poor fit with a p-value < 0.05 (p = 0.011). Of the six constructs that were tested, actual usage, intention to use, attitude, perceived usefulness and subjective norms demonstrated good fit, while perceived ease of use returned a value that is indicative of a poor fit. This variation may be a result of the magnitude of the sample size that was tested.

The Root Mean Square Error of Approximation (RMSEA) indicates how well the model would fit the population covariance matrix when using carefully chosen estimates (Byrne, 2013). A root mean square error approximation (RMSEA) value of less than 0.07 represents a close model fit, while values that are above 0.08 imply a reasonable fit. For this study to pass the good fit test, values of the RMSEA needed to be less than 0.07 (Steiger, 2007). The results of the study for actual usage (0.000), intention to use (0.000), attitude (0.000) and perceived usefulness (0.000) presented values that are below the recommended 0.07 cut-off and represent a perfect fit. The three-item perceived ease of use generated a value higher than the cut-off threshold (0.125), and this construct indicated a poor model fit. Subjective norms returned an acceptable value (0.062), which is an indication of a good model fit. The Standardised Root Mean Square Residual (SRMSR) index represents the average of the standardised residuals between the covariance observed from the empirical data and the hypothesised ones (Chen, 2007). The conversion of a scale from a four-item to a three-item one, as reflected on perceived ease of use, necessitated the SRMSR test to ensure easier interpretation (Coughlan *et al*., 2008). For the SRMSR test to be acceptable, computed values need to range between 0 and 0.1. The calculation of SRMSR values yielded results that proved actual usage (0.002), intention to use (0.000), attitude (0.002), perceived usefulness (0.004), perceived ease of use (0.035), and subjective norms (0.017) demonstrated acceptable indices.

The Goodness-of-Fit statistic (GFI) is an alternative to the chi-square test that ranges between 0 and 1, with values that are greater than 0.95 regarded as adequate (Shevlin & Miles, 1998; Tabachnick & Fidell, 2013). In this study, values for actual usage (1.000), intention to use (1.000), attitude (0.999), perceived usefulness (0.999), perceived ease of use (0.991), and subjective norms (0.993) were found to be within the 0 to 1 range, and above 0.95. The goodness of fit statistic, therefore, is accepted.

The Tucker-Lewis Index (TLI) is one of the incremental fit indices that are trusted in linear mean and covariance structure modelling (Cai *et al.*, 2021). This index computes the reduction of misfit per degree of freedom with values greater than 0.90 being the most desired (Schumacker & Lomax, 2010). The results of this index in the study indicated that actual usage (1.005), intention to use (1.005), attitude

(1.004), perceived usefulness (1.004), perceived ease of use (0.894) and subjective norms (0.989) centred on the sought 0.9 figure. The outcome of this index indicates an acceptable fit.

A good model fit needs to produce a Comparative Fit Index (CFI) greater than 0.95, even though values between 0.90 and 0.95 represent an acceptable fit. As expected, CFI values of actual usage (1.000), intention to use (1.000), attitude (0.999), perceived usefulness (0.999), perceived ease of use (0.991), and subjective norms (0.993) are above 0.95 and, as indicated by Hu and Bentler (1999), represent a good model fit. The Normed Fit Index (NFI) statistic values need to be between 0 and 1, with values exceeding 0.95 indicating a good fit and below 0.90 regarded as a poor fit. The computation of the NFI resulted in actual usage (1.000), intention to use (1.000) and attitude (1.000) representing the highest values. Perceived usefulness (0.999), perceived ease of use (0.980) and subjective norms (0.994) also exceeded the good-fit test. The yielded NFI measure is between 0 and 1, which indicates that the model is a good fit. The relative fit index (RFI) represents the adjusted Tucker-Lewis Index (TLI) measure (Jöreskog & Sörbom, 2001). The RFI is regarded as being a good fit when individual constructs produce values that are greater than 0.90 (Bollen, 1989). Individual constructs in this study, that include actual usage (1.000), intention to use (1.000), attitude (0.998), perceived usefulness (0.997), and subjective norms (0.981) returned adequate results. Perceived ease of use (0.887) returned a marginal fit.

According to Bollen (1989), the Incremental Fit Index **(**IFI) measure needs to exceed 0.90, with values of zero indicating the worst possible model and values of one reflecting the best possible model. All values computed in this study are centred on 1. The four constructs of Actual usage (1.001), intention to use (1.001), attitude (1.001) and perceived usefulness (1.001) returned a similar value, while perceived usefulness (0.983) and subjective norms (0.996) were the lowest of the measure. The overall performance of the IFI measure indicated a good model fit. While five of the six chi-square results returned values that demonstrate good model fit, the chi-square is not the only measure that is critical in the model fitness test. Indices that include RMSEA, SRMR, GFI, TLI, CFI, NFI, RFI and IFI also presented values that are indicative of a marginal to good model fit. Marsh *et al.* (2004) cautions against over-adhering to the minimum threshold fitness values as this may result in Type I error and, subsequently, in the incorrect rejection of an acceptable model. In order to minimise the occurrence of errors and improve model fitness, individual constructs are modelled in conjunction with each other in order to establish whether discriminant validity has been achieved (Coughlan *et al*., 2008).

Structural Equation Modeling (SEM)

The assessment of the structural model in the study was conducted to evaluate the structural relationship between measured variables and compressed ones. The t-values, path-coefficients and coefficient of determination (R^2) were used in the assessment of the structural equation model. The

results of the relationship between the constructs that include actual usage (AU), intention to use (IU), attitude (AT), perceived usefulness (PU), perceived ease of use (PEOU), and subjective norms (SN) are presented as part of the structural equation model in Figure 1.

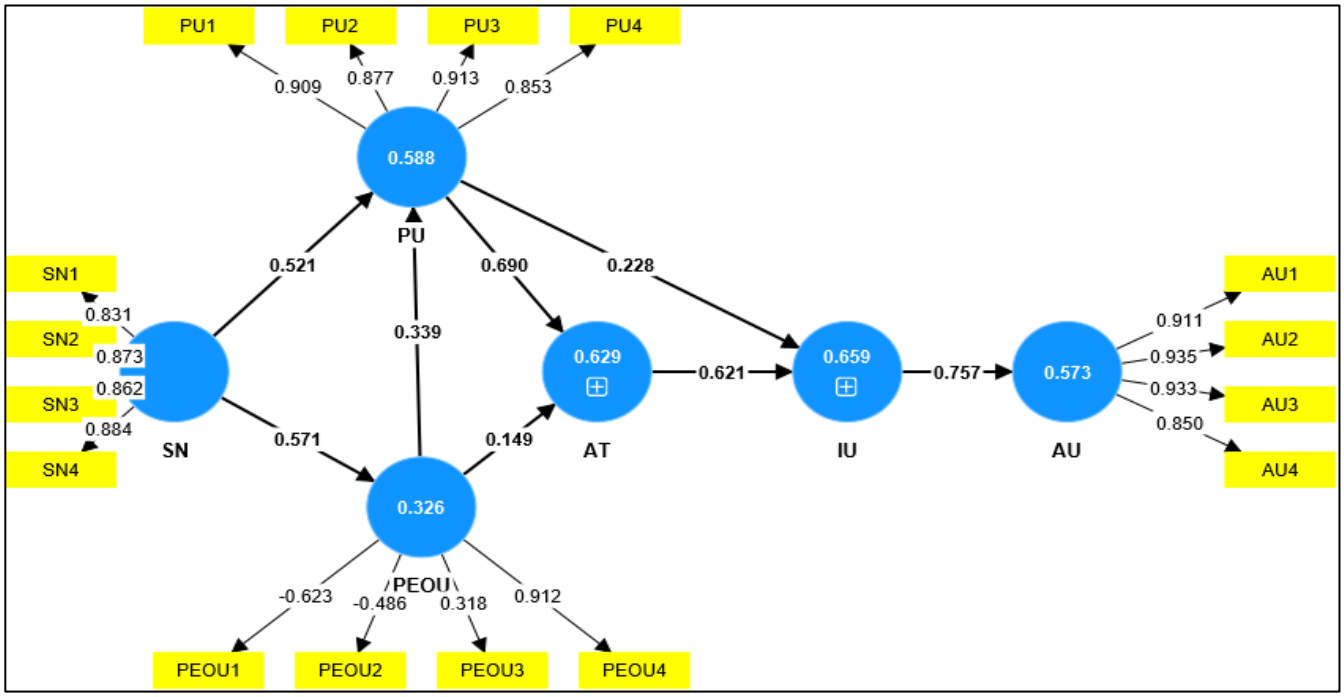

Figure 1: Structural Equation Model

Source: (Ntuli, 2023)

The measurement model demonstrated an acceptable model fit, together with acceptable levels of Cronbach's alpha, composite reliability, convergent validity and discriminant validity. At a significance level of a=0.05, this outcome was used to test the following hypothesis:

$H_0$1 - The usage of African language radio stations is not driven by a six-factor TAM structure comprising of actual usage, intention to use, attitude, perceived usefulness, perceived ease of use and subjective norms.

H_a1 - The usage of African language radio stations is driven by a six-factor TAM structure comprising of actual usage, intention to use, attitude, perceived usefulness, perceived ease of use and subjective norms.

The performance of the assessment model produced positive relationships and strong path co-efficients between the Technology Acceptance Model (TAM) constructs: intention to use (IU) and actual usage (IU -> AU = 0.757), attitude and intention to use (AT -> IU = 0.621), perceived usefulness and intention to use (PU -> IU = 0.228), perceived usefulness and attitude (PU -> AT = 0.69), perceived ease of use

and perceived usefulness (PEOU -> PU = 0.339), perceived ease of use and attitude (PEOU -> AT = 0.149), subjective norms and perceived usefulness (SN -> PU = 0.521), and subjective norms and perceived ease of use (SN -> PEOU = 0.571). Given the relationships that are evident in the measurement model, together with the positive relationship between constructs, the alternative hypothesis, H_a1, is supported and its alternative, H_01, rejected. The results indicate that the usage of African language radio stations is driven by a six-factor structure comprising of actual usage, intention to use, attitude, perceived usefulness, perceived ease of use and subjective norms.

Discussion and conclusion

This study's objective was to determine the applicability of the Technology Acceptance Model (TAM) (Davis *et al.*, 1989) in the usage of African language radio stations by Generation Y in South Africa. According to the assessment of the measurement model, TAM constructs influence one another and do with the positive relationships and moderate to strong path co-efficients collaborate in explaining the usage of ALS by Generation Y in South Africa. This has been evident through intention to use (IU) and actual usage (IU -> AU = 0.757), attitude on intention to use (AT -> IU = 0.621), perceived usefulness on intention to use (PU -> IU = 0228), perceived usefulness on attitude (PU -> AT = 0.690), perceived ease of use on perceived usefulness (PEOU -> PU = 0.339), perceived ease of use on attitude (PEOU -> AT = 0.149), subjective norms on perceived usefulness (SN -> PU = 0.521), and subjective norms on perceived ease of use (SN -> PEOU = 0.571). The outcome of the study as demonstrated in Figure 2, indicate the applicability of Davis *et al.* (1989) TAM in the usage of technological products such as African language radio stations by Genaration Y in South Africa. This TAM investigation has unearthed relationships between sets of constructs that allow for a deduction to be made that TAM may be used in studies that pertain to the consumption of African language radio stations (ALS) in South Africa, and possibly in other researches that investigate the consumption of indigenous language radio media in similar markets. ALSs constitute the biggest ensemble of radio media in South Africa and studying the factors that influence these media's consumption by the Generation Y market will assist marketers to better understand how to target consumers such as Generation Y and how to make ALSs attractive media options to both advertisers and consumers. This investigation has drawn marketers to the South African Generation Y's intention to use, attitude, perceived usefulness, perceived ease of use and subjective norms with respect to the usage of African language radio stations. This study further provided valuable contribution in addressing Teer-Tomaselli's (2019) contention about how limited radio media research is in Africa, while also assisting marketers to recognise the consumer behavioural components that form part of Generation Y's usage of African language radio station in South Africa.

Limitations and future research

The limitations of the study include that a convenience non-probability sampling method was used on account of budgetary and practical limitations. The study further opted to utilise social media and connectivity platforms that include Facebook, Twitter and WhatsApp in targeting this South African market for reasons that include covering as wide a geographical area as possible. This approach excluded population members who are not using these platforms. Reasearches that are to be conducted in future may consider using different sampling methods, explore the usage of physical data collection means and possibly consider a longitudinal research design.

Disclosure statement

The authors have no conflict of interest to report. The authors are solely responsible for the content presented in this article.

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Can Technological Diversity in M&A Network Improve Enterprise Investment Efficiency?

Jie Tian[a], Xindong Zhang[a,*], and Yanna Lyu[b]

[a]*School of Economics and Management, Shanxi University, Taiyuan, China; Business School, China University of Political Science and Law, Beijing, China*

Jie Tian

School of Economics and Management, Shanxi University, Taiyuan, China

PhD student, Cell: 15635113985, Email: 0210tianjie@163.com. Research in the fields of M&A and Corporate Innovation. The research results were presented in the form of conference reports at international conferences in the related research fields and were awarded as outstanding, such as "The 18th Conference on Financial Systems Engineering and Risk Management" (FSERM' 2020), "2022 International Finance Conference on New Challenges to Financial Stability in the Post Covid-19 Era", "Role of Economic Systems, Institutions and Regulatory Frameworks in Business Finance and Governance" and "The 2nd International Conference on Financial Regulation and Financial Stability". She has led a number of projects, including the project of Education Accounting Society of China, Social and Economic Statistics Research Projects of Shanxi Province, etc. She is a reviewer of the Emerging Markets Finance and Trade.

Xindong Zhang

School of Economics and Management, Shanxi University, Taiyuan, China

Professor of Accounting and Finance, doctoral supervisor, Cell: 13834565781, Email: zhangxd@sxu.edu.cn. She is the leader of the key innovation team of "1331 project" of Shanxi Province and research in the fields of Corporate Innovation and Corporate Governance, etc. She has conducted academic exchanges and visits at Durham University Business School, Nottingham University Business School, University of Massachusetts Dartmouth Business School, etc. She has led a number of projects, including National Natural Science Foundation of China, etc. More than 100 papers have been published, including articles in Emerging Markets Finance and Trade, Economic Modelling, Finance Research Letter, etc.

Yanna Lyu

Business School, China University of Political Science and Law, Beijing, China

PhD student, Cell: 18801132289. Email: lvxiaoqibeyond@163.com. Research in the fields of Quality Innovation and Alliance Network.

ABSTRACT

This paper breaks through the homogeneity of M&A activities and the dyadic relationship between the acquirers and target firms. Taking Chinese A-share listed firms that have implemented M&A deals from 2010 to 2019 as samples and building the M&A network with a rolling time window of 5 years, we empirically explore the impact of technological diversity in M&A network on the enterprise investment efficiency, as well as the mechanisms. Our study reveals that technological diversity in M&A network has an inverted U-shaped effect on enterprise investment efficiency. Mechanism analysis shows that the technological diversity in M&A network affects enterprise investment efficiency through information disclosure quality and resource allocation efficiency. Heterogeneous analysis indicates that enterprise investment efficiency is more likely to be affected by the technological diversity in M&A network in the excessive investment of enterprises, for firms in the non-SOEs, firms with a higher degree of digital transformation and market competition, and in the eastern and central regions. Our study helps to enrich the theory of M&A and network technology diversification. These findings also provide novel insights into how acquirers select appropriate target firms and use their M&A networks to optimize the allocation of resources, improve the quality of information disclosure and investment efficiency.

Keywords: technological diversity in M&A network; enterprise investment efficiency; resource allocation efficiency; information disclosure quality

1. Introduction

China's economy is shifting from a stage of high-speed growth to a stage of high-quality development, and is in a critical period of transforming the development mode and optimizing the economic structure. The driving force of economic growth is also shifting from investment scale to investment efficiency (Yao et al., 2020). Investment activity is an important strategic decision for enterprises to create value. Improving the efficiency of enterprise investment is the breakthrough and balance point to promote the transformation of economic structure and achieve high-quality development, and it is the eternal goal pursued by enterprises. Therefore, the national "14th Five-Year Plan" proposes to "optimize the investment structure, improve the investment efficiency and maintain the reasonable growth of investment". As a method to effectively obtain external technical resources, M&A has become an important way for enterprises to improve management efficiency. According to the theory of M&A efficiency, the implementation of M&A

can optimize the allocation of resources, exert the scale effect, bring potential incremental income, and improve the capital operation efficiency of transaction participants. The implementation of unrelated mergers and acquisitions can form the "internal capital market", reduce the internal cost of capital, produce synergistic operation effect, obtain more investment opportunities, optimize investment decisions and improve investment efficiency. The 14th Five-Year Plan calls for the establishment of a number of emerging industries with complementary advantages and encourages mergers and reorganizations. A wave of cross-border mergers and acquisitions with unrelated technologies has also arrived (Wang and Zhang, 2022).

Some scholars have begun to study the impact of M&A on enterprise investment efficiency. Some scholars believe that M&A can broaden business scope, integrate internal and external resources, and improve enterprise investment efficiency (Fu and Hao, 2012). Ren et al. (2019) believe that overseas mergers and acquisitions will bring uncertainty of business integration and organizational restructuring, and reduce the investment efficiency of Chinese enterprises. It can be seen that there is no consensus on the effect of M&A on enterprise investment efficiency at present. The main reason is that scholars regard M&A as an "event", that is, M&A activities are considered to be homogeneous and M&A behaviors are characterized through dummy variables (Bartov et al., 2021). However, when the acquirer undertakes multiple M&As or the target has different patented technologies, existing approaches cannot accurately reflect the M&A behavior. A few scholars emphasize the technological differences between the acquirer and target firms (Yao et al., 2022; Huang and Cai, 2020); however, these studies only explore the dyadic relationship between the acquiring firm and the target firm, while not considering the M&A network comprising multiple target firms. The heterogeneous knowledge and technology possessed by network members are the core resources of a network (Wang et al., 2022). Based on the research of Jaffe (1986), Sampson (2007), Rodan and Galunic (2004), Phelps (2010) proposed the concept of "network-level technological diversity," which refers to the technological differences between a firm and its partners and among the partners. Phelps (2010) further proposed the measurement method. For M&A, the joint examination of network content as technological diversity that reflects both acquirers-target firms and target firms-target firms relationships must be considered. Accordingly, we propose the concept of "technological diversity in M&A network," which is defined as the level of technological difference between the acquirer and the target firm and between target firms. In the critical period of China's economic growth momentum from investment scale driven to investment efficiency driven, economic structure transformation and upgrading, improving the efficiency of enterprise investment is the top priority. This leads to the following research questions. How can acquirers choose target firms to improve the enterprise investment efficiency? What is the impact of technological diversity in M&A network on enterprise investment efficiency? What are the mechanisms underlying this phenomenon, and is the effect heterogeneous? Addressing these questions entails significance for strategically creating a full play to the M&A value and improve enterprise investment efficiency.

Based on the resource allocation theory and synergy effect theory, this study takes Chinese A-share listed firms that have implemented M&A deals from 2010 to 2019 as samples and use a moving five-year window to establish the M&A network. We examine the influence of technological diversity in M&A network on enterprise investment efficiency and explore the potential mechanism information disclosure quality and resource allocation efficiency, which provide an effective reference for acquirers to choose the target firms, thus solving the problem of

"stuck neck" and improving the quality of information disclosure and investment efficiency.

The major contributions of this study are as follows. First, we break through the "homogeneity" of M&A activities and the "dyadic relationship" between the acquirer and target firms, proposing the research theme "technological diversification in M&A network," building and measuring this index. Existing scholars have considered taken joint research and development activities and patent applications as the basis for constructing enterprise cooperative networks, and studied "technological diversity in R&D alliance network" (Sampson, 2007; Zeng et al., 2015; Chen et al., 2015) and "technological diversity in innovation network" (Zhao et al., 2021). Some scholars proposed "technological diversity in supplier network" (Gao et al., 2015; Li et al., 2017; Yu and Sun, 2020). This study provides new insights into network technological diversity from an M&A perspective, contributing to the M&A- and network-level technological diversity literature. Second, this paper provides a new perspective for the research on the factors affecting the investment efficiency of enterprises. Some scholars have paid attention to financial reporting (Chan and Liu, 2022), Senior Executive (Zhang et al., 2020; Jing and Xing, 2022), Economic Policy (Chay et al., 2023), Environmental Governance (Yu et al., 2021; Gao et al., 2021), but few scholars pay attention to the impact of "network technology diversification" on enterprise investment efficiency. This paper examines the impact of technological diversity in M&A network on enterprise investment efficiency, and expands the research on the influencing factors of enterprise investment efficiency. Thirdly, this paper studies the mechanism of the influence of the technological diversity in M&A network on the enterprises investment efficiency. From the perspective of "resource-information", this paper explores its mechanism, constructs the theoretical framework and transmission path of "technological diversity in M&A network--enterprise resource allocation efficiency and information disclosure quality--enterprise investment efficiency", and opens the black box of how to improve enterprise investment efficiency through M&A.

2. Hypotheses Development

2.1. Technological Diversity in M&A Network and enterprise investment efficiency

The investment activities of enterprises are a dynamic process (Zhang et al., 2017). According to the dynamic capability theory, in the ever-changing external environment, enterprises create and expand the resource base by means of dynamic capability, constantly seek opportunities, and continuously obtain competitive advantages. As a kind of high-level capability and dynamic capability, network technology diversification can enrich and create enterprise resources, change and expand the scope of capability, and improve the efficiency of enterprise investment. Specifically, firstly, M&A is an important external source for enterprises to acquire new technologies. The diversification of M&A network technologies enables enterprises to have more heterogeneous knowledge and resources. New technologies of the target enterprises can enrich the "resource pool" and "technology pool" of enterprises, broaden the existing technology paths (Sampson, 2007), and realize complementary technological advantages. Improve the level of operation and competitive advantage, access to more investment opportunities, improve investment efficiency. Second, investment is usually characterized by great uncertainty.

Enterprises can introduce new technologies, information and resources through the merger and acquisition network with diversified technologies to reduce the uncertainty brought by investment and the volatility of business operation, optimize investment behavior, diversify investment risks, reduce investment costs and improve investment efficiency. At the same time, when enterprises make efforts in multiple technical fields, they can more accurately identify cutting-edge technologies (Acosta et al., 2018) and investment opportunities, reduce the dependence on a single technology, improve technical flexibility, avoid technology locking problems caused by enterprises focusing on specific technical fields, reduce the possibility of wrong investment, reduce investment risk and improve enterprise investment efficiency. Thirdly, the diversified technology M&A network enables enterprises to have more communication with the outside world. Especially in the aspect of specialized technology, enterprises can obtain more important external information, so as to identify better investment opportunities and improve investment efficiency. Fourthly, the establishment of a diversified technology M&A network can help enterprises to break the fixed knowledge framework to think, transcend the traditional technology constraints, form a novel thinking mode, bring new ideas for enterprises, provide new ideas, seize new investment opportunities, make up for technical defects, enhance the development advantages of enterprises, and improve the investment efficiency of enterprises. At the same time, the acquisition of network technology diversification will bring enterprise managers a broader strategic vision and rich professional technology, thus improving the decision-making process and investment efficiency (Huang and Luan, 2022).

However, if mergers and acquisitions network technology diversification degree is too high, that will have negative effects. On the one hand, the conflict theory holds that different types of organizations have certain differences in culture, resources and other aspects. When the diversity of network members exceeds a certain degree, communication barriers will easily occur among organizations, resulting in certain conflicts (Nonaka, 2007). Information communication and knowledge transfer between organizations are not smooth, which is not conducive to effective investment decisions of enterprises. On the other hand, based on the transaction cost theory, the heterogeneity of network members will increase the search cost and management cost of enterprises, and the search of heterogeneous partners in other fields is characterized by information asymmetry, uncertainty and complexity at the beginning of network construction. The heterogeneity of network members makes the management structure more complicated and the cost increases continuously, which is not conducive to optimizing the decision-making process and effectively identifying investment opportunities, thus reducing the investment efficiency of enterprises. Therefore, there is an inverted U-shaped relationship between M&A network technology diversification and enterprise investment efficiency. Specifically speaking: under the appropriate degree of M&A network technology diversification, improving the level of M&A network technology diversification is conducive to improving the investment efficiency of enterprises, but it will reduce the investment efficiency after a certain degree. Therefore, this paper proposes the following research hypothesis:

H1: The technological diversity in M&A network has an inverted U-shaped effect on the enterprise investment efficiency.

2.2. The Mechanism of Resource Allocation Efficiency

Merger and acquisition of network technology diversification is conducive to the optimal allocation of enterprise resources. First, it needs to avoid repeated investment and allocate resources effectively. Merger and acquisition of network technology diversification can bring more heterogeneous technologies and high-quality assets to enterprises. Centralized research and development can effectively avoid the repetition and redundancy of research and development investment, reduce the risks and uncertainties in the process of internal research and development, save the cost of technical elements, and better realize the optimal allocation of resources. Second, we should fully absorb and integrate technologies from both sides to optimize resource allocation. The diversification of M&A network technologies can enable enterprises to establish a knowledge base including their core technologies and external heterogeneous technologies, broaden their knowledge base, deepen their understanding of new knowledge, enable the full flow of technologies and resources within the acquirer, realize the accumulation of knowledge in related fields, and effectively transfer and apply new technical resources by identifying, absorbing and integrating external knowledge. Realize technology integration, optimize resource allocation, and improve resource use efficiency. However, excessive diversification of M&A network technologies will lead to greater complexity, and M&A enterprises may not have a deep understanding of heterogeneous knowledge and lack of experience in using it, which leads to the decline of enterprises' ability to identify, absorb and utilize the technologies and knowledge of the target party, and it is difficult to integrate resources. At the same time, enterprises need to pay more costs to identify the heterogeneous information brought about by the diversity of network technologies. The advantages of knowledge cross integration cannot be effectively played, and the communication cost, time cost and management cost increase (Zeng et al., 2015), which is not conducive to the resource allocation of enterprises. Therefore, there is an inverted U-shaped relationship between M&A network technology diversification and resource allocation efficiency.

Rational allocation of resources is the basic guarantee of improving the efficiency of enterprise investment. First, according to the synergistic effect theory, the integration of diversified technologies of the target party by M&A enterprises can generate economies of scale, optimize the industrial chain, broaden the scope of application of technological achievements, realize information sharing and collaborative innovation, and improve investment efficiency. The second is to improve the efficiency of resource allocation, which can optimize the production process and improve the production method, drive the optimization and upgrading of industrial structure, and urge enterprises to allocate limited resources to high-quality investment projects, so that investment opportunities can be converted into higher investment output and improve investment efficiency. Therefore, the merger and acquisition of network technology diversification can resist external business risks, defuse the threat of industry competition, optimize the allocation of resources, realize resource sharing, avoid repeated investment, effectively use resources, and improve investment efficiency. This paper proposes the following research hypothesis:

H2: Technological diversity in M&A network affects enterprise investment efficiency through resource allocation efficiency.

2.3. The Mechanism of Information Disclosure Quality

The diversification of network technology is helpful to improve the quality of information disclosure. First of all, the "information diversification" hypothesis proposes that diversified operations can effectively alleviate information asymmetry (han et al., 2013), restrain opportunistic behaviors of management, reduce agency problems and improve the quality of information disclosure. The low sensitivity of ownership and compensation performance in diversified enterprises reduces the possibility of the management to obtain benefits by hiding negative news. At the same time, the acquisition of enterprises with a high degree of network technology diversification needs to collect and report relevant information, including financial statements, which increases the difficulty for managers to manipulate earnings and helps improve the quality of information disclosure (Xu et al., 2020). Secondly, enterprises with a high degree of network technology diversification in mergers and acquisitions have relatively large financing needs. In order to facilitate financing, enterprises will actively disclose information, alleviate the information asymmetry with investors, improve the quality of information disclosure and reduce the cost of capital. Finally, the information of enterprises in the M&A network relationship is basically synchronized with each other. With a high degree of technological diversification, M&A enterprises can obtain more public and private information of customers, know the actual sales level of the other party's products and business strategy, and correctly estimate the expected benefit level of investment projects. In order to acquire more high-quality enterprises with diversified technologies and gain the trust of the target party, the acquirer will generally take the initiative or resources to disclose more relevant information, improve the information environment and improve the quality of information disclosure. However, mergers and acquisitions network technology diversification degree is too high, will also bring negative effects. Due to the high information asymmetry due to the deep cultivation of the two parties in different technical fields, it is difficult to establish a trust relationship between the members, resulting in greater information friction (Celik et al., 2022). The uncertainty of business and technology integration increases, the related costs increase, the difficulty of organization and management increases, the ability of coordination decreases, and the willingness of enterprises to disclose more information decreases. It is not good for enterprises to improve the quality of information disclosure. Therefore, there is an inverted U-shaped relationship between the diversity of M&A network technology and the quality of corporate information disclosure.

Corporate information disclosure is a bridge of communication between enterprises and investors, and it has been widely confirmed by domestic and foreign scholars that high quality information disclosure can improve enterprise investment efficiency (Biddle and Hilary, 2006; Li et al., 2022). Existing scholars believe that the quality of information disclosure can improve investment efficiency mainly through the following two aspects: On the one hand, through information disclosure, enterprises pass information about their operation and financial status to stakeholders, provide investors with more valuable information resources (Dutta and Nezlobin, 2017), help investors evaluate enterprise value, help reduce the asymmetry between capital owners and users, and enhance the effectiveness of communication with the market. We will improve the efficiency of business investment. On the other hand, the root cause of inefficient investment is the principal-agent problem. As a corporate governance mechanism, the quality of information

disclosure can supervise the internal behavior of enterprises, motivate managers to make correct investment decisions, effectively alleviate agency problems such as moral hazard and adverse selection, reduce speculative behavior, and improve investment efficiency (Zhang et al., 2020). Therefore, we propose the following research hypothesis:

H3: Technological diversity in M&A network affects enterprise investment efficiency through information disclosure quality.

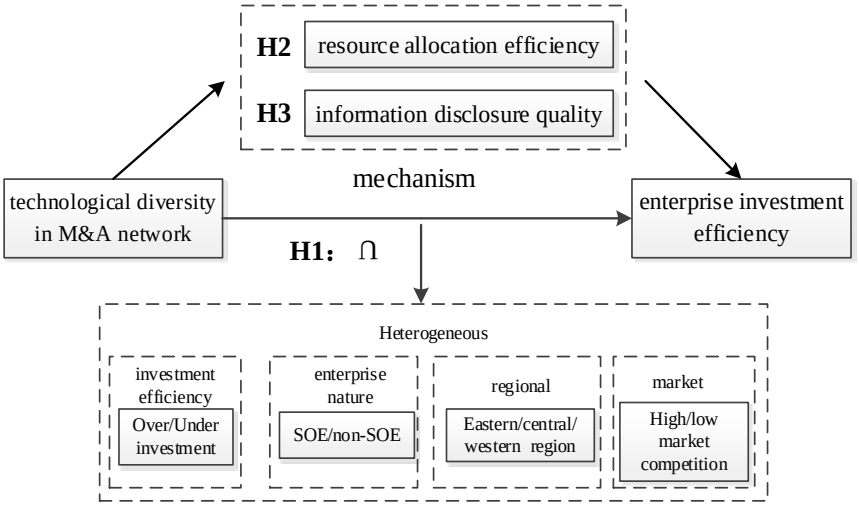

Figure 1. Theoretical model

3. Research Design

3.1. Data and Sample Selection

We select A-share listed companies with M&A transactions in China from 2010 to 2019 as samples. Following previous literature (Lebedev et al., 2015; Yao et al., 2022; Huang and Cai, 2020), the samples are screened as follows: (1) retain M&A events in which the listed companies are acquirers; (2) financial firms and ST firms are excluded; (3) drop samples of asset divestiture, asset replacement, debt restructuring, share repurchase, tender offer, or equity transfer; (4) the samples of overseas firms as the target firms are removed. (5) exclude samples if the M&A transaction fails. The financial data and M&A data come from the CSMAR database. Drawing on existing research (Cao et al., 2022), patent data of acquirers are derived from China Research Data Service (CNRDS), which is the leading comprehensive data platform for economic, financial, and business research in China. The International Patent Classification(IPC) of the acquirers and the target firms are collected and sorted out manually through China National Intellectual Property Administration[1] and verified repeatedly. Finally, we obtain a sample of 811 firms, consisting of 2758 firm-year observations from 2010 to 2019.

[1]http://www.cnipa.gov.cn/

3.2. Variable Definitions

3.2.1. Enterprise Investment Efficiency（INV）

Referring to the relevant studies of Richardson (2006) and Wang et al. (2011), this paper constructs model (4) to measure the investment efficiency of enterprises with the absolute value of its residual. This variable is a reverse indicator, and the larger its value is, the higher the inefficient investment and the lower the investment efficiency level. On the contrary, the smaller the value, the higher the investment efficiency. If the residual difference is greater than 0, it means that the enterprise is overinvested. If the residual difference is less than 0, it indicates that the enterprise has not invested enough. The specific model is as follows:

$$Invest_{i,t} = \delta_0 + \delta_1 Growth_{i,t-1} + \delta_2 Lev_{i,t-1} + \delta_3 Cash_{i,t-1} + \delta_4 Size_{i,t-1} + \delta_5 Return_{i,t-1} + \delta_6 Age_{i,t-1} + \delta_7 Invest_{i,t-1} + \sum_t Year_t + \sum_j Indu_j + \nu_{i,t} \quad (1)$$

Where, $Invest_{i,t}$ is the investment expenditure of the enterprise, $Growth_{i,t-1}$ is the growth rate of operating income, $Lev_{i,t-1}$ is the asset-liability ratio, $Cash_{i,t-1}$ is the cash holding, $Size_{i,t-1}$ is the size of the enterprise, $Return_{i,t-1}$ is the annual excess return of the company's stock, $Age_{i,t-1}$ is the age of the enterprise's listing, in addition, the year and industry dummy variables are added.

3.2.2. Technological Diversity in M&A Network（NTD）

We use technological diversity in M&A network (*NTD*) as independent variables. This paper uses a moving five-year window to capture the M&A network from 2010 to 2019, and the data are divided into 6-time windows. The first four digits of IPC are used to identify different patent types, that is, the technological diversity in M&A network constructed from 2010 to 2014 is used to measure that of 2014. Following Sampson (2007), Phelps (2010), and Chen et al. (2015) , we construct the multidimensional vector, $F_i = (F_i^1, ..., F_i^s)$, where F_i^s represents the number of patents assigned to firm i in patent class s. Technological diversity of a pair of firms in M&A network capabilities is then: $NTD_{ij} = 1 - \frac{F_i F_j^{'}}{\sqrt{(F_i F_i^{'})(F_j F_j^{'})}} (i \neq j)$. This measure calculates technological diversity between a pair of firms. We calculate this measure for every combinatorial pair of firms in the M&A network, including an acquirer and target, two target firms, and take the average, namely technological diversity in M&A network. This variable could range from 0 to 1. We use Matlab2019b to calculate the technological diversity in M&A network.

3.2.3. Resource Allocation Efficiency

Referring to existing research results (Duan, 2015), this paper takes total assets, total owners' equity, number of employees, operating costs and management expenses as input indicators,

returns on equity, operating income and asset turnover as output indicators, and uses DEA method to build an efficiency evaluation model to measure the efficiency of enterprise resource allocation. The detailed operation is achieved through MaxDEA 8Ultra software.

3.2.4. Information Disclosure Quality

Referring to the research of Bu Jun and Sun (2018), this paper measures the quality of information disclosure through the information disclosure rating of listed companies released by Shenzhen Stock Exchange. Compared with other indicators, this index is objective, comprehensive and authoritative, and can comprehensively consider the quality of information disclosure of listed companies (Xiao et al., 2017). The evaluation results are A, B, C and D, which respectively represent "excellent", "good", "qualified" and "unqualified". The scores are expressed as A=4, B=3, C=2, and D=1.

3.2.5. Control variables

Asset-liability ratio (Lev), the ratio of total liabilities to total assets; Cash holding level (Cash), which is the proportion of cash and cash equivalents in total assets; Return on assets (ROA), that is, the ratio of net profit to total assets; Enterprise Size (Size), that is, the total number of employees (thousands); Corporate ownership structure (Top), that is, the proportion of the largest shareholder. In addition, this paper also controls the Year effect and Industry effect.

3.3. Model

3.3.1. Baseline Model

To investigate the influence of the technological diversity in M&A network on the enterprise investment efficiency, this paper constructs the following model:

$$INV_{it} = \beta_0 + \beta_1 NTD_{it} + \beta_2 NTD_{it}^2 + \sum_{j=1}^{6} \beta_j controls_{jit} + \varepsilon_{it} \quad (2)$$

Where INV_{it} represents enterprise investment efficiency by firm i in year t; NTD_{it} denotes technological diversity in M&A network; $controls_{it}$ denotes control variables; ε_{it} denotes the stochastic disturbance term.

3.3.2. Mechanism Verification

To explore whether technological diversity in M&A network has an impact on enterprise investment efficiency by influencing resource allocation efficiency and information disclosure quality, we construct model（3）and (4).

$$Allocation_{it}/Disclosure_{it} = \beta_0 + \beta_1 NTD_{it} + NTD_{it}^2 + \sum_{j=1}^{6} \beta_j controls_{jit} + \varepsilon_{it} \quad (3)$$

$$INV_{it} = \beta_0 + \beta_1 NTD_{it} + \beta_2 NTD_{it}^2 + \beta_3 Allocation_{it} / Disclosure_{it} + \sum_{j=1}^{6} \beta_j controls_{jit} + \varepsilon_{it} \quad (4)$$

Where $Allocation_{it}$ and $Disclosure_{it}$ represent resource allocation efficiency and information disclosure quality, respectively. The other variables are the same as before.

4. Empirical Results and Discussion

4.1. Descriptive Statistics

Table 1. Summary statistics.

Variables	N	Mean	Sd	Min	P50	Max
INV	2758	0.049	0.067	0.000	0.031	0.931
NTD	2758	0.689	0.301	0.014	0.771	1.000
Allocation	2758	0.714	0.147	0.279	0.735	0.998
Disclosure	2758	3.078	0.616	1.000	3.000	4.000
R&D	2758	0.331	0.611	-0.454	0.190	4.098
Lev	2758	0.402	0.175	0.079	0.391	0.830
Cash	2758	0.136	0.089	0.016	0.113	0.443
ROA	2758	0.048	0.066	-0.317	0.050	0.200
Size	2758	4.858	11.831	0.158	2.246	285.405
Top	2758	30.995	13.250	7.840	29.210	66.130

Table 1 shows the descriptive statistics of variables of sample enterprises. It can be seen that the maximum value of enterprise investment efficiency is 0.931, and the minimum value is 0. The average value of M&A network technology diversification is 0.689, which is at a relatively high level, indicating that M&A network technology diversification is relatively high on the whole. There is a certain gap between the efficiency of resource allocation and the quality of information disclosure. As for the control variables, the minimum values of R&D investment growth rate, leverage ratio, cash holding level, profit level, enterprise size and shareholding ratio of the largest shareholder differ greatly from their maximum values respectively. It can be seen that there are great differences among enterprises in debt repayment, scale and shareholding concentration.

4.2. Baseline Regression Results

Table 2. Baseline regression results.

Variables	(1) INV	(2) INV	(3) INV
NTD	-0.042**	-0.044**	-0.041**
	(-2.23)	(-2.40)	(-2.29)
NTD^2	0.041**	0.041***	0.040***
	(2.56)	(2.66)	(2.60)
R&D		0.026***	0.024***

		(12.94)	(11.91)
Lev		-0.030***	-0.024***
		(-3.91)	(-3.02)
Cash		-0.040***	-0.053***
		(-2.75)	(-3.61)
Roa		0.037*	0.021
		(1.88)	(1.07)
Size		-0.000	-0.000
		(-1.12)	(-0.56)
Top		-0.000	-0.000
		(-0.08)	(-0.47)
Constant	0.055***	0.064***	0.030
	(11.40)	(9.21)	(0.65)
N	2,758	2,758	2,758
Year	NO	NO	Yes
Industry	NO	NO	Yes
R^2	0.003	0.070	0.113

Table 2 is the benchmark regression result, which shows the nonlinear relationship between M&A network technology diversification and enterprise investment efficiency. In column (1), without any control variables, the coefficient of the primary term of M&A network technology diversification is significantly negative, and the coefficient of the secondary term is significantly positive, indicating that the relationship between M&A network technology diversification and enterprise investment efficiency is inverted U-shaped without considering other factors. In column (2) of Table 2, control variables are added on the basis of column (1), but industry and year factors are not controlled. According to the regression results, the primary coefficient of M&A network technology diversification is -0.045, significant at the 5% level, and the secondary coefficient is 0.043, significant at the 1% level. Column (3) controls the industry and year factors on the basis of column (2). From the results, it can be seen that the coefficient of the primary term of M&A network technology diversification is -0.044, significant at the 5% level, and the coefficient of the secondary term is 0.041, significant at the 1% level, which further verifies the inverted U-shaped relationship between M&A network technology diversification and enterprise investment efficiency. Merger and acquisition of network technology diversification will improve the efficiency of enterprise investment in a certain range, but excessive diversification will reduce the efficiency of enterprise investment. Therefore, enterprises should ensure the appropriate diversification of M&A network technology, which supports H1.

4.3 Robustness Tests

We conducted robustness tests to verify the validity of the results, which are summarized in Table 3.

4.3.1. Exclude the influence of industry over time

Different industries have different development cycles, and the policies introduced each year bring different investment opportunities to enterprises in different industries (Shang et al., 2022; Pan Yue et al., 2020). Changes in the external macro environment, such as the industry development cycle and relevant policies, may have an impact on the M&A and investment behavior of enterprises. Referring to the study of Pan et al. (2020), this paper controls the fixed effect of annual industry cross-pollination on the basis of benchmark regression, eliminating the influence of industry over time. The regression results are shown in column (1) of Table 3. The primary regression coefficient of M&A network technology diversification is significantly positive, while the secondary regression coefficient is significantly negative, and the conclusion does not change.

4.3.2. Construct different regression models

The firm fixed effect model can effectively control the problem of missing variables. In order to solve the endogeneity problem caused by missing variables, this paper adopts the individual and time bidirectional fixed effect model for testing by referring to the research method of Li et al. (2022). The results of Table 3 (2) show that the quadratic regression coefficient of M&A network technology diversification is significantly positive, and the conclusion is consistent with the above, indicating that the research conclusion is reliable.

4.3.3. Test of alternative variables

When calculating investment efficiency according to Richardson's (2006) method, the research of Liu et al. (2014) was referred to, and TobinQ was used instead of INV_TobinQ to measure investment efficiency again. The regression results are shown in column (3) of Table 3. The primary regression coefficient of M&A network technology diversification is significantly positive, while the secondary regression coefficient is significantly negative, which further verifies the above hypothesis.

4.3.4. Change the sample rolling period

From the original rolling period of 5 years to a rolling period of 3 years, the M&A network technology diversification index is re-measured according to the practices of Sampson (2007), Phelps (2010), Chen et al. (2015), and variables such as INV_3year are recalculated. As can be seen from Table 3 (4), the quadratic regression coefficient of the diversification of M&A network technologies is significantly positive, which is consistent with the main empirical results of this paper, indicating that the research conclusion is reliable.

Table 3. Robustness Test.

Variables	(1)	(2)	(3)	(4)

	INV_Year_Ind	INV_FE	INV_TobinQ	INV_3year
NTD	-0.043**	-0.043	-0.029	-0.002
	(-2.38)	(-1.28)	(-1.56)	(-0.56)
NTD^2	0.040***	0.046*	0.031*	0.006**
	(2.65)	(1.65)	(1.95)	(2.09)
R&D	0.025***	0.021***	0.024***	0.000
	(12.20)	(8.79)	(11.29)	(1.44)
Lev	-0.025***	-0.002	-0.023***	-0.024**
	(-3.16)	(-0.10)	(-2.79)	(-2.27)
Cash	-0.051***	-0.040	-0.057***	-0.081***
	(-3.48)	(-1.58)	(-3.63)	(-4.34)
Roa	0.013	0.053**	0.016	0.028
	(0.69)	(2.04)	(0.85)	(1.17)
Size	-0.000	0.001	-0.000	-0.000
	(-0.66)	(1.64)	(-0.38)	(-0.02)
Top	-0.000	-0.000	0.000	0.000
	(-0.42)	(-0.67)	(0.09)	(0.39)
Constant	0.058	0.070***	0.017	0.045
	(0.60)	(3.97)	(0.39)	(1.52)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Firm	NO	Yes	NO	NO
Industry×Year	Yes	NO	NO	NO
N	2,758	2,758	2,409	2,762
R^2	0.142	0.123	0.110	0.046

4.4. Mechanism Analysis

In order to test whether the mechanism between the efficiency of resource allocation and the quality of information disclosure is valid, we use the mediation effect model to test. Table 4 shows the test results of intermediary mechanism. It can be seen from column (1) that there is an inverted U-shaped relationship between M&A network technology diversification and enterprise investment efficiency. According to column (2), there is an inverted U-shaped relationship between M&A network technology diversification and resource allocation efficiency. As shown in Column (3), the coefficient of primary term of M&A network technology diversification is significantly negative at the 5% level, while the coefficient of secondary term and efficiency coefficient of resource allocation are significantly positive at the 1% level, indicating that the efficiency of enterprise resource allocation is the transmission path of M&A network technology diversification to enterprise investment efficiency, and H2 is supported. As can be seen from column (4), the regression coefficients of the primary and secondary terms of M&A network technology diversification are 0.440 and -0.457 respectively, both of which are significant at the 1% level, indicating an inverted U-shaped relationship between M&A network technology diversification and information disclosure quality. Column (5) Add the quality of information

disclosure on the basis of column (3), we can read that in the process of the merger and acquisition of network technology diversification affecting enterprise investment efficiency, the quality of information disclosure is its transmission mechanism. Therefore, H3 is supported.

Table 4. Mechanism Verification.

Variables	(1) Allocation	(2) INV	(3) Disclosure	(4) INV
NTD	-0.070*	-0.043**	0.440***	-0.036*
	(-1.94)	(-2.37)	(2.59)	(-1.86)
NTD^2	0.093***	0.042***	-0.457***	0.034**
	(3.03)	(2.73)	(-3.17)	(2.08)
Allocation		-0.021**		
		(-2.21)		
Disclosure				-0.004*
				(-1.72)
R&D	-0.009**	0.024***	-0.013	0.028***
	(-2.21)	(11.82)	(-0.66)	(12.10)
Lev	0.317***	-0.017**	-0.129	-0.015*
	(19.93)	(-2.03)	(-1.64)	(-1.72)
Cash	-0.024	-0.053***	0.604***	-0.045***
	(-0.81)	(-3.65)	(4.34)	(-2.85)
Roa	-0.346***	0.013	2.844***	0.023
	(-8.85)	(0.69)	(15.87)	(1.06)
Size	0.000**	-0.000	0.001***	0.000
	(2.02)	(-0.47)	(5.71)	(0.04)
Top	0.001***	-0.000	0.002**	-0.000
	(3.59)	(-0.32)	(2.32)	(-0.22)
Constant	0.679***	0.044	3.513***	0.038
	(7.42)	(0.96)	(8.60)	(0.80)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
N	2,758	2,758	2,435	2,435
R^2	0.257	0.114	0.168	0.128

5. Heterogeneity Analysis

5.1. Over Investment and Under Investment

Referring to the existing literature (Chen and Xie, 2011), we divided the investment efficiency of enterprises into two groups: over-investment and under-investment. Column (1) in Table 5 shows the regression results of M&A network technology diversification and over investment. It can be seen that the primary regression coefficient of M&A network technology diversification is 0.077, and the primary regression coefficient is -0.081, both of which are significant at the 5%

level, indicating that M&A network technology diversification first reduces the over-investment of enterprises, and then increases the over-investment of enterprises when it exceeds a certain range. However, merger and acquisition of network technology diversification has no significant impact on the under investment of enterprises.

The reasons are as follows: firstly, the merger and acquisition of network technology diversification brings abundant heterogeneous resources and knowledge to enterprises, introduces new technologies and new processes, and enables enterprises to improve innovation level, optimize investment behavior, improve resource allocation efficiency, avoid technology locking, reduce resource waste, and reduce excessive investment through technology integration and pollination effect. Secondly, by acquiring technologies beyond their own organizational boundaries, enterprises can cope with the risks brought by external complexity, improve product performance, adapt to the competitive environment, seize investment opportunities, avoid repeated investment, reduce excessive investment, and improve investment efficiency. Finally, through the connection with other enterprises in the M&A network, the M&A enterprises can obtain more external information including capital, technology and innovation, which is conducive to improving information transparency, enhancing the ability to identify investment opportunities, and reducing excessive investment. However, when the diversification of M&A network technology reaches a certain degree, it will cause the dispersion of funds, increase the risks of M&A and operation of enterprises, weaken the competitive advantage, which is not conducive to the enterprises to convert investment opportunities into higher output, and reduce the investment efficiency of enterprises.

5.2. Enterprise Nature

State-owned enterprises and non-state-owned enterprises have certain differences in resource endowment, governance mechanism, business objectives and other aspects. In order to explore
In this paper, the samples are divided into state-owned enterprises and non-state-owned enterprises. Columns (5) and (6) in Table 5 are regression results of two sample groups, respectively. It can be seen that the influence of M&A network technology diversification on enterprise investment efficiency is more significant in non-state-owned enterprises.

The reasons are as follows: Firstly, based on the perspective of resource endowment, state-owned enterprises have natural advantages and are mostly distributed in resource concentration or monopoly industry, strong financial strength, the government in credit supply, resource allocation, tax incentives, investment and financing, fiscal subsidies also give more support. Although the acquisition of network technology diversification is helpful to bring in more external technologies and resources, the resource effect has a weak influence on state-owned enterprises and a small impact on investment efficiency. Non-state-owned enterprises, on the other hand, receive less government support and are relatively difficult to obtain external financing. They need to obtain external technical resources through the role of market resource allocation (Yu, 2021). Therefore, enhancing the availability of external resources is more conducive to non-state-owned enterprises to carry out innovation, investment and other activities (Feng et al., 2021), and it is easier to improve the investment efficiency of non-state-owned enterprises. Second, state-owned enterprises and non-state-owned enterprises have different governance mechanisms. State-owned enterprises are also subject to more regulation and intervention, have a

certain political connection, are prone to government interference, the principal-agent relationship is more complex, and there may be soft budget constraints and other phenomena (Zhang, 2020). Therefore, compared with state-owned enterprises, state-owned enterprises are more likely to deviate from the optimal investment decisions. It is difficult to improve the decision-making process and investment efficiency by optimizing the allocation of resources and improving the quality of information disclosure. Finally, state-owned enterprises and non-state-owned enterprises have different business objectives. State-owned enterprises need to achieve economic benefits, but also bear more social responsibilities, while taking into account environmental benefits, social employment and other issues, it is difficult for the management to make optimal investment decisions based on market demand and actual enterprise. Non-state-owned enterprises are usually not restricted by direct assessment of social benefit objectives, so they focus on business objectives such as maximizing enterprise value (Feng et al., 2021). The acquisition of network technology diversification is more conducive to improving enterprise investment efficiency. However, the high degree of diversification of M&A network technologies, covering too wide a range of technical fields, will make heterogeneous technologies difficult to be correctly understood in a short period of time, is not conducive to the absorption of new knowledge and new technologies, resources integration, improve the decision-making process, and thus reduce the efficiency of enterprise investment.

5.3 Enterprise Digital Transformation

Driven by a new round of scientific and technological revolution and industrial transformation, digital transformation is a process of deep integration of digital technology and various production factors of traditional industries. It is a new driving force for economic transformation and development. Different enterprises have different degrees of digital transformation, and their attitudes towards heterogeneous technologies are also different. The impact of the diversification of M&A network technologies on the investment efficiency of enterprises may also be different due to the differences in the degrees of digital transformation of enterprises. A large number of studies have used the word frequency or proportion of digital-related keywords in annual reports to measure the digital transformation or digitalization level of enterprises. Referring to existing studies (Lin, 2022), this paper uses the number of word frequencies of keywords related to "digitalization" in the annual report to describe the digital transformation of enterprises, and captures keywords based on each dimension. Among them, the dimension definition of digital transformation includes "artificial intelligence technology", "cloud computing technology", "blockchain technology", "big data technology" and "digital technology application". From Table 6, it can be seen from column (1) that the primary term of M&A network technology diversification is -0.048, which is significant at the 5% level, and the secondary term coefficient is 0.049, which is significant at the 1% level, indicating that the influence of M&A network technology diversification is more significant in enterprises with a high degree of digital transformation. As can be seen from column (2), enterprises with low degree of digital transformation are not significant.

The reason is that digital transformation is a disruptive force for enterprise development and a strong engine for value creation. First of all, enterprises with a high degree of digital transformation are more conducive to reducing the information asymmetry in the investment

process, providing more valuable information resources for enterprise investment, reducing the irrationality of managers' decision-making behavior, optimizing investment decisions, and improving investment efficiency. At the same time, through the construction of digital governance platform, improve the corporate governance mechanism, effectively constrain and supervise the irrational behavior of managers in the investment process, promote the precision, efficiency and intelligence of management decision-making, and improve the investment efficiency. Secondly, compared with enterprises with a low degree of digital transformation, enterprises with a high degree of digital transformation are more open and flexible in thinking, more willing to actively embrace diversified technologies, build differentiated competitive advantages, actively respond to challenges, identify and seize better investment opportunities, improve enterprise investment efficiency through the merger and acquisition of network technology diversification, so as to comprehensively enhance enterprise value. Finally, enterprises with a high degree of digital transformation tend to have a higher level of science and technology, and are more likely to achieve major breakthroughs in key technologies, solve major problems in the process of industrial upgrading, resource allocation and input-output, and provide a strong guarantee for improving enterprise investment efficiency. However, enterprises will also invest more costs, take greater risks and face greater uncertainty in digital transformation, which increases the difficulty of M&A management, increases the investment risks and makes it difficult to effectively identify investment opportunities, thus reducing the investment efficiency of enterprises.

5.4 Regional Heterogeneity

There are obvious differences among different regions in resource endowment, quality of economic development and comprehensive economic strength, and the government attaches different importance to M&A and investment. In order to investigate the relationship between the diversification of M&A network technology and the investment efficiency of enterprises in different regions, this paper divides enterprises into eastern, central and western regions according to the provinces where they are located, and performs grouping regression. As can be seen from columns (3), (4) and (5) of Table 6, the relationship between M&A network technology diversification and enterprise investment efficiency is more significant in eastern and central regions, but not in western regions.

The reason is that compared with the western region, the eastern region and the central region have a better market environment, which can bring complementary resources to the members, avoid repeated investment, reduce investment costs and improve investment efficiency. More open thinking and views will provide more inspiration and investment opportunities for enterprises, which will help improve the originality and diversity of technology, generate greater synergy effect and spillover effect of technical knowledge, invest in high-quality projects and improve investment efficiency. But firms in the east and midlands will also face greater uncertainty, greater risks and greater costs from new external technologies. As the degree of diversification of network technologies increases, enterprises need to spend more time and cost to select a large amount of heterogeneous information, which increases the cost of resource acquisition and is not conducive to the utilization of investment opportunities for enterprises, and then translates into investment output and reduces investment efficiency.

5.5 Market Competition Degree

Will the influence of the diversification of M&A network technology on enterprise investment efficiency be different due to the different degree of market competition? In this paper, the degree of competition in product market is expressed by Herfindahl-Hirschman index (HHI). When HHI is lower than the sample median, the value is 1, indicating a high degree of market competition. Otherwise it is 0. In Table 6, column (6) is the group with high market competition, and the coefficient of primary term and secondary term of M&A network technology diversification is -0.060 and 0.052, both of which are significant at the 1% level. In column (7), the regression coefficient of the group with low market competition is not significant. It can be seen that the higher the degree of market competition, the more significant the impact of M&A network technology diversification on enterprise investment efficiency.

The reasons are as follows: First, in a market environment of fair competition, it is easier for enterprises to break through their own boundaries, integrate internal and external resources, make full use of the resources and technologies of both sides of the merger and acquisition, realize resource sharing, and optimize investment behavior. At the same time, areas with a higher degree of market competition tend to have a higher level of corporate governance and less government intervention, which is conducive to enterprises to optimize investment decisions and improve investment efficiency. Secondly, the market, as a carrier of information exchange, collects the effective information that traders need to communicate, so that when enterprises enter the new technology field, they can search and select the knowledge resources in the merger network more efficiently, quickly absorb and use the external heterogeneous technology, improve the speed of technology transformation, improve the investment decision, and improve the investment efficiency. Under the action of competition mechanism, the transparency of enterprise information is improved, the asymmetry of information is reduced, the investment decision of enterprise is more transparent and efficient, the pricing function of information can be effectively played, so as to make effective investment decision and improve the efficiency of enterprise investment. Finally, a higher degree of product market competition provides a platform for enterprise managers to reform with determination and display their talents, which is beneficial to give full play to the pioneering spirit of managers, and provides a broader space for enterprises to make flexible investment decision thinking, which is conducive to obtaining technical resources through the diversified technology merger network and choosing more high-quality investment projects. Improve investment decision-making and investment efficiency. However, because members in a highly heterogeneous network have their own languages and norms (Wuyts et al., 2014), the higher the degree of market competition, the greater the technical heterogeneity, and the more difficult it is to utilize these knowledge and technologies and establish connections between elements. When the diversification of M&A network technology reaches a certain degree, the investment risk increases and the investment efficiency decreases.

Table 5. Heterogeneous analysis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Variables	Over investment	Under investment	SOE	non-SOE	High digital Transformation	Low digital Transformation	eastern region	central region	western region	High market	Low market competition

										competition	
NTD	-0.079**	-0.011	-0.006	-0.040**	-0.047**	-0.021	-0.025	-0.101**	-0.062	-0.055***	-0.002
	(-2.06)	(-0.97)	(-0.16)	(-1.99)	(-2.25)	(-0.59)	(-1.22)	(-2.13)	(-0.96)	(-2.83)	(-0.04)
NTD^2	0.073**	0.014	0.004	0.043**	0.048***	0.017	0.030*	0.082**	0.052	0.049***	0.014
	(2.22)	(1.42)	(0.14)	(2.50)	(2.70)	(0.56)	(1.69)	(2.04)	(0.94)	(2.94)	(0.40)
R&D	0.039***	0.007***	0.017***	0.027***	0.024***	0.022***	0.028***	0.018***	0.023***	0.029***	0.016***
	(9.51)	(5.43)	(5.88)	(10.34)	(10.10)	(5.95)	(10.52)	(3.99)	(4.74)	(12.57)	(3.90)
Lev	-0.030*	-0.014***	-0.047***	0.001	-0.020**	-0.038**	-0.018**	-0.032	-0.022	-0.019**	-0.044**
	(-1.71)	(-2.62)	(-3.13)	(0.11)	(-2.18)	(-2.44)	(-2.02)	(-1.55)	(-0.74)	(-2.15)	(-2.46)
Cash	-0.110***	0.004	-0.044	-0.039**	-0.030*	-0.100***	-0.042**	-0.108***	0.010	-0.053***	-0.054*
	(-3.02)	(0.45)	(-1.53)	(-2.32)	(-1.84)	(-3.18)	(-2.54)	(-2.79)	(0.18)	(-3.24)	(-1.75)
Roa	0.003	-0.004	-0.026	0.019	0.023	0.001	0.014	0.044	0.016	0.009	0.042
	(0.06)	(-0.33)	(-0.49)	(0.90)	(1.03)	(0.03)	(0.65)	(0.87)	(0.21)	(0.43)	(0.79)
Size	-0.000	-0.001***	-0.000	-0.000	0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(-0.51)	(-3.49)	(-0.45)	(-0.41)	(0.39)	(-0.83)	(-0.48)	(-0.21)	(-0.45)	(-0.04)	(-0.46)
Top	-0.000	0.000	0.000	0.000	0.000	-0.000	-0.000	0.000	-0.000	-0.000	0.000
	(-0.53)	(0.59)	(1.21)	(0.36)	(0.63)	(-1.22)	(-0.30)	(0.07)	(-1.23)	(-0.90)	(0.51)
Constant	0.049	0.036***	0.039*	0.015	0.014	0.072***	0.022	0.067**	0.072**	0.054***	0.011
	(0.76)	(4.58)	(1.85)	(0.32)	(0.33)	(2.89)	(0.49)	(2.04)	(2.31)	(2.82)	(0.20)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,129	1,629	608	2,075	1,857	817	2,072	472	214	2,038	720
R^2	0.166	0.108	0.106	0.121	0.134	0.099	0.115	0.134	0.161	0.132	0.119

6. Conclusions

6.1. Findings

M&A is an effective way for enterprises to cope with market changes and open up technological paths, as well as an important way to acquire external knowledge, optimize resource allocation and improve enterprise investment efficiency. It is of great significance to study how to promote enterprise investment efficiency through M&A. This paper breaks through the existing researches on the homogeneity or binary relationship between the merger and acquisition parties, takes China's A-share listed companies from 2010 to 2019 as research samples, manually collects the patent classification number (IPC) and other information of the merger and acquisition enterprises and the target enterprises, takes five years as A rolling time window, constructs the merger and acquisition network, and explores the influence of the diversification of merger and acquisition network technology on the investment efficiency of enterprises. Moreover, the in-depth exploration of its internal mechanism from the two aspects of enterprise resource allocation efficiency and information disclosure quality is a useful supplement to the existing research, and provides enlightenment for enterprises to choose the right merger object, optimize resource allocation, improve the quality of information disclosure, and improve the efficiency of enterprise investment.

Firstly, it is found that proper diversification of M&A network technology is the most beneficial to improve the investment efficiency of enterprises. In a broad sense, the merger and acquisition behavior of enterprise technology diversification is based on enterprise production and will generate transaction costs at the same time. It is biased to consider only one of them. Only by combining the two, making full use of the resource heterogeneity of Schumpeter rent and saving transaction costs, can investment decisions be optimized more comprehensively and in essence, and enterprise investment efficiency be improved. Promote enterprise development. Secondly, the merger and acquisition of network technology diversification can improve the efficiency of enterprise investment by affecting the efficiency of enterprise resource allocation and the quality of information disclosure. Opportunity identification and the selection of acquisition objects belong to external capabilities, which facilitate enterprises to obtain external resources and enable enterprises to quickly adapt to environmental changes; The quality of resource allocation and information disclosure is an internal ability, which has an important impact on enterprise operation and management, especially investment decisions. Enterprises should improve the ability of external access to technical resources, and then convert it into their own internal ability, so as to improve the efficiency of enterprise investment. Thirdly, heterogeneity analysis shows that the influence of M&A network technology diversification on enterprise investment efficiency is mainly reflected in excessive investment, and the relationship between the two is more significant in non-state-owned enterprises, enterprises with high degree of digital transformation, enterprises in eastern and central regions, and enterprises with high degree of market competition.

6.2. Managerial Implications

6.2.1. Government perspective

First, the government, especially the local government, should attach great importance to the role of technology diversified M&A in improving the investment efficiency of enterprises, provide policy support for the M&A aimed at acquiring heterogeneous technologies, optimizing the allocation of enterprise resources and improving the investment efficiency of enterprises, create a relatively loose environment, reduce the cost of M&A and reduce the obstacles of M&A. To effectively integrate merger and acquisition policies with investment policies, relevant departments should take the essence of enterprise investment, financing and development as the starting point, and actively guide enterprises to implement mergers and acquisitions aimed at optimizing enterprise resource allocation and improving enterprise investment level, so as to provide support for Chinese enterprises to improve the quality of information disclosure and investment efficiency and break through high-quality development obstacles. Meanwhile, regulation of mergers and acquisitions should not be relaxed. Strict supervision should be maintained on mergers and acquisitions that blindly expand their scale and excessively diversify their technologies. For cross-border mergers and acquisitions, attention should be paid to the disclosure of the authenticity of the target party's performance, the sustainability of profits and the rationality of the assessed value.

Second, differentiated policies should be adopted in the course of policy implementation. To some extent, non-state-owned enterprises should continue to be encouraged to merge with enterprises with heterogeneous technologies, especially to integrate various heterogeneous

technologies, optimize resource allocation and improve investment efficiency. At the same time, the government should promote the reform of state-owned enterprises, improve the decision-making mechanism and improve the investment efficiency of state-owned enterprises. Digital transformation has endowed enterprises with new driving forces for development. The government should formulate relevant policies to promote digital transformation of enterprises, guide enterprises to optimize investment behavior and improve investment efficiency by using digital technologies, and lay a foundation for forming a strong and resilient national economic circular system. With the help of digital technology to drive the standardization and structure of corporate information disclosure, improve the information disclosure system, and promote the deep integration of capital market and entity enterprises.

Third, governments at all levels should continue to build and optimize a favorable market environment, create an operating atmosphere and business environment of fair competition, further remove barriers to market access and exit, break regional restrictions, remove market barriers, reduce transaction costs, speed up the building of a large unified national market, and optimize resource allocation through market competition. At the same time, it should improve the effectiveness of information transmission in the capital market, reduce the degree of information asymmetry of small and medium-sized enterprises, pay attention to the internal governance of small and medium-sized enterprises, especially the investment decision-making mechanism, to help them improve investment efficiency and get out of the development dilemma.

Fourth, vigorously develop western enterprises, narrow regional development gap and imbalance. We will encourage enterprises from the eastern region to relocate to the central and western regions, and support the optimization and upgrading of the industrial structure in the western region. The government should, to a certain extent, encourage the technology diversified merger and acquisition network by strengthening the policy of enterprise technology diversified merger and acquisition and investment in the regions with low marketization level and the western underdeveloped regions, so as to make up for the technical shortcomings, provide favorable conditions for improving the investment level, improve the allocation of social resources and operation efficiency, promote the complementary advantages of various regions and promote the balanced development of regions. Build a coordinated development mechanism for shared growth and value creation among regions.

6.2.2. Firm perspective

Firstly, the diversification of M&A network technology should be maintained at an appropriate level. Too high or too low diversification of M&A network technology is not conducive to improving the investment efficiency of enterprises. Enterprises should not only give full play to the synergies brought by technology diversification M&A to improve investment efficiency and market competitiveness, but also avoid the loss caused by excessive cost and excessive investment. When constructing the merger and acquisition network, enterprises should start from the overall strategy, select the target enterprises with certain heterogeneity with their own technologies, consider the technological differences among different target enterprises, timely grasp the development trends of new technologies, and improve the level of enterprise investment through restructuring and utilizing external resources. In addition, enterprises should combine with their own characteristics to prevent blind diversification and excessive investment. Enterprises should

not blindly acquire companies with technologies different from those of themselves and other target parties, so as to avoid difficulties in effectively absorbing and utilizing the knowledge and technologies of target companies, increasing resource acquisition costs and reducing investment efficiency.

Secondly, enterprises should give full play to the resource allocation effect and information disclosure effect of the diversification of M&A network technology. Heterogeneous technologies are introduced through the merger and acquisition network to make up for the technical defects, improve the efficiency of resource allocation, realize the adjustment, optimization and transformation of enterprise product structure, accelerate the transformation of production mode, and support enterprise value creation. At the same time, improve the quality of information disclosure, improve the corporate governance mechanism, alleviate agency problems, improve internal management efficiency, optimize investment decisions, and improve investment efficiency.

Thirdly, enterprises should fully grasp the opportunities of digital transformation, follow the trend of scientific and technological development, promote the effective application of digital technology in investment decisions, and build a data governance platform with data mining, analysis and application as the core to improve the accuracy and scientific nature of enterprise investment decisions by taking advantage of the wind of digital transformation. At the same time, digital technology should be deeply integrated with business operation and management decision-making, especially embedded in different links of investment, so as to provide enterprises with comprehensive information technology and investment decision-making support.

6.3. Limitations and Further Research

Firstly, the internal mechanism of the influence of the diversification of M&A network technology on the investment efficiency of enterprises can be deeply explored through theoretical models. In particular, mathematical models can be constructed by game theory and complex network methods to make up for the lack of mathematical models in this field. Secondly, this paper focuses on the influence of M&A network technology diversification on enterprise investment efficiency, and can further study its influence on enterprise innovation, high-quality development and other economic consequences and its mechanism of action. In the future research, these deficiencies and limitations need to be further improved and in-depth.

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Productivity, Economic Structure, and Labor Rate: A Valued-added Analysis of China's Economy

Nika Qiao
West Texas A&M University, USA

Yueyun (Bill) Chen
University of the West, Los Angeles, USA

Abstract

Using an econometric model based on the value-added approach for Gross Domestic Product (GDP) measurement, our research examines how productivity, economic structure, and labor rate affected China's GDP per capita from 1978 to 2021. The regression results indicate that labor rate contributed the most to China's economic development followed by productivity improvement in the industrial sector. Our research results show that economic structure and urbanization rates also significantly impacted China's economic development. Our study further compares the pre-WTO (1978-2001) and post-WTO (2002-2021) periods and concludes that all the economic variables significantly improved after joining the WTO in 2001, except for labor force in the agriculture sector, which decreased significantly in the post-WTO period. Our paper then explores how changes in productivity, labor rate, economic structure, and urbanization rate will affect China's economic development in the coming decades and projects China's GDP per capita in 2025 and 2035. Finally, we discuss relevant strategies and policies for China to maintain sustainable, stable, and fast economic growth.

Keywords: China economic growth, Value-added GDP, Productivity, Economic structure, Labor rate, Urbanization

I. Introduction

China's economy has slowed down in the past decade. Its annual economic growth has been less than 8% since 2012 and less than 6% since 2019. This is a significant drop compared with an average annual growth rate of 9.53% from 1978-2018 (Chen and Qiao (2022)). What caused such a substantial decrease? How much annual growth can China maintain in the future? These are essential questions for not only China but also for the world.

Sustaining high growth in the coming decades is important to China, since it is still a developing country. China's gross domestic product (GDP) per capita is only around $12,600 in 2021, which is slightly higher than the global average of $12,300, but much lower than the GDP per capita of developed economies. For example, Japan has a GDP per capita over $39,000 while the US has a GDP per capita over $70,000. Without continued development, China will fall into the middle-income trap as some countries like Argentina and Brazil have experienced. Also, China is facing economic and social problems like population aging, income gaps among regions and groups of people, and potential shortage of financial resources for its social security funds. These economic and social problems can't be resolved without economic prosperity.

China's growth also affects the world economy. Over the past years, China contributed more than 30% to global annual economic growth. The slowdown of China's economy will directly affect many other economies and significantly influence global prices for many products, natural resources, and raw materials (Chen et al. 2021). China is also a major trade

partner with many countries. Dramatic deceleration of the Chinese economy will lead to the loss of exports from these countries to China and the loss of many jobs for these export economies.

There are differing opinions on China's economic prospects. One view is pessimistic. Pritchett and Summers (2014) and Barro (2016) stated that China's growth rate could drop to 3%–4% over the coming decade. Lee (2017) concluded that China will face challenges to sustain a 5%–6% GDP growth rate in the coming decades and that China's potential GDP growth is expected to decrease to 3%–4% in the long run. However, other authors are optimistic. Lin and Zhang (2015) believed that China will have 8% annual growth potential over the next 20 years. Chen and Qiao (2022) used the expenses-based approach for GDP measurement and determined that China still has potential of sustainable growth in the coming decades. Chen et al. (2022) investigated variables that have affected China's economy and concluded that China should be able to maintain 5.5-6.5% annual growth by 2030 if it is able to avoid any potential financial or economic crises and disasters like COVID-19.

In our paper, the value-added approach for the GDP measurement is used to analyze China's economy. Based on Chen et al. (2017)'s study, this research first establishes an econometric model with variables such as GDP per capita, productivity in three sectors, labor rate of the total population, and labor distributions in three sectors. In our analysis, we use labor rate (number of employees / total population) instead of labor participation rate (numbers of employees / population at ages 16-64) because our model derived from economic theory uses labor rate and the two variables are very similar. In addition, an urbanization rate variable is included in our analysis because of the importance of urbanization to China's economic development.

There have been numerous studies on China's economy. Our paper is unique from other papers and contributes to the literature in several ways. First, we use the latest data from 1978 to 2021 to analyze China's economy. Second, we apply the value-added approach for GDP measurement to develop two regression models and also use natural log values for all the variables. Third, we use the natural log value of GDP per capita for the dependent variable, instead of GDP or GDP growth. GDP per capita better measures a country's economic development level, compared with total GDP or annual GDP growth. Fourth, we include the urbanization rate in our analysis to capture how this variable has affected China in the past and will impact China's future growth. Finally, based on an analysis of China's future economic factors, we provide projected values for China's GDP per capita in the coming decades and explore what China should do in order to maintain sustainable and stable economic development.

The rest of the paper is organized as follows. Section II reviews the literature. Section III specifies the econometric models. Section IV explains the data and variables. Section V examines the regression results. Section VI projects China's future productivity, economic structure, labor rate, and urbanization in the coming decades. Section VII forecasts China's GDP per capita in the coming decades. Section VIII discusses policy implications. Section IX concludes the paper.

II. Review of Literature

China's unprecedented economic development in the past 45 years has attracted numerous studies. This literature review focuses on the relationship of economic growth with productivity, economic structure, labor participation, and urbanization.

Productivity is essential to economic development. Korkmaz and Korkmaz (2017) studied the relationship between productivity and economic growth for seven OECD countries and found that a long run equilibrium between labor productivity and economic growth exists. Auzina-Emsina (2014) analyzed data for European Union countries in the pre- and post-crisis periods for the 2008 financial crisis. The author showed that productivity growth weakly affected economic growth before the crisis and that there was no relationship during the post-crisis period. Heshmati and Su (2013) observed that labor productivity affected economic growth based on Chinese data from 2000 to 2009. Chen et al. (2011) showed that the contribution of productivity to output growth in China declined after 2001. Chen et al. (2017) discusses how China has significant potential for catch-up growth through improvements in total factor productivity. Chen et al. (2019) proved that manufacturing and economic growth in the US and Japan were mainly attributed to productivity and investment while China's growth was attributed to export increases.

Previous research also indicates that productivity can be substantially improved through fixed asset investment and human capital accumulation. Demurger (2001) provided empirical evidence on the link between infrastructure investment and real GDP per capita. Baier et al. (2002) examined the relative importance of the growth of physical and human capital and the growth of total factor productivity (TFP) using data for 145 countries. Heshmati and Yang (2006) showed that China benefited from its information and communication technology (ICT) investments. Meng and Li (2002) provided evidence on the China's ICT industrial development and diffusion. Chen and Hamori (2009), Fleisher and Wang (2005), and Heckman and Li (2004) explained that return to education was higher in China than in the other transition economies. Weitzman and Kruse (1996) argued that a profit-sharing system would be more effective for improving labor productivity than a wage system since workers would work harder if employees' gains were highly related to outcomes. Morbey and Reithner (1990) found that R&D expenditure was strongly correlated with future profit margin and labor productivity.

Economic structure and its change or advancement are fundamental to an economy (Chen 2015, Chen 2016a, Chen 2016b). Chen et al. (2017) observed that labor would move from the agricultural sector to the industrial sector and then to the service sector when an economy advances. As a result, the share of the GDP among the three sectors changed accordingly. In the developed economies, the service industry is dominant. For example, the GDP from the service sector is about 78% in the US.

Change in the economic structure directly contributes to economic development. Kuznets (1981) emphasized that rapid growth of GDP per capita or GDP per worker will be impossible without a commensurate substantial shift in the shares of various sectors. Brondino (2019) analyzed productivity growth and structural change in the Chinese economy for the period of 1995–2009. He observed the transition of China from a development phase based on agriculture to a phase based on technology-intensive industry and services. Chen et al. (2017) derived an economic model to show how economic structure changes contributed to China's development. Chen et al. (2022) further projected China's economic growth based on China's future economic structure and labor participation.

Countries and their economic structures are different so the contribution of changes in economic structure differ among countries. Zhao and Tang (2018) found that the acceleration in economic growth in China for 2003-2008 was mainly due to increased contribution from the manufacturing sector and to a lesser degree the service sector. In contrast, the authors found that the service sector followed by the primary sector driven by the mining and oil and gas extraction

industry contributed to economic growth in Russia for 2003-2008. Shi (2021) used data from 2008-2018 for China to study whether wage-guided labor industry allocation affected economic growth. The author determined that the allocation of labor force to high-wage industries hindered economic growth

Economic growth also depends on population and labor participation. Chen et al. (2017) and Chen et al. (2022) showed that China's overall labor ratio and labor force participation rate increased since 1978 for more than three decades, which significantly contributed to China's fast economic growth. Li et al. (2017) analyzed the relationship between human capital and China's economic growth. They noticed that the size of China's working-age population peaked in 2014 and has started to decline since then and labor reallocation from rural to urban areas has decelerated. Thus, given the importance of human capital and especially education level, they concluded that it will not be possible for China to maintain a 7% annual growth rate in the coming decades. Feng et al. (2017) demonstrated that the labor force participation rate in urban China was about 80% in 1988-95 and decreased to about 73% in 2002-2009.

Chen et al. (2021) and Chen et al. (2022) demonstrated that urbanization is closely associated with economic development. Liang and Yang (2019) showed that urbanization improved economic growth through the accumulation of physical capital, knowledge capital, and human capital. Nguyen and Nguyen (2018) conducted an empirical study of urbanization and economic growth for ASEAN countries. They found that urbanization positively affected economic growth. However, they also found that there is a threshold after which the rise of urbanization may hurt economic growth. The estimated threshold was 69.99% for their static model and 67.94% for their dynamic model for these ASEAN countries.

Our study analyzes the economic effects of productivity, economic structure, labor rate, and urbanization. Our research results provide comprehensive insights into the economic development of China. In addition, the focus of our research is on GDP per capita instead of total GDP or annual GDP growth.

III. Econometric Model for the Value-Added Approach for GDP Measurement

According to Chen et al. (2017), the value-added method for GDP measurement can be expressed as the GDP of three sectors as shown in Equation (1) below where A, M, and S represent the agriculture, industrial, and service sectors, respectively. In Equation (2), the GDP for each sector is decomposed into two components where P_i is the productivity per employee in sector i and T_i is the total number of employees in sector i. In Equation (3), T_i is decomposed into three components where L_i is the ratio of employees in sector i to the total labor force, Lr is the ratio of the labor force to total population, and T is total population. In Equation (5), GDP on the left-hand side is converted to GDP per capita (gdp) by dividing total population on both sides of the equation. In Equation (8), Pw (P_A*L_A + P_M*L_M + P_S*L_S) is the average productivity for all employees.

$$GDP = GDP_A + GDP_M + GDP_S \quad (1)$$

$$GDP = P_A*T_A + P_M*T_M + P_S*Ts \quad (2)$$

$$GDP = P_A*L_A*Lr*T + P_M*L_M*L_r*T + P_S*Ls*Lr*T \quad (3)$$

$$GDP = (P_A*L_A*Lr + P_M*L_M*L_r + P_S*Ls*Lr)*T \quad (4)$$

$$GDP / T = P_A*L_A*Lr + P_M*L_M*L_r + P_S*Ls*Lr = \text{GDP per Capita (gdp)} \quad (5)$$

$$gdp = P_A*L_A*Lr + P_M*L_M*L_r + P_S*Ls*Lr \quad (6)$$

$$gdp = (P_A*L_A + P_M*L_M + P_S*Ls)*Lr \quad (7)$$

$$gdp = P_W * Lr \quad (8)$$

According to Equation (7), GDP per capita (gdp) can be calculated from the productivities of the three sectors, the labor distribution among three sectors, and the labor ratio (Lr). Therefore, according to Equation (8), change in annual GDP per capita will be:

$$gdp(2)/gdp(1) = (P_{W2}/P_{W1}) * (L_{r2}/L_{r1}) \quad (9)$$

where P_{W2}/P_{W1} is the overall productivity change from period 1 to period 2 and L_{r2}/L_{r1} is the change of the labor ratio from period 1 to 2. Thus, gdp growth rate is a nonlinear function of overall productivity growth and labor force growth. From Equation (8), we have:

$$\log(gdp) = \log(P_w) + \log(L_r) \quad (10)$$

Thus, a relevant econometrical model can be

$$\log(gdp) = a + b1*\log(P_A) + b2*\log(P_M) + b3*\log(P_S) + c*\log(L_r) + d*Log(UR) \quad (11)$$

where Pi is productivity in each of the three sectors, Lr is the labor ratio, and UR is the urbanization rate. In the Equation (11), productivity in the agricultural, industrial, and service sectors substitutes for overall productivity (P_w) from Equation (10) to determine which sector has the greatest effect on GDP per capita.

In Equation (11), urbanization rate is added as a control variable. For many developing countries like China, economic development is closely associated with industrialization, modernization, and urbanization. Changes and advancements in economic structure and productivity reflect the economy's progress in industrialization and modernization. Thus, the addition of the urbanization rate variable in the model is necessary to better capture the whole economy. China's economy has been significantly stimulated from its substantial improvement in urbanization over decades. China's average urbanization rate has risen by more than 1% annually over several decades (Chen 2019).

IV. Data and Variables

Data are obtained from China's National Bureau of Statistics (CNBS) and cover the period from 1978 to 2021. The data values are in nominal Chinese Yuan. The natural log values of these variables are used in the regression analysis, instead of their original values. This treatment is necessary since the regression model is derived from Equation (11) that demonstrates the relationship of variables in terms of log values. Many studies use log values of variables even if the original relationship among variables is not logarithmic. Log values are used to limit the effects of large or small extreme values on the regression results. The differences among values are much smaller after taking the natural log transformation.

Below are the summary statistics of all variables used in the models.

Table 1 Summary Statistics (Unit Yuan)

	Whole Data (1978-2021)	**Pre-WTO Data (1978-2001)**	**Post-WTO Data (2002-2021)**

	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation
gdp (GDP per Capita)	19,423	23,739	2,931	2,784	39,212	22,589
PA (Agriculture Productivity)	10,288	12,987	1,895	1,473	20,360	13,539
PM (Industrial Productivity)	53,777	59,357	10,791	9,441	105,361	52,257
PS (Service Productivity)	43,392	50,326	7,978	6,564	85,889	46,845
LR (Labor Rate) (%)	53.24	5.02	51.08	5.88	55.84	1.42
UR (Urbanization Rate) (%))	37.99	14.22	26.60	5.49	51.65	7.80
LA (Agriculture Employee (%))	48.12	14.57	59.19	7.15	34.83	8.82
LM (Industrial Employee (%))	23.99	3.95	21.18	2.03	27.36	2.90
LS (Service Employee (%))	27.89	10.87	19.62	5.29	37.81	6.59

Data Source: CNBS

Note: The differences between the pre- and post-WTO periods for all the variables are significant at the 1% level.

Table 2 Summary Statistics for the Natural Log Values of the Variables

	Whole Data (1978-2021) (Unit Yuan)	
	Average	**Standard Deviation**
LN(gdp)	8.80	1.72
LN(PA)	8.34	1.46
LN(PM)	10.06	1.47
LN(PS)	9.80	1.50
LN(LR)	3.97	0.10
LN(UR)	3.57	0.38
LN(LA)	3.82	0.34
LN(LM)	3.16	0.17
LN(LS)	3.25	0.41

Data Source: CNBS

Table 1 presents the summary statistics for all the variables in terms of their original values. In addition, the averages and standard deviations for all the variables are calculated and compared for the pre-WTO (1978-2001) and the post-WTO (2002-2021) periods. The t-tests show that the differences between these two periods are significant at the 1% level. In other words, all economic factors significantly improved after joining the WTO in 2001, except for the share of labor in agriculture, which decreased significantly. These results are consistent with the results from the expenses-based approach for GDP growth in Chen and Qiao (2022). In other words, joining the WTO contributed to the China's economic advancement.

Table 2 presents the summary statistics for all variables in terms of natural log values, where LN is the natural log. The table shows that each variable's standard deviation is dramatically reduced after taking the natural log transformation. The summary statistics also show that the differences among the relevant variables are smaller in Table 2 compared with the differences in Table 1.

V. Regression Results

We ran two regression models. Model 1 has five independent variables: LN(PA), LN(PM), LN(PS), LN(LR), and LN(UR). Model 2 has three additional variables: LN(LA), LN(LM), and LN(LS). Table 3 provides the main regression results.

Table 3 Regression Results (1978-2021)

	Model 1	Model 2
Intercept	-6.12***	-6.48***
LN(PA)	0.30***	0.19***
LN(PM)	0.40***	0.52***
LN(PS)	0.36***	0.26***
LN(LR)	1.05***	1.02***
LN(UR)	0.17***	0.18***
LN(LA)		-0.10**
LN(LM)		0.37***
LN(LS)		0.14***
Observations	44	44
F-Statistic	97,576***	329,960***

Note: ** 5% significant, *** 1% significant

Table 3 shows that both models are significant at the 1% level and all estimated coefficients are also significant at the 1% level, except for LN(LA), which is significant at the 5% level. Among all the estimated coefficients, only LN(LA) is negative in Model 2 (Model 1 does not include this variable). This result means that labor share in the agriculture sector has a negative effect on annual GDP. However, China's labor share in the agriculture sector has been decreasing over time. As a result, this independent variable actually positively contributed to China's GDP per capita.

In Model 1, the estimated coefficients for LN(LR) and LN(PM) are the largest. Therefore, improvement of the labor rate and industrial productivity contributed the most to China's economic advancement in the past decades. The estimated coefficient for the urbanization rate is also significant, so urbanization also helped China's economic progress. In Model 2, the coefficients for LN(LR) and LN(PM) are still the largest among all the variables.

VI. Productivity, Economic Structure, Labor Rate and Urbanization: The Past and the Future

In order to project China's GDP per capita, we first need to estimate future values for productivity, economic structure, labor rate, and urbanization.

1. Productivity

GDP per employee in China has been improving over the past several decades in all three sectors. The biggest increase has been in the industrial sector. Thus, it is reasonable to project that GDP per employee in China will continue to rise. However, China's productivity is still far behind advanced economies. Table 4 demonstrates that the gap between China's productivity and the productivity of developed countries has not narrowed even when China became the second largest economy and its economic growth rate was much faster than developed economies over the past decades.

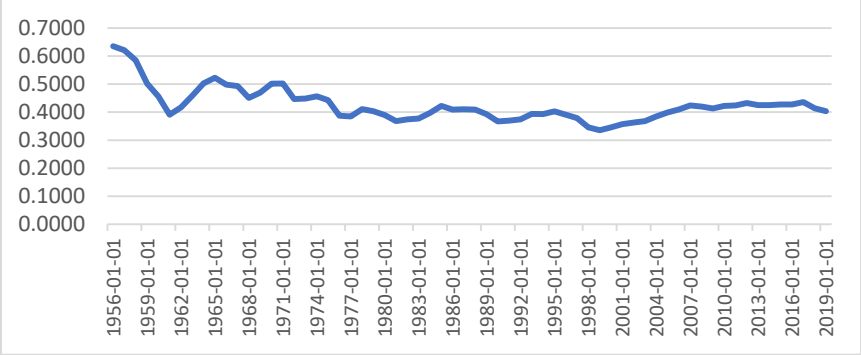
Table 4 Comparisons of Productivity of China with Other Developed Economies

Year	1990		2000		2010		2020	
Productivity	GDP Per Capita	GDP per labor	GDP Per Capita	GDP per labor	GDP Per Capita	GDP per labor	GDP Per Capita	GDP per labor
China	318	565	959	1,655	4,550	7,864	10,409	19,546
USA	23,889	46,824	36,330	70,133	48,651	9,5635	63,531	127,149
Japan	25,371	48,805	39,169	73,261	44,968	86,953	39,918	73,094
Germany	22,304	45,834	23,695	48,863	41,572	81,042	46,773	89,415
South Korea	6,610	14,867	12,257	25,196	23,087	45,007	31,721	57,499

Data source: World Bank

China's development has relied less on advancing productivity and more on its resources and the shift of labor from agriculture to the industrial and service sectors. China's total factor productivity (TFP) has not improved substantially in the past decades. Instead, Raiser and Soh (2019) provided evidence that China's TFP has been decreasing. Figure 1 shows that there has been a big gap between the TFP of China and the United States. However, the current low level of productivity, particularly TFP, indicates that China has a large potential for improvement and thus possible rapid economic growth through improving productivity.

Figure 1. China Total Factor Productivity (PPP-based) (Index USA=1)



Data Source: Federal Reserve Economic Data (FRED)

Table 5 China's Productivity (1978-2021)

Year	Productivity (¥ Yuan)	Productivity (US$)
1978	916	
1979	1,000	
1980	1,083	
1981	1,129	
1982	1,186	
1983	1,297	
1984	1,510	
1985	1,824	
1986	2,023	
1987	2,307	
1988	2,794	
1989	3,105	
1990	2,915	565
1991	3,360	592
1992	4,111	651
1993	5,340	671
1994	7,210	840
1995	9,012	1,078
1996	10,415	1,250
1997	11,417	1,369
1998	12,061	1,444
1999	12,685	1,514
2000	13,911	1,655
2001	15,229	1,812
2002	16,610	1,967
2003	18,637	2,198
2004	21,793	2,565
2005	25,094	2,971
2006	29,267	3,554
2007	35,859	4,575
2008	42,248	5,918
2009	45,962	6,578
2010	54,151	7,864
2011	64,038	9,702
2012	70,630	10,954
2013	77,714	12,285
2014	84,292	13,429

2015	90,259	14,169
2016	97,894	14,392
2017	109,395	15,809
2018	121,306	17,899
2019	130,756	18,418
2020	135,349	19,546
2021	153,200	22,725

Notes: (1) Data Source: CNBS and World Bank; (2) The differences between the pre-WTO (1978-2001) and the post-WTO (2012-2021) periods are significant at the 1% level.

Table 5 provides China's productivity (GDP / Total Employees) in Yuan and US dollars from 1978-2021. The t-tests indicate that joining the WTO in 2001 significantly improved productivity in terms of both Yuan and US dollars.

2. The Economic structure

China's economic structure will further change in the coming decades. The share of labor and GDP in the service sector will continue to increase while the share of labor and GDP in the agriculture sector will continue to decrease. The share of labor and GDP in the industrial sector will shrink, but China has been taking active measures to stabilize this industry. Table 6 shows China's economic structure in 2021 and projected economic structure by 2025 and 2035. According to Chen (2022), China will have 3-5% of GDP and 10-15% of labor in agriculture, 30-35% of GDP and 20-25% of labor in the industrial sector, and 60-67% of GDP and 60-70% of labor in services by 2035.

Table 6 China Projected Share of Labor and GDP for Three Industries (2025 and 2035)

	Primary		**Secondary**		**Tertiary**	
Year	GDP Share	Labor Share	GDP Share	Labor Share	GDP Share	Labor Share
2021	7.3%	22.9%	39.4%	29.1%	53.3%	48.0%
2025	6.5%	20.5%	38.8%	27.9%	55.7%	51.6%
2035	4.0%	12.5%	32.5%	22.5%	63.5%	65.0%

Note: The values for 2025 and 2035 are based on projected numbers from Chen et al. (2022).

3. Labor rate and labor distribution among three sectors

China's population growth has slowed down for many years and now there is negative growth. In 2022, China's total population was down by 850,000, a decrease of 0.6% from the previous year. Like some developed economies, such as Japan and South Korea, China's population will further decrease in the coming years. Assuming a 0.6% annual decrease, Table 6 shows that China's expected total population will be approximately 1.379 billion in 2025 and less than 1.3 billion in 2035. This population decline will not only affect the labor force, but also aggregate demand in the economy.

Table 7 China's Projected Total Population (2025 and 2035) (unit: millions)

Year	Total Population
2021	1,412.60
2025	1,379.00
2035	1,298.46

In addition, China is facing a population aging problem and its labor rate has been decreasing since 2010 (Chen et al. 2022). From 2010 to 2022, China's annual labor rate has decrease by 0.37% on average. We expect the labor rate will continue to decrease. Assuming that the labor rate will be 0.4% lower on average, Table 8 projects that China's labor rate will be 51.25% and 47.25% in 2025 and 2035, respectively.

Table 8 China's Labor Rate Projections (2025 and 2035)

Year	Labor Rate (%)
2021	52.85
2025	51.25
2035	47.25

Table 9 summarizes China's labor distribution among the three sectors from 1980-2021. We project the labor distribution for 2025 and 2035 based on Chen et al. (2022).

Table 9 China's Labor Share in Three Sectors (1980-2021) and Projected Labor Share for 2025 and 2035

Year	Agriculture %	Industrial %	Service %
1980	68.75	18.19	13.06
1990	60.10	21.40	18.50
2000	50.00	22.50	27.50
2010	36.70	28.70	34.60
2020	23.60	28.70	47.70
2021	22.90	29.10	48.00
2025	20.5%	27.9%	51.6%
2035	12.5%	22.5%	65.0%

Data Source: CNBS

To better understand future labor force trends for China, we look at the changes in the labor force in developed countries over time. Table 10 shows the labor rates for China, the United States, Japan, Germany, and South Korea. The table demonstrates that China's labor rate has been decreasing since 2010. China's labor rate is close to the labor rate of Japan and Korea, but still higher than the labor rate for the US and Germany. In 10-12 years, we expect that China's rate will decrease to approximately 50%, which is close to the current labor rate for the United States.

Table 10 Comparison of China's Labor Rate with Developed Economies (%)

	1990	2000	2010	2020

China	56.30	57.97	57.86	53.25
USA	51.02	51.80	50.87	49.97
Japan	51.99	53.47	51.72	54.61
Germany	48.66	48.49	51.30	52.31
South Korea	44.46	48.65	51.30	55.17

Notes: (1) Data Source: World Bank; (2) World Bank data is used instead of CNBS data for China so that China can be compared with other countries.

4. Urbanization

The significant rise of urbanization in China has contributed to China's stable and fast economic growth over the past 45 years. China's urbanization rate was 17.92% in 1978 and 64.72% in 2021. Table 11 shows the urbanization rate in China from 1978 to 2021 and projects China's urbanization rate for 2025 and 2035. China still has potential to raise its urbanization rate to 73-75% by 2035 (Chen et al. 2022). Over the past 40 years, China's annual urbanization rate has risen by more than 1% on average, but recently it has slowed down to less than 1%. We project that the urbanization growth rate will continue to decelerate.

Table 11 China's Urbanization Rate (UR) (1978-2021) and Projections for 2025 and 2035

Year	Urbanization Rate
1978	17.92
1980	19.39
1985	23.71
1990	26.41
1995	29.04
2000	36.22
2005	42.99
2010	49.95
2015	56.10
2020	63.89
2021	64.72
2025	67.92
2035	73.92

Data source: CNBS

Table 12 provides comparisons of China's urbanization rate with developed countries. The table shows that Japan has the highest urbanization rate at 91.87% while Germany has the lowest rate at 77.54%. Based on these comparisons, we expect that China's urbanization rate will stabilize after it reaches about 75% since China is a large country where rural development and the agriculture industry will be critical to its future.

Table 12 Comparisons of the Urbanization of China with Other Developed Economies

	1970	1980	1990	2000	2010	2020	2021
China	17.40	19.36	26.44	35.88	49.23	61.43	62.51
USA	73.60	73.74	75.30	79.06	80.77	82.66	82.87
Japan	71.88	76.17	77.34	78.65	90.81	91.78	91.87
Germany	72.27	72.84	73.12	74.97	76.97	77.45	77.54
South Korea	40.70	56.72	73.84	79.62	81.94	81.41	81.41

Notes: (1) Data Source: World Bank; (2) World Bank data is used instead of CNBS data for China so that China can be compared with other countries.

Furthermore, there may be a threshold after which the rise of urbanization may hurt the economy (Nguyen and Nguyen 2018). China's urbanization rate will reach 70% in the coming years so it is close to the turning point identified in Nguyen and Nguyen (2018). In other words, increase in urbanization will have little or even a negative effect on China's economy in the future.

Table 13 provides a summary of projected values for our key variables in 2025 and 2035.

Table 13 Projected Values of Key Variables (2025 and 2035) (Yuan)

		Projected Value	
Variable	**2021**	**2025**	**2035**
PA (Agriculture Productivity)	48,602	68,345	117,698
PM (Industrial Productivity)	207,563	256,130	392,141
PS (Service Productivity)	170,145	208,995	310,794
LR (Labor Ratio) (%)	52.85	51.25	47.25
UR (Urbanization Rate) (%)	64.72	67.92	73.92
LA (Agriculture Employee) (%)	22.90	20.50	12.50
LM (Industrial Employee) (%)	29.10	27.90	22.50
LS (Service Employee) (%)	48.00	51.60	65.00
LN(PA)	10.79	11.13	11.68
LN(PM)	12.24	12.45	12.88
LN(PS)	12.04	12.25	12.65
LN(LR)	3.97	3.94	3.86
LN(UR)	4.17	4.22	4.30
LN(LA)	3.13	3.02	2.53
LN(LM)	3.37	3.33	3.11
LN(LS)	3.87	3.94	4.17

Data source: CNBS

VII. Projected GDP per capita

Using our regression models, we can project China's GDP per capita (gdp) in Yuan. We then use projected exchange rates of 6.7 to 1 in 2025 and 6 to1 in 2035 to convert Yuan to US dollars. Table 14 shows China's projected gdp in terms of Yuan and US dollars for 2025 and 2035 based on our two regression models.

Table 14 Projected GDP per capita from Regression Models (Yuan & US$)

Year	2021	2025		2035	
Model		Model 1	Model 2	Model 1	Model 2
gdp (Yuan)	80,962	106,789	102,024	160,919	146,735
gdp (US$)	12,556	15,939	15,227	26,820	24,456

Data Source: CNBS

Chen et al. (2017) states that China will be able to pass the middle-income trap and become an advanced economy in the coming several years. There is no single factor to classify an economy's development level. There are also different standards by the World Bank and the International Monetary Fund (IMF). However, the main measurement for most economies to be classified as an advanced economy would be its GDP per capita. Currently, an economy would reach the advanced development level if its GDP per capita is greater than $13,000. China's current GDP per capita is very close to meeting this requirement.

Table 15 presents the average and standard deviation for China's GDP per capita growth from 1978-2021 and from 2012-2021. We alternatively project China's future GDP per capita by using the average GDP per capita growth from 2012 to 2021. To be conservative, average GDP per capita growth and the lower limit of one standard deviation is used. For example, future annual GDP per capita is expected to increase by 5.64% (8.41%-2.77%), which is calculated as the average minus the standard deviation. Table 16 summarizes our projections for China's future GDP per capita. We first calculate GDP per capita in Yuan and then convert the projections to US dollars using projected exchange rates of 6.7 to 1 in 2025 and 6 to 1 in 2035. Based on statistics theory, the probability of actual GDP per capita for this projected value in 2025 or 2035 will be about 83.5%.

Table 15 China's GDP per capita Annual Growth (1978-2021) (%)

	1978-2021	2012-2021
Average	13.46%	8.41%
Standard deviation	6.89%	2.77%
Lower limit of One Standard Deviation	6.57%	5.64%

Data Source: CNBS

Table 16 China projected GDP per capita in 2025 and 2035

Year	2025	2035

Projected GDP per capita (Yuan)	100,842	174,598
Projected GDP per capita ($)	15,051	29,100

Data Source: CNBS

Using World Bank data, similar projections can be done for China's GDP per capita in US dollars. This approach can avoid using projected exchange rates. Since the exchange rate was unstable during the 2012-2021 period, China's GDP per capita in US dollars was also unstable. Thus, Table 17 uses China's average GDP per capita growth in US dollars for the time period of 2002-2021 instead of 2012-2021 to project 2025 and 2035 GDP per capita in Table 18.

Table 17 China's Average Annual Growth and Standard Deviation for GDP per capita (2002-2021)

	2002-2021
Average growth, %	13.46
Standard deviation, %	8.08
One Standard Deviation, %	5.39

Data Source: World Bank

Table 18 China's Projected GDP per capita (US$)

Year	2025	2035
Projected GDP per capita ($)	15,488	26,174

Data Source: World Bank

Table 18 presents China's projected GDP per capita in terms of US dollars. Chen et al. (2017) argued that a country's currency appreciation will raise its GDP per capita in US dollars and vice versa. Although the Chinese Yuan has gone through some depreciation in recent years, it is expected that China's currency has significant appreciation potential in the coming decade. Therefore, China's actual future GDP per capita could be substantially higher than our projected number if the Yuan appreciates more than we projected. In addition, inflation affects an economy's nominal GDP and its currency value (Chen et al. (2017) and Chen (2022)).

VIII. Policy Implications

China's economy has been converging to the global economy and is following in the footsteps of many developed economies. China is experiencing what many developed countries have experienced, such as negative population growth, aging population, environmental issues, income inequality, and rising cost of labor, especially dramatic jumps in manufacturing sector costs and the shift of manufacturers to other cheap labor countries. Continuous economic development will be essential to solve most of these economic and social problems.

China will face barriers to sustaining stable and rapid economic growth in the future. China's productivity growth has been slow and the gap between China's productivity with the

productivity of advanced economies is huge. However, there is a large potential for China to significantly raise its productivity in the future.

China's population will further shrink and China's labor rate will also continue to decrease. Compared to the past, China's economic structure will change less substantially in the future. Therefore, the benefits from changes in China's economic structure will be marginal in the future. China's urbanization rate will rise but the annual change will be small. The effect of urbanization on the economy will be less significant or even negative in the coming decades.

Chen et al. (2017) pointed out that the growth of GDP per capita comes from the improvement of the labor rate, economic structure, and productivity. In addition, inflation and currency appreciation will increase GDP per capita. In the coming 5-7 years or by 2030, improvement of labor quality, productivity, economic structure, and urbanization will continuously drive China's economic development. In addition, reasonable inflation and currency appreciation will also help grow the economy. After that, productivity will determine China's future, the competitiveness of Chinese firms and industries in the world, and China's economic advancement.

Based on Figure 1, China's TFP is only about 40% of the current US level. Therefore, China will be able to reach constant, stable, and rapid economic growth in the decade after 2030 if it is able to raise its productivity consistently and substantially. Overall productivity rises when TFP rises. Science and technology are the key for the improvement of TFP, especially crucial are innovations and rapid expansions of new sectors and industries. Productivity can also be raised through economies of scale and reduction of production costs. Moreover, productivity can be increased through more efficient investments in human and financial capital. Furthermore, an acceptable level of inflation and currency appreciation will help improve the economy. In contrast, deflation and jumping inflation are dangerous and harmful to the economy.

Slowing down the pace of population shrinkage and maintaining a high labor rate will be critical to China's long term economic success. Gradually extending the retirement age and attracting foreign workers are feasible policies that many developed economies have adopted.

IX. Conclusion

This paper focuses on the effects of productivity, economic structure, and labor rate on China's economy. Using the value-added model for GDP measurement and data from 1978-2021, we identified important factors that determined China's fast economic growth in the past. Our regression results showed that significant increases in employment ratios, shifts of labor among the three sectors, and substantial improvement of industrial productivity contributed the most to China's past economic success. Our results also indicate that urbanization was a significant contributor to China's economic growth.

Our paper also compared the key variables between the pre- and post-WTO periods. Our results demonstrated that all variables were significantly improved after China's entry to the WTO in 2001, except for the agriculture labor share, which decreased significantly. We also projected China's potential GDP per capita in the coming decades based on extensive analysis of potential changes to China's productivity, economic structure, labor rate, and urbanization.

Table 19 Summary of China's GDP per capita Projection

		Regression Models		Standard Deviation	Standard Deviation
		Model 1	Model 2	& Yuan-based Data	& US $-based Data
2025	Yuan	106,789	102,024	100,842	103,772

	US$	15,939	15,227	15,051	15,488
	Yuan	160,919	146,735	174,598	157,043
2035	US$	26,820	24,456	29,100	26,174

Notes: We assume an exchange rate of 6.7:1 between US$ and Yuan in 2025 and 6:1 in 2035.

Table 19 above summarizes China's projected GDP per capita in 2025 and 2035. China's GDP per capita in 2025 will be between ¥100,842 to ¥106,789 or $15,051 to $15,939. By 2035, China's GDP per capita will be between ¥146,735 to ¥174,598 or $24,456 to $29,100.

If we assume that China's population will decrease 0.6% annually on average, then China's total population will be 1.298 billion by 2035. As a result, China's total GDP will be $34.575 trillion by 2035 based on the average of the four GDP per capita projections above.

If we assume that US's population will rise 0.7% annually on average, then the US population will reach 365.95 million by 2035. Average annual GDP growth in the United States was 2.04% from 2000 to 2021. Excluding the years for the 2007-2008 financial crisis and the COVID-19 pandemic, the US's average annual growth was 2.25% from 2010 to 2019. If assume that US GDP will increase 2.25% annually on average, US total GDP will be $31.860 trillion in 2035.

Therefore, China will surpass the US to become the largest economy in the world before 2035. This comparison between the US and China is very conservative since the projected GDP from our regression models is underestimated. The more optimistic estimation would be China's GDP per capita of $29,100 from the Yuan-based data. In this scenario, China's total GDP will be $37.777 trillion. Based on these projections, the US must maintain 3.50% annual growth rate to keep its title as the largest economy in 2035.

In conclusion, China has recently faced many challenges and barriers in its economic development. China's TFP has not been significantly improved in the past decades and the benefits from changes in the economic structure, labor rate, and urbanization will be marginal in the future. However, China still has a large potential for sustainable and rapid economic growth in the coming decades if it is able to adopt better technologies to raise its productivity, increase investment returns on human and financial capital, and control and reduce the side effects of population and labor force shrinkage. Most importantly, better motivation of people and companies is the key for China's future prosperity. The government and its policies should encourage fair competition and effective and efficient allocations of limited resources. A market oriented economic system and relevant reforms can better allocate limited resources and better motivate people and entrepreneurs.

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An Analysis of Japan's Economic Development: What China Can Learn from Japan's Experience

Yueyun (Bill) Chen
University of the West, Los Angeles, USA

Nika Qiao
West Texas A&M University, USA

Abstract

This study provides a comprehensive analysis of Japan's economic development since 1970 using both the expenditure and the value-added approach for GDP measurement. For the expenditure model, personal consumption and change in net exports made the most contributions to Japan's economic growth. For the value-added model, labor rate and service industry productivity are the most important factors for Japan's economic prosperity. In contrast, urbanization and labor share in the agriculture sector did not have a significant effect in the value-added model. Next, our paper focuses on the past and future changes for all economic factors, including economic structure, labor rate, productivity, trade, investment, consumption, and urbanization, to explore how these changes have affected and will impact Japan's economy. We then compare China with Japan and discuss what China can learn from Japan's experience. There are many similarities and differences between these two East Asian countries. The major difference is that Japan achieved industrialization, modernization, and urbanization when it became the second largest economy in the world in 1968, but China has still been going through these processes and advancements after it surpassed Japan to be the second largest economy in 2010. Therefore, China still has a large potential for continuous and sustainable growth. One of the most important lessons from Japan is that economic shocks, especially external shocks, hurt the economy, but panic and overreaction can damage the economy more severely and persistently.

Keywords: Japan Economy, China Economy, Productivity, Economic Structure, and Labor Rate

I. Introduction

Japan was the world's second largest economy, behind the United States, from 1968 until 2010, when it was overtaken by China. Japan's gross domestic product (GDP) in 2022 was $4.3 trillion and its population of 125.7 million people enjoyed a high standard of living with a GDP per capita of $39,000.

Japan has played an important role in the global economy for many decades. After World War II, Japan embarked on a period of rapid industrialization and modernization and experienced significant economic growth and prosperity. This growth continued through the 1980s and threatened US economic dominance. The Japanese economy is known for its strong manufacturing sector, technological innovation, and high levels of productivity. The country has also been a leader in international trade and many Japanese companies operated globally.

However, since the 1990s, Japan has experienced "the lost decades", in which it has had a prolonged period of low economic growth and low or negative inflation (deflation). Many factors led to this economic outcome, including an aging population and negative population

growth. The country has responded with a range of policy initiatives, including monetary and fiscal stimulus, structural reforms, and efforts to increase female labor force participation and attract more foreign workers. Some of these policies such as retaining female labor have worked marginally, but the overall economy has not been improved. Japan still faces the threat of future economic recession and deflation. Table 1 summarizes Japan's economy from 2017-2021.

Table 1 Japan's Economy (2017-2021)

Year	**2017**	**2018**	**2019**	**2020**	**2021**
GDP per capita (USD)	38,834	39,727	40,458	39,918	39,313
Population (million)	126.972	126.811	126.633	126.261	125.682
Labor Force (million)	67.225	68.387	69.046	68.954	68.859
Labor Force, Female (million)	29.365	30.163	30.684	30.616	30.694
GDP (USD trillion)	4.931	5.038	5.123	5.040	4.941
Economic Growth (Nominal USD GDP, %)	-1.46	2.17	1.70	-1.62	-1.97
GDP (JPY trillion)	553.073	556.294	558.491	538.155	542.283
Economic Growth (Nominal JPY GDP, %)	1.60	0.58	0.40	-3.64	0.77
Core Inflation (%)	-0.07	0.19	0.45	0.11	-0.73
Exports growth (USD %)	7.95	6.44	-3.19	-12.26	16.11
Imports growth (USD %)	8.75	11.12	-1.48	-12.35	17.59

Data source: World Bank

It is crucial to identify the significant factors that contributed to Japan's past economic success and find out the changes and challenges that Japan has faced. A study to understand Japan's economy and its economic policies is valuable not only to Japan, but also to the world since Japan is still the third largest economy. China can especially learn from Japan's experiences because China is facing similar problems and challenges, such as slower economic growth, an aging population, global trade disputes, and deflation.

In this paper, we use the expenditure and value-added approaches for GDP measurement to establish relevant econometric models. Then, we use the World Bank (WB) data to identify significant variables for these two models and discuss how these variables have impacted Japan's prosperity over the past decades. These econometric models are based on studies by Chen et al. (2017), Chen and Qiao (2022), and Qiao and Chen (2023).

Although there have been numerous studies on Japan's economy, this study contributes to the literature in a number of ways. First, we use the latest data for Japan up to 2021. Second, both expenditure and value-added models for GDP measurement are used to analyze relationships among variables. Finally, we provide a comprehensive comparison between China and Japan to

investigate their similarities and differences and explore what China can learn from Japan's economic history.

The rest of the paper is organized as follows. Section II reviews the literature. Section III discusses the econometric models. Section IV explains the data and variables. Section V presents the regression results. Section VI discusses the implications from the study. Section VII compares China and Japan and explores what China can learn from Japan's experience. Section VIII concludes the paper.

II. Review of literature

The literature on Japan's economy is enormous. This review first focuses on studies that examine what led to Japan's prosperity after 1945 and to the 1980s. Our review then focuses on why Japan had serious economic problems after the 1990s and experienced the "lost decades" and how to solve these economic troubles. In addition, we review the lessons that China and other countries may learn from Japan.

Leitner (1999) found that Deming helped launch a campaign for institutionalizing quality control within the Japanese manufacturing sector, which improved Japan's ability to produce quality products and its industrial resurgence in the 1980s. Phan et al. (2011) showed that many Japanese companies persistently applied quality control methods, which enhanced Japan's manufacturing competitiveness in the world. Lee (1993) concluded that effective interactions between capitalism and socialism benefited Japan and other East Asian countries. Beckley et al. (2018) demonstrated that Japan achieved its economic miracle because of sudden and dramatic changes in its relationship with the United States in the late 1950s. The authors find that Japan could still have had high growth, but it would have been much slower. Bery (2011) explained that Japan's integration with the US and Europe within the liberal trading and monetary order set up by the US after World War II led to Japan's reconstruction. This successful path was later adopted by South Korea, Taiwan, Hong Kong, and Singapore in the 1970s and ASEAN economies in the 1980s. Chen et al. (2019) proved that Japan's manufacturing industry's growth was mainly attributed to productivity and investment while China's and Germany's manufacturing industry growth was attributed to exports of manufacturing products.

Yoshino and Taghizadeh-Hesary (2016) presented empirical evidence to show that stagnation of the Japanese economy is caused by its vertical investment-saving curve instead of a horizontal liquidity-money curve so the Japanese economy has been facing structural problems. Wevers (1998) called Japan the "Troubled Giant" and believed that its economic and structural issues in the 1990s were caused by mismanagement of economic policies and political and administrative weaknesses. Koo (2001) pointed out that blaming structural issues entirely for the poor performance of the Japanese economy in the 1990s is inappropriate because most structural problems existed for many decades. The author noted that just structural issues cannot explain why an economy that was so powerful until the end of the 1980s suddenly lost its forward momentum in the 1990s. Guo and Yakura (2009) argued that the cross holding of company shares contributed to the spike and collapse of Japan's economy. Pasierbiak (2013) showed that strong support from the government and entrepreneurship led to successful development of the high-technology industry in Japan and its dominance in the world. More competition, especially from other Asian countries, threatened Japan's position so Japan lost its advantages in some areas of technology. Lee and McKibbin (2018) found that Japan experienced a large flow of workers out of the service sector into other sectors, especially into the durable goods sector, and

that Japan's service sector was much more labor intensive compared with other Asian economies.

Saito (1999) recommended that Japan must continue to stimulate its economy using fiscal policy and stabilize the financial system. In addition, steps must be taken to transform Japan's economic and industrial structures to meet the demand of global markets. Boltho and Corbett (2000) advocated fundamental changes to Japan's economic system to resolve stagnation in the economy. Akram (2019) emphasized that Japan's structural reforms should aim at boosting its living standards, human capital, and capabilities. Ihori and Nakamoto (2005) proposed that the Japanese government must drastically revamp the fiscal system and reduce mass deficits for economic recovery. İmrohoroğlu and Yamada (2017) analyzed Japan's guest worker program and concluded that this program may ease Japan's fiscal problems by generating more tax revenues in addition to solving labor force shortage.

Urata (2020) described the US and Japan trade wars in detail and concluded that the US sought to reduce its trade deficit with Japan and to protect and promote US industries. The US failed to achieve the first objective, but had some success with the second objective. Thorbecke (2023) argued that the Plaza Accord in 1986 benefited the US, Japan, and other Asian countries since the depreciation in the dollar improved U.S. trade imbalances with East Asia and the world. East Asian countries also benefited from the dollar depreciation because it lowered the local currency costs for imported oil, commodities, and food, which reduced imported inflation.

Baek (2007) compared East Asian economies and concluded that successful development in those countries shared many characteristics, such as state control over finances, direct support for state owned enterprises by the government, import substitution industrialization in heavy industries, a high dependence on export markets, and a high rate of domestic savings. Murach and Wagner (2017) found that China's adjustment from an investment- and manufacturing-led growth model toward a consumption- and service-led model is similar to historical developments in Japan and South Korea. Fukao and Yuan (2016) compared Japan and China's economies. They emphasized that China should learn from Japan's experience by focusing on improving total factor productivity growth instead of capital accumulation because high speed growth based on rapid capital accumulation is not sustainable. Wangping and Xiaolu (2018) analyzed China and Japan's economies and found that the impact of Japan's economic fluctuations on China was bigger than the impact of China's economic fluctuations on Japan. Weede (2004) compared Japan and China and found that Japan's catch-up with the West started about a hundred years earlier than China. Savings, investment, and human capital formation in both countries were high and contributed to economic growth. Political instability, diluted property rights, and distorted incentives in China hurt its progress. However, since 1978, China has re-established incentives, opened up its economy, and established some substitute for private property rights, which has led to China's sustainable and rapid growth. As a result, China surpassed Japan to become the second largest economy in 2010 and the gap in GDP between the two economies has continued to widen rapidly, but there is still a big gap for per capita income between Japan and China.

This study aims to identify the significant factors that resulted in Japan's past economic development and analyze the changes in the factors that led to Japan's economic troubles. We then compare China with Japan and explore the lessons China can learn from Japan's experience.

III. Econometric Models

An economy's total domestic gross product (GDP) can be measured using the expenditure, value-added, or income-based approach. Most studies on a country's economic growth adopt the first two approaches (Chen et al. (2021)). In this paper, we use the expenditure and value-added approaches to develop relevant econometric models and then use the World Bank data to test which variables are significant for Japan in each model.

3.1. Expenditure econometric model

Following Chen and Qiao's (2022) methodology, a country's GDP depends on personal and governmental consumption, investment, and net trade. Thus, we use the following model where r is the annual growth of the relevant variable:

$$GDP^r = a + b1*\text{Personal-Consumption}^r + b2*\text{Governmental-Consumption}^r + c*\text{Investment}^r + d*\text{Change in Net-Export} \quad (1)$$

As explained by Chen and Qiao (2022), change in net-export proxies for net export growth since net exports growth changes dramatically and has outliers while change in net-export is smoother over time.

3.2.Value-added econometric model

Based on Chen et al. (2017) and Qiao and Chen (2023), a country's GDP per capita for the valued-added approach can be expressed as following:

$$LN(gdp) = a + b1*LN(PA) + b2*LN(PM) + b3*LN(PS) + c*\log(LR) + d*Log(UR) + e1*LN(LA) + e2*LN(LM) + e3*LN(LS) \quad (2)$$

Where gdp is the GDP per capita, PA, PM and PS are the productivity per employee in the agriculture, industrial, and service sectors, LR is the labor rate (# of total employees/total population), UR is the urbanization rate, and LA, LM and LS are the labor shares in the agriculture, industrial, and service sectors.

IV. Data and variables

All data in the regressions are from the World Bank. GDP data are available from 1960 to 2021. For the expenditure model, data for the variables are available from 1970 to 2021. For the value-added model, many variables only have data available from 1994 to 2020.

Table 2 provides the summary statistics for the key variables used in the expenditure model. Personal consumption and government consumption have higher annual growth than annual GDP growth. Average change in net export was negative and total investment growth was lower than GDP growth.

Table 3 provides the summary statistics for the key variables used in the value-added model. The standard deviation for Japan's GDP per capita was small. Japan's agriculture productivity is extremely low, compared with the productivities for the other two sectors. Japan has a very high urbanization rate.

Table 2 Summary Statistics for Variables in Expenditure Model (%) (1970-2021)

Variable	Average	Standard Deviation

GDP Growth	7.10	13.09
Personal Consumption Growth	7.40	13.09
Governmental Consumption Growth	8.51	13.36
Total Investment Growth	6.09	14.09
Change in Net Export	-0.03	0.93

Data source: World Bank

Table 3 Summary Statistics for Variables in Value-Added Model (1994-2020)

Variable	Average	Standard Deviation
GDP per Capita ($)	39,049	4,140
PA (Agri Productivity) ($)	21,726	2,985
PM (Ind Productivity) ($)	79,002	10,190
PS (Service Productivity) ($)	75,537	8,680
Labor Rate (%)	52.79	0.98
Urbanization Rate (%)	86.03	5.66
LA (Agri Employee %)	4.28	0.81
LM (Ind Employee %)	28.28	3.35
LS (Service Employee %)	67.44	4.15

Data source: World Bank (WB)

V. Regression results

Table 4 presents the regressions results for Japan based on the expenditure and value-added approaches.

Table 4 Summary of Regression Results
Panel A: Model 1 Expenditure Approach (1978-2021)

Variable	Estimated Coefficient
Intercept	0.00
Personal Consumption Growth	0.61***
Governmental Consumption Growth	0.08***
Total Investment Growth	0.30***
Change in Net Export %	0.99***
Observations	51

F-Statistic	10,893***

***: 1% significant

Panel B: Model 2 Value-added Approach (1994-2020)

Variable	Estimated Coefficient
Intercept	-6.24***
LN(PA)	0.01***
LN(PM)	0.28***
LN(PS)	0.71***
LN(LR*100)	0.99***
LN(UR*100)	0.01
LN(LA*100)	0.00
LN(LM*100)	0.12***
LN(LS*100)	0.29***
Observations	27
F-Statistic	114,008***

***: 1% significant

The results for the expenditure approach show that all the coefficients for the independent variables are significant. The estimated coefficient for change in net export is the largest while the coefficients for personal consumption and total investment growth are the second and third largest. However, the average value for net export to GDP from 1970-2020 was only 0.89% with a standard deviation of 1.30% (Table 8). On the other hand, the average value of the personal consumption to GDP was 53.19% with the standard deviation of 2.59% (Table 7) and the average value for total investment to GDP was 30.81% with the standard deviation of 5.53% (Table 9). Therefore, personal consumption and investment contributed the most to Japan's economic growth. In addition, the estimated coefficient for personal consumption is more than double the coefficient for total investment.

The results for the value-added approach indicate that labor rate significantly affected Japan's economy. Furthermore, the estimated coefficient for labor share in agriculture was negative, which is consistent with the results from the value-added analysis of China in Qiao and Chen (2023).

Labor share in the agriculture sector did not have a significant impact on economic growth. The estimated coefficient for urbanization rate is also not significant, which means that urbanization did not significantly contribute to Japan's economic growth. This result is different from China's value-added model in Qiao and Chen (2023). However, this result is reasonable because Japan has undergone urbanization for many decades.

Among the three sectors in Japan, the estimated coefficient for service sector productivity is the largest and is almost three times the coefficient for industrial sector productivity. Productivity in the service sector contributed the most to economic growth, compared with the other two sectors. Labor share in the service sector also has the largest estimated coefficient among the three sectors. Therefore, compared with the other two sectors, the shift of labor to the service sector affected Japan's economy the most.

VI. Implications

1. Economic structure

Table 5 shows Japan's economic structure from 1994-2020. The table shows that Japan's economic structure has been stable since 1994. Japan's labor share and GDP share in the service sector rose in the 2000s, but such changes have been very marginal since 2011. In the past decade, Japan's economy did not benefit much from economic structure changes. Thus, in the future, potential changes in economic structure will continue not to contribute to Japan's economic growth.

Table 5 Japan's Economic Structure (1994-2020) (%)

		Agriculture		Industrial		Service	
Time Period		**Labor Share**	**GDP Share**	**Labor Share**	**GDP Share**	**Labor Share**	**GDP Share**
1994-2000	Average	5.41	1.63	32.87	33.69	61.73	64.68
	Standard deviation	0.30	0.13	1.04	0.79	1.33	0.88
2001-2010	Average	4.30	1.18	28.44	29.46	67.26	69.36
	Standard deviation	0.26	0.13	1.55	1.11	1.80	1.20
2011-2020	Average	3.47	1.07	24.91	27.99	71.62	70.94
	Standard deviation	0.17	0.05	0.57	1.05	0.73	1.05
1994-2020	Average	4.28	1.25	28.28	30.02	67.44	68.73
	Standard deviation	0.81	0.25	3.35	2.51	4.15	2.74

Data source: World Bank

2. Population, aging and labor rate

Table 6 shows Japan's population growth, aging rate, and labor rate from 1994-2020. Japan's population growth has slowed down substantially over the decades and was negative in the 2010s. Japan's aging rate (% of people over 65 or above) was close to 15% in the 1990s. Since then, the aging rate has increased to over 27% in the 2010s. This is a serious economic and social problem. Population aging affects the labor force and also impacts total demand (Qiao and Chen (2023)). We project that Japan's population will continue to decline and its aging rate will continue to rise. All of these changes will negatively impact Japan's future economic growth.

Japan's labor rate decreased in the 2000s and has slightly increased over the 2010s. This is good news because a higher labor rate means more labor supply. However, this rise in labor rate could be caused by unfavorable economic conditions. When the financial support from a social system worsens, many retirees or seniors will be forced to look for jobs and consider delaying their retirement. In other words, the rise in the labor rate could be a signal of bad economic conditions.

Table 6 Japan's Population growth, aging rate, and labor rate (1990-2020)(%)

Time Period		Population Growth	Aging Rate	Labor Rate
1990-2000	Average	0.27	15.03	53.40
	Standard deviation	0.07	1.79	0.59
2001-2010	Average	0.10	21.02	52.26
	Standard deviation	0.10	1.78	0.41
2011-2020	Average	-0.14	27.22	52.67
	Standard deviation	0.07	1.97	1.27
1990-2020	Average	0.08	20.90	52.80
	Standard deviation	0.19	5.40	0.94

Data Source: World Bank

3. Productivity

Table 7 compares annual labor productivity growth for Japan, US, and Germany. According to Baily et al. (2020), Japan's labor productivity has slowed down since 1995 and the contribution of total factor productivity (TFP) to overall labor productivity has been less than capital investment since 2004. Thus, Japan's economic growth has been increasingly attributed to capital investment, instead of progress from TFP improvement. Japan used to have annual labor productivity growth that was higher than the US and Germany, but the relationship has reversed and now its labor productivity growth is lower. Low productivity hurts Japan's economy so Japan needs to figure out feasible and effective actions to improve its productivity, especially TFP, in order to stimulate its economy.

Table 7 Comparison of Labor Productivity Growth for Japan, US, and Germany

Country	Years	From Capital	From TFP	Total Labor Productivity
Japan	1985-1995	1.58	1.69	3.27
	1995-2004	0.73	1.3	2.03
	2004-2016	0.52	0.27	0.79
US	1985-1995	0.68	0.62	1.3
	1995-2004	1.52	0.95	2.47
	2004-2016	0.55	0.47	1.02
Germany	1985-1995	1.57	0.89	2.46
	1995-2004	0.9	0.79	1.69
	2004-2016	0.69	0.26	0.95

Data source: OECD

4. Personal and government consumption

Table 8 summarizes personal consumption and related ratios for Japan. The table shows that annual growth for personal consumption and the ratio of personal consumption to governmental consumption have been decreasing over the decades while personal consumption to total GDP ratio has been increased over the decades.

Japan's personal consumption to total GDP ratio is lower than many developed economies. For example, this ratio is about 69% in the US. Thus, Japan still has potential to raise its personal consumption level to stimulate its economy.

Table 8 Japan's Personal Consumption (1970-2020)

Time Period		Personal Consumption Annual Growth (%)	Personal Consumption / GDP Ratio (%)	Personal / Government Consumption Ratio (%)
1970-1980	Average	19.86	49.97	3.71
	Standard deviation	12.54	2.07	0.27
1981-1990	Average	11.56	52.36	3.68
	Standard deviation	15.12	0.82	0.08
1991-2000	Average	5.72	52.65	3.50
	Standard deviation	10.85	0.92	0.16
2001-2010	Average	2.32	55.40	3.08
	Standard deviation	7.45	1.04	0.06
2011-2020	Average	-1.54	55.89	2.81
	Standard deviation	8.46	1.62	0.11
1970-2020	Average	7.58	53.19	3.36
	Standard deviation	13.16	2.59	0.39

Data source: World Bank

5. Exports and manufacturing product exports

Table 9 summarizes export growth and related ratios. Exports are crucial to Japan's economy. Japan's export annual growth has been decreasing over the decades. The net export to GDP ratio was highest in the 1980s, but has been decreasing since then. The export to GDP ratio rose in 1980s, fell in the 1990s, but has been increasing since 2000s. Merchandise export growth has been decreasing over the decades and was negative in the 2010s.

Japan needs to develop and export more to international markets in the future. However, it is unlikely that net exports will heavily contribute to economic growth. Stabilizing international trade, particularly exports, should be Japan's priority to avoid negative effects on economic growth.

Table 9 Japan's Exports

Time Period		Export Annual Growth (%)	Net Export/ GDP Ratio (%)	Export / GDP Ratio (%)	Merchandise Export Growth (%)

1970-1980	Average	21.32	0.61	11.55	21.62
	Standard deviation	12.74	1.27	1.29	12.72
1981-1990	Average	8.55	1.89	12.04	8.52
	Standard deviation	8.52	1.11	2.03	8.22
1991-2000	Average	5.22	1.48	9.66	5.50
	Standard deviation	7.47	0.53	0.63	7.59
2001-2010	Average	6.38	1.20	13.65	6.12
	Standard deviation	16.28	0.55	2.57	16.59
2011-2020	Average	-0.65	-0.68	16.48	-1.58
	Standard deviation	7.51	1.19	1.34	7.12
1970-2020	Average	8.16	0.89	12.65	8.05
	Standard deviation	12.89	1.30	2.81	13.23

Data source: World Bank

6. Investment

Table 10 presents summary statistics for investment. Japan's annual investment growth has been very low since the 1990s. Investment growth was negative in the 2001-2010 period. Investment's contribution to total GDP has been decreasing since the 1970s. In the 2000s and the 2010s, investment's contribution to GDP was only about 25%. Low investment directly affects economic growth and poor economic prospects further lower the interest of investors. Japan needs to break this vicious cycle in order to return back to normal economic development.

Table 10 Japan's Investment (%)

Time period		Investment Annual Growth, %	Investment / GDP Ratio, %
1970-1980	Average	16.76	38.20
	Standard deviation	16.99	3.32
1981-1990	Average	12.08	33.49
	Standard deviation	16.93	1.63
1991-2000	Average	2.70	31.33
	Standard deviation	9.84	2.40
2001-2010	Average	-0.43	25.39
	Standard deviation	9.20	1.59
2011-2020	Average	0.18	24.90
	Standard deviation	8.52	0.72
1970-2020	Average	6.26	30.81
	Standard deviation	14.18	5.53

Data source: World Bank

7. R&D and FDI

Table 11 compares Japan's total R&D and R&D to GDP ratio with six other countries, including the US, China, Germany, South Korea, France, and the UK. R&D is crucial to an economy's competitiveness and long-term development. Japan's R&D to GDP ratio has been higher than many developed economies. Japan's ratio is 3.2%, which is higher than all the other countries, except South Korea.

Table 11 Comparison of Japan's R&D with Other Countries (2019)

Country	Total R&D Spending (PPP US$ million)	R&D/GDP Ratio (%)
US	668,351	3.13
China	525,693	2.23
Japan	173,267	3.20
Germany	148,150	3.19
South Korea	102,521	4.64
France	73,287	2.20
United Kingdom	56,936	1.76

Data source: US National Center for Science and Engineering Statistics

Table 12 summarizes Japan's FDI and R&D annual growth. Japan's annual R&D growth has been very low and unstable with an average of 1.71% and a standard deviation of 7.89% from 1997-2014. In many years, R&D growth was negative. These drops in R&D investment have affected Japan's long-term economic development, which may explain why many Japanese industries, especially consumer electronics, semiconductor, and information technology, have been far behind the US since the 2000s.

Attracting FDI directly helps an economy. In addition, the ability to attract FDI and the ratio of FDI to total GDP are good indicators of a country's economic prospects. Table 12 indicates that Japan's average FDI to GDP ratio was 0.19% with a standard deviation of 0.16% from 1997-2014. This FDI to GDP ratio is very low compared with other countries. According to the World Bank, the US's FDI/GDP ratio was 1.71% in 2013 and China's ratio was 2.56% in 2014.

Japan needs to keep and maintain high R&D investment even if economic conditions look unfavorable. In addition, Japan should be more open to foreign investments and foreign firms. Foreign entry to Japanese markets may hurt many Japanese companies in the short-term, but increased competition benefits Japanese industries and economy in the long-term.

Table 12 Japan's FDI and R&D Annual Growth (1997-2014) (%)

Year	R&D Growth	FDI / GDP
1997	-6.69	0.06
1998	-4.49	0.06
1999	13.77	0.32
2000	8.05	0.22

2001	-9.81	0.11
2002	-3.11	0.28
2003	9.03	0.19
2004	7.90	0.15
2005	4.27	0.11
2006	-1.87	-0.05
2007	1.05	0.47
2008	11.69	0.48
2009	0.30	0.23
2010	5.52	0.13
2011	12.53	-0.01
2012	-0.56	0.01
2013	-13.65	0.20
2014	-3.07	0.40
Average	**1.71**	**0.19**
Standard Deviation	**7.89**	**0.16**

Data source: World Bank

VII. A Comparison of China and Japan and Lessons from Japan's experience

Besides their location in East Asia, China and Japan share other similarities. Japan was once the second largest economy in the world and challenged the US economic dominance in the 1990s. China is now the second largest economy and most likely will surpass the United States to become the largest economy in about 10 years. Japan had serious trade wars with the US during the 1980s and 1990s. Recently, China has had the similar problems with the US. Both countries have relatively low arable land per capita and their export to GDP and trade to GDP ratios are relatively high, compared with many other countries. China's current labor rate is very close to Japan's, even though China is still a developing economy.

Table 13 provides a comprehensive comparison between China and Japan in terms of key economic factors. In some areas, China is far behind Japan. For example, China's current GDP per capita is only at the level of Japan in 1967. China's urbanization rate is equivalent to the Japan's level in 1960. However, China is a much larger economy. China not only exports more than Japan, but also has a higher export to GDP ratio than Japan.

Table 13 A Comparison of China and Japan

	China	**Japan**	
Variable	**2020**	**1994**	**2020**
Population	1,411,100,000	125,178,000	126,261,000
Total GDP ($)	14,687,673,892,882	4,998,797,547,741	5,040,107,754,084
GDP per capita ($)	10,409	39,934	39,918
Arable land per capita (hectares)	0.0847	0.0372	0.0325

Fresh water per capita (cubic meter)	402.86	716.74	620.94
Total consumption ($)	8,126,754,869,001	3,373,095,791,124	3,771,346,058,843
Total consumption / GDP ratio (%)	55.33	67.48	74.83
Total consumption per capita ($)	5,759	26,946	29,869
Total trade ($)	5,104,597,627,354	790,325,200,229	1,580,512,856,376
Total trade / GDP ratio (%)	34.75	15.81	31.36
Total export ($)	2,729,871,520,706	441,885,061,610	784,167,900,505
Total export / GDP ratio (%)	18.59	8.84	15.56
Total import ($)	2,374,726,106,648	348,440,138,620	796,344,955,872
Total import / GDP ratio (%)	16.17	6.97	15.80
Total investment ($)	6,369,555,703,687	1,532,256,833,627	1,280,938,750,609
Total investment/GDP ratio (%)	43.37	30.65	25.41
Agriculture GDP (%)	7.70	1.89	1.04
Industrial GDP (%)	37.84	34.55	29.02
Service GDP (%)	54.46	63.55	69.94
Labor rate (%)	53.25	53.47	54.61
Senior rate (65 and above)	12.60	14.44	29.58
Agriculture Labor (%)	24.85	5.81	3.25
Industrial labor (%)	27.73	34.19	23.97
Service labor (%)	47.41	60.00	72.78
Agriculture productivity ($)	6,054	24,335	23,490
Industrial productivity ($)	26,670	75,484	88,497
Service productivity ($)	22,451	79,108	70,236
Urbanization rate (%)	61.43	77.88	91.78
Core Inflation rate (%)	0.73	0.88	0.11
Stock market total value ($)	12,214,465,600,000	3,592,193,910,000	6,718,219,550,000

Data source: World Bank

The above comparisons also indicate that China has a large potential for improvement. First, China's productivity is very low compared with Japan. Second, China's service industry has much room for further growth. Third, China's urbanization rate has potential to increase. Finally, China's total consumption to GDP ratio is comparably low.

Given its similarities with Japan, China can definitely learn from Japan's past successes and failures. However, these two countries are also quite different and face different global environments, so China has to be careful in applying Japan's experience to solving its own problems.

Japan has had serious trade disputes with the US and other Western countries for many years, especially during the 1980s. In 1985, the G-5 nations, including France, Germany, the United States, the United Kingdom, and Japan, signed the Plaza Accord. As a result, Japan was forced to appreciate its currency. A rising yen led to a major short-term shock to Japanese export-based industries, so the Japanese government adopted expansionary monetary and fiscal policy to boost its domestic economy. This led to bubbles in real estate and stock markets. As a result, Japan experienced "the lost decade" and now "the lost decades" in which both economic growth and inflation were extremely low and even negative.

Scholars have had different opinions on what led to Japan's economic troubles and how to solve these problems. But the basic fact is that Japan still has not fully overcome these economic hurdles.

China faced similar trade disputes when then US President Trump imposed extremely heavy tariffs on China-imported products. Although the US president has changed since 2020, these tariffs still remain in place. In addition, the US and other Western nations have taken additional measures against China to protect their economic interests, such as providing government subsidies to encourage the construction of manufacturing plants and limiting sharing of advanced technology with China.

China has faced more challenges than Japan in dealing with Western countries. But, China has advantages such as its huge domestic market and the rising demand for foreign made products. China also does not have the pressure of appreciating its currency. In fact, in the past several years, the Chinese Yuan has generally depreciated. China should follow the global trade rules set by the World Trade Organization (WTO) and other internationally recognized organizations of which China is a member. China also should further reduce government interference in the economy and open its markets. It should be noted that China's markets are more open than many other countries, including some developed economies like Japan.

The lessons that China can learn from Japan's experience are discussed below.

1. Economic policy

What Can China learn from Japan's experience? First and foremost, the economic policy must consider its long-term effects. During the 1986-1988 period, Japan's government took dramatic fiscal and monetary policies to stimulate its economy after the Plaza Accord and the Yen appreciated. Table 14 indicates that Japan's net exports to GDP ratio decreased from 1986-1988, but the ratio was still positive at 1.96% in 1988. In other words, currency appreciation did not negatively affect Japan's economic growth, since net exports are directly related with GDP.

The Yen's significant appreciation caused panic and thus led to the government taking extreme measures based on traditional economic theories and models. As a result, personal consumption, government consumption, and total investment sharply increased. However, these measures had severe consequences such as bubbles for fixed and financial assets, which eventually caused the crash of the whole economy.

Table 14 Japan's Economy from 1986 to 1988 (%)

Year	GDP Growth	Total Consumption Growth	Personal Consumption Growth	Governmental Consumption Growth	Total Investment Growth	Net Export/GDP Ratio	Total Export Growth
1986	48.61	47.64	47.61	47.76	48.25	3.67	16.73
1987	21.83	21.70	21.84	21.19	25.24	2.77	10.95

1988	21.28	18.90	19.21	17.73	28.61	1.96	16.85

Data source: World Bank

2. Population and labor rate

The second lesson is that the population and labor rate are crucial to the economy. It is difficult for the economy to recover when population growth and labor rate have slowed down. The government must have a strategic view and recognize the importance of human capital accumulation. China has waited for too long to take the necessary actions to avoid slow-down in population growth. From 2022, China's population has been decreasing and its labor rate has already passed its peak years ago. China now can only slow down this downward trend. China needs to gradually extend the retirement age and also attract foreign workers to make up labor shortages eventually. Most importantly, China needs to continuously improve its labor quality and raise its labor productivity as Chen (2022) and Qiao and Chen (2023) emphasized.

3. Manufacturing industry

Table 15 compares the manufacturing value-added GDP share for four countries (Japan, China, US, and Germany) and for the world. Among developed economies, Japan has maintained a strong and competitive manufacturing industry. The share of GDP from the manufacturing industry in Japan has been high and stable. Japan's manufacturing share in GDP was 19.75% in 2020, which is higher than the share for the US and Germany. This is an important success for the Japanese economy.

Table 15 A Comparison of Manufacturing's GDP Share (%)

Country	2005	2010	2015	2016	2017	2018	2019	2020
Japan	21.42	20.77	20.46	20.29	20.44	20.62	20.06	19.75
China	32.09	31.61	28.95	28.07	28.11	27.84	26.77	26.29
US	12.98	11.91	11.66	11.22	11.26	11.35	11.06	10.63
Germany	20.07	19.70	20.35	20.66	20.39	20.04	19.56	18.70
World	16.26	15.88	16.40	16.20	16.26	16.39	15.99	15.94

Data source: World Bank

China's manufacturing share in GDP was above 26% in 2020. It is crucial for China to maintain a strong and competitive manufacturing industry. China is the world's manufacturing center. Recently, rising wages and other costs has pushed many manufacturers to move out of China. The trade war with the US and political issues between China and other Western countries have negatively influenced foreign investment in China as well. Chen (2015), Chen et al. (2016a and 2016b), Chen et al. (2017), Chen 2022, Chen and Qiao (2022), and Qiao and Chen (2023) have repeatedly emphasized that the service and agricultural sectors are important, but the industrial sector, especially manufacturing, will decide China's future.

4. Entrepreneurship

Economic development relies on businesses and especially entrepreneurs. The US has several top companies with total market values over $1 trillion. What makes these companies different from others? Entrepreneurship differentiates them from other competitors. They are more innovative and risk taking with great vision and strategic perspective. Thus, these companies are very successful. Japan used to have many great successful entrepreneurs who

created famous companies in consumer, chemical, and IT industries. But many of these companies lost competitiveness and failed in the 2000s. Japan is calling for new entrepreneurs who can lead their companies and industries to be able to compete globally.

Since its opening and reforms in the 1980s, China has had many successful entrepreneurs who had the vision to lead their companies to become strong competitors in the world. Many of these leaders have now retired or are close to retirement. Thus, China also needs to call for a new generation to stand up and become globally recognized entrepreneurs.

The strength of the economy comes from businesses and entrepreneurs, not governments. To improve the economy, the government must motivate people and particularly encourage more entrepreneurship.

5. Market economy and government's role

Market competition determines the winners and losers. The free market system generally is the most efficient way to allocate limited resources, but the system has flaws and failures from time to time. Therefore, government interference in business and economy is necessary. The government has a responsibility to provide needed public goods. However, in principle, a market system works better than a central planning system and free market competition creates a good business environment that encourages innovation and risk-taking, which leads to a booming economy.

Japan's market has not been very open to outsiders. Its traditional culture and practices such as cross sharing of company stocks prohibit normal competition. Japanese seniority-based promotion and wage systems are not consistent with the modern free market system. The good news is that many Japanese companies have changed its management practices and some of them have started adopting US companies' practices by giving stock options to employees.

China's fast economic growth since 1978 can be mainly contributed to its opening policy and reforms, particularly its market-oriented reforms. China's future still depends on further openness and reforms. Establishing an efficient market-oriented economic system will be the key. Businesses adopt their management styles and practices based on their country's social values and cultures. However, to be a global leader, companies need to learn from others and benchmark against best business and management practices in other cultures.

6. Productivity and Innovation

Productivity determines the competitiveness of companies and a country's economy. A sustainable industry leader must be both innovative and productive. Japan established a good reputation for its manufacturing products because of quality and low costs. As a result, Japanese products were popular in the world from the 1970s to the early 1990s. The Japanese manufacturing industry is still strong, but it has lost some competitive advantages in areas such as consumer electronic products and semiconductors. Japan will continue to play an important role in the global economy because of its strong manufacturing industry, high productivity, and solid innovation.

China needs to invest more in R&D, particularly in the basic sciences. At the same time, China has to improve its adoption rate of innovations and patents to benefit consumers, society, and the whole economy. China still has a large potential to raise its productivity.

Innovation comes from individuals, businesses, and entrepreneurs. Innovation is associated with a well functioned economic system. Government's support to innovation and small start-

ups is valuable, but it is the market system, including a sufficient financial system, that supports and drives innovation.

7. Personal consumption

Japan's personal consumption is about 50% of its total GDP, which is lower than most Western countries. Like other Asian economies, Japan has a high tendency to save, which will be very difficult to change. Thus, trying to push personal consumption to raise economic growth will result in a very limited outcome and will often be useless.

China's personal consumption to GDP is less than 40% (Chen 2022). This ratio is low compared with many developed economies. This ratio will gradually increase as China's economy advances. In the near future, personal consumption will be essential to the economy, but China like Japan cannot rely on rising personal consumption to save the economy from a possible recession.

8. Investment

Investment is fundamental to economic development. When an economy encounters recession, huge unemployment, or extreme economic shocks, the government has the responsibility to take firm actions to stimulate the economy through fiscal and monetary policies. The government will commonly spend more money and invest more in infrastructure to help economic recovery. In most cases, such actions work well. But overspending and overinvestment have serious side effects as demonstrated by Japan during the 1980s and 1990s.

Private investment generally is more efficient than government investment since private investors assess the risks and returns with more precaution. No investment will be sustainable with low or negative returns. The government needs to trust and rely on private sectors for investment. Governments should create fair, transparent, supportive, and competitive markets where entrepreneurs compete, take risks, and get returns if successful.

China has to learn from its own experience as well as Japan's experience. On one hand, economic growth depends on both private and government investment. On the other hand, effective and efficient investment is the key to maintaining sustainable and steady economic development so the government has to limit its own investment and encourage private investment. Governments in principle should not compete against private investors, but should focus its investment on public goods and long-term strategic projects.

9. Exports

Every country encourages exports. Exports of products and services create jobs and raise a country's foreign currency reserves. Exports promote economic growth and wealth. Government policy and support are crucial in promoting exports. In most economies, more exports lead to more imports because of globalization. As a result, net exports are steady in many economies. Therefore, the net effect from exports on economic growth is limited.

Japan is strong and competitive in global trade. As Chen (2022) and Chen et al. (2015) demonstrated, China has to further strengthen its manufacturing industry and maintain stable exports of its products and services, especially manufacturing products. However, China's future sustainable and rapid growth relies on other economic factors, including productivity improvement.

10. Urbanization

Urbanization has played a critical role in China's fast economic and social development in the past decades. China has the potential to raise its urbanization rate in the coming years. However, Japan shows that urbanization does not directly and significantly contribute to economic growth after it reaches a certain level, so in the near future, China will experience the same situation. China has to consistently invest to improve urbanization and people's living conditions, but it also needs to change its thinking and purpose. Urbanization is no longer used for pushing economic advancement, but for social justice and better meeting people's needs.

11. Inflation

Inflation is a dangerous disease that affects individuals, businesses, and society (Chen (2022)). In recent years, most countries have experienced extremely high inflation. But Japan and China are the exceptions. Both have had low inflation and are worried about deflation.

Chen (2022) points out that deflation could be more harmful than inflation as demonstrated by Japan. Economic policies are completely different in dealing with deflation compared with inflation. In addition, inflation-controlling policies are more effective than deflation-eliminating policies. For example, raising the interest rate generally will slow down inflation, but lowering the interest rate often does not push up inflation.

An appropriate level of inflation can also raise an economy's GDP per capita and the living standard (Chen et al. (2017) and Chen (2022)). China has been facing deflation pressure. China has to take firm and correct actions to avoid the serious side effects of low inflation or deflation in order not to repeat Japan's mistakes.

12. Exchange rate

The exchange rate influences an economy's trade, foreign direct investment, foreign reserves, and economic growth. It also directly impacts an economy's GDP and economic development level (Chen et al. 2017). A country should develop relevant economic and financial policies aiming at a sustainable and steady exchange rate. The Japanese Yen was forced to be appreciated dramatically after the Plaza Accord, which led to a substantial drop in Japan's exports of manufacturing products. Japan would be in a much better position if it had taken strong actions to appreciate its currency gradually years earlier before the Plaza Accord.

China's currency has depreciated recently. But in the long term, China will be pushed by other Western countries to significantly raise its Yuan value similar to what happened to Japan in the late 1980s. China needs to have a strategic vision and determine what is an appropriate exchange rate in the long-term so that it will not repeat Japan's mistake by being forced by outsiders to suddenly appreciate its currency value.

VIII. Conclusion

In this paper, we applied the expenditure and value-added GDP models to analyze Japan's economy. The variables of consumer consumption, private and government investment, change in net export, economic structure, labor rate, labor productivity, and urbanization rate are tested. Results show that personal consumption and investment contributed the most to Japan's economic growth in the expenditure model. Change in net export significantly affected Japan's economic growth, but the effect of net export on the economy was marginal.

In the value-added analysis, labor rate and labor productivity in the service sector are the most important variables. In contrast, the effects of urbanization and labor share in the agriculture sector are insignificant for Japan's economic growth in the value-added model. We

then discussed changes in these economic variables in the past and future and its effects on Japan's development.

Current global economic conditions are different from the 1950s or 1980s. China's population is more than eleven times that of Japan. China's domestic markets are also much bigger than Japan. But all countries face similar challenges and issues during its industrialization, modernization, and urbanization stages. There are similar economic development targets such as maintaining fast growth, increasing exports, and attracting foreign investments. There are also similar government economic actions, such as using fiscal and monetary policies to stimulate economic growth. Therefore, China can and should learn from Japan in order not to repeat the mistakes that Japan made.

One weakness of this study is that data for the value-added model starts from 1994. More advanced analyses could be conducted if there was data from 1970-1993 available for the value-added approach. For example, we would be able to compare how estimated coefficients changed between the pre-Plaza Accord (1970-1985) and post-Plaza Accord (1986-2000) sub-periods and study the effects of the Plaza Accord on Japan's economy.

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A Conceptual Framework for Analyzing Financial Policy, Strategic Emphasis and Firm Value: A Stakeholder and Resource-based View

Olimpia C. Racela[1] and Amonrat Thoumrungroje[2]
[1]Mahidol University International College, Nakhon Pathom, Thailand
[2]Mahidol University International College, Nakhon Pathom, Thailand

***Corresponding author email: olimpia.rac@mahidol.edu**

Abstract

This paper proposes an integrative framework of the links between corporate financial policy, strategic emphasis in terms of value-creation (e.g. R&D innovation) versus value appropriation (e.g. advertising spending), and firm value in emerging market firms. By drawing on the stakeholder perspective of strategy and the resource-based view (RBV) of the firm, a conceptual framework is proposed that depicts the relationships among key constructs. A proposed methodology, which will rely on public listed firms' available financial and market data in order to operationalize the constructs of interest and to empirically investigate these relationships, is discussed, followed by the theoretical and practical implications of this research undertaking. Given the current gaps in the literature that attempts to link financial policy to the strategic emphasis of firms, particularly in the context of non-western Asian economies, fulfillment of this research endeavor would shed some light on how firms whose home-base is in developed (i.e., Japan) versus in emerging (i.e., Thailand) economies in Asia coordinate their financial policy and resource allocation for different strategic foci (i.e., innovation vs. marketing) in order to attain and sustain shareholders' wealth maximization.

Keywords: Value Creation, Value Appropriation, R&D, Marketing Expenditure

Business Network and Capability Building: The Impact of Culture and Technological Turbulence

Nang Sarm Siri1 and Amonrat Thoumrungroje2*
1Assumption University, Bangkok, Thailand
2Mahidol University, Nakhon Pathom, Thailand
***Corresponding author email: amonrat.tho@mahidol.ac.th**

Abstract

Building on the resource-based view of the firms, this research proposes a model to investigate relationships between business ties (formal and informal) and two types of capabilities, namely resource-bridging capability and adaptive capability of foreign subsidiaries of multinational enterprises (MNEs) which operate in emerging economies of Thailand and Myanmar. Since business network ties have been suggested in prior literature as sources of competitive advantages for firms operating in emerging markets, characterized by weak institutional environments, through resource and capability building, this study proposes to extend the literature by advocating the moderating roles of technological turbulence, power distance, and assertiveness. It is postulated that the positive relationships between business ties and capabilities vary based on the environmental factor (i.e., degree of technological turbulencne) and cultural factors (i.e., power distance, and assertiveness).

Keywords: Formal business ties, Informal business ties, Capability building, Power distance, Assertiveness, Technological turbulence, Thailand, Myanmar.

Performance Comparison

between acquiring firms on mergers and acquisitions in China and India

Jianyu Ma and Yun Chu

Robert Morris University - Pittsburgh, PA, USA

Abstract

This research targets the Mergers and Acquisitions (M&A) occurred in China and India during the period of 2010 to 2018. We find that most M&A have created value for owners and investors of acquiring firms when they are measured by the abnormal percentage returns. When classifying the acquiring firms based on the industry, method of payment, form of acquiring, and firm size, we find that the abnormal percentage returns varies in different categories. Comparisons between China and India are made. The firm size of the acquiring firms plays a significant role and a positive return reflects all those small M&A that created value. The k-NN algorithm in machine learning is employed to assess the accuracy of the conclusions.