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SCHOOL OF SLAVONIC AND EAST EUROPEAN STUDIES

IMESS: Economics and Business

Master's Thesis

2024 **Xinyuan JIANG**

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The Role of Housing Market in Financial Crisis: Evidence from Hungary and China

Master's Thesis

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Year of the defence: 2024

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Abstract

This dissertation investigates the role of the housing market in financial crises by empirically analysing data from Hungary and China from 2008 to 2019. Financial crises typically trigger shocks in interest rates and foreign exchange rates, subsequently affecting the aggregate economy through various channels. This work introduces a theoretical framework that includes interest rate channels, such as the interest effect, credit effect, wealth effect, and the foreign currency rate channel. It utilizes GDP, housing price index (HPI), foreign exchange rate (FX), stock market indices (BUX and SSEC), credit to the private non-financial sector (CR), and the interbank 3-month interest rate (IR) as variables to represent different economic aspects. The study employs the Vector Error Correction Model (VECM) to empirically examine the relationships and interactions among these indicators. Impulse response function analysis and variance decomposition analysis are conducted to further understand the housing market's role in the economy. The results indicate that both the interest effect and the wealth effect are evident in Hungary and China. In China, the credit effect shows that the housing market and GDP decline with credit expansion. The foreign exchange rate has a more significant impact on Hungary than on China. Based on these findings, the study offers several recommendations. Firstly, the impacts generated through different channels on the housing market and GDP occur at different times, a factor that policymakers should consider when constructing economic models. Secondly, the factors that most significantly influence fluctuations in housing prices and GDP vary across countries, suggesting that the focus of macroeconomic regulation should also vary.

Keyword

Housing Market, Financial Crisis, Macroeconomic Transition Mechanisms, Foreign Exchange Rate, VECM, Emerging Markets

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1 Introduction

Emerging markets are currently a focal group in economic research. These markets are primarily characterized by two fundamental features: transitional traits and high volatility. The term "transition" refers to changes across multiple dimensions, including political regimes and economic systems. For instance, China embarked on a transition to a market economy after 1978, while the countries of Central and Eastern Europe shifted towards capitalism. During these transitions, due to the instability of emerging governments, these economies tend to exhibit higher volatility when confronted with shocks such as natural disasters, domestic policies, and external aggressions (Mody, 2003). There is no denying that many observers perceive the potential for development within the instability of emerging markets, along with expectations of rapid economic growth and high returns on investment, albeit often accompanied by high risks (Hoskisson et al., 2000; Wu & Pan, 2021; Fincke & Greiner, 2015). Indeed, evidence shows that only a minority of developing countries achieve economic growth rates that are higher than those of developed nations (Mody, 2003).

In the 1950s, the Soviet Union assisted Hungary in its economic reconstruction and in the development of its economic resources. However, their aim was to better serve the interests of the Soviet Union rather than necessarily benefiting Hungary. Additionally, Hungary's membership in the Council for Mutual Economic Assistance (COMECON) meant that its economic interactions with non-communist countries were restricted. It can be argued that Hungary's economy and politics were dominated and even coerced by the Soviet Union (Borhi, 2001). The dissolution of the Soviet Union in 1991 brought significant shocks to the development of Central and Eastern Europe, while also creating opportunities for economic development (Sadorsky, 2011). One of the biggest shocks came from the loss of the Soviet export market, which led to a decline of more than half of Hungary's GDP in 1991. The transition from CMEA trading rules to a

market economy also resulted in deteriorated trade conditions, with a significant increase in import prices (Rosati, 1994). However, not long after, not only Hungary but the entire Central and Eastern European region experienced a period of rapid economic growth following a severe transitional recession (Libman & Vinokurov, 2012).

China's path to economic transition was not triggered by external factors like the collapse of the Soviet Union, which influenced Eastern Europe but rather stemmed from severe economic stagnation, food shortages caused by adverse natural disasters, and flawed development strategies. Led by a new generation of national leaders, China embarked on economic reforms. Similar to Hungary, China's economic transition also exemplified gradualism. However, this was not a deliberate choice but rather a result of a political balance within the Chinese Communist Party between leaders supportive of reform and those resisting rapid changes (Woo, 1999). In addition, one of the major differences between China's transition and that of Eastern Europe is that during its economic transformation, China did not simultaneously undergo a political system change. On the contrary, as the fruits of economic transition became apparent, China's rapidly growing economic level further consolidated its political structure (Nee, 2000). China's reform and opening-up policy also achieved globally recognized success. Over the following thirty years, the average GDP growth rate reached 8%, and China joined the World Trade Organization in 2001, becoming the world's second-largest economy by 2010.

The 2008 financial crisis was the most severe financial shock since the Great Depression, triggered by the subprime mortgage problem in the United States, yet it had profound global repercussions (Tang & Aruga, 2021; Senarath & Copp, 2015). In the early 2000s, the Central and Eastern European region experienced rapid GDP growth amid loose liquidity conditions and global economic expansion. However, the financial crisis later exposed vulnerabilities in the region's financial system and banking sector, making it one of the most adversely affected areas (Balas & Kaya, 2019).

Domestic financial markets saw significant stock market losses and the banking sector faced challenges such as an increase in non-performing loans and a slowdown in deposit growth. On the international financial scene, there were severe currency depreciations and capital outflows. The real economy also suffered major setbacks due to reduced trade volumes and deteriorating labour markets (Gardo & Martin, 2010). To maintain external stability, the Hungarian government implemented measures such as foreign exchange liquidity injections and cross-central bank currency swap arrangements. Additionally, a series of measures were taken to stabilize the banking industry. Hungary was the first country in the region to seek assistance from the IMF. In order to help stabilize Hungary's financial system and prevent a government default, the IMF and the World Bank provided more than 20 billion euros in loan assistance to Hungary (Andor, 2009).

The financial crisis had a significant impact on China as well. Despite maintaining a GDP growth rate of approximately 9.5% during 2008-2009, which was higher than most countries worldwide, this was a considerable decline from the 14.2% growth observed in 2007. The effects of the financial crisis on China were broadly evident in several areas, including total factor productivity, the stock market, and energy consumption, and due to spillover effects, it exacerbated market volatility (Wang et al., 2020; Tang & Aruga, 2021; Zhu, 2018). In response, the Chinese government implemented a large-scale fiscal stimulus plan valued at about 4 trillion yuan to boost domestic demand, with a focus on developing infrastructure, housing, healthcare, and other sectors (Liu, 2009).

The impact of the housing market on macroeconomic indicators has been extensively studied. Real estate serves as a significant driver of economic growth, generating public sector revenue through taxes such as property and stamp taxes, and creating wealth as a crucial component of the investment portfolios of households, businesses, and financial institutions. Additionally, the development of the real estate sector often

promotes urban infrastructure development (Case & Parker, 2000). Beltratti and Morana (2010) found that the macroeconomic impact of real estate market shocks exceeds that of the stock market and that real estate markets worldwide are interconnected through interest rate shocks and supply disturbances.

The relationship between financial crises and the housing market is complex. On one hand, during economic upturns, anticipated increases in housing prices often drive credit and asset booms before a crisis, with consumers increasing leverage and banks issuing more mortgage loans due to rising collateral values, underestimating the associated risks (Adelino et al., 2018). On the other hand, financial crises initiate new cycles in the real estate market, and the crises themselves, along with government policies designed to address them, significantly impact the real estate sector and housing mortgages (Wu, 2014; Nikitidou et al., 2021). During the financial crisis, Hungary's housing market was affected by currency devaluation, leading to a high default rate on mortgages denominated in Swiss Francs, severely impacting household finances and causing declines in consumption, income, and house prices (Eberly & Krishnamurthy, 2014). Although China coped with the shock of the financial crisis better than most countries, the monetary policies aimed at stimulating domestic demand and the relaxed lending standards of banks have also raised concerns about a real estate bubble (Barth et al., 2012). In recent years, as China's economic growth has slowed, a significant number of real estate firms have declared bankruptcy.

Many studies have empirically examined the role of the housing market in the macroeconomic transmission mechanism, with a majority focusing on the transmission mechanism of monetary policy, especially the impact of interest rates. Wilhelmsson (2020) found that Interest rates affect housing prices both directly and via bank lending in Sweden by conducting a SVAR analysis. Adams and Füss (2010) concluded that macroeconomic factors such as GDP growth, inflation, and construction costs are crucial determinants of housing prices across various international markets, with

significant differences across countries. By analysing the UK market, Elbourne (2008) found that housing wealth effects explain about 15% of consumption changes following monetary policy shocks. However, overall, there are two issues. Firstly, with the development of globalization, the shocks to the macroeconomy are no longer just interest rates, and nearly no country can avoid the impact of financial crises. Thus, exchange rates in the international financial markets also have significant effects on the housing market and the economy. Secondly, there are few comparative studies of Hungary and China, which, although both are emerging markets, have followed dramatically different development paths after undergoing transformations. This study contributes in both these respects.

The structure of this work is as follows. Chapter one provides a theoretical analysis framework concerning financial crises and the real estate market, and introduces the developmental backgrounds of Hungary and China. Chapter two elaborates on the research methods, including the empirical models and data. Chapter three presents the results and interpretations of each step in econometric analysis. Finally, the conclusion summarizes the findings of the study, its limitations, and future research directions.

2 Theoretical Framework and Background

2.1 Financial Crisis

2.1.1 Types of Financial Crisis

In terms of the types of financial crises, Reinhart & Rogoff (2009) stated that people often believe they had sufficiently learned from past financial crises, thinking that such crises were far from themselves. Meanwhile, they maintained an optimistic attitude towards the current economic environment they lived in, attributing the thriving economy and booming market to technology, policy, or solid fundamentals. For instance, prosperity in the 1930s was attributed to the end of the world war, and in the 1990s, it was believed that Asia had never experienced a financial crisis before and this time would be the same. Crises happen time and again, even though it is well-known that excessive prosperity could be a harbinger of disaster. Reinhart and Rogoff analysed financial crises that have occurred worldwide over nearly eight centuries and compiled a detailed database. According to the information they collected, they categorized financial crises into two types: the first type is crises that can be explained by clear quantitative indicators and the second type is caused by events. Based on this theory, the IMF summarized that currency crises and sudden stops are in the first category, and debt and banking crises are in the second (Claessens & Kose, 2013).

Currency Crisis

A currency crisis refers to the phenomenon where the value of a currency experiences a rapid and sustained decline within a short period, leading to a series of negative impacts on the economy and society, such as increased unemployment rates, business failures, economic recession, and inflation (Breuer, 2004). From the perspective of identifying a currency crisis, researchers commonly use the depreciation of a country's currency value relative to the U.S. dollar by at least 15% as a measure (Reinhart & Rogoff, 2009). Many works have also employed different methodologies to identify

currency crises, including the use of specific thresholds for nominal exchange rate depreciation, changes in interest rates, or the presence of speculative pressure (Cruz-Rodríguez, 2013; Lestano & Jacobs, 2007). Literature about currency crises are among the most abundant and mature in the field, having evolved to the third generation of models, with each generation focusing on different aspects (Claessens & Kose, 2013).

Krugman (1979) was the first to propose the first-generation currency crisis model. He concluded that a fixed exchange rate regime, coupled with expansive fiscal policy financed through foreign borrowing or the creation of domestic credit, led to a gradual depletion of foreign reserves. This situation became unsustainable when market participants anticipated that the government would run out of reserves and be forced to devalue the currency. The anticipation of devaluation led to a speculative attack on the currency, resulting in a crisis when the government can no longer defend the fixed exchange rate and is forced to devalue. At that time, the currency crisis was also called the balance-of-payments crisis. Flood and Garber (1984) extended and refined the initial first-generation currency crisis model proposed by Krugman. They provided a more detailed and mathematically rigorous analysis of the dynamics leading to a currency crisis and made it clearer about how and why fixed exchange rate regimes could become unsustainable, leading to speculative attacks and currency devaluations. However, empirical analyses related to forecasting crises showed unsatisfactory results. Many currency crises occurred without being predicted, and there were also instances where crises forecasted by models did not materialize (Rangvid, 2001).

The second-generation models were first proposed by Obstfeld (1991) in the context of the European Monetary System (EMS) in 1992-1993 (Kaminsky, 2006; Obstfeld, 1991), which highlighted the limitations of traditional crisis models in explaining the sudden and severe currency depreciations. The second-generation models of currency crises represent a significant shift in the understanding of financial crises. These models, introduced in the early 1990s, depart from the traditional view that crises are solely

caused by fundamental economic weaknesses. Instead, they emphasize the role of self-fulfilling prophecies and market expectations in triggering crises. One of the key features of second-generation models is the concept of multiple equilibria, where a crisis can occur due to a shift in expectations, even in the absence of fundamental economic weaknesses (Rangvid, 2001).

The third-generation currency crisis models derived from the background that the financial crises that occurred in emerging markets during the 1990s did not align with the first and second-generation models. Following the financial crises in Asia and Latin America, severe recessions ensued, leading most scholars to posit the necessity of a third-generation model to explain these situations (Krugman, 2000). Third-generation models go beyond the traditional fundamentals-focused first-generation models and the self-fulfilling prophecy considerations of second-generation models. It introduces additional elements such as liquidity constraints, moral hazard issues, and contagion effects as crucial determinants of speculative attacks and currency crises (Cruz-Rodrígue, 2013).

there is a lack of empirical research providing evidence to differentiate among the three models (Claessens & Kose, 2013). Kaminsky (2006) applied the regression tree methodology through a quantitative method to classify currency crises. Also, there were still no clear indicators for judgment. Instead, classification was based on a basket of 20 countries, including emerging markets and developed markets, and the quantiles of their economic indicators.

Sudden Stop

Sudden stops have occurred at different times in history. A notable similarity exists in the sudden stops of the 1990s to the early 2000s and those of 1880-1890: a sharp decline in capital inflows from developed economies in Western Europe to emerging economies. However, the consequences of the same beginning are different (Bordo,

2006). The concept of sudden stops has been extensively studied in economic literature, with researchers highlighting the importance of understanding the dynamics and implications of such events. Sudden stops are distinguished by their sudden and sizable nature, representing a sharp reversal of capital flows that can have profound effects on economic performance (Agosin et al., 2019). Research has empirically demonstrated that sudden stops may result in declines in output and the downfall of credit systems, demonstrating the significant impacts these crises have on economic performance and financial security (Dagher, 2013). The effects of sudden stops on economic systems can extend over time, particularly when originating from external financial distress in the whole world (Ozkan & Unsal, 2010).

The sudden default by Russia in 1998 led to a type of financial crisis known as a capital flow sudden stop, which had severe impacts on the international capital markets, particularly for emerging markets. Taking Latin America as an example, Argentina faced a severe financial and economic collapse, with both the public and private sectors suffering substantial losses. However, the sudden stop was not an isolated event, as the crisis quickly spread throughout the entire financial system. The rise in interest rates and the depreciation of the exchange rate due to dollarized debts had severe effects. The Argentine government also delayed responding to the crisis until it collapsed. In contrast, Chile's economic structure and policies differed. On one hand, Chile's higher degree of trade openness enabled more effective management of the real exchange rate and had a lower amount of dollar-denominated debt. Additionally, Chilean authorities were more proactive in managing exchange rates and interest rates, so despite also experiencing an economic slowdown, they avoided a complete collapse (Calvo & Talvi, 2008).

Banking Crisis

As financial intermediaries, banks' operations and business models inherently mean that they take risks in various aspects, including interest rates, exchange rates, defaults,

regulatory changes, and so on (Kaufman, 1988). The banking sector is typically fragile, and issues within a single bank can rapidly spread throughout the entire industry due to depositor runs (Claessens & Kose, 2013). A banking crisis is defined as an event where the banking system experiences significant financial distress or incurs substantial losses that require policy intervention. Although it is an event, when establishing a database, one can artificially add some indicators to facilitate the identification of a banking crisis, such as the non-performing loan ratio of banks or the cost of financial restructuring (Laeven & Valencia, 2020).

Bank runs are considered one of the significant causes of banking crises. When economic environments start to turn worse, depositors may withdraw their deposits in anticipation of an economic downturn, leading to liquidity pressure in the banking sector. However, at times, depositors may excessively withdraw their money without any specific reason, putting pressure on banks and even forcing them to liquidate assets at a low price (Laeven, 2011). But from the depositors' perspectives, the choice is reasonable. Even though banks can react to such pressures by liquidating assets, borrowing, or seeking assistance from central banks, there is no guarantee that these measures will prevent the worst scenario—the bankruptcy of banks. Under the circumstances of banking bankruptcy, the depositors who suffer the most are inevitably those who react the slowest, while those who run quickly may be able to fully recover their deposits. This characteristic further exacerbates the impact of bank runs (Kaufman, 1988).

The other common reason for banking crises is the problems in the balance sheet of banks (Laeven, 2011). For banks, maturity mismatches, currency mismatches, and capital structure mismatches can lead to losses or defaults, and in severe cases, pose risks of bankruptcy, forcing them into involuntary liquidation of assets. These factors often serve as primary catalysts for the escalation of banking issues into financial crises (Allen et al., 2002). Meanwhile, Laeven and Valencia (2018) found that banking crises

were always accompanied by currency crises, with the peaking of currency crisis approximately one year after the eruption of banking sector crises. Reinhart and Rogoff (2009) also concluded that banking crises happened before the credit and asset price boom.

In addition, evidence suggests that, unlike currency crises, banking crises are often considered a consequence of difficulties in the real economy rather than a cause (Kaufman, 1988).

Debt Crisis

A debt crisis, as a type of financial crisis, is characterized by situations in which lenders face losses due to nonpayment, repudiation, or debt restructuring (Barthelemy et al., 2020). Specifically, in the context of sovereign debt, a debt crisis is defined as either missed payments (legal default) or the announcement of a debt restructuring by a key government official (Trebesch & Zabel, 2017).

Debt crises often follow banking crises or occur simultaneously with banking crises, with a phenomenon of debt accumulation preceding banking crises. Sovereign debt crises and banking crises are also closely linked. Banks may be pushed by authority to purchase government bonds or other types of debts under the background of financial repression, directly impacting their balance sheets in the event of a government default (Reinhart & Rogoff, 2011).

The Eurozone debt crisis represents one of the most severe debt crises in recent years. By 2010, the Eurozone's public debt had already reached 85% of its GDP. The causes of this debt crisis are considered to be imbalances in international trade, the impact of the global financial crisis, and the failure of government bailouts (Waliullah, 2014). The introduction of the euro allowed some countries to borrow at much lower costs than before. Lane (2012) posited that the design of the euro itself had inherent flaws.

On one hand, it failed to coordinate key policies with the United States; on the other hand, the common currency encouraged some countries to be free-riders, which also undermined the existing regulatory mechanisms among nations.

2.1.2 Credit and Asset Price Boom-Bust

Although there are various types of financial crises, different kinds share common characteristics, among which the most common is the boom and burst of credit and asset prices. In discussions about the asset prices boom-bust cycle, asset prices typically refer to the price of the stock market and real estate (Bordo & Jeanne, 2004). Looking at the long history, the Tulip Mania and South Sea Bubble were two of the most famous speculative bubbles in history, both characterized by rapid price escalation and eventual market crashes. When it comes to the nearly a hundred-year history, the most dramatic crises are the Great Depression in 1929 in the US and the Bubble Economy in Japan in the 1990s (Bordo & Jeanne, 2004).

As the United States continued to develop and strengthen, it overtook the United Kingdom to become the world's largest economy in 1894. In 1918, World War I came to the end. The United Kingdom was deeply wounded and significantly weakened, and the world's financial centre shifted from London to New York. Gradually, the US dollar began to replace the British pound in its hegemony. The United States ascended to become the world's leading economic power, entering a decade of economic boom in its history. In the 1920s, the US's economy grew by 42% and its industrial production accounted for 50% of the world's total. It was not until the crash of the US stock market in 1929 that ended this decade of prosperity. On October 24th, 1929, known as Black Thursday, the US stock market experienced a sudden crash, with stock prices falling by 11%. Wall Street's major bankers began to stabilize the market, and the closing loss was limited to 2%. Over the next three days, stocks even rose by 1%. However, on October 28th, stocks decreased by 13%. And on October 29th, the stock market

decreased another 12%, with trading volume reaching a record 16 million shares. Major bankers intervened again, but panic had already started to spread. The market reached its bottom on July 8, from its peak in 1929, the stock market had wiped 89% out of its value, marking the lowest point of the 20th century. It was not until over twenty years later, on November 23, 1954, that the Dow Jones Industrial Average finally regained its levels before 1929. At the same time, the real estate industry also collapsed completely after 1929. Properties purchased in 1920 had plummeted by 51% by the end of 1939 (adjusted for inflation), and it took 21 years until 1960 for prices to recover. In 1933, land prices in Chicago alone plummeted by 70%. And 50% of all mortgage loans were in default in the United States (Nicholas & Scherbina, 2013). The story not only happened in the US, but many areas in the whole world. The Japanese economic bubble that began in the 1980s was also closely tied to the boom-bust cycles of asset prices and credit. Okina (2001) summarized the rise in asset prices and credit as two of the factors of the bubble economy.

Asset boom

According to previous literature, people factors, such as investors' choices and emotions, and monetary policy are the main explanations for significant fluctuations in asset price (Claessens & Kose, 2013).

Rational bubbles refer to situations where asset prices deviate from their fundamental values but are sustained by rational factors such as arbitrage opportunities or expectations of future price increases. This concept was first introduced in Blanchard's work in 1979 to explain the long-term observed deviations between prices and fundamental values (Malevergne & Sornette, 2001). The model of rational bubbles was further developed in 1985, introducing the concept of rational bubbles in stock prices, highlighting the possibility of sustained rational bubbles in asset markets due to factors beyond traditional fundamentals (Diba & Grossman, 1985). Martin & Ventura (2018) provided a comprehensive guide to incorporate rational bubbles into standard

macroeconomic models, demonstrating their utility in explaining various macroeconomic phenomena. Work in 2020 extended the construction of rational bubbles to nonlinear business cycle models for closed and open economies (Kollmann, 2020). Rational bubbles have been studied across various markets, including commodity and real estate markets, where the existence of bubbles has been attributed to both rational and irrational behaviours, as well as psychological biases (Aren & Hamamcı, 2021; Ren et al., 2012).

Moreover, numerous studies have demonstrated that investor sentiment and behaviour significantly influence asset prices. The prevailing market mood affects investor behaviour, which subsequently impacts asset prices (Brown & Cliff, 2005). It has also been recognized that behavioural factors affect asset pricing especially in scenarios where arbitrage opportunities are limited (Lemmon & Portniaguina, 2006). In many traditional models and works, a basic condition is that investors are rational. However, a lot of empirical evidence supports the argument that emotions and behaviours would affect asset prices. Gu (2021) used the AAII Sentiment Indicator, a measure obtained through surveys to understand individual investors' expectations of the stock market, to construct a regression model with U.S. macroeconomic announcements from 1998 to 2016 and stock market prices. The findings revealed that when investors were in a bullish mood, the macroeconomic impacts reflected in stock prices are 50% lower compared to periods of bearish sentiment. Rupande (2019) used the JSE All Share Index from the McGregor BFA database and summarized that stock return volatility was significantly related to investor sentiment by conducting a GARCH model. They also suggested that the sentiment factor should be added to the asset pricing model. Similar results were also seen in the Chinese stock market (Xie & Wang, 2017).

The intricate relationship between monetary policy and asset prices has always been a focal point for the public, capturing the attention of not only investors and macroeconomists but also central banks, who also face challenges in achieving their

targets due to fluctuations in asset prices (Filardo, 2004). Research indicates that an accommodative monetary policy reduces risk aversion in the stock market and increases risk appetite. It can also affect asset prices by influencing market uncertainty, albeit to a lesser extent. Moreover, the impact of monetary policy on asset prices may be delayed, with loosened monetary policy affecting stock market risk preferences approximately nine months later (Roache & Rousset, 2013). After analysing the Chinese market through the structural vector autoregression method, researchers summarized that successful monetary policies that maintain low levels of inflation can increase the likelihood of asset price bubbles, highlighting the significant influence of monetary policy on the dynamics of asset prices (Koivu, 2010). The relationship between monetary policy and asset prices is bidirectional, with monetary policy affecting asset prices and vice versa (Simo-Kengne et al., 2013). Central banks adopting a passive stance may struggle to identify bubbles or high-cost asset price booms in advance, raising concerns about their ability to mitigate the adverse effects of such developments (Bordo & Landon-Lane, 2013). The other possibility is that it is a well-considered and viable policy to loosen monetary policy at the end of a high-cost boom under the Taylor rule (Detken & Smets, 2004).

Credit Boom

Credit growth is a robust indicator of an impending financial crisis, highlighting that crises often stem from uncontrolled credit booms (Schularick & Taylor, 2009). Loose monetary policy has been considered as one of the reasons for credit booms in both developed and developing countries (Elekdag & Wu, 2011; Jiménez et al, 2012). When central banks maintain low-interest rates and adopt accommodative monetary policies, it can incentivize borrowing and investment, fuelling a credit expansion. Moreover, easy liquidity conditions can induce excessive investment and speculative lending by financial intermediaries, distorting price signals and contributing to a credit boom. Funding shocks may also prompt some intermediaries to engage in speculative lending practices, further exacerbating the expansion of credit (Perotti & Rola-Janicka, 2019).

Financial liberalization, particularly highlighted in the aftermath of the banking crises in the 1980s and 1990s, emerged as a significant precursor to credit expansion (Sufi & Taylor, 2021). Demirgüç-Kunt & Detragiache (1998) summarized that deregulation in various economies led to increased monetary expansion, foreign borrowing, and speculative investment. This finding was supported by evidence from advanced economies, where financial liberalization events were shown to accelerate the growth of credit to GDP significantly in the subsequent five years, reflecting on the long-term positive trend post-World War II.

Gorton & Ordóñez (2016; 2019) found that credit booms typically began with a rise in productivity growth. However, during "bad booms," productivity growth tended to decline at a faster rate, indicating a complex relationship between productivity and credit dynamics. This suggested that while an initial increase in productivity can trigger credit booms, the subsequent trajectory of productivity growth can impact the sustainability and outcomes of these credit expansions. Aghion (2018) highlighted an inverted U-shaped relationship between credit access and productivity growth. While improved credit access can facilitate innovation among entrepreneurs, it can also enable less efficient incumbent firms to persist in the market, potentially hindering the entry of more efficient innovators. This finding demonstrated that the impact of credit on productivity growth is nuanced, depending on how it is utilized within the market.

Overall, not only the factors mentioned above contribute to the fluctuation of asset price and credit. Bean (2004) also discussed how improvements in economic fundamentals, such as an increase in total factor productivity growth driven by new technologies, can prompt asset price booms, suggesting that microeconomic factors related to technological advancements and productivity growth can contribute to the initiation of asset price booms. There are many other economic factors affecting them in other channels as well. For example, credit booms can be fuelled by factors such as low real

interest rates, high loan-to-value levels, and permissive mortgage approvals, which provide easy access to credit for borrowers (Glaeser et al., 2010). These conditions create an environment where borrowing increases, leading to a surge in credit activity and potentially unsustainable levels of debt.

2.1.3 Consequence of financial crisis

Economic consequences

The impact of financial crises on the economy is direct and evident, often identified through fluctuations in economic indicators or events related to banking and debt crises (Reinhart & Rogoff, 2009). From the perspective of the monetary transmission channels, financial crises always lead to higher borrowing costs, especially for private credit, which results in raising the market's expectations for investment returns. The increase in market interest rates results in higher debt servicing costs, and this transmission mechanism leads to a decrease in household disposable income. At the same time, during financial crises, lending channels diminish due to the turmoil within the financial system. Moreover, when facing the market in crisis experiencing a sharp decrease, investors also tend to become more risk-averse (Cecchetti et al., 2009).

The decline in asset prices is one of the most readily observable phenomena resulting from financial crises. Scholars have conducted empirical analyses on the performance of stock markets across various countries following financial crises, with some studies focusing on single specific countries (Ali & Afzal, 2012) and others on a certain group of countries, such as Asian countries (Lim, Brooks, & Kim, 2008) or emerging economies (Grima & Caruana, 2017). Beyond the decline in prices, financial crises also have a negative impact on stock market efficiency, which demonstrates to what extent the price could reflect all information in the market. (Lim, Brooks, & Kim, 2008). For stock prices, a decline always signifies a decrease in expected profitability. Furthermore, the decrease in property prices can be attributed to investors' preference to convert

illiquid fixed assets into assets with higher liquidity during periods of crisis (Cecchetti et al., 2009).

Productivity and consumption are also significant economic impacts that should not be ignored. Financial crises can drive economies away from equilibrium with high output to a scenario where output sharply declines (Mishkin, 1991). After examining data from 34 OECD countries, Mourougane (2017) provided empirical evidence that hysteresis effects can amplify the impact of financial crises on potential output, further exacerbating the consequences on production. Meanwhile, the effects of financial crises on consumption behaviour are significant, with households becoming more cautious about spending and prioritizing saving during times of economic uncertainty, and consumption tends to decline because of increased uncertainty, reduced consumer confidence, and decreased household wealth (Jordà et al., 2013).

When it comes to inflation and deflation, there is some new evidence explaining the actual market dynamics. Contrary to expectations derived from the Phillips Curve, the occurrence of deflation during the global financial crisis was not as severe as anticipated. On one hand, some companies facing internal liquidity shortages opt to raise prices to counteract economic shocks (Gilchrist et al., 2017), while on the other hand, the effects of contractionary financial shocks prevent more severe deflation. However, within the dynamics of inflation, the increase in borrowing costs can be observed to cause a slight inflationary trend (Abbate et al., 2023).

The International Monetary Fund (IMF) was established in 1945 with the primary objectives of promoting exchange rate stability and assisting member countries in balancing their international payments, thus playing a crucial role in mitigating currency crises. The impact of the IMF on currency crises can be categorized into direct and indirect channels. Direct channels include financial assistance, which becomes critical when a country faces speculative threats due to inadequate foreign exchange

reserves. This funding provides the central bank with sufficient international reserves to counteract speculative attacks. The approval of these funds comes with attached conditions; the IMF anticipates that the likelihood of a currency crisis will decrease as these stipulations are implemented. However, in practice, the probability of fully adhering to this plan is often lower than expected. Additionally, providing policy advice is another direct channel through which the IMF exerts its influence. Indirectly, the IMF may serve as a tool for disseminating unpopular recommendations, which can lead to moral hazards, such as the misuse of rescue loans (Dreher & Walter, 2010).

The Structural Adjustment Program (SAP) of the 1980s and 1990s was a significant initiative aimed at aiding the economic development of developing countries, proposed jointly by the International Monetary Fund (IMF) and the World Bank. The goal of this program was to enhance productivity in developing nations through economic reforms, reduce public expenditures, and accelerate economic development (Sulaiman & Aluko, 2014). Empirical results have demonstrated the effectiveness of this program in some countries, but it has also been met with considerable criticism. The research of Ortiz (2015) scrutinizes the global austerity landscape over the decade following the 2008 financial crisis, analysing trends across 187 countries from 2010 to 2020. In the immediate aftermath of the crisis, many nations implemented fiscal stimulus measures, rapidly expanding public expenditure to counteract potential economic downturns induced by the financial turmoil. However, post-2010, a shift towards fiscal austerity precipitated significant reductions in public spending. Notably, subsidies were diminished or altogether eliminated in 132 countries, and at least 130 nations witnessed reductions in public sector wages. Moreover, reforms in pensions and healthcare further impacted the populace's living standards. The direct repercussions on residents' income and welfare subsequently inflicted macroeconomic setbacks. On one hand, economic growth decelerated, accompanied by rising unemployment rates. On the other, stringent austerity policies occasionally catalysed social unrest and political instability (Ortiz et al., 2015). Additionally, these initiatives exacerbated inequalities. Reforms in fiscal

policies and cutbacks in education and public health adversely affected low-income groups. Concurrently, affluent segments of the economy often benefited from the promotion of trade liberalization and the privatization of financial institutions, while the interests of the working class could be compromised by fluctuations in international markets. Such impacts are frequently sustained in the medium to long term (Forster et al., 2019). Many critics argue that the IMF's policy recommendations fail to take into account the impacts on inequality in developing countries. They emphasize that policies should focus on long-term development rather than short-term austerity (Ortiz et al., 2015; Stubbs et al., 2022).

There is no denying that the IMF's Structural Adjustment Program (SAP) poses challenges for many individuals in developing countries, yet it is also deemed necessary. SAPs are typically implemented in response to severe balance of payments crises, and thus, IMF assistance aids recipient countries in restoring external equilibrium and rebuilding foreign exchange reserves. More crucially, many economies undergoing SAPs exhibit significant structural imbalances, such as an oversized public sector and economic inefficiency. Although the reform process entails growing pains, in the long run, it can enhance the economic competitiveness of beneficiary nations. Successfully executed SAPs can also bolster international investor confidence, yield additional economic benefits, and assist countries in re-entering the international capital markets (Kentikelenis et al., 2016).

Social Consequence

Okun (1962) first revealed the inverse relationship between the unemployment rate and economic growth. This relationship has been extensively studied across different regions and countries. Empirical research, such as that by (Sögner & Stiassny, 2002), has analysed the structural stability of Okun's Law through a cross-country study, confirming its validity. Similarly, studies like that of Soylu (2018) have provided empirical evidence supporting Okun's Law in various regions, reinforcing its

applicability. Cuaresma (2003) revisited Okun's law that the immediate impact of economic growth on unemployment displays asymmetry, being notably more pronounced during recessions compared to periods of expansion.

In addition to the unemployment rate, the long-term unemployment rate is also affected by financial crises. Through the report of OECD countries conducted by OECD (2010), it has been found that the financial crisis has led to an increase in the structural unemployment rate. The transmission from aggregate to structural unemployment is primarily through hysteresis effects, which is originally a concept in Physics, associated with the rise in long-term unemployment. Workers who remain unemployed for extended periods become less attractive to employers due to diminished human capital or reduced job search intensity, which in turn puts less downward pressure on wages and inflation. Differences in labour markets and institutional settings among countries result in various levels of increase in the long-term unemployment rate when faced with economic shocks. For example, higher unemployment benefits can lead to a higher rate of long-term unemployment because the willingness of job seekers to work is reduced. Meanwhile, as for people of different ages, it is the youth who suffer most from the financial crisis in terms of the unemployment rate (Verick, 2009).

Financial crises also disproportionately affect lower-income workers with the increase in unemployment, thereby widening income disparities (Atkinson & Morelli, 2011). Many different channels were mentioned in this report by Atkinson and Morelli as well: the decline in asset prices during a crisis can have a varied impact; it might reduce wealth inequality if the wealthy hold a significant proportion of their wealth in assets that depreciate in value. Moreover, the subsequent recession can severely impact lower-income individuals, potentially increasing income inequality. In addition, policy responses to crises, including austerity measures and bailouts, can further influence the direction and magnitude of the impact on inequality. For instance, fiscal austerity may disproportionately affect lower-income groups if it leads to cuts in social spending. The

impact of financial crises on lower-income people not only caused worse inequality but also resulted in an increase in poverty. Apart from unemployment and recession, crises often result in currency depreciations, which can alter relative prices, notably making imported goods more expensive, and the reduction in social services exacerbates the impact of the crisis on the poor by limiting their access to essential services during times of economic hardship (Baldacci et al., 2005).

Global consequences

When financial crises occur, not only fundamental situations but the impact on international trade is an important part. One of the main factors in the volume of international trade is demand, which could be represented by GDP. Therefore, the decline in the world GDP significantly hurt international trade (Shelburne, 2010). Ma and Cheng (2005) argued that current account deficits can lead to issues with foreign debt and foreign exchange reserves, thereby affecting public confidence in the national currency's exchange rate. They categorized financial crises into banking crises and currency crises and their impact on international trade respectively. Based on the bank run model, they found that during banking crises, exports increase during the crisis period but decrease afterward. In the case of currency crises, governments may abandon fixed exchange rate regimes to mitigate impacts on social fundamentals. Consequently, enterprises that conduct import and export adjust their volumes accordingly, with imports and exports declining during the currency crisis, and the post-crisis impact depends on the source of external shock. Currency crises affect international trade via a competitiveness effect and a balance-sheet effect. Empirical results indicate that currency crises have long-term negative effects on exports, and the extent of these impacts varies across different industries (Berman, 2009).

2.2 Housing Market

According to the data reported by Savills, which is one of the top real estate companies

in the world, the total value of the world's property reached $379.7 trillion at the end of 2022. Real estate plays a crucial role in the real economy, not only fulfilling the essential housing needs of citizens but also existing as a kind of significant financial asset, and also an important part of the portfolio for investors (Ekemode & Olaleye, 2019). However, numerous characteristics distinguish the purchase and transaction of real estate from other assets, attracting considerable attention from scholars. Real estate assets are known for their illiquidity, heterogeneity, and information asymmetry, which set them apart from more liquid and standardized financial instruments (Ekemode & Olaleye, 2019; Wong et al., 2012). The illiquidity of real estate assets implies that they cannot be easily and quickly converted into cash without significantly impacting their value, making them less suitable for short-term investment strategies (Hoesli & Reka, 2015). In addition, the heterogeneity of real estate assets refers to their diverse nature, with each property having unique physical characteristics, location attributes, and potential uses, which can complicate valuation and investment decisions (Ekemode & Olaleye, 2019).

Real estate's high operational resource requirements further contribute to its distinct character as an asset class (Lekander, 2017). In Lekander's work, he concluded that managing real estate assets involves significant operational efforts, including property maintenance, tenant management, and regulatory compliance, which can require substantial time, expertise, and financial resources. These operational demands highlight the hands-on nature of real estate investment compared to more passive forms of investing in financial markets.

Moreover, real estate's behaviour as an asset class may not always align with traditional economic drivers that influence stocks and bonds, it may exhibit different responses to economic conditions, leading to diversification benefits when included in investment portfolios (Hoesli & Hamelink, 1996). Studies have shown that real estate can serve as a portfolio risk diversifier, offering unique benefits in terms of returns and risk

management (Etebari, 2016).

2.2.1 Housing Market in financial crisis

Triggers of financial crises

Many researchers concluded that the housing market itself and other relevant financial products, such as mortgage loans, are triggers of financial crises.

In recent history, the most famous and serious financial crisis was the global financial crisis starting in the US in 2008. Acharya and Richardson (2009) analyse the financial crisis, pinpointing the crucial role of the real estate market's expansion and collapse. They argue that the crisis stemmed not solely from the housing market downturn but was aggravated by banks' manipulation of regulatory capital requirements through mortgage securitization. This practice not only aimed to enhance lending capacity by reducing capital buffers but also concentrated default risks within banks, exacerbating the crisis when the housing bubble burst. The crisis's roots lay in the rapid escalation of debt and house prices, fuelling an unsustainable credit boom and housing bubble that, once burst, significantly impacted the economy through decreased household wealth and consumption. The strategic retention of AAA-rated mortgage-backed securities by banks, to circumvent capital regulations and increase leverage, ultimately magnified the systemic risk, leading to widespread financial instability.

In terms of the 2008 financial crisis, Adelino, Schoar, and Severino (2018) underscored the consensus that the crisis was deeply rooted in the mortgage lending boom and the subsequent burst, with inflated house-price expectations playing a pivotal role in fuelling both the supply and demand sides of mortgage credit. Contrary to popular belief, they argued that the crisis was not confined to the subprime sector but was more accurately described as a middle-class crisis, affecting households across all income groups, particularly those with moderate to high incomes who had embraced increased

housing and mortgage leverage. They concluded that the explosion in mortgage debt was not a result of deteriorating lending standards alone but was significantly influenced by the collective over-optimism regarding future house price appreciation. This optimism led to a substantial increase in demand for housing and mortgage debt across the board. Financial institutions played into this scenario by lending against rising collateral values without properly accounting for the risk of a downturn in house prices. This misjudgement of financial institutions resulted in a concentration of default risks within the banking sector, triggering widespread insolvency when the housing bubble burst.

The crisis did not only affect the US market, it quickly spread to the whole world and became a global financial crisis in the end. Ron Martin (2011) summarized that the shift from traditional, localized lending practices to a model that involved securitizing mortgages and distributing them globally allowed the U.S. subprime mortgage collapse to have widespread international repercussions. Moreover, the crisis's spread globally was accelerated by the innovative financial instruments that banks employed to expand mortgage lending, such as mortgage-backed securities (MBSs) and collateralized debt obligations (CDOs), which were traded on global markets. When the local U.S. housing market faltered, the value of these globally traded securities plummeted, affecting financial institutions and economies worldwide. Following the global financial crisis, financial markets in Europe and East Asia experienced a marked increase in volatility. Even the stock market in mainland China, which was widely regarded as insulated from international markets, demonstrated a high degree of correlation. The channels through which the East Asian region was affected by the international financial crisis were primarily through the real economy, whereas in Europe, the contagion began within the financial system and subsequently spread to other sectors. Moreover, the impact on European markets was more severe than on those in East Asia (Johansson, 2011). The crisis also impacted the economic environment in Latin America through shocks to exchange rates and effects on international trade conditions and volumes. In the period

following the crisis, the financing environment for the private sector in Latin America deteriorated. However, due to lower public debt and higher foreign exchange reserves, the region was relatively less affected compared to other areas (Ocampo, 2009).

Prior to the emergence of the subprime mortgage crisis, Japan had already experienced a significant economic downturn precipitated by a burst of bubble in its real estate market. In the late 1980s, Japan witnessed a rapid escalation in housing prices, culminating in a bubble that burst in the early 1990s. The burst accelerated deflation within the country, markedly diminishing household wealth and resulting in significant losses for financial institutions (Shi & Phillips, 2021; Kobayashi, 2016). The crisis, originating within the real estate industry, quickly spread across various sectors, leading to an economic stagnation that lasted for over a decade (Arestis & Zhang, 2020). And this era is commonly referred to as the "Lost Decade" (Pan, 2018).

Business cycle

The housing market also plays a key role in the macroeconomic aspect. In terms of the US economy, Leamer (2015) even argued that "Housing IS the Business Cycle", as housing is not just predictively but also causally central to the U.S. business cycle. This opinion is based on observations that housing activities often precede economic downturns, making the sector a significant indicator of economic health. The intertemporal nature of monetary policy, where decisions have both immediate and future ramifications, needs to be carefully considered, especially in relation to housing market dynamics. Leamer suggests that optimal moments for policy intervention in the housing cycle occur when construction volumes exceed normal levels and continue to rise, highlighting the importance of pre-emptive measures rather than post-crisis management. Interestingly, while housing typically undergoes a volume cycle, the period leading up to 2008 saw an unusual price cycle, attributed to lenient lending standards and monetary policy actions that inadvertently encouraged overbuilding. Furthermore, the analysis points to the substantial impact of housing on GDP growth,

with residential investment and the housing sector's contribution to GDP being significant yet fluctuating elements. The unique characteristics of the housing market, including its sensitivity to interest rates and the consequential effects on construction and employment, underscore its integral role in the broader economic cycle. The experiences of 2008–09, therefore, provide crucial lessons on the interplay between housing, monetary policy, and economic resilience, underscoring the necessity for a nuanced understanding and strategic regulatory approaches to stabilize economic cycles.

OECD Economics Department Working Paper No.394 (2004) revealed that complex interactions between the housing market and the business cycle have significant implications for economic resilience and policy effectiveness. These interactions are primarily mediated through the responsiveness of house prices to economic cycles, housing wealth effects on consumption and investment, and the structural characteristics of housing and mortgage markets. Countries exhibit varied degrees of sensitivity in their housing markets to economic fluctuations, with real house price movements often lagging behind the business cycle. This lag can either dampen or amplify economic cycles, depending on whether house prices continue to rise or start to decline relative to the broader economic context. The extent to which housing wealth impacts consumption—a key component of economic activity—differs across countries, with some experiencing more pronounced effects due to larger and more efficient mortgage markets that facilitate housing equity withdrawal. This phenomenon suggests that the structure and development level of a country's mortgage market play a critical role in transmitting monetary policy effects through the economy. Cheng and Chiu (2019) offered empirical evidence of the differential impacts of mortgage spread shocks across various phases of the business cycle in the United States, employing a sophisticated smooth-transition vector autoregression (STVAR) model. Their findings illuminated the nuanced and asymmetric nature of these impacts, revealing that shocks to mortgage spreads during recessionary periods precipitate significantly deeper and

more prolonged downturns in consumption and housing market variables than during periods of economic expansion. This observation is critical for understanding the dynamics of credit supply shocks within the mortgage market and emphasizes the importance of the housing market in the broader economic cycle.

Moreover, the degree of synchronization between housing markets and the business cycle can significantly affect a country's economic resilience to shocks. Housing markets that react more directly and immediately to monetary policy changes can help stabilize economic fluctuations by influencing household consumption and investment decisions (Price, Catte, Girouard, & André, 2004).

2.2.2 Housing market and macroeconomic transmission mechanism

The housing market plays a vital role in the macroeconomic study, many researchers have analysed the relationship between the housing market and macroeconomic transmission, especially the monetary policy mechanism. Monetary policy affects the housing market by adjusting the short-term interest rate, and the channels widely studied could be summarized in interest rate effect, wealth effect, and credit effect (Mishkin, 2007).

Interest rate effect

The cost of capital, the expectations of housing prices, and the housing supply are the three main direct channels of interest rate effect (Mishkin, 2007). Mishkin assumed that investors would seek arbitrage opportunities between interest rates and the expected return on the property, and proved that it worked in no matter short term or long term theoretically. Therefore, when the interest rate is raised, the cost of capital increases consequently, which lowers the housing demand and aggregate demand. Moreover, because a decrease in demand for the housing market is predictable when the interest rate decreases, the expectations of housing prices further affect the dynamics in the

housing market. As for the housing supply, it will be affected by the cost of construction. When the short-term interest rate grows, the housing supply will decline.

Elbourne (2008) emphasized that the direct impact of interest rates on consumption is realized through their effect on income, specifically depending on the responsiveness of mortgage rates, the proportion of variable-rate mortgages, and the duration of fixed-rate loans. The proportion of variable-rate mortgages is currently on the rise, indicating an increase in households that are more sensitive to changes in interest rates (Wilhelmsson, 2020).

Mortgage loans serve as a direct channel through which interest rates affect households. Given that real property is often one of the most significant assets within a household, with high value and typically long tenure, mortgage loans are characterized by their low risk, large scale, and long duration. Generally, the shorter the term, the greater the impact of the base interest rate on the mortgage interest rate, with variable-rate mortgages being more sensitive to interest rate fluctuations than fixed-rate loans. Furthermore, the possibility of mortgage prepayment and debtors refinancing at lower interest rates should be taken into consideration. Under such circumstances, the transmission mechanism would change, indicating that the impact of monetary policy can only be discussed at the time when interest rates are determined. (Kiss & Vadas, 2007)

The relationship between exchange rates, monetary policy, and housing prices cannot be ignored. For instance, in Hong Kong, the currency is pegged to the U.S. dollar, leading the Hong Kong Monetary Authority to adjust its policies in accordance with U.S. monetary policy to maintain the exchange rate (Yu & Hui, 2018). When interest rates are reduced, the cost of financing mortgages decreases accordingly, thereby stimulating demand in the housing market and leading to an increase in housing prices.

Wealth Effect

The augmentation of societal wealth is intricately linked to household consumption, often reflected through the stock market or the housing market. Consequently, interest rates also exert an influence on household consumption and demand via the housing market. Moreover, given that real estate constitutes a significant portion of household wealth and is characterized by lower liquidity compared to other assets, its fluctuations tend to persist for longer durations and have comparatively fewer impacts (Mishkin, 2007).

Maclennan (1998) considered that the anticipation of income growth and the uncertainty associated with income represent crucial elements in the indirect effects on consumption. The expectation of income growth significantly influences the consumption function. Meanwhile, the uncertainty of income, often measured by the unemployment rate, exhibits a lagged response to interest rate shocks. The impact of the asset price channel extends beyond household real estate; government bonds, corporate bonds, and stocks are all indirectly affected by interest rates, then impacting aggregate output and consumption. Under the pressure of government debt and corporate bankruptcy, the real estate market is unlikely to remain unaffected. However, the specific circumstances of how each country is affected will vary due to the differing interest rate sensitivities of their assets. Elbourne (2008) also identified a phenomenon where, upon an increase in interest rates, investors tend to shift assets from real estate to bonds, resulting in a decline in housing prices.

Exchange rate fluctuations impact the wealth effect through two main channels. Firstly, changes in exchange rates resulted in fluctuations in the value of residents' household assets, which correspondingly altered purchasing power. Secondly, they trigger the inflow or outflow of international capital for arbitrage or hedging purposes. Beyond the fluctuations in the actual value of assets, exchange rates also precipitate shifts in people's expectations. The behaviours of investors and speculators act to drive price

changes, facilitating the attainment of a new equilibrium over time (Qiao & Guo, 2014).

Credit Effect

On the one hand, while the impact of the housing market on consumption through wealth effects channels may appear modest, particularly in comparison to the stock market, the influence it exerts through credit effects is significantly more pronounced. Residential mortgages serve to alleviate some of the asymmetrical information issues prevalent in credit markets, as the presence of collateral increases the cost of default for borrowers. An appreciation in housing prices elevates the value of such collateral, thereby improving the household's balance sheet and supporting the higher consumption financing for households. On the other hand, when short-term interest rates rise, households experience a diminution in cash flow, and those with variable-rate mortgages are concurrently subjected to increased interest payments. Specifically, families that have opted for variable-rate mortgages find themselves facing augmented financial burdens due to escalated interest obligations. This phenomenon further exerts downward pressure on the amount of mortgage financing that households are eligible to receive. Residents have to adjust their exceptions to properties that are affordable to them. Consequently, the confluence of reduced cash flow and elevated interest payments culminates in a marked contraction in housing demand (Mishkin, 2007). When analysing the direct effects, an increase in interest rates results in a high level of burden of all remaining debts on households, subsequently affecting their disposable income (HM Treasury, 2003). However, from a long-term perspective, wage increases and inflation can reduce the real value of outstanding loans, thereby gradually alleviating the pressure of loan repayment (Rosen, 1984).

Empirical Evidence

In a structural VAR analysis of quarterly data on the UK real estate market from January 1987 to May 2003, Elbourne (2008) identified significant dynamics through the channels of interest and wealth effects. The study reveals that increases in short-term

interest rates lead to declines in both retail sales, aggregate societal consumption, and housing prices, highlighting the 'interest effect'. In addition, via the wealth effect channel, fluctuations in housing prices account for approximately one-seventh of the consumption reduction following interest rate shocks. Furthermore, Elbourne simulated a scenario assuming the housing price does not have any impacts on consumption, illustrating that a large part of consumption variability within the monetary policy transmission mechanism stems from changes in housing prices, emphasizing the critical role of real estate values in influencing economic activity.

Bjørnland and Jacobsen (2010) conducted a study on the housing market in Norway, and Sweden, specifically choosing these nations as exemplars of small, open economies. They chose the data from 1983 to 2006, deliberately omitting the impact of the global financial crisis. By utilizing a Structural Vector Autoregression (SVAR) model, they dissected the transmission mechanisms over both short and long terms. Empirical evidence from their analysis strongly indicates that both tight monetary policies and interest rate shocks exert a significant influence on housing prices. Further exploration through variance decomposition analysis revealed that shocks to housing prices substantially impact GDP growth, inflation, and short-term interest rates, underscoring the pivotal role of the real estate market in economic dynamics.

Musso et al. (2011) conducted their analysis by using data from the late 1980s through to 2009, capturing the dynamics of several major financial crises to compare the effects on the United States and the Eurozone. Their findings indicate that monetary policy shocks have a more significant impact in the United States, particularly evident in real estate investment and real housing prices. Conversely, credit shocks manifest more significantly in the Eurozone, leading to a reduction in mortgage debt within the area. Despite the real estate market playing a crucial role in the monetary policy transmission mechanisms in both the United States and the Eurozone, the study highlights a divergence in the primary channels of impact: the United States experiences effects

predominantly through the wealth effect, while the Eurozone is more influenced through the credit effect.

Kiss and Vadas (2007) focused on Hungary, a country in central and eastern Europe, to explore the dynamics of the real estate market, considering both housing prices and housing investment as indicators of market activity. Due to Hungary's housing mortgage subsidy policies in the early 2000s, the impact of the interest effect on household disposable income was found to be weak and delayed. The influence of the wealth effect on the macroeconomy was also deemed very limited. Given the uniqueness of the Hungarian currency system and the issuance of excessive foreign currency loans, the study extended beyond Mishkin's three primary effects to include foreign exchange as a significant factor in the research on macroeconomic transmission mechanisms. The results showed that currency depreciation directly affected household disposable income, with this channel showing a notably rapid adjustment speed.

2.2.3 housing market and mortgage

Aside from housing prices, mortgage loans are a critical indicator for scholars and economists to assess the dynamics of the real estate market, especially in discussions related to financial crises. Moreover, the relationship between housing prices and mortgages has been widely discussed.

As for the impact of housing prices on mortgage credit, the anticipation of rising housing prices has led a segment of the population, particularly middle-class families, to increase their leverage through mortgage loans. Concurrently, as the value of collateral increases, banks tend to expand lending volumes while often underestimating the risk of default (Adelino et al., 2018).

When it comes to how mortgages affect housing prices, Barlevy and Fisher (2021) set

a model for interest-only mortgages. The speculators also take mortgages as an important tool to get involved in the financial market during the asset price boom-bust cycle. As interest-only mortgages allow a low payment at the initial stage, it was preferred by speculators. The speculative bubbles in house prices lead to greater use of interest-only mortgages, which subsequently results in the increase of real estate prices. By analysing the data in Ireland from 1980 to 2001, Fitzpatrick and Mcquinn (2007) found empirical evidence that housing prices and mortgages mutually strengthen the impact on each other in the long term. This rule is also found to be applied in Hong Kong (Gerlach & Peng, 2005).

Researchers further studied the specific relationship between these two factors. Chen and Yang (2017) found that mortgage rate was negatively related to housing prices at a significant level. This is not consistent with Gerlach and Peng's finding that mortgages have no impact on housing prices.

2.3 Background in Hungary

2.3.1 Economic Development

In the decades following World War II, Eastern European countries embarked on post-war reconstruction under the planned economic system of the Soviet model. Problems such as brain drain and economic decline forced Central and Eastern European countries to seek new solutions. Hungary's economic reform began with the New Economic Mechanism in 1968. This reform introduced some market mechanisms into society compared to the previous system and brought qualitative changes in the short term. It made Hungary a pioneer in economic reform in the Central European region (Antal, 1979). The development of socialist democracy in Hungary during this period was accompanied by economic reforms to the planned economy starting in the early 1960s (Pap, 2023). This reform had profound effects on Central and Eastern Europe

and indeed the whole of Europe in political and economic aspects (Landesmann, 1989).

However, when it came to the 1970s, such growth stopped and even turned worse. In the early 1980s, economic reforms were further deepened. During this stage, the Hungarian government continued to advance market-oriented reforms, further easing restrictions on private enterprises, expanding the freedom of foreign economic trade, and simultaneously strengthening economic ties with Western countries. The currency exchange rate was unified in 1891 and Hungary joined the IMF in 1982. In the 1980s, foreign direct investment increased with more and more multinational enterprises. Until 1988, all enterprises were permitted to do business internationally and started to face competition with foreign companies (Žídek, 2014).

However, the 1980s saw Hungary experiencing an increasing deficit in its balance of payments due to external factors like the oil crises, leading to a growing dependency on Western loans and political decision-makers (Valki, 2001). The exchange rate to USD devaluated by more than 30% within just 2 years. At the same time, the economic reformation was taken by the Hungarian government, and a series of new regulations taxes, bankruptcy, and privatization were issued (Žídek, 2014). Also, the revenue from enterprises to the government declined a lot even with the increase in inflation, especially since the contribution of the private sector was less than expected (Adam, 1995). It made the actual economic performance far from the original goal of monetary policy: balancing the costs and revenues of the government. At the same time, distorted labour incentives were identified as a major constraint on growth from the mid-1960s, contributing to an economic slowdown in the 1980s (Kukić, 2018). The burden of taxation, labour market regulations, and the quality of public goods and services were highlighted as driving forces of the shadow economy in Hungary (Schneider et al., 2010).

By the late 1980s, Hungary was primed for a comprehensive economic transformation

aimed at diminishing state control and fostering the privatization of enterprises, particularly targeting sectors directly interfacing with consumers, such as retail and services. On one hand, this reform granted enterprises greater autonomy in operational decisions, initiating a transition where domestic market prices began to seek alignment with international market levels to find equilibrium. On the other hand, the liberalization of prices combined with the government's subsidy reductions to address fiscal deficits contributed to escalating levels of inflation. Unlike many Eastern European countries where economic and political transitions occurred synchronously, some of Hungary's economic reforms were implemented prior to its political transformation. This sequence not only bestowed a greater continuity on Hungary's reforms compared to other nations but also highlighted the nuanced interplay between economic liberalization and macroeconomic stabilization during transitional periods (Hare, 1991).

2.3.2 Foreign currency loans in Hungary

Between 2000 and 2011, as Western European banks entered Eastern Europe and offered more favourable loan interest rates, foreign currency loans and deposits became very popular in Eastern European countries. For banks, their interest rate strategies were influenced by market competition and regulatory requirements, shifting the risk of currency mismatches on their balance sheets to borrowers (Fidrmuc et al., 2013). For consumers, the demand side for loans, the choice of foreign currency loans was driven by interest rates and expected exchange rate fluctuations. Although regulatory authorities limited the scope of business and risk exposure of foreign banks, the foreign currency banking business in Central and Eastern Europe was generally driven by the supply and demand relationship between banks and consumers. Undeniably, the entry of foreign banks into the market enhanced the competitiveness and efficiency of the financial sector in Central and Eastern Europe, but it also brought significant risks due to currency mismatches, which had severe negative impacts during economic

recessions (Temesvary, 2016). Moreover, scholars believe that the growth of foreign currency loans in the Central and Eastern European region is due to citizens' lack of confidence in the stability of the local currency and domestic financial institutions (Fidrmuc et al., 2013). By using macro and micro data for empirical analysis of nine Central and Eastern European countries, Fidrmuc concluded that the anticipated depreciation of the local currency and the lower interest rates on foreign currency loans are the driving factors behind the growth of foreign currency loans.

Hungary joined the European Union in 2004, with the government, banks, and residents all holding optimistic expectations that economic integration following EU membership would bring financial stability. They believed that Hungary would soon join the Eurozone. However, they overlooked the currency risk, especially for loans denominated in Swiss Francs. The 2008 financial crisis led to a severe devaluation of the Hungarian Forint, increasing the repayment costs of Forex mortgages. The default rate on mortgages rose, and many Hungarian families faced financial difficulties (Pellandini-Simányi & Vargha, 2018). Driven by the impact of the financial crisis and the proliferation of foreign currency mortgages, which accounted for up to 60% of the total, the Hungarian real estate market also experienced a bust following its boom. Real estate prices dropped rapidly and even faced a freeze. The total output was also severely affected, with a 6.7% decline, especially industries reliant on foreign investment, such as electronics and automotive, were greatly impacted. The government took a series of measures to address this shock, such as allowing the repayment of foreign currency loans at fixed exchange rates and restructuring the financial sector. However, the public remains cautious about these reforms (Egedy, 2012).

2.4 Background in China

2.4.1 Economic Development Process

The People's Republic of China, established in 1949, triumphed on the battlefield and

in seizing power, but soon faced the arduous task of post-war reconstruction and the planned economy era, which significantly hindered economic development. In the planned economy period, land, capital, and even labour was subjected to public ownership, with income distribution designed to ensure absolute equality (Hou, 2011). This demonstrated similar issues found in planned economies worldwide, such as technological backwardness and inefficient resource allocation (Zawalińska et al., 2018).

Unlike the rapid transformation in Russia, China's transition to a market economy was gradual (Nee, 2000). In the early years of the People's Republic of China, agricultural development was managed under the commune system, where farmers could not earn more by working harder. It was not until farmers spontaneously began experimenting with the household responsibility system, which proved successful, that this approach started to be widely adopted across the country. The formal beginning of China's market economy transition was in 1978, which, besides the shift in agricultural production methods, also granted state-owned enterprises greater decision-making autonomy. Deng Xiaoping's Open Door Policy encouraged international trade and foreign investment, breaking nearly 30 years of economic isolation (Chow, 2004). From 1979 to 2010, China's economy grew at an average annual rate of nearly 10%, and in 2009, it became the world's second-largest economy. Rapid industrialization and urbanization also transformed China's economic structure (Lin, 2011). Furthermore, China's economic transition was built on the existing national political system, rather than seeking political restructuring during economic reform, as was the case with the Soviet Union and many former socialist countries in Central and Eastern Europe (Nee, 2000; Chow, 2004). The political system led by the Communist Party facilitated China's transition to a market economy, and the political system itself was also consolidated by the strengthened economy (Naughton, 2008).

In 2001, China joined the World Trade Organization. The liberalization of trade and

investment rules following WTO membership has facilitated increased foreign direct investment (FDI) inflows and enhanced market access for Chinese goods and services (Walmsley et al., 2006). When China joined the World Trade Organization in 2001, it coincided with economic recessions in several other economies, which further propelled the growth of the Chinese economy. Although half of the export products were still light industrial goods, high-end products such as scientific equipment and household appliances saw the highest growth in exports. Additionally, China had already secured a position in the international metal trading market (Hansen, 2003).

During the global financial crisis of 2008, while most countries experienced economic recessions, China still maintained GDP growth rates of 9.7% and 9.4% in 2008 and 2009, respectively. Although most countries would consider these growth rates satisfactory, in reality, they were significantly lower than China's GDP growth rate of 14.2% in 2007, indicating that the negative impact of the economic crisis on China was more severe than most people believed. Since the end of 2007, the market value of the Chinese stock market has decreased by more than 60%. At the same time, the real estate industry has developed rapidly, resulting in a severe asset bubble. China's plan to stimulate the economy in response to the economic crisis was successful, but it also led to problems of excessive credit expansion and inflation. (Li et al., 2012).

In 2013, Chinese President Xi Jinping introduced the Belt and Road Initiative (BRI), aimed at strengthening economic cooperation and cultural exchanges with neighbouring countries. After experiencing three decades of rapid economic growth, China's growth rate began to slow down. Some scholars attribute this slowdown to macroeconomic cycles (Lin & Zhang, 2015), while other economists point to issues within China's industrial structure (Chen et al., 2021; Chen, 2018). However, looking at China's successful development experience, enhancing international trade and foreign direct investment has proven effective. Thus, China is also seeking new opportunities like other emerging economies to sustain rapid economic growth. On the

other hand, as the world's second-largest economy, China is also striving for greater international influence. Through the Belt and Road Initiative, it hopes to enhance understanding and cooperation with related countries (Huang, 2016).

2.4.2 China's real estate market

China's economic growth is closely tied to the development of its real estate industry. The relationship between real estate investment and GDP has been extensively studied, with empirical evidence analysing the unidirectional or bidirectional influences and their long-term or short-term relationships, which exhibit significant regional differences (Kong et al., 2016). In 1998, China's State Council proposed making the real estate sector a new point of economic growth, and by 2003, it was officially designated as a pillar industry. By 2020, the output value of the real estate industry, together with indirectly driven related industries, had reached 17% of GDP. For households, housing is usually the largest component of family assets. For governments, many local authorities finance themselves through land as collateral or rely on income from land sales. For enterprises, there is also a trend to invest in or acquire land as the economy develops (Liu & Xiong, 2020).

A major factor in the growth of housing prices is the population migration and urbanization that China has experienced over the past few decades. China has undergone thousands of years of agrarian civilization, with the economy traditionally dominated by agriculture. However, following the economic reforms and opening-up policies, significant urbanization achievements have been made, and the economy has successfully transitioned. Urbanization has also made important contributions to the construction of urban infrastructure and the improvement of residents' living conditions (Guan et al., 2018). According to data from the World Bank, the proportion of China's urban population to the total population increased from 18% in 1978 to 64% in 2022. Western scholars have conducted many studies on the relationship between migration

and housing prices. In China's case, there is less overseas migration, but significant population flows between provinces and cities. Overall, residents migrate from less developed to more developed areas, forming urban clusters such as the Yangtze River Delta, Pearl River Delta, and Jing-Jin-Ji (Wang et al., 2017). The positive relationship between urbanization and housing prices has been widely supported by empirical evidence, whether urbanization is considered a direct driver of housing price growth or believed to lead to higher housing demand and higher expectations of housing prices (Hu et al., 2021; Lu et al., 2014).

In addition to housing demand, investment demand is also a significant driver of rising real estate prices. A major characteristic that distinguishes China's real estate market from those of the US or Japan is the state ownership of land. Local governments publicly sell land use rights through bidding and auction processes. Furthermore, land mortgage is the most common method for local governments to obtain loans. Local governments can use their monopolistic advantage to increase revenue. Banks, acting as financial intermediaries, have close ties with local governments, real estate developers, and homebuyers. The continuous expansion of real estate credit by banks has also led to rising house prices (Liu et al., 2016). For individuals and households, the anticipation of rising house prices and the lack of other investment channels are the main reasons for choosing to invest in real estate (Liu & Xiong, 2020). The increasingly high vacancy rate nowadays indicates that the demand for buying homes is not for living but for speculation (Liu et al., 2016). The rise in house prices and high investment returns have attracted many manufacturing enterprises to try investing in the real estate sector (Rong et al., 2016).

The real estate market in China has been remarkably booming, with the price-to-income ratio for housing in first-tier cities (Beijing, Shanghai, Guangzhou, Shenzhen) reaching 40 times, far surpassing those of London and New York. However, after supporting rapid economic growth for three decades, some economists believe that China is on the

brink of a slowdown in its real estate sector, which could cumulatively reduce GDP by 5%-10% over the next few years due to the ripple effects through the housing channel. From a macroeconomic perspective, there is a clear mismatch between supply and demand in China's housing market. On one hand, China is grappling with severe population aging, exacerbated by the one-child policy from previous decades, which has significantly curtailed population growth. On the other hand, current housing prices have exceeded affordable levels for many people, whether in third-tier cities or metropolitan areas, leading to a decline in housing demand. Consequently, the housing market is experiencing an oversupply. Historical real estate bubbles, such as those in Japan and the United States, keep the Chinese government vigilant about preventing a similar crisis (Rogoff & Yang, 2021).

In 2020, the People's Bank of China (the central bank) and the Ministry of Housing and Urban-Rural Development implemented the "Three Red Lines" policy to strengthen financial supervision of real estate companies, prevent excessive borrowing, and reduce the risk of market bubbles. The specifics of the policy require real estate developers to adhere to the following financial metrics: (1) Asset-Liability Ratio (excluding advance receipts) must not exceed 70%; (2) Net Debt Ratio must not exceed 100%; (3) Cash to Short-term Debt Ratio must not be less than 1.

The real estate market in China has inevitably experienced significant fluctuations. According to data released by the People’s Courts of China, in the year 2022 alone, more than 300 real estate enterprises filed for bankruptcy liquidation. One contributing factor to this downturn was the macroeconomic impact of COVID-19 in 2020, which, amid pandemic-related controls and production halts, led to a decline in the total retail sales of consumer goods across China. Additionally, there was an increase in unemployment rates which adversely affected households' purchasing power and desire to buy homes. This economic downturn disrupted the operational models of real estate companies that were heavily reliant on transferring leverage to the consumer side (Zhao,

2024). Furthermore, the implementation of the "Three Red Lines" policy, which imposed strict regulations on debt financing for real estate firms, resulted in significant liquidity shortages. Simultaneously, the financial markets' rigorous oversight regarding the initial public offerings (IPOs) of these companies further constrained their ability to secure equity financing. The convergence of these factors precipitated the bankruptcy and liquidation of numerous firms, including major developers like Evergrande and Country Garden (Ma, 2023). In addition to external economic and policy shocks, the intrinsic high-leverage business models adopted by these companies over the long term also played a critical role in their eventual collapse. This scenario underscores the complexities of financial management within the real estate sector and highlights the profound impacts of stringent regulatory environments combined with adverse market conditions (Zhao, 2024).

3 Research Framework

3.1 Methodology

3.1.1 Vector Error Correction Model

The model applied in this research is the Vector Error Correction Model (VECM). Sims (1980) posited that traditional macroeconomic models were burdened with excessive theoretical assumptions and failed to adequately unveil economic dynamics. Concurrently, he critiqued static single-equation models for neglecting the interdependence among variables, leading to biased estimations of the models. The VAR model considered all variables as endogenous, reducing constraints and facilitating the capture of dynamics and mutual influences among multiple time series. However, VAR models require all series to be stationary, otherwise spurious regression problems may occur. Therefore, Johansen (1988, 1990) introduced the Vector Error Correction Model, which includes methods for using maximum likelihood estimation to test the number of cointegration vectors and estimate parameters in vector autoregressive models, as well as how to determine cointegration relationships. With the cointegration relationships, the following empirical analysis steps do not strictly require all the original time series data to be stationary.

The P-order vector autoregressive model could be written as:

$$y_t = A_y y_{t-1} + \cdots + A_p y_{t-p} + Bx_t + \varepsilon_t$$

Where y_t is a k-dimension vector and x_t is a d-dimension vector, and they are endogenous and exogenous variables respectively. ε_t is a k-dimension perturbation vector. p is the lag order.

Once confirming the cointegration relationship among the series, a VECM can be established. Compared with VAR, the VECM does not require time series to be stationary. The VECM model is suitable for non-stationary multivariate time series and

can adjust deviations from the long-term equilibrium relationship of variables, as well as observe the impact of short-term fluctuations on the series.

The VECM could be written as:

$$\Delta y_t = \alpha ecm_{t-1} + \sum_{i=1}^{p} \Gamma_i \Delta y_{i-1} + \varepsilon_t$$

Where y_t is the vector from variables, ecm is the error correction term, the coefficient vector α reflects the speed of adjustment towards equilibrium when the deviation from the long-term equilibrium state among variables is observed. In the matrix Γ, each element represents the coefficient of the differenced terms of the explanatory variables, reflecting the impact of short-term fluctuations of various variables on the short-term changes of the dependent variable.

3.1.2 Stationary Test

The stationarity test is conducted to prevent spurious regressions among the variables. Spurious regression can occur when non-stationary processes are mistakenly interpreted as having meaningful relationships due to their time-dependent nature. This testing ensures that the estimated relationships are genuine and not due to random similarities in trending or seasonal behaviours of the series.

The Augmented Dickey-Fuller (ADF) test, developed by Dickey and Fuller, is a widely used method for testing the stationarity of time series data. In 1979, Dickey and Fuller firstly introduced the DF test to determine the presence of a unit root in time series. To improve upon the DF test, which had limitations in handling serial correlation within the series, they devised the ADF test that incorporates lagged difference terms. The ADF test is currently one of the most commonly employed tests for stationarity. The fundamental hypothesis of this test, the null hypothesis, posits that the time series has a unit root, indicating it is non-stationary.

In the realm of time series analysis, applying a logarithmic transformation to the original data set is a prevalent technique. This transformation aids in stabilizing the variance, effectively mitigating issues related to non-normality and heteroscedasticity (Fitzgerald & Karlinger, 1983), and it facilitates the reflection of relational dynamics in rate changes among the data metrics (Tian & Chen, 2017). In this empirical analysis, we transformed the variables CR, GDP, and HPI logarithmically.

2.1.3 Cointegration Test

When the outcomes of the unit root tests demonstrate that examined series are integrated of the same order, such as I (1), but indicating that they are not stationary in their original form, the subsequent step is conducting cointegration tests.

Cointegration tests are crucial as they detect long-term equilibrium relationships among non-stationary variables and allow for the analysis of interdependencies and impacts among these variables over time (Pedroni, 2004; Roman et al., 2020). Establishing a cointegration relation is pivotal as it facilitates the development of an Error Correction Model (ECM), which significantly enhances the precision of estimations (Niyimbanira, 2013).

In the current empirical analysis, two main methods are applied for cointegration testing: the Engle-Granger two-step procedure and Johansen's cointegration test method. The Engle-Granger method involves two steps: firstly, constructing a linear regression equation of the non-stationary series, and secondly testing the stationarity of the residuals from this regression equation (Engle & Granger, 1987). In terms of Johansen's cointegration test, which tests by establishing a Vector Autoregression model, is more suitable for testing the cointegration relationships among more than two variables (Johansen, 1991). Given that this empirical analysis incorporates six variables, the Johansen test, which is more appropriate for multiple variables, was selected.

Initially, the optimal lag order must be determined by constructing the Vector Autoregression (VAR) model. The optimal lag order ensures that the VAR model adequately captures the dynamics of the data without overfitting or underfitting, thereby providing a reliable basis for subsequent cointegration testing (Wahyudi & Palupi, 2023).

3.1.4 Granger Causality Test

The Granger causality test is a statistical method to determine whether one time series can predict another. This test was proposed by Clive Granger in 1969. It is important to note that the existence of Granger causality does not imply a true cause-and-effect relationship between the variables but merely indicates the predictive power of historical data. This methodology assesses the capability of lagged values of one variable to forecast another, providing a quantitative basis to evaluate the direction and strength of interdependencies in time series data.

The null hypothesis for the Granger causality test posits that there is no Granger causal relationship between the variables. Rejection of the null hypothesis indicates the existence of a Granger causality relationship. This test primarily examines whether endogenous variables can act as exogenous variables, implying that changes in one variable can be explained by another variable (Wahyudi & Palupi, 2023).

3.1.5 Impulse Response

Impulse response analysis enables the observation of the reactions produced in other variables following a shock of one standard deviation in one variable, thereby assessing the dynamic relationships among variables. This method was initially proposed by Christopher Sims in the application of the Vector Autoregression (VAR) model.

In this study, we choose to observe the dynamics of impulse responses over 20 periods,

with each period representing a quarter.

3.1.6 Variance Decomposition

The impulse response model is capable of better illustrating the dynamic relationships between variables, especially in terms of how other variables fluctuate in response to a shock from one variable, and how these fluctuations vary over time. Variance decomposition, on the other hand, tends to describe the extent to which each variable can explain the value of a certain variable, and this explanatory power may increase or decrease as time progresses.

3.2 Data

This model estimated the data from 2008Q1 to 2019Q4 in Hungary and China. With data starting in 2008, we could capture the impact of the global financial crisis and the dynamics of macroeconomic indicators in Hungary and China. After 2019, COVID-19 has a significant impact on countries all over the world, affecting international trade, the real economy, public health, and many other aspects. To better focus on the role and impact of the real estate market within the economy, the author has chosen to exclude the effects of COVID-19 from the time series analysis. In addition, quarterly data could balance the need for sufficient data volume in time series analysis and the accessibility of indicators required.

We applied indicators including short-term interest rate (IR), credit to non-financial private sector (CR), foreign exchange rate (FX), housing price index (HPI), gross domestic product (GDP), and stock market index (BUX and SSEC). For two different countries, the specific indicators or statistical measures used to evaluate the same aspect are not completely same.

Interest Rate is represented by the 3-month short-term interbank rate for both Hungary and China. Interbank interest rate is an important tool for central banks to deal with the pressure in the banking sector (Freixas et al., 2010). The interbank interest rate is a key indicator reflecting liquidity and expectations in the market (Jin et al., 2014; Ito， 2017). In addition, it is a core rate used as a benchmark for loans, mortgages, and other financial products. Credit plays a significant role in the economy, affecting monetary policy transmission and financial stability, it is also an alert for financial crises, as a credit boom often happens before that (Dembiermont et al., 2013). The boom-bust cycles of credit and housing prices mutually influence each other. When housing prices are expected to rise, banks increase the issuance of loans, and speculators also raise their leverage to invest in the real estate sector. Risk accumulates throughout this process, until the bubble bursts (Guerrieri & Uhlig, 2016). We applied the credit to private non-financial sector as the indicator of this aspect for these two countries. Data is from the Bank for International Settlements.

CHF to HUF exchange rate was used as the indicator for the foreign exchange rate in Hungary. In around 2005, banks in Hungary issued a large scale of foreign currency mortgages, mainly in euros and Swiss francs. Due to the lower interest rate and easier access, foreign currency loans attracted a lot of people (Buszko & Krupa, 2015). However, the excessive credits were gradually out of the authority's control and resulted in a mortgage crisis in Hungary. Therefore, we chose the CHF to HUF to evaluate how the exchange rate plays a role in the housing market and macroeconomic transmission. As for China, the USD to CNY exchange rate represents the foreign exchange indicator. China is one of the largest creditors to the US treasury bonds, holding approximately 10% of US treasury bonds as foreign exchange reserves.

The housing price index is the indicator of the housing market, both Hungary and China use the national data from OECD. As the price in different areas and for different types

of property differs from each other, the index could better reflect the general dynamics.

The Budapest Stock Exchange Index (BUX) and Shanghai Composite Index (SSEC) are indicators for the Hungarian stock market and Chinese stock market respectively. They both include a basket of stock prices of representative main companies. Many quantitative and qualitative findings have proved the relationship between the stock market, wealth, and consumption (Case et al., 2005). Even though it is not a comprehensive indicator of aggregate household wealth, it is a convincing number to reflect market dynamics with sufficient information.

4 Empirical Results

4.1 Hungary

4.1.1 Descriptive Analysis

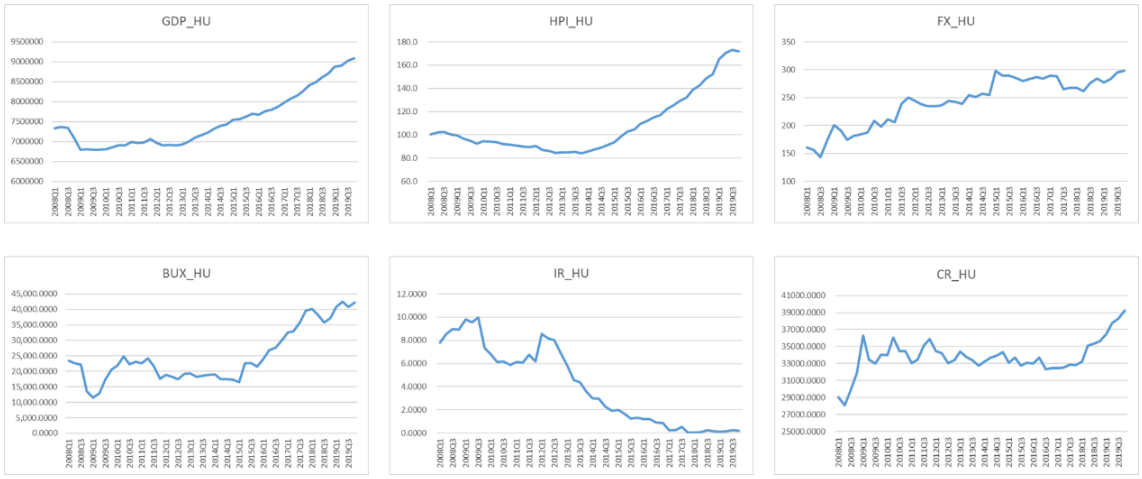

Figure 1 Variables Trends in Hungary

Source: World Bank, OECD dateset, Bank for International Settlements, Magyar Nemzeti Bank

As Figure 1, the GDP indicated that Hungary's economy was significantly impacted by the financial crisis of 2008, experiencing a decline of 8% from the third quarter of 2008 to the first quarter of 2009. From 2009 to 2013, the GDP remained relatively stable, peaking in the first quarter of 2012 before it began to decrease slowly again. Over the following six years, the Hungarian GDP maintained a stable growth with minor fluctuations. The overall trend in the stock market was consistent with that of the GDP, particularly the growth observed from 2015 to 2018, while the volatility in the stock market was much greater than that in the GDP.

The BUX showed a substantial decline following the 2008 financial crisis as well, but it began to recover in 2009, and by the first quarter of 2010, it had almost returned to its pre-crisis level. Conversely, it took six years after the crisis, until 2014, for the GDP

to rebound to the levels observed in 2008. The stock market also showed significant downturns in 2012 and 2018, this kind of fluctuations were not captured by the GDP data.

The House Price Index was observed to follow a steady declining trend after reaching its peak in the third quarter of 2008. This trend continued until 2014. In the subsequent five years, the House Price Index reached twice its former level, indicating a sharp increase in housing prices.

The overall trend of the CHF to HUF exchange rate over these 12 years has been upward, but significant fluctuations occurred during 2008-2009, 2011-2012, and in 2015. The 3-month interbank rate in Hungary experienced continuous growth following the 2008 financial crisis until reaching its peak in the third quarter of 2009 at around 10%, after which it sharply decreased. Similar to the stock market, the interest rate also exhibited notable volatility in 2012, followed by a persistent decline. The rate of decline appeared to slow down as observed from the magnitude of statistical charts, and the interest rate stabilized at below 1% after 2017.

In Hungary, the volume of credit experienced a brief decline following the shock of the 2008 financial crisis, reaching its lowest point at 28119 billion HUF in the second quarter of 2008. It then quickly rebounded and from 2009 to 2018, it fluctuated within the range of 31,000 to 37,000, exhibiting cyclical fluctuations with each cycle lasting about 1.5 years. After 2016, there was a gradual increase in credit volume, which accelerated after 2018, eventually exceeding 39,000.

4.1.2 Unit Root Test

The Augmented Dickey-Fuller (ADF) test as showed in Table 1 is used to eliminate the effects of autocorrelation. According to the data presented in the table 1, the null

hypothesis that each of the six variables from Hungary contains a unit root cannot be rejected at the 5% significance level for their original time series. Consequently, the first differencing is applied to these series. After first differencing, the interest rate series becomes stationary at the 5% significance level, while the other variables achieve stationarity at the 1% significance level. Therefore, the series are integrated into order one, denoted as I (1).

Table 1 ADF Unit Root Test for Hungary

	At level		At 1st difference	
	t-Statistic	Prob.*	t-Statistic	Prob.*
FX	-1.522918	0.513400	-7.549397	0.000000
IR	-0.657288	0.847300	-3.453236	0.014100
LCR	-2.231569	0.198200	-7.089343	0.000000
LGDP	-2.550269	0.303900	-5.135170	0.000700
LHPI	-0.479088	0.981200	-5.369267	0.000300
LBUX	-0.631746	0.853400	-5.246751	0.000100

4.1.3 Cointegration Test

Table 2 The Optimal Lag Lenth for Hungary

Lag	LogL	LR	FPE	AIC	SC	HQ
1	236.518	NA	4.48E-12	-9.114456	-7.654664*	-8.573095*
2	282.8598	67.40626	3.02E-12	-9.584538	-6.664955	-8.501816
3	329.7463	55.41129*	2.29e-12*	-10.07938	-5.700003	-8.455295
4	373.3656	39.65388	2.65E-12	-10.42571*	-4.586542	-8.260264

In the determination of the optimal lag length, different tests yielded varying results. As Table 2, the Schwarz criterion (SC) and Hannan-Quinn criterion (HQ) indicated

significance at the 1 lag, while the likelihood ratio (LR) test and Akaike Information Criterion (AIC) suggested significance at the 3 lags. The AIC specifically showed significance again at the 4 lags. To balance the inclusion of information from larger lag lengths and to select a lag that is significant across multiple criteria, we ultimately chose the third lag as the optimal lag length for analysing the Hungarian data.

According to the results of the Johansen cointegration test as table 3, it is observed that there are six cointegrating relationships among the series of six variables at the 5% significance level.

Table 3 Johansen Cointegration Test Result for Hungary

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.820031	190.52	95.75366	0
At most 1 *	0.674168	113.3463	69.81889	0
At most 2 *	0.429989	62.88451	47.85613	0.0011
At most 3 *	0.321948	37.59005	29.79707	0.0052
At most 4 *	0.239714	20.10617	15.49471	0.0094
At most 5 *	0.158646	7.773415	3.841466	0.0053
Trace test indicates 6 cointegrating eqn(s) at the 0.05 level				

4.1.4 Vector Error Correction Model

As appendix 1 (Table 13), the adjusted R-squared for FX is small and it is not significant, while the adjusted R-squares for other equations are large. Therefore, it can be considered that this vector error correction model is effective and convincing.

4.1.5 Granger Causality

Table 4 Granger Causality Relationship for Hungary

	FX	IR	LBUX	LCR	LGDP	LHPI
FX		0.0131	0.2470	0.3841	0.2415	0.2297
IR	0.9705		0.2623	0.7836	0.7699	0.0012
LBUX	0.8204	0.0373		0.1552	0.0523	0.2548
LCR	0.1417	0.1008	0.0010		0.7404	0.3040
LGDP	0.3475	0.8107	0.0012	0.0154		0.5687
LHPI	0.8373	0.7947	0.2688	0.2454	0.9268	
ALL	0.1720	0.0000	0.0000	0.0000	0.1567	0.0357

The test results for the Granger causality relationships among various variables in Hungary are as described in the Table 5. When FX is the dependent variable, the null hypothesis that there is no dynamic time series causality relationship, either from the impact of other variables individually or from their combined effects, cannot be rejected. When IR is the dependent variable, LBUX exhibits a Granger influence on IR at a 5% significance level. LCR is the Granger cause of LBUX, and LGDP is the Granger cause of both LBUX and LCR. When LGDP is the dependent variable, no variable is its Granger cause at a 5% significance level. However, when LHPI is the dependent variable, only IR is identified as a Granger cause. It's noteworthy that no bidirectional Granger causality relationships were observed among the six variable sequences in Hungary. Furthermore, when IR, LBUX, LCR, and LHPI are each considered as the dependent variable, the joint causality tests of the remaining five variables can reject the null hypothesis at a 5% significance level.

4.1.6 Impulse Response Function Analysis

From the perspective of the interest rate effect channel as Figure 2, the house price

index demonstrates a sustained enlarging negative reaction to a one standard deviation shock in interest rates, with the magnitude of response diminishing gradually until stabilizing after the 4th year. The GDP's response to the IR shock is similar to that of the HPI, characterized also by an enlarging negative impact. However, the rate of response for GDP is notably more pronounced in the initial six periods than post-twelve periods, a conclusion evident from the decelerating slope observable in the chart. A positive standard deviation shock in interest rates distinctly results in a continuous decline in both HPI and GDP, aligning with the hypothesis regarding the direct effects of interest rates. Facing the shock of HPI, GDP will decline in the first two quarters, then show a positive response, and remain stable after the tenth quarter. This also indicates that the fluctuations in housing prices take about six months to manifest their impact on the overall economy.

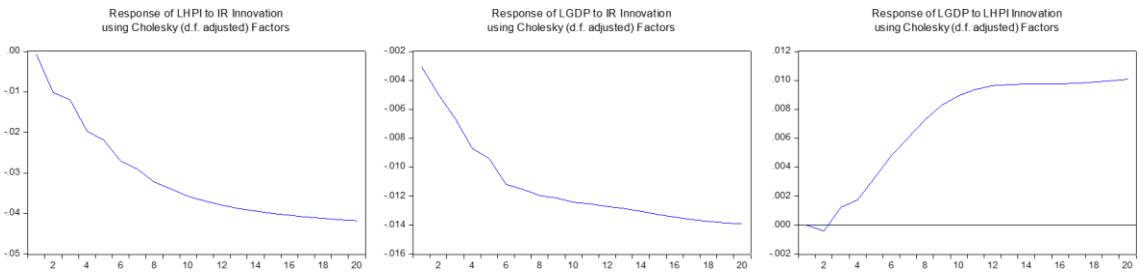

Figure 2 Interest effect impulse responses in Hungary

From the credit effect channel perspective as Figure 3, when interest rates are shocked, the response of credit first sharply increases, reaching its peak in the second period, then falls below zero in the third period. From the third to the tenth period, the volume of credit fluctuates between positive and negative responses to the interest rate shock, stabilizing below zero starting from the eleventh period as the curve converges. The initial response of the house price index to the credit shock in the first two periods is positive, but it gradually decreases. Thereafter, it consistently increases in a negative direction until stabilizing after the 18th periods. The BUX decreases following the shock of credit, with the polyline consistently in the below-zero region. However, a significant

fluctuation is noted in the fourth period. This fluctuation is also captured in the GDP responses to the CR shock, with the peak in the GDP response occurring one period later than in the BUX. The response of these indicators elucidates the transmission through the credit channel: following a positive standard deviation shock in interest rates, credit volume initially rises then falls, reflecting the market's reaction to the supply of funds. The impact on household balance sheets and cash flow is manifested in the decline in housing prices and the stock market, while GDP, influenced by credit, also undergoes an initial rise followed by a decline, reflecting the timing and process of macroeconomic transmission.

From the wealth effect perspective as Figure 4, the stock market responds intensely and swiftly to the interest rate shock, achieving a short-term nadir by the third period, but subsequently exhibits a rebound; the negative response diminishes in the fourth and fifth periods, then declines amidst fluctuations, ultimately stabilizing by about the tenth period. The BUX shock impacts the HPI with a consistently rising curve, which illustrates the stock market led to the accumulation of household wealth and then affects the housing market. In addition, its impact on GDP shows fluctuations: following a positive standard deviation shock from BUX, GDP initially increases in the first and second quarters, then starts to decline reaching a low by the fifth period, before gradually stabilizing and ascending, similar to the HPI. The wealth effect channel could be captured in Hungary.

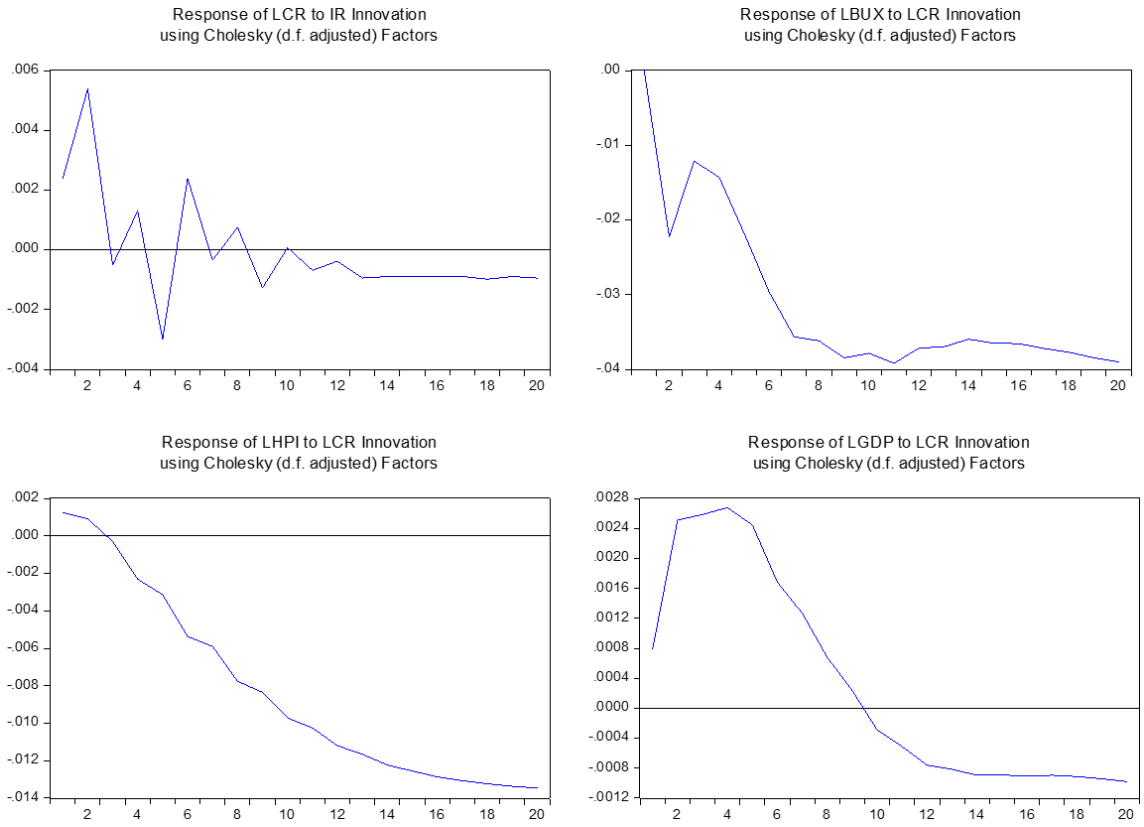

Figure 3 Credit effect impulse responses in Hungary

Due to Hungary's proximity to the Eurozone and its substantial volume of foreign currency loans during this period, the exchange rate is an essential factor influencing its economy and housing market. As Figure 5, upon experiencing a standard deviation shock in the foreign exchange rate, both the stock and housing market asset prices initially show a negative response, which diminishes gradually within two periods before transitioning to a positive and progressively increasing response. Unlike the stock market, whose response stabilizes positively, the housing market's reaction fluctuates, growing and declining repeatedly, ultimately stabilizing below zero. Credit volumes initially rise after being impacted by exchange rate fluctuations, but begin to decline after reaching a peak in the second period, and generally fluctuate below zero after the fourth period. This indicates that the exchange rate has a significant impact on credit volumes in Hungary, and the short-term and medium-to-long-term responses are not the same. GDP's reaction to the FX shock is consistently negative, intensifying

quickly in the short term and reaching its peak by the fourth period. The reactions to interest rates and GDP are analogous but in opposite directions. In the short term, the HUF depreciation will successively lead to a boom in the Hungarian housing, stock, and credit markets, but the long-term results suggest that both the housing market and GDP will be negatively impacted.

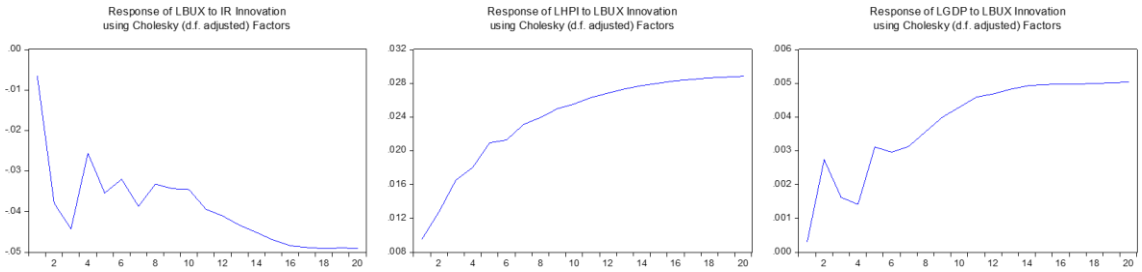

Figure 4 Wealth effect impulse responses in Hungary

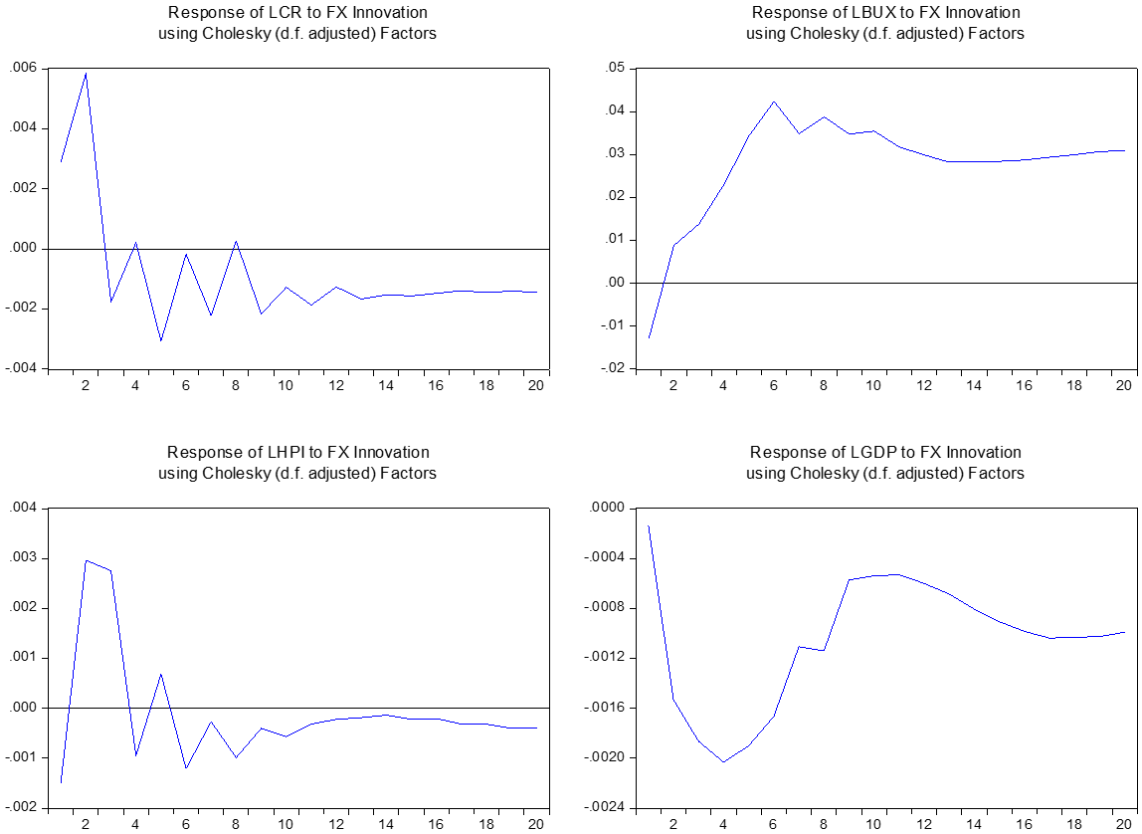

Figure 5 Foreign exchange rate channel impulse responses in Hungary

4.1.7 Variance Decomposition

Table 5 Variance Decomposition Results for LHPI in Hungary

variance decomposition LHPI							
Period	S.E.	FX	IR	LBUX	LCR	LGDP	LHPI
1	11.66161	0.841993	0.159067	34.5818	0.597152	4.816988	59.003
2	15.13564	1.207569	11.308	27.9295	0.265625	6.996845	52.29245
3	17.47364	0.929945	12.24042	26.38621	0.125722	7.825662	52.49204
4	19.44848	0.540627	17.49026	23.65903	0.217157	7.130153	50.96278
5	21.15354	0.351563	19.53345	22.74377	0.310176	6.491208	50.56983
6	22.77509	0.259829	22.31963	21.15504	0.562867	5.566685	50.13595
7	24.57726	0.191324	23.87471	20.27856	0.722624	4.997367	49.93541
8	26.12456	0.152899	25.3174	19.40137	0.96131	4.429828	49.7372
9	27.77225	0.122158	26.29394	18.75373	1.138119	4.041021	49.65104
10	29.23634	0.101041	27.05959	18.16248	1.343126	3.695063	49.6387
11	30.74962	0.084764	27.59956	17.71222	1.507323	3.435233	49.6609
12	32.17819	0.072313	27.98864	17.33029	1.675543	3.220032	49.71318

In the variance decomposition forecasting future variations showed in Table 6, the House Price Index is predominantly impacted by shocks to itself. In the short term (within a year), HPI's own shocks contribute maximally, reaching up to 59%. Over the long term, this contribution declines but remains substantial at 50%, marking it as the variable with the highest contribution among those affecting changes. In the short term, the second largest contributor is the Budapest Stock Exchange Index, especially in the first period where it accounts for 34.5% of HPI volatility, thereafter slowly declining to stabilize around 20%. This underscores the influence of the wealth effect on housing market volatility. Unlike the trend of BUX's impact on HPI variance, the influence of interest rates in the first period is minimal, thus it can be considered as an exogenous

variable. Starting from the second period, IR's contribution to HPI variance markedly increases to 11% and continues to rise, reaching over 25% after the eighth period. Consequently, HPI variance fluctuations are primarily driven by HPI itself, BUX, and IR. GDP's contribution initially rises, reaching its maximum of 7.8% in the third period, before steadily declining to around 3%. The contributions of foreign exchange rates and credit to HPI variance are very small, not exceeding 2%.

GDP reflects the ultimate effects mediated through various channels such as interest rates, credit, and exchange rates. The results from the GDP variance decomposition in Table 7 indicate that initially, GDP itself predominantly accounts for its own variance fluctuations, contributing as much as 76.8% in the first period, though this contribution swiftly diminishes over time, dropping below 10% from the eighth period onwards. Conversely, the impact of the House Price Index on GDP's variance is negligible in the short term, registering zero in the first period. However, it demonstrates a marked increase over the long term, exceeding 10% after the eighth period and reaching up to 22% by the twelfth period. This indicates that HPI's impact on GDP variance is increasing and displays a lagged effect.

Similarly, the effects of Credit, Budapest Stock Exchange Index, and Foreign Exchange on GDP's variance also exhibit lagged responses, with their contributions in the first period being 1.4%, 0.2%, and 0.04%, respectively. These figures rise to 6.8%, 7.4%, and 2.3% by the second period, though their total contributions remain relatively small. The second most significant influence on future variations in GDP is IR, where IR's contribution significantly escalates in the short term—from 21.4% in the first period to 56.9% by the fourth period. However, after peaking in the sixth period, it gradually decreases and stabilizes, underscoring the direct impact of the interest rate effect within the variance fluctuations.

Table 6 Variance Decomposition Results for LGDP in Hungary

Variance Decomposition LGDP							
Period	S.E.	FX	IR	LBUX	LCR	LGDP	LHPI
1	11.66161	0.041476	21.43918	0.232228	1.428254	76.85886	0
2	15.13564	2.310035	33.35452	7.432898	6.775997	49.96325	0.163296
3	17.47364	3.462204	46.54665	6.073573	8.078558	34.84511	0.993911
4	19.44848	3.681151	56.93914	4.519687	7.683869	25.42585	1.750303
5	21.15354	3.415002	60.95546	5.517907	6.736779	19.50607	3.868778
6	22.77509	2.875588	64.58593	5.39744	5.20697	15.16826	6.765815
7	24.57726	2.313627	65.81419	5.331591	4.108546	12.56853	9.86351
8	26.12456	1.930386	65.75157	5.444528	3.238699	10.53288	13.10194
9	27.77225	1.574054	64.74802	5.67375	2.600448	9.256705	16.14703
10	29.23634	1.312779	63.58034	5.902233	2.142203	8.395853	18.66659
11	30.74962	1.120761	62.40507	6.160972	1.8179	7.8019	20.6934
12	32.17819	0.979887	61.44795	6.358154	1.589124	7.338794	22.28609

4.2 China

4.2.1 Descriptive Analysis

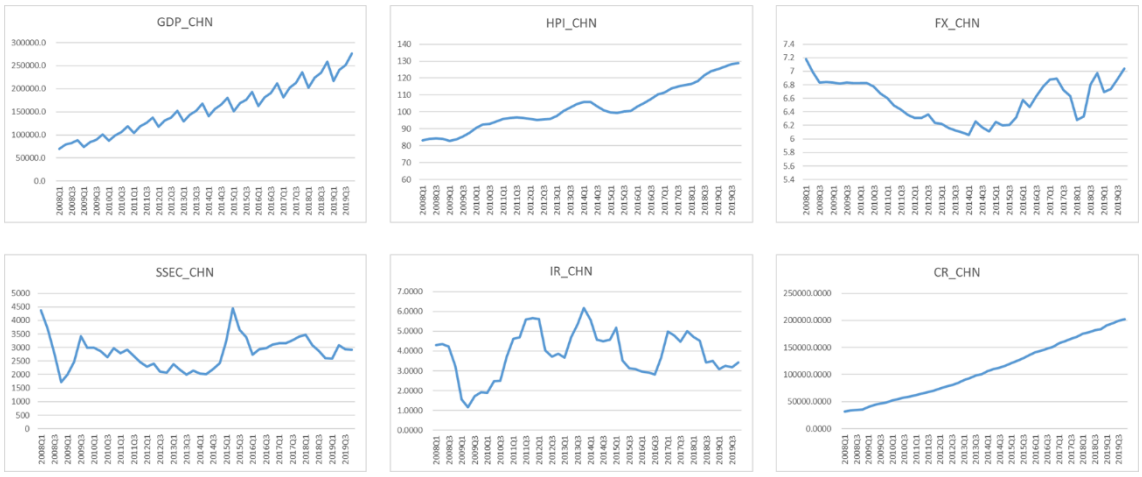

Figure 6 Variables Trends in China

Source: World Bank, OECD dateset, Bank for International Settlements, National Bureau of Statistics of China

Over twelve years, China's GDP has witnessed a steady growth, no evidence of the impact of the financial crisis on GDP could be seen. However, it is notable that, by employing current quarter data, the seasonal fluctuations existed in GDP. Specifically, the GDP values in the third quarter are always higher than those in the first quarter of the same year, which the author considers could be related to China's New Year and other major national holidays in the first quarter. Credit volume also showed a stable increase, without significant fluctuations. By the year of 2019, the credit to the private non-financial sector had been four times as it was in 2008.

The house price index and the SSE Composite Index, as indicators for asset prices, exhibited completely different dynamics. Similar to credit, house prices generally maintained an upward trend during this period, though with more obvious fluctuations. But unlike credits, there were declines in HPI during 2008-2009 and 2014-2015. The volatility in the stock market was much greater than in the real estate market. Focusing

on the data post-2008, we could observe a sharp decline in the SSE Composite Index after the financial crisis, continuing until the end of 2008. Indeed, the SSE Composite had reached a peak of 6124 points in June 2007, and it has not returned to such a prosperous state up to the present day. After 2009, China's stock market began to recover, reaching around 3500 points in the first quarter of 2010 before entering a long-term downturn. A peak was also observed in the fourth quarter of 2015, reaching approximately 4500, followed by years of fluctuation around 3000 points.

Interbank interest rates, as critical economic indicators that reflect market conditions and monetary policy, have exhibited fluctuations that diverge significantly from many other macroeconomic trends. Over these twelve years, unlike GDP or credit volume, interest rates did not show a long-term trend but were highly volatile and demonstrated some correlations with stock price indices. For instance, in 2008, following a sharp decline in stock prices, the interbank interest rate also began a descent lasting about half a year, falling to nearly 1% by early 2009, lagging behind the stock index by approximately two quarters. Subsequently, interest rates experienced significant volatility with two major fluctuations in 2012 and 2014, each reaching around 6%. In the fourth quarter of 2016, rates once again fell to below 3% and maintained within the 3%-5% range over the following years. This pattern of fluctuation highlights the sensitivity of interest rates to broader economic shifts and the reactive nature of monetary policy to changing economic conditions.

Following the year 2008, the USD to CNY exchange rate initially experienced a decline but stabilized around 6.8 from 2009 to 2010 with little fluctuation. From 2010 until the first quarter of 2014, the Renminbi (RMB) appreciated continuously, with the exchange rate dropping below 6.1, marking a period of significant strengthening against the dollar. This was followed by a three-year period of rising fluctuations. The exchange rate peaked in the third quarter of 2017. Subsequently, influenced by economic and political factors, including Sino-US relations and the trade wars, the exchange rate significantly

declined, followed by a sharp increase in 2018.

4.2.2 Unit Root Test

Table 7 ADF Unit Root Test for China

	At level		At 1st difference	
	t-Statistic	Prob.*	t-Statistic	Prob.*
FX	-1.909123	0.325400	-5.858389	0.000000
IR	-2.824153	0.062700	-5.074121	0.000100
CR	-0.573627	0.976000	-4.155284	0.011000
GDP	-3.878095	0.021900	-3.610545	0.040900
HPI	2.270468	0.993700	-2.143314	0.032200
SSEC	-3.823136	0.023900	-5.390707	0.000300

The results of the Augmented Dickey-Fuller (ADF) unit root tests for data from China in Table 8 are as follows: the original series of FX, IR, CR, and HPI, were found to be non-stationary at level. The null hypothesis that unit root exists in the series cannot be rejected. At the first difference level, all series achieved stationarity at the 5% significance level, integrating with order one.

4.2.3 Cointegration Test

Table 8 The Optimal Lag Lenth for China

Lag	LogL	LR	FPE	AIC	SC	HQ
1	6.100734	NA	1.58E-07	1.359058	2.818849	1.900419
2	72.01253	95.87171	4.38E-08	-0.00057	2.919013	1.082152
3	113.0045	48.44506	4.35E-08	-0.227478	4.151897	1.396606
4	221.131	98.29681*	2.68e-09*	-3.505954*	2.333212*	-1.340510*

According to table 9, both the Akaike Information Criterion (AIC) and the Schwarz Criterion (SC) indicate that the best lag length is 4, thereby setting the lag length for Johansen's cointegration test to 3.

Table 9 Johansen Cointegration Test Result for China

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.95914	270.5562	95.75366	0
At most 1 *	0.772765	129.8614	69.81889	0
At most 2 *	0.604779	64.66342	47.85613	0.0006
At most 3	0.269559	23.81781	29.79707	0.2082
At most 4	0.203243	9.997124	15.49471	0.281
At most 5	2.39E-06	0.000105	3.841466	0.993

The findings in Table 10 demonstrate that there are three cointegrating relations among the six variables analysed in China, enabling the rejection of the null hypothesis that there is no cointegration at a 5% level of significance. This supports the presence of long-term equilibrium relationships among the variables, which are statistically significant.

4.2.4 Vector Error Correction Model

As appendix 2 (Table 14), according to the adjusted R-squared, the equations of LCR, GDP, LHPI, SSEC showed effective results, and the model is significant.

4.2.5 Granger Causality

As table 12, when establishing the dependent variable as FX, the analysis revealed no indicators to suggest Granger causality, indicating a lack of significant direct impact on exchange rate movements, which is the same as Hungary. When using IR as the dependent variable showcased that LGDP could reject the null hypothesis of no causality at a 5% significance level. Moreover, a joint causality test involving five variables could also reject the null hypothesis at a 5% significance level, suggesting a short-term influence of these indicators on GDP variations.

Table 10 Granger Causality Relationship for China

	FX	IR	LCR	LGDP	LHPI	SSEC
FX		0.3408	0.1473	0.4745	0.3916	0.0341
IR	0.8642		0.5695	0.4293	0.3484	0.0170
LCR	0.9554	0.2231		0.2093	0.5100	0.0013
LGDP	0.8494	0.0296	0.0353		0.5089	0.0001
LHPI	0.9970	0.1490	0.2231	0.0436		0.0000
SSEC	0.7028	0.3837	0.2440	0.3303	0.8935	
ALL	0.9941	0.0136	0.1945	0.5180	0.1214	0.0000

Further, at a 5% significance level, LGDP was identified as a Granger cause for LCR, and LHPI was determined to be a Granger cause for LGDP. However, the fluctuations in LHPI could not be significantly explained by either individual or combined variable relationships.

Remarkably, all examined indicators substantially influenced the changes in SSEC, particularly LCR, LGDP, and LHPI, which all rejected the null hypothesis of no Granger causality at a 1% significance level. This finding implies that stock market fluctuations are explicable through the involved metrics: exchange rates, interest rates, credit volumes, house prices, and GDP.

Notably, the study did not uncover any two-way Granger causality relationships among the six economic indicators analysed, highlighting a unidirectional influence pattern within the vector error correction model framework.

4.2.6 Impulse Response Function Analysis

From the perspective of the interest effect channel as Figure 7, housing prices also drop significantly following the interest rate shock, with the negative impact intensifying until it peaks during the fifth period. After that, the negative effects begin to diminish.

Between the 10th and 14th periods, the response turns positive, increasing initially and then decreasing. After the 14th period, it turns negative again. The response of GDP to interest rate shocks also exhibits a 4-quarter cycle, initially declining and then rising within each cycle. The overall effect fluctuates positively. It can be seen that GDP is directly and positively affected by house price shocks, but responds to interest rate shocks in the opposite way as expected in theory. An increase in interest rates makes GDP negative in periods 7-9, but most of the time China's GDP still shows a positive response. The interest effect channel could be witnessed in China, however, in an opposite direction.

As for the credit effect channel as Figure 8, there is a significant impact on the volume of credit. Within 1-2 periods after experiencing the shock of one standard deviation in interest rates, the volume of credit showed a negative increase. The negative impact decreases gradually after the second period, turning positive from the seventh period and continuing to grow thereafter. The impact of credit volume has led the stock market, which responds more rapidly to market information, to show an increase. After a shock of one standard deviation to credit volume, the Shanghai Composite Index initially showed a negative reaction, which gradually weakened. Starting from the second period, the reaction turned positive and continued to rise, remaining positive thereafter, peaking in the fifth period, then slightly declining and stabilizing. However, both housing prices and GDP exhibited negative responses to the positive shock in credit volume. This outcome is contrary to the findings of Iacoviello and Minetti (2008) and Wilhelmsson (2020) regarding Finland, the UK, and Sweden. A reasonable hypothesis is that when credit expands, households theoretically have increased purchasing power. However, due to cultural factors in China, citizens tend to prefer saving or repaying mortgages rather than increasing consumption (Ye & NG, 2021). At the same time, even during periods of economic prosperity, Chinese households still save a substantial amount of cash at minimal deposit interest rates. An underdeveloped financial system also limits economic growth (Fang et al., 2016).

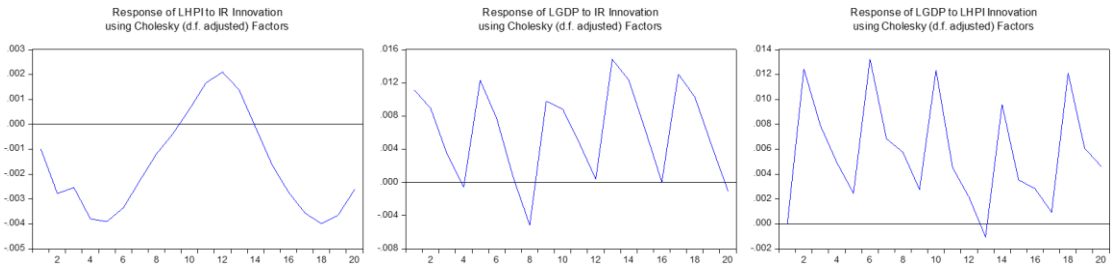

Figure 7 Interest effect impulse responses in China

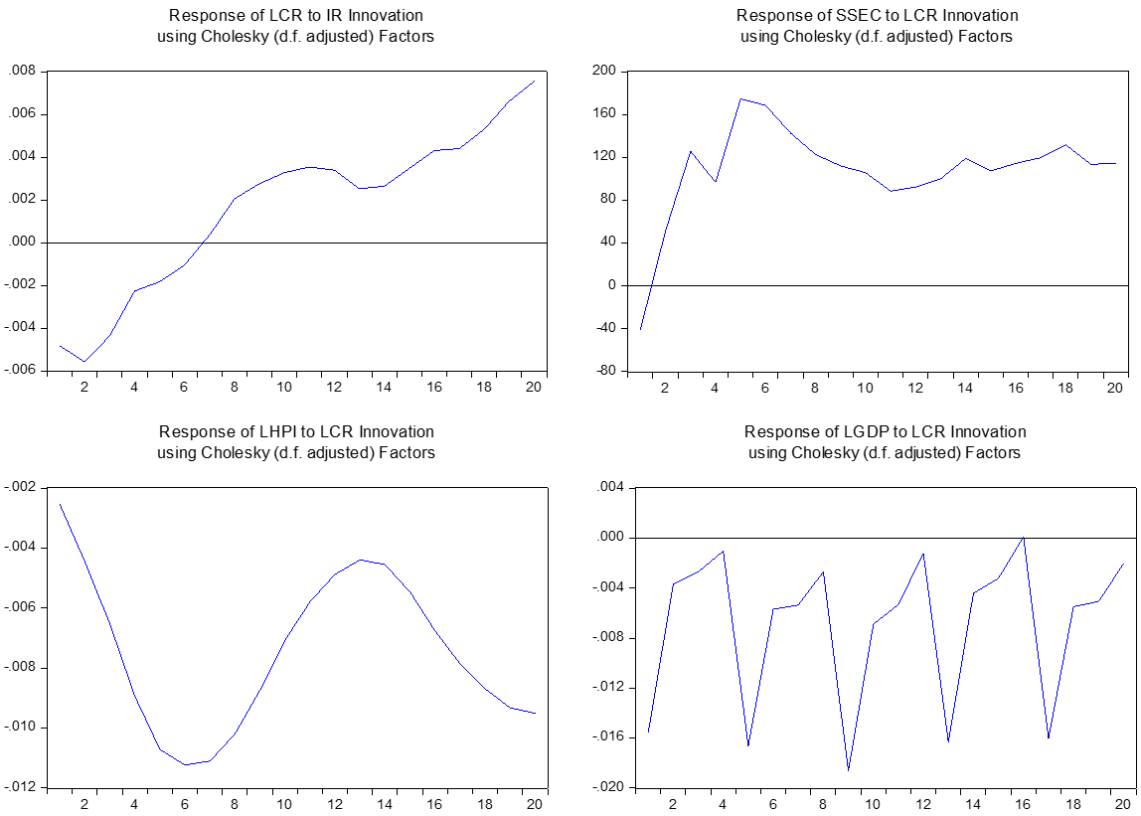

Figure 8 Credit effect impulse responses in China

In terms of the wealth effect channel as Figure 9, the impact of interest rate shocks on both housing prices and the stock market is generally negative, with the stock market experiencing particularly significant effects. During the first four periods following an interest rate shock, the negative impact on stock indices gradually decreases. However, between the fourth and seventh periods, the negative impact sharply increases, reaching its peak in the stock market two periods later than in the housing market. The stock market also impacts the real estate market due to its influence on household wealth and

liquidity. The response of housing prices to shocks in stock indices is consistently positive, and this response gradually increases, peaking in the tenth period. Unlike the findings of Wilhelmsson (2020), the response of GDP to the stock market is not always positive and fluctuates over the cycle. This is also distinctly different from GDP's response to shocks in housing prices, which shows a complex interaction between these variables influenced by macroeconomic policies and investor sentiment. These dynamics highlight the interconnectedness of housing, stock markets, and overall economic output, reflecting the sensitivity of these sectors to interest rate changes and their broader economic implications. Additionally, this provides empirical evidence for the existence of a short-term wealth effect in China.

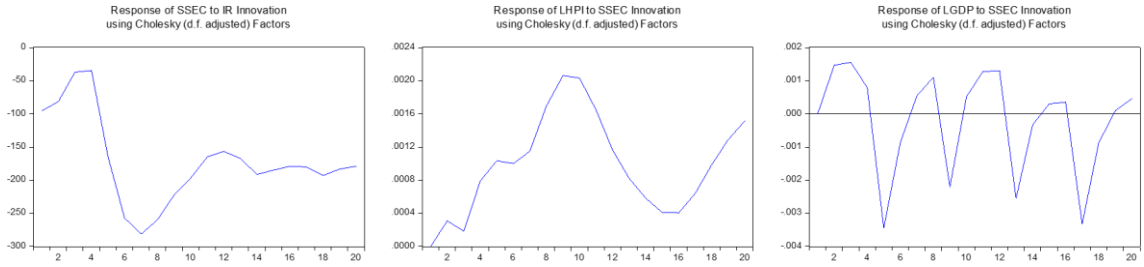

Figure 9 Wealth effect impulse responses in China

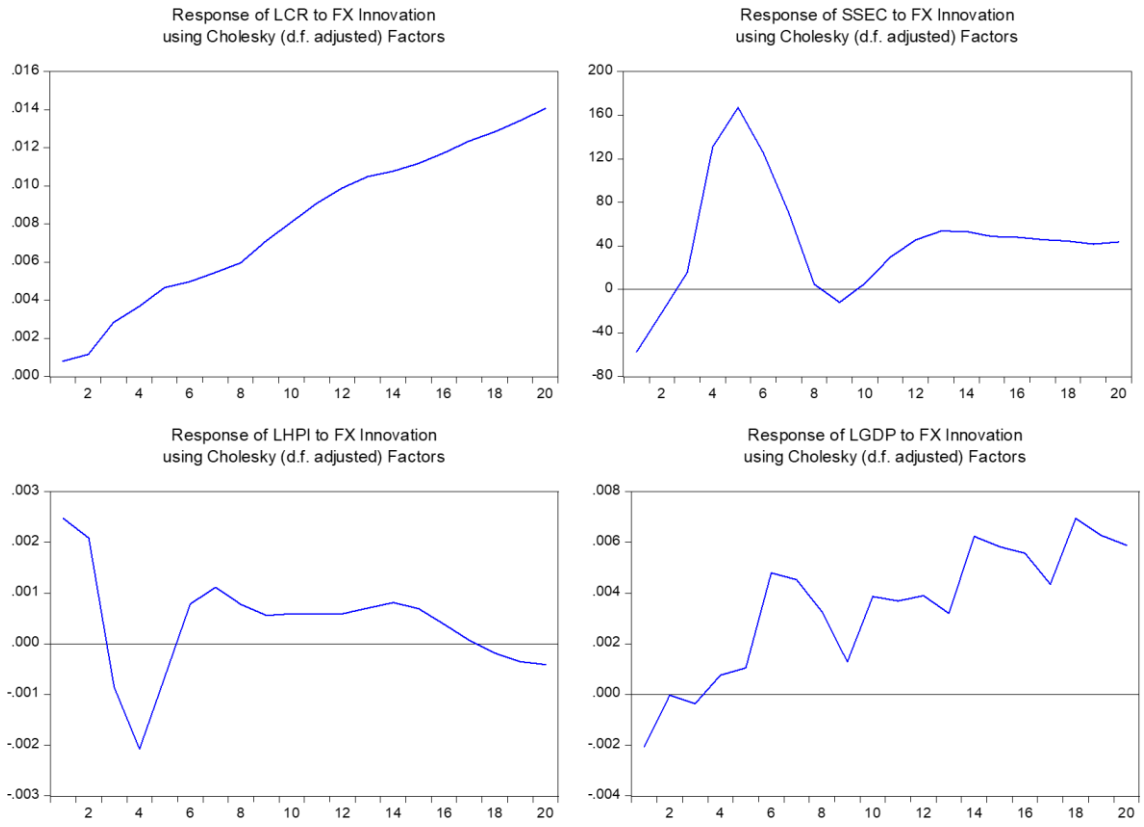

Figure 10 Foreign exchange rate channel impulse responses in China

The mechanism of foreign exchange rate impact is also incorporated when considering the role of the real estate market in macroeconomic transition. As Figure10, following an exchange rate shock, housing prices decrease. The response turns negative starting from the third period, reaching its maximum negative value in the fourth period, then begins to diminish. From the sixth period onwards, the response becomes positive and gradually converges. This is largely consistent with the observations of Qiao and Guo (2014), although they used the nominal effective exchange rate of the renminbi as their exchange rate indicator. In contrast, the stock market's reaction to exchange rate changes is entirely opposite; it starts with a negative response that gradually diminishes to a positive response, peaking in the fifth period. This indicates that although both markets reflect asset prices, their responses to exchange rate shocks are completely different. Due to the frequent fluctuations in exchange rates and the rapid response of the markets, the differences between the stock market and real estate market could be

attributed to factors such as asset liquidity and trading processes. This analysis underscores the complex interplay between exchange rates and asset markets, highlighting the differential impacts and response timings of housing versus stock markets to exchange rate volatilities. This complexity is crucial for policymakers and investors who need to understand sector-specific sensitivities to effectively navigate financial decisions. Compared to the real estate market, in the medium run, the response of GDP to exchange rate fluctuations is more similar to the trend in the stock market, also showing a negative-then-positive pattern. The peak response of GDP occurs two quarters later than the peak in the stock market. However, in the long run, GDP will show a continuous and increasing rise.

4.2.7 Variance Decomposition

Table 11 Variance Decomposition Results for LHPI in China

Variance Decomposition of LHPI							
Period	S.E.	FX	IR	LCR	LGDP	LHPI	SSEC
1	0.147116	9.974614	1.589555	10.55108	21.92521	55.95954	0.000000
2	0.218631	4.199829	3.490457	10.55776	24.72370	56.98981	0.038455
3	0.242616	2.076559	2.811760	12.79495	26.95055	55.34204	0.024134
4	0.262451	1.646082	3.140456	15.81433	27.39065	51.92822	0.080268
5	0.289430	1.176243	3.311718	19.47960	27.14153	48.75592	0.134993
6	0.314382	0.956430	3.240516	22.54760	26.80219	46.28983	0.163437
7	0.333622	0.879595	3.023633	25.38812	26.39763	44.10564	0.205379
8	0.348446	0.825271	2.807352	27.70823	25.93897	42.40478	0.315406
9	0.361745	0.789861	2.648068	29.30600	25.49255	41.28676	0.476763
10	0.375322	0.774943	2.565373	30.25870	25.14318	40.63025	0.627557
11	0.388709	0.768493	2.609543	30.80504	24.88506	40.21268	0.719190
12	0.401129	0.765131	2.722503	31.04520	24.71218	39.99905	0.755938

The variance decomposition results for the HPI indicate that volatility in the housing prices index was most significantly driven by the HPI itself, with a contribution rate as high as around 56% in the first and second periods. As time progressed, the ability of housing prices to explain the variance weakened, stabilizing at around 40% since the

tenth period. Throughout the entire study period, the HPI has been the variable with the largest contribution to its own fluctuations in variance. The contribution of GDP to the volatility in the HPI was also significant and stable. In the first period, GDP's contribution was 21.9%, which slowly increased and peaked at 27.4% in the fourth period, before gradually decreasing. However, overall, the contribution rate consistently remained around 25%. The Credit volume displayed a lagged impact on the variance of HPI volatility; in the short run, its contribution was around 11%, but this gradually increased over time, explaining 30% of the variance in HPI by the tenth period. In contrast, the influence of the USD to CNY exchange rate on Chinese housing prices was immediate, with a contribution rate of 10% in the first period, which continuously decreased to less than 1% starting since the sixth period. The contribution of interest rates remained between 1% and 3%, while the contribution from stock market knowledge was consistently below 1%, with no contribution in the first period. These two indicators had a minimal impact on the variance in the housing prices index. Overall, the main factors affecting housing prices in China were the HPI itself, GDP, credit volume, and the exchange rate.

The variance decomposition results for GDP demonstrated the contribution of different variables to GDP fluctuations. The contribution of the HPI was one-quarter lagged, and it had a strong exogenous impact on predicting GDP in the first period. Since the second period, the HPI contributed about 23% of GDP variance. This impact did not show a clear long-term trend but fluctuated over time, with the highest value occurring in the fourth period, reaching 27.3%, and the lowest value, aside from the first period, occurring in the fifth period, at 16.7%. The contribution of GDP to its own variation remained around 20%, also without a clear trend. The contribution of shock in credit volume to the volatility of GDP was the largest among these variables. The contribution rate in the first period was as high as 52.3%, then it declined and stabilized at around 30%. In the fifth and ninth periods, the contribution of credit volume was slightly greater than in the adjacent periods, which may also be related to the seasonal

fluctuations of GDP. The contribution of interest rates generally decreased over time. There was a slight increase in the first two periods, from 26.9% to 27.4%, reaching its maximum in the second period and then starting to decline. Afterward, it stabilized at 20% from the ninth period onwards. The impact of exchange rates on the variance of GDP was not significant, but overall, it tended to increase slowly over time. The contribution of stock indices was even smaller, generally below 1%, and reached its highest value of 1.2% in the fifth period.

Table 12 Variance Decomposition Results for LGDP in China

Variance Decomposition of LGDP							
Period	S.E.	FX	IR	LCR	LGDP	LHPI	SSEC
1	0.147116	0.912439	26.905200	52.309390	19.872960	0.000000	0.000000
2	0.218631	0.565467	27.365070	34.246050	16.819760	20.715700	0.287952
3	0.242616	0.514442	25.490750	31.070450	16.763800	25.620340	0.540213
4	0.262451	0.560266	24.513270	29.954780	17.040730	27.340570	0.590374
5	0.289430	0.409063	24.888340	36.559270	20.253110	16.734920	1.155302
6	0.314382	1.590486	23.405260	31.361660	19.517790	23.148670	0.976149
7	0.333622	2.548225	22.020050	30.954390	19.375110	24.169480	0.932742
8	0.348446	2.948276	22.273890	29.848500	19.332490	24.648280	0.948554
9	0.361745	2.321488	20.669920	35.896480	21.031610	19.171670	0.908826
10	0.375322	2.550256	20.888930	33.352530	20.347570	22.047230	0.813479
11	0.388709	2.911938	20.979840	33.238800	19.989970	22.037920	0.841540
12	0.401129	3.373456	20.816810	33.020040	19.894270	22.006890	0.888535

4.3 Comparable Analysis

A comparative empirical analysis between Hungary and China reveals both similarities and differences.

Firstly, in both China and Hungary, GDP is statistically a Granger cause of changes in credit volumes, aligning with the economic theory that links credit boom-bust cycles to overall societal output. Although no direct empirical evidence was found regarding the relationship between credit volumes and housing price indices, credit volumes in both

countries serve as a Granger cause for stock market fluctuations.

The housing market plays a significant role in the direct effects of macroeconomic transmission mechanisms. Empirical results from both Hungary and China have captured the impacts of interest rate shocks on declining housing prices. Furthermore, the response of housing price indices and GDP to interest rate shocks suggests that real estate is a crucial intermediary in how interest rates affect overall demand, with this process being more pronounced in Hungary. In China, the result of a positive interest rate shock is still GDP growth, which may be related to Chinese culture and the savings habits prevalent in Chinese society.

From the indirect effects of transmission mechanisms, the credit effects reveal that in Hungary, credit expansion positively impacts the housing market in a short term, and the response of GDP to credit shows a fluctuation increasing to its peak and then decreasing, highlighting the importance of housing market in credit effect channel. However, in China, the response of housing prices to a positive standard deviation shock in credit volumes is consistently negative, contradicting the hypothesized boom in the real estate market following credit expansion. In China, a credit expansion shock leads to GDP growth, which may be related to Chinese culture and the savings habits prevalent in Chinese society. Yet, the dynamics observed in the stock market and GDP indicate that in China, the stock market plays a more significant role than the housing market in the transmission mechanism of credit effects.

The transmission mechanisms of wealth effects are significantly observed in both countries. The stock market reacts to interest rate fluctuations, impacting household wealth, which in turn affects housing prices and GDP. Although both housing price indices and stock indices are critical indicators of asset values, it is evident that stock market fluctuations are more pronounced and respond faster to interest rate shocks. In addition, a key difference in the wealth effect between the two countries is that

Hungary's GDP exhibits a long-term growth trend in response to increases in wealth, whereas China's GDP shows a short-term positive response to the stock market, with long-term periodic fluctuations.

The exchange rate significantly impacts real estate market and GDP. When the Hungarian forint depreciates, housing prices initially decline, then rise, and decline again. The direct impact of exchange rate fluctuations on GDP is more apparent, with GDP showing a long-term negative response, although the degree fluctuates over time. Faced with the depreciation of their national currency, China's housing market shows a trend completely opposite to that of Hungary. However, the response of GDP to exchange rate shocks in China is relatively rapid, declining in the short term but beginning to rise soon after.

In both countries, variance decomposition results indicate that the housing price index's own variance is the most influential on its fluctuations. However, a notable distinction is that in China, GDP significantly impacts the variance of the housing price index, whereas this impact is minimal in Hungary. This reflects the prosperity of China's real estate industry alongside economic growth. Moreover, credit and short-term exchange rates also contribute to the variance in housing prices. In contrast, in Hungary, the stock market significantly explains the variance in housing prices, reflecting the process of household wealth flow.

Variance decomposition results for GDP show that the housing market's contribution to GDP variance is zero in the initial period, reflecting the lag in transmission mechanisms. In China, housing plays a crucial role in the macroeconomy, contributing up to 20% to GDP as a pillar industry. Credit is the most significant contributor to GDP variance, highlighting the phenomenon of credit expansion in China's economic development. In contrast, credit's contribution to Hungary's GDP is much smaller.

5 Conclusion

This article discusses the role of the real estate market in the macroeconomic transmission during financial crises when impacted by various factors. In addition to discussing the effects of interest rate shocks within the monetary policy transmission mechanisms across different channels, it also adds foreign exchange rates as a variable. Given the interconnection of financial systems worldwide, influenced by exchange rates and trade among other factors, no country is immune from global economic shocks (Shelburne, 2010; Ma & Cheng, 2005). This paper applies the Vector Error Correction Model to conduct an empirical study on data from Hungary and China in 2008-2019. Hungary and China are both countries that have transitioned from centrally planned economies to market economies. However, there are few articles that compare them on the role of housing market in financial crisis shocks. This dissertation provides econometric evidence via impulse response analysis and variance decomposition analysis. The results indicate that the housing market affects the overall economic level through shocks in both interest rates and exchange rates. In Hungary and China, the role of the housing market in the macroeconomic transmission mechanisms is evident through both interest rate effects and wealth effects. However, in China, contrary to expectations, housing prices did not rise with credit expansion in the credit effect channel. And foreign exchange rate has a larger impact on Hungary than China. In terms of variance fluctuations and forecasting, the housing price index and GDP in China contribute significantly to each other, demonstrating that economic development in China has promoted the prosperity of the real estate industry and is also driven by it. In Hungary, both the housing price index and GDP variance fluctuations are more dependent on their own historical data.

As for the policymakers, we have some suggestions. Firstly, the impacts generated through different channels on the housing market, stock market, and GDP occur at different times, which policymakers should consider when constructing economic

models, some lagged fluctuations also need to be taken into considerations. Secondly, the factors that most significantly influence fluctuations in housing prices and GDP vary across countries, meaning that the focus of macroeconomic regulation will differ. For examples, China's government and central bank should focus more on credit risk, as it is the main factors of GDP. And Hungary should focus on the interest rate, which has a sharply increasing impact on GDP flucations.

The dissertation also has limitations. The dynamics of the housing market are not solely captured by the housing price index. Other dimensions such as rental price dynamics, mortgage default rates, and housing investment amounts also effectively measure different aspects of the housing market. However, due to difficulties in obtaining data for these indicators that meet the required time and frequency criteria, this study solely uses the housing price index to represent the real estate market. This method of assessment may cause bias into the results. For example, the foreign exchange rate might affect more in the Hungarian housing market on foreign currency mortgage default rate, rather than the house price.

Current research often focuses on individual countries or a few developed European nations, but the role of the real estate market in the macroeconomics of highly volatile emerging transitional economies is equally crucial. Future studies could pay more attention to emerging markets and conduct comparative analyses. On one hand, understanding their macroeconomic transmission mechanisms can more effectively aid in the formulation of economic policies, especially in response to shocks such as financial crises. On the other hand, comparative studies can also shed light on the distinct economic characteristics of different emerging markets' development, offering insights into their unique challenges and opportunities.

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Appendices

Appendix 1

Cointegrating Eq:	CointEq1	CointEq2				
FX(-1)	1	0				
IR(-1)	0	1				
LBUX(-1)	-291.3482	-2.91673				
	-37.7014	-1.2468				
	[-7.72778]	[-2.33937]				
LCR(-1)	-177.2498	-20.7681				
	-108.264	-3.58034				
	[-1.63720]	[-5.80060]				
LGDP(-1)	-1768.846	34.33553				
	-290.867	-9.61909				
	[-6.08130]	[3.56952]				
LHPI(-1)	982.2559	-0.46192				
	-107.93	-3.56931				
	[9.10082]	[-0.12941]				
C	27959.32	-299.259				
Error Correction:	D(FX)	D(IR)	D(LBUX)	D(LCR)	D(LGDP)	D(LHPI)
CointEq1	-0.089944	-0.00273	0.002473	3.08E-05	-8.74E-06	4.67E-05
	-0.06464	-0.00271	-0.00033	-0.00013	-3.70E-05	-9.00E-05

	[-1.39156]	[-1.00804]	[7.42880]	[0.22816]	[-0.23910]	[0.51778]
CointEq2	1.198585	-0.03153	-0.033263	0.013752	-0.005362	-0.000587
	-1.51229	-0.06346	-0.00779	-0.00316	-0.00086	-0.00211
	[0.79256]	[-0.49677]	[-4.26998]	[4.35722]	[-6.26802]	[-0.27827]
D(FX(-1))	-0.19317	-7.44E-05	-0.00056	0.000233	-7.68E-05	0.000443
	-0.1983	-0.00832	-0.00102	-0.00041	-0.00011	-0.00028
	[-0.97413]	[-0.00894]	[-0.54812]	[0.56292]	[-0.68421]	[1.59959]
D(FX(-2))	-0.035969	0.022576	-0.001643	-0.000418	-0.000181	-3.58E-05
	-0.1909	-0.00801	-0.00098	-0.0004	-0.00011	-0.00027
	[-0.18842]	[2.81817]	[-1.67079]	[-1.04930]	[-1.67219]	[-0.13427]
D(IR(-1))	0.188469	-0.10747	-0.02907	-0.003985	-5.78E-05	-0.016032
	-3.49246	-0.14656	-0.01799	-0.00729	-0.00198	-0.00487
	[0.05396]	[-0.73328]	[-1.61592]	[-0.54678]	[-0.02926]	[-3.28991]
D(IR(-2))	-0.7254	0.422707	-0.009226	-0.003573	-0.001309	0.004437
	-3.23537	-0.13577	-0.01667	-0.00675	-0.00183	-0.00451
	[-0.22421]	[3.11341]	[-0.55358]	[-0.52920]	[-0.71519]	[0.98286]
D(LBUX(-1))	-3.75605	-2.34623	0.005091	-0.038917	0.023359	-0.00211
	-22.2384	-0.93322	-0.11455	-0.04641	-0.01258	-0.03103
	[-0.16890]	[-2.51413]	[0.04444]	[-0.83852]	[1.85685]	[-0.06801]
D(LBUX(-2))	13.82573	0.554291	-0.329151	0.083308	-0.020788	-0.052061
	-22.623	-0.94936	-0.11653	-0.04721	-0.0128	-0.03157
	[0.61114]	[0.58386]	[-2.82456]	[1.76446]	[-1.62435]	[-1.64929]
D(LCR(-1))	140.7304	-0.1755	-1.322029	-0.014437	-0.029608	-0.053148
	-71.208	-2.98819	-0.3668	-0.14861	-0.04028	-0.09936

	[1.97633]	[-0.05873]	[-3.60427]	[-0.09715]	[-0.73503]	[-0.53493]
D(LCR(-2))	45.75633	6.764513	-0.832658	0.120207	0.000128	-0.172214
	-80.03	-3.35839	-0.41224	-0.16702	-0.04527	-0.11167
	[0.57174]	[2.01421]	[-2.01985]	[0.71971]	[0.00283]	[-1.54222]
D(LGDP(-1))	-328.24	-4.63558	5.865764	0.015214	-0.084279	0.453657
	-311.171	-13.058	-1.60285	-0.64941	-0.17602	-0.43418
	[-1.05486]	[-0.35500]	[3.65958]	[0.02343]	[-0.47879]	[1.04487]
D(LGDP(-2))	185.0594	5.222712	2.378289	1.833923	-0.279654	0.245055
	-323.296	-13.5668	-1.66531	-0.67472	-0.18288	-0.45109
	[0.57242]	[0.38496]	[1.42814]	[2.71806]	[-1.52914]	[0.54325]
D(LHPI(-1))	-72.29393	2.559386	-0.286261	0.4239	-0.026593	0.38768
	-121.331	-5.09155	-0.62498	-0.25322	-0.06863	-0.16929
	[-0.59584]	[0.50267]	[-0.45803]	[1.67406]	[-0.38746]	[2.29000]
D(LHPI(-2))	13.67164	1.887733	-0.930503	-0.095785	0.001653	0.388709
	-124.27	-5.2149	-0.64012	-0.25935	-0.0703	-0.17339
	[0.11002]	[0.36199]	[-1.45364]	[-0.36932]	[0.02351]	[2.24176]
C	4.06179	-0.27345	0.009296	-0.007895	0.007259	-0.002096
	-3.07261	-0.12894	-0.01583	-0.00641	-0.00174	-0.00429
	[1.32194]	[-2.12075]	[0.58734]	[-1.23124]	[4.17630]	[-0.48881]
R-squared	0.428464	0.646148	0.843996	0.669743	0.785588	0.714128
Adj. R-squared	0.161748	0.481018	0.771194	0.515624	0.68553	0.580721
Sum sq. resids	4079.795	7.184494	0.10825	0.01777	0.001306	0.007943
S.E. equation	11.66161	0.48937	0.060069	0.024338	0.006597	0.016271
F-statistic	1.60644	3.912951	11.59307	4.345602	7.851268	5.353012

Log likelihood	-165.2629	-22.5706	71.8222	112.4785	171.2235	130.5962
Akaike AIC	8.011683	1.669806	-2.525431	-4.332376	-6.943267	-5.137609
Schwarz SC	8.613904	2.272027	-1.92321	-3.730155	-6.341046	-4.535388
Mean dependent	3.446044	-0.19539	0.014244	0.006099	0.004708	0.011533
S.D. dependent	12.73712	0.679299	0.12558	0.034969	0.011764	0.025129
Determinant resid covariance (dof adj.)		3.20E-13				
Determinant resid covariance		2.81E-14				
Log likelihood		318.9527				
Akaike information criterion		-9.64234				
Schwarz criterion		-5.54724				
Number of coefficients		102				

Table 13 Vector Error Correction Model for Hungary

Appendix 2

Vector Error Correction Estimates						
Date: 04/22/24 Time: 21:30						
Sample (adjusted): 2009Q1 2019Q4						
Included observations: 44 after adjustments						
Standard errors in ( ) & t-statistics in [ ]						
Cointegrating Eq:	CointEq1	CointEq2	CointEq3			
FX(-1)	1	0	0			
IR(-1)	0	1	0			
LCR(-1)	0	0	1			
LGDP(-1)	-1.216471	-11.7608	-1.95391			
	-0.28928	-1.24671	-0.06424			
	[-4.20523]	[-9.43349]	[-30.4149]			
LHPI(-1)	-4.463707	18.71896	1.549868			
	-0.79927	-3.44466	-0.1775			
	[-5.58474]	[5.43420]	[8.73164]			
SSEC(-1)	-0.000514	0.001701	-5.86E-05			
	-4.70E-05	-0.0002	-1.10E-05			
	[-10.8446]	[8.32095]	[-5.56026]			
C	30.06013	45.13027	4.782529			
Error Correction:	D(FX)	D(IR)	D(LCR)	D(LGDP)	D(LHPI)	D(SSEC)

CointEq1	0.018498	0.39837	0.024409	0.017613	-0.00037	418.7572
	-0.07834	-0.31104	-0.00466	-0.01147	-0.00417	-116.366
	[0.23613]	[1.28076]	[5.24329]	[1.53619]	[-0.08805]	[3.59862]
CointEq2	-0.03724	-0.224373	-0.004509	0.019025	-0.00332	-159.84
	-0.04385	-0.17411	-0.00261	-0.00642	-0.00233	-65.1383
	[-0.84923]	[-1.28866]	[-1.73011]	[2.96433]	[-1.42392]	[-2.45386]
CointEq3	0.277124	0.642211	-0.119588	0.184445	-0.06883	7277.657
	-0.96227	-3.82068	-0.05718	-0.14083	-0.05117	-1429.38
	[0.28799]	[0.16809]	[-2.09130]	[1.30967]	[-1.34520]	[5.09149]
D(FX(-1))	-0.003802	-1.652197	-0.017242	-0.037025	-0.01521	-502.929
	-0.2429	-0.96443	-0.01443	-0.03555	-0.01292	-360.808
	[-0.01565]	[-1.71313]	[-1.19449]	[-1.04151]	[-1.17797]	[-1.39390]
D(FX(-2))	-0.456333	0.558318	-0.022898	0.026903	-0.01481	-369.867
	-0.23182	-0.92043	-0.01378	-0.03393	-0.01233	-344.346
	[-1.96850]	[0.60658]	[-1.66215]	[0.79294]	[-1.20151]	[-1.07411]
D(FX(-3))	-0.106519	-0.265772	-0.018492	0.017731	-0.0004	665.816
	-0.24528	-0.97388	-0.01458	-0.0359	-0.01304	-364.343
	[-0.43428]	[-0.27290]	[-1.26870]	[0.49394]	[-0.03068]	[1.82745]
D(IR(-1))	-0.004579	0.240003	-0.002908	0.003816	0.00184	108.0389
	-0.04947	-0.19642	-0.00294	-0.00724	-0.00263	-73.4844
	[-0.09256]	[1.22187]	[-0.98909]	[0.52705]	[0.69951]	[1.47023]
D(IR(-2))	0.023566	0.276046	-0.001526	-0.002966	0.003068	233.9866
	-0.05546	-0.22021	-0.0033	-0.00812	-0.00295	-82.3836
	[0.42491]	[1.25356]	[-0.46292]	[-0.36540]	[1.04033]	[2.84021]

D(IR(-3))	-0.033365	-0.03108	0.002153	-0.013098	-0.00262	145.3106
	-0.05988	-0.23777	-0.00356	-0.00876	-0.00318	-88.9525
	[-0.55716]	[-0.13072]	[0.60507]	[-1.49445]	[-0.82400]	[1.63357]
D(LCR(-1))	-0.01923	13.65245	-0.198785	-0.263705	0.203001	-5439.08
	-2.62507	-10.4228	-0.156	-0.38419	-0.13958	-3899.33
	[-0.00733]	[1.30986]	[-1.27429]	[-0.68639]	[1.45433]	[-1.39488]
D(LCR(-2))	-1.62955	-7.977358	-0.15862	-0.799415	0.061775	670.7868
	-2.93202	-11.6415	-0.17424	-0.42911	-0.1559	-4355.27
	[-0.55578]	[-0.68525]	[-0.91037]	[-1.86294]	[0.39623]	[0.15402]
D(LCR(-3))	0.346368	-11.25024	-0.179908	-0.363623	0.027145	-15992.5
	-2.72875	-10.8344	-0.16216	-0.39936	-0.1451	-4053.33
	[0.12693]	[-1.03838]	[-1.10946]	[-0.91050]	[0.18708]	[-3.94551]
D(LGDP(-1))	-0.060167	2.828352	-0.170438	-0.55355	-0.11767	10439.41
	-1.7156	-6.81178	-0.10195	-0.25109	-0.09122	-2548.39
	[-0.03507]	[0.41522]	[-1.67176]	[-2.20462]	[-1.28988]	[4.09648]
D(LGDP(-2))	-0.441549	-0.165599	-0.062502	-0.800594	-0.06908	8146.337
	-1.22211	-4.85235	-0.07262	-0.17886	-0.06498	-1815.34
	[-0.36130]	[-0.03413]	[-0.86063]	[-4.47607]	[-1.06299]	[4.48751]
D(LGDP(-3))	-0.145747	-3.433646	0.006225	-0.950579	-0.03907	3004.447
	-0.59408	-2.3588	-0.0353	-0.08695	-0.03159	-882.463
	[-0.24533]	[-1.45567]	[0.17632]	[-10.9329]	[-1.23679]	[3.40462]
D(LHPI(-1))	0.403182	31.76878	-0.127177	1.511914	0.928437	-9809.7
	-3.80124	-15.0927	-0.22589	-0.55633	-0.20212	-5646.42
	[0.10607]	[2.10491]	[-0.56300]	[2.71767]	[4.59341]	[-1.73733]

D(LHPI(-2))	-0.024901	-30.14341	0.528559	-1.142421	-0.04722	-8616.86
	-5.37922	-21.3581	-0.31966	-0.78727	-0.28603	-7990.38
	[-0.00463]	[-1.41134]	[1.65349]	[-1.45111]	[-0.16510]	[-1.07840]
D(LHPI(-3))	-0.93222	27.50347	0.030069	0.295342	0.057939	-28266.1
	-5.6601	-22.4733	-0.33636	-0.82838	-0.30097	-8407.6
	[-0.16470]	[1.22383]	[0.08940]	[0.35653]	[0.19251]	[-3.36197]
D(SSEC(-1))	-9.58E-06	0.000437	7.71E-06	-4.20E-06	3.18E-06	0.112499
	-9.30E-05	-0.00037	-5.50E-06	-1.40E-05	-4.90E-06	-0.13825
	[-0.10294]	[1.18173]	[1.39467]	[-0.30840]	[0.64163]	[0.81376]
D(SSEC(-2))	4.01E-06	0.000289	9.24E-06	2.57E-06	-7.49E-07	-0.01476
	-8.40E-05	-0.00033	-5.00E-06	-1.20E-05	-4.50E-06	-0.12482
	[0.04766]	[0.86743]	[1.85057]	[0.20908]	[-0.16755]	[-0.11824]
D(SSEC(-3))	8.33E-05	0.000474	2.13E-06	1.82E-05	1.57E-06	-0.03175
	-7.70E-05	-0.00031	-4.60E-06	-1.10E-05	-4.10E-06	-0.1145
	[1.08045]	[1.54719]	[0.46401]	[1.61084]	[0.38310]	[-0.27734]
C	0.077403	0.020753	0.062543	0.1366	-0.00503	768.7845
	-0.20522	-0.81483	-0.0122	-0.03004	-0.01091	-304.839
	[0.37717]	[0.02547]	[5.12839]	[4.54804]	[-0.46111]	[2.52194]
R-squared	0.418475	0.638723	0.900833	0.981243	0.814761	0.823403
Adj. R-squared	-0.136616	0.293868	0.806174	0.963339	0.637942	0.654834
Sum sq. resids	0.476149	7.506357	0.001681	0.010199	0.001346	1050605
S.E. equation	0.147116	0.584122	0.008742	0.021531	0.007823	218.5286
F-statistic	0.753885	1.85215	9.516576	54.80516	4.607877	4.884653
Log likelihood	37.14343	-23.52763	161.3567	121.6993	166.2482	-284.208

Akaike AIC	-0.688338	2.069438	-6.334396	-4.531785	-6.55674	13.91856
Schwarz SC	0.203757	2.961532	-5.442301	-3.63969	-5.66464	14.81066
Mean dependent	0.004509	0.004394	0.039464	0.025865	0.00973	27.27886
S.D. dependent	0.137992	0.695121	0.019858	0.112451	0.013001	371.9583
Determinant resid covariance (dof adj.)		3.73E-11				
Determinant resid covariance		5.83E-13				
Log likelihood		245.14				
Akaike information criterion		-4.324546				
Schwarz criterion		1.757919				
Number of coefficients		150				

Table 14 Vector Error Correction Model for China