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# Financial Crises and Financial Contagion in Japan

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***Abstract***

The article analyzes the features of the financial crises in Japan in the context of using theoretical and practical approaches to financial contagion. A brief overview is made with the identification of the causes, nature, and consequences in relation to the three significant financial crises observed in the period 1990–2009. A strong impact on the Japanese economy was exerted by the banking crisis of 1997–2001, which became one of the most noticeable events of the "lost decade." Its lessons allowed the Japanese government to overcome the global financial crisis of 2007–2009 with minimal losses, which negatively affected not so much the credit and stock markets as the real sector of the Japanese economy and its foreign trade.

From a scientific standpoint, the spread of crises is productively considered from the standpoint of the theory and methodology of financial contagion. It is a process of transmission of negative shocks that can lead to the disruption of fundamental links between countries and markets, thereby contributing to the growth of crises and instability. The article shows that Japan can act as both a transmitter and a recipient of infection. Examples of studies that examine the channels and direction of financial contagion in Japan are given. An important feature has been identified, which is that the main channel for the transmission of shocks in a given country is trade relations, and not financial ones. Taking this circumstance into account explains the effectiveness of the policy of supporting the real sector of the economy pursued by the Japanese government during the global financial crisis of 2007–2009.

In order to illustrate the methodology of financial contagion, the article conducted an empirical study of the country and cross-industry effects of infection in the Japanese economy during the COVID-19 period. A specific infection detection tool (statistical tests) and an extensive empirical base were used. As a result, the country effects were confirmed only partially – Japan was the recipient of the financial contagion that came from China, but weakly transferred it to other countries. Cross-industry infection spread more actively (it was recorded by more than half of the tests). At the same time, uneven transmission of shocks between sectors was detected; possible causes of high or low susceptibility to infection in different sectors were discussed.

***Keywords:*** Japanese economy, financial crises, financial contagion, channels of contagion, testing, industry, COVID-19.

## Introduction

Financial crises are a mandatory attribute of the global economy. The first sovereign default was recorded in England in 1340,[1] and since then developed and developing economies have experienced crises of various types and duration. Negative consequences of financial crises affect direct financial market participants (investors of bankrupt banks and securities holders lose money during defaults, etc.) and the entire economy. There are estimates that total GDP losses caused by a local financial crisis amount to 5–10 percent, while economic recovery takes 2 to 3 years [Rustamov 2012].

Each crisis is specific in that it is not a one-off event; it acts through mechanisms that intensify arising problems and disseminate those by various channels from one market or from one country to another market

[1] Carmen M. Reinhart, Kenneth S. Rogoff. *This Time Is Different: A Panoramic View of Eight Centuries of Financial Crises,* p. 20. https://www.nber.org/system/files/working_papers/w13882/w13882.pdf

or another country. In our opinion, it would be productive to study these processes from the standpoint of theory and practice of financial contagion: this concept is widespread in foreign research papers but is poorly presented in Russian scientific works. It focuses on special features of negative shock transition from the source to the recipient and makes it possible to determine causal relationships between economic indices before and after the crisis. In addition to a general theoretical interest, this concept has a great value providing researchers with precise instruments for detecting contagion, and, thus, understanding mechanisms of crisis development.

This article will identify the causes and characteristics of contemporary crises development in Japan and provide potential methodology of financial contagion for detecting national and multisector effects. As it is well known, Japan is one of the largest global economies being a leader according to many indicators. For example, according to the 2011 data, it was the third global economy by the absolute value of gross (€ 15.8T) and net (€ 12.7T) financial assets.[2] However, Japan's economy faces problems mostly associated with high public debt and population ageing, which can be regarded as a crisis harbinger. In addition, economic vulnerability can be observed in relatively "quiet" periods, which allows us to consider the use of financial contagion detection methods as a way of early financial crises diagnosis.

## Peculiar Features of Financial Crises in Japan: A Brief Historical Insight

Japan's economy, compared to other economies, can be defined as resistant to financial crises. The actual database covering 206 countries

[2] Allianz Global Wealth Report 2021, p. 50-51. https://www.allianz-trade.com/content/dam/onemarketing/aztrade/allianz-trade_com/en_gl/erd/publications/pdf/2021_10_07_Global-Wealth-Report.pdf

and counting 765 local financial crises in more than 50 years contains only one mention of Japan [Nguyen, Castro, Wood 2022]. This base has a single Japanese bank crisis recorded; its timeframe was defined as 1997–2001. The database of sovereign defaults maintained by the Bank of Canada and the Bank of England does not mention Japan at all. There have never been any exchange or sovereign debt crises in the recent history of the country.[3] Such a situation is typical of some other countries, but it is rather an exception than a rule. Most developed and developing economies have repeatedly experienced severe crises of various duration and with various consequences; many of them have faced what is called "double" and "triple" crises. For example, South Korea's economy has seen one double crisis of 1997–1998 (bank and foreign exchange) and a series of seven exchange crises since the 1950s.

Yet it would be incorrect to mention the only crisis that Japan's economy faced. Our analysis of relevant publications lets us conclude that a discussion is underway about three grave economic crises ("financial bubble" in the early 1990s and a series of Japanese banking collapses and spillovers of the 2007–2009 global financial crisis). The first crisis is a post-bubble collapse followed by a long economic slump. The very notion of the "financial bubble" in the economy, as it is known, is associated with the deviation of the asset market price from a particular level defined by fundamental factors, primarily by the expected income and interest rates. If prices break away from these factors and begin growing exclusively through speculations and market sentiments, the "bubble" inflates and, finally, bursts. Japan's "financial bubble" originated in the late 1980s at

[3] The fact that Japan is among top countries with the highest level of sovereign debt (the list of the top-20 countries with the highest pubic debt/GDP index states Japan occupied the second position with 263.14 percent after Venezuela in 2021) (https://www.statista.com/statistics/268177/countries-with-the-highest-public-debt)) does not imply a debt crisis environment. For the debt to be recognized, a documented fact is required that the state is unable to satisfy its public debt or debt interest commitments, or it has to restructure debt on less beneficial terms.

the time of economic rise, when stock prices, real estate prices, money supply, and banking loans showed explosive growth [Leontyeva 2006, p. 364]. The bubble sprawled for several years due to speculations with financial assets and plots of land with commercial banks' active involvement in the process. However, the "bubble" burst in 1991: the price growth was replaced by a fall thereof that was deeper and longer (the total amount of losses from the fall of prices for assets was estimated at JPY 1200T, which is almost three times as big as Japan's annualized GDP). The fall of prices for assets resulted in lower demand, reduction of wholesale and, later, consumer prices, as well as the "deflationary spiral" (a combination of price reduction with production fall). That period was referred to in literature as the "lost decade" or Japan's "Great Depression".

The period has been described in economic research in every detail. The slump of economic activity could theoretically be explained by Japan's adherence to a normal cyclic model, albeit somewhat longer than usual. The real data were compliant with this approach: the slump of the early 1990s was followed by incipient signs of economic growth throughout the major part of 1996 and early 1997. However, no recovery happened and Japan fell into a deep recession – the first case since the 1950s of a large industrial country that consistently pursued an anti-cyclic policy [Bayoumi 2001]. Thus, more profound analysis was required to explain the reasons for the "lost decade," as some competing hypotheses rose to view.

One of them is that the crisis was caused by inadequate political measures, especially those related to expansionary budget spending [Posen 1998]. Although Japan's government adopted some programmes aimed at recovery in various spheres, they had a minimal effect on the economy. An alternative viewpoint, which focuses on monetary policies, states that Japan found itself in the liquidity trap [Krugman 1998]. Japan has a low rate of consumption and, conversely, a high rate of saving. This accounted for large-scale investments in the pre-crisis years. Yet slowdown in economic growth and deflationary processes created a great imbalance between savings and investments,

making the clearing real interest negative. Households and enterprises prefer holding cash in such situations, as this increases real profits equal to deflation level. Given the expectations for further price fall, the Japanese authorities were unable to reduce interest rates, thus rendering investment incentives impossible.

There is also an opinion that the crisis was associated with financial mediation. Japan's banks play a greater role in this process than banks of "Anglo-Saxon" countries such as the USA and Great Britain. When the "financial bubble" was inflating, they lent large amounts to companies using land as a collateral. However, the deflated "bubble" sent prices for land down, and many of these loans stopped functioning. Such shocks of financial mediation had a negative effect on bank capital and resulted in a steady decrease of investments throughout the 1990s, which was confirmed by empirical research [Hirakata et al 2016].

Finally, the influence of non-financial factors on deep recession in Japan's economy cannot be underestimated. Two reasons are normally identified in this context: slowdown of total factor productivity growth (TFP) and shortening of weekly work hours from 44 to 40 in 1988–1993 [Hayashi, Prescott 2002]. Proponents of this approach believe that the problem is not so much in the national financial system's collapse and the failure to use good investment opportunities because of no access to capital markets as in slow growth of labor productivity.

Evidently, any explanations of the "lost decade" are not mutually exclusive. Each explanation indicates a different set of factors (fiscal, monetary, labor, etc.) that have a crucial importance for understanding the scale and character of recession. Given the context of the issues discussed in this article, the "banking factor" plays a significant role as the most severe banking crisis in the entire history of Japan broke out in those years. In fact, there had been no significant bank failures in the postwar period and until the late 1990s. It has been due to the existent "convoy system" – tough regulation by the Central Bank of the entire financial sphere in order to maintain the health of any, even weak, lending institutions. Banks were then considered as formal financial mediators required solely for rechanneling funds from households to the industrial

sector, playing a key role in economic recovery after World War II. In other words, Japanese banks of the second half of the 20th century acted as providers of state financial services rather than competitive financial institutes. They had no incentives to compete for investors, develop new products, etc. Everyone knew that the banking system was stable and reliable and the government would not let it weaken. As a whole, this approach was justified: the banking system worked faultlessly and promoted sustained economic growth that turned Japan into a large economic power.

However, in the 1970s, Japan launched financial deregulation processes, which indirectly provided for higher risks in the financial system. Occasional failures were observed after 1991, when the "financial bubble" burst. Bank risks continued to build up in the subsequent years giving rise to such a specific problem as "zombie-lending". This meant that many troubled banks began lending to insolvent borrowers to avoid losses on their own books; they hoped these companies would somehow recover or be aided by the government (these borrowers received the name "zombie"). But in reality, "zombie-lending" practice resulted in an irrational use of banking loans. Ineffective industries specifically, such as real estate or construction, received more banking loans than other sectors which showed better results (for example, processing industries) [Caballero at all 2008].

It became evident that non-working loans threatened the banking system's health. While official data estimated the rate of overdue (NPL – nonperforming) loans in 1995 at JPY 40T (USD 469B) or 10 percent of GDP, by the end of 1998, the NPL indicator was equal to JPY 88T (USD 725B) or 18 percent of GDP. Unofficial estimates indicated even the amount of USD 1T, which is equivalent to 25 percent of GDP.[4] A number of bankruptcies among banks and large companies, reorganizations, and mergers affected stability of the entire Japanese economy and required extra measures of government and monetary support. In all, seven

[4] Systemic Banking Crises: A New Database, p.40. https://www.imf.org/external/pubs/ft/wp/2008/wp08224.pdf

banks were nationalized, 61 financial institutions were closed, and 28 institutions were merged. For example, a 1998 merger of three banks, which were part of competing financial and industrial groups, created Mizuho, the largest financial association in the world with the capital of JPY 140T. In 2001, the merger of Sakura Ginko and Sumitomo Ginko gave birth to a new giant – Mitsui-Sumitomo Ginko. Finally, in 2005, the merger of two banks resulted in the world's largest bank with total assets of about USD 2T [Lebedeva 2007, p. 115–116].

We have marked some characteristics of this banking crisis in Table 1, compared with similar crises in other Asian countries roughly at the same time. The table shows that Japan showed lower losses and less expense on combatting the crisis than other countries, although the anti-crisis policy was, as a whole, very intensive. The government reformed financial market regulation, taking some liberal measures (removing barriers to access to financial markets, permitting over-the-counter securities trading, etc.), as well as introducing tough rules for solving the problem of non-performing loans. Some USD 500B were allocated for those purposes, allowing for drastic changes in the banking sector structure and the previous model of performance.

*Table 1*

Characteristics of Financial Crises and Anti-Crisis Policies in Japan and Other Asian Countries

| Characteristics | Country | | | | |
|---|---|---|---|---|---|
| | Japan | South Korea | Indonesia | Malaysia | Thailand |
| Period | 1997-2001 | 1997-1998 | 1997-2001 | 1997-1999 | 1997-2000 |
| Economic indicators of the crisis | | | | | |
| Overall production losses, percent of GDP | 17.6 | 50.1 | 67.9 | 50.0 | 97.7 |
| NPL share at the crisis peak, percent of the total volume of loans | 35.0 | 35.0 | 32.5 | 30.0 | 33.0 |

| | | | | | |
|---|---|---|---|---|---|
| Drop in the real GDP at the crisis peak, percent | 2.0 | 6.9 | 13.1 | 7.4 | 10.5 |
| Banking sector liquidity at the crisis peak*, percent | 2.4 | 27.4 | 23.1 | 9.7 | 5.1 |
| Debt-to-GDP ratio gain, percent | 41.7 | 9.9 | 67.6 | 0.2 | 42.1 |
| Characteristics of anti-crisis policies | | | | | |
| Budget expenditure**, percent of GDP | 14.0 | 31.2 | 56.8 | 16.4 | 43.8 |
| Government guarantees for banking liabilities, months | 89 | 37 | 78 | 91 | 89 |
| Recapitalization of banks, percent of GDP | 6.6 | 19.3 | 37.3 | 16.4 | 18.8 |
| Nationalization of banks | Yes | Yes | Yes | Yes | Yes |
| Purchase of bank assets | Yes | Yes | Yes | Yes | Yes |
| Freezing of deposits | No | No | No | No | No |

*Source:* Systemic Banking Crises: A New Database. https://www.imf.org/external/pubs/ft/wp/2008/wp08224.pdf (date of access: 15.12.2022).

*Notes:*

* liquidity in this case is measured as the ratio of Central Bank requirements for banks with depositors' money to the total amount of deposits and liabilities for non-residents;

** accounted for budget expenditure directly involved in financial sector restructuring.

The problem with "bad debts" had been, as a whole, solved by 2003 and economic growth continued until 2007, yet the global crisis of 2007–2009 (not just Japanese, but the global "Great Recession") put an end to it. Formally, if we follow identification principles for local banking, debt, or currency crises, none of those were recorded in Japan while it was done in respect of many other countries from different regions. Reference here is made to spillovers of the global crisis that resulted in considerable

deterioration of the economic environment. The situation was peculiar in that, unlike in many other developed economies, this crisis made a direct and much stronger influence on Japan's real sector and its trade than on the financial and lending spheres. Financial institutes were, of course, affected by the crisis; yet the losses they suffered on low quality assets were not high. Total losses of lending institutions from low quality mortgage securities made only 2.1 percent of the total first tier capital for the period from April 2007 to March 2009.

Although financial environment worsened from September 2008,[5] it was global trade that bore the brunt of the crisis. *Figure 1* shows a quarterly motion of Japan's export and import growth rates compared with the GDP growth rate for a long period. The figure proves that the depth of the slump in global trade turnover exceeds the general GDP decline by multiple times.

The global trade reduction was caused by the lower demand in developed economies, especially the USA and Great Britain, that suffered greatly from the financial crisis. Export had always been a major sector for Japan and such a shock, therefore, affected the real economy badly. Production fell by roughly one third from September 2008 until February 2009, which resulted in a high unemployment rise by the middle of 2009.

It should be noted that problems with trade relations proved a major reason for the crisis in Japan's economy on the micro level, too. The analysis of changes in Japanese companies' operational performance for one and two-year periods after the crisis showed that the 2007–2009 financial crisis transmitted to Japanese companies mainly through trade channels. The liquidity channel played a less significant part in the price drop and return on investment reduction. The shock on financial markets subsided faster than in trade, which is attributed to non-traditional monetary policies pursued by the Bank of Japan as well as government measures to provide extra corporate financing [Hosono, Takizawa, Tsuru 2016].

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5 For example, the diffusion index characterizing the attitude for lending to companies of different size fell sharply and approached the level of the late 1990s [Shimizu 2019].

## Financial Contagion and Its Effects in Japan

Financial crises and recessions in Japan's economy signify its perceptibility to effects made by financial contagion – shock transfers from one country to another or between economic sectors. The term *contagion* is taken from medicine and used in economics to underline the important role of transmission mechanisms in the periods of instability and crises. The process of contagion in economic systems can be presented as follows: a negative shock initially engaging one market or region spreads through a particular channel to other markets and regions. These, in turn, transmit contagion further, sending it by the same or other channels to other recipients. The result is a "chain reaction" ("domino effect") causing structural gaps and a decrease in stability of the entire economic system.

From the theoretical viewpoint, it is important to identify channels of contagion transmission and all participants of this process. Given the differences countries have in the degree of liability to trade and financial shocks, researchers most frequently compare trade and financial channels. Yet the results are ambiguous, since priority is given to different channels in various papers. For example, the analysis of the data for 20 industrial economies (including Japan's economy) in 1959–1993 led to a conclusion about the key role of trade channels in transmission of contagion [Eichengreen et al 1995]. On the other hand, financial channels were more often considered for Asian crises of the 1990s. There is evidence that financial ties manifested through the stop of lending by large Japanese banks to investors from different countries played an important role in the dissemination of those crises [Kaminsky, Reinhart 2000].

Many banks bearing losses due to toxic assets during bank crises reduce lending. If banks work on a global level, asset quality deterioration and drop in value thereof will transmit contagion across borders. However, Japan's experience during the 2007–2009 financial crisis testifies that direct influence of this channel was limited. Since foreign banking loans to Japanese companies were small (their share made only 2 percent),

they did not suffer from the lending crisis seriously. Moreover, after Lehman Brothers' default, Japanese banks themselves increased lending in response to the growing demand aroused by contracted liquidity on the market of securities and corporate bonds. Japan can be regarded in this respect as a contagion transmitter rather than a recipient.

If, conversely, Japan is regarded as a recipient of contagion, then trade ties played a major role during the global financial and, later, pandemic crises. They can be manifested in various ways. Thus, as the country that suffered from the crisis is plunging into recession, the demand for import in that country goes down due to income effect. If the currency of the suffering country devalues, the demand for import goes down both in the given country and on the third markets due to the price effect. Finally, devaluation in the country that first suffered from the crisis may exert pressure on other countries to devalue their currencies as well. This mechanism failed to work in Japan because its national currency strengthened during the global crisis. But the mechanism of trade barriers impeding export-import operations proved to be quite effective. In particular, it was noted that the strengthening of trade barriers in 2008–2009 resulted in trade shrinkage in some countries including Japan.[6] Moreover, consequences of these changes largely compensated for each other on the global level.

Financial contagion is experienced by various sectors and spheres of the economy. Thus, a study was made of contagion transmitted on the market of securities based on the volatility analysis for stock exchange indices and risk-related bonuses.[7] Shocks of volatility during the world financial crisis resulted in mutual contagion on the markets of the USA, Europe, and Japan. Contagion was especially significant after the collapse of Lehman Brothers – Japanese markets grew more susceptible

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[6] Trade and the Global Recession. https://www.nber.org/system/files/working_papers/w16666/w16666.pdf

[7] Yoshihiko Sugihara. Global Contagion of Volatilities and Volatility Risk Premiums. https://www.bis.org/repofficepubl/arpresearch201003.03.pdf

to volatility risks transmitted to various sectors of the economy. It was confirmed in another paper [Naifar 2011], where Credit Default Swap (CDS) indices were chosen to measure susceptibility to contagion. The economic model revealed that CDS indices during the crisis act as a higher risk indicator and become very susceptible to financial market conditions and macroeconomic changes.

When detecting contagion, it is be important to be able to separate intensification of mutual dependence that is virtually always observed during local and, even more so, global crises from a fundamental change in the ties, which testifies to contagion. Moreover, since developed economies are very much integrated on a global scale, many macroeconomic and financial indicators of different countries strongly correlate with each other in a continuous mode. This particularly relates to return on equity and other financial assets listed in the US and Asian markets. Japan's index Nikkei 225, for example, showed a close link to US S&P 500 before the 2007–2009 global financial crisis and during this crisis as well. Complex models, therefore, are not always able to discover significant correlation movements. Thus, secondary volatility effects on Japan's market proved similar in the crisis and non-crisis periods, which clearly indicates contagion absence [Morales, Andreosso-O'Callaghan 2012].

It should be noted that not only Japan's financial markets alone show susceptibility to contagion. For example, real estate markets may become its "target," but response of these markets to contagion is not as rapid as that of the banking sector, stocks, and derivatives. Some papers did not find any contagion effects at all in the period of serious shocks. For example, [Hatemi, Roca 2011] did not identify any signs of shock transmission to Japan's real estate market during the US mortgage crisis spreading throughout the world. Yet such signs were found during the earlier 1997–1998 Asian crises. Japan then was one of the main contagion recipients with the bulk of increased real estate price volatility caused by shocks that came from Hong Kong [Bond, Dungey, Fry 2006].

There is also evidence of contagion in other sectors of Japan's economy. During the global financial crisis, intra-industry contagion

was recorded in primary production, manufacturing industry, consumer goods, and informational technologies [Baur 2012]. In this connection, it would be of interest to compare its dimensions with other countries. Table 2 shows empirical estimates of four types of contagion in different countries. The non-financial segment is presented in the last two columns with indication of particular sectors – contagion recipients. The table proves that all countries underwent contagion to a different degree. Japan looks resilient (shock- or stress-resistant) to global contagion of financial and non-financial sectors, compared to the global situation. As to the real sectors of the economy, where contagion developed through internal channels, Japan proved to be more vulnerable than, for example, the USA, Germany, and Australia.

*Table 2*

Contagion of Financial and Non-Financial Markets in Japan and Other Countries During the 2007–2009 Global Financial Crisis

| Country | Type and channel of contagion | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| Japan | Yes | No | No | Yes (B, C, D, I) |
| Australia | Yes | Yes | Yes (A, B, C, H) | Yes (I) |
| Brazil | No | Yes | No | Yes (A, B, C, F) |
| Germany | No | Yes | Yes (C, D, H) | No |
| India | Yes | Yes | No | Yes (A, B, C, H) |
| Canada | Yes | Yes | Yes (B) | Yes (G) |
| China | Yes | Yes | No | Yes (A, B, C, D, F,G, H) |
| Norway | Yes | Yes | Yes (B, F, H) | Yes (D, E, F) |
| Russia | Yes | Yes | Yes (D) | Yes (A, B, C, E, F, H) |
| USA | No | Yes | Yes (A, B, C, D, E, G, H, I) | No |
| SAR | Yes | No | Yes (A, B, C, G, H) | Yes (A) |

*Compiled according to:* [Baur 2012].

Symbols: I – overall contagion of the stock market (global equity portfolio → national equity), II – contagion of the financial sector (global

financial sector equity portfolio → national financial sector equity), III – global contagion of real economy (global financial sector equity portfolio → national non-financial sector equity), IV – internal contagion of real economy (national financial sector equity portfolio → national non-financial sector equity).

A – oil and gas, B – primary production, C – manufacturing industry, D – consumer goods, E – healthcare, F – services, G – communications, H – energy, I – informational technologies.

It should be noted that once detected contagion requires the government's immediate interference aimed at preventing its further spread and emergence of "chain reactions" when the recipient becomes a shock transmitter and new transmission channels are added. Very important here is to highlight the unique situation of Japan – while most countries saved their financial markets during the crisis, the Japanese government concentrated its efforts on industrial production support. In fact, the first government support package alone amounted to JPY 14B in 2009; it was directed at funding industry, innovations, infrastructure, etc. Yet no support was rendered to the financial sector. The Deposit Insurance Corporation of Japan (DICJ) did not allocate a single yen for these purposes, although DICJ support amounted to JPY 6B in various forms during the 1997–1999 financial crisis [Miyakoshi et al 2014].

This policy is quite explainable from the viewpoint of the theory and practice of financial contagion. In fact, government support measures for production are justified if the source of contagion on the internal market is not the financial sphere, but the real sector. This very situation was observed in Japan's economy in those years. Major risks transmitted from other countries by a trade channel because the largest companies (Toyota, Honda, and Nissan) faced difficulties with production and export. It was found that the negative exogenous effect of foreign companies on Japan's economy was clearly manifested in risk premiums for five-year bonds [Miyakoshi et al 2014]. In addition, the negative exogenous effect existed in the direction of "real sector → financial sector" but not vice versa. Simply put, contagion in Japan

transmitted from foreign industries to local production and then – to national financial markets. That explains a large financial support provided to the real sector as a starting point for the risk flush to Japan.

It is not obligatory that some negative economic event should give an impetus to contagion processes in various markets. The shock may have a non-economic nature but then spread by financial, trade, and other channels to different parts of the economic system. It was fully proved in the period of the crisis caused by COVID-19. The geographical factor becomes very significant in the pandemic environment. The territorial proximity or remoteness of some country from China may affect the character and mechanisms of contagion not only in the medical but also in the economic context as well. Therefore, Japan's and China's neighborhood can be interpreted in two ways. On the one hand, there is evidence that the spatial financial contagion effect most severely affected China and geographically remote countries [Zorgati, Garfatta 2021]. Japan is not among them; therefore, it should be less vulnerable to the pandemic shock. In addition, many Asian countries including Japan were quick to respond to the COVID-19 outbreak introducing restrictive measures, which reduced the intensity of medical and economic contagion. Econometric models assessing dimensions, direction, and intensity of contagion transmission showed that the Asian region least of all suffered from financial contagion (USA proved to be the most vulnerable country, followed by Brazil, Mexico, and Argentina) [Benkraiem et al 2022].

On the other hand, some studies testify to growth, under the influence of COVID-19, of correlations between macroeconomic indicators within Japan as well as intensification of their co-movement with the indicators of other countries, which is interpreted as a sign of financial contagion. For example, the application of high frequency data confirmed the hypothesis of jump contagion of the stock market in Japan and some other Asian markets (Hong Kong, South Korea, Singapore, and others) [Zhang et al 2022]. The authors found a high intensity of those jumps, non-linear character of their movements, as well as their great contribution to the increase of financial indicators volatility.

Japan in the period of the pandemic crisis was considered not only as a contagion recipient but also as a source thereof. The focus was particularly made on the spread of contagion along the line "Japan → Asian region" and "Japan → Africa and Middle East." As to the first line, not a single fact of contagion was found (calculation was made of pair dynamic correlations with India, China, Taiwan, and Thailand), the second line (calculations were made paired with Egypt, SAR, Saudi Arabia, and the UAE) provided a single fact (Japan transmitted the effect of contagion only to the UAE) [Siddiqui et al 2022]. On the whole, it proves the minimal role of Japan as a contagion transmitter for developing markets. Yet the situation was different in respect of developed economies. Japan and China appeared as "net transmitters of spillovers" as they transmitted more spillovers than they received to those countries [Akhtaruzzaman, Boubaker, Sensoy 2021]. Mathematical models did not only confirm the presence of financial contagion between China and Japan, on the one hand, and developed economies, on the other; they showed that the degree of contagion was much higher for financial companies in comparison with non-financial ones.

## Financial Contagion in Japan in the National and Inter-Industry Aspects: Assessment

The practical part of our paper contains results of our own study conducted to obtain assessment of damage and tendencies of contagion in Japan's economy during the pandemic. Using quantitative analysis methods, we test two hypotheses reflecting the national and inter-industry aspect of the problem:

1. Japan was a source and recipient of contagion, i.e., the country received shocks from China and transmitted them to other countries.
2. Japan had inter-sectoral effects of contagion, i.e., shocks of the pandemic within its national economy spread among industries.

A vast statistical database was used to confirm or disprove these hypotheses. It was presumed that contagion spread by securities market

channels, and, therefore, information on stock exchange indices was collected on a daily basis. Movements in Japan's most important index (Nikkei 225) and similar indices from other countries were considered to test the first hypothesis. We decided to ensure a certain "consistency" of the article's empirical part with the previous one. Therefore, the sample contained stock indices of the countries discussed in Table 2 (Australia – S&P/ASX 200, Brazil – Bovespa, Germany – DAX, India – BSE Sensex, Canada – S&P/TSX, China – Shanghai, Norway – OSE Benchmark, Russia – RTSI, USA – Dow Jones, and SAR – South Africa Top 40).

Nikkei industry indices were applied to test the second hypothesis. We selected two sectors (N500 Banking and N500 Real Estate) that were unstable during previous crises (especially in the 1990s crisis) as well as a number of other industries of Japan's economy, which were particularly hit by the pandemic. They include N500 Automobiles & Auto parts, N500 Marine Transport, N500 Air Transport, and N500 Retail. In addition, the sample included traditionally important sectors for Japan such as N500 Electric Machinery, N500 Fishery, and N500 Shipbuilding.

As known, macroeconomic indicators fluctuate stronger in the periods of crises and instability. Volatility is often used to assess these fluctuations. As to Japan, *Figure 2* compares volatilities of some stock indices computed by us: a. – China's and Japan's indices (country section), b. – Japanese banking, air transport, and fishery indices (industry section). The widely known statistical "sliding" method was used, i.e., volatility (ratio of the index standard deviation and its mean value) was first defined by the data for the ten first values, with the sample then shifting by one date forward and the procedure repeating.

The figure shows that there was a surge of volatility of stock indices in Japan at the start of the pandemic with response to the shock from China coming with approximately a two-month lag. This allows suspecting contagion along the "China → Japan" line, which then spread to Japan's economic sectors.

It is necessary to use an instrumental analysis to provide a solid confirmation of such contagion (or, conversely, to disprove it). Financial

contagion is detected using a variety of methods with a different degree of complexity – from assessments based on standard descriptive statistics to quantile regressions and copula functions. We will apply methods of advanced correlation analysis. To do it, we will break our sample down into two periods – pre-crisis and crisis (the date of the pandemic official announcement, i.e., March 11, 2020, will serve as a divider). The presence of contagion will be defined with the help of two special tests:

The Forbes-Rigobon test (*FR*-test) is the most widespread approach to financial contagion estimates based on comparison of correlations between economic indicators (in our case – between stock indices) in the pre-crisis and crisis periods.[8] Calculations in this case are made with an adjustment for heteroscedasticity. The point is that volatility always goes up in the crisis period (we showed it for Japan in Fig. 2); using standard correlation ratios may result in biased ratings. This test applies adjusted ratios in order to avoid bias.

The co-volatility test (*CV*-test) is a less frequently used approach based on measurement of dependence between an extreme event in one market and a similar event in another. The purpose of the test is to define whether joint volatility increases in the crisis period as compared with the pre-crisis one.

We will not provide a formal (mathematical) description of the tests and mention only that in case of financial contagion the test statistics must indicate significant strengthening of interrelations in the pandemic period as compared with the "quiet" one. Reference in our case is made to interrelations between Japan and other countries or between sectors of Japan's economy. If it does not happen, we may speak only about

[8] It was first applied in [Forbes, Rigobon 2002] – one of the most cited articles in the world on contagion. It would be interesting to note in the context of our article that this test helped the researchers assess country effects of contagion during three crises (stock market collapse in USA markets in 1987, Latin American crisis in 1994, and Asian crisis in 1997); they did not find any transmission of contagion into Japan.

co-movement of indicators, which cannot be considered as financial contagion.

Tables 3 and 4 show test results of country and industry effects of contagion in Japan that spread by stock market channels in the COVID-19 pandemic period. We deliberately did not show digital values of test results but limited ourselves to just recording the presence or absence of contagion. The country section is presented in one direction, i.e., by the "China → Japan" and "Japan → other countries", while the industry one – in both directions, i.e., each sector is simultaneously regarded as a potential source and a potential recipient of contagion. Each cell of Table 4 has two signs: the first corresponds to the *FR*-test, and the second – to the *CV*-test. Arrows and ovals show bi-directionality (bilateral direction) of potential contagion as an example for the "I – IV" parcel. The signs in the cells signify that both tests proved contagion from the banking sector (I) to that of marine transport (IV), and only one test (co-volatility) confirmed contagion in the reverse direction.

*Table 3*

Test Results for Presence (+) or Absence (–) of Country Contagio

| Country – Contagion Recipient | Country – Contagion Source | |
|---|---|---|
| | FR-test | CV-test |
| | China | |
| Japan | + | + |
| | Japan | |
| Australia | – | – |
| Brazil | – | – |
| Germany | – | – |
| India | – | + |
| Canada | + | – |
| Norway | – | – |
| Russia | – | + |
| USA | + | + |
| SAR | – | – |

*Table 4*
Test Results for Presence (+) or Absence (–)
of Inter-Industry Contagion

| Industry – Contagion Source and Recipient | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| I | – + | + + | – + | + + | + – | + + | + + | + + |
| + + | II | – + | – + | – + | + + | + – | + + | + – |
| + + | + + | III | + + | – + | – + | + – | – + | + + |
| + + | + – | + – | IV | – + | + + | – + | + + | – + |
| – + | + – | – – | – – | V | + + | + – | – + | – – |
| + + | + + | + + | + – | + + | VI | + + | + + | + – |
| – + | + – | – – | + + | – + | + + | VII | + + | + – |
| + + | – – | + – | – + | – – | + – | – – | VIII | – – |
| + + | – + | – – | – – | + – | + – | – + | – – | IX |

Symbols: I – Banking, II – Real Estate, III – Automobiles & Auto Parts, IV – Marine Transport, V – Air Transport, VI – Retail, VII – Electric Machinery, VIII – Fishery, IX – Ship Building.

Reviewing the results presented in Table 3 suggests a partial confirmation of the first hypothesis about country contagion. Japan appeared to be a recipient of financial contagion spreading from China, but it transmitted it very weakly to other countries in our sample (there was only one case recorded when both test statistical summaries provided a positive result). China is Japan's main trade partner accounting for nearly a quarter of Japan's exports and imports. The main shock caused by the sharp drop in deliveries (especially in import) in 2020 was determined by close trade ties between the two countries [Dyomina, Mazitova 2021]. This shock proved vulnerability of Japan's economy in the short run; but packages of anti-crisis measures and support of local manufacturers managed to reverse this negative trend. The small number of positive tests for contagion along the line "Japan → other countries" may be accounted for by the geographical remoteness of those countries

and insignificant economic connections (none of them are ASEAN members, in particular).

As to inter-industry contagion (Table 4), the hypothesis related to this contagion was confirmed in most cases (88 tests out of 144 recorded facts of contagion, which makes up 66.1 percent), although the results are quite ambiguous. This allows us to conclude that the influence of one industry on another changed considerably during the pandemic; but the change is not ubiquitous but rather selective. For example, the banking sphere proved less resistant to contagion than fishery and shipbuilding. However, financial intermediaries turned out to be contagion transmitters into these and other industries. The higher susceptibility to contagion of the banking sector was indirectly confirmed by the discussion of the recently renewed discussion of the old "zombie lending" problem in a new light – provision during the COVID-19 period of government support in the form of subsidies and preferential loans to companies with low credit ratings whose performance efficiency had been low before the pandemic [Hoshi, Kawaguchi, Ueda 2022]. It possibly made a negative effect on relationship between banks and the real sector resulting in financial contagion.

Quite unexpected was the result that showed weak susceptibility of the transport sector. It seems that transport shipments, being an integral part of the tourist sector of the economy, should have shown a high degree of contagion. Tourism in the entire world, including Japan,[9] suffered the most from the pandemic. However, the tourist segment in Japan was vigorously supported by the government. Very effective was the "Go-To Travel" program aimed at stimulating demand for internal tourism and suggesting various

[9] Tourist flow to Japan dropped by 85.1 percent in 2020. It was even 99.9 percent according to the second quarter results, i.e., tourism came to a halt. UNWTO World Tourism Barometer, p. 17. https://www.e-unwto.org/doi/epdf/10.18111/wtobarometereng.2020.18.1.7?role=tab

support measures, transport fare discounts included.[10] In addition, support was provided in the form of subsidies to employers who sent their employees on an enforced leave as well as in the form of non-interest and uncollateralized loans. The effectiveness thereof was confirmed by a number of studies (See, for example, [Matsuura, Saito 2022]) and real figures – tourist activity rose to 20–30 million people in the course of the program, and the total decrease of the tourist flow, although not overcome, was only 25–30 percent. We believe it was quick and comprehensive assistance to tourism on the part of the government that prevented contagion in the sector of passenger shipments.

Conspicuous is the large number of recorded cases of contagion in the retail segment, which appeared to be simultaneously a recipient and a transmitter of contagion. This can be explained by the unstable structure of the Japanese' consumer behavior. According to the opinion expressed in [Timonina 2022], the "lost decade" resulted in consumer behavior changes that became evident in the period of the financial crisis and intensified during the pandemic. Growth rate fluctuations in the Japanese' monetary incomes, increased anxiety and worry, emergence of new consumers (the Y and Z generations), and other factors made retail modify their strategies and organizational forms of business. Evidently, not all companies managed to do it, as many proved to be unprofitable, and some went bankrupt. COVID-19 was an extra stress to trade – some market participants were able to adapt to it,[11] but many failed to withstand the pandemic shock. As of September 16, 2020, particularly, i.e., six months after the start of the pandemic, 44 bankruptcy cases were detected in clothes retail trade. This segment found itself in the third place in the rating of spheres that were most hit by the pandemic

[10] The campaign was carried out from July 22, 2020, until December 28, 2020, with the total budget of JPY 1.35B (USD 12.8B).

[11] For example, the largest Asian retailer AEON invigorated its activity in online sales and food delivery.

(the first two places were occupied by catering and hotels) [Kanno 2021]. Trade as a whole, therefore, proved to be more susceptible to the pandemic shock and contagion that followed.

Thus, methods of financial contagion detection in Japan showed that the country was vulnerable to the pandemic shock. Yet, having caught infection, Japan's economy manifested irregularity of shock transmission by internal channels – some sectors became active recipients and transmitters of contagion, while others showed moderate or high resistance to the crisis.

## Conclusion

Below are our major conclusions. Japan has gone through three financial crises in its modern history. One of them (the only one indicated in current databases for banking, currency, and lending crises) broke out in the late 1990s. It served as one of the illustrations for the "lost decade" of Japan's economy and manifested itself by a series of bank bankruptcies and reorganizations caused by ubiquitous practice of lending to insolvent companies (the "zombie lending" problem). Japan showed better resistance compared to other Asian crises of those years due to consistent and effective measures taken by government and monetary authorities.

The 2007–2009 global financial crisis had a negative effect on Japan, although formally – if we use the criteria of local crisis identification – there was no crisis in that country at that time, only spillovers. The global shock made a key impact on Japan's trade with other countries – the depth of the recession both in imports and exports considerably exceeded the overall GDP drop (for example, the peak value of the export decline was 50 percent, while the GDP decrease was 5 percent max).

Japan, like many other countries, is affected by financial contagion – a process of shock transmission from one country to another, when fundamental ties are destroyed, and economy loses its stability. Reviewing publications on this issue allows concluding that Japan is susceptible to contagion transmitted through various channels. Japan's situation

is specific in that the key channel of contagion is trade ties rather than financial ones. This circumstance enables the government to build its anti-crisis policy in the best way. Our paper describes a very interesting situation that was observed in the period of the financial crisis when many countries provided assistance predominantly to financial markets, while Japan supported its real sector. This policy is in full conformity with the theory and practice of combatting financial contagion. Shocks during crisis periods were transmitted first to Japan's industry from foreign companies through trade ties and only then to financial markets. This circumstance served as the basis for the government to begin supporting the real sector as a source of inter-industry contagion.

The article deals with an important aspect associated with the contagion spread during the pandemic crisis. Many studies devoted to COVID-19 regarded Japan as a source and a recipient of contagion. We have also decided to dedicate the empirical part of this article to testing the role of Japan in that contagion. We formulated hypotheses about the presence of country and inter-industry contagion effects. A large bulk of data on the securities market was used to confirm them – we collected information on movements of Nikkei225 and other countries' indices as well as a number of Japanese industry indices. Methods of non-classical correlation analysis (statistics calculated by two contagion tests) served as instruments for detecting contagion. The results showed that Japan had been a recipient of financial contagion coming from China, but it weakly transmitted it to other countries. Intra-industry contagion within Japan's economy occurred more vigorously because positive tests were confirmed in 66.1 percent of cases. We also found irregularities in shock transmission between sectors caused by various reasons. Thus, low susceptibility to contagion of the passenger shipment sector can be accounted for by the timely and overwhelming support provided by Japan's government to the tourist sector (particularly, the "Go-To Travel" program being efficiently implemented). Conversely, the high degree of contagion in the retail trade segment may be linked to structural shifts in behaviors of consumers and business that experienced a negative shock during the pandemic and failed to get adapted promptly.

The overall conclusion of the study is as follows: Japan has recently been resistant to financial crises yet susceptible to financial contagion. The major channel of vulnerability to external shocks is global trade rather than finances; however, government policies prevent contagion from spreading ubiquitously and localize it in separate markets.

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