



The Twin Crises in the Iranian Economy and Its Determination during 1980–2018

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Abstract

The coincidence of banking and currency crises since the 1990s has attracted the attention of many economists to the causal relationship between them. The current paper aims to determine the potential indicators of banking and currency crises and their causality in the Iranian economy during 1980–2018. For this purpose, we first study the different developments in the Iranian economy over the last four decades. Then, two types of variables, including multi-categorical and dummy variables, are extracted from the exchange market pressure index (EMPI) and money market pressure index (MMPI). The empirical results found that the two crises could occur closely together in the same periods. According to the ordered logit and logit model, the results showed that the impact of the currency crises on banking crises was positive and statistically significant. Still, banking crises did not lead to currency crises when banking crises were peroxide as the dependent variable. In addition, the Granger causality test showed some one-way causality from EMPI to MMPI.

Keywords: Banking Crises, Currency Crises, Logit Model, Iranian Economy.

JEL Classification: G01, G20, E50, C01.

Introduction

The banking and currency crises of the 1990s, especially the 1997 Asian crisis, led to a significant discussion on the relationship between the two crises. Twin crises appear to be a recurring and persistent phenomenon that is still part of the current economic events (Hutchison and Noy, 2005). Since the two components of foreign assets and liabilities are part of commercial banks' balance sheets, this can be a good scientific reason for linking the two crises (Glick and Hutchison, 2001). The anatomy of the twin crises suggests that common principles drive banking and currency crises. Countries that have faced banking crises in the past are more prone to experience another crisis (Falcetti and Tudela, 2008). The exchange rate risk is located in the banking system, and a banking crisis may coincide with the currency crisis.

In a study of the relationship between banking crisis and currency crisis, Kaminsky and Reinhart (1999) have highlighted close links between banking and currency crises; usually, a banking crisis occurs before a currency crisis. They found that the currency devaluation further undermined an ailing banking sector. When the two crises arise together, they are far more severe than when they occur separately. Hence, Kaminsky and Reinhart (1999) define the twin crises as episodes of a currency crisis following the banking crisis. Another definition of twin crises is provided by Glick and Hutchison (2001). They define the twin crises as instances in which a bank crisis is accompanied by a currency crisis in the previous, current, or following year.

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On the other hand, the currency may be supported through central bank reserves, leading to a sudden drop in resources with the currency crisis. Authorities may repel attacks by raising interest rates (Eichengreen and Rose, 1999). So, twin crises are far more costly than personal crises associated with a more significant economic recession (Von Hagen and Ho, 2003). Bordo et al. (2001) have considered that twin crises are twice as disruptive as currency crises, which are, in turn, twice as disruptive as banking crises. Given that the economic systems in developing countries are structured differently from those of developed countries, the variables affecting the crisis may be different because of the heterogeneity across countries. In addition, even if the origins of the crisis are homogeneous in some countries, the degree to which they affect the likelihood of a crisis occurring may differ from one country to another (Mariano et al., 2004).

In connection with the banking crisis, Laeven and Valencia (2008; 2013; and 2018) met two requirements for diagnosing a banking crisis: the first requirement is 'financial distress in the banking system'. This situation may be accompanied by the high share of unconventional loans, bank closures, and the rising fiscal restructuring costs of the banking sector. Secondly, there should be significant policy interventions in response to the high losses in the banking system.

Also, Boonman (2019) divides the definition of a currency crisis in two general categories concerning the currency crises. The first category is the practical depreciation approach, in which currency crisis is defined as the depreciation of currency significantly, where "significantly" varies among multiple definitions. The second one is the exchange market pressure approach. Eichengreen et al. (1995) designed the EMPI. In addition to the depreciation of the currency, it includes periods of the incredible stress of the exchange rate.

In the old crisis models, little attention has been paid to the interaction between the banking and currency crises. It should be noted that many studies have investigated the crisis and its determinants separately. However, since the 1990s, twin crises have attracted the attention of many economists because of the high costs they can impose on the countries experiencing these crises. Today, a growing body of empirical studies investigating the relationship between the two crises. For example, Von Hagen and Ho (2007), Falketti and Tadella (2008), Kaminski and Reinhart (1999), and Rossi (1999), using dummy variables, have investigated the relationship between the two crises.

The study of Iran's economy shows that severe fluctuations and instability in exchange rates, inflation, the ratio of government debt, banks reserves, and M2 have coincided with the banking and currency crises. Statistically and empirically, in the 1980s, the average government debt to GDP was more than 50%; economic growth was also negative in 1983 and 1984. At the end of 1984, the real growth rate of the currency increased by more than 100%. During this period, the Iranian economy experienced negative growth in exports and credit. Moreover, the growth of bank debt to the central bank in late 1984 increased from -0.06 to 0.12%.

On the other hand, in late 1989 and early 1990, government debt rose to more than 50%. In some seasons, the real exchange rate experienced a sharp rise. Also, during this period, the Iranian economy experienced negative growth in actual money, with the development of the debt to foreign reserves by more than 20% and negative credit growth. However, in the early 1990s, the turmoil in the economy caused significant fluctuations in macroeconomic variables. So, in some seasons of 1992 and 1993, the growth of the real money became hostile, and the bank debt experienced a sharp increase.

Furthermore, at the end of 1992, the real exchange rate experienced a growth of more than 40%. Nevertheless, negative growth in exports and more than 100% in foreign debt to foreign assets in late 1993 could be regarded as another sign of this period. Also, in some seasons of 1995, the bank debt growth was more than 100%, the growth rate was close to zero, and the

average inflation was 47%, with a sharp fluctuation of the exchange rate. In 2008, economic growth reached a rate of about 0%, and export growth was negative; also, the deficit to GDP ratio was roughly 0.057%. In early 2014, the growth of the bank debt increased to more than 13%, and inflation was about 30%.

To the best of our knowledge, no study has yet been done on the twin crisis in the Iranian economy. However, several papers have studied banking and currency crises separately. For example, Mahmoudinia (2019), Zarei and Komeijani (2015), and Moshiri and Nadali (2013) have investigated banking crises and their determinants in the Iranian economy; also, some studies, e.g., Yavari et al. (2019) and Nasrollahi (2017), have considered the early warning system of currency crises in Iran. Therefore, the purpose of this paper has been to fill this gap in the empirical literature for the Iranian economy.

The remainder of the paper is organized as follows. Section 2 briefly summarizes the existing literature on the two crises. Section 3 presents stylized facts on the Iranian economic system and the factors affecting the occurrence of crises. Section 4 is concerned with the different proxies for currency and banking crises and describes the methods. Then, section 5 discuss the data set and the empirical analysis. Finally, section 6 draws the conclusion.

Literature Review

The literature on the relationship between banking and currency crises may be attributed to many channels of causation. Several papers have been theoretical reviews of the relationship between the two crises.

Some studies have been focused on causality from the banking crises to the currency crises. In this context, the noncompliance in the bank balance sheets by borrowing foreign currency and lending domestic money could lead to currency crises. Conversely, some studies have found that the currency crises could lead to the banking crises. In this case, it is assumed that the banks are indebted to foreign currency. Therefore, the increase in shock caused by the foreign interest rate or domestic interest rate spreads the currency crisis to the banking system (Eijffinger and Karatas, 2019).

Among other studies, Obstfeld (1995) argued that a troubled domestic banking sector might lead to the devaluation of the domestic currency if policymakers preferred inflation over exchange rate stability to reduce pressure on the damaged banking sector. Velasco (1987) and Miller (1999) showed that under a fixed exchange rate, with the occurrence of a banking crisis as a result of the banking run, the central bank that financed the bailout of the troubled banking system by printing money could contribute to currency attack and currency crisis. Mishkin (1996) considered that when more share of bank liability was determined in a foreign currency, banks would be weaker if devaluation occurred. Gonzalez-Hermosillo (1996) demonstrated that banking problems might lead to the large outflows of capital, precipitating a currency crisis in a poorly developed financial system, when agents preferred the foreign assets to the domestic assets.

There are some empirical studies on the relationship between banking crises and currency crises. In the following, we briefly describe the results obtained from the empirical studies that are relevant to this paper.

Kaminsky and Reinhart (1999) studied the causal relationship between the two crises for several industrial and developing countries from the 1970s to the 1990s. To identify the currency and banking crises, they used the index of speculative pressure and the events method (characteristics such as bank closures, mergers, deposit freezes, and government interventions), respectively. They found that in the 1980s and 1990s, there was a close link between the two crises; usually, a banking crisis occurred before a currency crisis, and the currency crisis deepened the banking crisis.

Rossi (1999) estimated a logit model for banking crises to investigate the causal effect of the banking crisis on the currency crisis. However, this study restricted its analysis to a sample of annual data for 15 developing countries from 1990 to 1997. It was found that lagged banking crises helped predict the currency crisis, while the past currency crisis was not a leading indicator of the banking crisis.

Glick and Hutchison (2001) used dummy variables similar to the Kaminsky and Reinhart (1999) method to identify the relationship between the two crises. However, they used the real exchange rate rather than the nominal exchange rate and multivariate Probit models to identify the relationship between the two crises for 90 developed and developing countries between 1975–1997. They found that twin crises were more common in developing countries and emerging markets than in industrialized countries. So, there was a strong correlation between the two crises in the emerging markets. Moreover, Falcetti and Tudela (2008) investigated the causal relationship between the banking and currency crises using quarterly data from 1980Q1 to 2010Q4 in the emerging markets. Unlike Kaminsky and Reinhart (1999), they concluded that there was no evidence of a significant causal link between the two crises, but common fundamentals drove the two crises.

Von Hagen and Ho (2007) identified the currency and banking crises by two continuous variables, the EMPI and MMPI, respectively. They used a sample of 49 countries and annual data from 1980 to 2004. Their empirical results showed that the frequency of twin crises increased over time. In addition, they found that past banking crises helped to predict currency crises and vice versa. Jing (2015) investigated the relationship between banking and currency crises in 94 developing countries using high-frequency data from 1980Q1 to 2010Q4. In this study, the two types of crises were considered by three continuous, multilevel, and dummy variables based on market pressure indexes, as well as a dummy variable. Their results showed that currency crises tended to lead to banking and vice versa. Only when banking crises were proxied by dummies based on the market pressure indexes the banking crisis did not cause the currency crisis.

Ari and Cergibozan (2016) considered the link between banking and currency crises and its determination using the multivariate logit model for 1990–2013. Their results showed that some macroeconomic variables, e.g., excessive fiscal deficits, the rise of short-term external debt, overvaluation, and external adverse shocks, led to the currency crises in the Turkish economy, such that banking crises could be affected by excessive money supplies and short bank positions. Eijffinger and Karatas (2019), using Panel data Probit and bivariate Probit models, considered the links between currency and banking crises for 21 developed and developing countries. Their findings indicated that banking crises tended to precede currency crises, and currency crises helped to predict future banking crises. Also, their results showed that the currency crises had a robust leading effect on the banking crises. Filippopoulou et al. (2020) employed the multivariate binary logit model to predict the banking crisis in the Eurozone. They found that most of the risk indicators used by the European Systemic Risk Board were significant in forecasting the systemic banking crisis.

Regarding the Iranian economy, Yavari et al. (2019), using the bounds testing approach, considered the currency crises incidence over the period from 1988:02 to 2016:02. Their results showed that some reasons such as the growth of oil export earnings, the ratio of loans to banks' deposits, the decline in the industrial production growth, and the increase in the ratio of central bank claims on the government to the monetary base led to a rise in the currency crisis. Mahmoudinia (2019) investigated the central bank monetary policy on banking crises in the Iranian economy seasonally during the period 1973–2016. In this study, the bank crises were identified in the framework of the adjusted index of the money market pressure. The empirical results showed that Iran's economy had experienced banking crises in the early 1979, the late 1990, and the time between 1994 and 1996, as well as between 2013

and 2015. On the other hand, the results showed that the central bank's expansionary monetary policy had played a significant role in the banking crises.

A Review of Important Events in the Iranian Economy (1980–2018)

With the occurrence of the Islamic Revolution and the onset of the Iran-Iraq war in the 1980s, the Iranian economy experienced severe financial tensions. The deterioration of banking conditions, such as the closure, mergers, and acquisitions of banks and the unstable political environment, led to some monetary and financial uncertainty in the Iranian economy during this decade. The existing fragility had severe economic consequences. So, in 1984Q2, the GDP growth was at its lowest level, by -7%, and the nominal interest rate was at its highest level in this decade. After the revolution, government intervention in the foreign exchange market increased. To prevent capital flight, the government imposed restrictions on current and capital accounts transactions.

Moreover, the country's currency system had been extended to the multiple-exchange rate one. In addition, the reduction of oil exports and their price had caused a decline in oil revenues. These factors exerted considerable pressure on the foreign exchange market. The actual foreign exchange rate raised by 52%, and the national currency fell by 29% in 1984Q2, leading to the loss of 8% of the international reserves. The liquidity ratio to Foreign Reserve increased to 7% in this period.

The late 1989 and early 1990 coincided with the end of the imposed war and the post-war rebuilding period; Iran's economy, on the one hand, was facing rising government expenditures, falling oil revenues, and aggravated foreign debt crisis. Hence, the real exchange rate raised dramatically from 10% growth in 1989Q4 to 130% growth in 1990Q1. On the other hand, the central bank's policy shifted to an expansionary policy, and government borrowing to compensate for war losses increased. These factors all led to high liquidity and inflation. So, policymakers raised interest rates to control liquidity. The nominal interest rate raised to 13% in 1990Q2. However, they failed to meet their targets because, during this period, central bank claims on banks, as an essential indicator of monetary base and liquidity changes, had been increased by 35%, worsening the liquidity condition. Simultaneously, this period was accompanied by currency instability, and the real exchange rate was raised by 45%, leading to a fall of international reserves by -4%. The liquidity ratio to foreign reserve increased to 6% and 5% in 1990Q1 and 1990Q2, respectively. As a result, the Iranian economy again experienced economic growth of 4% in the 1990Q2 period.

In 1993, the government implemented a policy of economic adjustment in financial liberalization and the exchange rate unification, changing the multiple exchange rates policy to a single exchange rate one. Because of the lack of coordination of all country policies to ensure a unified exchange rate, the implementation of this plan had severely fluctuated the foreign exchange market. This increased government obligations for foreign currency debts and foreign currency debt increased by 860% in 1993Q2. The actual exchange rate rose to 42% in 1993Q1 and 4% in 1993Q2. The government faced a severe budget deficit; as a result, the monetary base grew by 8.4% in 1993Q1, 8.2% in 1993Q2, and 5% in 1993Q4, providing greater vulnerability to the liquidity problems. Another condition of the Iranian economy in 1993 was the increase in central bank claims on banks. These debts were associated with 86%, 8%, and 60% for the 1993Q1, 1993Q2, and 1993Q4 periods, respectively. These factors increased inflation to 20% in 1993Q1 and 1993Q2, and 22% in 1993Q4.

The unified exchange rate policy failed in 1995 because of falling oil prices and overdue foreign debt repayments. The unprecedented expansion of the liquidity measure due to the poor management of the liquidity and the banks' overdrafts from the central bank discount

window caused the central bank claims on banks to be in a high position. The growth of these liabilities reached 77% in 1995Q1, 14% in 1995Q2, and 109% in 1995Q3. On the other hand, the rising inflation trend in the 1990s led to inflation at its highest level in 1995 during the last four decades. Inflation rates reached 49% in 1995Q1, 51% in 1995Q2, and 50% in 1995Q3. As a result, the liquidity ratio to foreign reserve increased to 2% in 1995Q2 and 8% in 1995Q3.

In 2001, with the rise of oil prices, the foreign exchange rate began to decline. So, the real exchange rate growth decreased by -12% in 2001Q4. The government, again, implemented multiple exchange rate policies in 2002. However, this time, due to the abundance of oil revenues, it continued its operations without the challenges of its first experience (1993) until 2009. The foreign exchange rate did not change significantly. Increasing the oil revenues led to a monetary base growth, and the economic base in 2006Q1 reached a record of 31% growth over the past four decades.

With the beginning of international sanctions against Iran in 2011, the unified exchange rate policy did not continue. As sanctions were intensified, restrictions on foreign exchange resources occurred, and the exchange rate immediately increased. Iran's economy in 2014 witnessed an unprecedented increase in economic sanctions. Due to the sanctions mentioned above, oil sales revenue declined, and the successive government budget deficit led to a rise in government borrowing from the central bank. These factors increased the monetary base by 19% in 2014Q1.

On the other hand, the expansionary policy of the central bank during this period had a significant effect on the increase of liquidity, and the liquidity growth reached 16%. Increasing the liquidity led to the high inflation of about 22%, and speculative activity moved to the currency market, raising the real exchange rate by 108% in 2014Q1. Banks' interest rate jumped to 22% in 2014Q2. During this period, we saw quasi-money and liquidity growth of about 6% and 4%, respectively. In addition, the central bank claims on banks increased to 12%, inflation reached 18.24%, and the real exchange rate raised by 29%.

A review of the Iranian economic events shows that some periods associated with bank instability experienced currency instability at the same time. According to these events, we can state that banking activity has been the main factor in spreading such instability in the economy. The statistical results showed that from the revolution until 2018, the average liquidity growth had been 26%, while the average economic growth had been less than 2%. One of the main reasons for the expansion of liquidity in recent years has been the creation of excessive money by the banking system. So, the share of the banking system in creating liquidity in 2018 had reached 85%.

On the other hand, increasing liquidity and sanctions against Iran have recently challenged foreign exchange rate management. The poor banking system has closed the central bank's hands-on currency defense. As sanctions intensified, foreign exchange resources were declined. These factors led to an increase in the foreign exchange rate from 200 Rials at the beginning of the revolution to 107,832 Rials in 2018.

Methodology

Defining Currency Crises and Banking Crises

According to IMF (1998), a currency crisis occurs when a speculative attack on the exchange value of a currency leads to the sharp depreciation of the currency or makes policymakers defend the currency by sharply increasing short-term interest rates or expending a large number of foreign reserves. Furthermore, Eichengreen et al. (1996) believe that currency crises develop under severe speculative pressure, while Glick and Moreno (1999) have

defined currency crises as a significant depreciation or the devaluation episode.

In this study, we apply the EMPI, as introduced by Kaminsky and Reinhart (1999) and modified by Jing (2016), as a proxy for the currency crises. The crises index is made up of quarterly changes in the real exchange rate, changes in the nominal interest rate, and changes in the foreign reserves, as weighted by w_1 , w_2 , w_3 , which are represented as follows:

$$EMPI = w_1 \left(\frac{\Delta E_t}{E_t} \right) + w_2 \left(\frac{\Delta i_t}{i_t} \right) - w_3 \left(\frac{\Delta FR_t}{FR_t} \right) \quad (1)$$

Where Δ is the difference operator, E_t is the real exchange rate, i is the nominal interest rate, and FR is the foreign reserve. The weights fall in the interval (0, 1]; it can be calculated as follows:

$$w_1 = \left(\frac{\frac{1}{\sigma_E}}{\frac{1}{\sigma_E} + \frac{1}{\sigma_i} + \frac{1}{\sigma_{FR}}} \right), w_2 = \left(\frac{\frac{1}{\sigma_i}}{\frac{1}{\sigma_E} + \frac{1}{\sigma_i} + \frac{1}{\sigma_{FR}}} \right), w_3 = \left(\frac{\frac{1}{\sigma_{FR}}}{\frac{1}{\sigma_E} + \frac{1}{\sigma_i} + \frac{1}{\sigma_{FR}}} \right) \quad (2)$$

Here, σ_E , σ_i and σ_{FR} are the standard deviations of the three components. Also, the real exchange rate is calculated by the following equation:

$$E = \text{nominal exchange rate} \times \frac{p^*}{p} \quad (3)$$

Where p and p^* are the consumer price index in Iran and the United states, respectively. A positive index value of Eq. (1) indicates the increased $EMPI$ stem from any combination of depreciation, the increase of the nominal interest rates, or the decrease of the foreign reserves.

In addition, the IMF (1998) defines a banking crisis as a situation in which bank runs persuade them to suspend the internal convertibility of their liabilities or to compel governments to intervene to prevent this by extending assistance on a large scale. However, Von Hagen and Ho (2007) define banking crises as periods in which the demand for liquidity in the money market is excessive. In this study, we employed the MMPI index as constructed by Von Hagen and Ho (2007); it has been modified by Jing (2015), which is shown by Eq. (4):

$$MMPI = w_1 \cdot \Delta \varphi_t + w_2 \cdot \Delta i_t \quad (4)$$

In this equation, φ_t is the ratio of the central bank reserves to total bank deposits, and i is the nominal interest rate. Also, the weights w_1 and w_2 are estimated as follows:

$$w_1 = \left(\frac{\frac{1}{\sigma_\varphi}}{\frac{1}{\sigma_\varphi} + \frac{1}{\sigma_i}} \right), w_2 = \left(\frac{\frac{1}{\sigma_i}}{\frac{1}{\sigma_\varphi} + \frac{1}{\sigma_i}} \right) \quad (5)$$

Where σ_φ and σ_i are the standard deviations of $\Delta \varphi_t$ and Δi_t , respectively. According to Eq. (4), a banking crisis index is characterized by increasing the stock of central bank reserves, a sharp increase of short-term interest rates, or both.

Relationship Between EMPI and MMPI

In this section, to consider the relationship between currency and banking crises, we employed the EMPI and MMPI, which are calculated from Equations 1 and 4. As can be seen

from Figure (1), within a short period, including 1984–1985, 1989–1991, and 2014–2016, both EMPI and MMPI changed simultaneously. The fluctuation and instability in these periods are compatible with events discussed in Section 3.

The volatilities of EMPI and MMPI during 1989–1991 were in their highest state. As noted in Section 3, factors such as the decline in crude oil exports, the increase in liquidity and inflation, the decline in real GDP, and an increase in the M2/foreign reserve ratio have all led to the increased volatility during this period. Banking crises often occur along with currency crises. In addition, descriptive statistics for EMPI and MMPI implied that the mean of EMPI and MMPI was close to zero, and the maximum value of EMPI and MMPI was 0.20 and 0.16. These were related to the second quarter of 1992 and the second quarter of 2014.

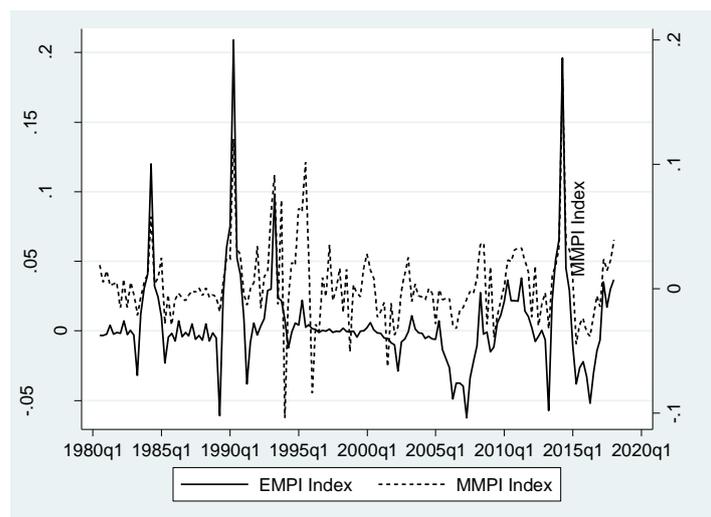


Figure 1. The Relationship between EMPI and MMPI

Source: Research finding.

The Multi-Categorical and Binary Crisis Variables

In this subsection, the two variables EMPI and MMPI are transferred into multi-categorical and binary variables according to Boonman et al. (2012), and Jing (2015). Based on Multi-Categorical, the dependent variables (Y) such as EMPI and MMPI can only take four values. It can take the values 3, 2, 1, and 0 for very deep, deep, mild, and no crises, respectively. Table (1) shows how to calculate the dependent variables.

Table 1. Calculation of Multi-Categorical Variables

	Value	Condition
Very Deep Crisis Period	3	$Y \geq \mu + 3\sigma$
Deep Crisis Period	2	$\mu + 2\sigma \leq Y < \mu + 3\sigma$
Mild Crisis Period	1	$\mu + \sigma \leq Y < \mu + 2\sigma$
No Crisis Period	0	Other observations

Source: Research finding.

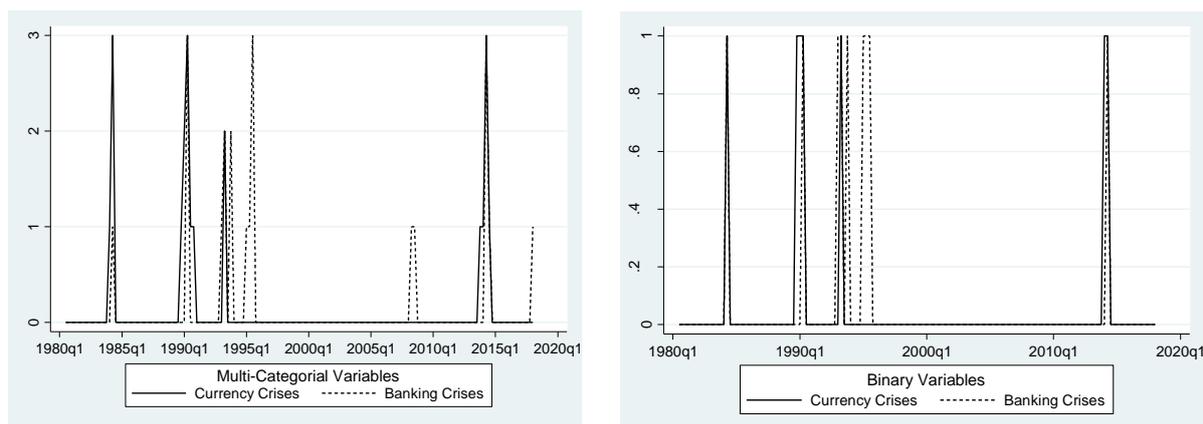
Here, μ indicates the mean, and σ represents the standard deviations of the crises variables. Also, the continuous variables are converted into dummy variables for the binary crises dummy. The dependent variables (Y) such as EMPI and MMPI can only take one and zero values. The crisis is signaled when the values of the EMPI and MMPI exceed the mean plus 1.5 times their standard deviation. Table (2) shows the calculation method for the binary variables.

Table 2. Calculation of Binary Variables

	Dummy Value	Condition
Crises Period	1	$Y > \mu + 1.5\sigma$
Tranquil Period	0	Other observations

Source: Research finding.

Figure 2 illustrates the lead-lag relation between Multi-Categorical and Binary variables for banking and currency crises in the Iranian economy. The figures show that two crises may occur closely together, so that during the periods 1984–1985, 1989–1998, and 2014–2015, they are coincident with each other.

**Figure 2.** Multi-Categorical and Binary Variables

Source: Research finding.

Empirical Results

Data and Unit Root Tests

The quarterly time series data used in this paper cover the period 1980Q2–2018Q1, as obtained from the Central Bank of Iran. The quarterly time series data include inflation, real GDP growth, real interest rate, M2/foreign reserve, export growth, real credit growth, and foreign asset/foreign debt.

In the first step, it is necessary to investigate the unit root properties of the data series. For this purpose, we apply the ADF Unit root test. It should be noted that the null hypothesis in the ADF test is non-stationary, and the data has a unit root. The Augmented Dickey-Fuller test statistic results in Table (3) show that all variables are stationary at the level.

Table 3. The Augmented Dickey-Fuller Unit Root Test Statistic
Test in the Level

	T-Statistic	Prob.
Banking Crises	-10.01	(0.00)*
Currency Crises	-7.10	(0.00)*
Inflation	-3.29	(0.01)*
Real GDP Growth	-4.73	(0.00)*
Real Interest Rate	-2.97	(0.03)*
Real Exchange Rate	-4.27	(0.00)*
M2/Foreign Reserve	-3.64	(0.02)*
Export Growth	-3.62	(0.03)*
Real Credit Growth	-3.14	(0.02)*
Foreign Asset/Foreign Debt	-3.51	(0.00)*

Note: * indicates the statistical significance at the 5% level.

Source: Research finding.

Ordered Logit Model Results

According to subsection 4.3, based on the extraction of crisis variables in terms of multi-categorical variables, we have studied the lag relationship between the two crises. As shown in Table (4), when the dependent variable is the banking crisis, the first lag of the currency crisis has a significant positive coefficient, indicating that the currency crisis increases the probability of banking crises.

Also, the impact of inflation, real exchange, and M2/foreign reserve on the banking crisis is positive and statistically significant. On the other hand, the effect of the real interest rate, export growth, and foreign asset/foreign debt on the banking crisis is negative and statistically significant. According to the available literature, the variables affecting the banking crisis are in some cases similar to the results of this paper. For example, Falcetti and Tudela (2008) state that the real exchange rate and the M2/foreign reserve ratio have a positive impact on the banking crisis. They have also found that increasing the foreign debt could enhance the vulnerability of the banking system. Demirguc-Kunt and Detragiache (2005) state that inflation and M2/foreign reserve can have a positive effect on the banking crisis and, therefore, can be statistically significant. Eijffinger and Karatas (2019) claim that the domestic interest rates has a negative relationship with the banking crisis because the fall in the interest rates can lead to a banking crisis due to the lack of the attraction of depositors in the domestic banking system. They also show that rising inflation increases the likelihood of a banking crisis.

On the other hand, when currency crises are defined as the dependent variable, the coefficient of the banking crises is not statistically significant. Still, the first lag of the currency crises is positive and significant. Table (4) shows that past currency crises help predict the current currency crises. In addition, the results indicate that inflation, GDP growth, and M2/foreign reserve are significant at the 5% level, and the coefficients are positive. However, the real exchange is not statistically significant.

Similarly, Eichengreen and Rose (1999) and Hutchison and Noy (2005) have found a significant positive correlation between the inflation rate and currency crisis. The empirical results of Glick and Hutchison (2001) and Von Hagen and Ho (2007) also showed that the M2/foreign reserves ratio was positively and significantly correlated with the currency crises. Further, Bauer et al. (2007) have shown that the impact of the real GDP on the currency crisis is weak, but significant positive that is the higher growth appears to increase the risk of a currency crisis. They have also stated that high inflation raises the likelihood of a currency crisis.

Table 4. The Ordered Logit Model Results

Dependent Variable	Categorical Variables			
	Banking Crisis Model		Currency Crises Model	
	Coefficient	Z-test (Prob.)	Coefficient	Z-test (Prob.)
Banking Crises (-1)	-0.47	-0.75 (0.45)	-0.95	-1.11 (0.26)
Currency Crises (-1)	2.04	2.76* (0.00)	3.10	3.47* (0.00)
Inflation (-1)	0.18	3.23* (0.00)	0.12	2.18* (0.02)
Real GDP Growth (-1)	36.00	1.33 (0.18)	71.12	2.31* (0.02)
Real Interest Rate (-1)	-0.44	-1.94* (0.05)	-0.67	-2.12* (0.03)
Real Exchange Rate (-1)	0.001	2.16* (0.03)	-0.00	-0.32 (0.74)
M2/Foreign Reserve (-1)	0.20	2.24* (0.02)	0.21	2.03* (0.04)
Export Growth (-1)	-13.05	-2.00* (0.04)	-15.40	-1.72* (0.08)
Real Credit Growth (-1)	-8.84	-1.41 (0.16)	11.89	1.68** (0.09)
Foreign Asset/Foreign Debt (-1)	-1.13	-1.89* (0.05)	-1.15	-1.71** (0.08)
LR Test		27.03 (0.00)		45.04 (0.00)

Note: * and ** indicate statistical significance at the 5% and 10% levels, respectively. The probability values are in parenthesis. Moreover, LR Test (likelihood-ratio test) assesses the fit of a model.

Source: Research finding.

These cases can be in line with the statistics related to the Iranian economy, as mentioned in Section 3. According to these statistics, in the second quarter of 1984, the increase in the real exchange rate by 52% and the increase in M2/foreign reserve by 2% positively affected the banking crisis and currency crisis. In 1990, the increase in the real exchange rate by 130% in the first quarter of 1990 and 45% in the second quarter of 1990, and the increase in M2/foreign exchange reserve by 6% in the first quarter of 1990 and 5% in the second quarter of 1990 all had a positive impact on the banking and currency crises. The economic instability in 1993, including the 20% inflation in the first and second quarters of 1993 and 22% inflation in the fourth quarter of 1993, raised real exchange rates by 42% in the first quarter and 4% in the second one, all leading to the banking crisis and currency crises in 1993. In 1995, the most important factor affecting the occurrence of the banking crisis and currency crises was the increase of inflation to 49% in the first quarter of 1995 and the inflation of 51% in the second and third quarters of 1995. In the first and second quarters of 2014, the increase in the real exchange rate by 108% and 29%, and inflation by 22% and 18%, respectively, all had a positive effect on the banking and currency crises.

Logit Model Results

In this section, MMPI and EMPI are converted into dummy variables as the proxies of banking and currency crises. We use the logit model to consider the lead-lag relationship between the two crises. From Table (5), it can be seen that there is a positive relationship between the currency crisis and the banking crisis when the latter is the dependent variable. However, when a currency crisis is defined as the dependent variable, the effect of the banking crisis is insignificant. Unlike these results, Jing (2015) found that when the

dependent variable was the currency crisis, the banking crisis had a great effect on the probability of the currency crisis.

Moreover, the lagged currency crises also affect the current currency crisis significantly. These results confirmed what we have obtained from the ordered logit model.

Table 5. The Logit Model Results

Dependent Variable	Logit Model			
	Banking Crisis Model		Currency Crisis Model	
	Coefficient	Z-test (Prob.)	Coefficient	Z-test (Prob.)
Banking Crises (-1)	-0.58	-0.34 (0.73)	3.66	1.12 (0.26)
Currency Crises (-1)	8.90	2.72* (0.00)	8.71	2.16* (0.03)
Inflation (-1)	0.20	2.08* (0.03)	0.25	1.88** (0.06)
Real GDP Growth (-1)	86.5	2.03* (0.04)	138.7	1.66** (0.09)
Real Interest Rate (-1)	-1.33	-2.05* (0.04)	-2.36	-1.98* (0.04)
Real Exchange Rate (-1)	-0.001	-0.93 (0.35)	-0.0002	-0.16 (0.87)
M2/Foreign Reserve (-1)	0.73	2.43* (0.01)	0.98	2.28* (0.02)
Export Growth (-1)	-35.15	-2.37* (0.01)	-46.75	-1.78** (0.07)
Real Credit Growth (-1)	-4.03	-0.43 (0.66)	31.47	1.87** (0.06)
Foreign Asset/Foreign Debt (-1)	-5.83	-2.36* (0.01)	-5.90	-2.12* (0.03)
LR Test		37.33 (0.00)		36.25 (0.00)

Note: * and ** indicate statistical significance at the 5% and 10% levels, respectively. The probability values are in parenthesis. Also, LR Test (likelihood-ratio test) assesses the fit of a model.

Source: Research finding.

Vector Autoregression (VAR) and Granger Causality Test Results

For more sensitive analysis, we investigated the lag relationship between MMPI and EMPI using the Granger causality test and the VAR model. As can be seen from Table (6), the results suggest that the lagged EMPI did Granger-cause MMPI significantly at the 5% level. In addition, when the EMPI was the dependent variable, the lagged MMPI did not significantly Granger-cause EMPI. The Wald test was significant at the 5% level so that EMPI could be regarded as an effective leading indicator of MMPI. There was a one-way casualty from EMPI to MMPI.

Table 6. VAR and Granger Causality Test Results

Dependent Variable	VAR			
	MMPI Model		EMPI Model	
	Coefficient	Z-test (Prob.)	Coefficient	Z-test (Prob.)
MMPI (-1)	0.07	0.71 (0.47)	-0.3	-0.34 (0.73)
EMPI (-1)	0.32	3.32* (0.00)	0.58	6.20* (0.00)
Granger causality Wald tests		11.01* (0.00)		0.11 (0.73)

Note: The null hypothesis of the Wald test is that x(Y) variable does not Granger-cause y(x) variables.

Source: Research finding.

Conclusion and Summary

This paper investigated the twin crises in the Iranian economy from 1980 to 2018. These twin crises in recent years have led to economic instability for some countries. According to the existing literature, twin crises have had more adverse economic consequences than currency and banking crises separately. Contrary to the previous empirical studies in the Iranian economy that have investigated the currency and banking crises separately, the purpose of this paper was to investigate the causal relationship between currency and banking crises.

For this purpose, this paper reinvestigated the relationship between the two crises using multi-categorical and dummy variables extracted from the EMPI and MMPI. First, the currency and banking crises were peroxided by the EMPI and an MMPI. Then, the two variables EMPI and MMPI were converted into multi-categorical and binary. Based on multi-categorical variables, the crises could be divided into four categories: very deep crisis, deep crisis, mild crisis, and no crisis. In this case, the ordered logit model was used to investigate the relationship between the two crises. Finally, the two variables EMPI and MMPI were converted into dummy ones, and the logit models were used to examine the lead-lag relationship between the two crises.

The empirical evidence suggested that the Iranian economy had experienced twin crises in some periods over the past four decades. These periods include 1984–1985, which coincided with the onset of the Islamic Revolution, 1989–1998, which coincided with the end of the imposed war, the post-war reconstruction period, and 2014–2015 when the Iranian economy witnessed an unprecedented escalation of the economic sanctions. The statistical analysis in Section 3 confirmed the validity of these cases. In addition, the results obtained by the Ordered logit and logit model showed that when the banking crisis was taken as the dependent variable, the impact of the currency crisis on the banking crisis was positive and statistically significant, and the currency crisis led to the banking crisis. However, when the currency crisis was defined as the dependent variable, the banking crisis did not lead to the currency crisis. The results also showed that the past currency crises could help predict the current currency crisis.

According to the results, Iran's currency and banking crises are due to the combination of macroeconomic imbalances such as high liquidity growths, inflation, sharp rises in government debt, and a high monetary base. These results also showed that for the banking sector's stability in the Iranian economy, the first step is to stabilize and reduce the exchange rate fluctuations. The currency crisis in the Iranian economy is also based on the imbalances in the real sector, the balance of payments, and the country's financial sector.

According to the empirical results, it could be argued that in the Iranian economy, the speculative attack on a currency can lead to a bank crisis because of the shock arising from the currency market, the maturity mismatch between the assets and liabilities in the bank sector and excessive bank debt in foreign currency. Hence, authorities respond to the pressure on the exchange rate by raising the interest rates.

The results of this paper can serve as the first step in studying the relationship between the two currencies and banking crises in the Iranian economy. Moreover, these results can help policymakers deal with currency and banking problems.

References

- [1] Ari, A., & Cergibozan, R. (2016). The Twin Crises: Determinants of Banking and Currency Crises in the Turkish Economy. *Emerging Markets Finance & Trade*, 52, 123–135.
- [2] Bauer, C., Herz, B., & Karb, V. (2007). Are Twin Currency and Debt Crises Special? *Journal of Financial Stability*, 3(1), 59–84.

- [3] Boonman, T. M., Jacobs, J., & Kuper, G. H. (2012). The Global Financial Crisis and Currency Crises in Latin America. *Research Report 12005-EEF*, University of Groningen, Research Institute SOM, Retrieved from https://research.rug.nl/files/15133011/12005-EEF_def.pdf
- [4] Boonman, T. M. (2019). Dating Currency Crises in Emerging Market Economies. *The North American Journal of Economics and Finance*, 49, 273–286.
- [5] Bordo, M., Eichengreen, B., Klingebiel, D., & Martinez-Peria, M. S. (2001). Is the Crisis Problem Growing More Severe? *Economic policy*, 16(32), 52–82.
- [6] Demirgüç-Kunt, A., & Detragiache, E. (2005). Cross-Country Empirical Studies of Systemic Bank Distress: A Survey. *National Institute Economic Review*, 192(1), 68–83.
- [7] Eichengreen, B., Rose, A. K., & Wyplosz, C. (1996). Exchange Market Mayhem: the Antecedents and Aftermath of Speculative Attacks. *Economic Policy*, 21, 249–312.
- [8] Eichengreen, B., & Rose, A. K. (1999). Contagious Currency Crises: Channels of Conveyance. *Changes in Exchange Rates in Rapidly Developing Countries: Theory, Practice, and Policy Issues (NBER-EASE, 7)*. Chicago: University of Chicago Press.
- [9] Eijffinger, S. C., & Karataş, B. (2019). Together or Apart? The Relationship between Currency and Banking Crises. *Journal of Banking & Finance*, 119, Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S0378426619302067>
- [10] Falcetti, E., & Tudela, M. (2008). What Do Twins Share? A Joint Probit Estimation of Banking and Currency Crises. *Economica*, 75(298), 199–221.
- [11] Filippopoulou, C., Galariotis, M., & Spyrou, S. (2020). An Early Warning System for Predicting Systemic Banking Crises in the Eurozone: A Logit Regression Approach. *Journal of Economic Behavior and Organization*, 172, 344–363.
- [12] Glick, R., & Moreno, R. (1999). Money and Credit, Competitiveness, and Currency Crises in Asia and Latin America. *Pacific Basin Working Paper Series 99-01*, Retrieved from Federal Reserve Bank of San Francisco.
- [13] Glick, R., & Hutchison, M. (2001). Banking and Currency Crises: How Common Are Twins? In R. Glick and M. M. Spiegel (Eds.), *Financial Crises in Emerging Markets*. New York: Cambridge University Press.
- [14] González-Hermosillo, M. B. (1996). Banking Sector Fragility and Systemic Sources of Fragility. *IMF Working Paper 96/12 (Washington: International Monetary Fund, March)*.
- [15] Hutchison, M., & Noy, I. (2005). How Bad Are Twins? Output Costs of Currency and Banking Crises. *Journal of Money, credit and Banking*, 37, 725–752.
- [16] IMF. (1998). Financial Crises: Characteristics and Indicators of Vulnerability. *IMF Working Paper*, Retrieved from International Monetary Fund.
- [17] Jing, Z. (2015). On the Relation between Currency and Banking Crises in Developing Countries, 1980–2010. *The North American Journal of Economics and Finance*, 34, 267–291.
- [18] Kaminsky, G. L., & Reinhart, C. M. (1999). The Twin Crises: The Causes of Banking and Balance-of-Payments Problems. *American Economic Review*, 89(3), 473–500.
- [19] Laeven, L., & Valencia, F. (2018). Systemic Banking Crises Revisited. *IMF Working Paper*, 18/206, Retrieved from International Monetary Fund.
- [20] ----- (2013). Systemic Banking Crises Database. *IMF Economic Review*, 61(2), 225–270.
- [21] ----- (2008). *Systemic Banking Crises: A New Database*. Washington, DC: International Monetary Fund.
- [22] Mahmoudinia, D. (2019). Central Bank Monetary Policy and Its Role in the Emergence of Banking Crises in the Iranian Economy within Modified Money Market Pressure Index. *Quarterly Journal of Economic Research and Policies*, 27(89), 61–97 (In Persian).
- [23] Mariano, R. S., Gultekin, B. N., Ozmucur, S., Shabbir, T., & Alper, C. E. (2004). Prediction of Currency Crises: Case of Turkey. *Review of Middle East Economics and Finance*, 2(2), 87–107.
- [24] Miller, V. (1999). The Timing and Size of Bank-Financed Speculative Attacks. *Journal of International Money and Finance*, 18(3), 459–470.
- [25] Mishkin, F. S. (1996). Understanding Financial Crises: A Developing Country Perspective (29–62). In M. Bruno and B. Pleskovic (Eds.), *Annual World Bank Conference on Development Economics*. Retrieved from https://www.nber.org/system/files/working_papers/w5600/w5600.pdf

- [26] Moshiri, S., & Nadali, M. (2013). The Determinants of Banking Crises in Iranian. *Journal of Economic Research*, 13(48), 1–27 (In Persian).
- [27] Nasrollahi, M. (2017). The Design of an Early Warning System of Currency Crisis in Iran: A Logistic Regression Approach. *Journal of Economic Research*, 12(1), 187–214 (In Persian).
- [28] Obstfeld, M. (1995). The Logic of Currency Crises (62–90). In *Monetary and Fiscal Policy in an Integrated Europe*. Berlin, Heidelberg: Springer.
- [29] Rossi, M. M. (1999). *Financial Fragility and Economic Performance in Developing Economies: Do Capital Controls, Prudential Regulation and Supervision Matter?* Washington, DC: International Monetary Fund.
- [30] Velasco, A. (1987). Financial Crises and Balance of Payments Crises: A Simple Model of the Southern Cone Experience. *Journal of Development Economics*, 27, 263–283.
- [31] Von Hagen, J., & Ho, T. (2007). Money Market Pressure and the Determinants of Banking Crises. *Journal of Money, Credit and Banking*, 39(5), 1037–1066.
- [32] Von Hagen, J., & Ho, T. (2003). Twin Crises: A Reexamination of Empirical Links. *6th Annual Conference on Global Economic Analysis*. Amsterdam: The Hague.
- [33] Yavary, K., Najarzadeh, R., & Mehregan, N. (2019). Investigation of Currency Crises Incidence in the Iranian Economy. *Iranian Journal of Trade studies*, 23(90), 1–23 (In Persian).
- [34] Zarei, Z., & Komijani, A. (2015). Identification and Prediction of Banking Crises in Iran. *Economic Modelling*, 9(1), 1–23 (In Persian).

