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**AN ANALYTICAL PANEL STUDY ON THE
DETERMINANTS OF FIANCIAL CRISES AND THE
ROLE OF THE SHADOW ECONOMY**

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ABSTRACT

EARLY WARNING INDICATORS FOR CURRENCY CRISIS: A CASE OF EMERGING MARKETS

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This paper examines the determinants of Economic crises with an annual panel dataset for 37 countries while comparing them in different groups, between 1990 and 2018. We employ a probit model with random effects and conclude that variables such as exchange rate, annual changes in the housing prices and bank credit given to the private sector are common denominators across all of our groups, while other variables such as inflationary expectation, Net portfolio equity inflow, Income from natural resources, Bank concentration of assets in the top three banks, stock market capitalization and real interest rate are group-specific variables in our study. Our results are verified via the use of robustness tests such as the use of a logit model, and they are in support of theories such as the exchange rate effect on the crisis and the moral hazard and adverse selection of the financial markets. We also found that the shadow economy as the percentage of GDP is an important and significant component in our paper and plays a vital role in the explanation of the crises within different groups of countries.

Key Words: Economic Crisis, Shadow Economy, Panel limited dependent variable, Exchange rate

OZ

PARA KRİZLERİNİN ERKEN GÖSTERGELERİ: GELİŞMEKTE OLAN ÜLKELER ÖRNEĞİ

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Bu çalışma 37 ülkeden oluşan ve 1990-2018 dönemini kapsayan bir panel veriseti kullanarak, finansal krizlerin belirleyicilerini incelemektedir. Kullanılan rastsal etkiler probit modeli göstermiştir ki döviz kuru, ev fiyatlarındaki yıllık değişim ve özel sektöre verilen banka kredileri gibi değişkenlerin etkileri bütün gruplar için ortak bir payda oluştururken enflasyon beklentileri, net portföy yatırımları, doğal kaynaklardan sağlanan gelir, bankacılık sektörü konsantrasyonu oranı, hisse senedi piyasası kapitalizasyonu ve reel faiz oranı değişkenlerinin etkileri ülke grupları arasında farklılık göstermektedir. Dayanıklılık sınamaları ve logit modeli tahmini gibi yöntemlerle sağlaması yapılan tahmin ve sınama sonuçları döviz kurlarının krize etkileri ve finansal piyasalardaki asimetric bilgi sorunlarının krize etkileri konusunda literatürde bulunan kuramları desteklemektedir. Ayrıca kayıtdışı ekonominin Gayri Safi Yurtiçi Hasıla'ya oranının da bir ülkenin finansal kriz yaşama olasılığı üzerine önemli bir etkisi olduğu ve bu etkinin farklı ülke grupları için istatistiksel olarak anlamlı olduğu gözlenmiştir.

Anahtar Kelimeler: Ekonomik kriz, kayıtdışı ekonomi, panel kısıtlı bağımlı değişken modelleri

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Ali Mashhadi
İzmir, 20202

TEXT OF OATH

I declare and honestly confirm that my study, titled “Early warning indicators for currency crisis: A case of emerging markets.” and presented as a Master’s/PhD Thesis, has been written without applying to any assistance inconsistent with scientific ethics and traditions. I declare, to the best of my knowledge and belief, that all content and ideas drawn directly or indirectly from external sources are indicated in the text and listed in the list of references.

Ali Mashhadi

Signature

.....Ali Mashhadi.....

September 22, 2020

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LIST OF ABBREVIATIONS

BCON	: Bank concentration of assets in the top 3 banks as the percentage of GDP
BCP	: Bank credit given to the private sector as a percentage of GDP
CA	: Current account
FDI	: Foreign direct investment
IMF	: International monetary fund
INFR	: Income from natural resources
NBER:	: National Breau of economic research
NETBL	: Net lending / Net borrowing
NPEI	: Net portfolio equity inflow

CHAPTER 1

INTRODUCTION

In the year 2008, the world experienced a massive financial crisis that stemmed from the U.S Housing Market. Prior to this event, we have also observed instances in Latin America and Southeast Asian countries that were caused by currency crises and led to the development of theoretical models that could study such a phenomenon. Banking crises and debt crises are other issues that troubled economies in the past and propelled economists and experts to contemplate further about these issues. The literature on financial crises has a tremendous number of studies and papers. Each of these studies emphasizes one of the many aspects of financial crises, and even some of these papers realized that often crises could emerge due to a few correlated issues, in the form of twin crises.

In this paper, we use our understanding of these issues and apply each classification of financial crises and their respective indicators to develop an empirical analysis regarding the possible causes of financial crises, featuring 36 countries, including developed, developing, and lower-income countries, over the period from 1990 to 2018. Explanatory variables are selected with relation to the highlighted indicators in the literature, after extensive testing to fit the correct set of explanatory variables with the appropriate statistical properties.

Our study departs from other empirical works in this literature in some essential ways.

First, our sample embodies a large group of countries in which we benefit from a diverse selection of most influential and impactful economies in the world to some of the most impoverished and yet noticeable economies in some key regions. For instance, many studies before this paper highlighted a currency crisis in a single country, while we benefit from a multi-country model. Additionally, our model also covers a timeline that has not

been much studied in the existing literature namely the post 2015. Our dataset benefits from updated definitions in the variables and their method of calculations and covers the most recent events in the financial calendar.

Secondly, we do not single out a type of financial crisis. Instead, we benefit from a wide range of explanatory indicators. We use vital indicators from the currency crisis, banking crisis, debt crisis, and even add some new variables as experimental variables that might help our model.

Thirdly, due to having an extensive model, we use a definition for a crisis which incorporates all aspects of various financial crises types. This paper uses the GDP growth rate, change in the GDP growth rate, and industrial value-added annual growth rate as the measure of crisis criteria rather than using other methods that exclusively study a single type of crisis.

Fourthly, using the probit model with random effects takes into account the traits and features of both cross-section and time-series data. Even though this method is proven to be satisfactory for this type of analysis, we also use a logit model to evaluate our findings from the probit model to eliminate any bias or result that could have been found due to the choice of the model rather than the actual findings from our dataset.

Lastly, our paper emphasizes the effect of the shadow economy. We use the concept of the shadow economy and try to find a relation between this unofficial economy and the financial crises in our study.

This paper is organized as follows. Chapter 2 reviews the theoretical and empirical literature on the financial crisis and classifies all the underlying subcategories of a financial crisis. This section is followed by a secondary and complementary literature review for the shadow economy review and covers some of the most known empirical works in this field. Chapter 3 explains the data and the list of the countries in this study, this section incorporates the full list of the potential explanatory variables, their definition, and how they might help us to form an appropriate model to explain our issue. Chapter 4 discusses the definition of the crisis criteria in our study. This chapter focuses on explaining the discrete choice models in the panel data and explains our method of estimation. This section presents our empirical results and interpretations, covering all

different groups of countries. Furthermore, our findings on the role of the shadow economy in the financial crisis are discussed. Chapter 5 presents the concluding remarks.

CHAPTER 2

LITERATURE REVIEW

2.1. Financial crises: Types and Theories

Financial crises have been a pandemic that troubled many financial systems. These types of crises often occur without much clear warnings. The global financial crisis of 2007-2009 has been a great reminder of the true nature of these crises. They affect all countries, regardless of being poor or rich. Reinhart and Rogoff (2009a) described these events as “equal opportunity menace.” they can have domestic or external origins, and they quickly spread beyond the borders. Financial crises are often influenced by a few events: notable changes in the credit volume, and changes in asset prices along with the need for external financing for several institutions in the economy.

A financial crisis is defined by different approaches. One approach is based on the views of M. Friedman and Irvin Fisher's monetarist school of thought and the neoclassical thinking. The general way of thinking is based on the idea that the monetary sphere can cause trouble for the real sphere in the short and medium-term, which explains that the financial crises occur due to the potential "Bank panics." These panics cause an abrupt decline in the money supply and economic activity in hindsight. M. Friedman and A.J. Schwartz (1971).

Moreover, according to other scientists, when there are different scenarios of the sudden drops in asset prices and increases in bankruptcies, it is treated as a pseudo-financial crisis A. J. Schwartz (1986). According to this view, during the pseudo- financial crisis, government intervention is not needed and can lead to inefficient markets. Hence rescuing troubled companies that are destined to fail is not advised.

Hyman Minsky (1992) is known for one of the most distinguished hypotheses surrounding the financial crises. Minsky's work, financial instability hypothesis, argues

that financial crises are a common feature of a capitalistic economy, and due to prolonged periods of prosperity, both borrowers and lenders are encouraged to act more recklessly. The excess of optimism creates a financial bubble that can burst in the future. Traditionally, banks would lend against the secured assets, which hedge the lending against default. However, in the presence of continuous economic growth and rising asset prices such as housing market prices, lenders and borrowers are more optimistic and take on more risks. Banks become more lenient on their requirements for borrowing funds. This surge in lending, in turn, increases the asset prices even further, and an irrational hive mentality of crowd emerges. This mentality supports the idea that the rising prices will not stop, and the group cannot be wrong. Speculative lending and Ponzi borrowing become a norm, even though they are not sustainable in the future. Credit rating agencies also get caught in this bandwagon and allow for this Ponzi borrowing. This unreasonable expectation of ever-rising asset prices is not sustainable, and when it crashes, borrowers and lenders don't have enough liquidity. This results in a loss of confidence and a credit crunch.

Hence one of the characteristics of a capitalistic economy is that it is prone to go from financial stability to instability. This hypothesis argues that government intervention is needed for amending the market failures. The point where the economy moves from stability to uncertainty is referred to as the Minsky moment. Despite growing support for this hypothesis after the 2008 financial crisis, this model was heavily criticized due to its praise of government interventions in financial markets.

Kindleberger, in his book, "The World in Depression" (1973), gave a clear explanation as to why panic in the financial market occurs. Kindleberger's ideas were against the schemes of Friedman regarding the stability of markets. Friedman believed that the markets would come back to equilibrium, and speculations are not destabilizing. Kindleberger thought that the markets could get it wrong for a long time. Kindleberger also believed in the contagious nature of financial crises by observing the history of these events in the European Union, USA, and Asia. Kindleberger and Minsky discuss three patterns related to speculative bubbles. These three types are broadly mentioned in Kindleberger's book, "Manias, Panics, and Crashes" (1978, 2000). The first type illustrates that the price rises solely due to the expectations of agents regarding the rising

prices. If an exogenous shock stops these increasing prices, this cycle of expectations breaks, and the speculative demand stops. This type is known as the self-fulfilling type. In the second type, the prices stagnate after a period of rising to the top and then declines. This sort of fall does not lead to a panic or a crash. Some agents might be discontent with the drop in prices, but eventually, it won't lead to a severe crash. The third type of bubble discloses a period of financial unrest. This type was first introduced by Minsky (1972). In this type, price rises to the top, and then it's followed by a gradual decline, but then it results in a panic and a crash. Kindleberger (1978, 2000, Appendix B) believes that this is the most common type of bubble.

In *Manias, Panics, and Crashes*, Kindleberger develops a cycle of the financial crisis by using the Minsky framework.

Displacement caused by Macro shocks → Bank credit feeds the boom → Urge to speculate → Interest rates, the velocity of money and prices rises → Overtrading → insiders taking profits → financial distress and rush for liquidity → Fraud and discredit → Lender of last resort restoring order by promising liquidity. This cycle continues.

Proponents of this type of view often have a clash of theory with the monetarists and criticize them for their lack of explanation and their limited view of the issue, which associates the financial crisis only with banking panics and money supply growth. On the other hand, the counter-argument of the monetarists is that Minsky and Kindleberger's views are too comprehensive and broad and does not specify the root of the issue.

According to Mishkin (1991) and Antczak, (2000), asymmetric information theory provides more satisfactory explanation for the financial crisis compared to the other approaches. According to asymmetric information theory, a financial crisis emerges when five factors are in action and lead to a disorder within the markets. These factors are increases in interest rates, stock market declines, increases in uncertainty, bank panics, and unanticipated declines in the aggregate price level. Due to the moral hazard and adverse selection, markets fail to allocate resources efficiently.

According to the International Monetary Fund (1998), a financial crisis is classified into four types: Currency crisis, banking crisis, systemic financial crisis, and foreign debt crisis. Based on this definition, a financial crisis can occur because of the loss

of confidence in the currency regime or the banking system due to changes in the asset prices, lower ability to receive credit, and lower external flows of finances. All types of crises such as currency, banking, and debt crisis can happen simultaneously or trigger another one, as seen by evidence from Turkey and Venezuela in the 90s or the case of Chile and Argentina in 1981-1982, in terms of the spillover effect of a banking crisis into a debt crisis.

M. Dabrowski (2003) agrees on the categorization of financial crises laid down by the IMF and reaches to the conclusion that a banking crisis is capable of forcing a government and its central bank into draining their resources to provide help and liquidity to the banking sector. This, in turn, can lead to a speculative attack on the currency. There have been shreds of evidence of such events, as seen in Bulgaria in 1996 and Turkey 2000-2001.

2.2. Currency crisis: Theories and Types

Economic history is rich with an abundance of currency crises. A currency crisis is an episode in which the exchange rate depreciates tremendously within a short period of time. Many of these crises happened in 1980s during the Latin American debt crisis. These full spread events have affected global developments, and they are one of the most studied and discussed aspects of the financial crises. Three generations models dominate the literature surrounding currency crisis.

2.2.1. First Generation Models

According to the first-generation of models, a system of a fixed exchange rates collapses due to unstable economic policies. These models are based on the works of Krugman and Flood (1979) Garber (1984) and are inspired from the earlier works of Henderson and Salant (1978). These models were mainly developed to explain the crises in Latin America. The main focus of these models was related to speculative attacks on the currency due to improper policies in place. In a fixed exchange rate system, a government has to fix the money supply. This severely hurts the government's ability to earn revenue from seigniorage or forces the government to run deficits. To finance such deficits, governments use foreign exchange reserves or borrow to sort out the deficit.

Speculation also plays an important role. Speculator's attacks on the reserves as they switching from the domestic currency to foreign currencies, can collapse the fixed exchange rate system. Krugman (1979), in his model, suggests that, if the foreign exchange rate is pegged to another currency, the peg should be abandoned, when the reserves of that pegged currency are emptied. Krugman believed that weak fundamentals and the policies which led to the depletion of the foreign exchange reserves forces the governments to leave the fixed exchange rate system.

Despite Krugman's work, some other authors believe that governments might still leave the fixed exchange rate system, even if the reserves are intact, only due to the loss of some crucial policy tools, which could help them to tailor their economy's needs. Such as problems with the high-interest rate or unemployment. One of the critical assumptions of this model is based on the perfect rationality of the agents. Still, the government, as the biggest actor, is capable of avoiding the crisis if they agreed to change their policy. Although this model was successful on its premise regarding the Latin America crisis, it was not successful enough to explain the European Monetary System crisis in 1992-1993 and the next crisis in Mexico in 1994. Some argued that European countries and Mexico had a more structured economy and policy system compared to countries involved in the Latin American crisis explained by the first-generation models, and the first-generation model is incapable of handling this issue. Flood and Marion (1996).

2.2.2. Second Generation Models

With the emergence of the currency crisis within the European countries in 1992-1993 and Mexico in 1994, the limitations of the first-generation models became more apparent in explaining the roots of the crises for those cases. The second-generation model was introduced as an alternative. The focus of this model mainly rests on the likelihood of the crisis, even in situations that economic fundamentals are not suffering from deterioration. Esquivel and Larrin (1998). In these models, the government priority is based on the optimization between different policies, such as affecting the private interest or fixing the exchange rate or related doctrines. Based on the assumptions of this model, government acts can be nonlinear, leading to a multiple equilibria. Hence in the second-generation models, there is a possibility for the self-fulfilling crises. A self-fulfilling crisis

occurs when the financial crisis is not caused due to the bad state of the economy, or inadequate government policies, instead, because of the negative expectations of the investors. For instance, when there is a massive outflow of the capital due to the pessimistic expectations of the investors, the exchange rate is negatively affected and verifies those negative expectations.

Obstfeld (1994) states that decision-makers decide based on the cost and benefits of whether to leave or stay in the fixed exchange rate system. Additionally, speculative expectations of the investors are driven by government actions and responses when the government has to choose between committing to the fixed regime and amending another aspect of the economy when they are compromised. This chain of events leads to price changes that are influenced by expectations in a circular flow. According to Obstfeld (1994), this sort of flow is capable of causing a crisis solely with the anticipation of that crisis by the investors. Even though the second-generation models assure that the fundamental conditions of the economy are not the reason behind the crisis, the likelihood of success for a speculative attack by investors tremendously increases once the underlying state of the economy such as banking system or employment status of the society is already weakened.

2.2.3. Third Generation Models

First and second-generation models had their shortcomings on the onset of the Asian financial crisis. The third-generation models of currency crisis focus on problems regarding the banking and financial systems and how they correlate with the currency crises and the length of the effects on the entire economy. Krugman, Corsetti (1999), Pesenti, Roubini (1998), and their works point out that moral hazard issues concerning excessive borrowing and lending by banks during Asian crisis. The authors assume that relying on future bailout programs from the government prompts financial institutions to engage in risky ventures. Corsetti (1999) explains that guaranteed policies from the government should not assure expectations of the next bailout. Even without the promise of such plans by the governments, agents and foreign investors usually expect some degree of government intervention. Therefore, government promises regarding staying faithful to *laissez-faire* don't instill confidence into agents. Krugman (1998) explains that implicit

government-guaranteed policies encourage financial institutions to behave riskier and, in turn, entails inflation in asset markets. Inflation in the asset market is partially sustained when the increase in the prices of assets bring more lending and improved the balance sheets of the financial institutions. With the onset of the crisis, that inflationary pattern is somewhat reversed. The falling prices in the assets market, reveal the insolvency of the financial institutions and forces to halt their operation, which also pushes the prices further down.

Chang and Velasco (1998) claim that Krugman's (1998) statements are not complete and they ignore some key facts and that, in the aftermath of the crisis the price level is brought down lower than its actual level and if insolvent banks and institutions have to abort and liquidate their plans before the maturity date, the value of the assets will be at a lower level than it would have been in the absence of the crisis. They demonstrated that insolvent institutions like banks are a necessary condition for the crisis. Their model suggests that within a fixed exchange rate system, a bank run is quickly switched into a currency run if the central bank acts as the lender of the last resort.

As stark and hopeless, this situation can be, but there are remedies to rectify the issue. Overcoming this situation is possible when a big international lender such as IMF steps in and helps the troubled system by lending and conditioning their cash flow to overcome the self-fulfilling crisis. As Jeanne and Zetelmeyer (2002) suggests.

2.3. Banking crisis: Types and Theories

Banks are vulnerable to a wide variety of risks. These risks include credit risk, liquidity risk, and interest rate risks. Banking related issues are capable of reducing the value of the bank's assets. As it was seen in the 2008 crisis, a reduction in the value of the real estate collapsed significant banks.

A banking crisis can also be triggered when the government is not capable of paying its obligations; this can plummet the value of their bonds, which are held in the banks' portfolios. When such an event happens, banks are met with massive liabilities that exceed their assets. This issue can entail another problem when those liabilities are due. For instance, when many depositors wish to withdraw their deposits from these banks,

banks will not be able to have that amount of liquidity even if they are solvent, meaning they have enough capital.

A systematic crisis happens when a couple of banks in a country are plagued with severe solvency and liquidity problems when all of these institutions are targeted by the same external shocks, originating from a failure in a bank or a group of banks. Within this environment, the chances are that many financial institutions are the brink of collapse, and many struggles with defaults and not being able to meet the terms of their contract. This situation can cause a severe setback on the prices of assets since most of these financial institutions are desperate to liquidate themselves. Hence, they would list many of their assets at a much lower cost as it was clearly demonstrated in the 2008 financial crisis.

One of the most prominent works regarding the banking crisis belongs to Demirguc-Kunt and Detragiache (2002, 2005) these works were issued based on the previous works done by Caprio and Klingebiel (1999), and they managed to muster a dataset includes a broad array of countries and banking crisis episodes. According to the authors, a systematic crisis is defined an episode when the majority of the banking sector becomes insolvent and will not be able to operate without assistance from authorities. (2002, p. 1381). Banking distress was labeled as a systematic problem when one of the following criteria occurred. (i) Large scale nationalizations, (ii) emergency acts such as deposit freezes, "blanket guarantees "to depositors, (iii) hefty rescue operation for troubled institutions amounting to 2% of GDP, (iv) Non-performing assets pass the 10% threshold of the total assets.

Another important work is compiled by Reinhart and Rogoff (2008). They state that there are two types of events in the banking crisis. (i) Bank runs that lead to closure, merger, or public takeover of a bank or a financial organization (ii) in the absence of bank runs, the other events such as closure, consolidation, public acquisitions, and governmental assistance send worrisome signals to agents. Based on their work, there are two types of crises: The First type is the systemic banking crisis, and the second type is financial unrest or milder crises. Their works are very similar to the findings of Kaminsky (1999).

According to the Bordo (2008) and the bank of Lithuania (2010) a banking crisis involves both banking waves of panic, that if not helped by a lender of last resort act, will lead to a recession, and an insolvency crisis affected by a lot of fiscal bailouts, safety nets for the financial institutions and capital erosion within the sector.

2.4 Debt crisis: Types and theories

2.4.1 Sovereign debt

A sovereign debt crisis occurs when a country is not able to meet its liabilities. In the majority of studies related to foreign debt crises, a credit event is known as a non-repayment of debt service. Sachs (1984). This situation does not erupt suddenly, and the signs of its emergence are foreseeable to those who have critical information. When these signs are neglected, and the government doesn't act with due diligence, the country will be on the brink of a crisis. Traditionally a country finds itself in such a place when they are not able to find lenders who are willing to bring their funds to their country due to the fear of defaulting from the debt unless a higher interest rate offered. This ever-increasing fear regarding the economic climate of the country raises the interest rate demanded by lenders, and respectively makes it a lot more challenging for that country to fund its debt problems. By looking into the history of these sorts of events, we can find some notable instances such as Greece, Italy, and Spain, which were followed by the Eurozone debt crisis and Iceland, which was exacerbated by its banking sector debt. Another notable instance of such an issue of debt servicing occurred in Latin America and parts of Africa in the 1980s. Many authors conducted studies on these cases of sovereign default risk. McDonald and Donough (1982), Eichengreen, and Mody (1999), to name a few.

There are multiple methodologies regarding the calculation of default probability. One method that was introduced by Edwards (1984) involves using interest rate spreads in a country. Another technique uses credit default swaps. Chan- Lau (2003). Another method uses credit ratings as a measure of the likelihood of defaults. Schmukler (2001). When these ratings fall, they work as an indicator to show a higher probability of defaults.

Sovereign debt variables have been used extensively in financial crisis studies. Redalet and Sachs (1998) view capital flows as an essential factor. Reinhart (2002) evaluates the relationship between default and currency crises.

A lot of the discussion in this literature focuses on the foreign creditors, and often domestic credit has been sidelined as a topic of review, but some authors have put the domestic debt as the center of their work. According to Rogoff and Reinhart (2009), domestic debt has been an essential topic across the world. During the Eurozone crisis, a large amount of the sovereign debt issue was related to the intra-European debt. There are several different viewpoints on the topic of sovereign debt. One perspective is associated with Eaton and Gersovitz (1981) and followed by Grossman and Van Huyck (1988). This view states that borrowing and repayment are tied to consumption smoothing and emphasizes the reputation of lenders. According to this model, debtors repay their debt in a good cycle and scramble to borrow more in bad periods. The chance of default is higher in the good times since the consumption smoothing rationale is based on the idea that borrowing will continue in bad conditions. Tomz (2007), in his book "Reputation and international cooperation" labels the fund borrowers into "stalwarts", "fair-weather," those who repay in good times and "lemons," those who default in bad times and even sometimes in good times. Another viewpoint is concerned with the idea of punishment. Works associated with Bulow and Rogoff (1988) demonstrate that creditors have rights in foreign countries. If one country borrows from a bank in country X and then defaults on that loan and proceeds to borrow from a bank from country Y, then the former bank should have a claim and should be repaid before another loan should go through. Kaminsky and Garcia (2016) evaluated a model on emerging markets defaults. Based on their findings, defaults usually are the result of a slowdown in the growth of most advanced economies or a global liquidity problem. Most of the defaults occur within a systematic crisis. For instance, the Latin debt crisis began with a fall in commodity prices followed by high real interest rates in the United States. To showcase the effect of liquidity, authors observed the global real interest rates and capital flows to non-Latin emerging markets as an economic activity measure.

In the case of the European debt crisis, the northern countries were on the surplus side while the periphery countries were in deficit. Some of those deficits were stemmed

from Asian countries, according to experts. Some banks financed these deficits. But as Hale and Obstfeld (2016) suggests, inadequate banking regulations deepened the crisis. This led to a change of view in the following works done in this literature. For instance, Fillipo Brutti and Saure (2016) used the data on bank portfolios to demonstrate how much of the bank's holdings are made of foreign-issued debt and how much of those holdings are domestically issued. At the time of crisis, sovereign debt payment should flow from foreigners to domestic investors via secondary markets. Since defaults are more probable, these flows are more important for the public than the private sector.

2.4.2 Debt deflation

Another important topic in the debt crisis literature belongs to the debt deflation issue. But why deflation is concerning for us? "During the Great Depression era, most analysts placed general deflation, and the bankruptcies it caused, at or near the center of the worst macroeconomic disaster the world had ever seen" DeLong (1999). Debt deflation is associated with the early works of Irvin Fisher (1933) and explains how debt and deflation bring destabilization for one another. Deflation is capable of delivering financial distress, and financial distress worsens the deflation. Bordo and Filardo (2004). Fisher's (1933) article "The Debt-Deflation theory of the Great Depression" uses the monetary theory to show how financial distress worsens the deflation issue. Fisher states that agents want to reduce their indebtedness by liquidating debts. Fisher uses a chain of events to explain his views: "Debt liquidation leads to distress selling and contraction of deposit currency, as bank loans are paid off, which leads to slowing down the velocity of circulation. This will lead to a fall in the level of prices." Fisher believed that deflation in the price levels was "the root of all evils." He further explains that agents attempt to reduce their indebtedness by stress selling, to gain enough money to repay their bank loans. Repayment, in turn, decreases the aggregate quantity of money, and leads to deflation. As he quotes, "when the over-indebtedness is great enough, the liquidation cannot keep up with the falling prices, and in that case, the more debtors pay, the more they owe." Fisher's theory was criticized heavily by other experts; for instance, classical experts such as Pigou believed that deflation is stabilizing since the higher real value of money combined with lower price level stimulates the aggregate demand, which was contrary to the Fisher's

ideas. Tobin (1975) argued that the Fisher's channel is more appropriate since debtors have a higher propensity to spend compared to creditors. Tobin also believed that deflation decreases the value of capital stock and equity, and in turn, consumption and investment become less attractive.

Minsky (1982) uses the asset prices and asset market to elaborate further on the debt-deflation issue. He states that distress selling decreases the asset prices, which in turn intensifies the distress selling even more and exacerbates the deflation. Minsky quotes: "Fisher does not identify the ways a unit can get cash to repay loans that fall due. Once a situation exists where debt payments cannot be made either by cash from operations or refinancing so that assets have to be sold, then the requirements imposed by the debt structure can lead to a fall in the prices of assets. In a free market, the fall in asset prices can be so large that the sale of assets cannot realize the funds needed to fulfill commitments." This means that when distress selling reduces asset prices, this will lead to indebtedness, which brings more distress selling.

Bernanke (1983) evaluated the importance of credit contraction for aggregate spending. His work was in the context of the great depression and inspired by Keynes's ideas. Bernanke states that borrower defaults and banks run reduced the effectiveness of financial intermediation by increasing the cost of information-gathering and market-making services. He quotes: "The banking problems of 1930-33 disrupted the credit allocation process by creating large, unplanned changes in the channels of credit flow. Plus, the actual failures, forced a contraction of the banking system's role in the intermediation of credit. Experience does not seem to be inconsistent with the point that even good borrowers may find it more difficult or costly to obtain credit when there is extensive insolvency. The debt crisis should be added to the banking crisis as a potential source of disruption of the credit system. The effects of this credit squeeze on aggregate demand helped convert the severe but not unprecedented downturn of 1929-30 into a protracted depression." This means that issues in the financial sector impair the credit intermediation and credit contraction leads to lower aggregate demand.

2.5 Empirical works related to the financial crisis literature

Saches et al. (1996) evaluate the timeline after the crash of the Mexican currency in December 1994. According to their estimated results, low international reserves relative to broad money, Real exchange rate appreciation, and improper banking system explains most of the variation in their crisis indicator. This indicator is made of the change in reserves and nominal depreciation.

Kaminsky et al. (1998) use the monthly data related to fifteen developing countries and five industrial countries from 1970 to 1995. Their definition of the crisis is based on the idea of the exchange market pressure indexes, but due to the lack of available data regarding the interest rate, they formed an index known as Exchange market pressure index that is made of changes in the nominal exchange rate and the international reserves. According to their study, a crisis is identifiable if this index exceeds by more than three standard deviations for that country. This study is one of the pivots in the crisis literature, which uses the signal approach to evaluate fifteen macroeconomic indicators before the crisis. They conclude that the weakness in the fundamental economics is the reason behind the currency crisis that includes overvaluation of the real exchange rate, loss in reserve, and a high ratio in broad money to reserves and slowdown in the economy.

Frankel and Rose (1996) use a probit model to estimate a currency crisis, using data for 105 countries. According to their definition, a currency crisis as a nominal depreciation of the currency by at least 25%, or at least a 10% increase in the rate of the depreciation. Based on their deduction, the currency crisis occurs when the output decreases, domestic credit growth increases, and foreign interest rate increases, and lastly when the exchange rate is overvalued.

Bussiere and Fratzscher (2002), Lestano and Kuper (2003), and Feridun (2008) constructed a model with 32 emerging countries with the help of the logit model. They found out that many variables have a significant place in predicting a currency crisis, such as the ratio of M2 to foreign reserves, the domestic real interest rate, and the contagion effect variables.

Aziz et al. (2000) employed a comparison method before and after a crisis behavior of indicators, consisting of overheating indicators, external imbalances, unemployment

rate, short-term capital inflows, and the foreign interest rate. They concluded that terms of trade, overvaluing the currency inflation, domestic credit growth, M2 reserve ratio, current account, and world interest rate are the most critical indicators.

Berg and Pattillo (1999) used a static probit model alternative to the signaling approach to prove that there is a nonlinearity relation between the predictive covariates and the banking crisis likelihood. Most of the crises were not signaled in advance, and they were mostly false, although the predictions were better than random guesses in terms of significance. The addition of current accounts relative to GDP and M2 / reserve ratio improved their results. However, their results were different from the findings of Kaminsky et al. (1998).

Milesi-Ferretti and Razin (1998) followed on the work of Frankel and Rose (1996), in their study which covered 105 countries from 1970 to 1996 with the help of panel probit model. They identified the indicators that helped to predict the currency crisis and their impact on the economy. They had four different definitions for the currency crisis, one being similar to the Frankel and Rose (1996). This definition finds out about the large exchange rate fluctuations along with the high inflation. They concluded that low reserves, appreciated real exchange rates and high-interest rates cause a currency crisis.

Demirguc-Kunt and Detragiache (1998) conducted a study to examine banking crisis and their determinants in a sample of 65 developing and developed countries from 1980 to 1994 with the help of a logit model. They concluded that low GDP growth rates, high inflation, and high-interest rates, along with a high rate of credit, are significant in case of the banking crises. They also believe that the crises are not solely explained by self-fulfilling theories, and instead, they are connected to the state of the economy, and the institutional environment in a country is capable of propelling the country towards a banking crisis.

Gorton (1988) released one of the first classic empirical studies in the banking crisis literature, in which this crisis was linked to the fundamentals. This study was set from 1863 to 1914 in the United States, and according to its findings, crisis was the outcome of the response of the deposit holders to growing perceived uncertainty. Based

on his study, a crisis was looming when the key variables related to the recession became significant. In this paper, the most important variable is the liabilities of the failed firms.

Schumacher (2000) conducted her study on the information-based runs. This study is revolving around the Argentinian banks following the Mexican peso devaluation. Mexican crisis was critical for Argentina since it led people to speculate about Argentina's devaluation. These speculations ignited a bank run of depositors who wanted to withdraw the deposits from the banks. This bank-run also speeded to the dollar-denominated deposits, which suggests that this speculation was more concerned about the financial strength of the country rather than the banking system alone.

Calomiris and Mason (2003) studied the banking crisis during the great depression era. The bank crises in these eras are mostly the bank panics and bank runs, as Friedman and Schwartz (1963) mentions. However, Calomiris and Mason supported the fundamental view by addressing the bank-specific variables such as leverage, asset risk, and liquidity affect the probability of the likelihood of a crisis. They also mentioned that some residuals were remaining while trying to explain the crisis. Hence the fundamental view is not fully capable of explaining these crises, and therefore there is some room for panic involvement in the banking crisis.

2.6 Literature review of Shadow Economy

Shadow economy, also known as the unofficial economy, informal economy, and black economy have been a major topic of interest with different dimensions across economies of all income groups, and the consensus is that the shadow economy harms the development of economies. Shadow economy consists of unrecorded transactions that are not represented in the gross domestic income. Shadow economy incorporates all market-based activities that are hidden from the authorities for various reasons, including: (i) to avoid paying income taxes or value-added taxes, (ii) to avoid paying social security contributions, (iii) not complying by certain administrative procedures. Torgler and Schneider (2007). These issues also stem from weak institutions and regulations. Shadow economy is measured by methods that use surveys and samples and tax audits or by indirect techniques such as multiple indicator multiple cause (MIMIC) or currency and transaction approaches. Combating this economy in the shadows has been a high priority

task for many countries. The existence of a shadow economy makes public planning very challenging since the statistics are very unreliable. The harmful outcomes of the shadow economy are as follows: Sarac and Basar (2014)

1. Underreported GNP and growth rate values
2. Tax injustice
3. Budget deficit due to tax evasions
4. Economic instability
5. Underreported creditworthiness
6. Biased unemployment and inflation rate reports
7. Biased income distribution

The aforementioned points are a small glimpse of the entire harmful effects of the shadow economy.

However, despite its flaws, this underreported economy is capable of positive contributions in some interesting ways. Firms that operate within this environment benefit from the lower cost of operation. This can also benefit the low-income population of the society since they can have access to goods and services at a lower price. Shadow economy can also create job opportunities especially for the impoverished population, and create a new line of supply.

Hence, the overall effect of the shadow economy on economic growth is ambiguous.

After the creation of the European Union, many countries transitioned from planned economies into free-market economies, and under the integration of the EU system, countries adopted clear regulation and standardization, which helped in achieving several benefits for the member countries.

1. Stable organizations that valued human rights and property rules and the rule of law.
2. A clear structure for the economy under the EU regulations and visions.
3. Ability to enforce the obligations of members within the group to follow the EU goals.

These underlying points massively improved the underground economy situation for these countries. Many studies in the literature of the shadow economy emphasized the improvements to the financial sector and the role of the unofficial economy and concluded that improvements in the fundamentals decrease the shadow economy size.

Gobbi and Zizza (2007) studied the link between the shadow economy and financial sector development in the Italian debt markets from 1997 to 2003. They deduced that the growth of the shadow economy halted the development of the financial sector, but the financial sector development had no major effect on the shadow economy.

Bose et al. (2008) evaluated the connection between improvement in banking sectors and the shadow economy in 137 countries from 1995-2007, using the panel regression method. They realized that there is a negative relationship between the banking sector developments and the unofficial economy.

Blackburn et al. (2012) introduced a theoretical model that is comprised of financial intermediation and tax evasions. Their model suggested that the economies with a lower level of financial sector development faced a higher rate of black economy activities combined with more instances of tax evasions.

Capasso and Jappelli (2013) developed a theoretical model using the Italian macroeconomic data that linked the underground economy with the financial sector developments. Their work deduced that, given affordable financing options to firms, it may have a positive result in reducing the effect of the shadow economy. The literature also focuses on the links between the institution's quality and the shadow economy.

Bovi's (2003) study covers 21 OECD countries with the help of panel regression during 1990-1999. This study states that improvement in the institutional quality decreases the size of the underground activities.

Schneider (2006) examines the role of the shadow economy on institutions in 120 countries from 1994-2002 by employing a panel regression method. He deduced that when institutional quality increases, the shadow economy reduces corruption in high income countries (substitution effect) and increases corruption in low income countries (complementary effect).

Enste (2010) evaluated the effectiveness of the regulation in controlling the underground economy. He employed a panel regression method for 25 OECD countries from 1995-2005. This study concluded that deregulation reduces the shadow economy size.

CHAPTER 3

METHDODOLOGY & DATA

Our sample includes 36 countries of various industrialization levels from Asia, Europe, and America. This data is an annual from 1990 to 2018. The data is obtained from International Monetary Funds, International Financial Statistics, and the World Bank database, and lastly, the index Mundi database. This literature covers 18 variables to study as the most suitable leading indicators of economic crisis. The initial pool of selected variables and countries had to be reconsidered and reduced to make the estimation and testing possible due to a lack of data for various countries in this period. We excluded the countries in which we had not enough reliable data; many African countries had to be eliminated. For instance, variables such as bank capital to asset ratio and bank non-performing loans to total gross loans had to be excluded due to the availability of very few data points across the board.

Table 1. List of all countries

Hong Kong *	Greece	Ukraine *	Argentina *
China *	Hungary	Austria	Brazil
India	Iceland	Belgium	Bolivia *
Indonesia	Ireland	Denmark	Canada
Japan	Italy	Switzerland	Chile
Malaysia	Norway	Sweden	Colombia
Philippines	Netherland	Turkey	Mexico
Singapore	Portugal	UK	Peru
South Korea	Russia	Finland	Uruguay *
Saudi Arabia *	Spain		USA
South Africa			
Thailand			
Nigeria *			
Australia			

The list of the countries above is broken into the four groups of all nations, G20 countries, G8 countries, and OECD countries. The countries marked with the asterisks are not included in the estimation due to listwise deletion of missing data in Stata.

Table 2. Group of countries

G20		G8	OECD	
Argentina	USA	Canada	Australia	Norway
Australia		France	Austria	Portugal
Brazil		Germany	Belgium	Spain
Canada		Italy	Canada	Sweden
China		Japan	Switzerland	Mexico
France		Russia	Denmark	Turkey
Germany		UK	Finland	UK
India		USA	France	USA
Indonesia			Germany	Netherlands
Italy			Greece	
Japan			Hungary	
Saudi Arabia			Iceland	
South Africa			Ireland	
South Korea			Italy	
Russia			Japan	
Turkey			South Korea	
UK				

Table 3. List of Potential Variables

Variables	References
Current account	Oktar and Yüksel (2015), Berg et al. (1999), Berg and Pattilo (1999), Bussiere and Fratzscher (2006), Davis and Karim (2008), Cashin and Dutttagupta (2008), Edison (2000), Kaminsky et al. (1998), Vlaar (2000), Gerni et al. (2005), Erkekoğlu and Bilgili (2005), Altıntaş and Öz (2007)
Real interest rate	Oktar and Yüksel (2015), Barrell et al. (2010), Berg and Pattilo (1999), Ergüngör and Thompson (2005), Cashin and Dutttagupta (2008), Edison (2000), Frankle and Rose (1996),
Inflation	Oktar and Yüksel (2015), Barrell et al. (2010), Davis and Karim (2008), Cashin and Dutttagupta (2008), Vlaar (2000), Gerni et al. (2005), Erkekoğlu and Bilgili (2005), Kaya and Yılmaz (2007)
FDI	Lipsev (2001), Alfaro and Chen (2010), Mamata (2011)
Total reserves	Kaminsky et al. (1998), Berg and Pattilo (1999)
The risk premium on lending	Graham and Harvey (2014)
Broad money growth	Kaminsky et al. (1998), Berg and Pattilo (1999), Frankle and Rose (1996)

Table 3. Continued

Variables	References
Official exchange rate	Kaminsky et al. (1998), Berg and Pattilo (1999), Frankle and Rose (1996)
Domestic credit provided by the financial sector	Aisen and Franken (2010), for Demirguc-Kunt and Detragiache (2000), Eichengreen and Arteta (2000),
Bank concentration of assets	Demirguc-Kunt and Detragiache (2000)
Claims on central government	Author's Choice
Shadow Economy	Gobbi and Zizza (2007), Capasso and Jappelli (2013), Enste (2010)
Bank System Capital	Demirguc-Kunt and Detragiache (2000)
Gross saving	Eichengreen and Arteta (2000)
Net lending / net borrowing	Smyth (2017)

Table 3. Continued

Variables	References
Bank	Demirguc-Kunt and Detragiache (2000)
Non-interest income	
Economic globalization Index	Bustelo and Olivie (1999)
House Price Index	Sanders (2008), Reinhart and Rogoff (2008)
Capital investment	Kahle and Stulz (2013)
Short term debt	Diamond and Rajan (2001), Krishnamurthy and Vissing-Jorgensen (2012)
Broad money to total reserve ratio	Chadha et al. (2017)
INFR	Beck and Poelheckke (2017)
Internet Users	Authours Choice

3.1 Potential Explanatory variables

According to the World Economic Outlook of IMF (1998), a competent early warning system have to follow certain traits: Firstly, these indicators should be selected in such a way to be capable of detecting future crises effectively with a reasonable degree of certainty. Secondly, the estimated coefficients of indexes must be statistically significant. We attempt to find a pool of variables concerning other empirical works of

literature on this topic while introducing a few new variables that we think of as potential significant variables in this study. Firstly, the list of these variables in the context of the empirical works are shown, and then we explain our possible variables.

Table 4. Significant variables in related empirical works

Indicator	KLR	BP	DKD	EA	LL
Real exchange rate	*	*	-	-	-
Export Growth	*	*	-	-	-
Import Growth	-	-	-	-	-
Terms of trade	-	-	-	-	-
CA/GDP	-	*	-	-	*
M2/ Reserves changes	*	*	*	-	-
Growth of foreign Exchange	-	*	-	-	-
M1 and M2 growth	-	-	-	-	-
M2 money multiplier	-	-	-	-	-
Domestic credit/ GDP	-	-	*	*	-
Excess Real M1 balance	-	-	-	-	-

Table 4. Continued

Indicator	KLR	BP	DKT	EA	LL
Lending and deposit rate spread	-	-	-	-	-
Commercial bank deposits	-	-	-	-	-
Bank Reserves/Bank assets	-	-	-	-	-
Fiscal balance / GDP	-	-	-	*	-
Public Debt / GDP	-	-	-	-	-
Growth of industry production	*	-	-	-	-
Changes In stock prices	*	-	-	-	-
Real interest rate	-	-	*	-	-
Inflation rates	-	-	*	-	-
GDP per capita	-	-	*	-	*
National Saving growth	-	-	-	-	-
Growth of world Oil prices	-	-	-	-	-
USA interest rates	-	-	-	-	-
OECD GDP growth	-	-	-	-	-
Observations	1970-95	1970-96	1980-95	1975-97	1989-96
Frequency	Monthly	Monthly	Monthly	Annual	Annual
Method	Signal	Probit	Logit	Probit	Probit
Country coverage	20	23	65	78	93

Notes:

1. KLR stands for Kaminsky, Lizondo, Reinhart (1998) this study is based on the currency crisis.
2. BP stands for Berg and Pattillio (1999) this study is based on the currency crisis.

Table 4. Continued

Notes:

3. DKD stands for Demirguc-Kunt and Detragiache (2000) this study is based on the banking crisis.
 4. EA stands for Eichengreen and Arteta (2000) this study is based on the banking crisis.
 5. LL stands for Lanoie and Lemar (1996) this study is based on the debt crisis.
 6. The * sign in the table shows the significance of the variables
-

Current account

The current account balance is sum of net exports of goods and services, net primary income and secondary income. This variable is defined as a percentage of GDP. This variable has been a common term in almost any study regarding economic crises and financial crises. We expect a negative relationship between this variable and the likelihood of economic crisis since the deterioration of the current account is one of the major causes behind the crisis.

Real interest rate

The real interest rate is the lending interest rate, which is adjusted for inflation with the use of GDP deflator. The real interest rate can be quite foretelling about the state of the economy, and many kinds of literature prove its prominence in the study of recessions. Interest rates often do not increase at the time of a recession, and most of the time, the opposite happens the interest rate falls when the economy is contracting. The anticipated relationship between this variable and the crisis is expected to be volatile. During a recession, expectations are built around the falling rates of interest rates amid a recession. However, also records of the past event have captured particular and significant moments in which the real interest rate was not following the expected pattern due to some other factors and shocks and influences from other aspects of the economy.

Inflation rate

Inflation is measured as the change in the consumer price index, which reflects the annual changes in the cost of the representative basket of consumer goods. Like real interest rate is also deemed as one of the essential variables in the study of the crisis. If the inflation is too high, the economy can suffer something which is often seen as a hyperinflation phenomenon. A controlled inflation rate can be the reason behind the prosperity of an economy. At times of recession in the economy due to lower demand, inflation tends to steep downward.

Foreign direct investment net inflows

Foreign direct investment showing the net inflow of investment from abroad coming to the host economy. The crisis has a severe impact on the confidence of the investors. Often this lack of faith emerges from speculations around the economic environment of a country. This news is capable of changing the course of investment in that country, in which no investor feels safe to carry on with their investment decision. This phenomenon can result in a crisis in the country, and we expect the relationship between the FDI and the crisis index to be negative.

Total reserves

Total reserves work as the hedge against the risk of facing a financial crisis. These sorts of crises are looming against the countries which are not endowed enough in terms of their total reserves, including the foreign exchange reserves. A country with a shortage of reserves is susceptible to the speculative attacks and, in turn, exposed to the higher chances of a crisis. Our total reserves variable is expressed as a percentage of the external debt, which depicts how well-endowed the country is in terms of their liabilities owned to the foreign economies. A high rate of reserves makes it easier to sustain the exchange rate and instill trust in the eyes of foreign investors who are deciding for an offshore investment environment.

Stocks Traded

The variable represented here embodies both foreign and domestic traded shares. Stocks market is seen as a vote of confidence in the overall economy, and investing in

stocks often seen as a battle plan to beat the inflation in the economy. A wrong signal coming from the stock market can slow down the pace of the economic growth and upset many investors; additionally, a crash in this market can devastate the economy. A crash in the stocks market, therefore, can have a spillover and trouble the economy afterwards. Lower stock prices translate into less wealth for businesses and individual investors. When stock prices stay down for long-time new businesses will not be able to have access to funds, and their growth will halt, and the other companies that had an investment in the stocks will have severe problems regarding their employees' payrolls.

Official Exchange rate

The exchange rate has always been of the hot topics in the literature surrounding any financial and currency crisis. Many developing countries with different exchange rate regimes such as pegged or floating exchange rates experienced at least a mild degree of exchange rate crisis. Nowadays more than ever even the political tensions between global actors can result in the weakening of the national currency of a country. The topic of a weakened currency is sophisticated and important and it is not merely limited to the deterioration of the economic outlook, instead, often it is seen as a strategic asset to establish a country into an essential factor in the global export market, depending on the degree of the industrialization of the country.

On the other hand, a weakened national currency could worsen the country's foreign debt and make the cost of living much higher for the residents inside and even lead to a financial crisis. That is why the exchange rate is one of the staple indicators in almost any economic study, and we don't treat it differently here.

Claims on central government

Claims on the central government is an indicator of government indebtedness. Higher level of indebtedness leads a country into cutting on spending and welfare and raising taxes. This phenomenon often prompts a debt crisis. A genuine debt crisis occurs when a country is not able to meet its debt obligations. A debt crisis deteriorates the image of the country in the eyes of investors and exacerbates the speculations of debt defaults in the country.

The rule of law

Economic prosperity foundations are laid on the back of a successful and distinctive legal system, which upholds property rights and makes it possible to establish an environment to benefit society. Having a set of rules is crucial for economic growth, a country without clear rights and regulations is not respected by financial institutions and investors. This variable encompasses multiple components, ranging from individual security, property rights, checks, and balances on the central government and control of corruption. These regulations must be fair, public, and enforceable so that the markets can work efficiently and effectively.

Shadow Economy

Also known as underground, informal, or parallel economy, this measure includes both illegal and unreported activities. The shadow economy comprises all of the economic events that would be taxable if they were reported to the authorities. Shadow economy is a significant factor in many countries; many households evade taxes and regulations by contributing to the shadow economy. These unreported activities can result in reduced tax revenues, higher regulatory control costs, and lower economic growth rates. The shadow economy can also boost the overall production of goods and services in the economy.

Short term debt

Domestic revenue and foreign debt are two important factors when it comes to evaluating the performance of the economy. Many of the developing countries are the victim of growing debt in their accounts. Many of them fail and cannot repay their liabilities, and their problems spiral out of control. The higher the short term-debt to the external debt ratio, the more problematic the situation will be for the indebted country. This fact for sure will tarnish the outlook of the economy as a troubled one, and many investors will not step into risk in such an environment. A short-term debt can also manipulate other variables such as interest rate, due to loss of the confidence in the eyes of the investors, and that is why sometimes the interest rate is one of the things that is tweaked to make the country's investment outlook more promising.

Gross saving as a percentage of GDP

The saving ratio is a determinant of economic activity. Saving and its rate works with many facets of the economy and influence the consumption and investment culture of a country. In economics, it is often expressed that the level of saving is equal to the level of investment, and investment is funded by saving. The higher is the saving in one economy; there will be more activity within the banking sector to lend more for investment. The economic growth depends on the level of savings and investment in the country and some economic growth models such as the Harrod-Domar model of economic growth portrays this statement. Long term saving is seen as an engine that drives the investment, but the effect of short-term saving decisions is often neglected in the literature. A sudden spike of short-term savings decreases the current consumption at the national level, and this will influence many domestic producers, and this fall in domestic use can cause a recession in a country.

Net lending (+) / net borrowing (-)

Net lending/net borrowing is equal to government revenue minus expenditure minus net investment in nonfinancial assets. This indicator shows the extent that the government is providing financial resources at the disposal of other sectors in the economy or utilizing the financial resources generated by other sectors in the economy or from abroad. This indicator shows the public state of affairs.

Broad money to total reserve ratio

The multiplier effect refers to the proportional amount of increase in final income that ensues from the injection of new funds either in terms of spending or money. The way banks make money is by making loans. A bank is required to keep a particular portion of its deposits as reserves. The money multiplier process changes the money supply. When the monetary base is increased, banks loan out most of this money. This money, later on, is deposited again in other banks, and this cycle keeps on going on. During a financial crisis, banks do not feel comfortable to loan out their excess reserves out of the fear that

they might not be repaid. The excess reserve or shortage of reserves is capable of changing the monetary base and, even more importantly, the inflation rate.

Broad money growth

Broad money is defined as the sum of the currency which is available outside of the banks, and it is a category that measures the amount of money circulating in the economy. Mainly central banks track the growth of the broad money to forecast the inflation. The term broad money incorporates things like short-term deposits and short-term securities. Broad money is widely used as a policy tool to keep the economy in check. At times when enough or more than enough money is available, the economy tends to speed up its growth since it is easier for businesses to have access to the funds necessary and vice versa. Hence the study of broad money growth is a vital part of understanding the movements behind an economic crisis.

Number of internet users

The emergence of the internet and the revolution in information technology changed many aspects, of how people, share information, create new ideas, and even work. The internet accounted for 21 percent of the GDP growth in mature economies over the past five years. Many large enterprises and even small start-up entrepreneurs benefited from the advantages of this new technology. The impact of the internet on the GDP can be higher than other sectors such as agriculture in the past decade. This technology is capable of cutting unnecessary costs such as logistics and economies of scale, and in turn, ramps up productivity growth.

House price index

House price index is a measure of the movement of the single-family house prices. Aside from being used as an indicator of house prices, HPI is one of the many indicators that is monitored by investors, to keep track of general movements of the economy and the shifts in the stock market. As seen in the past, turmoil in the housing market is capable of sending devastating shocks into many sectors of the economy and cripple the investors and cause a recession. Apart from being a critical asset, many households see the housing

market as a long-term investment, and this is another reason behind the necessity of this indicator in this study.

Net Portfolio Equity Inflow

Portfolio equity includes net inflows from equity securities other than those recorded as direct investment and including shares, stocks, depository receipts, and direct purchases of shares in local stock markets by foreign investors.

Economic Globalization Index

Economic Globalization Index has two dimensions: actual economic flows and restrictions to trade and capital. This index includes economic inflow data such as FDI, trade data, and portfolio investment. This index demonstrates the degree of openness and investment in a country. We expect to have clear and distinctive feedback from this index. Based on our expectations, the higher the economic globalization index is, the chances for an economic crisis will be slimmer.

Capital investment as a percentage of GDP

Economic growth increases the production of goods and services. Economic growth ensues from consumer spending, international trade, and business investment. However, sustainable economic growth is not possible without innovations and technological advances, and the progress in technology requires a capital investment, which consists of purchases and investments by other companies and parties. The increased capital investment allows for a higher degree of research and development, and this will result in higher production efficiency.

Income from natural resources

The fundamental factor affecting the development of an economy is natural resources. Natural resources are comprised of minerals, gas, oil, climate, forest wealth, etc. resources are crucial for the development of any country. The energy required for any industrial activity demands some extent of fossil fuels or green energies, such as solar. Countries that are well-endowed in terms of natural resources are benefiting from the use and trade of these resources. Many countries are solely dependent on the sale of these resources to function their economy, ranging from the sale of crude material such as oil

and gas or selling petroleum products. These crude materials comprise a large portion of the GDP size for many countries, and global fluctuations in their prices affect countries.

Bank concentration: percent of bank assets held by the top three banks

Bank concentration of assets showcases the assets that are held by the top three banks. This value carries an interesting meaning, and that refers to the possibility of a big event that might occur in case of a severe banking crisis that can have a detrimental effect on the entire sector and the economy. The global financial crises of 2008 ensued after the bankruptcy of big banks such as Lehman Brothers and Merrill Lynch, and the bank concentration variable is capable of highlighting the vulnerability of the entire banking system in case of a big failure in one of the major actors in this sector.

Bank non-interest income to total income, in percent

Bank non-interest income to total income is an indicator that shows the amount of income each bank can pocket outside of the main intermediary activities of a bank, which is earning the difference between lending and borrowing rate difference, known as the interest rate spread. This variable is capable of highlighting the strength of each bank portfolio. At times, many lenders may find other depositary and investment institutions more profitable than a conventional commercial bank. This lack of confidence in the banking system will not leave a good trail on the balance sheet of these banks. Nevertheless, not all of these banks share the same fate, even though all of them co-exist in the same environment, and follow the same regulations. Some banks differentiate themselves from their counterparts by figuring out creative and non-traditional ways to earn higher revenue from their customers. These non-interest related incomes will act as a hedge against the encountered attacks and critical slowdowns in the banking system. When the banks are less reliant on interest income, there is less chance that these institutions default and go out of the business.

Freedom from Corruption index

The score for the freedom of corruption index is derived mainly from the transparency international corruption perception index. For the countries that are not covered in the CPI the freedom from corruption, the score is determined by using

information from internationally recognized and reliable sources. A country riddled with corruption has a significant obstacle to its economic development. Such corruption reduces domestic investment and spreads wrong signals towards the foreign investors who once were interested in investing in that economy. Each corruption has its extent, but in general, they are capable of inflating government spending or shifting it away from projects in dire need of attention towards projects that are in favor of a few people or some organizations.

Bank credit to the private sector as a percent of GDP

Domestic credit to the private sector by banks refers to financial resources provided to the private sector by other depository corporations, through loans, purchases of non-equity securities, and trade credits. Credit is one of the reasons behind the increase in spending, and that, in turn, results in a higher income level in the economy. More credit is sought after when the interest rates are lower, and the banks perform better when there is a higher demand for affordable funds. It is not hard to see the link between the importance of the credit market and the economy; therefore, it is vital to have it in this study to analyze the effect on the economic crisis.

Property rights Index

The property rights index evaluates the degree to which a country's laws protect private property rights and the degree to which the government enforces those laws. A country with a well-established judiciary system that protects the rights of owners in all aspects from copyright infringements to land thefts is a safe place for investment and attracts investors, compared to a country that has many vague or legal loopholes. Rules and regulations are proven to be the backbone of a thriving economy.

The risk premium on lending

The risk premium on lending is known as the interest rate charged by banks on loans to private sector customers minus the Treasury bill interest rate. In some countries, this spread could be negative, which means that the market deems that the corporates are lower risk than the government itself. An unforeseen shock in the risk premium brings financial instability, and lack of attention in adjusting it can cause macroeconomic instability. Monitoring the risk premiums provides us with additional information

associated with future economic outcomes that are not revealed by other typical indicators. For instance, a sudden spike in the risk premium can be a sign of a severe recession.

3.2 Definition of a Crisis

Among various crisis literature writings, there have been many different methods and approaches to how a crisis is defined. For instance, a currency crisis in the eyes of Frankel and Rose (1996) is seen as "A nominal depreciation of the currency of at least 25% or at least a 10% increase in the rate of depreciation." According to Kaminsky et al. (1998), a currency crisis is viewed as "A weighted average of monthly percentage depreciations in the exchange rate and monthly percentage declines in foreign exchange reserves when they exceed the mean by more than 1.1 standard deviations." A systematic banking crisis happens when many banks in a country are in severe solvency and liquidity issues. These events can occur either because they were targeted by outside shocks or due to the failure of other banks, which has a contagion effect on the other banks in the system. This is followed by a decrease in the value of bank assets.

In our approach for this study, an economic crisis is a situation in which the economy of a country faces an abrupt downturn and slowdown in its gross domestic product rate of growth. We define a crisis as a negative growth rate in GDP, or a fall of more than two points in the annual GDP growth rate, and lastly, two or more consecutive periods of negative economic growth rate when it is matched with a decreasing value added in the industrial production index. The addition of changes in GDP growth rate helps us to avoid the problem of having murky results for our dependent variable since, due to movements in the business cycles, there will be some cases of negative GDP growth rate. A growth rate of 9 % in year X is not showing any crisis in the economy; meanwhile, a growth rate of 2% in the following year is a positive value, but it bears a negative 7-unit difference in the GDP growth, and without having the GDP growth rate differences, this fact would be overlooked. Besides, we also compare these criteria against the changes in the value-added to the industrial production index across all the countries, this will help us to reduce the likelihood of identifying a wrong crisis window. A fall in the value of this index points out towards the loss of overall production in the economy, and it will clarify the time windows in which our GDP criteria are marginally showing a crisis.

Our definition of economic crisis yields 369 cases of this occurrence out of 1305 samples for an economic crisis happening in our timeline amid all the countries involved in this study. In the following, these event years that fit our criteria are depicted for each one of the potential countries in our study.

Table 5. Crisis Years Identified

Argentina	1990,1994,1995,1998,1999,2000,2001,2002,2008,2009,2011,2012,2014,2016,2018
Australia	1991,2001
Brazil	1990,1991,1992,1996,1998,1999,2001,2005,2009,2011,2012,2014,2015,2016
Canada	1991,2001,2007,2008,2009,2015
Chile	1993,1996,1998,1999,2001,2008,2009,2014
China	1995,2008,2012
Colombia	1991,1996,1998,1999,2008,2009,2012,2017
Denmark	1990,1993,1995,2001,2007,2008,2009
Finland	1991,1992,1993,2001,2008,2009,2011
Greece	1992,1993,2005,2007,2008,2009,2010,2011,2012,2013,2014,2015,2016
Hong Kong	1995,1998,2001,2002,2003,2005,2006,2007,2008,2009,2011,2012
Hungary	1992,1996,2007,2008,2009,2012
Iceland	1992,1995,1999,2002,2008,2009,2010,2014,2017
India	1991,1997,2000,2008,2011
Indonesia	1997,1998,1999
Ireland	1991,1996,1998,2001,2003,2008,2009,2013,2016
Italy	1992,1993,2001,2002,2003,2008,2009,2012,2013
Japan	1992,1993,1997,1998,1999,2001,2008,2009,2011

Table 5. Continued

Malaysia	1997,1998,2001,2008,2009,2011
Mexico	1992,1993,1995,1999,2001,2007,2008,2009,2013
Netherlands	2001,2002,2003,2008,2009,2012,2013
Norway	1998,2006,2008,2009,2010
Peru	1990,1992,1995,1996,1998,2001,2009,2011,2014
Philippines	1991,1998,2005,2008,2009,2011
Portugal	1992,1993,2001,2002,2003,2005,2008,2009,2011,2012,2013
Russia	1990,1991,1992,1993,1994,1995,1996,1998,2001,2008,2009,2013,2014,2015
Singapore	1991,1995,1998,2001,2005,2008,2009,2011,2012,2015
South Korea	1992,1996,1998,2000,2001,2003,2008,2009,2011
Spain	1992,1993,2008,2009,2010,2011,2012,2013
Sweden	1991,1992,1993,1996,2001,2008,2009,2011,2012
Switzerland	1991,1992,1993,2001,2008,2009
Thailand	1991,1996,1997,1998,2005,2008,2009,2011,2013,2014
Turkey	1991,1994,1998,1999,2001,2006,2007,2008,2009,2012,2014,2016,2018
UK	1991,2008,2009,2012
Uruguay	1993,1995,1998,1999,2000,2001,2002,2006,2009,2011,2015
USA	1991,2001,2008,2009

Table 5. Continued

Bolivia	1992,1999,2009
Nigeria	1991,1993,1994,1995,1999,2003,2005,2011,2015,2016
Ukraine	1990,1991,1992,1993,1994,1995,1996,1997,1998,1999,2002,2005,2008, 2009,2012,2013,2014,2015
France	1993,2008,2009
Germany	1992,1993,1996,2002,2003,2008,2009,2012
Austria	1993,2001,2008,2009,2012
Belgium	1993,1998,2001,2008,2009,2012
Saudi Arabia	1992,1993,1999,2001,2002,2003,2005,2006,2007,2009,2012,2013,2016, 2017
South Africa	1990,1991,1992,1998,2008,2009

3.3 History of the empirical literature

Two prominent different methodologies have been used extensively in the empirical studies of the early warning systems of the crisis: the first type is the methodology is used by the Kaminsky and Reinhart (1996),and Lizondo and Reinhart (1998) which is known as the “Signals” approach which capitalizes on the signal to noise ratio for the potential indicators of the crisis.

The second, the more famous and popular approach among scholars is the use of probit or logit models. This type of model has been illustrated by Eichengreen and Rose (1998) for the currency crisis models and Demirguc-Kunt and Detragrache (1998) for the

banking crisis models. In this paper, we chose the Probit / Logit models over the Signals approach to conduct our study.

3.4 Panel limited dependent variable models

In qualitative response models, the variable to be explained, y , is a random variable that takes on a finite number of outcomes. Binary response models are a special case where the dependent variable takes on the values of zero and one, according to whether or not a specific event has occurred, in our case whether a financial crisis has occurred. These models have extensive use across many fields of economics.

The use of limited dependent variables in the context of panel data is a relatively recent and developing field of econometrics. There are a number of technical issues that the literature is still working on resolving, like the incidental parameters problem in fixed effects models, the assumptions for the distribution and the correlation structure of the errors that facilitate reliable coefficient estimators, the appropriate handling of time-invariant regressors, dynamic models, GMM versus ML and conditional ML estimators, etc. The discussion of such issues is beyond the scope of this study so the empirical work here is confined to the application of panel probit/logit random effects models using STATA.

In this study we use a panel probit/logit random effects model in the following form:

$$y_{it}^* = x_{it}'\beta + v_{it} \quad i = 1,2, \dots N \text{ and } t = 1,2, \dots T$$

$$v_{it} = \alpha_i + u_{it}$$

and

$$y_{it} = 1 \text{ if } y_{it}^* > 0 \text{ and } y_{it} = 0 \text{ if } y_{it}^* \leq 0$$

where, y^* denotes the unobservable latent variable, y is the observed outcome, x is the vector of observable time varying and time invariant strictly exogenous characteristics which influence y^* , β is the vector of coefficients associated with the x , α_i denote the individual specific unobservable effects and the u_{it} is a random error.

In order to estimate β using the maximum likelihood method, we need to use an assumption regarding the joint distribution of the v_{it} , which depends on the distributions of α_i and u_{it} . Multivariate normal is the distribution of choice in most discussions, although other distributions are theoretically possible.

The more pressing issue is the complex structure of the likelihood function which is computationally very inconvenient. The contribution of individual i to the overall likelihood is the joint probability of observing T outcomes y_{i1}, \dots, y_{iT} . This joint probability is determined from the joint distribution of the latent variables $y_{i1}^*, \dots, y_{iT}^*$ by integrating over the appropriate time intervals. This will mean that we have T integrals, which have to be estimated numerically. A large T makes maximum likelihood estimation very impractical. In fact, the likelihood contribution of individual i looks like:

$$L_i = P(y_{i1}, \dots, y_{iT}|X) = \int_{L_{iT}}^{U_{iT}} \dots \int_{L_{i1}}^{U_{i1}} f(v_{i1}, v_{i2}, \dots, v_{iT}) dv_{i1} dv_{i2} \dots dv_{iT}$$

This computational problem can be overcome using simulation-based estimators. These estimators are widely discussed by Keane (1993), Weeks (1995), and Hajivassiliou and McFadden (1998). Another solution is the Butler and Moffit (1982) method. It is also possible to use a GMM estimator as discussed by Avery, Hansen and Holtz (1983), Bertshek and Lehner (1998) and Inkmann (2000).

In order to demonstrate the issue, we can assume that

$$E(u_{it}|X) = 0, Cov(u_{it}, u_{js}|X) = Var(u_{it}|X) = 1, \text{ if } i = j \text{ and } t = s; 0 \text{ otherwise.}$$

$$E(\alpha_i|X) = 0, Cov(\alpha_i, \alpha_j|X) = Var(\alpha_i|X) = \sigma_\alpha^2, \text{ if } i = j; 0 \text{ otherwise.}$$

$$Cov(u_{it}, \alpha_j|X) = 0 \text{ for all } i, t, j.$$

$$Cov(x_{it}, \alpha_j|X) = 0 \text{ for all } i, t, j.$$

where X indicates all the exogenous data in the sample, x_{it} for all i and t . Then we have:

$$E(v_{it}|X) = 0$$

$$Var(v_{it}|X) = \sigma_\alpha^2 + 1$$

$$Cov(v_{it}, v_{is}|X) = \rho = \frac{\sigma_\alpha^2}{1 + \sigma_\alpha^2} \quad \text{and} \quad \sigma_\alpha^2 = \frac{\rho}{(1 - \rho)}$$

Here notice that conditioned on the α_i , the v_{it} are independent. Thus, we can write the likelihood contribution of individual i in terms of a one-dimensional integration instead of a T-dimensional one¹.

$$L_i = P(y_{i1}, \dots, y_{iT} | X) = \int_{-\infty}^{+\infty} \left[\prod_{t=1}^T P(Y_{it} = y_{it} | x'_{it}\beta + \alpha_i) \right] f(\alpha_i) d\alpha_i$$

We also need to specify the distribution of α_i . Using the multivariate normal distribution, if we assume $\alpha_i \sim NID(0, \sigma_\alpha^2)$ and $u_{it} \sim NID(0, 1)$, the likelihood contribution of individual i becomes:

$$L_i = P(y_{i1}, \dots, y_{iT} | X) = \int_{-\infty}^{+\infty} \left[\prod_{t=1}^T P(Y_{it} = y_{it} | x'_{it}\beta + \alpha_i) \right] \frac{1}{\sqrt{2\pi\sigma_\alpha^2}} \exp\left\{-\frac{\alpha_i^2}{2\sigma_\alpha^2}\right\} d\alpha_i$$

This integral can be computed accurately using a Gauss-Hermite quadrature. This is the Butler and Moffit (1982) method. Note that this method relies on a rather restrictive correlation structure and particularly the normal distribution for the α_i . If the normality assumption and/or the correlation structure given above are deemed inappropriate Maximum Simulated Likelihood or GMM estimators can be considered.

The discussion so far has been in terms of the panel probit model but the same discussion applies to the panel logit model with the qualification that u_{it} are i.i.d.

logistic distributed with mean zero and variance $\sigma_u^2 = \frac{\pi^2}{3}$, independently of α_i .

As far as diagnostic tests are concerned, the first indicator to consider is ρ which is the proportion of the total variance contributed by the panel-level variance component. If $\rho = 0$, then variance across the panel is negligible and a pooled model may be preferable. This is given by an LR test in STATA. Another indicator to consider is the pseudo- R^2 , as a measure of goodness of fit, which, in such models, is likely to have a low value. Wooldridge (2002) test for autocorrelation was also conducted for the estimated panel probit/logit models, to verify that the estimate of the variance-covariance matrix is reliable.

¹ See Greene (2008) for a detailed derivation.

3.5 Elimination of improper potential variables

We discussed the importance of the potential variables and their role in the financial crisis phenomena. We also introduced our method of examination. Our goal is to create a situation that is capable of delivering the most accurate statistical estimation, given the limitations on the data and the method of estimation itself. As we stated previously, our data is fragmented in some parts due to the difficult nature of finding consistent and reliable international data for a long period. On the other hand, we are not in favor of overloading our estimation with excessive explanatory variables, since it would lead to lower degrees of freedom. This would be a very big problem for groups that have a lower observation count compared to the bigger groups. Hence, to avoid this problem, we cherry-pick the most critical and most interesting variables in terms of their value towards the subject and our curiosity. The process of elimination is conducted after running multiple estimations with a larger number of explanatory variables that drop the most insignificant and distant variables from the economic theory respectively. We also consider statistical measurements to ensure that our results are as unbiased and consistent as they could be. This process includes eliminating variables that have a large degree of missing data entries, correlation issues, and other statistical discrepancies. The following table depicts the order of elimination for each potential variable and in the next section, we show the degree of correlation for some of these variables with the help of the correlation matrix.

Table 6. Eliminated variables

Variables	Reason for elimination
Total reserves	Similar components been used
Claims on the central government	Missing data entries
The rule of law	Correlated with other potential variables
Short term debt	Missing data entries
Broad money to reserve ratio	Correlated with other potential variables
Broad money growth	Correlated with other potential variables
Economic globalization index	Correlation and significance issue
Freedom from corruption index	Correlated with other potential variables
Property rights index	Correlation issues and missing data entries
The risk premium on lending	Missing data entries

CHAPTER 4

ESTIMATION, INTERPRETATION AND ANALYSIS

To achieve a consistent and meaningful result for our estimation, our first task would be a way to detect multicollinearity. We use the correlation statistics to see the degree of collinearity. All four groups of interest are tested through this method and the results are shown in the following tables:

Table 7. Variable correlation list for all countries

Variable pairs	Correlation coefficient
Shadow economy – Freedom from corruption index	0.78
Property rules index- Freedom from corruption index	0.89
Current account – Foreign exchange reserve	0.61

Table 8. Variable correlation list for G20

Variable pairs	Correlation coefficient
Shadow economy- Freedom from corruption index	0.78
Property rules index – Freedom from corruption index	0.89
Current account – Foreign Exchange reserve	0.61
Freedom from Corruption index – Bank credit given to private sector	0.62
Saving- income from natural resources	0.56
Saving- Current account	0.60
Stock market capitalization- Shadow	0.66

Table 9. Variable correlation list for G8

Variable pairs	Correlation coefficient
Shadow economy- Freedom from corruption index	0.78
Property rules index – Freedom from corruption index	0.89
Freedom from Corruption index – Bank credit given to private sector	0.62
Saving- Current Account	0.66
Saving- Capital investment	0.63
Stock capitalization- Current account	0.55
Bank non-interest income- annual changes in the house prices	0.58

Table 10. Variable correlation list for OECD

Variable pairs	Correlation coefficient
Shadow economy- Freedom from corruption index	0.78
Property rules index – Freedom from corruption index	0.89
Current account – Foreign Exchange reserve	0.61

The variables, as mentioned above, suffer from a high degree of collinearity in our models, and it is essential to address them before plugging them into each model since they are capable of producing biased results.

4.1 Panel Probit Regression

With the help of testing measures, we inferred that the correct regression for our panel data model would be a panel regression that allows us to account for binary dependent variables. Before testing our model, we estimated and accounted for the problem of multicollinearity. Additionally, it is possible to tackle the heteroscedasticity in

our estimation with the use of robust standard errors instead of using the default standard errors. Estimation results about the all countries are presented here:

Table 11. Probit Estimation results

Variables	All countries	G20	G8	OECD
Inflation L1	0.11 (0.10)	0.001 (0.988)	0.13 (0.23)	0.21 (0.014)
Stock market cap	-0.05 (0.003)	N/A	N/A	-0.006 (0.001)
Exchange rate	0.15 (0.00)	0.12 (0.000)	0.14 (0.11)	0.13 (0.000)
FDI	0.002 (0.787)	-0.01 (0.822)	0.40 (0.692)	-0.002 (0.808)
NPEI	-0.00002 (0.00)	0.0000003(0.91)	0.000001 (0.612)	-0.000001 (0.002)
CA	0.005 (0.801)	0.020 (0.408)	0.30 (0.609)	0.024 (0.368)
Shadow Economy	0.012 (0.124)	0.05 (0.001)	0.25 (0.529)	0.03 (0.849)
Internet users	0.004 (0.306)	0.005 (0.387)	0.005 (0.569)	-0.002 (0.642)
IFNR	-0.005 (0.824)	-0.08 (0.02)	-0.027 (0.79)	0.005(0.877)
BCON	0.010 (0.078)	0.002 (0.618)	0.01 (0.462)	0.007 (0.238)
BNON	-0.007 (0.29)	0.002 (0.856)	N/A	-0.007 (0.444)
Interest rate	-0.0006 (0.943)	-0.004 (0.708)	0.151 (0.038)	0.037 (0.225)
Inflation	0.41 (0.310)	0.081 (0.338)	0.334 (0.794)	0.088 (0.197)
Capital Investment	-0.012 (0.455)	-0.001 (0.944)	0.10 (0.126)	-0.034 (0.278)
Net Savings	-0.004 (0.669)	N/A	N/A	0.015 (0.361)
Net lending/borrowing	-0.015 (0.336)	-0.03 (0.047)	-0.11 (0.106)	-0.033 (0.281)
BCP	0.009 (0.000)	0.007 (0.051)	0.012 (0.012)	0.009 (0.000)
Real House prices	-0.400 (0.002)	-0.02 (0.021)	-0.092 (0.001)	-0.057 (0.005)
Intercept	-1.777 (0.030)	-2.78 (0.016)	-6.57 (0.006)	-1.392 (0.234)

Table 11. Continued

Notes:

1. Numbers outside of the () indicate the coefficient for the variables and numbers inside of the () indicate the significance of those variables.
 2. NPEI stands for Net portfolio equity inflow
 3. INFR stands for Income from natural resources
 4. BCON stands for Banks Concentration of assets in top three banks
 5. BNONI stands for Banks non-interest income
 6. BCP stands for Bank credit given to the private sector
-

According to the Panel probit estimation, seven significant variables explain our dependent variable. The first lag of inflation is put in this model to take into account the expectation effects. This value is significant, and this implies that the inflationary expectations values work well in explaining the current economic crisis. The second important variable, the exchange rate, is another critical factor for all country model. This variable is one of the leading factors behind the currency crisis, and our results are supporting our expectations that this variable is of high importance for the general model containing all of our sample countries. The third significant variable, according to our regression, is net portfolio equity inflow. This variable is an indicator of the short-term investment in an economy. Our fourth significant variable is the Stock market capitalization. Bank concertation of the asset in the top three banks is our fifth significant indicator according to our estimation results. Our sixth significant variable for the general group of the countries is the bank credit given to the private sector. Lastly, seventh important indicator of economic crisis is the annual change in real house prices. This variable is expected to have a significant effect on the economy, and previous studies showed a strong correlation between the housing market boom and busts and economic crisis. This variable behaves as expected in our model for all countries involved in our study.

4.2 Estimation results for the G20 group

By looking at Table 11 we can discuss the G20 group of countries. The results related to the G20 group of the countries embody some interesting results. According to the findings from the estimated regression, the exchange rate is significant for the G20 group. and the shadow economy as a percent of the GDP is significant for indicating an economic crisis, unlike the general group of countries. Net lending/net borrowing of the government is the next significant variable in our list. When we check the history of these top 20 economies from 1990, it becomes apparent that not all of these countries benefited from a surplus in their government budgets, and hence our results ensue. Another significant variable is the shadow economy, and our expectations regarding this variable have been met by our findings. In the next spot, income from natural resources is another significant variable in predicting a crisis. There are many economies in the G20 list that massively benefit from the trade-in crude materials and other natural resources such as land. By considering these facts, we expected the income from natural resources to be a significant indicator, and our expectations are met once again. Similar to the previous results for the general group of the countries, bank credit provided to the private sector by the banks is another significant indicator in the economic crisis for the G20 economies. Annual changes in the residential prices are another essential leading indicator in this Group.

4.3 Estimation results for G8 Countries

The next list of countries consists of G8 countries. Table 11 discloses the significant variables in the economic crisis for these eight countries over 132 observations. The first significant variable is once again the exchange rate, and it has been a consistent variable for all of our groups thus far. The second significant indicator for our analysis is the interest rate. According to the probit results, the third indicator of our economic crisis belongs to the net lending/net borrowing of the government. Bank credit given to the private sector is the next significant indicator, similar to the previous groups. We do have a near-significant variable in the G8 list, and this variable is the capital investment, which is another indicator of the economic crisis. lastly, the annual changes in the prices of the residential houses are once again a significant indicator for the G8 groups of the countries

from the year 1990-2018 according to the probit estimations. According to these results, we can conclude that the exchange rate and net lending/net borrowing of the government, along with the real interest rate, are the most impactful indicators

4.4 Estimation results for OECD Countries

The last group of countries is a list consisted of a selection from the OECD countries. Once again, we use the table 11 for this task. The first significant variable in this group is the first lag of inflation; followed by the stock market capitalization as the second significant variable. The third significant indicator for the economic crisis is the exchange rate. Bank credit given to the private sector is once again a significant indicator of the economic crisis, and the annual changes in the house prices conclude the significant indicators of the economic crisis for the OECD group of the countries.

4.5 Interpretation of marginal effects for all countries group

Due to the nature of coefficients in the probit model, to achieve a meaningful interpretation, we calculate the marginal effects to translate our estimation results into interpretable values, and the results are as follows:

Table 12. Marginal Effects

Marginal Effects	All	G20	G8	OECD
Inflation L1	0.0372321	0.0142425	0.1361	0.0681826
Stock Market CAP	-0.0017381	NA	NA	-0.0020184
Exchange rate	0.0505562	0.318767	0.1416031	0.00422199
FDI	0.0009406	-0.0035073	0.0405104	-0.0007783
NPEI	-0.0000007	-0.0000006	0.0000015	-0.0000005
Current Account	0.0019609	0.0003962	0.0305912	0.0079684
Shadow Economy	0.0041269	0.0987	0.025843	0.0010083

Table 12. Continued

Marginal Effects	All	G20	G8	OECD
Internet users	0.0015604	0.000831	0.0051782	-0.0007008
IFNR	-0.0017967	-0.0181677	-0.0273088	0.0016385
BCON	0.0033284	0.0031239	0.010	0.0023474
BNONI	-0.0023357	0.0011234	NA	-0.0023948
Interest rate	0.0002266	0.0002266	0.151265	0.0118976
Inflation	0.0138229	0.0296045	0.0334565	0.0285398
Capital Investment	-0.0039907	0.000458	-0.1056351	-0.011097
Savings	-0.0013867	NA	NA	0.0017561
Net lending/borrowing	-0.0052972	-0.019693	-0.1128549	-0.0107476
BCP	0.0030999	0.002109	0.0127021	0.0029131
Real House	-0.0132812	-0.0087354	-0.0924801	-0.018320

Notes:

1. NPEI stands for Net portfolio equity investment
2. INFR stands for Income from natural resource
3. BCON stands for Banks Concentration of assets in top three banks
4. BNONI stands for Banks non-interest income
5. BCP stands for Bank credit given to the private sector

All of the marginal effect coefficients are calculated with at means method of estimation, a one-unit change in the lagged change in inflation increases the likelihood of a crisis by 3.7%. A one-unit change in the exchange rate variable increases the likelihood of an economic crisis by 5% for our general model. A unit change in the net portfolio equity inflow decreases the likelihood of a crisis by 0.00007 %. A unit change in the value of the stock market capitalization decreases the likelihood of a crisis by 0.1 %. A unit

change in the value of the bank assets concentration by the top three banks increases the likelihood of an economic crisis by 0.3%. A unit change in the value of the bank credits given to the private sector increases the likelihood of the economic crisis by 0.3 % points. A unit change in the value of the annual change in the original residential prices decreases the likelihood of the economic crisis by 1.3 %. Based on this interpretation, we can conclude that some variables such as lagged inflation, exchange rate, and the annual change in the residential prices lead to the highest degree of change per unit compared to the other significant variables for the general group of the countries. More so, the shadow economy effect for the all country group is near significant but doesn't reach our satisfactory 10% threshold.

Contrary to our expectations the effect of internet use for this group is not significant. This could be because much of our timeline is set in the early 1990s and the internet was still in its infancy period.

4.6 Interpretation of marginal effects for the G20 group

Based on our findings from the marginal effects, a unit change in the value of the exchange rate increases the probability of a crisis by 31.18 %. A unit change in the shadow economy increases the likelihood of the crisis by 9.8%. Furthermore, a unit change in the of the income from the natural resources decreases the likelihood of the crisis by 1.8 %. A unit change in the value net lending/net borrowing decreases the likelihood of the economic crisis by 1.9%. A unit change in the concentration of bank assets in the top three banks increases the likelihood of the crisis by 0.3%. A unit change in the value of the real house price changes decreases the likelihood of the crisis by 0.87%.

Based on the marginal effect findings, variables such as the exchange rate, income from natural resources, and net lending/net borrowing of the government have a tremendous effect on the economic crisis for the G20 list. The Shadow economy effect is also significant for this group.

4.7 Interpretation of marginal effects for the G8 group

A unit change in the value of the exchange rate increases the likelihood of the economic crisis by 14.1%. A unit change in the of the interest rate increases the likelihood

of the economic crisis by 15% points. Additionally, a unit change in the net borrowing / net lending decreases the probability of the occurrence of a crisis by 11% according to our data. Lastly, a unit change in the value of the annual change in the prices of the residential properties decreases the likelihood of an economic crisis for the G8 countries by 9.2%.

By acknowledging these results, we can conclude that the exchange rate and net lending/net borrowing of the government, along with the real interest rate, are the most impactful indicators.

4.8 Interpretation of marginal effects for OECD group

A unit change in the value of the inflationary expectations increases the likelihood of the economic crisis by 6.8%. A unit change in the value of the stock market capitalization decreases the likelihood of the economic crisis by 0.2% points. A unit change in the value of the exchange rate increases the probability of the economic crisis by 0.42%. A unit change in the of the net portfolio equity inflow decreases the probability of the economic crisis by 0.00005 %. A unit change in the value of Bank credit given to the private sector increases the likelihood of the crisis by 0.2%. Furthermore, a unit change in the value of the annual changes in the prices of the residential properties decreases the likelihood of the crisis by 1.8%.

We can conclude that the residential price changes and the exchange rate are the most useful indicators when we look into their magnitude. The positive or negative effects of each variable for each group are as follows.

Table 13. The most significant variables for all countries group

Increases the likelihood of the crisis	Decreases the likelihood of the crisis
Lagged Inflation	Stock market capitalization
Exchange rate	Net portfolio equity inflow
Bank concentration of assets	Annual changes in the house prices
Bank credit is given to the private sector	

Table 14. The most significant variables for G20 countries group

Increases the likelihood of the crisis	Decreases the likelihood of the crisis
Exchange rate	Income from natural resources
Shadow Economy	Net lending / net borrowing
Bank credit given to the private sector	Annual changes in the house prices

Table 15. The most significant variables for G8 countries group

Increases the likelihood of the crisis	Decreases the likelihood of the crisis
Interest rate	Net lending / net borrowing
Bank credit is given to the private sector	Annual changes in the house prices

Table 16. The most significant Variables for OECD countries group

Increases the likelihood of the crisis	Decreases the likelihood of the crisis
Lagged inflation	Stock market capitalization
Exchange rate	Net portfolio equity inflow
Annual changes in the house prices	
Bank credit is given to the private sector	

4.9 Diagnostic tests

4.9.1 Autocorrelation test

To ensure that our estimations have desired statistical properties, we check for possible problems. In the first step, we can check for the use of the correct standard errors. Our default standard errors for our method of testing has been the robust standard errors. Robust standard errors are often more significant than the non-robust standard errors counterparts. We use these errors to correct for the heteroscedasticity and autocorrelation issues in our model. Wooldridge test for autocorrelation in the panel data is a proper measurement for this task, and the results are as following:

According to the results from this estimation, we can reject the null hypothesis and assert our assumption of autocorrelation for the all country group, hence the use of the robust standard errors is justified. According to these findings, there is no evidence of autocorrelation for the G8 list of the countries, and our robust standard errors can be replaced with the typical standard errors according to this test, and we accounted for this occurrence in our previous estimations. The rest of the groups are calculated with the choice of robust standard errors. In the next step of our stress testing, we attempt to change our method of estimation. Due to inherent similarities between the Probit and logit regressions, it would be beneficial for our analysis to double-check the same estimations for each group with the panel logit regression to make sure that our results are not sensitive to the choice of distribution. We don't expect our results to deviate a lot from the probit findings since the inherent difference between the logit and probit models is very minor. The difference lies in the assumption on the distribution of the error terms for both models. In the case of logit models, the error terms are assumed to follow the standard logistic distribution. Whereas, for the probit models the errors are assumed to follow a normal distribution. In practice, these models approximately produce similar output.

Table 17. Wooldridge test for autocorrelation in panel data for all countries

H0: no first-order autocorrelation

$$F(1, 35) = 10.114$$

$$\text{Prob} > F = 0.0031$$

Table 18. Wooldridge test for autocorrelation in panel data for G20

H0: no first-order autocorrelation

$$F(1, 13) = 4.181$$

$$\text{Prob} > F = 0.0617$$

Table 19. Wooldridge test for autocorrelation in panel data for G8

H0: no first-order autocorrelation

$$F(1, 7) = 2.871$$

$$\text{Prob} > F = 0.1340$$

Table 20. Wooldridge test for autocorrelation in panel data for OECD

H0: no first-order autocorrelation

$$F(1, 7) = 2.871$$

$$\text{Prob} > F = 0.0032$$

4.9.2 Logit model estimation

Table 21. Panel logit for all groups

Indicator	All	G20	G8	OECD
Inflation L1	0.189825 (0.021)	-0.01590 (0.897)	.0235750 (0.236)	0.364338 (0.023)
Stock market capitalization	-0.00890 (0.003)			-0.01022 (0.002)
Exchange rate	0.254607 (0.000)	0.235918 (0.000)	0.217430 (0.169)	0.209462 (0.000)
FDI	0.003417 (0.844)	-0.03145 (0.783)	0.075771 (0.669)	-0.00429 (0.795)
NPEI	-0.00004 (0.000)	-.0000005 (0.939)	-.000003 (0.539)	-.000376 (0.000)
Current account	0.007511 (0.847)	0.03988 (0.359)	0.058314 (0.569)	0.038294 (0.405)
Shadow Economy	0.020101 (0.170)	0.092438 (0.001)	0.038487 (0.579)	0.000358 (0.990)
Internet users	0.007420 (0.339)	0.007584 (0.477)	0.007730 (0.622)	-0.00538 (0.491)

Table 21. Continued

Indicator	All	G20	G8	OECD
BCON	0.017141 (0.055)	0.005815 (0.517)	0.017858 (0.460)	0.012587 (0.227)
BNONI	-0.01162 (0.302)	0.003980 (0.833)	NA NA	-0.01781 (0.313)
Interest rate	0.001168 (0.945)	-0.00644 (0.767)	0.260607 (0.031)	0.065412 (0.198)
Inflation	0.071847 (0.296)	0.135722 (0.372)	0.025109 (0.910)	0.151993 (0.180)
Capital INV	-0.01902 (0.490)	-0.004569 (0.903)	0.174841 (0.141)	-0.06447 (0.254)
Savings	-0.00882 (0.599)	NA NA	NA NA	0.02663 (0.348)
NETBL	-0.02909 (0.273)	-0.051587 (0.040)	-0.20411 (0.107)	-0.05865 (0.290)
BCP	0.016125 (0.000)	0.013348 (0.052)	0.021613 (0.011)	0.015085 (0.000)
Real house	-0.06917 (0.002)	-0.045999 (0.022)	-0.16136 (0.001)	-0.10232 (0.006)
INFR	-0.0093 (0.833)	0.12674 (0.039)	-0.0280 (0.873)	0.0009 (0.988)
Intercept	-2.97277 (0.033)	-4.67162 (0.018)	-10.9931 (0.009)	-1.86257 (0.358)

Table 21. Continued

Notes:

1. Numbers outside of the () indicate the coefficient for the variables and numbers inside of the () indicate the significance of those variables.
 2. FDI stands for foreign direct investment
 3. IFNR stands for Income from natural resources
 4. BNONI stands for Bank non-interest income
 5. NETBL stands for net lending / net borrowing
 6. BCP stands for Bank credit given to the private sector
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By looking at the results from this segment, we cannot find any noticeable change in the answers. Moreover, it is safe to conclude that we have attained our findings regardless of choosing an alternative method, and logit results are on par with the previous probit estimations, this is not unexpected. Both of these methods only differ in some minor aspects in terms of their coefficients; however, we can compare both of the methods in a more fitting way, using the marginal effects for logit and probit estimations.

Table 22. Marginal effects for logit estimations

Marginal effects	All	G20	G8	OECD
Inflation L1	0.03669	-0.0159	0.2357	0.0670
Stock market CAP	-0.00172	NA	NA	-0.0018
Exchange rate	0.04922	0.2359	0.2174	0.03851
FDI	0.00066	-0.0314	0.07577	-0.000789
NPEI	-0.000008	-0.0000005	-0.000003	-0.000006
Current Account	0.00145	0.0398	0.05831	0.007042
Shadow Economy	0.00388	0.09243	0.03848	0.000065
Internet users	0.00143	0.00758	0.00773	-0.000989

Table 22. Continued

Marginal effects	All	G20	G8	OECD
IFNR	-0.0018	-0.1267	-0.0280	-0.00016
BCON	0.00331	0.00581	0.01785	0.0023147
BNONI	-0.0022	0.00398	NA	-0.003275
Interest rate	0.00022	-0.0064	0.26060	0.01202
Inflation	0.01389	0.13572	0.02510	0.02795
Capital investment	-0.0036	-0.00456	-0.17484	-0.01185
Savings	-0.0017	NA	NA	0.00489
Net lending / borrowing	-0.0056	-0.05158	-0.20411	-0.01078
BCP	0.00311	0.13348	0.02161	0.00277
Real House	-0.0133	-0.04599	-0.16136	-0.01881

4.9.3 Interpretation of the marginal effects for logit estimation

According to the findings of Table 22. We can talk about the marginal effects of each significant variable pertaining with each sample group. Firstly, we look into the All countries group. A unit change in the value of the inflation in the previous cycles increases the probability of the economic crisis by 3%. A unit change in the value of the stock market capitalization decreases the likelihood of the crisis by 0.1%. A unit change in the value of the exchange rate increases the likelihood of the crisis by 4%. A unit change in the value of the net portfolio equity inflow decreases the probability of the crisis by 0.0008%. A unit change in the shadow economy increases the likelihood of the crisis by 0.3%. A unit change in the bank concentration of assets increases the likelihood of the crisis by 0.3%. A unit change in the bank credit given to the private sector increases the probability of the crisis by 0.3%. And lastly a unit change in the value of the real house prices decreases the likelihood of the crisis by 1.3%.

In our second group we have the G20 countries. The first significant indicator is the exchange rate, A unit change in the value of the exchange rate increases the probability of the crisis by 23%. A unit change in the value of the shadow economy increases the

likelihood of the crisis by 9.2%. A unit change in the value of net lending / borrowing decreases the likelihood of the crisis by 5%. A unit change in the value of the bank credit given to the private sector increases the likelihood of the crisis by 0.3%. A unit change in the value of the real house prices decreases the probability of the crisis by 4.5%. And lastly, a unit change in the value of the income from natural resources decreases the likelihood of the crisis by 12.6%.

Our third segment is dedicated to the G8 group. A unit change in the value of the exchange rate increases the likelihood of the crisis by 21%. A unit change in the value of the interest rate increases the likelihood of the crisis by 26%. A unit change in the value of the capital investment decreases the likelihood of the crisis by 17%. A unit change in the value of the net lending / borrowing decreases the likelihood of the crisis by 20.4%. A unit change in the value of the bank credit given to the private sector increases the probability of the crisis by 2%. A unit change in the value of the real house decreases the probability of the crisis by 16%.

Our last group is the OECD countries. A unit change in the value of the inflation in the past cycles increases the probability of the crisis by 6.7%. A unit change in the value of the stock market capitalization decreases the probability of the crisis by 0.18%. A unit change in the value of the exchange rate increases the probability of the crisis by 3.8% points. A unit change in the value of the net portfolio equity inflow decreases the probability of the crisis by 0.00006%. A unit change in the value of the bank credit given to the private sector increases the likelihood of the crisis by 0.2%. A unit change in the value of the real house prices decreases the likelihood of the crisis by 1.8%.

4.9.4 Comparison of the marginal effects between logit and probit

It's time to put together marginal effect results from both methods of estimation, and discuss about what they entail. In the all countries sample group, both method of estimations covers the same variables, except the shadow economy that is not included in the probit estimation at first but later added in the logit estimation. The remaining findings from both methods are near identical. In the G20 sample group, our probit estimation shows a slightly higher probability of the effect of the exchange rate in crisis. G8 sample group behaves a little different compared to previous groups. Logit estimation depicts a

higher degree of likelihood for crisis in the cases of exchange rate, interest rate, real house prices and net lending / net borrowing compared to probit estimation.

Our last sample group is the list of OECD countries. The results from both methods are quite similar for this group. The only notable difference each method between the two set of results is restricted to the exchange rate variable which shows a higher degree of likelihood for causing a crisis in the logit method of estimation.

4.9.4 Removal of non-significant explanatory variables and lagged inflation

Our last attempt in finding the most accurate and unbiased results would be dropping a few variables that were not significant across any of the groups and also were not at the highest degree of theoretical importance. By considering our current empirical results and much considerations into our variables, it is possible to tweak two groups within our model slightly. In general, all country group and the OECD group we could drop the variable FDI and also do not take the lagged inflation into account. These changes bring some slight changes to our final results.

Revised estimation

Table 23. Revised Probit estimation results

Indicators	All countries	OECD
Inflation L1	NA	NA
Stock market capitalization	-0.0050283 (0.005)	-0.0067102 (0.000)
Exchange rate	0.1564181 (0.000)	0.1378807 (0.000)
FDI	NA	NA
NPEI	-0.0000227 (0.000)	-0.0000213 (0.000)
Current account	0.0100229 (0.660)	0.0269153 (0.346)
Shadow economy	0.0144529 (0.044)	0.218029 (0.109)
Internet users	0.0039532 (0.347)	0.257709 (0.439)
INFR	-0.0019068 (0.934)	0.0257709 (0.419)
BCON	0.0095353 (0.056)	0.00794 (0.109)
BNONI	-0.054159 (0.459)	-0.0032762 (0.726)
Interest rate	0.0053157 (0.591)	0.051142 (0.086)
Inflation	0.0982205 (0.008)	0.1543775 (0.006)
Capital investment	-0.006148 (0.710)	-0.0198735 (0.523)
Savings	-0.0069273 (0.479)	0.0089001 (0.558)
NETBL	-0.0229893 (0.168)	-0.0432473 (0.158)
BCP	0.00855172 (0.002)	0.008434 (0.000)
Real house	-0.0386768 (0.003)	-0.059479 (0.002)
Intercept	-1.674626	-1.775469

Table 23. Continued

Notes:

1. Numbers outside of the () indicate the coefficient for the variables and numbers inside of the () indicate the significance of those variables.
 2. FDI stands for foreign direct investment
 3. IFNR stands for Income from natural resources
 4. BNONI stands for Bank non-interest income
 5. NETBL stands for net lending / net borrowing
 6. BCP stands for Bank credit given to the private sector
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These changes results in a few adjustments in our results pertaining to two groups of all countries and OECD countries. For instance, the exchange rate is a significant factor for OECD countries. Inflation is a new significant factor for both groups with the new changes. Net lending and borrowing are not significant enough to pass our acceptance threshold but it is in that vicinity. And lastly, the shadow economy is a new significant variable for both groups.

4.10 Important variables in this study

In this paper, we emphasize the role of two potential variables that were not in the center of attention in the previous studies related to the financial crises. We attempt to depict the effect of the internet as a news intermediary. Our intuition leads us to think that this technology could be an important variable, given the knowledge and information that it can spread to everyone and exacerbate the contagion effects crises as well as contributing to the economy in terms of productivity gains, employment and growth. Additionally, we also try to find the effects of the informal economy or the underground economy on financial crises. The study of the shadow economy is an entirely different subject on its own, however, experts extensively discussed that this informal economy is, directly and indirectly, shaping the growth of many economies. We are interested to figure

out whether the shadow economy was a significant factor in our study and whether it had a hand in exacerbating the financial crises or making it happen in our study's timeline.

4.11 Contagion effect of the internet

The invention of the internet redefined every aspect of our lives. Our workplaces, schools, banks, and even entertainment very much depends on the internet. Despite its recognition, the overall effect of the internet on the GDP and economy as a whole is underappreciated. Based on the SEC government data for the USA from 2018:

1. The internet sector contributed \$ 2.1 trillion to the United States GDP, which makes it the fourth-biggest sector in the economy.
2. More than 6 million of the USA population is employed in this sector, which doubles this number in 2014.
3. The internet sector grew rapidly and about nine times faster than the USA economy from 2012 to 2018.
4. The internet sector contributed and invested more than \$60 billion into the economy in 2018.

These facts will continue to become more and more apparent with the ever-growing integration of our livelihoods with the innovations. Companies such as Facebook, Google, and Amazon each have a higher market value than the GDPs of many underdeveloped and developing countries. Hence the impact of this industry is undeniable in this time and age. On the other hand, we are aware of the contagion effect of the financial crises. The nature of many instances of financial crises which were originated from South East Asia in the late 1990s was due to the fact that a troubled economy plagued with improper structure and fundamentals instilled bad faith in the minds of investors and households. This led to a wide-spread issue not only surrounding one country but the entire region asking the question: whether country X with its resemblances of conduct and structures to the troubled country may have the same fate?

It's time to lay out the question that led us to take the population of internet users as a percentage of GDP as a representative for the contagion. The reason behind this choice relates to the wide-spread use of the internet between people. The usage of the

internet comes with the good and the bad. It can contribute to the society as a mean of telecommunication, setting up startup businesses with low overhead costs, new opportunities for the minorities and even the impoverished people to take the initiative and act as an entrepreneur, and establishing global connection and businesses across the world to grow the economy faster. What could be the detrimental effect of this new technology? We might have heard about this old saying “bad news travels fast”. The Internet can act as an enabler. But is it possible to hold the internet accountable for the wide-spread of a phenomenon such as a financial crisis? It is not farfetched to think of how the internet and social media propagate the news to circle much faster than 30 years ago. Therefore, it might be capable of creating a higher frequency of speculations in the markets. These speculations, in turn, can prompt disruptive behaviors and even led to inefficiencies. For instance, one speculation regarding the insolvency of a bank could be devastating for the institution if it trends between people with a fast momentum. Hence the higher is the access of the population to this technology, the more risk-prone these institutions can be.

By applying this mindset, we selected our variable of the percentage of the population who have access to the internet. However, our results did not back up our initial theory. In between our four groups, we don't have one instance of significance for this variable. The closest we achieved to the significance threshold, belongs to all countries' general groups with the significance level of 0.3 and G20 group with 0.38 We conclude that the negative contagion effect of this technology is not significant for our model. This could happen due to a noticeable reason. Our model uses a timeline that starts from 1990 to 2018. And this doesn't quite align well with the date that the internet was invented and become a mainstream tool in our daily lives until the beginning of the 2000s. Therefore, we might have gotten a better result if we had a more insolated timeline that covered the data from the 2000s onward.

4.12 The role of the shadow economy

The role of the shadow economy is often proven to be ambiguous. It can differ from a country to another. In this paper, the informal economy has an undeniable effect on our financial crisis study. Starting with our general model that contains all of the

countries in one set, we found out that the shadow economy is very close to being a significant factor, but it lacked enough significance to be included in the assorted list of our key variables for the financial crisis. In the second step, Removal of some insignificant variables and altering the inflation variable alleviated the issue. Hence shadow economy is a significant factor for the general set of countries. In the G20 country list, the shadow economy is a significant variable for this group. This significance stays relevant even after the revised model. Whereas, in the group of G8 countries, the shadow economy is not a significant factor for the financial crises at all. This issue is persistent, even when the model is put through the second phase of testing. Lastly, the shadow economy is not a significant variable for the OECD countries in the initial testing. However, when the model is revised, the shadow economy becomes a significant factor. We can conclude that the role of the shadow economy in the financial crisis during our period of study is significant. Three out of four groups show its significance and the sole group that is not plagued with this issue is the G8 country list, which benefits from the most meticulous and structured economies and societies in the world. Even though we expect to see some significant levels of informal economy activities for some countries such as Russia in this list, the overall collective effect is not great enough to be considered a wide-spread problem.

Based on our learnings from the literature surrounding the shadow economy, the reasons behind the shadow economy are well known. The consequences of informal economies are ambiguous due to their vague nature. However, in our study, we can assert that the shadow economy was an important contributor in the financial crisis across three out of four groups from 1990 to 2018.

The highest degree of the shadow economy in our data belongs to South American countries followed by the South East Asian countries and Southern and Central European countries.

Some of these countries managed to lower their degree of the shadow economy in their country by improving their taxation system, social credit and security regimes, and better regulations for their institutions. Starting from the year 1990, the highest degree of shadow economy belongs to Peru with 59.87 percent of GDP. In the year 1995 the size of

the shadow economy does not change much and constitutes 58.52 percent of GDP. This trend rises in the year 2000 and reaches its highest degree of 60 percent of GDP. In the year 2005 Peru manages to decrease its level of shadow economy to 54.68 percent of the GDP and in the following years of 2010 and 2015, this decreasing trend continues with 43.03 and 40 percent of the GDP. Brazil is also another country with a higher degree of shadow economy activities in this region. By referring to Table 5 in this paper, we can cross-check the years of crisis identified for each country and see whether these high instances of shadow economy activity are correlated with those crises' years. In the case of Peru, our model identified years of 1990-1992-1995-1996-1998-2001-2009-2011-2014 as the crisis years for Peru. And for Brazil, our criteria identified years, 1990-1991-1992-1996-1998-1999-2001-2005-2009-2011-2012-2014-2015-2016 as the crisis's years. We can see that these benchmark years are marked by a very high and relatively high percentage of the shadow economy as the percentage of GDP for Peru and Brazil respectively. This case is also relevant for countries like Colombia and Mexico. Both of these countries experienced multiple cases of the financial crisis and also recorded a very high degree of shadow economy activities across the board. Let's shift our attention to another part of the globe. In the case of Southeast Asian countries, Thailand is the pioneer in terms of the highest degree of shadow economy among the other countries in this region. The highest degree of the shadow economy in Thailand is visible in the year 1990 at 55.72 percent of the GDP, and then it decreases gradually to 47.25 percent of the GDP in the year 2015. Ours cross-check with the crisis dates of 1991-1996-1997-1998-2005-2008-2009-2011-2013-2014 supports our previous statements regarding this pattern.

The second highest degree of the shadow economy in this region belongs to the Philippines. Its highest degree shadow economy belongs to the year 1990. These high degrees of shadow economy once again match the crisis years marked by our criteria by looking at the data in Table 5. Now it is time to look into the highest degree of shadow economy activities among European countries. Russia is the country with the highest level of shadow economic activity across Europe. The highest level of the shadow economy is 39.73 percent of GDP in 1990. By going towards the year 2015, Russia successfully dropped lower in its shadow economy level, at each 5-year interval. Our Table 5 data indicate that years with high shadow economy activities are troubled with periods of

financial crises. The second-largest activities related to the shadow economy are visible in Turkey. The highest record for Turkey is submitted in the year 1990. And once again table 5 indicates that the year of crisis identified for Turkey overlap with the high degree of shadow economy activities reported in the upcoming figures. On the other hand, we have a different story of the Northern European and Scandinavian countries. For instance, Switzerland is blessed with the lowest degree of shadow economy activity among other countries in our study with the highest degree of activities reported at 8 percent of GDP in the year 1995. Our data indicate that Switzerland had a few instances of crises in years of 1991-1992-1993-2001-2008-2009, and as we know many of these instances are due to the turmoil in the period of 1990-1992 in Europe and before Eurozone creation.

There are some major key points concerning these discoveries. Firstly, there is a clear trend of decreasing the rate of shadow economy activities from the year 1990 onwards. Majorities of the countries successfully amended the flaws in their social systems or reformed and improved their tax structures. Secondly, the creation of the European Union introduced a new streamlined and unified system that severely reduced the size of the shadow economy across European countries by changing the old structure of institutions.

We can conclude that the shadow economy is an important factor for this study. The following figures show the percentage of the shadow economy as the percentage of GDP.

Table 24. Shadow economy as the percentage of the GDP

Percentage of Shadow Economy	1990	1995	2000	2005	2010	2015
Australia	16	15	13	12	9	8
Austria	9	10	9	9	9	9
Belgium	22.1	23.19	19.9	21.11	18.8	17.8
Brazil	40.64	39.61	39.8	38.47	34.55	33.01
Canada	19	17	13	13	10	10
Chile	20	19	19	16	14	13
Colombia	35.69	35.24	39.1	33.98	30.71	25.25
Denmark	17.08	16.15	14.6	13.75	16.17	14.7
Finland	17	16	12	12	13	12
France	15	17	14	14	14	12
Germany	13	14	13	12	11	8
Greece	28.79	29.76	26.1	25.99	26.15	26.45
Hungary	31.9	30.18	25.1	22.52	22.82	20.49
India	28.43	26.67	26.7	23.44	20.65	17.89
Indonesia	27	24.62	23.7	24.82	23.44	21.76
Ireland	19	17	13	13	12	10
Italy	29.14	24.8	22.7	24.62	26.13	24.33
Japan	10	11	11	11	10	8
Malaysia	37.47	33.22	31.1	29.77	30.17	26.07
Mexico	33.06	38.25	30.1	29.47	31.15	28.07
Netherlands	13	13	10	11	9	8

Table 24. Continued

Percentage of Shadow Economy	1990	1995	2000	2005	2010	2015
Norway	16	16	13	13	14	15
Peru	59.87	58.52	59.9	54.68	43.04	40.18
Philippines	45.43	45.04	43.3	36.5	34.63	28.04
Portugal	23.28	23.62	21.4	22.26	20.79	17.82
Russia	39.73	45.65	41.91	36.41	33.7	33.72
Singapore	14	12	13	11	11	9
South Africa	29.87	27.66	28.4	25.44	23.23	21.99
South Korea	29.13	27.48	27.5	26.03	22.97	19.83
Spain	27.49	27.37	22.7	23.32	23.91	22.01
Sweden	16	15	12	12	12	11
Switzerland	7	8	7	7	7	7
Thailand	55.72	51.84	52.6	48.7	48.65	47.25
Turkey	35.99	32.84	32.1	28.77	30.21	27.43
USA	10	8	7	8	9	7
U.K	13	12	10	11	10	8

CHAPTER 5

CONCLUDING REMARKS

In this paper, we have examined the indicators of an economic crisis across a broad set of countries from 1990 to 2018. Our empirical findings point out towards multiple ubiquitous indicators that play a significant role in determining an economic crisis. More specifically, we found out that, even though some of these crisis events might have similarities, there are unique and distinctive characteristics that set them apart from each other across each group. What we deduced from this study is that the exchange rate and annual changes in the housing prices along with the bank credit given to the private sector were the common denominators across all of the groups; Meanwhile, variables such as lagged inflation, shadow economy as a percentage of the GDP, net portfolio equity inflow, income from natural resources, bank concentration of assets in the top three banks, stock market capitalization and real interest rate were group-specific significant variables. Many of these variables were mentioned and suggested by the theoretical literature. Our findings are in support of these theories such as, the exchange rate effect on the crisis and the moral hazard and adverse selection in the financial markets that stems from the five factors of increase in the interest rate, stock market declines, increase in the uncertainty, bank panics and unanticipated declines in the aggregate price level Mishkin's anatomy of the financial crisis (1991). However, while our model speaks about the significant role of the variables such as exchange rate and housing market prices, there are exciting additions to these findings such as the shadow economy effect over the economy. Our conclusions assert that the shadow economy has been an omnipresent threat for the countries in our different groups and directly or indirectly affected the financial crises within this timeline. Our results also indicate that a history of inflation plays an essential role in our model and the expectations of markets and agents for a continuing inflationary climate can set us towards that path.

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