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In a Global Pandemic, Modeling the Central Bank Functions

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Abstract

In 2020, the global corona-virus pandemic created economic crises and market panics in most nations of the world. The central bank, in each nation, took actions to calm financial markets and avoid economic depression. This expansion of central bank functions had begun in the previous 2008 global financial crisis and was increased in 2020. We analyze this 2020 pandemic financial crisis to understand the new spectrum of central bank functions, and we apply system models of monetary policy and fiscal policy to identify operations of central banks.

Keywords

Financial Systems, Central Banks, Financial Crises, Economic Recessions

1. Introduction

In 2019-20, the impact of the COVID-19 virus pandemic on the worlds' economies stimulated an expansion of the functions of central banks to assist in stemming economic collapses. Why were changes in central bank policies necessary? What were the implications of these changes for modern economic theory about monetary policy and about fiscal policy? What did the fragility of financial markets indicate about the nature of a modern economic system?

The empirical evidence this research will show is that: in modern financial crises (banking crisis in 2008 and pandemic crisis in 2020), both traditional monetary policy and fiscal policy need to be up-graded and coordinated. Coordination between financial-market rescue and fiscal stimulation was required in both crises to save a national economy when its entire financial system collapses. Also we shall depict two kinds of models (of a monetary system and of a fiscal system) which are useful for coordinating monetary and fiscal policies.

The organization of this paper is as follows. First, we summarize the case history of the U.S. central bank (U.S. Federal Reserve System) in responding to the economics of the 2019-2020 pandemic. And then we analyze this historic event in a cross-disciplinary research technique to abstract key societal factors in the case. Then we continue the case history as to: 1) how the U.S. central bank managed its expanded functions, 2) how the European Union central bank expanded its functions, and 3) how globally most of the central banks expanded their functions. Next, we briefly summarize the economic literature background on the history of central bank policy. Then we model the monetary flow in an economy in which a central bank operates. And next we enlarge this model to indicate the expansion of central bank functions in the pandemic. Then we discuss the policy implications of the pandemic historical case on governmental monetary and fiscal policies. We show two kinds of models, one for the monetary system and one for the fiscal system, useful to formulating proper cooperation between monetary and fiscal policies.

2. Methodology of This Research

The approach of this research uses observations of an economic history to provide empirical evidence for grounding (verifying) economic theory. Empirical evidence is obtained by abstraction from the history the key societal factors in the event. This research technique analyzes any historical event in a cross-disciplinary perceptual space. Also we use the research technique of modeling economic processes to facilitate the verification of theory in the particular context of an economic history.

In the depiction of historical events, we will use the technique of historians in quoting historical sources (observers of a historical scene). These quotes directly show some of the historical evidence about an event. For modeling the societal processes in a historical event, we model such processes by means of a systems analysis of the operations of the economic activity.

> Theoretical models in the economics are methodologically essential in order to use historical cases of an economy to explain economic action and to ground economic theory. History provides the empirical experience about the nature of human economies; and economic models enable the generalizations of economic theory across the different contexts of historical cases.

3. Case History: U.S. Central Bank Response to the 2020 Pandemic

The pandemic of a new virus COVID-19 spread around the world, creating economic havoc in every nation. The U.S. government and other national governments generally had four responses: market rescues, economic lockdowns, fiscal stimuli, and support of vaccine development.

Eric Platt, Laura Noonan, James Fontanella-Khan, Joe Rennison, and Miles

Kruppa wrote: "The economy is really suffering. It has hit an iceberg, and nobody knows frankly how long this will last," said Carlos Hernandez, executive chair of global investment banking at JPMorgan Chase.... JPMorgan had almost $367 bn of undrawn commitments to corporate clients at the end of last year, equal to more than 13 per cent of its $2.7 tn balance sheet. Bank of America, Citigroup and Wells Fargo together provided another $1.2 tn of lines, while Morgan Stanley and Goldman Sachs had a combined $260 bn, according to recent filings with US securities regulators... But in February, it became clear (as the meltdown began on February 21) that the corporate bond, loan and equity markets gummed up.... Said Scott Barshay, a corporate lawyer at Paul Weiss: "Unlike 9/11 or the financial crisis, this is a crisis for companies in every single sector of the economy. Everyone's grappling with how to make business decisions when most businesses are shut down and you have no idea when they're coming back" (Platt, Noonan, Fontanella-Khan, Rennison, & Kruppa, 2020).

As the pandemic increased in the United States, its central bank played an important role in stabilizing the U.S. economic market. In March 2020, James Politi, Brendan Greeley, Colby Smith, and Joe Rennison wrote: "(In the U.S.) stocks fell yesterday despite the U S Federal Reserve unleashing its full firepower to support the US economy through the coronavirus outbreak when it pledged to buy government bonds in unlimited amounts. The new moves include a historic step to buy corporate debt and add monetary heft to the effort to minimize the pandemic's economic damage... The Federal Reserve is committed to using its full range of tools to support households, businesses and the US economy overall in this challenging time, the Fed said, adding that it had 'become clear' that the US economy faced 'severe disruptions'" (Politi, Greeley, Smith, & Rennison, 2020).

The U. S. Central Bank (Federal Reserve System) innovated new programs to stabilize the U.S. stock market. James Politi, Brendan Greeley, Colby Smith, and Joe Rennison wrote: "In an unprecedented move for the central bank, the Fed unveiled two new facilities that allow it to purchase corporate bonds, including new issues. The Fed had stopped short of buying corporate debt during the 2008 financial crisis" (Politi, Greeley, Smith, & Rennison, 2020).

The backing of monetary funds was also announced. Jenna Smialek reported: "Friday's announcement expanded an emergency lending program that the Fed had announced this week. The central bank said in a release late Wednesday that it would establish a so-called Money Market Mutual Fund Liquidity Facility, backed by $10 billion from the Treasury Department. That program was intended to prevent runs on the funds, which many investors use as a short-term place to stash cash for a small return" (Smialek, 2020).

The U.S. central bank, the Federal Reserve, acted because the New York Stock Market had nose-dived. It was a new and unprecedented policy in a financial crisis for the U.S. Federal reserve to inject money into corporations. James Politi, Brendan Greeley, Colby Smith, and Joe Rennison wrote: "The first Fed facility

aims to support large employers and involves offering bridge financing for up to four years to investment-grade companies in exchange for purchases of newly issued corporate debt by the central bank.... A second programme would allow the Fed to purchase corporate debt in the secondary market.... This is shock and awe from the Fed,' said Jim Paulsen, chief market strategist for the Leuthold Group. "This has some real merit of easing some of these short-term financial illiquidity issues'" (Politi, Greeley, Smith, & Rennison, 2020).

Also U.S. Federal Reserve action was aimed at stabilizing the U.S. government bond market (U. S. sovereign bond market). Colby Smith wrote: "When cracks emerged in the $18tn US government bond market this month, the Federal Reserve sprang into action to ensure volatile trading conditions did not destabilize the world's largest and most liquid financial benchmark. In addition to slashing US interest rates to zero, the Fed ramped up its interventions in short-term funding markets and announced it would buy at least $700bn in Treasuries and agency mortgage-backed securities. The US central bank went further this week, awarding itself the power to buy an unlimited amount of government bonds. These measures have helped to bring back a semblance of order to a market where it had become alarmingly difficult to get deals done. Volatility has abated...." (Smith, 2020).

These central bank extensions of monetary policy suggested to some that a different goal for policy might be next followed, called "yield curve control". Colby Smith wrote: "Now, fixed-income investors are encouraging the Fed to wade into even more unconventional waters, and consider a policy last used in the US in the second world war: yield curve control. The policy, long employed by Japan's central bank, and more recently by Australia, calls for the Fed to set targets for bond yields. If they rise above those levels, the Fed then buys as many bonds as necessary to bring them back in line..... 'But Japan's experience with yield curve control does not inspire confidence', said Michael Darda, chief market strategist at MKM Partners. He notes that since the policy was established in 2016, the country has struggled to liberate itself from decades of deflationary pressures and anemic growth" (Smith, 2020).

In addition to the monetary policies of the U.S. Central Bank (Federal Reserve) for stabilizing the pandemic economy, the U.S. Congress passed a large economic stimulation bill. Gillian Tett wrote: "Can the new $2 tn Coronavirus Aid, Relief and Economic Security Act stem this shocking tide? A first test comes today when part of the act swings into action. Under the Paycheck Protection Plan, businesses with less than 500 staff can apply for $350 bn in loans, and 75 per cent of the total will be forgiven for companies that retain their staff... So, Mr Mnuchin's team is asking private sector banks to dispense the cash instead, for substantial fees.... This promises to give applicants cash to cover 2.5 times monthly payroll costs, up to $10 m, as long as they are US taxpayers. If 75% is spent on salaries, the "loan" becomes a free grant" (Tett, 2020a).

In this fiscal policy of economic stimuli, there were regulatory risks, as to

whether or not the funds would be properly spent. Gillian Tett wrote: "This is not without risks. The Treasury is not asking the banks to conduct credit surveillance, so some fraud is likely. And since the funds will come from the government, the Treasury must create swift credit lines and legal protection for the lending banks, or they will not participate... To have any chance of success, the structure should include three things. First, "the overwhelming priority [must be] the protection of employees and not shareholders or bondholders," as Larry Summers, former Treasury secretary, said on Wednesday. Second, taxpayers must enjoy some of the economic upside after a recovery.... Third, there must be simplicity, consistency and clarity" (Tett, 2020a).

The expansion of central bank functions had begun earlier in the financial panic of 2008. Ben Casselman wrote: "A lot of what the Fed is doing under Jerome H. Powell, its chair, is taken from the 2008-9 playbook of his predecessor Ben S. Bernanke. The Fed bought Treasury notes and mortgage bonds then, as it is doing now, though in the past it has always put a dollar figure on its bond-buying programs it took the extreme uncertainty of the current moment for the Fed to pledge open-ended stimulus. The central bank is also reviving several other programs that made their debut during the last crisis. But policymakers are also taking some novel steps. Most important, the Fed will 627ffecttively lend money directly to large corporations, something it has never done before. The central bank framed the program as "bridge financing" to help otherwise healthy companies keep their doors open and their workers employed during a period of disruption" (Casselman, 2020).

> When a central bank extends its operations in monetary policy, then issues of proper regulation arise for the central bank, going in the new areas of credit support.

4. Case History Event Analysis: In a Cross-Disciplinary Perceptual Space

To abstract empirical evidence for economic theory from such a historical case, we will use the research technique of modeling a historical event. This case study of the central bank in the 2020 pandemic is of a significant historical event for economic theory. And the methodological issue is this. How can one analyze historical economic events so as to provide the empirical basis for building economic theory? The answer is to analyze historical events within the methodological framework of a cross-disciplinary social science framework of a *historical timeline* and a functional societal *perceptual space* (Betz, 2011).

In the physical and biological sciences, the analytical technique of a space-time observational space provided a common research framework for observation of physical and biological nature. All the physical sciences and biological sciences observe the physical world in this same observational framework of physical "space-time". This is important methodologically so that all physical and biological observations and experiments can be modeled as "mechanisms in

space-time". The result is that all physical and biological disciplines can communicate theory which each other, since they share the same analytical framework to observe "nature". In the same way, all the disciplines of the social sciences (e.g. economics, sociology, psychology, management science, anthropology, etc.) need to have a common observational framework for seeing the "nature of society" but not as a "mechanistic system" instead as a "structural-functional system" (Betz, 2011).

> A physical "space-time" observational framework is not methodologically appropriate to the social sciences because the social sciences observe the functional (not the mechanistic) phenomena of social nature. Social sciences describe society in terms of structures and functions "structural functionalism" (as this is called in the social science discipline of sociology). Such a functional observational framework is needed to observe institutions and functional activitie in the historical events of a society. We can call this a "societal-dynamics perceptual space".

A functional observation time for depicting change in a society's history has been constructed as temporal sequence of steady-state functional states (stasis) with alternating function-change events (historical event) (Betz, 2011). **Figure 1** displays how "historical time" can be analyzed as alternating stasis periods and change events. Societal structures (institutions) can be altered by change events in the society.

For example, the "change-event" of the New York Stock Market collapse in 1929 altered the "stasis economy" in the United States from the economic prosperity of the 1920s into the economic depression of the 1930s.

The 2020 pandemic financial crisis is an example of a 'change event' in the

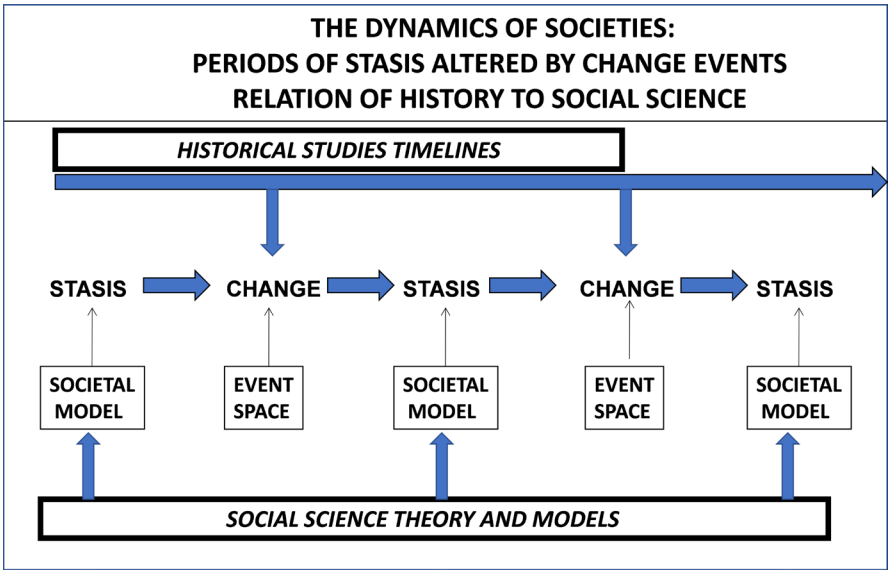

Figure 1. Dynamics of societal time with change events altering structural stasis.

economy of the U.S. society, altering the institutional processes of the U.S. central bank (Federal Reserve) and the U.S. Treasury – changing U.S. monetary and fiscal policies.

Next to describe a change event in a society's history (historical event), the social sciences (including economics) needs an analogy to the physical perceptual space, an analogy but a different kind of perceptual space a functional space for observing functional phenomena. Such a general societal-function space has been constructed from three of basic dichotomies in the disciplines of social sciences: *individual-society, groups-processes, reason-action* (Betz, 2011).

The first basic idea in the social sciences literatures is that every social science discipline distinguishes between individuals and the society in which they live the dichotomy of *individual & society*. For example, in economics, this dichotomy is called an "economic agent" and an "economic market". In management science, this dichotomy is called a "manager" and an "organization". In psychology, this dichotomy is called an "individual" and a "society". In anthropology, this dichotomy is called an "individual" and a "culture".

The second basic idea in the social sciences distinguishes within a society how individuals associate into groups within a society and the processes a group inculcates in members the dichotomy of *group & process*. A social process is a series of actions coordinated to produce an outcome planned by a group. For example, in economics, this dichotomy distinguishes between a "financial institution" and a "financial process". In sociology and in management science, this dichotomy distinguishes between "masses/groups/corporations" and "operations".

The third basic idea found in the social sciences is about individuals and their behavior in society. Individuals described as sentient (or cognitive) beings acting according to perceived reasons the dichotomy of *action & reason*. For example in economics, this dichotomy distinguishes between economic transactions and economic rationality. In management science, this dichotomy distinguishes between "implementation" and "strategy".

These three dichotomies have been used to construct three-dimensional societal-event space in which to analyze the historical activities in terms of six basic factors (individual-society, groups-process, and action-reason (Betz, 2011). This is graphically shown as a three-dimensional societal-event perceptual space, **Figure 2**.

In any historical event, the event can be generally analyzed in these three factors and interactions between them. To conveniently describe the analysis of events in the social-science perceptual space, one can show the areas around the dimensional axes as a kind of event box in **Figure 3**.

In this picture, we show a *three-dimensional space* for perceiving historic

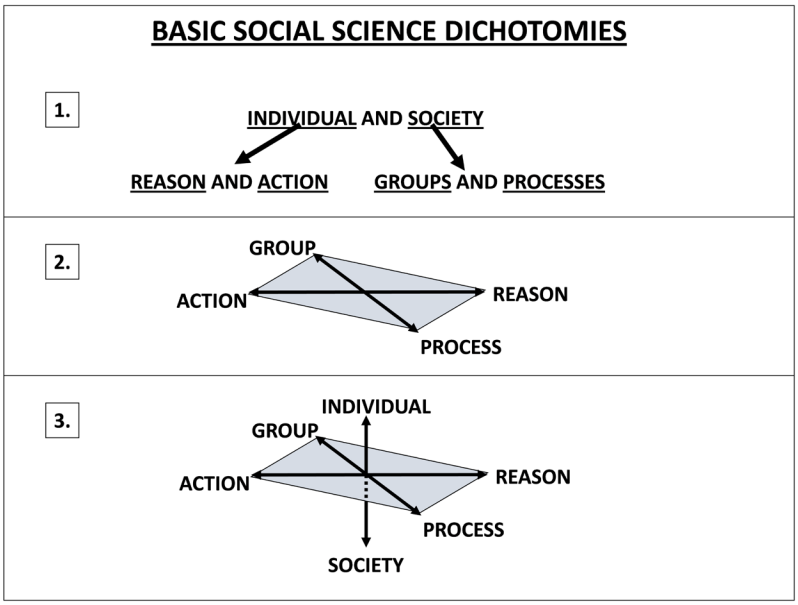

Figure 2. Observational space for analyzing historical change events in a societal structure.

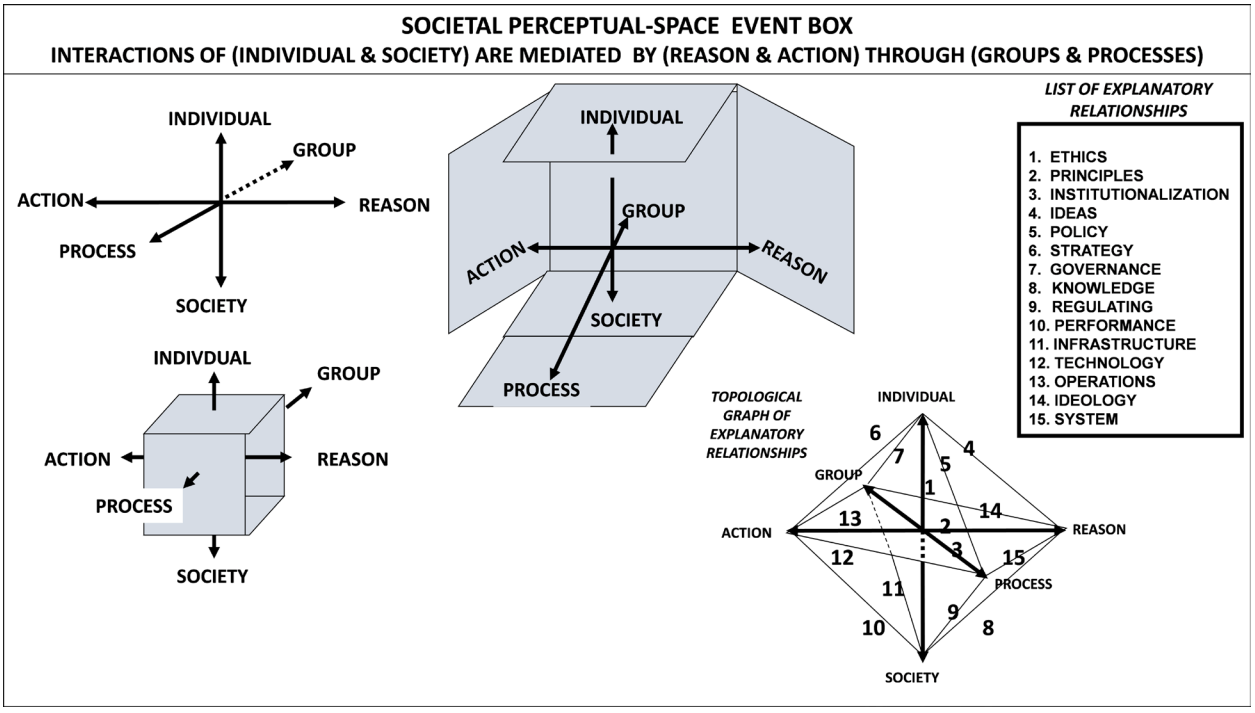

Figure 3. Societal perceptual space event box with 15 topological explanations.

events in a society as arrows in the space. Next one builds a *box around the axis-arrows*, in order to have surfaces for conveniently listing the factors (happenings) in the event. Since this box is three dimensional, opening up the box shows all surfaces in one view.

We will use the "box form" of the societal-event perceptual space to analyze the principal factors in the specific context of a historical event. In addition, the topological graph form of this 3-dimentional space allows description of the 15

connections between the 6 factors; and these 15 connections can display the different explanations possible in a change event.

> *An event box provides an analytical technique for abstracting and summarizing the key factors in the societal change event* (*historical event which changes structure-function in a society*).
> *Expressing the connections between the key factors provides a graphical model of the kinds of explanations which can analyze the change event – fifteen possible explanations in the historical event* (*of why history occurred*).

Now, as shown in Figure 4, we apply this analytical technique to summarize the key societal factors and explanations in the economic historical event of the 2020 pandemic financial crisis.

INDIVIDUAL: Individuals involved in economic shut-downs were heads of government; and parliamentary individuals funding fiscal stimuli for economic activity. Other individuals administered monetary and fiscal policy, such as heads of national banks and of government treasuries.

SOCIETY: Societies involved in the pandemic and accompanying economic crises were nations throughout the world.

ACTION: To stop the spread of COVID-19 19 virus pandemic, governments urged and shut-downs, temporarily closing businesses, which triggered financial panics in markets, sales losses in business, and labor losses of jobs.

REASON: Scientists used scientific methods to develop a vaccine against the

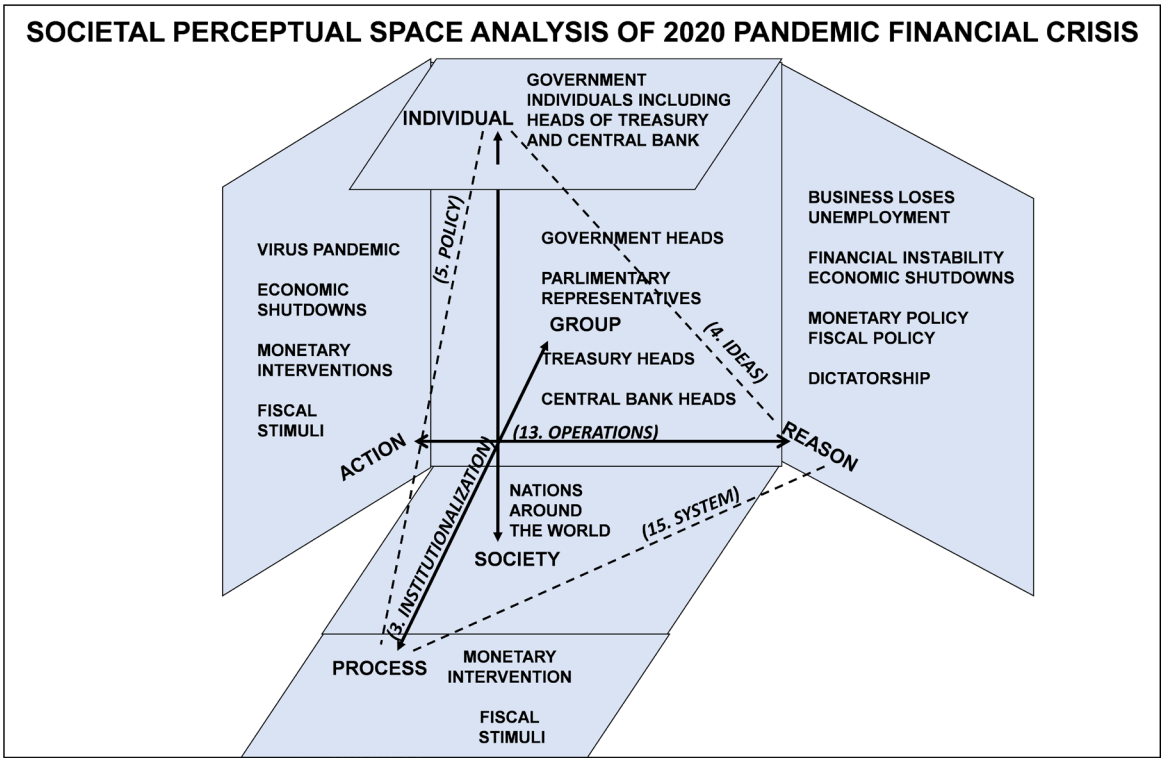

Figure 4. Event analysis of 2020 pandemic financial crisis.

virus. Government thinking used monetary and fiscal stimuli to reduce the economic impact of shutdowns.

GROUP: The groups involved were central banks in administering monetary policy and treasuries in administering fiscal policy.

PROCESS: The processes were 1) public health policies to contain the pandemic and eventually eliminate the virus and 2) monetary and fiscal policies of governments to reduce economic damage from the pandemic.

This analysis of the pandemic financial event in a 3-dimensional societal perspective space emphasizes what features in the event were general enough to learn about economic activity and to validate economic theory. In this event, the theory we are researching is that about the proper functions for a central bank.

Also in this analysis, we identified several important explanatory connections, to which we pay especial attention: (15. *System*), (4. *Ideas*), (5. *Policy*), (13. *Operations*), (3. *Institutionalization*).

15. *SYSTEM*: The systems fundamental to the economic action were both the financial system and the economic system.

4. *IDEAS*: The main ideas driving the actions of the federal and local governments were to isolate the epidemic by economic shut-downs, while ensuring financial markets and businesses did not collapse.

5. *POLICY*: The policies altered by government actions were 'monetary policy' and 'fiscal policy'.

13. *OPERATIONS*: The operations of the central banks were expanded to intervene in financial markets by purchasing bonds and making loans to banks, mutual funds, corporations, and small businesses.

3. *INSTITUTIONALIZATION*: The issue of institutionalizing these expansions of central bank functions for the future is raised. Functions, beyond that of regulating banks and controlling credit rates, was still not a settled issue.

As we continue to analyze the economic event of the pandemic of 2020, these connections (explanations) assist us in a deeper analysis of the event.

5. Case History Continued: Managing U.S. Central Bank Market Interventions

Let us next review how the U S central bank, Federal Reserve System, handled "operations" of some of its new policies during the 2020 pandemic – particularly to fund cash into the corporate bond market. Siobhan Riding wrote: "The US central bank in March appointed BlackRock (a private financial management fund) to manage two Fed-backed special-purpose vehicles to buy primary and secondary market corporate bonds. One of the vehicles has bought investment-grade exchange-traded-funds (EFT), marking the first time the Fed has included ETFs in this type of purchasing programme" (Riding, 2020).

Central banks had not anticipated how to operate in the new financial crises of the twenty-first century (which required a major expansion of rescuing finan-

cial institutions, beyond banks). In the pandemic crisis, the U.S. Federal Reserve had asked a private hedge fund to manage some of the financial interventions. Gillian Tett wrote: "As the wild (central bank) policy experiments unfolded (in March 2020), a familiar figure was also back in the frame: Larry Fink, chief executive of BlackRock, the $7 tn asset management behemoth. Twelve not-so-long years ago (2008), the Fed turned to BlackRock to manage the three Maiden Lane vehicles that it created to hold assets from the defunct insurer AIG and also Bear Stearns. On Tuesday, it again tapped BlackRock's Financial Markets Advisory, its consultancy arm, to run three vehicles the Fed will create to buy corporate debt from the primary and secondary markets, and also commercial mortgage-backed securities. Never mind that the Fed has used BlackRock before, or that Mr. Fink is fabulously well-connected. What is more notable is that BlackRock received this mandate without a contest" (Tett, 2020b).

In March 2020, the US Central Bank had rescued a financial market of Exchange Traded Funds (ETF) not only rescuing the market with BlackRock's management but while also BlackRock was the largest trader in the ETF market. Joe Rennison wrote: "BlackRock has been picked by the Fed to manage its bond buying in Exchange Traded Funds (ETF). The financial storm unleashed by coronavirus has ripped bonds of "exchange-traded-funds" from their moorings, providing the first big test of a market that has grown dramatically in recent years. Investors have flocked into fixed-income ETFs, which sell shares underpinned by corporate debt to give simple, speedy ways to bet on a market that can otherwise be tricky to access and trade. But a deep sell-off earlier this month created big dislocations between the prices of bond ETFs and the value of the bonds behind them. These discounts became so wide that some predicted investors would lose faith in the fund structure altogether and dump their holdings further damaging debt market conditions. Then, the US Federal Reserve stepped in. On Monday, the central bank announced that it would begin to buy corporate debt to quell the crisis including bond ETFs. And it picked BlackRock, one of the biggest providers in the $1.1 tn market, to manage the purchases. ETF prices surged" (Rennison, 2020).

Back in 2008 and down into 2020, this financial fund, Blackrock, had close ties to U.S. treasury secretaries. Gillian Tett wrote: "BlackRock has such a humungous footprint that it will inevitably collide with those Fed vehicles. Take the $40 bn world of investment grade US corporate bond Exchange-Traded-Funds (ETF). On Monday the Fed pledged to invest in some Exchange-Traded Funds (ETF) to support corporate funding flows. However, as it happens a BlackRock-run ETF, called LQD, is the biggest of this type. (BlackRock sponsors about 35% of the ETF market.) The price of BlackRock's LQD, like other ETFs, has already rallied since the announcement.... This leaves some BlackRock rivals muttering about conflicts of interest. (BlackRock is using government money to buy its own ETF fund.) And non-American regulators caustically pointing out, that since 2008, Mr. Fink has been adept in persuading US regulators to refrain from

sweeping regulatory reforms on asset managers, such as his" (Tett, 2020b).

Temporarily, at least in the U.S., a private financial institution, BlackRock, was assisting a public institution, the U.S. central bank (the US Federal Reserve) to manage its financial crisis interventions. Gillian Tett wrote: "For the key thing to understand about (BlackRock's) canny Mr. Larry Fink is that he has not only spent the past decade building a highly visible asset management company, he has also quietly... made his FMA division dominant in consultancy. (BlackRock's FMA) has 280 staff and has quietly worked for numerous public institutions, including the UK Treasury and European Central Bank" (Tett, 2020b).

Whenever a nation has a private financial institution performing (operating) in its public monetary policy, there is a possibility of a conflict of interest. Gillian Tett wrote: "Can BlackRock manage conflict-of-interest? Both sides insist so. BlackRock officials stress that its asset manager unit and its consultancy unit are separated by strict Chinese walls.... If, or when, we return to that point (of a normal economy), US regulators will then need to ask another question: why did they let the asset management world become so concentrated that the ever-present Mr. Fink reigns supreme? (Tett, 2020b).

We see in this analysis of the historic pandemic crisis that the connections of 'operations' and of 'policy' provide important explanations. Explanations in the event describe how central banks 'operated' in financial rescues for which they had not anticipated in 'policy'.

6. Case History Continued: European Union Central Bank Responses in Pandemic

Central banks in European nations also responded to their national economic crises. But in Europe, the political context was complicated by Europe having two kinds of central banks, national central banks and the European Central Bank (ECB). This provided a political tension within the European Union between 1) centralization of European monetary policy and 2) decentralization of national fiscal policies. For example, Ben Hall, Martin Arnold and Sam Fleming wrote: "Back in 2011 when Mr. Draghi took over as president in 2011 (of the ECB), divisions within the ECB were mirrored by a broader battle being played out at political level in Europe between those in favor of closer fiscal and political integration and those suspicious of it" (Hall, Arnold, & Fleming, 2020).

But in 2020 in Europe, the need for expansion of centralized monetary action became urgent to all. The ECB extended its functions to assist member nations of the European Union to cope with the pandemic financial crisis. Ben Hall, Martin Arnold and Sam Fleming wrote: "As the Italian death toll from the Covid-19 pandemic reached grim new heights just over a week ago, Pope Francis broke strict quarantine rules to visit the church of San Marcello in central Rome. The pontiff went to pray for a miracle before a crucifix which the pious believe helped save the city from plague in 1522. Around him was a country in lockdown and a continental economy in freefall, as the virus spread across Europe,

freezing factories, snarling borders and confining hundreds of millions of citizens to their homes. Workers, business leaders and investors were seeking deliverance not only from the almighty, but from EU policymakers, who they implored to stop the slump from turning into a lasting depression that could destroy the eurozone. For a moment last week, it looked like at least some of those prayers had been answered. The ECB stunned global markets on Wednesday night with an audacious plan to expand asset purchases by a vast €750 bn over the next nine months. European bond markets immediately rallied as the scale of the ECB's intervention became plain to buy member nations' sovereign bonds, thereby reducing the financing costs of governments from Italy and Greece to Germany and France" (Hall, Arnold, & Fleming, 2020).

The ECB purchased sovereign bonds from European member nations. Ordinarily central banks do not purchase sovereign bonds (government-issued bonds). But national central banks purchased their own government's bonds in the financial panics of 2008 and 2020; and in 2020 the ECB purchased European governments' bonds. *What makes this an important issue is that, in economic history, a central bank's purchase of its own government bonds has often resulted in major inflation of the nation's money.*

This was an important expansion in rescue function by the ECB. Ben Hall, Martin Arnold and Sam Fleming wrote: "Investor alarm in recent weeks was amplified by the ECB, which until Wednesday struggled to deliver policies to match the scale of the economic threat. It expanded its bond-buying program and agreed a vast new scheme to, in effect, pay banks to lend to smaller companies... The ECB's €750 bn Pandemic Emergency Purchase Program was the kind of intervention that the markets had been calling for and the likes of Italy, Spain, France had been demanding. The impact was immediate. The yield on Italian bonds fell by some 80 basis points, or about a third, as did those on Spain, Portugal, France and Greece which all have high public debt" (Hall, Arnold, & Fleming, 2020).

In the pandemic and around the globe, the big companies were also hurting. As an example of European companies facing financial disaster, Joe Miller wrote: "Volkswagen is burning through approximately €2 bn in cash per week (in March 2020), the world's largest carmaker revealed, as factory closures across Europe and the Americas push the auto industry towards the worst recession in decades. Manufacturers and suppliers around the globe are scrambling for extra credit, with Fiat Chrysler securing an extra €3.5 bn, while VW, which is one of Europe's largest employers, urged the European Central Bank to buy short-term commercial debt to help it weather the coronavirus pandemic. The German group has already put almost a third of its 300,000 workers in the country on reduced hours, relying on the government in Berlin to plug the gap. France's Renault, which has seen sales almost grind to a halt, has raised the prospect of applying for state-backed loans, although chairman Jean-Dominique Senard dismissed the idea of nationalization" (Miller, 2020).

Joe Miller and Robert Smith also added: "Volkswagen has called on the European Central Bank to speed up its plans to buy short-term corporate debt to help companies ride out the coronavirus crisis.... VW closed all its European plants last week as the motor industry, with the exception of China, came to an almost complete standstill" (Miller & Smith, 2020).

Eric Platt, Laura Noonan, James Fontanella-Khan, Joe Rennison, and Miles Kruppa wrote: "Over the past three weeks, more than 130 companies in Europe and the Americas have drawn at least $124.1 bn from their lenders.... Among the first to tap credit lines in this crisis were companies like Norwegian Cruise Line and Hilton Worldwide, which were hit by fallout from the pandemic as customers cancelled trips. Nearly every other industry followed. Ford borrowed $15.4 bn and announced it would shut down factories to preserve cash, Anheuser-Busch InBev raised $9 bn as taps stopped flowing, and TJ Maxx-owner TJX and Kohl's each drew $1 bn as they closed stores" (Platt, Noonan, Fontanella-Khan, Rennison, & Kruppa, 2020).

7. Case History Continued: Globally, Central Banks' Functions were Expanded in Pandemic

When private financial markets collapsed in February 2020, all central banks moved to inject cash into their financial systems. Siobhan Riding wrote: "Central banks have injected close to $100 bn to prop up investment funds hit by the coronavirus-induced market turmoil, raising fresh questions about the systemic risks posed by the asset management industry. Monetary authorities including the US Federal Reserve and the Reserve Bank of India stepped in to relieve stress on their fund markets after the escalating health crisis triggered heavy fund outflows and sharp falls in asset prices. Central banks have provided support totaling $93.8 bn to funds since the emergency began, according to rating agency Fitch" (Riding, 2020).

Central bank interventions were world-wide. Siobhan Riding wrote: "Mutual fund support facilities provided by monetary authorities in Thailand, India and Colombia respectively total $31.2 bn, $6.6 bn and $5 bn. The interventions were aimed at preventing contagion stemming from investor runs on several large funds. In late April, the Indian arm of US fund manager Franklin Templeton suspended six local bond funds managing more than $3 bn after jittery investors pulled their cash. Alastair Sewell, head of fund and asset manager ratings at Fitch, said the scale of central bank support was evidence of "regulators" sensitivity to the potential systemic risks that funds pose through spillover effects to financial markets'. Investment management has grown significantly since the last crisis, now controlling assets of about $55 tn, compared with $24 tn in 2008.... Fitch estimates the industry's asset pool is equal to 64% of global GDP, versus 38% in 2008" (Riding, 2020).

Banks and funds involved in the management of wealth, investment funds, now constituted over half (64%) of the world's GDP. Their instability due to the

pandemic was placing the world's wealth at risk. Sobhan Riding wrote: "In Europe, where the local fund industry has not benefited from direct central bank support, more than 80 funds managing assets of more than $40 bn were forced to suspend in March after failing to meet redemption requests. Although a small section of the €17.7 tn European fund market, it nevertheless casts doubt on whether asset management regulations 'fully address the liquidity risk that may materialize in a severe stress scenario', Mr. Sewell said" (Riding, 2020).

The pandemic was stopping the money supply all through an economy and all through the international system. Agustin Carstens wrote: "The financial turbulence unleashed by the corona-virus pandemic revives unhappy memories of the 2008 financial crisis. The outward symptoms of falling asset prices and tighter credit conditions are similar, but there are important differences.... One key difference between the current crisis and 2008 is the players involved. That 2008 event was a global banking crisis with overleveraged lenders at its center. Central banks had direct levers to address banking stress by providing funding to distressed banks or by purchasing assets. This time in 2020, the formal banking sector is a smaller part of the financial system, while market-based finance has become more important" (Carstens, 2020).

8. Background – Literature Review of the History of Central Bank Policy

In the literature of economic history, recently there have been published many excellent histories of central banks, such as: David Kynaston's history of the Bank of England (Kynaston, 2017) and also Andrew Black's et al.'s comparison of the U.S. Federal Reserve to the European Central Bank (Black et al., 2018). Also recently, there are several good histories of monetary systems, such as: Barry Eichengreen's, Arnaud Mehl's and Livia Chitu's description of global currencies (Eichengreen, Mehl, & Chitu, 2018) and also Barry Eichengreen's history of the International Monetary System (Eichengreen, 2019) and also Jeffry Frieden's history of financial capital systems in the twentieth and twenty-first centuries (Frieden, 2020). What we add in this paper is an analysis of a significant modern financial crisis to validate models of monetary and fiscal systems.

The earlier histories and these later histories of money and banks have documented the emergence of the economic concept of a "central bank" as a lender-of-last-resort in financial crises. And historically, central banks were created to improve the stability of a national financial system. And later, as argued by Minsky, financial markets have been shown to have an inherent tendency to instability of a long term (Minsky, 1982; Betz, 2015).

Yet has it been possible (sometimes) to construct a stable financial system? In economic history, the answer has been "yes". To briefly review this answer, we summarize the origins of two central banks, the Bank of Amsterdam and the Bank of England.

In European economic history, two especially stable financial systems existed

internationally, in the 1600s and 1800s. These were under the financial leadership of the Dutch Republic in the 1600s and the British Empire in the 1800s. A stable international trading and currency system has been called a "liberal financial hegemony" "liberal" for freedom of trade across countries, "financial" for an international currency, and "hegemony" for national leadership in international trade and finance.

> In the late 1900s and early in 2000, the United States financial system was looked at by the world to provide a 'liberal hegemon in international finance'. Thus actions of the Federal Reserve (U.S. central bank) were internationally important in the first two financial crises of 2008 and 2020.

The Dutch nation created the first liberal financial hegemon in Europe. Andrew Sobel wrote: "Dutch finance came to dominate international commercial and financial relations in the 1600s and for most of the 1700s.... Financial innovations, fiscal responsibility, respect for property rights and contracts, and Dutch adherence to the rule of law engendered confidence in the Dutch system and thus contributed to an increasing return dynamic that brought new capital to the Dutch financial markets from domestic and foreign savers" (Sobel, 2012). Before this in Europe, trade was impeded by the lack of "good" money and the tendency of sovereigns to default on their debts to merchants.

For a "reliable currency", Sobel wrote about the financial innovation of the Bank of Amsterdam: "The creation of the Bank of Amsterdam by the provincial government of Holland helped address the currency confusion.... First, the provincial government minted and supported two good coinages, the guilder and stuiver,... The Bank willingly served as a clearinghouse for currencies. It accepted deposits of any currency,.. assessed the gold and silver content of such currencies and gave the depositors an equivalent value in guilder and stuivers... The bank became a financial clearinghouse.... The guilder and stuiver became the preferred currency for international exchange" (Sobel, 2012). Other currencies then in use were deposited in accounts of the Bank of Amsterdam and translated into the preferred "guilder and stuiver" (Sobel, 2012).

Thus historically, the first basic function of a central bank is to ensure "good money" by means of an honest and stable currency. Traditionally, central banks used gold reserves to insure the national currency; but this use was discarded in the early twentieth century. Central banks no longer back currency with a substitution of gold for a currency. Now central banks insure the international exchange value of a currency by avoiding inflation in the currency mostly by means of controlling the credit rates in a national economy.

Also historically, a second basic function of a central bank has been to stop bank panics in an economy. A central bank regulates a nation's banks nation to ensure they have sufficient capital reserves to allow depositors to withdraw their funds. During a "bank panic", the central bank also allows a private bank to borrow money to keep the private bank liquid. This "back-up liquidity for banks" was popularized by Walter Bagehot in 1873 and has been called the "Ba-

gehot law".

For example, the 2008 financial crisis resulted from the collapse of the securitized-mortgage market and created bank runs. Then, the Federal Reserve opened their reserves to U.S. banks. But it also extended access to its loans by money-market funds. It also rescued a financial insurance company AIG. And it assisted some investment banks to be bought by other banks. In 2008, Neil Irwin wrote: "First, just three days after the Reserve Fund broke the buck, came the Asset Backed Commercial Paper Money Market Mutual Fund Liquidity Facility, or AMLF. With Fed staffers in New York and Washington already stretched thin with crisis fighting, the program was administered by the Federal Reserve Bank of Boston, which had particular expertise in money market funds.... The Fed would lend money to banks, which could then buy the securities the money market funds were selling off and pledge them to the Fed, with the banks themselves taking no financial risk for their role as intermediary. The program lent out $24 billion on its first day of operation, September 22, 2008, and $217 billion before the panic wound down, routing money through banks like State Street and J.P. Morgan Chase to mutual funds run by household-name companies such as Janus and Oppenheimerl" (Irwin, 2013). The panic in money market funds in 2009 had been stopped by the Federal Reserve intervention; and then the commercial short-term loans from the financial sector continued to fund the daily operations of U.S. production sector" (Irwin, 2013). Later in 2020, the Federal Reserve also acted to increase global access to the dollar. James Politi, Brendan Greeley, and Colby Smith wrote: "The Federal Reserve has taken a new step to meet the global demand for dollars, setting up a facility to allow central banks and international monetary authorities to enter into repurchase agreements with the US central bank and trade US Treasuries for dollars. The Fed said the new facility would work in tandem with the dollar-swap-lines already established by the central bank with its peers across 14 countries. In recent weeks, the greenback's value has risen sharply as investors have flocked to safe assets and companies have scrambled to offset the blow to revenues from economic shutdowns" (Politi, Greeley, & Smith, 2020).

In the pandemic crisis of 2020, the U.S. Federal Reserve extended its economic rescue function beyond the earlier Bagehot rule and even beyond the Bernanke extension of 2008 toward rescuing the commercial loan market and increasing foreign access to dollars.

9. Model of Central Bank in Monetary Flows

To better understand why the expanded responses by central banks (toward diminishing the economic effect of the pandemic financial crises) was so radical, we next briefly review the role of the central bank in in terms of "monetary theory". The Chartalist School of Money distinguished three kinds of money:

Fiat, Commodity, and Managed Money (Wray, 2015).

In a previous paper, the author and his colleagues used Wray's monetary theory to model the traditional role of a central bank in an analysis of a 2016-17 economic event in India its sudden demonetarization of Indian currency (Betz, Anderson, & Puthanpura, 2018). It was in December 2016, when the Indian government suddenly withdrew its small currency notes ("Fiat Money" in 500 and 1000 rupees).

This immediately decreased the amount of "Commodity Money" circulating in the economy and created an economic crisis in local Indian commerce. In India, its "Managed Money" (as bank accounts) was unable to fill the temporary gap in the supply of money, because a large portion of the Indian population did not have bank accounts. Also the government had not supplied a sufficient number of new "Fiat Money" (new 500 and 2000 rupee notes) to quickly replace the withdrawn 500 and 1000 rupee notes. To analyze this event, the monetary flow in India was modeled, as shown in **Figure 5**.

A model of the flow of currency within an economy traces the flow between the public and private sectors, because fiat money is created in the public sector. As L. Randall Wray wrote: "It is often useful to distinguish among different types of sectors in the economy. The most basic distinction is between the public sector (including all levels of government) and the private sector (including households and firms)" (Wray, 2015).

The model distinguishes two sectors in an economy, public and private'. It shows that "Fiat Money" is issued by the government in the public sector in order to collect taxes from the private sector. Issued "Fiat Money" enters the private sector from government spending (purchasing something from the private sector); and returns to the government sector by taxes on the private sector.

This model of the private sector distinguished between households, companies, and commercial banks. Households, companies, and commercial banks pay taxes into the treasury of the government (shown in the connective lines of "Fiat Money" by solid lines). From the government, this taxed "Fiat Money" enters

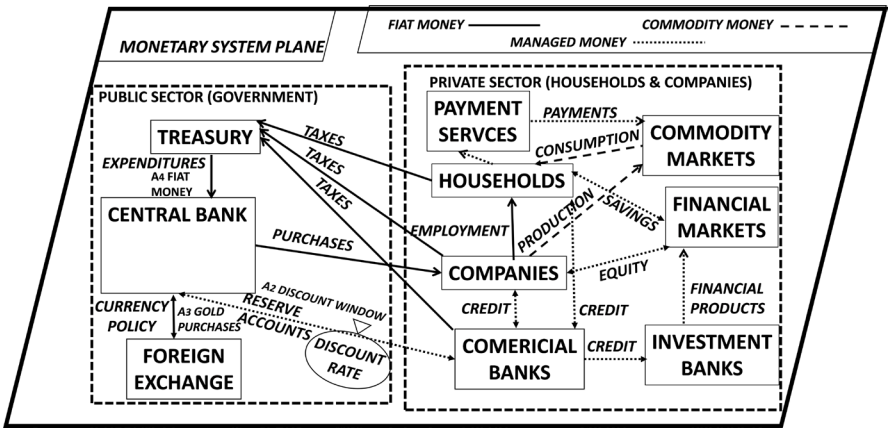

Figure 5. Model of the monetary flow in a nation, distinguishing between fiat, commodity, and managed money.

back into the private sector by government purchases (paid by the treasury as expenditures in the treasury account of the central bank). Currency, in the form of "Managed Money" (show as the dotted lines), also leaves the public sector of the central bank into the private sector as reserve accounts by commercial banks held in the central bank. The price of this government credit to commercial banks is controlled by the discount rate offered by the central bank.

In accordance with Chartalist monetary theory, the model shows that money goes from the private sector into the public sector as taxes paid in "Fiat Money" and, in contrast, money goes from the public into the private sector as 1) government purchases using "Fiat Money" and 2) as government credit in the form of "Managed Money" from the central bank in providing credit to commercial banks (at the "discount window" of the central bank). As in the Chartalist Modern Money Theory (MMT), this model distinguishes money between the public and private sectors as both printed currency ("Fiat Money") and credit ("Managed Money". Wray emphasized that these two forms of money, between the two sectors, enables the government to increase or decrease money in the economy through the control of the price of bank credit, without having to print or withdraw fiat money from the private sector (Wray, 2015).

Also in the private sector when companies provide employment to households, currency flows as "Fiat Money" and as "Managed Money" between companies and households. Money also flows between commercial banks and companies and households in the form of credit. Households and companies also interact monetarily with commodity markets in the form of production and consumption of commodity goods (often paid by payment services as "Managed Money"). Money flows in consumption and production by enabled trade in the currency form of "Commodity Money". This "Commodity Money" is composed of both printed currency ("Fiat Money") and bank and payment-services-accounts ("Managed Money").

To provide equity for companies and savings for households, both companies and households monetarily interact with financial market. Investment banks create and maintain financial markets through financial products, often financed with credit from commercial to investment banks (as "Managed Money").

In modern monetary theory (MMT), Wray also emphasized the use of accounting techniques to describe the actions of a central bank. Wray wrote: "... banks clear accounts among themselves by using central bank reserves. This leads to... "pyramiding" in modern economies leverage liabilities... all roads (monetary flows) lead back to the central bank – the sovereign's own bank... The balance sheet looks more or less like this: L1 + L2 = A1 + A2 +A3 +A4 + A5 − L3 − L4 − L5" (Wray, 2015).

In **Figure 6**, we use this accounting equation in our monetary system model, putting it into the Institutional component of a central bank.

This equation in the Central Bank is called its accounting balance at a given time. The quantity (L1 + L2) expresses "Reserves" currently held by the Central Bank, with L1 being the vault cash and cash in circulation (central bank notes

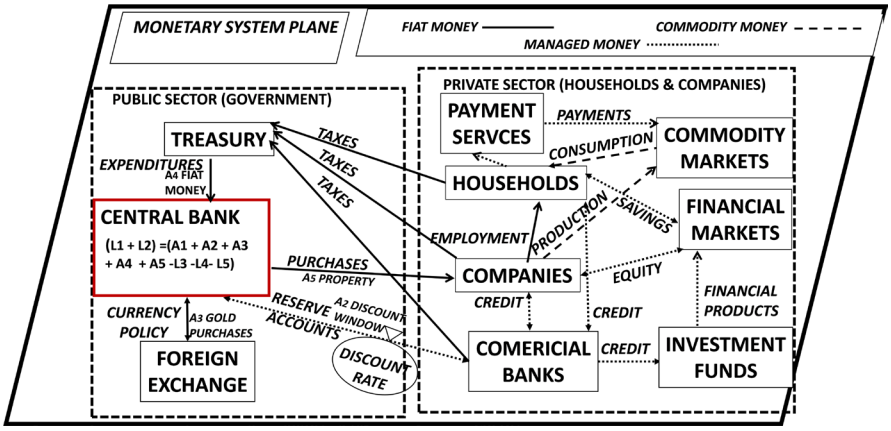

Figure 6. Accounting equation within the central bank of a national monetary system.

held by banks and the public) and L2 being the reserve balances of bank accounts held by the central bank. This balance can be altered by actions in the central bank to increase assets or decrease assets. For example when a central bank buys securities, such as treasury bonds or corporate bonds in a bond market, its asset of A1 increases. When the central bank advance federal funds to other private banks' reserve accounts (through the so-called "Discount Window Operation"), then it's assets of A2 increases. When a central bank buys gold, its asset of A3 increases; when it obtains treasury currency (fiat money) its asset of A4 increases; and when it buys a property, it assets of A5 increases (Wray, 2015).

> This monetary model depicts the role of a central bank in the flow of money and credit through the monetary system of a nation. The model facilitates the understanding of how central bank fiscal policies impact money and credit flows. It can also be used to track the balance sheet of assets and liabilities in a central bank operation.

10. Expanded Monetary Model of U.S. Financial System in 2020

In the pandemic financial crisis of 2020, the U.S. Federal System (and other national central banks expanded the accounting equation of the central bank by providing credit ("Managed Money") to financial institutions other than banks (e.g., money-market funds) and by purchasing commercial credit loans.

In the U.S. central bank assisting the cash flows throughout the economy, we can depict this additional complexity in functions, by expanding the monetary-system model, as shown in Figure 7.

The red arrows depict the expanded financial intervention from a central bank to stabilize the financial markets and commerce: A1 Purchase of Government Bonds (QE), A6 Purchase of Corporate Bonds, A7 Purchase of Bonds in Financial Markets, L8 Loans to Mutual Investment Funds.

> A monetary-system model provides a detailed depiction of the complicated system of the flow of money and credit in an economy (and in which central

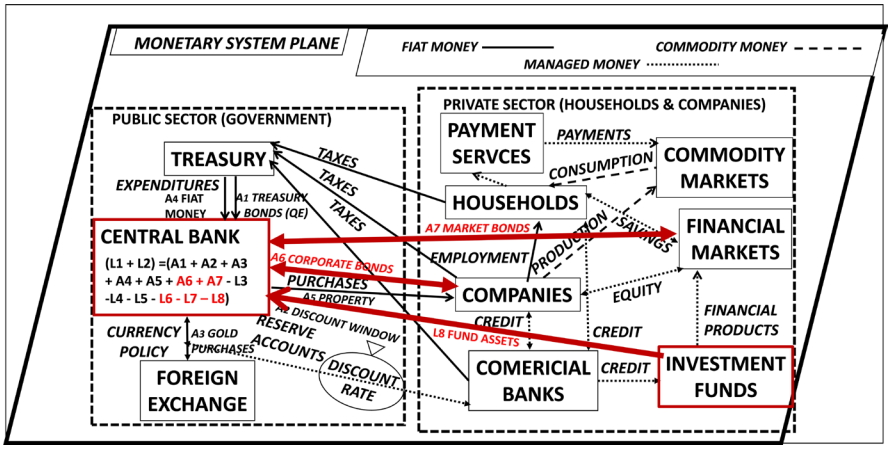

Figure 7. U.S. federal reserve purchases corporate bonds and provides credit to money-market funds.

bank operations are important). This provides a visual aid to indicate the types of regulation the central bank should engage in to assist in avoiding future financial collapses.

The expansion of Central Bank bond purchases and loans were intended to keep money flowing in the economy and reduce the economic impact of business lock-downs. On March 28, 2020, Michael Mackenzie wrote: "At the height of turmoil during the financial crisis, a Federal Reserve Bank of New York official confidently told me they would keep throwing stuff at the wall until something stuck. This week the US central bank ran some moves from its 2008 playbook then went far beyond it. Adding to the open-ended buying of US government bonds, the Fed will load up on investment-grade corporate debt for the first time. It is providing an array of other facilities to reduce strains in funding markets, having also slashed overnight rates to zero at the lower bound. This dovetails with $2 tn of fiscal spending from Washington, a figure that amounts to about a tenth of annual economic output. Policymakers' efforts to combat the coronavirus pandemic have sent equity markets up more than 10 per cent this week..." (Mackenzie, 2020).

Also, the U.S. Federal Reserve reintroduced a monetary policy, which it called "Quantitative Easing" (QE). In 2008, the term "QE" was a central bank code about a central bank buying the treasury sovereign bonds to keep government-bond interest rates low. A central bank buying its country's own sovereign bond issues over the long term has traditionally been a bad practice, a bad long-term monetary policy. But in the global pandemic, the U.S. central bank had an urgent policy, QE, to avoid rapidly rising bond prices. Colby Smith wrote: "When cracks emerged in the $18 tn US government bond market this month, the Federal Reserve sprang into action to ensure volatile trading conditions did not destabilize the world's largest and most liquid financial benchmark. In addition to slashing US interest rates to zero, the Fed ramped up its interventions in short-term funding markets and announced it would buy at least $700

bn in Treasuries and agency mortgage-backed securities. The US central bank went further this week, awarding itself the power to buy an unlimited amount of government bonds. These measures have helped to bring back a semblance of order to a market where it had become alarmingly difficult to get deals done. Volatility has abated..." (Smith, 2020).

Other national central banks followed the U.S. Federal System direction. Laurence Fletcher reported: "Reassured by the US Federal Reserve's pledge on Monday to buy government bonds in unlimited amounts, along with similar moves from central banks elsewhere, markets have regained a semblance of calm" (Fletcher, 2020).

Globally the reduction of interest rates in different nations by their central banks buying national sovereign bonds worked temporarily. Figure 8 shows the success in March 2020 of Central Banks' bond buying in stabilizing bond interest rates.

Former chairs of the Federal Reserve System (U.S. Central Bank), Ben Bernanke and Janet Yellen, approved of the expansions of central bank support in the pandemic crisis. Bernanke and Yellen wrote: "Around the world, policymakers are grappling with the effects of the devastating coronavirus.... For their part, fiscal policymakers are helping to fund the public health response while providing critical aid to people whose lives and livelihoods have been shattered by the virus and its effects.... Central banks, like the US Federal Reserve, also have a useful role to play. Some of the actions recently announced by the Fed, including cutting the short-term policy rate nearly to zero and preparing to buy at least $700 bn in Treasury debt and mortgage-backed securities, are superficially similar to those taken by monetary policymakers during the 2008 financial crisis. However, the underlying challenges today are quite different. Back then, the near-collapse of the financial system froze credit and spending; the goal of monetary policy was to restart both. Now, the problem is not originating from financial markets: they are only reflecting underlying concerns about the potential damage caused by the coronavirus pandemic, which of course monetary policy cannot influence" (Bernanke & Yellen, 2020).

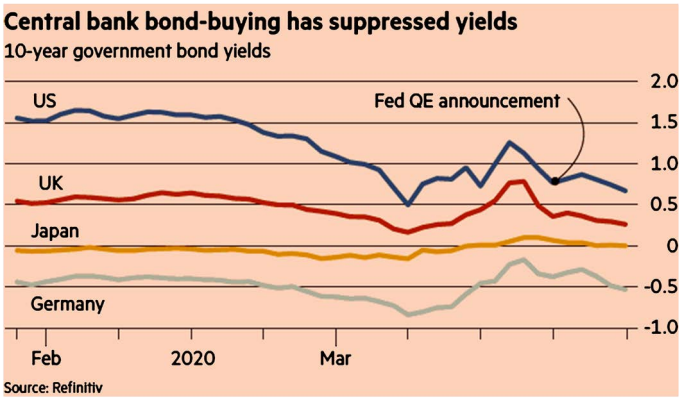

Figure 8. Governments around the world embarked on the biggest borrowing spree in history to tackle the Coronavirus crisis.

As explanations in the 2020 pandemic, we can see in this view (by former US central bankers) that 'Ideas' in a change event were also important explanations in altering economic 'Reasoning' and monetary 'Policies' and central bank 'Operations'.

11. Discussion

This 2020 pandemic financial crisis (with the central banks massive interventions) has now among some economic observers emphasized an important fact about modern economies. Now modern economies are centered less around "production" and more around "markets", financial markets and consumer markets.

Traditionally in economic history, many economists had regarded production as more central to an economy than domestic consumer markets. This was particularly true in the early days of industrialization in Europe, where colonial policies had made the export of industrially produced goods very profitable. Then commerce expanded rapidly through imports of raw materials and exports of industrially produced goods. But now in a modern economy, the internal markets are seen as equally important as production particularly with domestic employment powering a consumer market.

In the 2020 pandemic, the central banks and government stimulus programs focused upon keeping internal markets operating. A former president of the European Central Bank, Mario Draghi, emphasized this new importance of markets in an economy: "The key question is not whether but how the state should put its balance sheet to good use. The priority must not only be providing basic income for those who lose their jobs. We must protect people from losing their jobs in the first place. If we do not, we will emerge from this crisis with permanently lower employment and capacity, as families and companies struggle to repair their balance sheets and rebuild net assets" (Draghi, 2020).

When a system changes in a society, then policies about operations of the system need to change. Modern economies are "market economies" in which 'employment is the critical variable, enabling people to have jobs so they can purchase goods and services in the market. Draghi's view on the proper response to the pandemic financial crisis of 2020 was to emphasize: "We must protect people from losing their jobs in the first place" (Draghi, 2020).

This was an acknowledgement of the importance of both "employment" and "capital" for in a modern economy. This contrasts to the traditional emphasis in economic theory principally on "capital" (as in the concept of "laissez-faire" capitalism). To see the impact of financial crises on employment, we view the statistics of unemployment in the U.S., as shown in **Figure 9**.

Viewing the long-term unemployment levels over time, one sees a repeated set of unemployment cycles with relatively small peaks. These are the periodic recurrence of what has been called a "business cycle". A business cycle occurs in free markets, as producers of goods anticipate the growth of a market and increase employment. But later when the market ceases to grow, producers reduce

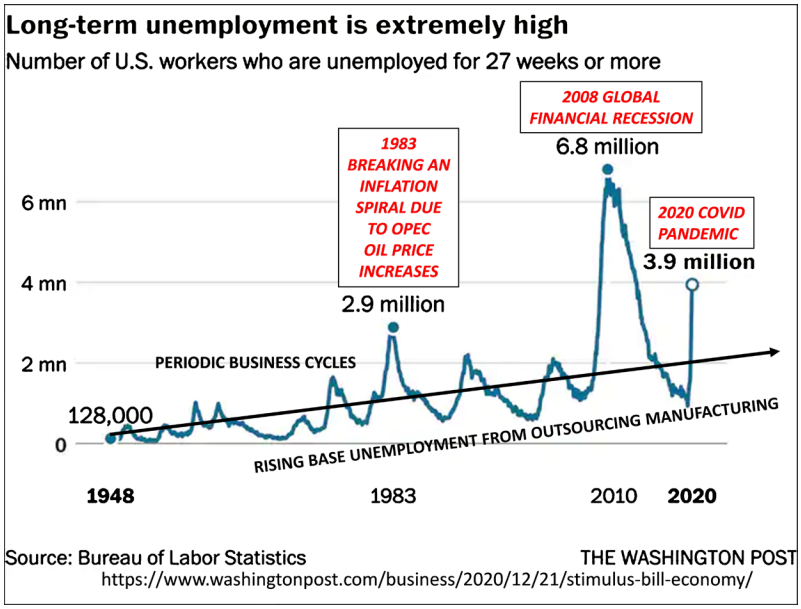

Figure 9. United States unemployment levels, since 1948.

production and lay-off employees. Then finally production falls lower than market sales, and producers increase production again, hiring back people and so beginning another business cycle.

But higher than the smaller peaks of business cycles, one can see in the chart that there were three larger peaks of unemployment in 1983, 2008 and 2020 and each of these was due to a financial crisis. The economic recession of 1983 was a deliberate raising of central bank credit rates to break the spiral of inflation in the U.S. (from the rapid rise in oil prices due to OPEC). The economic recession of 2010 was due to the financial crisis in 2008 from the exploded mortgage securitization market (CDOs, Collateralized Debt Objects). The economic crisis of 2020 was due to the lock-downs of the economy to combat the spread of the corona 19 virus pandemic.

If one draws an arrow through the average levels of the business cycles (due to production expansion and retraction to meet market demands) one can see a gradually rising of U.S. unemployment. This occurred from 1948 to 2019, due to the "outsourcing" by large corporations of U.S. manufacturing from 1948.

Outsourcing began in the U.S. in first transferring clothing manufacture to Hong Kong and to rise in the 1980s from foreign production of imported automobiles from Japan and again continued to increase as electronic products were outsourced from Japan, South Korea and China from the 1990s and onwards. The change in the U.S. from a dominant "production economy" to a predominant "market economy" accelerated after the second world war.

> The history of production in industrializing economies has been the continual innovations in automation in manufacturing – reduction the cost of labor in manufacturing but increasing the costs of capital in manufacturing. The growth of manufacturing in the economies of Asian countries after the

second world war has been based upon the import of Asian products into American and European countries. The pandemic lock-down of western economies in 2020 has highlighted the importance of employment in providing markets in the West.

For example, BlackRock's Philip Hildebrand recently emphasized the importance of distinguishing between traditional business cycles in production and financial crises in markets. Hildebrand, wrote: "Three things have become clear. First, a typical business cycle logic is the wrong framework to use. What we face now is a global natural disaster... Second, rather than trying to stabilize activity, governments are stepping in to avoid lay-offs and relieve cash flow pressures in the private sector. Unaddressed, these could set in motion a lethal credit crunch loop, whereby rising defaults make it harder for to extend credit, thus accelerating bankruptcies, which leads to more defaults, and so on. This would also destroy long-term production capacity. Third, this is where central banks come in. Monetary policy can help ease market liquidity problems. But it cannot be as effective now as in 2008 with interest rates already often at rock bottom levels.... (Hildebrand, 2020).

In 2020, the role of central banks (to rescue financial markets) along with the role of government subsidies (for businesses and unemployment) contradicted the economic ideology that the market was completely more important than government to an economy, the so-called "free market" belief of "Laissez-faire economists".

For example, in late 2020, Jonathan Guthrie wrote: "Just about everything economic libertarians disapprove of is happening all at once.... the works of libertarian philosophers like Rand are among the chattels going up in smoke. Traumatized by the evils of communism, this Russian émigré coined an equally ruthless materialist philosophy. It glorified entrepreneurs rather than workers and elevated financial relationships not community ties. It fed into the nineties neoliberal view of globalizing-corporations as a parallel power base to nation-states....For postwar individualist philosophers like Ayn Rand, cheerleader for the primacy of private capital—the jig is well and truly up. Witness the extraordinary efforts by governments to stabilize their economies and forestall the collapse of business. The US signed off on a $2 tn aid package in the early hours of yesterday morning and the global bailout—central bank liquidity support included—will have a sticker price of more than $4.5 tn" (Guthrie, 2020).

Other observers also emphasized that new lessons on central bank policies need to be learned. For example, Jim McCormick wrote: "Someday this crisis will end. When, and at what human and economic cost, remain big unknowns. But when markets return to something like normal, investors are likely to find a fundamentally altered political and economic landscape—one in which the role of monetary policy has shifted from primary to secondary importance." (McCormick, 2020).

The scale of monetary policy rescues and fiscal policy rescues in the global pandemic financial crisis were large. In the United States the central bank rate went down to zero and the treasury stimulated the economy with over $2 trillion dollars expenditures in the first half of 2020.

Now and in the future, the coordination of monetary and fiscal policy is important. For example, Philipp Hildebrand added: "To overcome the perennial inflation challenges of the past century, it was enough to assert that monetary policy decisions should be made independently from government decisions. But to deal with this existential threat (COVID-19 19 pandemic) to the very foundation of the world's economic system, a truly independent central bank needs to be confident in its ability to explicitly co-ordinate with other organs of policy, such as the state. What is required now is a coordinated approach in which governments disburse needed funds to provide a financial bridge to households and viable corporates. Meanwhile, central banks will be called upon to ensure that interest rates don't rise in an uncontrolled way amid the largest natural disaster relief program ever recorded... The bottom line is this: central banking is once again being reinvented dramatically. It is time to make co-ordination with fiscal counterparts an explicit reality in the face of an unprecedented type of crisis with an unprecedented rise of public debt" (Hildebrand, 2020).

The modeling of financial crises is now necessary to understand the proper interaction between monetary and fiscal policies in order to properly understand the needed coordination between central banks and government treasuries.

12. Summary

This research has analyzed the empirical evidence in recent economic history about central bank functions, focusing on the 2020 Covid-19 pandemic financial crisis. From the discussion, we can see that there are strong arguments for governments now to coordinate monetary policy and fiscal policy. For this coordination, it is useful to have economic models of monetary systems and of fiscal systems, as models can make clear where and how coordination should occur. This research contributes by depicting two basic economic models; a model of a monetary system and a model of a fiscal system.

From earlier in **Figure 10**, we describe again the model for a monetary system, which describes monetary flow in a national economy and in which a central bank plays a central role in formulating and administering monetary policy. We show this **Figure 10** again; but now as shown in red arrows, we add to the model the connections of a central bank rescue in subsidizing financial markets, investment funds, and in purchasing corporate bonds.

Here, also, the blue arrows show more of the connections in the monetary system which should be monitored by a Central Bank. The Blue Arrows depict the need to monitor Speculation in Financial Markets, Price Inflation in Commodity Markets, Unemployment in Households, and International Exchange Rate of national fiat currency. The Red Arrows show the connections of a Central

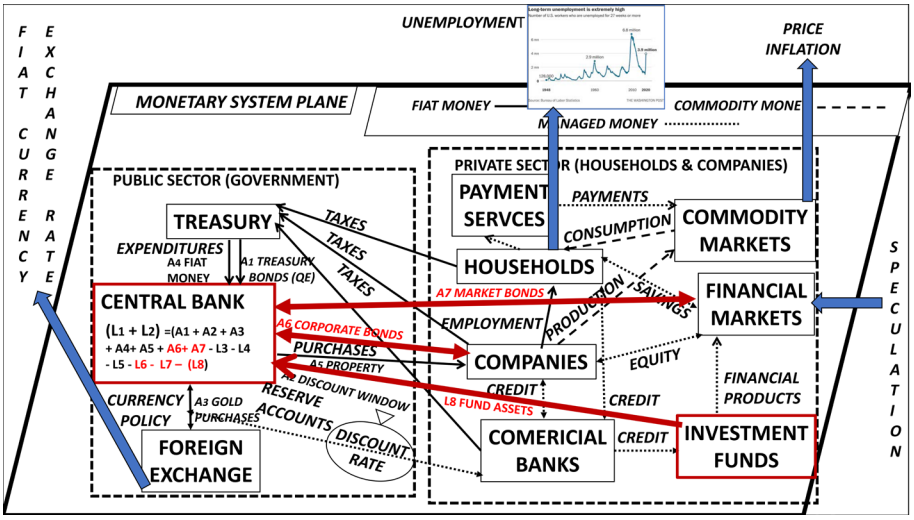

Figure 10. Economic model of a national monetary system.

Bank to Treasury Expenditures, Currency Policy in Foreign Exchange, Reserve Accounts, Corporate Bond Market, Bond Market, Mutual Fund Assets.

The Central Bank's rescue funds went beyond banking to all financial markets. Traditionally to avoid periodic bank panics, central banks have needed to monitor "speculation" in financial markets for potential financial bubbles. But now in this model we can see that a central bank should monitor not only commercial banking but also investment funds, financial markets, commodity markets and corporate bond markets.

> This potential expansion of central bank rescue operations in a financial panic may now go beyond simply rescuing banks (Bagehot Law) to also rescuing such investment funds, financial markets, and even large companies.

The traditional function of managing money for low inflation-levels has required central banks to watch for "price inflation" in commodity markets. Moreover, levels of unemployment are also important to central banks for help in managing prompt recovery from recessions. And watching the exchange rates of national fiat currency enables a central bank to coordinate with fiscal policy which is largely the responsibility of the treasury.

The model now depicts the connection for "Quantitative Easing" (QE), the policy which Central Banks temporarily purchase their own national sovereign bonds. This QE policy raises the possibility of a future inflation of national fiat currency. The short-term effects of Central Bank interventions did help limit economic collapses but still presented a long-term risk of currency inflations.

Even in 2020, worry about future inflation was on the minds of many. For example, Robin Wigglesworth wrote: "The aggressive monetary and fiscal response to the coronavirus crisis in the US could trigger a burst of inflation that the Federal Reserve might struggle to control... Quoting economist Milton Friedman's dictum that "inflation is always and everywhere a monetary phenomenon", Morgan Stanley's chief US equity strategist Mike Wilson highlighted a

surge in money circulating through the country's economy. The year-on-year growth in M2 a broad measure of US money supply has rocketed this year due to the efforts of monetary and fiscal policymakers to reduce the economic damage caused by the pandemic. Although the severity of the shock makes deflation the most likely short-term outcome, Mr. Wilson argues that there is now a "greater likelihood for inflationary pressures to build" (Wigglesworth, 2020).

Figure 11 shows the changes in U.S monetary supply year by year, from 1960 to 2020.

In the chart of the year-to-year percent-change in the US money supply, one can see two peaks of inflation in the 1970's (which was due to the formation of OPEC by oil producing nations and imposing a large increase in oil prices). This resulted in a longer-term U.S. inflation into the early 1980s (which was killed by the Federal Reserve Head, Paul Volker, by a large increase in the reserve credit rate.) Inflation which might by begun in the US government rescue of the financial markets in 2008-2009 was held down by the Quantitative Easing of the Fed in 2009-2010. Finally, Federal Reserve rescue of markets and government stimuli spiked the monetary supply in 2020.

But fiat monetary inflation can be caused not only by monetary expansion but also by extreme sovereign debt. We next summarize a model of a governmental fiscal system (illustrated by the Greek Fiscal Crisis of 2010).

In addition to a monetary system model, it is useful to have a model for a national fiscal system. As shown in Figure 12, a model a fiscal system in which the government's treasury plays a central role for formulating and administering fiscal policy.

This model was first published by the author in analyzing the fiscal crisis in Greece in 2010 (Betz & Carayannis, 2015). It shows two sources of government finance: "tax revenues" and "sovereign bond issues". (In this systems dynamics model, arrows depict flows of "things" from sources to stocks of the things. Sources are denoted in a cloud symbol; and stocks of things building up from the flow is depicted in a rectangle symbol; and control of a flow is depicted as a symbol of a triangle-over-a-circle.)

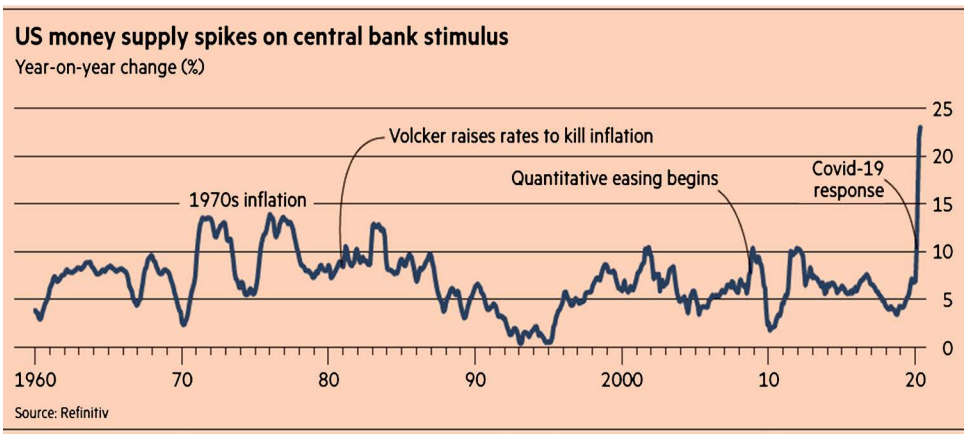

Figure 11. U.S. monetary supply from 1960 to 2020. (Source: Wigglesworth, 2020)

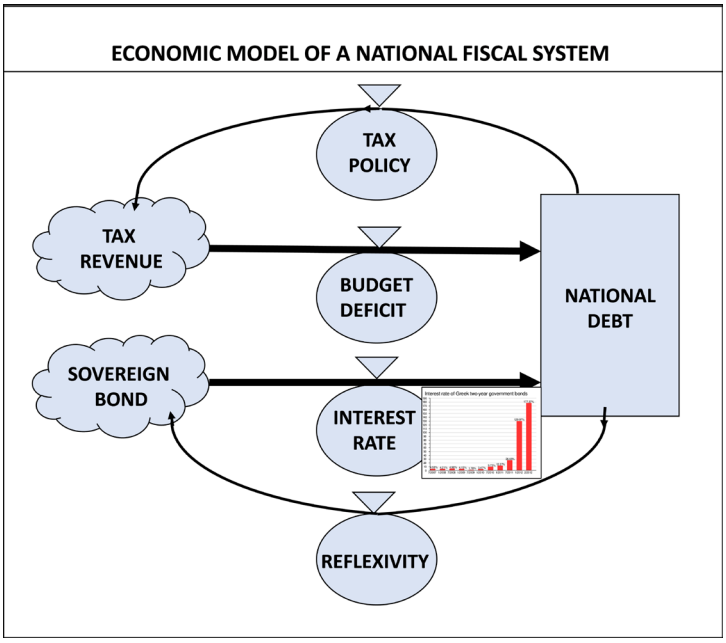

Figure 12. Economic model of a national fiscal system.

National debt can be indicated as build-up (accumulation) of debt from the issuance of sovereign bonds. When tax revenue is insufficient to fund a government budget, then the "stock" of national debt will accumulate. This occurs when a government finances budget deficits through issuing sovereign bonds. The interest rates on the sovereign bonds will vary in bond markets, considering the risk of investments in the government bonds.

Also shown in **Figure 8** is the international interest rate for the sale of a Greek bond in 2008, with a dramatic rise in 2009. Then confidence by the international financial market in the soundness of in Greek finances declined and interest rates for buying new Greek sovereign bonds jumped. (In the model, the level of "interest rate" is depicted as a kind of "control valve" on the "flow" of sovereign bonds into the "stock" of national debt.)

At that time of 2009, international confidence in the future value of Greek bonds had been undermined by the size of the Greek debt to Greek tax revenue. H. Smith and A. Seager reported: "Greece has the highest debt ratio within the 16-member eurozone, with the finance minister, Giorgos Papaconstantinou admitting that "the fiscal situation is dramatic". Next year, it is forecasted to reach 124.9 % of gross domestic product" (Smith & Seager, 2009). **Figure 13** shows the application of this fiscal policy model to the Greek Fiscal system in 2010.

This systems-dynamics model of the Greek fiscal system in its fiscal crisis of 2010 shows how a model can be used to coordinate information about a complex societal system. This model relates information (charts of data) of one part of the fiscal system to another. As an "information architecture" to describe the crisis, one sees how one part of the fiscal system impacted other parts. This model is

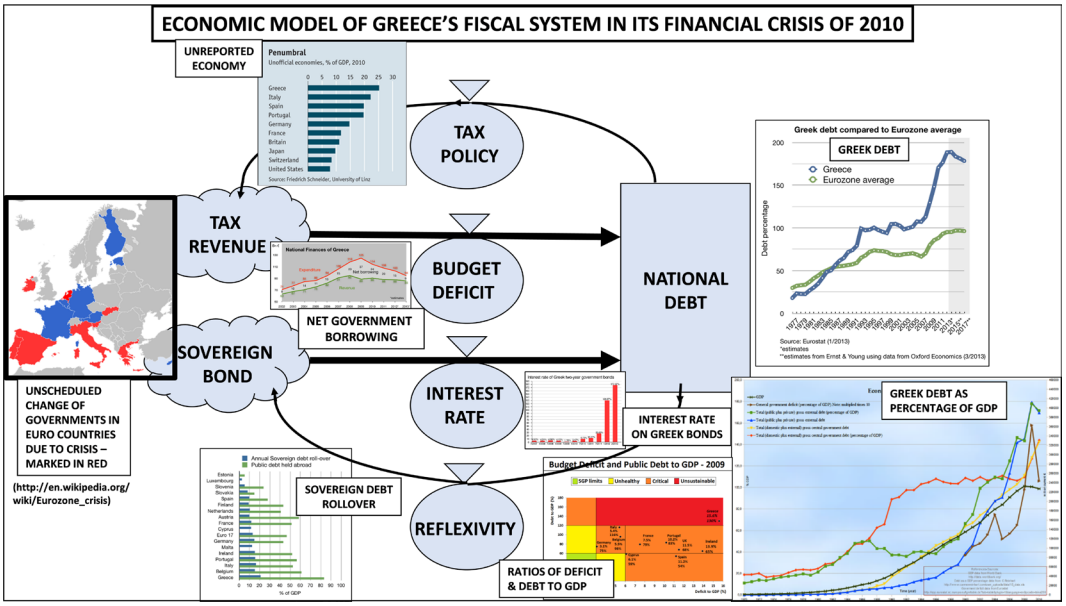

Figure 13. Systems model of Greek fiscal crisis of 2010.

not that of a simple "causal" system; instead, it is a "functional" model of a socio-technical system government budget funding fiscal system.

What is important in the display of this model is that financial crises result not from "causes" but from "perceptions" about system functioning. Financial bubbles occur from "perceptions" cognitive "reflexivity" in Soros' term expectations of the future values in a financial market (Soros, 1988). A so-called "Minsky moment" in a financial market occurs at a time when traders in a financial market have moved from speculative finance to the unstable reflexivity in Ponzi financing a government.

> By 2009, the previous governments in Greece had indulged in the dynamics of a budget policy of 'Ponzi' finance. Over the years until 2009, unsound fiscal policy in Greek governments had accumulated a very large and increasing government debt. Then in 2009, a (Soros-like) 'reflexive cognition' in the international sovereign bond-market traders finally triggered the Greek fiscal crisis in 2010—the 'Minsky moment' for Greek fiscal policy. The 'reflexive perception' of bond traders was that either the Greek government must 'default' or be 'bailed out'.

Although the above model depicts the Greek fiscal crisis of 2010, there now has occurred in most governments of the world potential future fiscal crise, beginning after 2020. Because of the large deficit spending by governments in fighting off economic collapse in the Corona virus 19 pandemic, many central banks had to think about their nation experiencing a "Minsky" moments in their sovereign bonds in the future. Figure 14 shows the rise in government debt (as % of GDP) from 2019 to 2020.

After the 2008 financial crises and even in 2020, national monetary and fiscal systems were not prepared for such global fiscal challenges. For example, Mark

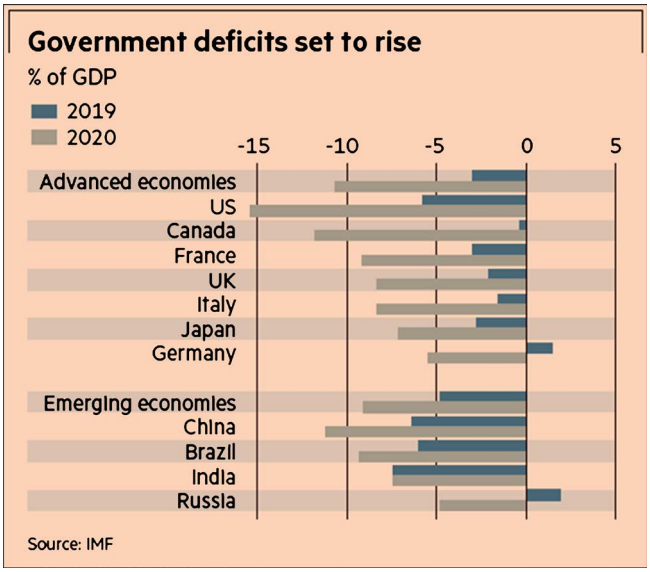

Figure 14. Increase in governments' debt as % of GDP from 2019 to 2020.

Sobel wrote: "Regulatory reforms after the Global Financial Crisis of 2008 were supposed to have created a more robust and resilient system. But the suddenness of the spread of the Covid-19 pandemic in 2020 and the subsequent lockdowns to contain it have created meltdowns, volatility and squeezes on liquidity. The (global financial) system is failing its first real stress test and the international community needs to start getting to the bottom of it.... During the Global Financial Crisis of 2008, we heard about turmoil in commercial paper, money market funds, asset-backed securities, dollar global funding and high-yield debt. Today in 2020, we hear the same but also about stresses in corporate and municipal bonds, "risk parity" trades, exchange traded funds, mortgage servicers, repo markets and even US Treasuries" (Sobel, 2020).

What has been added to risks in the global financial system is the increasing importance of "shadow banking" in the system. The rise of "shadow banking" in the financial system has added major complications to global financial stability. In addition to significant deregulation of the US banking sector, the "non-bank" financial sector has gone unregulated. Lack of proper preventative regulation has been a principle reason in the U.S. financial system for its lack of government preparedness for global financial crises, both in 2008 and in 2020. For example the earlier important U.S, regulation since 1937 of the Glass-Steagle act (separating investment and commercial banking) was withdrawn in 1998. Even after 2008, there had been only a pale reform in the US in the Dodd-Frank act.

This too was being weakened by 2020. Mark Sobel wrote: "The current US administration in 2020 has had a deregulatory bent when it comes to financial oversight. Within weeks of assuming office, President Donald Trump signed an executive order aimed at, in his words, "doing a big number" on Dodd-Frank, the main post-crisis law. The US Federal Reserve is still technically charged with critical responsibilities for financial stability but has seemingly left this terrain to

the FSOC. Last year, the FSOC issued a rule that watered down any possibility of designating a non-bank firm as systemically significant" (Sobel, 2020).

Outside the U.S., financial regulation on a global scale also had not been strong for reform. Mark Sobel wrote: "In the summer of 2007, at the urging of the US, the G7 called on the Financial Stability Forum, the forerunner to the Financial Stability Board (FSB) to undertake a comprehensive study of financial market pressures. In April 2008, the G7 received a report and, in October 2008, recommendations on reforms and implementation. This work formed the basis of the November 2008 G20 Leaders Action Plan and a foundation for the 2009 summits in London and Pittsburgh. But at the recent virtual meetings of the IMF, the G20, the FSB and the fund itself passed up a golden opportunity to launch analogous reports focused on non-banks" (Sobel, 2020).

The importance the "non-banking" (or "shadow-banking") sector has greatly increased the scale of possible financial instability. For example, John Plender wrote: "Be warned. The global financial system in 2021 will face a gigantic stress test. This follows from one of the more important lessons that emerged from the coronavirus-induced market turmoil in March last year.... The so-called dash for cash was in part a reflection of how the big banks' balance sheets had failed, since the 2008 financial crash, to keep pace with the growth in the stock of US Treasury securities that was spurred by the post-crisis surge in federal deficits. Their ability to act as intermediaries in the Treasury market was thus impaired. And their readiness to provide liquidity to the market by absorbing investor flows on to their balance sheets, as opposed to simply matching buyers and sellers, was further reduced by the tougher capital and liquidity regulations introduced after the financial crisis. The stricter framework was, in one sense, good for stability. Banks emerged relatively safe from last year's crisis" (Plender, 2021).

A half century ago, banks provided the principle institutional form of controlling money and credit flow in an economy. But in recent decades, the rise of hedge funds in creating "shadow banking" has increased their importance in global financial flows. John Plender added: "But the role of banks as providers of liquidity has increasingly been filled by less-regulated non-banks, or "shadow banks", such as hedge funds. These borrow heavily, often to maximize the return from trades that arbitrage tiny differences between the prices of closely related assets. With the onset of heightened volatility and market stress last March, these non-banks faced margin calls and funding difficulties. They went from being market stabilizers to amplifiers of market stress" (Plender, 2021).

Financial intermediation occurs in matching borrowers to lenders which earlier was the province of investment banks but now has increasingly occurred in "shadow banks". John Plender added: "Since the deregulatory thrust that began in the 1970s, a growing share of financial intermediation—borrowing and lending—takes the form of collateralized repurchase agreements or repos where cash is exchanged for high-quality assets such as US government debt. At the same

time, much of the risk-sharing function is conducted in multitrillion-dollar derivatives markets... In this more market-based framework, the provision of liquidity depends heavily on wholesale financial markets. Here the players often shadow banks—are leveraged and are part of complex networks of collateralized lending relationships. Shadow banks mainly repackage and recycle existing savings. Their funding model is based on short-term repos and they are much more exposed to interest rate fluctuations than banks. It is a more opaque and fast-moving financial world that now poses huge challenges for regulators" (Plender, 2021).

> For example, the 2008 financial crisis was created by the shadow-banking sector of hedge funds which had issued mortgage securitization contracts, a bad financial product in which interest payments had been stripped from mortgage payments leaving the underlying mortgage bonds worthless). In 2020, the financial crisis was due to a virus pandemic but the financial markets went volatile, partly due to the leveraged risks of hedge funds.

For both kinds of financial crises (banking and pandemics) now monetary policy and fiscal policy both need to up-graded, nationally and globally in order to properly regulate an entire financial system, and not just the banking sector. We have, in this research, shown how models of monetary systems and of fiscal systems can assist in understanding the stability and instability of financial systems.

13. Conclusion

This research adds a modeling methodology (in terms of societal change-events and operations system models) to enable the abstraction of empirical evidence to modify and verify modern economic theory about central bank functions.

We have developed models used a "graphic form" because this form of depicting an economic enables the coupling of "economic activity" to "economic agents" (e.g. markets) and institutions (e.g. central banks). This allows a system model to couple economic activity to agents, and such coupling can be altered historically by an economic historical event. As shown in the previous **Figure 9**, the graphic form also enables such models to be used as "information architectures" in monetary and fiscal information systems.

We note that this modeling approach, in a graphic systems approach, differs from other approaches, such as that by Flint Brayton, Thomas Laubach, and David Reifschneider in their "The FRB/US Model: A Tool for Macroeconomic Policy Analysis" (Brayton, Laubach, & Reifschneider, 2014).

Theoretical models in the economics are methodologically essential in order to use historical cases of an economy to explain economic action and to ground economic theory. History provides the empirical experience on the nature of human economies. Economic models enable the generalizations of economic theory about the nature of human economy, across the specific contexts of his-

tory. Economic theory must continue evolving to realistically deal with the increasing complexity of modern societal systems.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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