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Economic Stimulus and Financial Instability: Recent Case of the U.S. Household

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Abstract: The effectiveness of government policies and economic stimuli during the 2007 financial crisis and the COVID-19 pandemic are compared in this study. While the 2007 financial crisis started in the real estate market and spread through the contagion effect to other sectors, the pandemic halted the all sectors of the global economy simultaneously. In the United States, where the social safety net is not as strong as other advanced economies, the unemployment rate skyrocketed and many families lost income. The federal government countered with various relief packages, which have been, unlike the rounds of quantitative easing prevalent after the 2007 financial crisis, direct payments to households and businesses. The Agent Instability Indicator and default elasticity coefficient are used to quantitatively assess the financial instability and default risk of subgroups of United States households classified by percentile of income and net worth. It turns out that the financial instability level of the United States household during the pandemic has not been as high as that during the 2007 crisis and the Great Recession. It is concluded that the direct handout of cash—so called helicopter money—is more effective at preventing financial collapse and stabilizing the economy than quantitative easing through asset purchase.

Keywords: financial instability; COVID-19 pandemic; helicopter money; quantitative easing

JEL Classification: C02; G51; G01

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1. Introduction

The COVID-19 pandemic, believed to have started in Wuhan province of China at the end of 2019, spread to the rest of the world in a short time and all but stopped the global economy. The governments of developed countries countered with unprecedented policies, both fiscal and monetary. In the United States, first the Trump and then the Biden administrations, with the congress, enacted a series of policies to provide fiscal stimulus to the economy and relief to those affected by the pandemic. The Federal Reserve (Fed) also took a number of monetary stimulus measures to complement the fiscal stimulus (Alpert et al. 2022). The most notable difference between the COVID-19 stimulus policies and the ones for the 2007 Financial Crisis and the Great Recession is the stimulus and relief packages that were rolled out in five stages. The packages consist of fund paid to people, businesses, and local governments in the form of direct cash payment, extra unemployment benefit, tax credit, and grant, which can be summed as "helicopter money" (HM). Thanks to those stimulus measures, many laid off employees could access extra-large and long unemployment benefits that often exceeded their usual wages while the unemployment rate spiked to an all time high of 14.7% in April 2020 (Bureau of Labor Statistics 2022). Increased money supply from economic stimuli, lack of opportunity to consume, and confinement at home due to lockdown created many "traders", which made the stock markets soar to break all records (S&P 500® 2022). A financial crisis—defined as a situation in which asset values decline rapidly—never took place. Instead, the frozen goods and services market and the overheated stock market coexisted for more than a year. While most people suffered during the 2007 financial crisis and its aftermath, which is titled the Great Recession, some people, especially those owning significant financial assets, did better than ever during the pandemic, further intensifying already severe wealth inequality (Blanchet et al. 2022) in households.

The interest of this work lies in comparing the effectiveness of government stimulus measures for the household during the 2007 financial crisis and the COVID-19 pandemic. This goal is achieved by quantifying the financial instability level of United States households during the past two decades and comparing the numbers from the times before, during, and after the two events. Monetary authorities from different currency zones agree on the definition of financial stability as "a condition in which the financial system can resist shocks and unraveling financial imbalances to fulfill its basic functions needed in the real economy" (Bank of Korea 2022; European Central Bank 2022; Magyar Nemzeti Bank 2022; Rosengren 2011). In this research, financial stability is defined as, in the spirit of (Friedman 1969), "a condition in which optimal amount of money flows among economic agents" and financial instability as "a condition in which the optimality of flow of funds is broken". A dynamical system-based methodology called the *Agent Instability Indicator* (AII), which is a special case of the *Market Instability Indicator* (MII) first introduced in (Choi and Douady 2012) and verified with real data in (Choi 2019), is applied to subgroups of U.S. households classified by the income percentile and net worth. This classification, made by the Survey of Consumer Finances (SCF) (SCF 2019), divides U.S. households into six subgroups by percentile of income and five subgroups by percentile of net worth. The research found that none of the subgroups, whether classified by income percentile or net worth, have been affected by the pandemic in terms of financial stability and economic health. Specifically, for each subgroup, the asset level dropped at the beginning of the pandemic, but rebounded immediately and has been increasing to date; liability has stayed below the maximum allowable debt level and therefore there is no risk of potential default. [1] The debt-to-asset ratio, which determines the maximum allowable debt level, rose briefly at the beginning of the pandemic, but then has steadily declined to date. On the other hand, during the 2007 financial crisis and the Great Recession, all subgroups experienced volatile financial instability and potential default risk, despite the rounds of quantitative easing (QE) and ultra-low interest rates.

It is concluded that the direct handout of cash, in other words helicopter money, which increases the M1 monetary supply, is more effective, at least in the short term, in preventing economic collapse than the expansion of the monetary base, i.e., quantitative easing. As such, the next time an economic stimulus measure is needed, expansion of the M1 supply may as well be considered before deploying QE. Care should be taken, however, because the expanded M1 supply seems to have done more than boosting the economy. As of 2022 Q1, the inflation rate is higher than ever (Bureau of Labor Statistics 2022), while it was steadily low during the 2007 financial crisis and the Great Recession. This phenomenon suggests that economic stimulus measures, should they be fiscal or monetary, must be executed with carefully planned targets in mind. Unconditional injection of money into the system *à la* "whatever it takes" may result in undesirable long-term side effects.

The paper is structured as follows. The second section is a literature review. The background, theoretical framework, and methodology for working with real data are presented in the third section. The fourth section presents the results. Discussion and the conclusion follow. Appendix A provides a complete list of results.

2. Literature Review

Although the definitions of financial stability and its complement, financial instability, are well-established, there does not seem to have been much success in measuring either of them, despite attempts to establish a method to do so. Financial stability reports published by monetary organizations provide overall assessments of financial systems (Gadanecz and Jayaram 2009; International Monetary Fund 2021; The Federal Reserve 2022c). Recent publications on the pandemic and financial stability are only about the financial sector

(Annunziata and Siri 2020; Jackson and Schwarcz 2020). Adrian et al. (2015) uses financial stability as a tool to monitor systemic risk and investigates the financial stability of four sectors—the banking sector, shadow banking, asset markets, and the nonfinancial sector—yet there is no significant measurement for the nonfinancial sector other than debt-to-income (DTI) and loan-to value (LTV) ratios. In terms of measuring the sensitivity of an agent's assets and liabilities to external shocks and subsequent transmission of risks through feedback loop, the proposal of (Gray et al. 2007) is compatible with (Choi 2019), which is reminiscent of Minsky's celebrated financial instability hypothesis (Minsky 1992) in identifying the role of debt as a potential trigger of a financial crisis. Zabai (2017) acknowledges that the responsiveness of aggregate expenditure to shocks depends on household debt and liquidities, and the way household indebtedness affects the sensitivity of aggregate expenditure matters for both macroeconomic and financial stability. However, this study does not provide any methodology to estimate financial instability from real data. There is literature that addresses the role of household debt in measuring a household's sensitivity to external shocks and financial stability (Debelle 2004; Filardo 2009; Leika and Marchettini 2017; Monacelli 2009), which could be viewed as a household version of (Minsky 1992). Nevertheless, as reviewed in (Tescher and Siberman 2021), there is not an accepted method of assessing financial health, nor the right data to do so, and as such, it is hard to assess the effectiveness of the rounds of quantitative easing (QE) rolled out after the 2007 financial crisis. There has been research that suggests that QE does not contribute much to economic growth in general. In the case of Japan, liquidity injection increased the monetary base (MB), but not the M2 supply. Loans and bank credit decreased. In the case of England, reserve balances went up, but the M4 money supply changed little, and bank lending decreased. Private savings in both the United States and the United Kingdom massively increased after the bursting of the housing bubble (Koo 2011). In other words, everybody was sitting on money and there were not enough fund flows among economic agents. In the eurozone, stability in the banking sector reestablished by the intervention of the European Central Bank did not lead to economic growth for similar reasons (Acharya et al. 2019). In contrast, many argue that QE has intensified wealth inequality (Blanchet et al. 2022; Montecino and Epstein 2015; SCF 2019) because money created from QE only increases bank reserve and lowers interest rates, which promotes debt-financed stock buyback rather than investment in production.

In the meantime, the supporters of "helicopter money" (HM) has grown. It is a term first introduced in (Friedman 1969) and revitalized by the 14th Federal Reserve chair Ben Bernanke after his speech on deflation (Bernanke 2002), which gave him the nickname *Helicopter Ben*. HM is a money-financed (as oppose to debt-financed) tax cut or direct handout of money, so called "people's QE". Bernanke later called such a policy—an expansionary fiscal policy financed by a permanent increase in the money stock—a money-financed fiscal program (MFFP) (Bernanke 2016). Deflation prevailed in advanced economies, most notably in Japan, in the 2010s despite continuing QE, and the number of people that support HM kept growing. (DeLong 2017; Muellbauer 2014; Turner 2016; Wolf 2013) assert that HM should not be ruled out as a policy to promote economic growth. It is explicitly shown in (Buiter 2014; Galí 2016) that HM is more effective than QE in boosting demand and fighting deflation; some claim that it is not technical difficulties, but political problems that prevented HM from being deployed (Bernanke 2002; Eichengreen 2016; Kaletsky 2016; Turner 2015). The critics of HM address risks associated with such a fiscal policy, most notably persistently high inflation; Irwin (2016) cites Weimar Germany, Zimbabwe, and Venezuela as historical examples, while (English et al. 2017) uses a quantitative, theoretical model with no data, except for historical examples on the cooperation of fiscal and monetary authorities. Borio et al. (2016) argues that HM is equivalent to either debt or to tax-financed government deficits, in which case it would not yield the desired additional expansionary effects. Conversely, such debt-financed expansionary fiscal policy as seen in Japan is claimed to be de facto HM (Kihara 2016), yet it is *not* HM in the sense that no money was directly handed to people. Despite negative interest rates and the issuance of bonds with longer durations, Japan's inflation rate remained around 0% between 2016 and 2017, despite the massive bond buying of the Bank of Japan. It rose above 2% during the second quarter of 2022, which is still far lower than those of other advanced economies (Trading Economics 2022).

In December 2019, the first cluster of patients in Wuhan, Hubei Providence, China begin to experience shortness of breath and fever (CDC 2022). Three months earlier, a book had been published titled *The Case For People's Quantitative Easing* (Copolla 2019), which addresses in details the shortcomings of QE and argues that giving money directly to people is the best way of restoring damaged economies; therefore, 'QE for the People' should be the policy tool of choice when the next crisis comes. Then came the crisis known as the COVID-19 pandemic. The United States government was quick to respond with unprecedented policies, both monetary and fiscal, and stimulus packages that included HM (Alpert et al. 2022; Center Forward Basics 2020). In the eurozone, where transferring money directly to the state is explicitly forbidden in the European Central Bank's statutes, HM has, backed by research-based evidence (Batsaikhan et al. 2021; Martin et al. 2021; Massenot 2021), gained momentum as a viable contingent policy.

This research is the first to measures the financial instability of United States households to assess the effectiveness of the economic stimuli after the two recent crises, the 2007 financial crisis and the ongoing COVID-19 pandemic. It achieves two goals amid inadequate data: firstly, quantifying the financial instability level of a nonfinancial sector agent; secondly, directly comparing the effectiveness of two economic stimulus measures, one monetary (QE) and the other fiscal (HM).

3. Background and Methodology

3.1. Theoretical Background

The method used in this research is an early warning system called the Agent Instability Indicator (AII), which is a special case of the general Market Instability Indicator (MII) first introduced in (Choi and Douady 2012). The indicators are derived from a wealth dynamical system of economic agents that are interconnected by fund flows. The input variables of the AII are asset–both financial and nonfinancial–levels, liability level, and cash inflows. As such, it reasonably estimates the financial instability of households *and* other economic agents, financial or nonfinancial. Furthermore, investigating the feedback loop formed by the inter-agent fund flows makes it possible to track or predict the path of risk transmission and contagion. In (Choi 2019), it is shown that the AII of the domestic economic agents of the United States peaks in the order of households and nonprofit organizations serving households (HNISH), nonfinancial noncorporate business (NFNC), state and local government (SLG), financial business (FB), and federal government (FG), which coincides with the order of agent wealth decreasing along the feedback loop stemming from HNISH, whose massive default in the housing market triggered the 2007 financial crisis. The behavior of these indicators is a quantitative evidence of financial instability contagion on the brink of and during the 2007 subprime mortgage crisis. The same article shows the AII of the financial corporations and general governments of selected eurozone countries around the time of the eurozone sovereign debt crisis. The AII rises two to three quarters before important financial events, such as the national bailout of banks and the intervention of the International Monetary Fund. These examples verify the usefulness of the method chosen for this work.

The notation in this section is taken from Choi and Douady (2012), where more mathematical details can be found. Given an economic system with n agents, construct a dynamical system f of fund flows on $\mathbb{R}^{3n}$. The selection of n is research specific, but for a domestic economy, four core agents—the household, nonfinancial business, financial business, represented by "the bank", and the government—should be included. Therefore, $n = 4$ throughout the paper and indices from 1 to 4 are assigned to those core agents. Let

$w_i(t)$ be the wealth (commonly known as assets) of agent i at time t, defined to be the sum of equity and debt:

$$w_i(t) = E_i(t) + D_i(t). \tag{1}$$

The wealth can also be divided into liquidities $L_i(t)$, a subset of M1 monetary supply, and invested assets $K_i(t)$ such as stocks, property, and equipment:

$$w_i(t) = L_i(t) + K_i(t). \tag{2}$$

Denote by $\gamma_i(t)$ an average internal rate of return; then, we have the following dynamics of $D_i(t)$, $K_i(t)$, and $L_i(t)$:

$$D_i(t+1) = (1 + r_i(t))D_i(t) + \Delta D_i(t+1) \tag{3}$$

$$K_i(t+1) = (1 + \gamma_i(t))K_i(t) + \Delta K_i(t+1) \tag{4}$$

$$L_i(t+1) = L_i(t) + \sum_{j=1, j\neq i}^{n} F_{ij}(t) - \sum_{k=1, k\neq i}^{n} F_{ki}(t) - \Delta K_i(t+1) \tag{5}$$

where

- $\Delta D_i(t+1)$ is new loan minus (partial) payment of existing outstanding balance;
- $r_i(t)$ is the average interest applied to the debt of agent i at time t;
- $\Delta K_i(t+1)$ is new investment minus realization;
- $F_{ij}(t)$ is the funds transferred from agent j to agent i at time t;
- $F_{ii}(t) = \gamma_i(t)K_i(t)$ is the internal return on investment.

Therefore, by Equation (2) and the above dynamics:

$$w_i(t+1) = w_i(t) + \sum_{j=1}^{n} F_{ij}(t) - \sum_{k=1, k\neq i}^{n} F_{ki}(t). \tag{6}$$

The fund flow $F_{ji}(t)$ can be considered as an investment by agent i to j, obtained as an optimal solution of a Pareto nonlinear programming problem (NLP):

$$\text{NLP:} \qquad \max \quad z_i = \sum_{j=1}^{n} J_i(F_{ji}(t)) \tag{7}$$

$$\text{subject to} \quad L_i(t) \geq 0 \tag{8}$$

$$|\Delta K_i(t+1)| \leq \kappa_i(t)K_i(t) \tag{9}$$

$$\Delta D_i(t+1) \leq D_{i\,\max}(t+1) - (1 + r_i(t))D_i(t) \tag{10}$$

$$1 \leq i \leq n, \; t \geq 0$$

with the following assumptions:

(i) $F_{ji}(t)$ affects only j and induces a stream of returns $F_{ij}(s)$ at dates $s > t$;

(ii) The total benefit (net utility) of the agent i for the investment $F_{ji}(t)$ is

$$J_i(x) = \sum_{s>t} e^{-\beta(s-t)} E[U_i(F_{ij}(s)) | F_{ji}(t) = x] - x \tag{11}$$

where $U_i(F_{ij}(s))$ is some utility of agent i receiving F_{ij} from j at time s. $\alpha(t)$ is the growth rate; β is an actualization rate for utilities;

(iii) Each agent i tries to maximize $\sum_{j=1, j\neq i}^{n} J_i(F_{ji}(t))$ under the following constraints:

- $L_i(t) \geq 0$: any shortage of money is immediately converted to a debt increase;
- There exists $\kappa_i(t)$ such that $|\Delta K_i(t+1)| \leq \kappa_i(t)K_i(t)$; there is a limit to converting the invested asset into liquidities;

- $D_i(t) \leq D_{M,i}(t)$: each agent i has a maximum level of debt $D_{M,i}(t)$.

For each agent i, define its state at time t as the triple $X_i(t) = (L_i(t), K_i(t), D_i(t)) \in \mathbb{R}^3$ and $X = (X_1, X_2, \ldots, X_n)$. Solving the NLP (7) yields optimally selected $F^*_{ji}(t), 1 \leq i, j \leq n$, D_i, L_i, and K_i for each t, which subsequently yields a dynamical system in the $3n$-dimensional phase space $\mathbb{R}^{3n}$:

$$X^*(t+1) = f(X^*(t)). \tag{12}$$

Consider the non-random part of this random dynamical system f rescaled in constant dollars by the growth rate $\alpha(t)$:

$$\bar{f}(\alpha(t)^{-1}X^*(t)) = \alpha(t+1)^{-1}E[X^*(t+1)|X^*(t)]. \tag{13}$$

This $\bar{f}$ is a predictable dynamical system in the sense that it is measurable in terms of the respective σ-algebras of events at t and $t+1$. The original random dynamical system f displays the same stability type as $\bar{f}$, and when there is no exogenous random contribution, $\bar{f}$ is a function of only the current system and is therefore deterministic. For simplicity, write f for $\bar{f}$, $w(t)$, and $F_{ij}(s)$ for the respective expectations $\bar{w}(t)$ and $\bar{F}_{ij}(s)$; further, assume that all the variables are rescaled by $\alpha(t)$ to constant dollars and drop the $*$ symbol for the optimal solution to write $X(t+1) = f(X(t))$. Therefore, Equation (6) becomes a predictable dynamical system of wealth.

Let $Df(X)$ be the $3n \times 3n$ Jacobian matrix of the system f. Build an $n \times n$ "reduced Jacobian" $B(X) = (b_{kl})_{1 \leq k,l \leq n}$ by taking a shift in wealth $\delta w'_i(t) = \delta L'_i + \delta K'_i$ from

$$\delta X'_i = (\delta L'_i, \delta K'_i, \delta D'_i) = Df(X(t))\delta X$$

so that

$$\delta w' = B(X(t))\delta w \tag{14}$$

or equivalently,

$$\delta w'_i = \sum_{j=1}^{n} b_{ij}\delta w_j, \quad \forall i. \tag{15}$$

The *elasticity coefficient* $a_{ij} = a_{ij}(t)$ is defined as

$$a_{ij} := \frac{\partial F_{ij}}{\partial w_j} \quad \text{or equivalently} \quad dF_{ij} = a_{ij}\delta w_j. \tag{16}$$

This definition extends to the "self-elasticity" a_{ii}, which represents the change in internal investment upon a wealth change at time t, which implies that $a_{ii}\delta w_i = dF_{ii}$.

The change of wealth $\delta w_i(t+1)$ of agent i at time $t+1$ can now be expressed as

$$\delta w_i(t+1) = \delta w_i(t) + \sum_{j=1}^{n} a_{ij}\delta w_j(t) - \sum_{k=1,k\neq i}^{n} a_{ki}\delta w_i(t), \tag{17}$$

and along with Equation (15), the following relationship between the reduced Jacobian matrix $B = \left(b_{ij}\right)$ and elasticity coefficient a_{ij} is obtained:

$$b_{ii} = 1 + a_{ii} - \sum_{k\neq i}^{n} a_{ki} \quad \text{and} \tag{18}$$

$$b_{ij} = a_{ij} \qquad \text{for } i \neq j \tag{19}$$

Finally, define the *Market Instability Indicator* (MII) $I(t)$ as the spectral radius of the reduced Jacobian matrix $B(X(t))$. This idea is borrowed from theories of dynamical systems. When $I(t) < 1$, then perturbations (e.g., a negative shock on the wealth w_i of agent i) of the system tend to be absorbed and disappear. On the other hand, when $I(t) > 1$, then the perturbations will propagate through the system, creating a so-called "butterfly effect", which was the case in the 2007 financial crisis. There are two obstacles to using this indicator in real life, however. Firstly, there are no adequate data to estimate $I(t)$. Secondly, $I(t)$ may not give a good assessment of the financial health of a complex economy in which the agents are interconnected via feedback loops formed by flows of fund, because $I(t)$ may not be able to detect a shock that will become a full-blown financial crisis. It may be too late to prevent the crisis when $I(t)$ becomes big enough to fit into the "warning zone". Therefore, consider a local version of the MII and define the *Agent Instability Indicator* (AII). The mathematical method to estimate the AII is not unique, yet for the AII to work as an early warning system, it should be able to capture instantaneous shocks on the system. This means that any method that averages or evens out instantaneous shocks is not good for the purpose. It seems that, so far at least, a direct calculation of the AII from historical time series seems to work well. In the next section, mathematical details on how to calculate the AII from discrete data are provided.

3.2. Implementing Real Data

Most data suitable for research on households are given quarterly; hence, a method should be devised to estimate the AII with such discrete data. Choi (2019) derives a formula for b_{ii} for agent i other than the bank (i.e., $i \neq 3$), which is summarized below. Recall that in this study, "default" means failure to fulfill payment obligations. The default amount of agent i depends on the maximum allowable debt level $D_{M,i}$ which is usually determined by the agent's credit worthiness, but can change due to the circumstances, for example, a temporary credit extension due to a natural disaster. Therefore, define the *potential default amount* $\delta_i(t)$ to be the current liability exceeding the maximum allowable debt level:

$$\delta_i(t) = \max\{D_i(t) - D_{M,i}(t), 0\}.$$

This is the amount which agent i would default *if* the maximum allowable debt level $D_{M,i}(t)$ *were* enforced. Denote by $\alpha_i(t)$ the debt that repayment agent i actually makes to the bank at time t. Then:

$$F_{3i}(t) = \alpha_i(t) + \delta_i(t) \tag{20}$$

and the new debt level $D_i(t+1)$ is determined by

$$D_i(t+1) = D_i(t) + F_{i3}(t) - \alpha_i(t) - \delta_i(t), \tag{21}$$

where $F_{i3}(t)$ is the new loan made by the bank to agent i. From (20) and (21),

$$\begin{aligned} F_{i3}(t) &= D_i(t+1) - D_i(t) + \alpha_i(t) + \delta_i(t) \\ &= \nu_i(t) + \delta_i(t) \end{aligned} \tag{22}$$

where $\nu_i(t)$ is the net new loan that agent i has taken during $[t, t+1]$.

The elasticity coefficient a_{ij} can be expressed in terms of time derivatives, which is useful to use with real data. By the constraint assumption (i) of the NLP (7):

$$\frac{\partial F_{ik}}{\partial w_j} = 0 \quad \text{if} \quad k \neq j, \tag{23}$$

therefore:

$$\frac{dF_{ij}}{dt} = \sum_k \frac{\partial F_{ij}}{\partial w_k} \cdot \frac{dw_k}{dt} = \frac{\partial F_{ij}}{\partial w_j} \cdot \frac{dw_j}{dt}, \tag{24}$$

which, along with Equation (19), yields

$$a_{ij}(t) = \frac{F'_{ij}(t)}{w'_j(t)} = b_{ij}(t) \tag{25}$$

where $'$ represents the time derivative.[2] Then:

$$\begin{aligned} w_i'(t+1) &= \sum_j \frac{\partial w_i(t+1)}{\partial w_j(t)} \cdot \frac{dw_j(t)}{dt} \\ &= b_{ii}(t)\, w_i'(t) + \sum_{j\neq i} b_{ij}(t)\, w_j'(t) \\ &= b_{ii}(t)\, w_i'(t) + \sum_{j\neq i} F_{ij}'(t), \end{aligned}$$

which makes

$$b_{ii}(t) = \frac{w_i'(t+1)}{w_i'(t)} - \sum_{j\neq i,3} \frac{F_{ij}'(t)}{w_i'(t)} - \frac{\nu_i'(t)}{w_i'(t)} - \frac{\delta_i'(t)}{w_i'(t)}. \quad (26)$$

Its absolute value $|b_{ii}|$ is the AII of agent i. The AII is a local indicator in the sense that the period that demonstrates the highest $|b_{ii}|$ is not the most financially unstable zone. A rising $|b_{ii}|$ should be considered as an early warning signal that the agent is entering a financially unstable period. The AII can be applied to an agent of any size as long as data for the components in Equation (26) are available.

The last term in Equation (26) plays an important role in determining the financial instability of agent i. Define it as the *default elasticity coefficient* or simply *default elasticity*, and denote by Δ_i:

$$\Delta_i(t) = \frac{\delta_i'(t)}{w_i'(t)}. \quad (27)$$

The significance of this default elasticity $\Delta_i(t)$ is discussed in detail in the next section.

For this research, publicly available quarterly time series from the *Integrated Macroeconomic Accounts for the United States* (IMA 2022) are used, along with the triennial *Survey of Consumer Finances* (SCF 2019). In the IMA, there are six pre-classified domestic economic agents, and the data for households and nonprofit institutions serving households (HNISH) are taken for the "Household" (agent 1) in this article.[3] The household sector is further divided into six subgroups by percentile of income, and five subgroups by percentile of net worth. These subgroups are two of the classifications used by the SCF and are adopted for this study to correctly assess the financial instability and economic health of the U.S. household amid income and wealth inequality. In that sense, this work is a refinement of (Choi 2018), which shows that in the presence of severe wealth inequality, an economic sector in its entirety can look financially stable while its two subsectors possess extreme financial instabilities of opposite natures, one from excessive equity, the other from lack thereof. The income subdivision thresholds are: less than 20%, 20–39.9%, 40–59.9%, 60–79.9%, 80–89.9%, and 90–100%; the net worth ones are: less than 25%, 25–49.9%, 50–74.9%, 75–89.9%, and 90–100%. Denote the subgroups by their respective acronyms indexed by corresponding percentiles, for example, $IS_{<25}$, $NWS_{25\text{–}49.9}$, etc. The composition of assets in each subgroup follows the latest SCF 2019 results, which were released in 2020. Additionally, the following adjustments have been made:

- The income in the calculation of the AII does not include return on investment, so interest, dividends, capital gains, and other internal return on investment are excluded from the SCF income;
- The weights of the four components—income, nonfinancial asset, financial asset, and liability—from two consecutive surveys are linearly distributed to each quarter within the three-year period;
- The 2019 weight of the financial asset in the SCF has been adjusted by the S&P 500® index (S&P 500® 2022) to assign weights up to 2021 Q3;
- Likewise, the 2019 weight of the nonfinancial asset in the SCF has been adjusted by the Case–Shiller Home Price Index (Case-Shiller Index 2022) to allocate weights up to 2021 Q3.

The above adjustments, albeit crude, reflect the drastic increase of financial asset and real estate values during the pandemic, which took place after the 2019 survey. The adjusted weights are multiplied by the corresponding components in the IMA data to determine the income, assets, and liability of each income and net worth subgroup. The last and most important component in calculating $|b_{ii}|$ and Δ_i is the maximum allowable debt level $D_{M,i}$ which is not unique, but is situation-dependent. For this research, the three quartiles of the quarterly debt-to-asset ratio from 1989 Q2 to 2021 Q3 (the period covered by the SCF 2019 and its extension) are used. The potential default level $\delta_1(t)$ is calculated separately for each subgroup because using a single ratio for the entire household will make the upper income/net worth subgroups always financially stable and the lower ones always unstable. In the next section, the result is analyzed in detail with the second quartile (median) as the maximum allowable debt level $D_{M,i}$. A complete list of charts for all income and net worth subgroups with the three quartiles as $D_{M,i}$ can be found in Appendix A.

4. Result and Contribution

The Agent Instability Indicator $|b_{11}|$ and the default elasticity coefficient Δ_1 have been used to analyze the financial instability of the subgroups classified by income and net worth percentiles, respectively. It has been found that none of them experienced any financial instability or economic distress during the COVID-19 pandemic. Of course, there are certain part of the economy, such as the travel and leisure industry and restaurant business, that were directly hit by the pandemic, but all the subgroups in this study fared well. Some of them even seem to be doing better than ever. One straightforward piece of evidence would be the decreasing debt-to-asset ratio during the pandemic. The debt-to-asset ratio of all the income percentile subgroups rose sharply in 2020 Q1, then dropped equally sharply thereafter to the pre-2007 financial crisis level or even lower. The situation is similar for the net worth percentile subgroups. All but one subgroup have experienced a mild decline of debt-to-asset ratio since 2020 Q1. For $NWS_{<25}$, the debt-to-asset ratio has declined as sharply as those of the income subgroups (Figure 1).

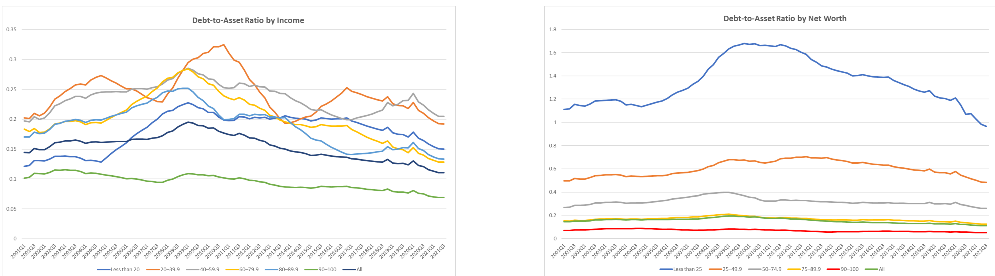


Figure 1. The debt-to-asset ratios of the income percentile subgroups moved differently before, during, and after the 2007 financial crisis, but they all behaved the same during the pandemic, rising in 2020 Q1, then dropping thereafter at almost the same rate. For the net worth subgroups, only $NWS_{<25}$ experienced a sharp rise of the debt-to-asset ratio during the 2007 financial crisis and equally sharp drop during the pandemic. The other subgroups have a much milder change of debt-to-asset ratio during the past two decades or so. For NWS_{90-100}, the debt-to-asset ratio has been almost constant.

The debt-to-asset ratio is, along with credit worthiness and market condition, a major factor that determines the maximum allowable debt level $D_{M,i}$. Recall the default elasticity in Equation (27), which is the change rate of potential default with respect to wealth:

$$\Delta_i(t) = \frac{\delta_i'(t)}{w_i'(t)}.$$

The default elasticity $\Delta_i(t)$ is positive when $\delta_i'(t) > 0,\ \ w_i'(t) > 0$ or $\delta_i'(t) < 0,\ \ w_i'(t) < 0$. The former includes an economic boom with overleveraging; the latter includes an economic downturn with deleveraging, either voluntary or from debt write-off. Negative $\Delta_i(t)$ occurs when $\delta_i'(t) < 0,\ w_i'(t) > 0$ or $\delta_i'(t) > 0,\ w_i'(t) < 0$; the former is an economic improvement with no overleveraging, an ideal situation. The latter is a situation heading toward de facto default, which was observed on the brink of the 2007 financial crisis. When the debt level D_i is below the maximum allowable debt level, the potential default level $\delta_i(t) = \max\{D_i(t) - D_{M,i}(t), 0\} = 0$; hence, $\Delta_i = 0$. This means that the liability stays below the maximum allowable debt level regardless of the wealth change rate $w_1'(t)$. Table 1 is a summary of the signs of Δ_i and their economic implications.

Table 1. Different signs of default elasticity Δ_i and corresponding economic implication.

$\delta_1'(t)$	$w_1'(t)$	Δ_1	Economic Interpretation
+	+	+	Economic boom, overleveraging
−	+	−	Economic improvement with no overleveraging
−	−	+	Economic downturn, deleveraging
+	−	−	Heading toward de facto default
0	±	0	Liability remains within the maximum allowable debt limit

By Equation (26):

$$b_{ii}(t) = \frac{w_i'(t+1)}{w_i'(t)} - \sum_{j \neq i,3} \frac{F_{ij}'(t)}{w_i'(t)} - \frac{\nu_i'(t)}{w_i'(t)} - \Delta_i(t). \tag{28}$$

Therefore, negative Δ_i will increase b_{ii}, but may lower $|b_{ii}|$. High $|b_{ii}|$ implies financial instability, but the size of $|b_{ii}|$ alone does not reveal whether financial bubbles are inflating or about to burst. As such, Δ_i should be observed along with $|b_{ii}|$ when monitoring financial instability.

For each quarter from 2001 Q1 to 2021 Q3, $|b_{11}(t)|$ and $\Delta_1(t)$ are calculated to assess the financial instability of the income percentile subgroups. Figure 2 shows the quarters when $w_1'(t) < 0$ and $\Delta_1(t) \leq 0$. Empty cells indicate $w_1'(t) > 0$ or $\Delta_1(t) > 0$. A quarter with negative $w_1'(t)$ is *always* followed by another with nonpositive $\Delta_1(t)$. This implies that consecutive quarters with negative $w_1'(t)$ and $\Delta_1(t)$ mean severe economic deterioration with worsening debt burden, while quarters with negative $w_1'(t)$ and zero $\Delta_1(t)$ mean an economic downturn that is still manageable thanks to liability below the allowed limit.

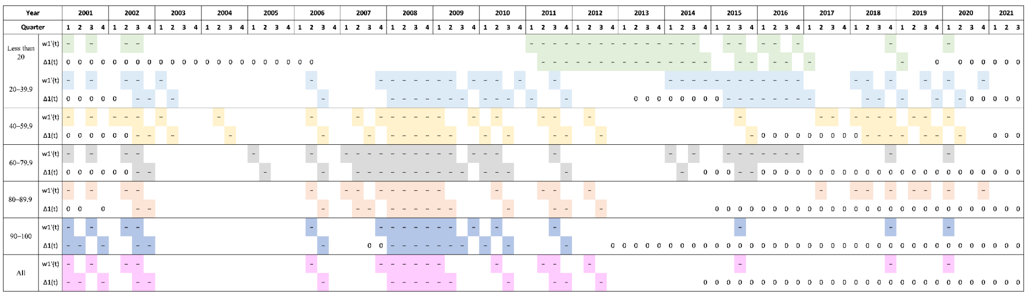


Figure 2. A quarter with $w_1'(t) < 0$ is followed by another with $\Delta_1(t) \leq 0$. Consecutive quarters with $w_1'(t) < 0$ and $\Delta_1(t) < 0$ imply severe economic deterioration with worsening debt burden, but quarters with $w_1'(t) < 0$ and $\Delta_1(t) = 0$ mean decreasing wealth with debt below the allowable limit. As such, the latter suggests a recession rather than a financial crisis. The period with $w_1'(t) < 0$ and $\Delta_1 < 0$ coincide with the economic downturns caused by the 2011 September 11 terrorist attack and 2007 financial crisis. Compared with those periods, the pandemic era from 2020 Q1 and on does not show much economic distress.

Here is the analysis for each subgroup.

- The subgroups with income percentiles between 20% and 89.9% and the entire household experienced at least six consecutive quarters with negative $w_1'(t)$ and $\Delta_1(t)$ from

2007 to 2009, then three to four more quarters of negative $w_1'(t)$–$\Delta_1(t)$ during the next three years. They kept receiving blocks of negative $w_1'(t)$ toward the end of 2019. While $\Delta_1(t)$ remained mostly at zero in 2015 for $IS_{60–79.9}$ and $IS_{80–89.9}$, the two lower subgroups $IS_{20–39.9}$ and $IS_{40–59.9}$ still had negative $\Delta_1(t)$ sporadically;

- The top income group $IS_{90–100}$ also had seven consecutive quarters of negative $w_1'(t)$ and $\Delta_1(t)$; it had only two quarters of negative $w_1'(t)$ and $\Delta_1(t)$ during 2010–2013 and two more quarters of $w_1'(t) < 0$ and $\Delta_1(t) = 0$ until the end of 2019;
- The lowest income group $IS_{<20}$ passed the 2007–2009 period with positive $w_1'(t)$ and $\Delta_1(t)$, yet had a longer streak of negative $w_1'(t)$ and $\Delta_1(t)$ much later, from 2011 to 2014, then five more quarters of negative $w_1'(t)$–$\Delta_1(t)$ in 2015 and 2016. This is not surprising because $IS_{<25}$ does not have many assets to begin with and thus was not affected by the collapse of the real estate market followed by financial bubble bursting. It was rather affected by the recession that followed the financial crisis;
- On the other hand, all the subgroups had negative $w_1'(t)$ in 2020 Q1; only two subgroups, $IS_{20–39.9}$ and $IS_{40–59.9}$ had negative $\Delta_1(t)$ next quarter and the rest had zero $\Delta_1(t)$ until 2021 Q3. The two subgroups soon followed the others, and all the subgroups, as well as the entire household, had zero Δ_1 in 2021;
- It should be noted that the signs of $w_1'(t)$ and $\Delta_1(t)$ of $IS_{90–100}$ closely match those of the entire household. This must be due to the strong income inequality in U.S. households and is a reason why monitoring the macroeconomic data of the household in its entirety does not provide an accurate assessment of the true economic state of the household sector.

For comparison purpose, charts are provided for $|b_{11}|$ and Δ_1 of the two middle income subgroups, $IS_{40–59.9}$ and $IS_{60–79.9}$ (Figure 3 and Figure 4, respectively), using the median of the debt-to-asset ratio from 1989 Q2 to 2021 Q3 as the maximum allowable debt level $D_{M,1}$, which produces the same result as in Figure 2. The AII is a local indicator in the sense that the period that demonstrates the highest $|b_{ii}|$ is not the most financially unstable time. A rising $|b_{ii}|$ should be considered as an early warning signal that the agent is entering a financially unstable state. Empirical research suggests that the "signal" comes two quarters on average before a major event that disrupts the financial system (Choi 2019). A complete list of charts of all the income subgroups with three levels of $D_{M,1}$ can be found in Appendix A.

The results for the subgroups classified by net worth percentile are similar. Figure 5 shows the quarters when $w_1'(t) < 0$ and $\Delta_1 \leq 0$. Empty cells indicate $w_1'(t) > 0$ or $\Delta_1 > 0$. As in the case of income percentile subgroups, no quarter with $w_1'(t) < 0$ is followed by another with $\Delta_1(t) > 0$. Therefore, consecutive quarters with negative $w_1'(t)$–$\Delta_1(t)$ (with one quarter lag) mean severe economic deterioration with worsening debt burden. Quarters with $w_1'(t) < 0$ followed by another with $\Delta_1(t) = 0$ mean a mild economic downturn such that the debt level remains below the maximum allowable limit $D_{M,1}$, allowing a choice between deleveraging and investment opportunity through debt financing.

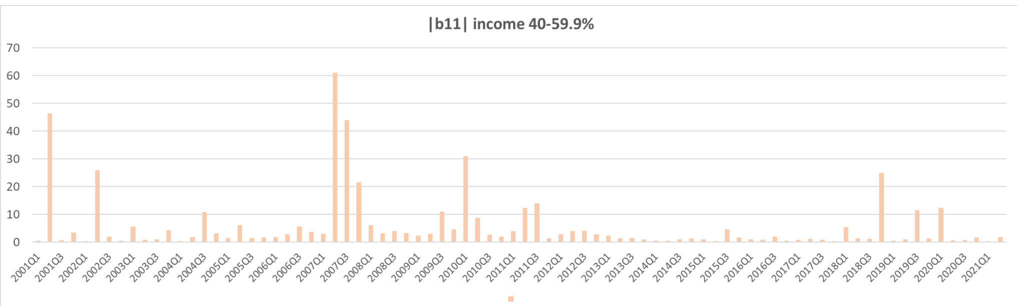


Figure 3. *Cont.*

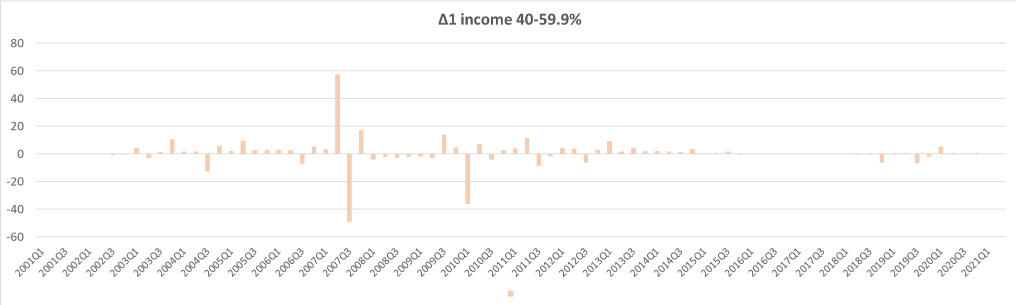
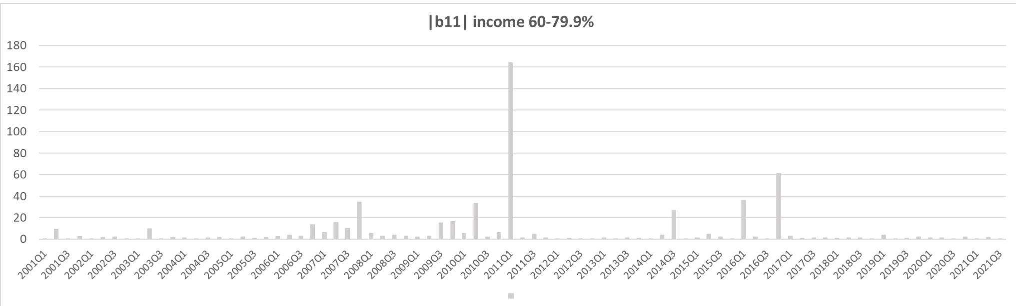


Figure 3. The AII and Δ_1 for $\text{IS}_{40\text{–}59.9}$. The AII (which is $|b_{11}|$) peaks in 2007 Q2 and from 2007 Q3, $w_1'(t) < 0$ for six quarters in a row, during which $\Delta_1(t) \neq 0$. $\Delta_1(t) \neq 0$ when $w_1'(t) < 0$ implies an economic downturn at best, and this combination of $w_1'(t) < 0$ and $\Delta_1(t) \neq 0$ captures the nature ofthe 2007 financial crisis. The next peak of $|b_{11}|$ comes in 2010 Q1, during which $\Delta_1(t) < 0$. From this time to the end of 2012 Q4, the signs of $w_1'(t)$ and $\Delta_1(t)$ alternate while $|b_{11}(t)|$ fluctuates, suggesting economic volatility. The AII rises again in 2018 Q1, which is the fourth quarter in which $w_1'(t) < 0$, following $\Delta_1(t) < 0$ with a one quarter lag. This suggests that economic distress for $\text{IS}_{40\text{–}59.9}$ has already started in early 2018 and the high $|b_{ii}|$ in 2018 Q4 reflects the subsequent financial instability of $\text{IS}_{40\text{–}59.9}$. Negative $w_1'(t)$ continues to appear until 2020 Q1 and $\Delta_1(t) = 0$ until 2021 Q1. This means that the wealth of $\text{IS}_{40\text{–}59.9}$ has increased during the pandemic and its liability has stayed below the allowable limit. We can conclude that $\text{IS}_{40\text{–}59.9}$ not only did not experience much financial damage, but that its economic situation has improved during the pandemic.



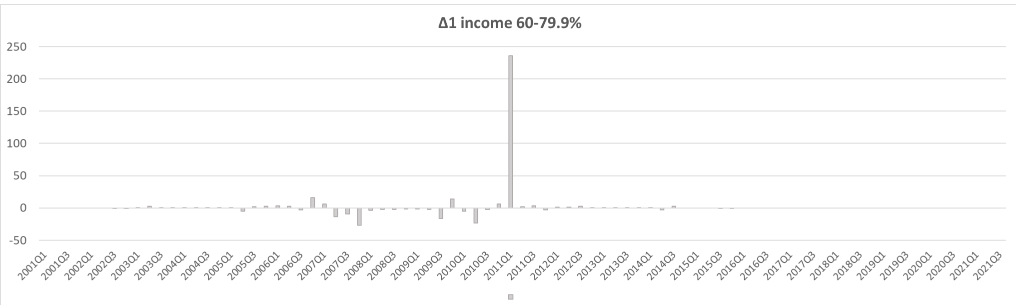


Figure 4. The AII and Δ_1 for $\text{IS}_{60\text{–}79.9}$. The first noticeable rise of $|b_{11}|$ starts in 2006 Q4 and continues to 2007 Q4. Negative $w_1'(t)$ and $\Delta_1(t)$ appear in 2007 Q1 and last for ten quarters. During the peak of the 2007 financial crisis, from 2007 Q2 to Q4, high $|b_{11}(t)|$ is matched by $\Delta_1(t) < 0$ with large magnitude, showing the financial distress and instability $\text{IS}_{60\text{–}79.9}$ went through. There were three more quarters of $w_1(t) < 0$ and $\Delta_1(t) < 0$ from 2009 Q4, which is reflected by high $|b_{11}(t)|$ and $\Delta_1(t) < 0$ during that period. The next spike of $|b_{11}(t)|$ and $\Delta_1(t)$ is in 2011 Q1, which is the harbinger of the economic boom that starts in 2011 Q4 and lasts for nine consecutive quarters. The sporadic peaking of $|b_{11}(t)|$ during 2014 Q3, 2016 Q1, and Q4 represent the mild economic downturn of $\text{IS}_{60\text{–}79.9}$, represented by nine quarters of $w_1'(t) < 0$ and seven quarters of $\Delta_1(t) = 0$ from 2014 Q1 to 2016 Q4. As for the pandemic, $w_1'(t) < 0$ only during 2020 Q1, while $\Delta_1(t) = 0$ since 2017 Q3. It can be concluded that $\text{IS}_{60\text{–}79.9}$ has been better off than any time during the past two decades.

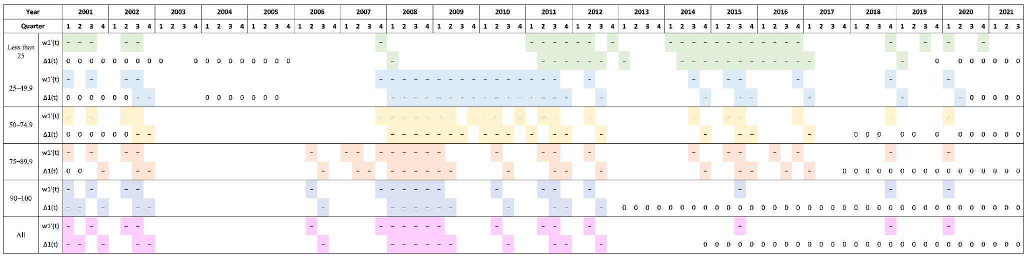


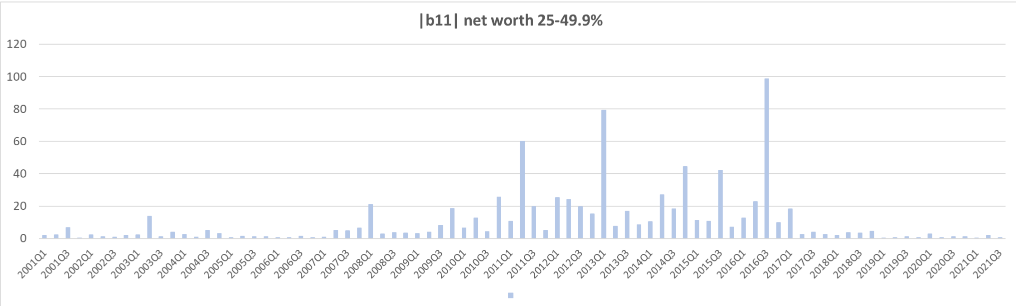
Figure 5. The result is similar to that of income percentile subgroups, but it is conspicuous that the lower the net worth percentile, the longer the period with $w_1'(t) < 0$ and $\Delta_1(t) < 0$. The household in its entirely shows the same level of financial instability as the top net worth group $NWS_{90–100}$ in terms of the signs of $w_1'(t)$ and $\Delta_1(t)$, while the subgroups with lower percentiles of net worth fare much worse. This must be due to the extreme wealth inequality in the U.S. household. Nevertheless, all the subgroups seem to have been financially stable during the pandemic. All the subgroups have $w_1'(t) < 0$ in 2020 Q1, but except for $NWS_{25–49.9}$, their respective default elasticities $\Delta_1(t) = 0$ ever since. $NWS_{25–49.9}$ recovered after one quarter of $\Delta_i(t) < 0$ and its $\Delta_i(t)$ has been zero so far.

- It is clearly visible from the chart that the lower the net worth percentile, the longer the period in which $w_1'(t)$ and $\Delta_1(t)$ are negative. This implies that lower net worth subgroups have endured more prolonged financial distress and instability than their higher net worth counterparts;
- The lowest net worth subgroup $NWS_{<25}$ does not show as much financial instability as other subgroups during the 2007 financial crisis and the Great Recession (its AII still rises during that time, as can be seen in Figure A8). This subgroup starts having negative $w_1'(t)$ and $\Delta_1(t)$ for six quarters from 2011 Q1 to 2012 Q2, which resumes, after a year's pause, in 2014 Q1 and lasts for three years. $IS_{<25}$ has more debt than wealth (SCF 2019) and very little share of the total nonfinancial assets owned by the U.S. household, and therefore was not affected by the collapse of the real estate market followed by the financial bubble bursting.
- The household in its entirely shows the same level of financial instability as the top net worth group $NWS_{90–100}$ in terms of the signs of $w_1'(t)$ and $\Delta_1(t)$, while the subgroups with lower percentiles of net worth fare much worse. This phenomenon show the extreme wealth inequality, far more severe than income inequality, prevalent in the U.S. household.

Below are the charts for $|b_{11}|$ and Δ_1 of the two middle net worth subgroups, $NWS_{25–49.9}$ and $NWS_{50–74.9}$ (Figure 6 and Figure 7, respectively), using the median of the debt-to-asset ratio from 1989 Q2 to 2021 Q3 as the maximum allowable debt level $D_{M,1}$, which produces the same result as in Figure 5. It should be emphasized again that the AII is a local indicator; therefore, the period that demonstrates the highest $|b_{ii}|$ is not the most financially unstable time. Rather, the movement of $|b_{ii}|$ should be monitored along with the signs of $w_1'(t)$ and $\Delta_1(t)$. A complete list of charts of all the net worth subgroups with three levels of $D_{M,1}$ can be found in Appendix A.

Quantitative evidence has been found that during the COVID-19 pandemic, the United States household has been financially healthy and stable; it never experienced the kind of financial distress and instability they endured during the 2007 financial crisis and the Great Recession. In other words, the various economic stimulus measures adopted by the presidential administration, congress, and the Fed have been very successful. The main difference between those measures and quantitative easing, the prime stimulus measure deployed to counter the 2007 financial crisis, is the way money was injected into the economic system. The pandemic stimulus measures are an expansion of M1 monetary supply, while the measures for the 2007 Crisis were monetary base expansion. At the beginning of the pandemic, the M1 supply skyrocketed to fund the various economic stimulus measures (Figure 8).

During financial turmoil, ordinary people tend to save and deleverage, and even extremely low interest rates do not prompt borrowing for consumption beyond necessities (Koo 2011). Such ultra-low interest rates, when kept for a long time, hurt retirees and pension funds (Antolin et al. 2011; Inhoffen et al. 2021). On the other hand, helicopter money, which is a subset of M1 monetary supply, will be spent and circulate in the economic system (Batsaikhan et al. 2021; Massenot 2021). As such, helicopter money is a more effective economic stimulus measure for the household than quantitative easing. Proof of this is the first contribution of this research. The second contribution is the confirmation, following the verification by (Choi 2019), of the usefulness and effectiveness of the Agent Instability Indicator (AII) as an early warning system of events that can trigger financial instability.



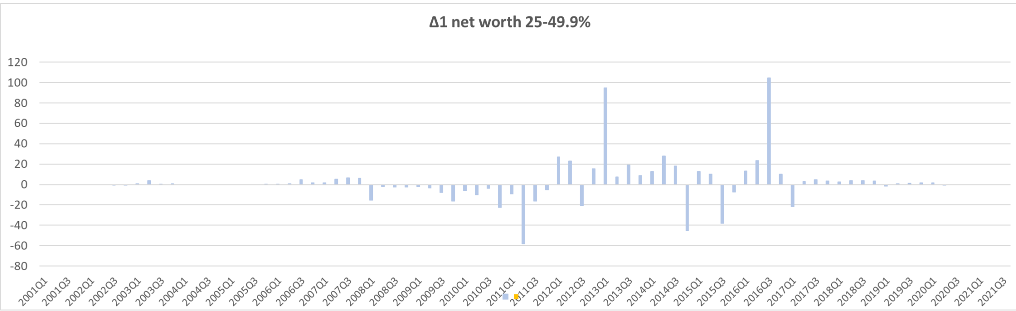


Figure 6. The AII and Δ_1 for $NWS_{25–49.9}$. The AII ($= |b_{11}|$) starts rising in 2007 Q2 and peaks in 2008 Q1, during which $\Delta_1(t)$ plunges below zero for the first time since 2002 Q4. $w_1'(t) < 0$ and $\Delta_1(t) < 0$ for sixteen consecutive quarters until 2011 Q3. During this period, $|b_{11}|$ fluctuated, rising to its highest level in 2011 Q2. The next peak comes in 2013 Q1. This high $|b_{11}(t)|$ indicates financial instability from the booming economy because both $w_1'(t) > 0$ and $\Delta_1(t) > 0$ from 2012 Q2 and 2014 Q2. Then comes a period of high volatility with fluctuating $|b_{11}(t)|$, $w_1'(t)$, and $\Delta_1(t)$. After 2017 Q1, both $|b_{11}|(t)|$ and $\Delta_1(t)$ remain low. In 2020 Q1, $|b_{11}|(t)|$ rises slightly, but drops next quarter and remains low. $w_1'(t) < 0$ in 2020 Q1, but $w_1'(t) > 0$ in the following quarters. $\Delta_1(t) < 0$ in 2020 Q2 and $\Delta_1(t) = 0$ afterward. This means that the wealth of $NWS_{25–49.9}$ has increased during the pandemic and its liability has stayed below the allowable limit. It can be concluded that $NWS_{25–49.9}$ has been financially healthy and stable during the pandemic.

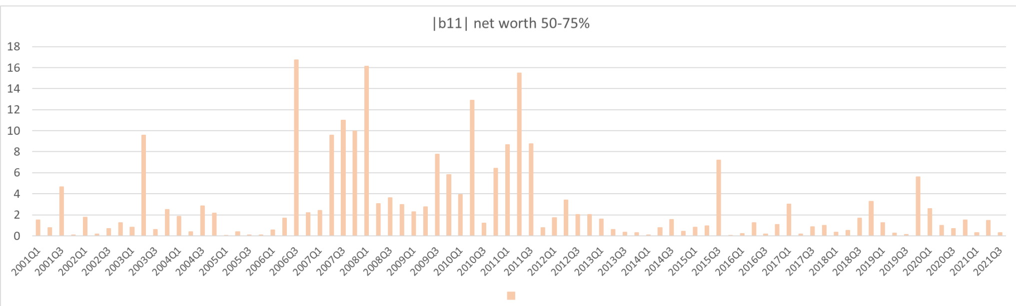


Figure 7. *Cont.*

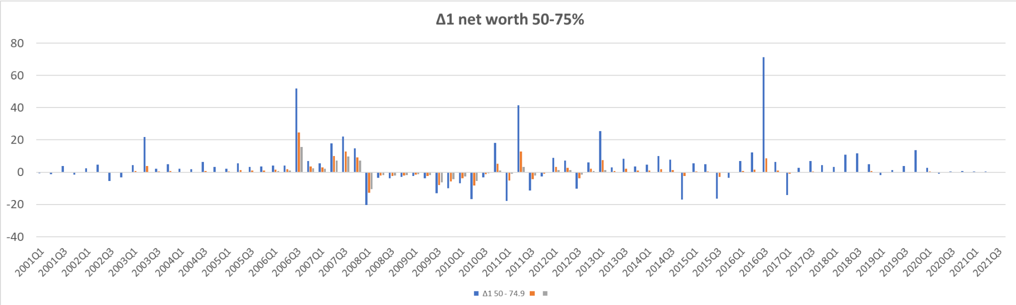


Figure 7. The AII and Δ_1 for $NWS_{50\text{–}74.9}$. This subgroup recovers from the 2007 financial crisis much sooner than $NWS_{25\text{–}49.9}$. There are seven quarters of $w_1'(t) < 0$ and $\Delta_1(t) < 0$ before it enters a recovery period of volatile $|b_{11}(t)|$, $w_1'(t)$, and $\Delta_1(t)$ in 2009 Q3. In terms of absolute scale, the range of $|b_{11}(t)|$ for $NWS_{25\text{–}49.9}$ is almost five time larger than that of $NWS_{50\text{–}74.9}$, and for $\Delta_1(t)$, almost four times larger. The default elasticity of $NWS_{50\text{–}74.9}$ $\Delta_1(t) = 0$ since 2017 Q4. The wealth level drops in 2020 Q1 and starts rising again from 2020 Q2 and on. As such, we conclude that $NWS_{50\text{–}74.9}$ has been financially healthy and stable during the pandemic.

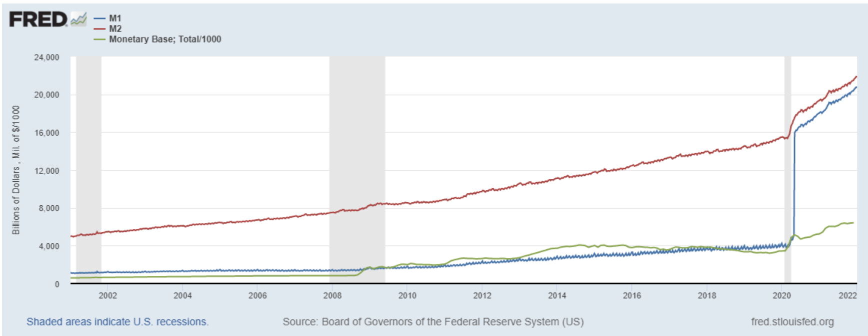


Figure 8. The supply of monetary base, M1, and M2.

5. Discussion

5.1. Limitation

The Agent Instability Indicator has been proven to be an effective tool to quantify the financial instability level of an economic agent, but with a serious limitation; there are not enough data for the AII to be fully utilized. Especially lacking is data for nonfinancial sectors such as households and nonfinancial businesses. The stock of nonfinancial assets is a crucial component in calculating the AII, but it is not available in the *System of National Accounts* (SNA 2008) that most countries follow, nor in the *European System of National and Regional Accounts* (ESA 2010), its European counterpart (or anywhere else, to the best of the author's knowledge). In the United States, the Fed and the IMA release national data (IMA 2022; The Federal Reserve 2022b) quarterly, which is not frequent enough to capture shocks that can disrupt the financial system. Moreover, in the case of the household sector, there are not enough data for subgroups classified by income and net worth percentile. The Survey of Consumer Finances provide such data, but this is released every three years with a one year lag. As seen in Section 4, the U.S. household in its entirely does not accurately represent the economic health and financial stability of the people in different income and net worth subgroups, due to the severe income and wealth inequality. Recently, *Realtime Inequality*, a website that tracks the month-by-month income and wealth distribution in the United States was launched (Blanchet et al. 2022), but it does not have any information on expenditure and debt, which are crucial information needed by the AII.

5.2. Targeted Monetary Expansion

The significance of the elasticity coefficient was confirmed during the research. The elasticity coefficient measures the change rate of outgoing cash flow with respect to the wealth level of the paying agent. It can have either sign and even be zero. For example, suppose a large part of household defaults (not in the legal sense, but failure to pay) on mortgage payments and as a result, the wealth of the bank decreases ($\delta w_3 < 0$). If the bank reduces its lending to businesses ($dF_{23} < 0$), then $a_{23} > 0$; if the lending continues as usual ($dF_{23} = 0$) despite the reduced wealth of the bank, then $a_{23} = 0$; if the government immediately provides the bank with emergency stimulus funds to make $\delta w_3 > 0$ even after the mortgage write-off, but the bank decides to sit on the money and still reduces lending ($dF_{23} < 0$), then $a_{23} < 0$. Moreover, the elasticity coefficient is asymmetric; an income deficit of $\$x$ resulting in a reduction of expenditure by $\$y$ does not mean that injecting $\$x$ will increase spending by $\$y$. Reduced bank credit during quantitative easing (Kapoor and Peia 2021; Koo 2011; Rodnyansky 2017) is an example of such a phenomenon. Indeed, a major factor that determines the size of F_{ij} is the utility function $U_i(F_{ij})$ in Equation (11). The elasticity coefficients computed from historical time series could be, and should be, used as a reference when launching a monetary expansion policy to avoid unwanted consequence, such as historically high inflation. Many researchers (for example, Cavallo and Kryvtsov 2021) say that the current high inflation is due to the supply chain disruption caused by the COVID-19 pandemic, the latest saga being the lockdown of Shanghai (Hille and Hale 2022). Some say that boosted employment benefits disincentivize people from working (Taylor and Kiersz 2021), which results in labor shortages that further slow production and economic growth. To combat inflation, the Fed is set to raise the fund rate and reduce its balance sheet by discontinuing QE and launching quantitative tightening (QT) (Anstey 2022; Tepper 2022; The Federal Reserve 2022a). However, we believe that there will be serious limitations to this approach. The bonds purchased for QE can be taken off the balance sheet after reaching maturity, but the helicopter money circulating in the system cannot be retrieved and burned. An effort should be made to find an optimal level of M1 supply so that, when the next round of economic stimulus measures is needed, an optimal quantity of money can be used to meet the goal, but at the same time, unwanted long-term consequences are prevented.

6. Conclusions

The research provides quantitative evidence that direct handout of cash—helicopter money—is more effective than quantitative easing via bond-buying as an economic stimulus measure during a financial disaster. The Agent Instability Indicator (AII), an early warning system for events that can trigger financial instability, was used to assess the financial instability level and default risk of subgroups of the U.S. households classified by the percentile of income and net worth. It was found that the United States household has never experienced the kind of financial instability and distress seen during the 2007 financial crisis and the Great Recession during the COVID-19 pandemic. This is the first contribution of our research. The second contribution is the confirmation of the usefulness and effectiveness of the Agent Instability Indicator. There have been attempts to establish a method to assess financial (in)stability, but no method has been accepted as a standard. In this regard, our contribution is to provide a tool that reasonably estimates the financial instability level of economic agents of any size with currently available data that have both quantitative and qualitative limitations.

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Informed Consent Statement: Not applicable.

Data Availability Statement: Publicly available data used in this study can be found on the websites of: Bureau of Economic Analysis, Bureau of Labor Statistics, FRED Economic Data St. Louis Fed, Survey of Consumer Finances—Federal Reserve Board.

Conflicts of Interest: The author declares no conflict of interest.

Abbreviations

The following abbreviations are used in this manuscript:

AII	Agent Instability Indicator
HM	Helicopter Money
IMA	Integrated Macroeconomic Accounts of the United States
MII	Market Instability Indicator
QE	Quantitative Easing
QT	Quantitative Tightening
SCF	Survey of Consumer Finances

Appendix A

Provided here is a complete list of charts for $|b_{11}|$ and Δ_1 of the subgroups of United States households classified by the percentile of income and net worth, respectively. These numbers are calculated using the three quartiles of the debt-to-asset ratio from 1989 Q2 to 2021 Q3 as the maximum allowable debt level $D_{M,1}$. As such, there are three sets of $|b_{11}|$ and Δ_1 for the given time period.

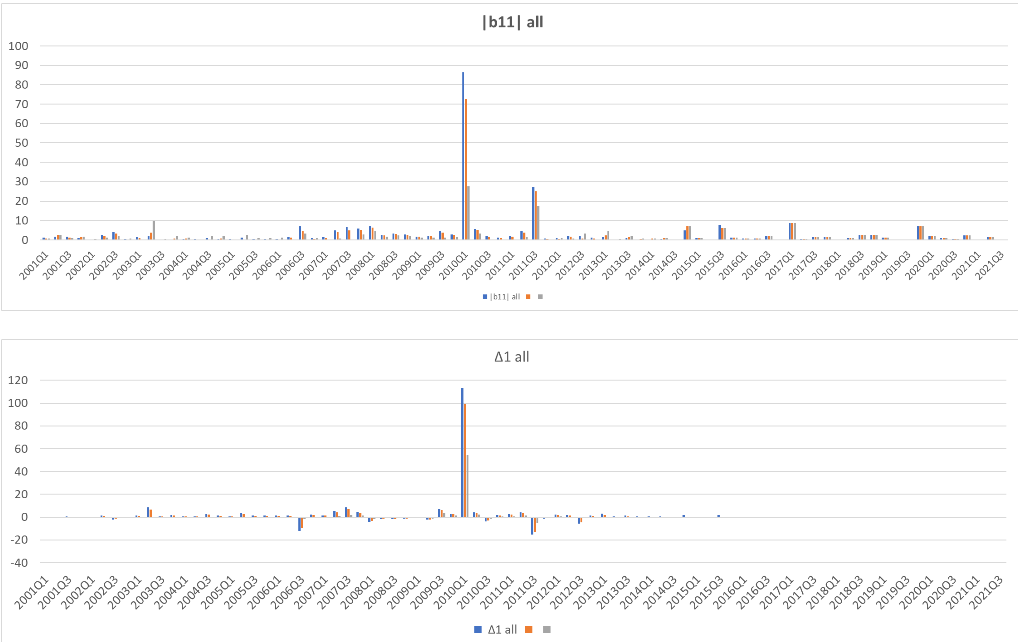


Figure A1. The AII and Δ_1 for all the U.S. household.

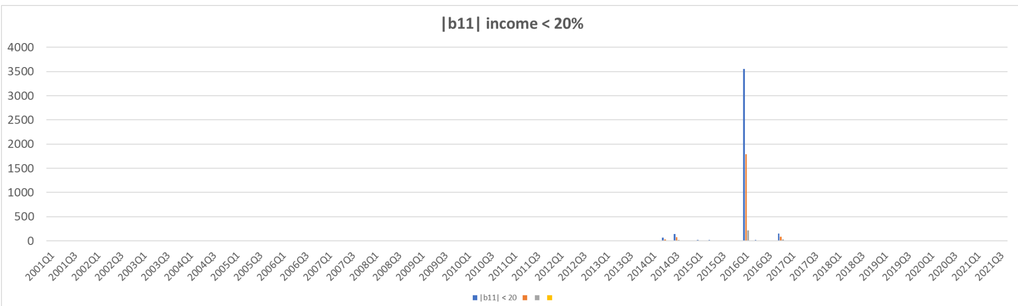


Figure A2. *Cont.*

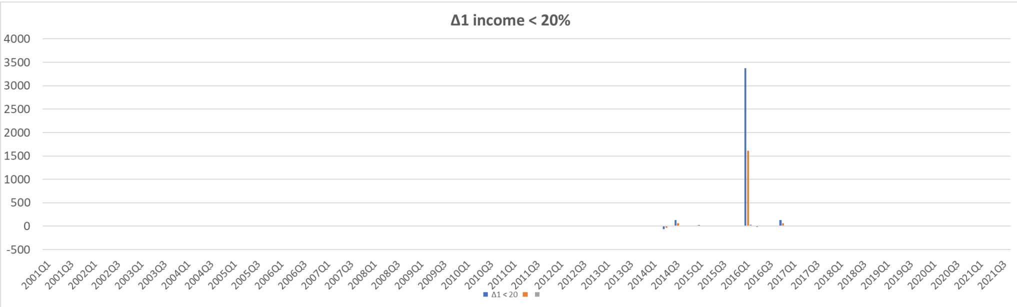


Figure A2. The AII and Δ_1 for those households that belong to the income percentile of less than 20%.

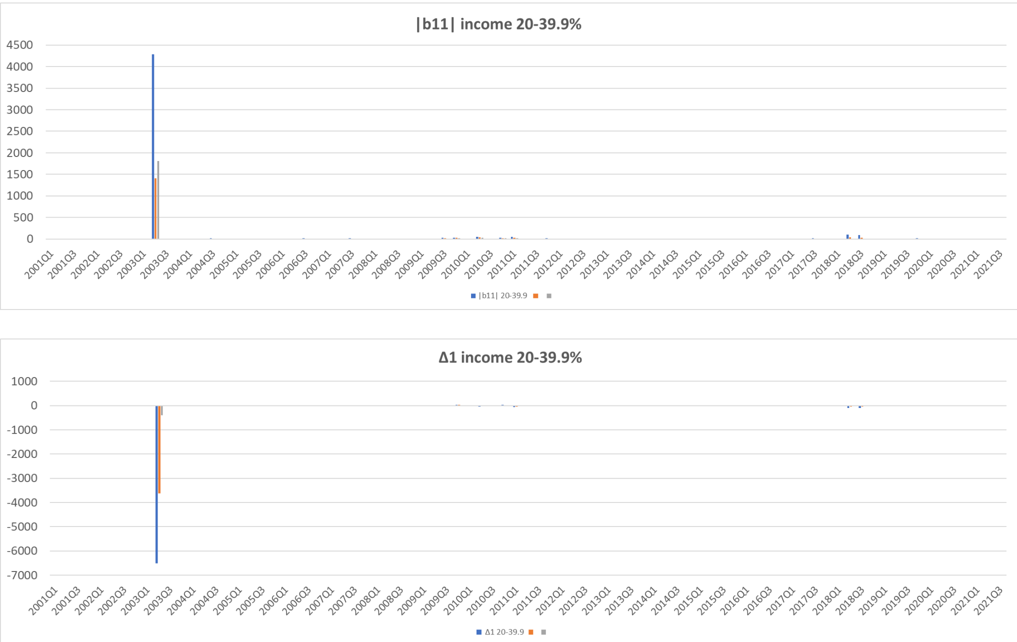


Figure A3. The AII and Δ_1 for those households that belong to the income percentile between 20% and 39.9%.

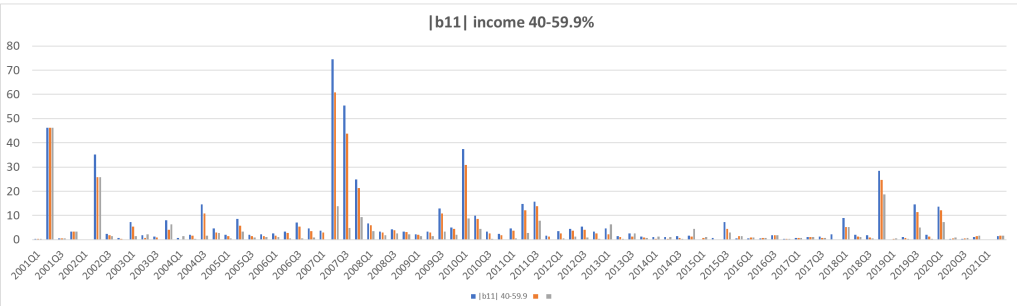


Figure A4. *Cont*.

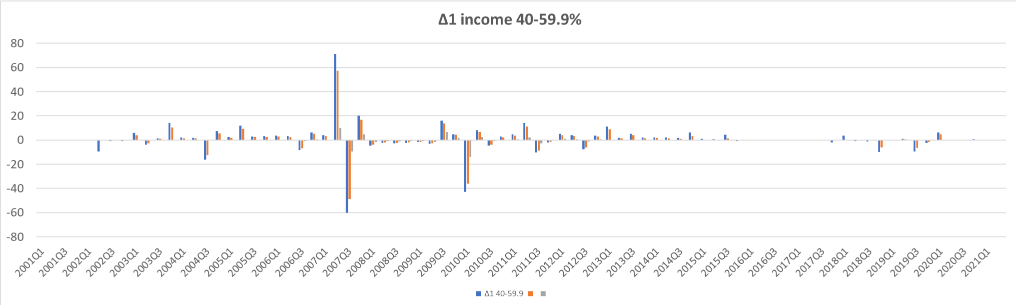
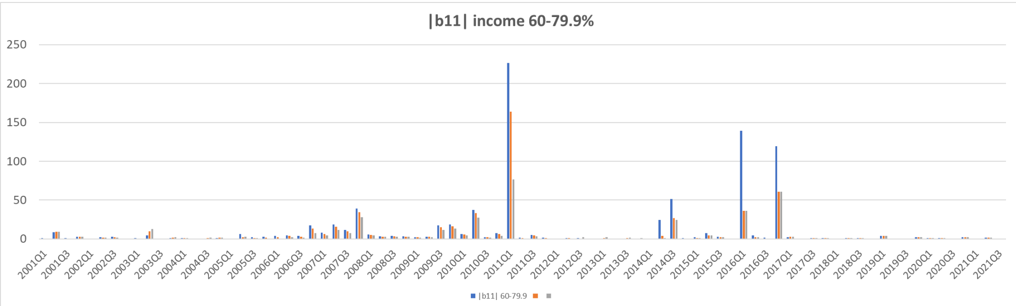


Figure A4. The AII and Δ_1 for those households that belong to the income percentile between 40% and 59.9%.



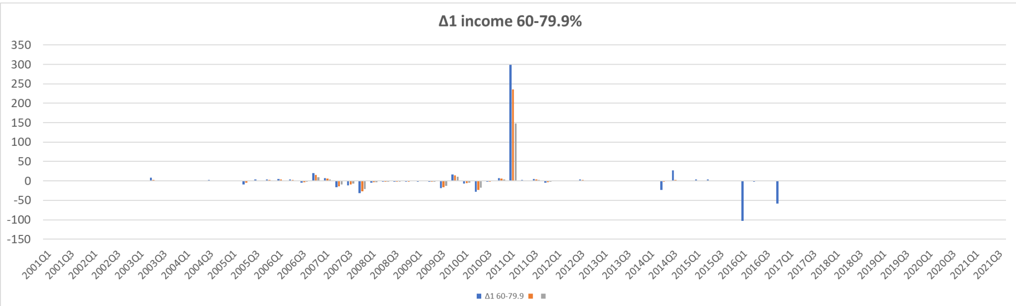


Figure A5. The AII and Δ_1 for those households that belong to the income percentile between 60% and 79.9%.

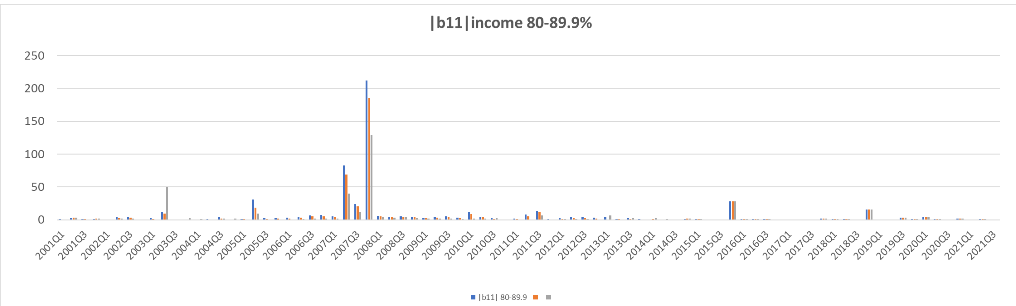


Figure A6. *Cont*.

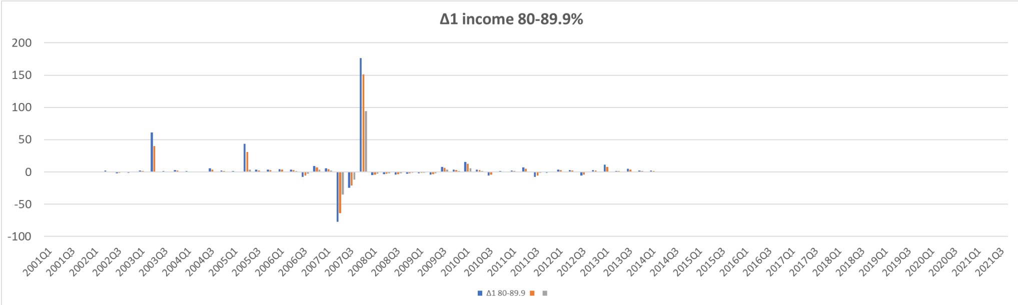


Figure A6. The AII and Δ_1 for those households that belong to the income percentile between 80% and 89.9%.

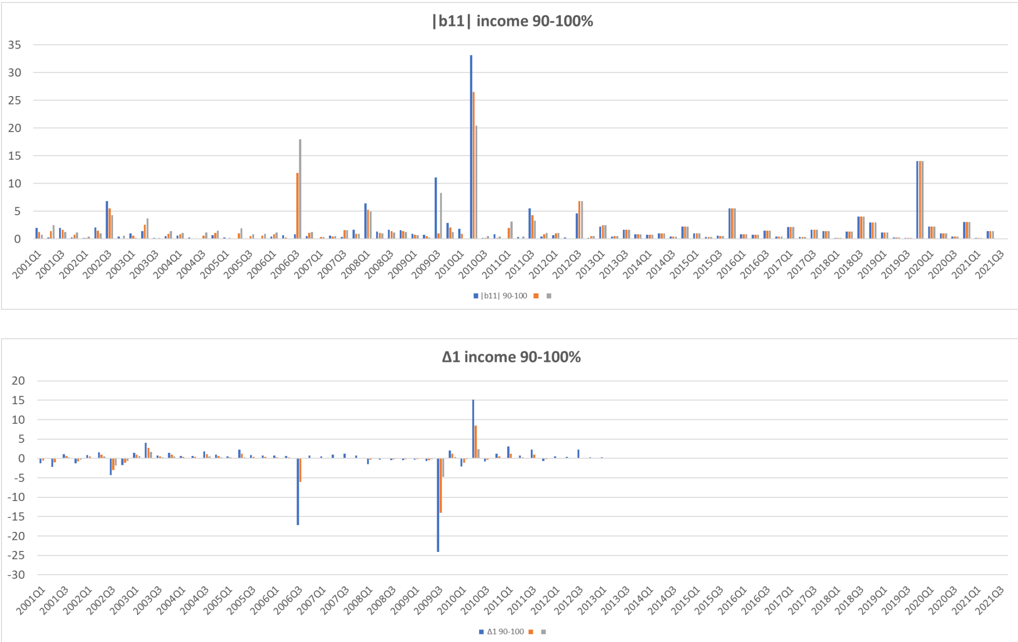


Figure A7. The AII and Δ_1 for those households that belong to the income percentile between 90% and 100%.

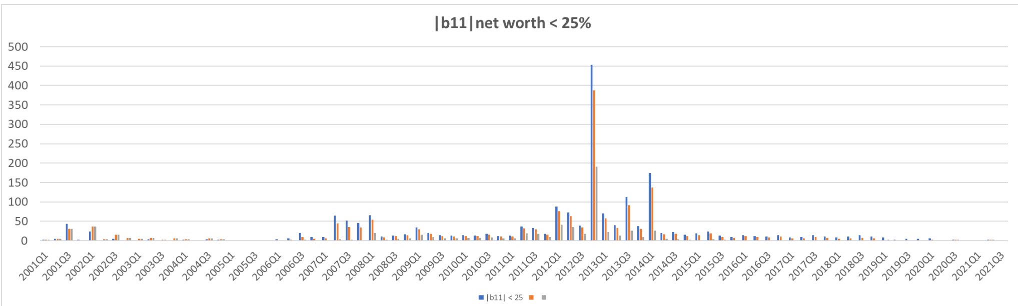


Figure A8. *Cont.*

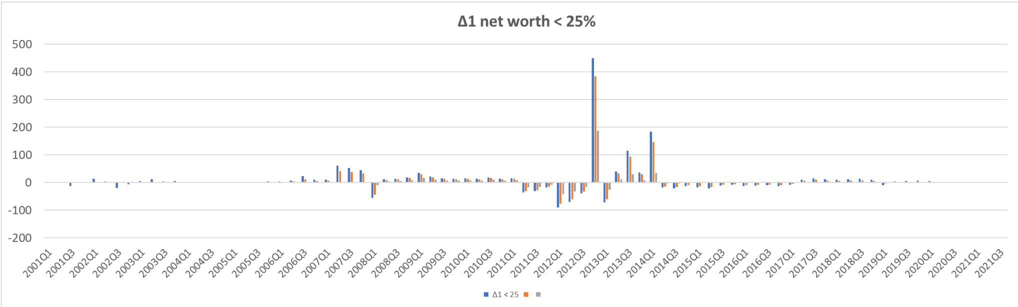


Figure A8. The AII and Δ_1 for those households that belong to the net worth percentile of less than 25%.

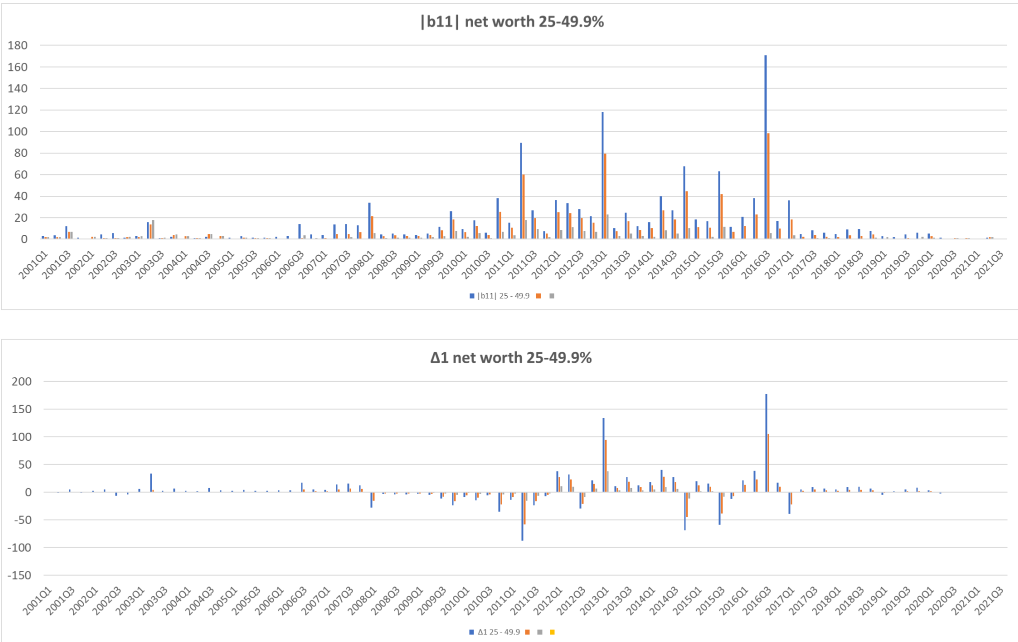


Figure A9. The AII and Δ_1 for those households that belong to the net worth percentile between 25% and 49.9%.

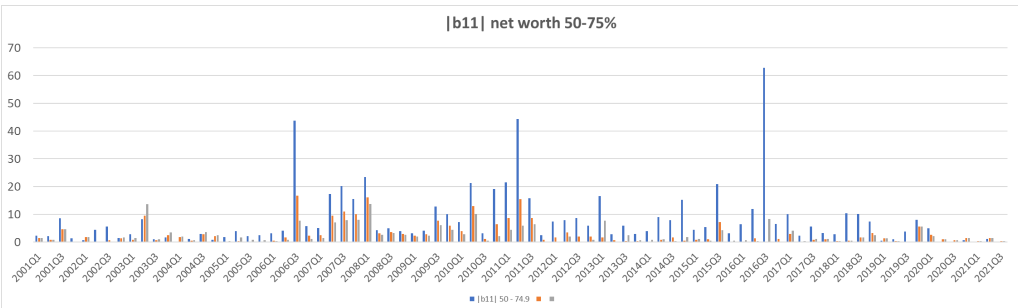


Figure A10. *Cont.*

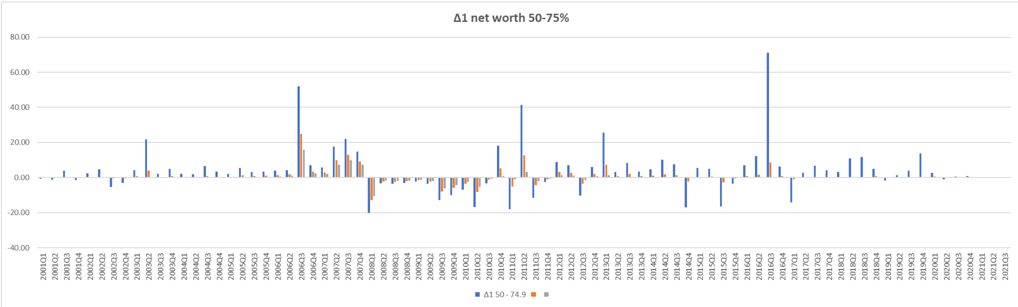


Figure A10. The AII and Δ_1 for those households that belong to the net worth percentile between 50% and 74.9%.

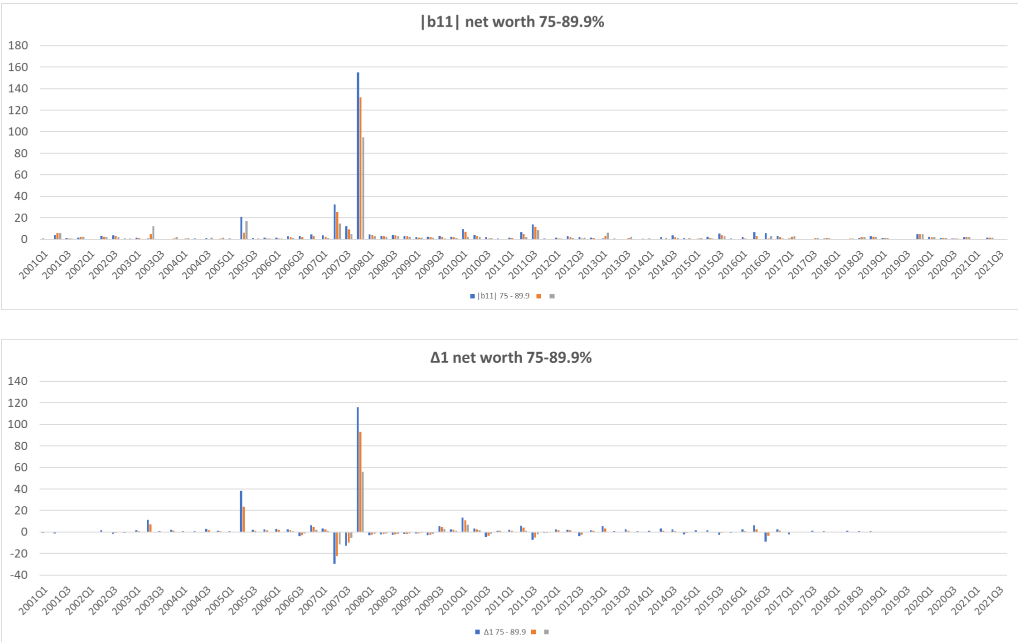


Figure A11. The AII and Δ_1 for those households that belong to the net worth percentile between 75% and 89.9%.

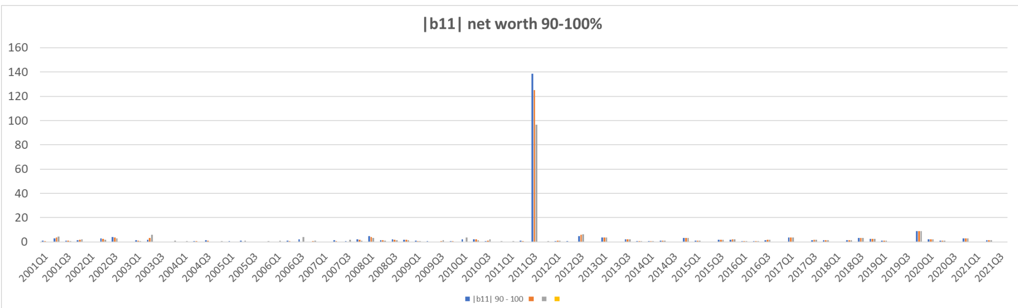


Figure A12. *Cont.*

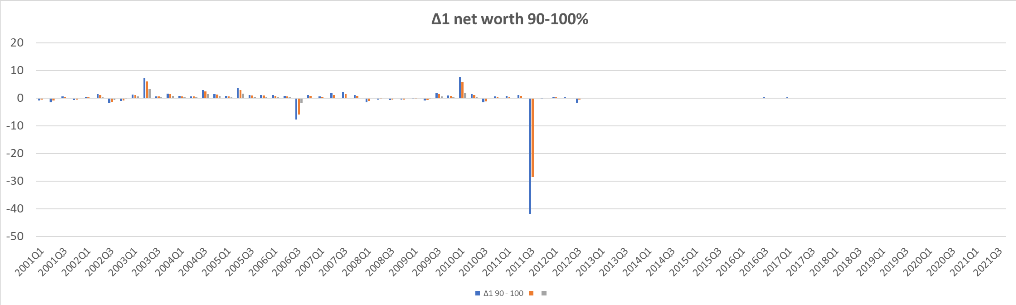


Figure A12. The AII and Δ_1 for those households that belong to the net worth percentile between 90% and 100%.

Notes

1 Potential default denotes the situation in which liability exceeds the maximum allowable debt level, such that if a strict debt-to-asset ratio were imposed, a default—not in legal sense but failure to pay—would occur.

2 When dealing with discrete time data, the time derivative is replaced by finite difference.

3 The IMA puts the households and nonprofit institutions serving household into one group. Nevertheless, we consider this HNISH as U.S. households because the two sets of data are not separable.

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