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FINANCIAL INFRASTRUCTURE: CHALLENGES AND SUSTAINABILITY

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Abstract: The gap between the rich and poor, the advanced economy and developing economy, is expected to grow even bigger if nothing is done about the current financial infrastructure. There are many fundamental flaws in the current system preventing us from making the economy inclusive and sustainable. In this investigation, we present evidence and analysis of some problems deeply rooted in the current financial system and discuss how traditionally marginalized wisdom and FinTech may help us fix the problems, thereby creating an inclusive, sustainable and more fair financial system that better assists the real economy. Specifically, the topics discussed include distorted risk-return relationship, debt products and the flaws, bank crises, insurance structure, etc.

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I. Introduction

This paper aims at investigating the link between the macro-level inequality and the fundamental mechanism of the current financial infrastructure, and how to improve its sustainability and inclusiveness at the dawn of the new industrial revolution.

The world has experienced three industrial revolutions marked by the steam engine, electricity, computer and Internet. Each industrial revolution has brought about fundamental changes in human society in terms of production, socioeconomic structure, trade, business model, or even geopolitics, etc. These revolutions have lifted human society from labor-intensive agrarian to manufacturing and informational society. Each step is characterized by exponentially increasing knowledge component in the process of wealth generation. This is why we are now already in a knowledge economy. In such form of economy, human manual labor becomes less important, and in many areas is no longer even necessary as the cost of robotics continues to drop.

During the first industrial revolution, the average growth rate was about 1%, while now 5% or even 10% is not that uncommon. This is because knowledge and technology have a phenomenon called the network effect – the more knowledge you have, the faster

it will accrue. Mathematically, it exhibits the feature of exponential growth. While we applaud the remarkable achievements made by these technological advancements, the flipside becomes increasingly worrisome as well.

The current financial system has reached an unprecedented level of sophistication. Financial innovations are happening at a faster pace and the financial sector. According to a Washington Post report (March 29, 2016), the FIRE (finance, insurance and real estate) sector has grown to 20% of the US's GDP compared with only 10% in 1947. The frequency of financial crises has also increased even more prominently.

The gap between the rich and poor, the advanced economy and developing economy, has deteriorated over the same period. The question facing all humanity is – whether we can only passively watch this happening or is there any hope that the rich-and-poor gap can ever be reduced and reduced peacefully; and whether there is a chance and opportunity for the developing economies to catch up. If the answer is yes, then the next question is how can we develop an economic system that is more fair, inclusive, and sustainable?

The fact that we are asking these questions is because the current economic system has some fundamental and intrinsic flaws. In this article, we will focus on the existing financial system and analyze some fundamental flaws that are to blame for causing some of the major socioeconomic problems. We argue and demonstrate that the origin of these problems is the mismatch between risk and return. A few representative cases are explained in greater detail and, if possible, remedies are recommended. We believe that many of the problems in the current financial system have long been recognized but they remain unsolved because of technical difficulties. Now, with the advent of AI and FinTech at the dawn of the new industrial revolution, we may have a rare and practical chance of fixing them.

2. Flaws in the Current Financial Infrastructure

2.1. Disconnect between the Financial System and Real Economy

First, the financial sector is supposed to serve the real economy, but in the current globally dominant system, there is a big disconnect between the financial sector and the real economy. The real economy productivity in the western world has not increased much compared to the stock markets' remarkable performances. Thus, this asymmetry can create a growing gap between those who participate in the capital market and those who are excluded. Figure 1 compares global nominal GPD and capital market sizes. We note that if the capital markets closely reflect the value of the real economy, then the capital market indexes and GDP should have very similar growth rates. If the debt market and equity market are two main financing sources as they practically are, and the financial markets reasonably reflects the real economy, then the growth rate of GDP should be between the average growth rate of equity and debt. However, Figure 1 shows that this is not the case. The fact that growth rate of debt and equity are both considerably greater than that of

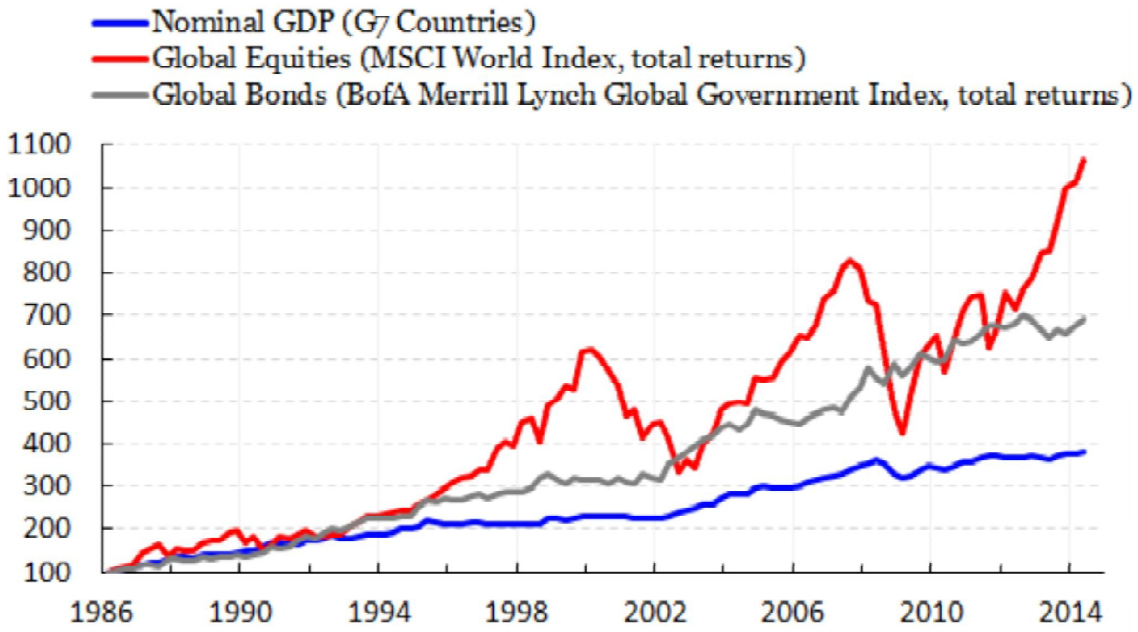


Figure 1: Global GDP and asset returns. All three measures are normalized to 100 at 1986 and in the US dollars

Sources: Haver Analytics, Merrill Lynch, MSCI.

GDP suggests that the financial economy is increasingly deviating from what it should match, a clear indicator that the financial system is flawed. There are two immediate adverse consequences. One is that more crises are expected in financial sector and economy, and the other is a direct contribution to the rich-and-poor gap, or the gap between the population that participate in capital investment and the people who are left out. These consequences are detrimental to building a sustainable and inclusive economy.

2.2. Risk-Return Relationship May be Distorted by Derivatives

The above mentioned disconnect has been further worsened by the increasingly use of financial derivatives. The important risk-return relationship in many financial products has been made recondite and esoteric or even destroyed. The futures contracts are predominantly used by speculators rather than importers and exporters or businesses that are directly having something to do with the underlying commodity or financial assets. According to a UN report (Food and Agriculture Organization, 2010), only 2% of futures contracts end in delivery of the physical commodity. More than 90% of the foreign exchange market volume is attributed to pure speculators for profits rather than genuine risk management in export/import business (see e.g., Venketas, 2019). Recent experiences have taught us that once these financial innovations or derivatives are not used by stakeholders

as risk management tools but by large numbers of speculators, the disconnect between the financial system and the real economy can be magnified and have adverse impacts on the latter. The traditional opinion is that large number of traders including speculators will be conducive to price discovery and help stabilize the market. This is actually based on a hidden assumption – the risk distribution is Gaussian or some variants of the sort that follows the Law of Large Numbers. Unfortunately, in the area of finance and economy, this assumption is normally violated. Ample evidence has shown that fat tail distribution such as power-law and Weibull distributions are more common in finance and economy. These fat tail distributions typically do not necessarily have stationary means. In other words, more data usually does not make the mean converge to a stable value. The fundamental issue here is that the risk and return may not match each other well and the size of the mismatch is magnified by the number of speculators.

2.3. Debt Financing, Banking, and Unfair Allocation of Economic Growth

The debt-driven economy and excessive consumerism have created considerable destruction to the society, global economy, and many families. The so-called *Minsky moment* is like a sword always hanging on our head. Here, the Minsky moment refers to the time when the values of debt assets start to collapse in a cyclic fashion. We have seen the power of this destructive force in the 2008 global economic crisis. It is fair to say that, despite its long history and wide use, debt financing is controversial and overly use of debt will

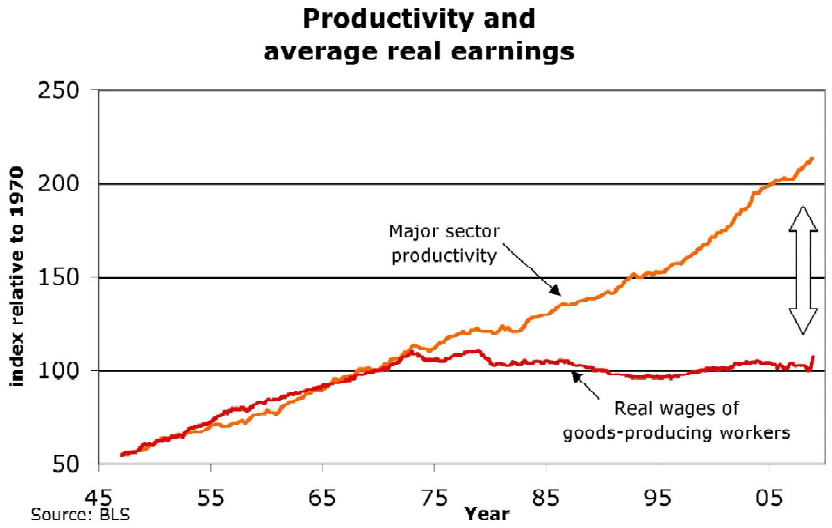


Figure 2: The gap between real wages of goods-producing workers and real economy's productivity has significantly widened since early 1970s. This gap contributes to the concerning rich-and- poor gap nowadays. This gap suggests the growing unsustainability of the economy

Source: Bureau of Labor Statistics

certainly lead to more socioeconomical disruptions and suboptimal resource allocation. The problem with debt financing is that the risk-return relationship is harder to maintain because debt cash flows are not fluctuating with the profits in proportion. In addition, what makes this even worse is that the for-profit banking industry and other lending agencies exploit this flaw in risk-return relationship in their favor. This is probably why both equity and bond market returns are higher than the real economy's growth which suggests the capital market is an open system in the sense that there is continuous wealth flowing in to boost the capital market investors like an incessant subsidy. Why does this subsidy come from? The most plausible candidates are the banks depositors whose real returns have been below zero.

Figure 2 illustrates the growing gap between wealth creation proxied by the real economy's productivity and the share of this wealth allocated to the working class represented by the goods-producing workers. This gap implies that the economic process is increasingly and unfairly biased in favor of the rich and against the working class or middle class. We specifically note that the widening gap shown in Figure 1 does not come from unfair allocation in Figure 2. Rather, it represents a further disconnect between the financial sector and the real economy and that disconnect is most likely magnified by the fast-growing financial sector and derivatives market.

2.4. Financial Sector Outgrows the Real Economy

Figure 3 indeed shows the increasing relative size of the financial sector and Figure 4 shows the disproportional rise of the financial sector's profits. We note that financial sector's faster growth itself may not necessarily be wrong. It is the fact that the financial sector's continuous prolonged outpacing the real economy raises the red flag. Indeed, among all major industrialized countries, the ones that have the highest weight of financial sector relative to their GDP are those suffered most economically in the crises.

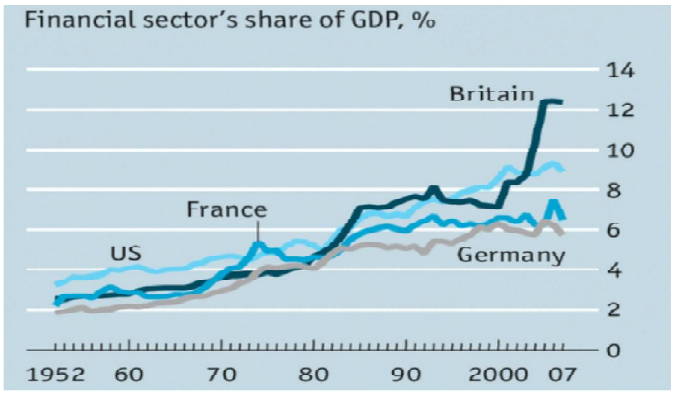


Figure 3: Financial sector has been increasing relative to the real economy

Source: Paris School of Economics

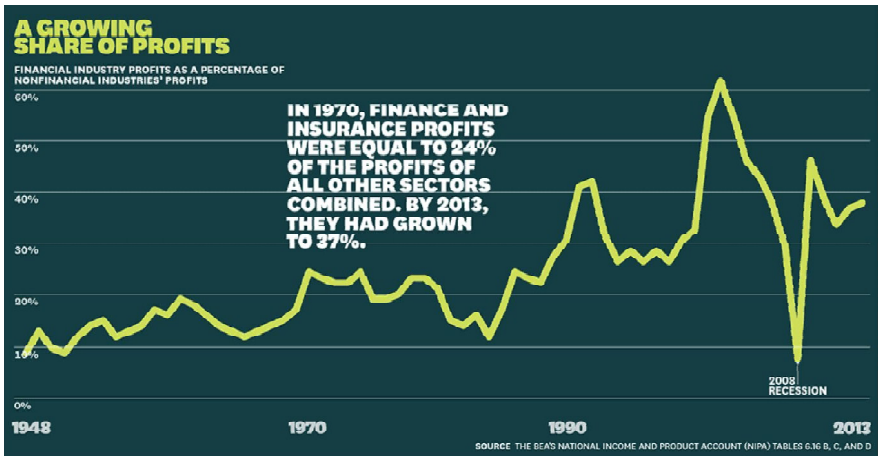


Figure 4: The relative disproportional rise of the financial sector's profits. Notice, this is on top of the financial sector's disproportional growth in size

Source: The BEA's National income and product account

Combining the gaps in Figure 1 and 2, we may get some insights: (1) the wealth-generation process has become extremely unfair in terms of profit allocation; (2) the fast-growing financial sector deviates more from the real economy which it is supposed to serve; and (3) the resultant adverse impacts are on the rise. Therefore, it is increasingly clear that the current economic system is increasingly exclusive and unsustainable.

2.5. Fast-Growing Financial Sector, Capital Mobility and Crises

Thus far, we have identified a few problems that seem to be intrinsic to the current financial system and they tend to get worse as the financial sector grows bigger. Indeed, this understanding is corroborated by Figure 5 showing capital mobility and banking crisis frequency (by Almas *et al.* 2010).

Despite all kinds of effort, including regulations and technological innovations, the banking industry seems to be unable to avoid bank crises and fraud. Another systemic flaw is what Joseph Stieglitz called "privatize gains and socialize losses" in the banking industry. Banks, especially the big ones, seem to always get bailed out after they screw up. This, we believe, has two main reasons. One is that the banks are mainly using debt-type of investments, which tends to distort the risk-return relationship and the "too-big-to-fail" effect further contributes to the distortion. Another reason is that the banks largely control the payment systems, and without a smooth payment channel, the real economy and the modern society cannot function. Once again, we saw this dilemma play out in the 2008 financial crisis – that is, the problematic banking structure is prone to crises, but the banking industry unfortunately controls a vital function that our socioeconomic life depends on.

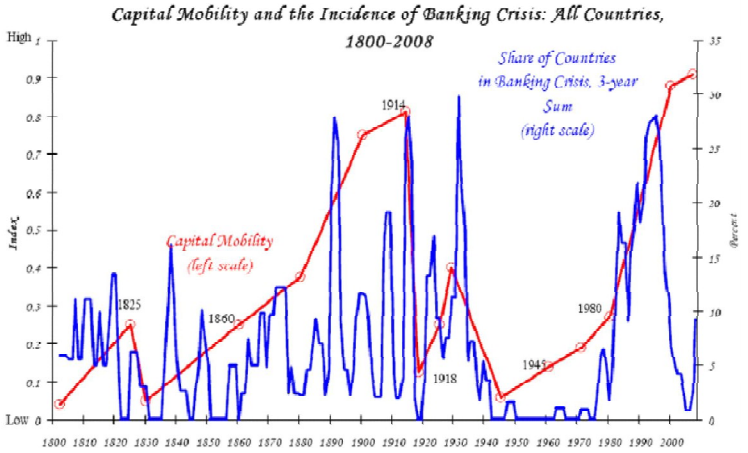


Figure 5: Capital mobility and the frequency of banking crisis. When capital moves more freely, financial sector tends to grow. However, with internal problem of mismatching risk and return in the for-profit banking system. The result is increasing frequencies of banking crises

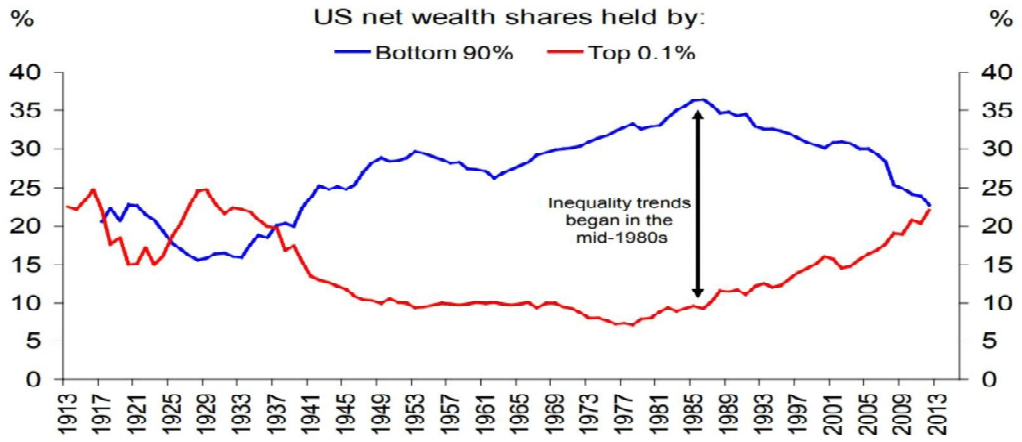
Sources: Reinhart and Rogoff 2009.

2.6. Inequality – an Ultimate Concern

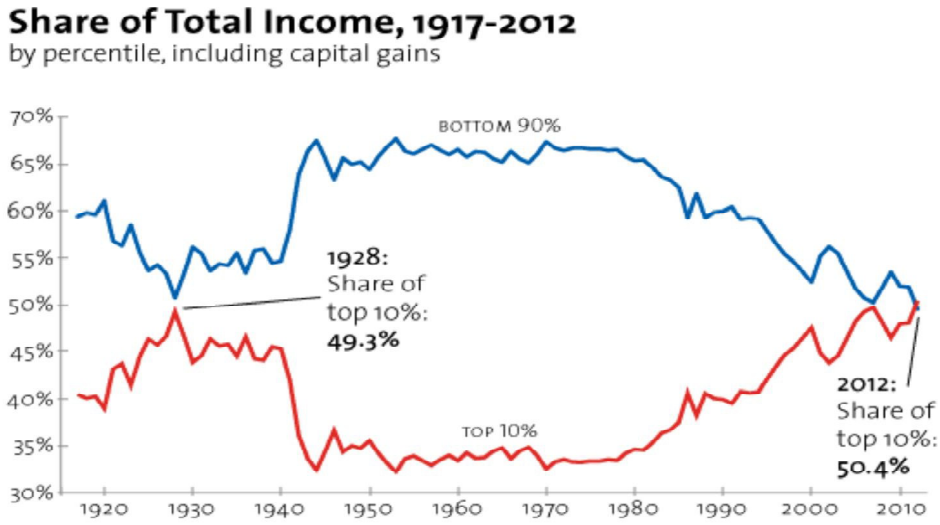
These deep-rooted fundamental flaws of our current system do not seem to be able to automatically correct path for our economy. Instead, the result is a widening gap between the rich and poor and all kinds of socioeconomic and political problems that come with it. Figure 6 illustrates the alarming social wealth disparity.

In Panel (A), we show the wealth share of the top 0.1% richest people versus the wealth share of the bottom 90% of the population of the U.S. In panel (B), the comparison is between the top 10% and the bottom 90%. These two patterns are similar. After the WWII, the bottom 90% have earned considerably more than the top 0.1% or 10%. The widening gap started to shrink after the deregulation wave since early 1980s. In 2013, the top 0.1% or 10% finally caught up with the bottom 90%. This trend is expected to continue if not getting faster. We note that this is a very serious concern that has already taken its effects in our social life and economic development.

"*Those who do not learn from history are doomed to repeat it*" – Philosopher Santayana's wisdom resounds especially loud in this era. Anyone who looks at these curves and knows the history of the last century can easily identify the similarity between the present time and the pre-Great Depression era and the following unprecedented tragedies in human history. We hope the history does not repeat itself this time. However, if we do not anything in our embracing of the new industrial revolution about the systemic flaws that we have discussed above, then it is quite reasonable to be pessimistic and even deeply worried that the new technologies – AI, FinTech, Rich Data, etc. – may likely do more harm than good and create more crises. Nevertheless, as an ancient



Panel A: US net wealth share held by top 0.1% versus bottom 90%



Panel B: US net wealth share held by top 10% versus bottom 90%

Figure 6: The evolution of the net wealth of the bottom 90% versus that of the top 0.1% (Panel A) and top 10% (Panel B). We especially note the two crossing points at 1929, and 2008. The current situation is still similar and this is why we need to cooperate to find a solution

Source: Capital in the Twenty-First Century (Piketty, 2017).

The advances of technology in the modern world should be welcomed because they generate more wealth and are expected to benefit our society. However, the current system seems to be creating problems that may even outweigh the benefits in many situations. Therefore, how do we solve this dilemma and build a socioeconomic system that is inclusive

and sustainable is not only an economic issue, but also, in a sense, a moral challenge to this generation, especially at the dawn of the new industrial revolution.

Upon careful analysis including the above discussion, we identify the main bane of the current system comes from the risk-return mismatch and other mechanisms that are largely these results of history or technological limitations. Now, with the fast advances in new technology, specifically the new generation of FinTech built upon AI and *rich data*,[1] combined with overlooked conventional wisdom, there is a great chance that we can overhaul the traditional system and solve most of the persistent problems embedded in the old system. Next, we will discuss four specific cases and explore some possible solutions by using AI- and rich data-aided FinTech.

3. The Main Cause of the Problems:Debt Financing

3.1. Debt Financing Problems

Debt has been one of the two major forms of financing for a long history of mainstream economy. Minsky (see, e.g., Minsky 1982) is the first one to elaborate on the mechanism of the adverse effects of the wide use of debt in economy. Specifically, he attributes the cyclicality of economic crises to debt financing-induced speculation bubbles and points out the existence of the so-called Minsky moment when the bubble bursts and asset values crash that spread over the entire economy. This cyclical wild fluctuation in economy always leads to great waste of resources and social turmoil. Figure 7 shows the cyclic default waves in percentage of countries in external default or restructuring from 1800 to 2015. We note that this wave-like feature of the cyclic defaults is also true to private economies.

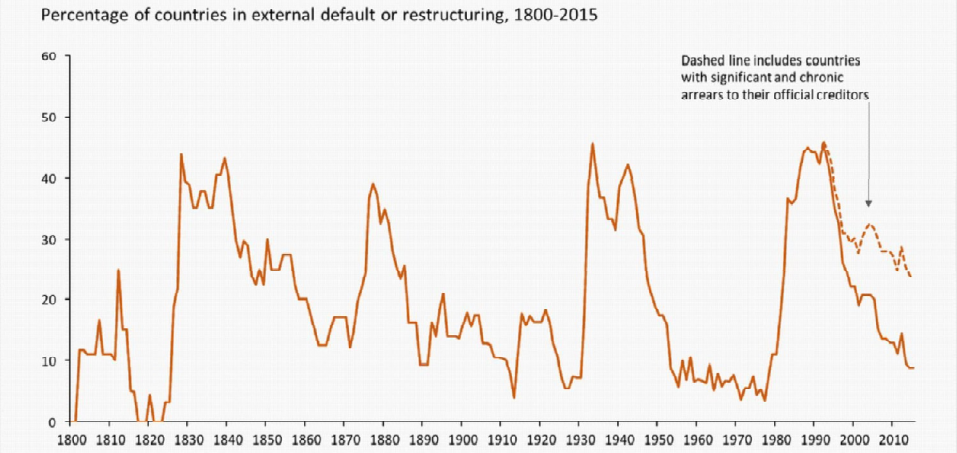


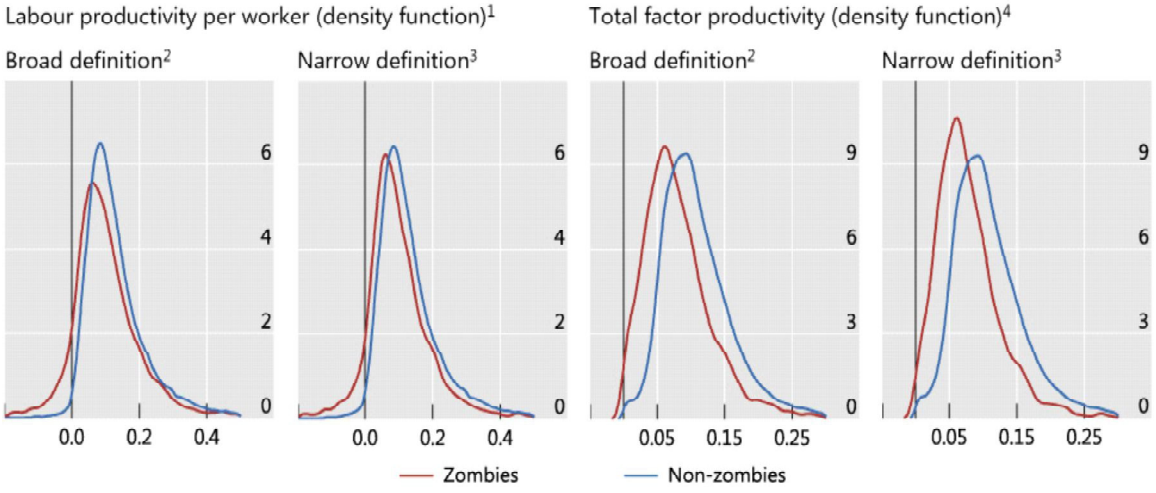
Figure 7: Default waves in percentage of countries in external default or restructuring. The wave-like feature of these default events can be easily explained by Minsky's theory of financial crises

Sources: Reinhart and Rogoff (2009).

Debt financing has been questionably considered to be a cheap way of financing. Thus, when interest rate is low, firms and individuals tend to borrow more debt. As the pecking order theory of capital illustrates (see, Majluf and Myers 1984), internal fund is superior to debt financing and latter is superior to issuing new equity and managers should follow this order. This essentially encourages debt financing over equity when a firm is seeking expansion without having accumulated enough internal funds, which applies to the situation of many firms. We also would point out that even for firms that are not seeking expansion, increasing debt is also attractive when interest rate is low and/or the economy is booming because corporate tax deduction is proportional to the amount of debt, and rising asset values make borrowing more affordable. The problem is that the raised level of debt becomes extremely vulnerable when the economy slows down and asset values drop. In this situation, leverage based on market values shoots up making the firm close to bankruptcy. If the firm tries to unload the debt by selling off some assets, then it may even have negative (book) equity. Firms in this situation are likely to be worth more liquidated or reorganized than kept going on except they have enough unrecorded valuable assets such as brand name, etc.[2]

According to a Bloomberg report (Sept. 17, 2018), 38% of the S&P 500 firms are having negative equity based on their tangible assets. For a discussion of negative equity and the impacts, we refer readers to Fairchild (2018). While one may argue that the phenomenon of negative equity could be sometimes an artificial flaw in the current accounting method, another related problem is real – the existence of zombie firms which are firms whose cash inflows are not enough to cover its interest liability for years. According to Banerjee and Hofmann (2018), 12% of global firms and 16% of U.S. firms are zombies in 2018, while these numbers were about only 2% in the early 1990. Zombies can be a big headache for economic development. On the one hand, they are a big waste of resources, material and human labor. They also compete for capital with efficient firms.

Since zombies would have to use all or majority of its cash inflows to pay debt interest, they lose incentive to be productive and innovative. Figure 8 shows such comparison. However, on the other hand, liquidating zombies may even be more costly considering the realization of huge asset losses on the book and social ramifications. Thus, some economies such as that of Japan have provided vivid images of zombie firms and the harm they have done. The negative dynamics of zombie firms might also be understood from the perspective of debt overhang – a notion that was elaborated on in Myers (1977). When a firm's leverage is too high, be it the result of an active borrowing effort or a recent asset value collapse, the firm may likely to be plunged in a coma-like trap – debt overhang. A firm in such a situation is similar to a zombie or may be already a zombie that has no incentive to be productive or innovative. In addition, their behavior starts to be highly irrational in that they seek extremely high-risk projects even though those projects ought to be rejected based on any rational analysis (such as the NPV analysis), while safe profitable projects are forgone.



[1] Gross value added per worker, in constant 2010 US dollars. [2] Broad zombies defined as firms with an interest coverage ratio less than one for three consecutive years and over 10 years old. [3] Narrow zombies defined as broad zombies with a Tobin's q below the median firm in the sector in a given year. [4] In constant 2010 US dollars, based on Solow residuals from ordinary least squares regression estimates of sectoral production functions.

Figure 8: Productivity density functions. The LHS is the dollar value added per worker. The RHS is the Solow residue (productivity growth). The productivity comparison between a normal firm and a zombie of similar traits clearly shows the adverse effect that zombies have

Source: Banejee and Hofmann (2018).

In sum, debt financing has its intrinsic flaws even if there is no crisis per se. We believe that the root cause traces to the problematic match between the risk and return. Indeed, debt financing is a type of extreme partition of the profit in the sense that one party bears all risk and the other does not bear any risk until bankruptcy occurs and the partition completely reversed. Since bankruptcy can be a complicated process and external parties such as the court, layers and new investors are likely involved, it would be very difficult to accurately assess the risk-return relationship in debt financing a priori. In addition, debt financing is always having the potential trap of debt overhang and zombie state where the risk-return relationship becomes irrational and detrimental.

4. Potential Solutions

4.1. Wisdom from Islamic Finance

To address the above-summarized problems, we advocate very conservative and limited use of debt. A traditionally overlooked source of wisdom is the Islamic banking and finance which has practiced no-debt financing for over a thousand years. The fixed interest rate of debt is considered both usury (riba) as well as immoral because return without (directly)

bearing risk is like profit without work. This ancient wisdom rings aloud especially in this era. Speculation (maisir) is explicitly prohibited through the ban of gharar which literally means uncertainty or hazard and the sale of something that is present at hand. This essentially prohibits speculative practices such as short sale and wanton use of financial derivatives which usually buy and sell items that are not at hand. Islamic finance is an old area that has received new interest after the 2008 global great recession. It has invented a rich collection of financial practices and products. For example, ijara is similar to lease which essentially makes it more like a short-term loan and thereby the distortion of the risk-return relationship is quite limited. In addition, ijara is not a standalone loan because it is firmly based on specific item.

In sum, Islamic finance emphasizes (1) profit and loss sharing (mudarabah; musharakah for joint venture), and (2) asset-backed financing as opposed to unlimited[3] and complex derivatives[4], therefore short sale is prohibited, forwards or futures (istisna) are for actual delivery rather than a game for many irrelevant speculators. There are several benefits. First, profit and loss sharing will not give rise to bankruptcy, an event that disrupts business and can cause large-scale crises. There would be no debt-overhang problem which hampers productivity and innovations. There would be no zombie phenomenon either because unsustainable businesses would be more easily closed by the stakeholders who bear the risk directly. When debt and equity are used, equity holders will normally have no incentive to liquidate the business even though V_L (liquidation value) exceeds V_g (going-concern value). If $V_L > V_g$, it is the creditors who may have the incentive for liquidation which would be good for the economy. However, as we have seen quite frequently in the recent decade, creditors do not liquidate some firms even if $V_L > V_g$ for various reasons such as cultural reasons (e.g., social stigma), banking flaws (e.g., keeping inflated book value), and government policy (e.g., loose monetary policy). This would lead to the zombie phenomenon which is a big problem facing some economies. The second benefit of Islamic finance is that finance and real economy are directly and firmly linked. This close link not only brings us back to the essence of financial system – to serve the real economy rather than bleed it, but it also make assets more accurately priced. For more details on Islamic finance, we refer readers to Abdullah and Chee (2014) and El-Gamal (2006).

4.2. Risk Sharing Products and AI-Aided FinTech

The financing structure has always been very rigid thus far. The main methods are basically two: equity and debt. Preferred stock is like debt in terms of cash flows. Therefore, the financial industry has not invented any products between these two extremes to support the real economy. We note that many financial derivatives are mostly for risk management and speculation instead of raising capital for real economic production and development. This is because (1) financial theoretical studies have not caught up as it should; and (2) technology was not ready for more sophisticated products. Now, we believe it is ready to leverage the benefits of AI, FinTech and rich data.

We propose financing products of various risk/return mixtures instead of equity and debt. Suppose we choose to offer three classes of profit/loss-sharing financing vehicles. The three classes have values of A_t, B_t, and C_t at t, respectively. The firm has overall expected return of R. Now based on our need we can decide different return rates for the three classes. Suppose we decide that $r_A = 2r_B = 3r_C$, i.e, class A bears most risk per dollar and class C least. Then, similar to the MM irrelevancy theorem, we have

$$A_t\left(1+3r_C\right)+B_t\left(1+2r_C\right)+C_t\left(1+r_C\right)=\left(A_t+B_t+C_t\right)\times\left(1+R\right)$$

and

$$r_C=\frac{\left(A_t+B_t+C_t\right)\times R}{A_t+2B_t+3C_t}$$

Hence $r_A = 2r_B = 3r_C$ are uniquely determined. Notice that we can choose many kinds of profit sharing partitions among A, B and C classes other than the current hypothetical case. Since there is only one condition – the total asset-weighted return is R, the profit sharing partition can be achieved in unlimited number of ways by adjusting the relationships among r_A, r_B and r_C.

Previously, this type of profit/loss partition would confuse investors. Now, with AI-aided FinTech, this becomes possible. First, AI aided with rich data would be able to help decide what kind of profit/loss sharing partition would best suit investor clienteles with different the risk averse levels. Specifically, we may use AI's pattern recognition capability to analyze a sizable universe of potential partitions and figure out which (combination) of partitions would maximize total firm value. Second, as the partitions become complex, AI-aided FinTech may be developed to continuously analyze the risk-return relationships in real time and give accurate asset valuation and recommendations. With these achieved, investors will feel used to and comfortable with these new financing products that shares the profits and losses at different levels rather than the traditional two extremes – equity and debt.

V. Conclusions

Based on significant amount of data analyzed by other scholars and ourselves, there is no doubt that (financial) inequality has been growing rapidly. Traditional system has many fundamental flaws that created this rich-and-poor gap so wide and for so long. In the era of new industrial revolution, we have a rare opportunity to revamp our existing system and built a new version that is efficient, secure, inclusive, stable, fair, and sustainable. We investigated the rich-and-poor gap and point out a few such fundament flaws that attributed to the gap. The most important one is the overuse of debt. Debt has the tendency of distorting the risk-return relation. We discuss the potential solutions to the flaws of debt financing by looking into some wisdoms from Islamic finance and explaining the

idea of creating intermediate financial products between equity and debt to get rid of the debt overhang and zombie firms. We hope at the dawn of the new industrial revolution we can take advantage of the good opportunities that FinTech presents to help fix the old problems and build an economy that is more inclusive, fair, sustainable, and intelligent.

Notes

1. We believe rich data is the term that better describes the nature of the structure and dimensions of the data that are the fodder for the age of AI and IoT rather than the buzzword big data. One important reason is that data does not have to be big but must be rich to better use the power of AI and FinTech.
2. Some intangible assets such as brand name are not recorded on the balance sheets unless they are acquired through a merger or acquisition.
3. For example, there is not limit to banks issuing ETF on its gold holdings. The majority of swaps and futures are not intended for the actual delivery and are used by speculators.
4. In Islamic finance, the asset in asset-backed financing directly anchors financing on real economic items as opposed to many fancy financial products in the modern western economy that do not correspond (directly) to any real economic items, such as swaptions, options and compound options, etc.

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