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# Social–financial approach for analyzing financial transitions

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## Abstract

This study proposes a social-financial approach (SFA) to fill the methodological research gap in strategic policy design for managing financial transitions during social changes. The SFA seeks to characterize inclusive transitions in response to innovation and analyze financial management in social changes. Using a multilevel perspective, we combine evolutionary finance and inclusive growth analytics into this framework. We contend that the interaction between the different levels can be summarized as spontaneous adjustments and the alignment of financial elements with the indicators. Actors who attempt to achieve their goals based on past performance evaluations and other forms of bounded rationality strive to cope with adjustments and further trigger a reorientation of the existing regime. We also developed a new configuration tool called the three-axis description to describe the evolution of financial transitions at different stages. These methods allow us to analyze the evolution of financial transition and efficiency, and we argue that market efficiency evolves in stages with the financial transition. Finally, to demonstrate the capability of SFA to identify diverse financial transition pathways, we examined an example case: the establishment of the Bretton Woods System.

**Keywords:** Social financial approach, Financial transition, Evolutionary finance, Multilevel perspective, Three-axis description, Market efficiency

## Introduction

In the development of human society, social innovation frequently requires the co-evolution of technology, culture, and finance. During social changes, institutions lack the ability to adapt, and appropriate research methods must be selected to formulate and develop policy strategies and design new systems and mechanisms. As an illustration, the issue of technological transition in social change (e.g., low-carbon transition) can be considered. The urgency of climate-change mitigation requires a transition to a low-carbon society (Wu et al. 2018; Zerbib 2017). Transitioning to a low-carbon economy is a complex process involving the dynamics of technological evolution, cultural discourse, and political conflicts, among others; it also requires interactions among multiple societal groups with various constraints such as equity, social acceptability, and political feasibility (Farla et al. 2012; Loftus et al. 2015; Pearson and Foxon 2012). As stipulated in the Paris Agreement (Agreement 2017; Ramstein et al. 2019), markets for permits or credits

to emit greenhouse gases are emerging worldwide, and attention should be paid to how financial approaches are engaging in the low-carbon transition as financial forces would also play a significant role in the financial transition. Moreover, there is a need to effectively manage financial transitions and market efficiency during social change.

The current literature on evolutionary finance, social change, and social finance focuses on the following:

#### Evolutionary finance

Social change is evolutionary and closely related to the development of evolutionary finance (https://www.britannica.com/topic/social-change; https://en.wikipedia.org/wiki/Social_change).

The process of economics became a real discipline starting with Adam Smith's "The Wealth of Nations" in 1759, and later evolutionary and social concepts were introduced into the financial and economic system by John Stuart Mill, Thorstein Bunde Veblen, Karl Marx, Joseph Alois Schumpeter, and George Catlett Marshall (Alchian 1950; Schumpeter 1939; Brian Arthur 1994). The modern financial theory is based on the concepts of Homo economicus and efficient markets (Levin and Lo 2021). In the field of economics, Homo economicus is described as a rare "species" of Homo sapiens that behave economically and rationally, interacting with other members of the species in the market. Subsequently, Eugene Fama proposed the Efficient Markets Hypothesis (EMH) in 1970, based on the paper called "Stock Market Price Behavior" published in 1965 (Fama 1965, 1970). With the EMH, participants' self-interested efforts to use their diverse information are aggregated, distilled, and compressed into a single number, the price, which adequately reflects all available information. Classical finance, based on the theory of static equilibrium analysis, focuses on the "mechanical," " programmatic," "stationary," and "equilibrium" aspects of economic systems (Fama 1965, 1970). However, a group of economists has observed that investors are irrational, and the markets are fundamentally inefficient. They began to reconsider standard economic assumptions through the lens of biological evolution and looked for other disciplines to retrieve new insights from economic systems. Consequently, behavioral finance was born (Hirshleifer 2015), which is a comprehensive theory that integrates finance, psychology, and anthropology to reveal the laws of irrational behavior and decision-making in financial markets. (Alchian 1950; Schumpeter 1939; Brian Arthur 1994; Liu 2011; Shiller 2000; Subrahmanyam 2007; Deng and Wang 2012). In addition, the last few decades have seen an increasingly rich connection between ecology and evolution on the one hand, and economics and finance on the other, along with the development of evolutionary finance. Evolutionary finance is a research paradigm that integrates evolutionary economics and finance, drawing on Darwin's ideas of biological evolution and Lamarck's genetic theory to explain the dynamic features of financial markets (Blume and Easley 1992; Doyne Farmer and Andrew 1999; Hens and Hoppe 2009; Dowling 2005). Based on assumptions such as "limited rationality," "heterogeneity," dynamics and change, learning and natural selection of strategies, etc., it is argued that participants have different investment strategies and their interactions lead to complex financial market phenomena from the perspective of evolutionary finance (Holtfort 2019; Evstigneev et al. 2013). Lastly, the study of social and economic transition as a response to innovation has interested economists

since Schumpeter and John Stuart Mill, or Adam Smith (Akdere and Benli 2018; Kurz 2012), and the sociology literature has weighed substantially on such studies of significant public policy imports (Jaumotte and Pain 2005). However, the finance literature is incomplete, and Lo et al. have noted the need for better modeling to service market efficiency management (Levin and Lo 2021).

### Social change

The evolution of social change is accompanied by a social financial transition (SFT), which is a financial change that alters the way society functions, such as the realization of markets and green finance related to climate change, involving changes not only in finance but also in participant practices, policies, social connections, and business models. The essence and paradigm of evolutionary finance can be found by analyzing it from the perspective of the evolution of social change. Social change refers to changes in the social order, including social institutions, behaviors, and relations. It also refers to social evolution, evolving from a financial ecosystem or technological evolution driven by cultural, financial, economic, scientific, or technological forces (https://www.britannica.com/topic/social-change; https://en.wikipedia.org/wiki/Social_change). First, modern society is intertwined with finance, and the adaptability of social finance to social change has evolved through financial innovation. Social changes have led to drastic shifts in internal and external environments, requiring financial innovation to balance endogenous and exogenous forces and ensure that participants can survive in an unknown evolutionary interaction (Levin and Lo 2021). Second, financial transitions require evolutionary preferences and biases in social change to modify financial characteristics (Akçaya and Hirshleifer 2021; Hirshleifer and Plotkin 2020) and ultimately determine the evolutionary path of social finance (Hirshleifer 2020; Han et al. 2021). Furthermore, to effectively manage the financial transition and market efficiency during social change, policy strategies and problem-oriented research methods are required (Wu et al. 2020). Regarding the social-technical approach in technological transition, Kling and Lamb (1999) noted that human and technological behaviors are consistent, and the fit between social and technological environments is referred to as the "socio-technical approach." Another study found that any change in technological behavior impacts social relationships, emotions, and attitudes (Mitra and Mishra 2016). The multilevel perspective (MLP) is used to examine technological transitions and the interaction between different levels that causes this transition (Geels 2002; Wu et al. 2020; Geels et al. 2017; Schot et al. 2016). Unfortunately, although the socio-technical approach has a systematic framework, it lacks a thorough examination of financial aspects because it is primarily biased toward technology-driven processes.

### Social finance

Modern society is financially parasitic, and the evolution of social finance is closely linked to social change. As behavioral finance scholars have pointed out, there is an urgent need to move from behavioral finance at the individual level to social finance at the societal level, studying the structure of social interactions, how financial ideas spread and evolve, and how social processes affect financial outcomes, etc. (Hirshleifer 2015). The study of social finance includes the impact of social relations, norms, moral

attitudes, and ideologies on financial behavior during social change (Ozsoylev et al. 2014; Hong and Kacperczyk 2019; Hutton et al. 2014). Moreover, the existing research on social finance is mainly defined in terms of pure investment. Scholars argue that social finance is a form of investment aimed at addressing social or environmental challenges while generating financial returns (Bishop and Green 2010; Adler and Kwon 2002; Emerson 2003; Martin and Osberg 2007; Nicholls 2010a, b; McWade 2012; Eadery 2006; Buttle 2007).

The literature review is summarized as follows: Neoclassical finance based on mechanical determinism is considered mainstream financial theory, but its unreality is increasingly criticized. The divergence between classical and evolutionary finance has led to the need for interdisciplinary research, such as the integration of biology and finance, which has resulted in the emergence of behavioral finance. Evolutionary finance abandoned the methodology of traditional finance, believing that its static, mechanical, and equilibrium ideas are unrealistic and replaced it with a dynamic, non-equilibrium, Darwinian approach that is closer to market reality. Furthermore, behavioral finance based on individual behavior suggests that the study of social finance is of great significance, and it will be an important field of evolutionary finance research in the future. There is a lack of research on financial transition and market efficiency in the context of social change. Moreover, modern society coexists with finance, and social change requires benign financial transition and synergistic co-evolution between the two. In conclusion, as per the reviewer literature: (1) evolutionary finance is still a developing discipline, (2) social change requires new adaptations to balance changes in internal and external environments through financial innovations, (3) existing social finance research has not yet addressed the financial transition to reveal evolutionary processes and details, and (4) In the context of social change, there is a need to effectively manage financial transitions and market efficiency.

To manage financial transition and market efficiency effectively during social change, this study proposes: first, financial innovation can breed new adaptations to balance the impact of internal and external environments brought about by social change evolution, which requires an evolutionary perspective to study financial transition; second, financial innovation is very fragile, forward-looking policy strategy research is needed to guide a successful transition; third, the primary issues that must be addressed concerning financial transitions during social change are:1) Is there an appropriate research framework and methodology to describe the evolutionary financial transition process for serving strategic policy design and effectively manage the financial transition and market efficiency? 2) What are the specifics of such a research framework, and can we describe the evolution of financial transition and its key evolutionary drivers (e.g., the establishment of the Bretton Woods system)?

Based on the above, this study develops a social-financial approach (SFA)—a complex socio-financial evolution based on the evolutionary theory framework for a forward-looking strategic policy of financial transition; we construct two specific approaches: the SFA-multilevel perspective (SFA-MLP) to examine financial transitions (niche innovations, social financial regimes, and social financial landscape are the three levels of concepts identified by the multilevel perspective) and the SFA-three-axis description (SFA-TAD) to examine financial transitions (niche innovations, social financial regimes,

and social financial landscape are the three levels of concepts identified by three-axis description). To describe the evolutionary details so that financial transition and market efficiency can be managed effectively, we propose the SFA as a strategic problem-solving framework to compensate for the deficiencies of existing studies, such as the lack of an overview of the overall transition, which limit the proliferation of financial transition in academia. Then, we propose the SFA-MLP, which adapts the concept of a multilevel perspective to the financial field and has unique evolutionary mechanisms and characteristics. Transitions with complex actor activities and strategy formation may be the primary driving force of niche evolution; thus, we attempt to assign markets to different levels in the MLP to develop SFA and argue that the behavior of the interaction can be crystallized as a modification of financial elements and indicators. This behavior is rapid, and properly adjusting financial elements can facilitate the transition process. This is evident from the participation of actors in the market, who strive to achieve desired goals based on decisions about past performance and other forms of bounded rationality. Actors' heuristic reasoning and behavioral biases contribute to the adaptation, evolution, and reorientation of the existing institutions, further embedding new designs into society. The attitudes and behaviors of market actors determine the fate of new designs, dictating whether they will fade away or become prevalent in society. In addition, a three-axis description of the SFA is developed to illustrate the interactions between various levels and what can occur at different transition stages. The three levels are represented by three axes that point in different directions and are relatively independent in the stable state, thus forming a tetrahedron. However, when momentum accumulates or the system is perturbed by the external environment, the axes rotate, evolve, and become unstable, propelling the system to a new stable state represented by a different tetrahedron. Unlike the overview diagram of the MLP, which provides only an overview of the transition but is ambiguous regarding the changes in the principal factors facilitating the transition, the overview diagram of SFA-TAD focuses on slices at a particular point in time but clearly depicts the driving forces at each stage of the transition through the motion of the axes. Moreover, we argue that financial characteristics and efficiency co-evolve with financial transition and that market efficiency evolves in stages with financial transition. Finally, an analysis of the establishment of the Bretton Woods system illustrates the advantages of our proposed framework.

The remainder of this paper is organized as follows: Sect. "Social–financial approach" proposes the research framework of the SFA and provides an overview of the SFA-MLP and SFA-TAD. Sect. "Transition pathway with an empirical case study: a radical change in the monetary system" applies our framework to a case study to illustrate the potential transition pathways and the interaction of transition dynamics with those involved. Finally, Sect. "Conclusion and policy implication" concludes the paper.

## Social–financial approach

Human and financial behavior is coherent, and the adaptation and fit between the social and financial environments are referred to as the "social finance approach," in which any change in financial behavior has an impact on social relationships, emotions, and attitudes. To study financial transition and market efficiency, SFA is based on evolutionary finance, sociobiological principles, concepts with evolutionary dynamics, and so on,

which are capable of describing complex socio-financial evolution. SFA is a strategy that presents the best ideas, solutions, and actions required to solve static and unstable social and financial problems arising within and outside the system. It involves complex social interactions in social change (e.g., socio-financial evolution) to renovate (and innovate) the evolution of financial characteristics and their efficiency. Strategic problem-solving-oriented policy design is a critical component of social finance innovation and vital to the success and growth of an organization or system (Kou et al. 2022). SFA can be used to determine whether the government is developing new financial systems or mechanisms, dealing with the changing landscape and ecological conditions of switching niches or regimes, or simply looking for new social finance ideas in a new era to build a community with a shared future for mankind and sociobiology-finance civilization. Furthermore, the SFA framework allows us to analyze financial transitions and market efficiency and find just evolutionary patterns that can serve to maximize social benefits and beautiful system initiative.

Additionally, we propose a market-based analytical approach to SFA-MLP and SFA-TAD, combining the concepts of evolutionary finance and inclusive growth to describe the interactions between different levels more comprehensively. Strategic policymakers can deduce SFA using the SFA-MLP and SFA-TAD approaches. SFA-MLP and SFA-TAD based on the SFA framework are like the "biological specimens" and "future images." Through further management of SFA specimens and image sets (collections), new evolutionary mechanisms, phenomena and laws can be discovered, and new theories and paradigms of evolutionary finance can be obtained.

#### SFA-MLP on financial transition

This section provides a multilevel overview of the SFA framework. In terms of STA, from a multilevel perspective, landscape, regime, and niche are used to distinguish different market levels. The use of levels to differentiate complex systems is common in several fields (Geels 2011; Simon 1991). This description of levels provides a practical framework for analyzing transitional conduct. We contend that financial transitions are governed by a combination of niche processes, developments in the existing regime, and the social-financial landscape. Here, the financial transition is viewed as a shift in financial practices or the emergence of new markets, etc. The SFA focuses on the social demand for a financial function or impact in the MLP in terms of policy, economics, technology, and other social strategies to promote justice, inclusion, resilience, and sustainable adjustment during financial transitions. Combining the perspectives of anthropology, science and technology studies, political economy, behavioral finance, cultural studies, and historical development in the social studies of finance (Goede 2005), we highlight that the transition process is situated in the landscape, with the external environments interacting with each other. The primary benefit of our approach is that it provides an integrated framework for simulating the interactions between different markets as adjustments for financial elements and actors' responses to financial indicators.

MLP refers to complex systems theory, and the system evolves under the combined roles and rules of public policies of innovation (hence, financial market implications) and evolutionary finance, among others, in response to the endogenous and exogenous driving forces of social change. First, in the MLP evolution, inclusive innovation policies

promote or inhibit iterative accumulation and markets to influence the transition process, and a change at one level also changes the path selection of change at another level. Second, MLP combines the adaptive market hypothesis (Lo 2004, 2019), sociobiological principles, and concepts with evolutionary dynamics (Wilson 1975) through the lens of evolutionary biology and ecology, arguing that social financial behavior and transition are sociobiological evolution and adaptation designed to respond to the challenges of the social financial environment. They lead to the evolution (e.g. renovate or innovate, etc.) of social financial characteristics, adaptability, security, and efficiency, and so on, while evolutionary dynamics (competition, mutation, reproduction, and natural selection, etc.) determine the complex evolution of the innovation effects and financial efficiency, etc., and different evolutionary paradigms affect participants and social financial behavior and adaptations leading to diverse adjustments and alignment of financial elements with the indicators and different transition paths emerge. The MLP has sociobiological and socio-ecological properties evolving through social and cultural norms, among others. (1) Evolutionary principles inspired by "evolutionary psychology" are applied to the social financial systems (Farmer 2002; Farmer and Lo 1999a); (2) financial transition has an evolutionary nature of renewing (and creating) financial characteristics and efficiency such as inclusiveness, diversity, adaptability, civilizational, sustainability, etc. SFT undergoes a complex transition evolution, similar to different transition types in biology. Moreover, MLP also has many biological and ecological evolutionary features that exhibit complexities at different stages of transition. The remainder of this section introduces more details on the SFA-MLP.

The landscape is an external structure or context for market-actor interactions. Market participants' behavior is rooted in a set of financial rules embedded in the financial environment and manifest in macro markets as a whole. In contrast to the social-technical landscape, which consists of a collection of heterogeneous factors, the SFA landscape is relatively more correlated, although differentiated, and focuses primarily on financial components, such as means of trading, market structures, currency in circulation, collective investment bias, and the principles of issuing financial products. A landscape is typically constrained by laws, regulations, cognitive agreements, culture, conventions, and other factors. Therefore, the SF landscape may experience more frequent fluctuations due to macro markets that are more sensitive and unstable.

The social-financial regime is a market that directly connects to micro units, each of which is relatively independent for political or geographical reasons to connect the landscape and niche. Both distributed and centralized markets are permissible, but the scale of each market depends on the particular circumstances. The main customers, trading products, and transaction methods of SF regime markets vary with greater differentiation (e.g., energy, vehicle, stock, investment, and food markets). Financial market participants evaluate these markets based on financial indicators and demand and make decisions based on such information. This transition may involve the convergence of multiple markets. Transformations of the SF regime are not only intended to accommodate newly emerging social-financial niches but may also be the result of adaptation and mutation alongside the transition within the regime. Regarding how a newly available design diffuses in competition with an established design, the punctuated equilibrium model is widely used. Other evolutionary diffusion patterns need to be

further discovered and explored, such as a gradualism strategy or combination. Market industries frequently undergo cycles of incremental innovation, interspersed with brief periods of radical transformation (Eaton and Kortum 1999; Loch and Huberman 1999; Briggs et al. 1998).

In a social-financial transition, a niche is a place where radical technical and financial innovations emerge. On the one hand, the spread and alignment of technological innovation depends on the trade between micro-units, which comprise niche markets in the SFA. When technological innovation emerges, market actors, both individuals and businesses, choose different strategies as a response. The formation and evolution of the social financial niche depends, in part, on the development of social-technical niches, the foundation of which may be a new technology with symbiotic characteristics. On the other hand, financial evolution is mediated by cognitive, social, geographical, and institutional processes, leading to the unique and independent emergence of financial innovation (evolving from inside and outside) and path dependence outside the ST-niche. Financial innovation emerges at the niche level, in response to the need to develop a financial system for social change. As in STA, where technology adopters change their selections between existing and newly emerging technologies based on their perceived performance (Loch and Huberman 1999), market actors in SFA choose their responses to emerging niche markets based on their past performance and expected futures. With the accumulation of options, the network propagates market bias. The rate of evolution accelerates at lower levels of action. Based on the establishment of cluster preferences and the selection and optimization of niche market performance, SF niches gain momentum for the emergence and initiation of the transition process (Loch and Huberman 1999). Moreover, potentially different types of transitions, similar to those in biology, are in constant gestation and budding.

Table 1 summarizes these market allocations, using the low-carbon transition as an example. Transitioning to a low-carbon economy requires a combination of carbon, energy, and environmental markets, among others. At the niche level, new energy technology markets and the relevant supporting industries and markets must be considered. At the landscape level, stakeholders may develop specialized financial products and measures to combine green energy and industrial policy. It must be emphasized that the allocation of a particular market does not imply that it is limited to a particular level. Market impacts permeate all levels, although to varying degrees. We would like to allocate a market at a particular level where it plays a relatively significant role. Moreover, such allocation does not imply that the SFA framework isolates these markets. During

**Table 1** Examples of Markets at different levels

| Level | Examples of Markets |
|---|---|
| Landscape (Macroscale) | Green bond, linkage, etc. |
| Regime (Mesoscale) | Carbon market, stock market, digital and information exchange market,<br>Resources and environmental market (both distributed and centralized),<br>Eco and circular management market, etc. |
| Niche (Microscale) | Low carbon technology market<br>Star market, knowledge management market, etc. |

the transition process, these markets evolve endogenously according to their transition pathways and interact with external factors. In addition to its symbiotic relationship with technological evolution, the SFA framework focuses on independent financial innovation in terms of financial instruments, technologies, systems, and products during the cyclical transition to realize potential economic, ecological, and policy benefits to society that are unavailable under the current system.

Various financial elements, such as bonds, currencies, insurance, and stocks, etc. and other indicators, such as market value, risk, interest rate, foreign exchange rate, and environment, link different market levels. Any changes in these financial elements are reflected in adjustments made at each level. Moreover, market participants react to these changes, resulting in additional adjustments. As financial activities become ingrained in people's daily lives in every aspect, this process moves quickly. For greater interest, market actors must adopt different strategies to respond in time and catch the arbitrage space, thus spreading the impact of adjustments more widely. Figure 1 depicts the dynamic financial transition process and highlights certain interactions. A relatively stable landscape is represented by long, wavy lines (Fig. 1). Compared to the social-technical landscape, macro markets are more likely to experience frequent changes, with small dotted fluctuations added to the overall vibration. A financial transition aims to change the originally distributed markets (which are denoted in brown) at the regime level. The different dimensions represent the various markets involved in the transition. With the establishment of a new distributed market, the introduction of a new institution, or a transition in trading routines, the regime changes to a new state, which is represented in green. The long arrows depict the regular and ongoing process. Although markets of different regimes are linked to some extent, they also exhibit internal dynamics. During the transition, the regime must be adjusted gradually, resulting in a tentative immature regime. Such uncertainty and differences in opinion can lead to "tensions" at the regime level, which are depicted by short diverging arrows. At the niche level, market actors attempt to create a new niche market that fills the gaps in the existing landscape and

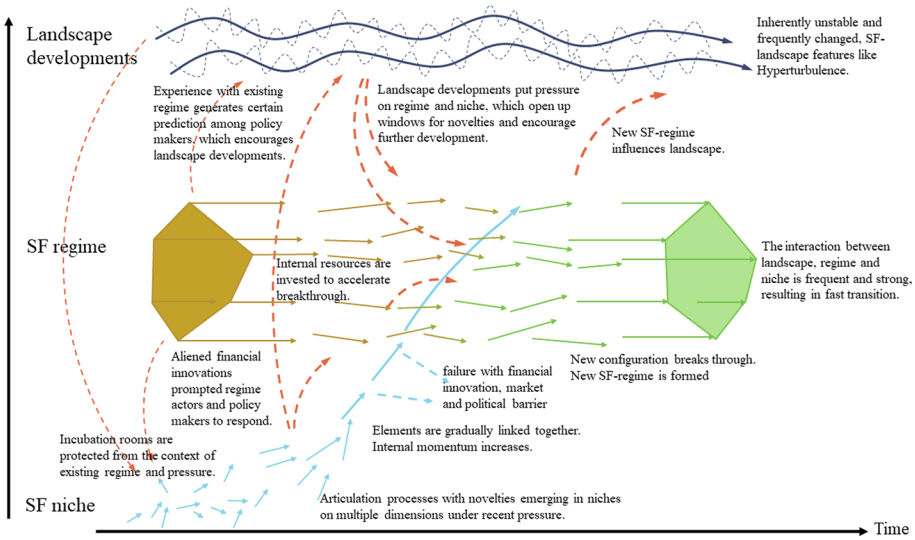


**Fig. 1** An overview of multilevel perspective on financial transition

regime to meet consumers' unmet needs. The efforts are directed in various directions, as represented by small arrows pointing in various directions. Some efforts fail because of innovation, market, and political barriers.

The success of the transition in SFA-MLP is determined by the interactions between different market levels, which can be embodied in adjusting various financial elements. With proper adjustment, these financial elements can facilitate such a transition because they can influence market actors' responses—either adopted or rejected—based on their interests. Moreover, these adjustments result in interactions between different levels, as denoted by the red dotted lines in Fig. 1. Although some niche markets may appear promising initially, they may quickly fade away. Several specific symbiotic and independent financial niche markets will develop and stand out from the immature markets as a result of venture capital investment and the selection of micro units from market adopters. The arrows become more aligned and longer. A type of market bias emerges as the niche and regime evolve through the selection of market actors and the propagation of cluster preferences. This sends a message to the regime and the environment. Stocks, market share, and other financial instruments can also be used to detect signals. At the upper market levels, actors can take action to counteract this trend. At the landscape level, policymakers can adjust bond and currency issuances to affect interest rates, thus providing guidance to the newborn market, whether to facilitate or suppress it. These actions also put pressure on the regime and help create opportunities for emerging niches. Internal resources can be injected at the regime level based on the bias from the regime to the niche to help emerging niche markets breakthrough faster. A dominant new market matures and enters a localized market through the rising channel provided by the existing financial rules. This means that the regime will be temporarily unstable but will eventually stabilize.

Furthermore, the financial transition is the fundamental condition for the system to survive, renew, and develop continuously in competition, with the flow and circulation of credit, resources, and information as the bond to achieve a highly adaptive, harmonious, and unified state of equilibrium among participants and between participants and the environment through internal and external drivers and interactions between levels (Hens and Hoppe 2009; Holtfort 2019; Evstigneev et al. 2013). During the transition, market efficiency evolves in stages to maintain and promote equilibrium, and a new equilibrium is continuously established under the guidance of policies to bring the financial system to a more rational structure with efficient functioning and better social benefits. (1) Early Transition period: The system has a limited variety of participants, a simple structure, high cost, weak ties between participants, a new institution in its infancy, sensitivity to external disturbances, little resistance, and a relatively fragile system. The adaptation of participants and the environment depends on culture, institutions, and civilization and lacks consistency and universality, although the arbitrage of the market, the strategies of participants, and social financial behavior have begun to evolve (Ozsoylev et al. 2014; Hong and Kacperczyk 2019; Hutton et al. 2014). At this stage, the evolution of the financial system and interactions such as competition, adaptation, and natural selection are weak; resource allocation is dominated by policy interventions (e.g., bias) and complemented by market mechanisms; the display and transmission of information

links are not solid; institutional innovation is in a state of trial and error; the adjustments of financial elements and the responses of participants to financial indicators are weak; and the adaptation of participants and social financial behavior, as well as the financial system, are in a dynamically stable state. (2) Transition period: There is an increasing variety of participants, the ties between them are gradually strengthened, the system is structurally complex and functionally efficient, resistance to external disturbance pressures is increased, and the adaptation of participants and social financial behavior gradually moves toward consistency and universality (Lo 2004, 2019; Wilson 1975). At this stage, prices gradually reflect as much information and financial conceptions as possible, determined by both environmental conditions and the number and nature of "market participants" in the economy. Furthermore, more complex trading strategies and heterogeneous traders, the development of financial factor adjustments, and the effective responses of participants to financial indicators have contributed to the development of market efficiency (Holtfort 2019; Evstigneev et al. 2013). However, fluctuations in the system (e.g., activated events, market mechanisms, or policy interventions in resource allocation) cause major evolutionary elements (e.g., adaptation) to accumulate over time out of their original equilibrium states and undergo non-equilibrium evolution. The long-term development of major evolutionary elements (e.g., adaptation) is interrupted by regions of rapid evolutionary change that cross some of the barriers in the landscape of each evolutionary element from one equilibrium state to another. Moreover, the synergistic development between levels allows the coordination of several different types of participants or resources in financial transition (Hirshleifer 2015; Subrahmanyam 2007), such that the financial system is in a benign non-equilibrium evolutionary state of relative structural and functional coordination through mutual constraints, transformations, compensations, and feedback. Coupled with policy intervention to appropriately link, closely coordinate, and mutually reinforce the elements of the financial system, synergy can facilitate the evolution of each major evolutionary element and ultimately promote transition and improve market efficiency. Finally, the improvement of market efficiency through resource allocation (coupling, complementarity, and improvement of market and government intervention), display and transmission of information and perceptions, design of financial incentives, institutional innovation, and correction of limited rationality can correct market efficiency and minimize "market failure," thus maximizing market efficiency. (3) Reconfiguration period: The system undergoes a long-term evolution from simple to complex and eventually forms a relatively stable state. At this stage, along with the profound social change, the long-term adaptive evolution of participants and social financial behavior, the construction of an inclusive environment, the adjustment of resource allocation (market mechanism as the dominant one, supplemented by policy intervention), the construction of the information display and transmission network, the renewal of the institution, and the correction of limited rationality have all completed and reconstructed the system one after another (Grossman and Stiglitz 1980; Fama 1998). Moreover, a high degree of mutual adaptation occurs among participants, between participants and the environment, and between the structure and function of the system. This facilitates the participants and financial elements of the system to gradually fill up the effective capacity

in the spiral, and the resources are allocated and utilized in the most rational and efficient way to maximize social benefits. The degree of harmony depends on the state of financial cognition in society and the level of financial promotion of productivity, and so on.

In SFA, a co-evolution process exists, and the transition is accomplished through interactions between processes. Besides the practice of "appreciative theory" (Nelson 2009), SFA combines evolutionary finance theory and inclusive growth analytics, and this is reflected at each level but with different priorities (Ianchovichina and Lundstrom 2009). According to the definition of inclusive growth, the macro- and micro-determinants of economic growth are inextricably linked. The neo-institutional theory posits that organizational behavior is situated in and influenced by other organizations and larger social forces (Scott 1995) such as border cultural rules, beliefs, regulations, and legislation. The external environment comprises exogenic factors that interact with the SF landscape.

Moreover, agents' instrumental behavior is coordinated such that the aggregate behavior becomes sufficiently regular (Arnsperger and Varoufakis 2006). This aggregation is guided by a set of relatively uniform and similar regulations that identify the division of distributed markets into different sectors at the regime level. The regime maintains a dynamically stable state by providing orientation and coordination for the activities of relevant actor groups. Social change occurs, and market participants act in their best interests based on both the predicted outcomes and the structure and history of the interaction. From a biological standpoint, attention has been paid to the organization of market dynamics within an evolutionary framework. In evolutionary finance (Farmer and Lo 1999b; Friedman 1991), participants' market interactions, the randomness of asset payoffs, and investment bias contribute to evolutionary finance's selection, retention, and differentiation mechanisms at the regime level (Evstigneev et al. 2009). Simultaneously, regime-level action is only a selection from a relatively narrowly defined set of legislated options (Wooten and Hoffman 2008), which can be identified as a landscape. In neo-institutional theory, institutions guide behavior and actors select it. Actors choose appropriate actions based on their self-interest, moral constraints, legal ties, and other factors. Institutionalized actions spread through actor networks and provide actors with templates for future action, resulting in self-evolution in the SF regime.

The micro dimension captures the importance of structural transformation for economic diversification and competition at the niche level, including the creative destruction of jobs and firms and financial changes to compensate for system deficiencies. Technical development (Nelson 2008) and financial innovation undertaken to deliver social benefits drive successful development. As new technical and financial development paradigms emerge, relevant symbiotic and independent financial market niches are built. Niche markets are important because they provide venues for learning processes that are essential for improving symbiotic and independent financial niche performance. Simultaneously, for financial attributes of SFAs, niche performance covers a wide range of estimators, such as price, system design, and expected return. Niche actors choose their responses based on the performances. Meanwhile, niche momentum grows as advantages accrue owing to superior niche performance, paving the way for further breakthroughs. This results in a radical shift at the regime level.

The potential transition pathways demonstrate that although the SFA has a partially symbiotic relationship with the social technological approach, it has its own independent evolution mechanics and features, making it a relatively complete system.

#### SFA-TAD on financial transition

As shown in Fig. 1, the SFA-MLP theory describes the transition trends and interactions among the levels. However, this perspective was unable to show the specifics of the transition process, such as the level in the SFA-MLP at which the transition occurred and which financial elements were the primary driving force at each time point. Although the red dotted arrows partially depict interactions and some of the key economic indicators involved are listed, this configuration is still too ambiguous. Therefore, this section proposes a new configuration with three axes to demonstrate the various system states of the entire transition process.

Similar to the MLP, the three-axis description (TAD) refers to complex systems theory from mathematics and physics, and the system evolves under a combination of the roles and rules of public policies of innovation (hence financial market implications) and evolutionary finance in response to endogenous and exogenous driving forces in social change evolution. With TAD, an analogy is drawn between the financial system and the biosphere, as both are complex adaptive systems in which participants evolve their adaptations to enhance interests, objectives, and goals, resulting in causality evolution and collective behaviors such as self-organization and emergence. Complex evolutionary phenomena can be found in the face of variability and uncertainty, from micro-to-macroscales, as well as the emergence of causation and transition patterns at higher levels from interactions between actors at lower levels. Moreover, many studies have adopted the idea of approaching society through the lens of physics to demonstrate the driving force and emerging phenomena of social dynamics (Castellano et al. 2009; Knebel et al. 2020). Notably, the driving force that forms a vector in the transition process can be viewed as an eigenvector, implying that the driving force carries important information at each time step. Therefore, this vector can be used as a pivotal handle for this transition. Therefore, we also referred to this description.

The system evolutionary phenomena and rules described above can be applied to more complex SF systems, and we propose a TAD approach to further develop the SFA-MLP approach, as shown in Fig. 2, where the axes of N, R, and L represent niches, regimes, and landscapes, respectively. The three axes move in different directions because, in most cases, the different levels operate independently under financial laws. However, as a transition occurs, the interactions between the levels become active, and the red dotted arrows between the two axes represent the dynamic processes. The existing regime

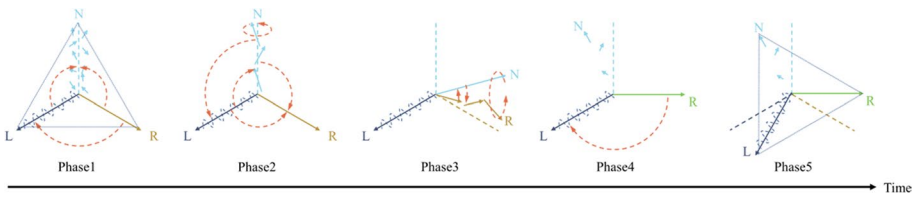


**Fig. 2** A three-axis description of a substitutional pathway

is dynamically stable at the beginning (Phases 1 and 2), as indicated by the straight brown arrows. Moreover, the dotted wavy line around the landscape axis indicates that the landscape is subject to regular macroeconomic volatility. New financial innovations have emerged at the niche level to fill this gap in the existing market. First, the three axes point in three completely different directions that are uniformly distributed in space and combine to form a tetrahedron that represents the entire system. The long solid arrows indicate that the related levels are stable and determinate. However, the broken arrows represent the uncertainty when a specific level changes, leaving its fixed state. We contend that when the transition occurs (Phases 3 and 4), certain levels represented by specific axes change first owing to external disturbances or intrinsic momentum accumulation, resulting in the overall instability of the tetrahedron. The rotation of the axes reveals the driving force and direction of hierarchical interactions. The axes break, rotate, and interact, causing the tetrahedron balance to collapse and complex dynamics to emerge within the system. The system achieves a new stable state through internal adjustments and external assistance during the transition process. Compared to the initial state, the three levels gradually return to a relatively independent status and form a new tetrahedron in a different direction (Phase 5). This may appear to be a physics-related phenomenon. The physical modeling of social phenomena is not a new concept.

At the same time, in the transition, the evolution of the financial system and adaptation is the process of constantly breaking the old equilibrium and establishing a new one, making the system's structure and characteristics more rational and improving market functions and efficiency (Hirshleifer 2015; Hens and Hoppe 2009). (1) Early transition period: Information transfer and resource allocation efficiency are in a dynamic equilibrium state of adaptation and coordination (stable tetrahedron). Capabilities of resource allocation and information adaptation are in the early stage of development, and participants learn to improve adaptive capabilities. Information flow and resource circulation among participants and between participants and the environment as well as environmental elements are progressing, and the system's structure and function are in dynamic equilibrium, requiring further improvements in market efficiency. In this phase, the system is directly or indirectly connected to the outside environment, often subject to external disturbances, and begins to evolve in terms of financial environmental conditions and strategies because of the inter-level interaction of pressure, innovation, expectations, and bias (Levin and Lo 2021). Prices also begin to have the initial ability to reflect as much information as possible, determined by environmental conditions and the number and nature of market participants, among others. During the early transition period, a single approach to resource allocation (dominated by policy intervention and supplemented by market mechanisms), weak synergies, incomplete information, institutional constraints, and limited rationality have debilitating effects on market efficiency. (2) Transition period: Information transfer and resource allocation efficiency are in a non-equilibrium state of adaptation and coordination (the stable tetrahedron is broken, and the interaction between the three axes is strengthened); resource allocation capacity and information and conception adaptability change dramatically, and participants continuously accumulate and improve their adaptive capacity. In this phase, the system is unstable, first due to external pressures that change a part, causing a dynamic evolution of non-equilibrium; then, the system relies on innovation, inter-level

interaction, participant adaptation, and the environment to enter a new equilibrium state (Nelson 2009). This iterative process evolves from equilibrium to non-equilibrium and then establishes a new equilibrium that drives the development and evolution of the entire system and its components. During the transition period, the number of participants changes from few to many, the connections between niches change from simple to complex, the types of participants evolve from a single type to multiple types, the financial environment is in a constant state of change, and the system is in a state of non-equilibrium in both structure and function and experiences a higher degree of market efficiency improvement. In addition, when the system is disturbed beyond the capacity of automatic regulation, it leads to the disruption of the equilibrium transition cycle and causes recession or even collapse. Therefore, uncertainty and variability give the financial system multiple evolutionary pathways and a guiding policy that requires attention to synergy and orderly evolutionary forces between all levels; otherwise, the system will enter a pathological state or trigger abnormalities and crises, resulting in an abnormal system structure and function and unmanageable market efficiency. (3) Reconfiguration period: Information transfer and resource allocation efficiency are in a relative equilibrium state of adaptation and coordination (a new stable tetrahedron is formed); the resource allocation capacity gradually produces optimal solutions; information and conception adaptation becomes stronger and stable; institutional turnover is sufficient; participants and social financial behavior are relatively stable in terms of adaptation; the financial system is in a relatively stable state; and market efficiency improvement is relatively complete (Grossman and Stiglitz 1980; Fama 1998). In this phase, the financial elements and components of the system maintain a certain proportional relationship with each other, forming a relative equilibrium, and the processes of participant evolution and institutional replacement tend to be relatively stable over a longer period, reaching a more rational structure, more efficient functions, and better social benefits.

## Transition pathway with an empirical case study: a radical change in the monetary system

In this section, the SFA framework is used to introduce a historical reflection on the radical change in the monetary system. Different factors are divided into different market levels, and the financial elements that work at different stages are outlined to better understand the entire process. We concentrated on a specific period in the twentieth century, the emergence of the Bretton Woods system. The case study outlines typical transition pathways, which validate that financial transitions and potential ways to manage market efficiency can be described and explained through the SFA framework.

### SFA-MLP of the emergence of the Bretton Woods system

Using the SFA-MLP approach, we examined the emergence of the Bretton Woods System. An avalanche change at the landscape level was a critical trigger of the transition—World War I & II (see Fig. 3). Avalanche change simultaneously affects multiple dimensions of the environment at the same time, causing the regime to collapse (Bordo 1993). The participating countries intervened in the domestic price levels during the war through massive borrowing and gold circulation restrictions. Without gold standard constraints, inflation soared. This made it impossible for them to return

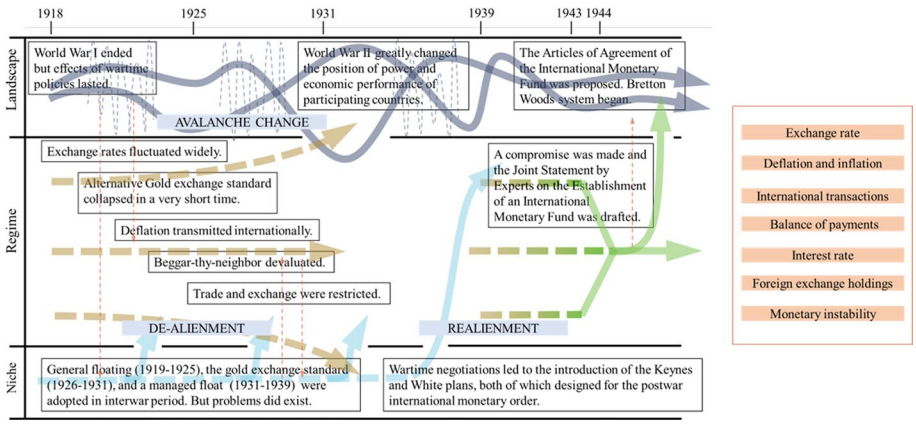


**Fig. 3** The transition pathway of the ascent of the establishment of the Bretton Woods System

to their gold standard after the war. General floating (1919–1925), gold exchange standard (1926–1931), and managed float (1931–1939) were used as alternatives during the interwar period. However, flaws were observed in all the systems. Interwar mistakes included widely fluctuating exchange rates, the collapse of the short-lived gold exchange standard, international deflation transmission, beggar-thy-neighbor devaluations, trade and exchange restrictions, and bilateralism (Bordo 1993). Although some of these perceptions and cognition were later challenged (Friedman 1953; Eichengreen and Sachs 1930s), they played an important role in the design of the Bretton Woods system. Therefore, a new monetary system capable of addressing the issues of adjustment, liquidity, and confidence was urgently required.

Changes in the landscape caused by World War II created opportunities for future international monetary order planning and bargaining. During the war, the United States and Britain began negotiating to establish a stable system. This study does not elaborate on the differences between White's plans and Keynes's plans from both countries as this is a competing and alienating process. The Joint Statement by Experts on the Establishment of an International Monetary Fund was published after intense negotiations. The Joint Statement served as a working draft at the Bretton Woods Conference and directly led to the International Monetary Fund's Articles of Agreement (Bordo 1993). The evolutionary dynamics of these stages directly influence pathways and evolutionary details.

This illustration depicts the dealignment of the classical gold standard as a result of an avalanche change in the landscape. The regime experiences various internal problems and is de-aligned. The vacuum causes various embryonic niche innovations to emerge. Owing to the lack of consistent rules, innovations were pursued in various directions over a relatively long period during the interwar period. Specific innovations may have an advantage at times but structural flaws in the system make its dominance fleeting, just as in the transition from general to managed floating. A consensus is gradually achieved after several turns of competition, coexistence, and decline. Common understanding improves niche innovation designs. Eventually, the design of the United States dominated the terms of the agreement, followed by a realignment around the design in a new regime.

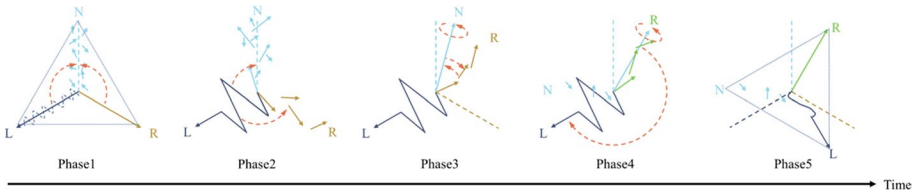


**Fig. 4** A three-axis description of a reconfiguration pathway

**SFA-TAD of the emergence of the Bretton Woods system**

The transition procedure using the SFA-TAD methodology is described in this section.

In Phase 1, the system is stable, as depicted by the tetrahedron formed by the three axes (Fig. 4). The current regime is dynamically stable, as indicated by the straight brown arrows. The routine macroeconomic volatility of the landscape is represented by a dotted wave around the landscape axis. However, structural flaws within the regime increase market return volatility, which negatively affects risk-averse investors. This may result in macroeconomic series exhibiting excessive volatility, which, when combined with other external structures or contexts, such as wars, cultural values, and environmental concerns, encourages the implicit emergence of visions for future improvement. Eventually, a consensus is reached regarding the design of future economic structures for landscape development. Simultaneously, radical innovations are generated in response to landscape pressure and tailored to existing regime problems. Efforts are directed in various directions, as represented by the short-circling arrows. None of them gained sufficient momentum to leave the niche; therefore, they remain positioned along the niche axis. In Phase 2, the zigzag arrow indicates a change in the avalanche activity at the landscape level. The regime is torn apart by drastic landscape changes. The influences are diverse, as demonstrated by extreme fluctuations and specific deterioration in the macroeconomic series. The regime experiences significant internal problems and de-alignment, as indicated by the relatively short, dispersed arrows. The absence of competition results in the emergence of numerous embryonic niche innovations. The diverse arrows of varying lengths represent long periods of coexistence, uncertainty, experimentation, and discovery. Iterations occur rapidly and frequently, similar to those of the interwar period. After several rounds of competition, coexistence, and decline, a consensus is gradually reached. A dominant design eventually gains sufficient momentum and emerges (Phase 3). The collapse of the regime also presents opportunities for this design to advance. Regime actors can also observe and facilitate this potential resolution through active negotiation and support. Because innovation is deeply ingrained in society, it serves as the foundation for related fields to establish appropriate regulations. Therefore, the regime arrows realign themselves around the niche arrows. In this transitional pathway, the initial regime may collapse completely. The realigning process occurs around the new dominant design to elevate this niche innovation to the regime level. In Phase 4, the niche axis rotates slightly, but broken regime arrows rotate significantly to support and surround the new niche axis. Realignment occurs, and the regime gradually returns to normal. As the regime stabilizes, this new regime aids in restoring the landscape, and

with minor adjustments, a new tetrahedron will emerge (Phase 5). At a given transition stage, evolutionary dynamics directly influence evolutionary details and affect the eventual transition pathway.

## Conclusion and policy implication

Modern society is financially parasitic, and the core issue of social change is achieving a synergistic evolution of social innovation with social elements. The essence and paradigm of evolutionary finance can be found by analyzing it from the perspective of social change and evolution. This study contributes to the literature by developing an SFA framework to analyze financial transitions and market efficiency. We argue that financial characteristics and efficiency co-evolve with financial transition and that market efficiency evolves in stages with financial transition. First, we proposed the SFA-MLP approach, which provides a "big picture" to accommodate the broader transition process and aids in explaining stability and change at the niche, regime, and landscape levels. The key concept of the SFA-MLP is that, in addition to the basic co-evolving framework of the SFA, interactions between different levels can be specified as financial element adjustments and trends in financial indicators. Appropriate adjustments to these elements can accelerate the transition. We also argue that in a financial transition, a highly adaptive and harmonious equilibrium is achieved among participants and between participants and the environment, with resources and information as a bond, driven by strategic policies and internal and external driving forces as well as interactions between levels. Market efficiency evolves in stages with the financial transition to maintain and promote equilibrium, and a new equilibrium is continuously established under appropriate policy guidance to achieve better structural, functional, and social benefits. Meanwhile, along with the financial transition, the adaptability, and attributes of participants (e.g., quantity and heterogeneity), environment, and information evolve dynamically in competition to promote market efficiency under policy guidance (e.g., cooperative adjustment of resource allocation by market and government intervention and the efficiency of information display and transmission) to achieve optimal resource allocation and create synergy between levels. Second, we further developed the SFA-TAD analytical framework to explicitly illustrate the interactions between different levels and identify the key processes of interactions between different levels to understand complex interactions in a relatively unified context. Furthermore, SFA-TAD focuses on slices at a point in time, and the movement of the axes clearly indicates the driving forces of each stage in the transition. We also argue that during the financial transition, the evolution of the system and the adaptation of participants, among other things, is a process of constantly breaking old equilibria and establishing new ones. With sufficient time and policy guidance, the system will evolve toward a more optimal financial composition, structure, and function, achieving optimal resource allocation in line with the laws of evolution. Meanwhile, at different phases of financial transition, information transmission and resource allocation efficiency are in dynamic evolutionary states of adaptation and coordination, and the state and degree of the need to improve market efficiency are also dynamically evolving. In addition, policymakers need to pay attention to orderly and coordinated policy guidance; otherwise, uncertainty will lead to the abnormal evolution of the system structure and function into a pathological state, triggering anomalies or even crises,

resulting in unmanageable market efficiency. In addition, the innovations of this study are as follows: first, the SFA framework and SFA-MLP and SFA-TAD approaches are established to analyze financial transition, characteristics, and efficiency evolution from an evolutionary perspective; second, appropriate and orderly policy recommendations can be provided for financial transition, characteristics, and efficiency management.

The conclusions are as followings:

We propose the SFA as a strategic problem-solving framework that focuses on financial transitions, characteristics, and efficiency. By applying the SFA framework, policymakers can deduce strategies, such as the exploration and exploitation of innovation processes that promote appropriate socially biased effects to guide evolutionary pathways, obtain details of innovation policies, and eventually design and develop new systems and mechanisms. We also propose the SFA-MLP approach to describe and explain the effective management of financial transition and market efficiency, which provides a "big picture" and demonstrates the image expression of the transition pathway using the SFA-MLP theoretical framework. Appropriate adjustments to financial elements, such as when the strategic landscape creates green (brown) finance and green (brown) markets (managing the evolution of development, competition, and selection at a particular stage of transition), can accelerate the transition process. For example, appropriate adjustments to the bank's green reserve ratio and green bond yield affect the expectations of carbon allowance policies to regulate carbon prices and the evolution of market characteristics in an appropriate transition period and accelerate the transition. Finally, the adaptation of participants and social financial behavior is guided by a combination of market and government interventions working together to ensure reasonable resource allocation efficiency and inter-level synergies to allow optimal resource allocation. The SFA-TAD analytical framework was further developed to explicitly illustrate the interactions between the different levels and identify the key processes of interactions between the different levels to understand complex interactions in a relatively unified context. Furthermore, SFA-TAD focuses on slices at a specific time point, and the movement of the axes indicates the driving forces at each stage in the transition period. Policymakers should remember that relevant regulations should be implemented in a specific order at an appropriate stage to make the adjustment of certain financial elements more efficient, such as when the strategic landscape initiates green (brown) finance and green (brown) markets (managing the evolution of development, competition, choice, etc., at a particular stage of transition). For example, the orderly implementation of free- and charge-based carbon allowances and certified emission reduction mechanisms for carbon pricing, as well as the orderly control of the issuance and proliferation rate of carbon or green bonds, influence the evolution of financial characteristics and efficiency at different transition stages. Finally, at different stages of the financial transition, the orderly regulation of resource allocation efficiency and synergistic evolution between all levels must be ensured so that the optimal allocation of resources is achieved. Finally, the proposed framework is demonstrated using a case study on the systematic organization and analysis of the creation of the Bretton Woods system. The SFA framework allows for the description of specific evolutionary processes

and drivers. For example, after the First World War, there was uncertainty in financial innovation under the pressure of exogenous drivers, whereas endogenous innovation ultimately led to a successful transition through complex interactions at different levels.

For the policy implication, in the evolutionary interaction between social change and financial transition, financial policy strategies need to be appropriately adjusted at different stages of transition to maintain a certain sequence of endogenous drivers. For example, the establishment of green (brown) finance and green (brown) markets, such as carbon markets, requires policies to promote proper regulation of carbon allowance and certified emission reduction and guide the sequential integration of carbon markets with carbon taxes, asset management, digital currency, environment, social, and governance policies to provide a suitable bias or preference. Some appropriate financial monitoring is also needed in parallel (Kou et al. 2021a, 2021b; Li et al. 2021). After several rounds of competition, coexistence, and decline, a consensus is gradually reached. However, policymakers should pay attention to the appropriate regulation of financial elements and the orderly control of exogenous drivers that exert pressure on the system to improve its evolutionary dynamics and adaptability (at a particular stage of the transition). For example, the design of China's carbon market and market mechanisms for carbon bonds or green bonds, as well as the progress in integrating green finance with carbon taxes, interest rates, global asset management, and foreign exchange rates, should be synchronized with the level of consensus and outcomes of the China-US, China–Europe, and global climate negotiations at different stages of transition. Finally, a smooth transition requires orderly strategies and appropriate regulations to adapt to new internal and external environments, balancing endogenous and exogenous drivers (managing the evolution of development, competition, and selection at a particular stage of transition). For instance, China's carbon market or emissions trading system allowance policy aims to carry out regional pilots first, followed by national unification, while mechanisms such as international pricing and settlement are determined and updated based on the outcomes of external negotiations. Finally, the adaptation of participants and social financial behavior can be improved through education and policy guidance; with the synergistic inter-level evolution under orderly regulation, market and government interventions work together to ensure the efficiency of resource allocation at different stages of financial transition to achieve the optimal allocation of resources.

The current study has several limitations. Since the evolutionary finance theory is still developing, the SFA framework, SFA-MLP, and SFA-TAD approaches need further refinement in line with the evolutionary finance development. We only evaluated the Bretton Woods system, and more cases need to be further developed to assess the SFA framework and two approaches.

Our efforts should be further refined, which means that the SFA-MLP and SFA-TAD approaches should search for more evolutionary mechanisms and mysteries in the resulting set based on historical data. Path prediction and further expansion should refer to research methods from other disciplines, such as ecology, complex systems science, physics, sociology, computer science, life science, philosophy, and data science. Moreover, in addition to the SFA-MLP and SFA-TAD approaches for

financial transition analysis in the SFA framework, new methods need to be explored to further investigate financial transition and market efficiency. In conjunction with the STA-MLP and SFA-TAD research frameworks, SFA can be broadly applied to other areas involving transition dynamics, thereby providing a new perspective.

**Abbreviation**

| | |
|---|---|
| SFA | Social financial approach |
| SFT | Social financial transition |
| MLP | Multi-level perspective |
| TAD | Three axis description |
| SFA-MLP | Social financial approach-multi level perspective |
| SFA-TAD | Social financial approach-three axis description |
| U.S. | United State |

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**Author contributions**
Conceptualization, XFW and YC; methodology, XFW; formal analysis, XFW, YS and YC; investigation, XFW and YS; resources, XFW and YS; data curation, XFW and YS; writing—original draft preparation, XFW and YS; writing—review and editing, XFW, JC and YC All authors have read and agreed to the published version of the manuscript.

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