Designing a Dynamic Model of Banking Services Sustainable Supply Chain Management Using System Dynamics (Case Study: Mehr Iran Bank)

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Abstract

Many service provider organizations have begun redesigning their strategies with a sustainable development approach. On their path toward providing sustainable banking services, banks are focused on redesigning banking services supply chain strategies. Nevertheless, banking services supply chain sustainability policy-making has received less inclusive, holistic and systemic attention. This study modeled and simulated banking services sustainable supply chain management using system dynamics approach in order to identify complexities and propose banking system sustainability policies. To this end, a banking service supply chain dynamic model was designed using data from Mehr Iran Bank, and after validation, simulation was conducted over a 10-year horizon. Considering the behavior of the variables and the sensitivity analysis of the model, some policies were identified in line with banking services supply chain sustainability, including economic, social, and environmental sustainability. Given the findings of the model simulation, the selected integrative policies were as follows: 1. Managing bank expenses through providing organizational agility; 2. Increasing efficiency of customer validation process and bank loan services monitoring; 3. Increasing commission incomes on banking services by allocating resources to development of electronic banking infrastructure; 4. Fulfilling employee empowerment and training programs; 5. Balancing the number of employees based on per capita payroll in a branch; 6. Increasing electronic services in order to improve accessibility to the bank; 7. Properly locating branches and ATMs; and 8. Raising customer awareness and promoting electronic services.

Keywords - Banking Services Supply Chain; Sustainable Supply Chain Management; System Dynamics; Mehr Iran Bank

INTRODUCTION

The importance of the service section is on the rise due to economic changes in the world. Nevertheless, from a scientific point of view, the main concepts of supply chain are still rooted in production, and service supply chain management has not yet been comprehensively and acceptably defined [1]. Service supply chain management is a tool utilized to predict, plan, execute,

and control the supply chain process with the aim of meeting customer needs in an efficient manner. On the other hand, the present era is a time when communities and customers expect organizations to be responsible, to take into consideration the society and future generations in their activities and operations [2], and to explicitly state the effects of their activities on society in various economic, social and environmental aspects, which doubles the need to pay attention to the issue of sustainability among organizations active in society [3]. Sustainable supply chain management is the strategic and transparent integration of three sustainability aspects toward realizing social, environmental, and economic goals [4]. Accordingly, many service providers with a sustainable development approach have redefined their organizational tasks. Among these organizations are banks that have taken a step toward sustainable banking by considering the concepts of sustainable development [5]. Sustainable banking is a subject deemed highly important throughout the world. Since the banking system is a major economic and financial intermediary, it has a significant influence on a diversity of stakeholders. In this regard, capturing the decisive factors of the banking industry's long-term survival seems to be the key to ensuring bank sustainability [6].

Banks are always competing for and assuming the top position and formulating strategies to improve their financial and operational processes; hence, identification and prediction of effective and efficient factors are deemed vital for leading the organization toward its long-term goals under complicated circumstances. Furthermore, the future Iran banking system will face graver system problems such as those with liquidity management and balance between deposits and loans, high rates of overdue claims, lack of transparency in bank financial statements, and destructive competition in raising bank interests [7]. Considering the decline of public trust in the banking system and the existence of a prevailing view held in society that banks only value themselves and their economic interests and ignore the interests of society on the one hand, and a significant reduction in bank shareholder profits on the other hand, necessitate a change in financing models from short-term speculations toward long-term and sustainable economic development [5].

Presently, a number of banks follow social and environmental indicators to some extent in order to present a proper image in the community, picturing banks as supporters of the environment and society; however, less attention is paid to economic indicators in terms of banking service supply chain sustainability, with none of the banks comprehensively considering the three aspects. Mehr Iran Bank is a social bank working in collaboration with large and governmental banks functioning without any business activities and with emphasis on Islamic banking and on empowerment of economic power of people at different levels of society.

Banks are focused on redesigning banking services supply chain strategies in an attempt to provide sustainable banking services. Nevertheless, banking services supply chain sustainability policy-making has received less inclusive, holistic and systemic attention. This study modeled and simulated banking services sustainable supply chain management using the system dynamics approach. To this end, the banking services sustainable supply chain dynamic model was designed using the system dynamics approach and Mehr Iran Bank's banking services supply chain sustainability development policies were presented, so that after a review of the literature on banking services sustainability, the banking services supply chain sustainability dimensions were structured and a dynamic system model was designed and simulated considering Mehr Iran Bank's data. The banking services supply chain sustainability policies were extracted based on the results of sensitivity analysis of the model and involvement of bank planning decision-makers.

RESEARCH BASICS AND THEORETICAL FRAMEWORK

Given the focus of the research on the system dynamics of sustainable supply chain management in this section, first a thematic review of the literature will be done and then the background of relevant studies will be addressed.

Services supply chain management: Services supply chain includes professional service providers, service integrators, end consumers, and chain members, who participate in the service process [8]. Services supply chain management is a tool used to predict, plan, execute, and control the supply chain process with the aim of meeting customer needs in an efficient manner [1].

Sustainable supply chain management: The present era is a time when communities and customers expect organizations to be responsible, to take into consideration the society and future generations in their activities and operations [2], and to explicitly state the effects of their activities on society in various economic, social, and environmental aspects, which doubles the need to pay attention to the issue of sustainability among organizations active in society [3]. Accordingly, given that sustainable supply chain management is a strategic and transparent integration of the three aspects of sustainability in order to achieve social, environmental, and economic goals [5], many service providers have redefined their organizational tasks with a sustainable development approach.

Background studies are conducted in three thematic areas, including supply chain management, sustainable supply chain studies, and models of banking services supply chain system dynamics. As for the banking services supply chain sustainability

studies, Mohaqer and Abbasi (2019) designed and explained the services supply chain sustainability model of Bank Mellat and identified the main dimensions and components of banking services supply chain sustainability and its presentation for implementation in the banking system [5]. Sadeghi Moghadam et al. (2015) measured the services supply chain sustainability of Parsian Bank using the design of multi-phase/multi-part fuzzy inference system [9]. Mansoori and Azar (2018) carried out configuration of services supply chain by employing a factor-based approach in Iran banking industry and made comparisons by simulating the most important output variables in 5 banks over a specific period of time [1]. Table (1) summarizes some of the selected studies on banking services sustainable supply chain.

TABLE 1
SUMMARY OF SOME STUDIES ON SUSTAINABLE SUPPLY CHAIN AND BANKING SERVICES

Researcher/Year	Objectives	Research Findings
Gianajis et al. (2016)	Sustainable supply chain risk management using the FMEA method	Identification of environmental, social, and financial/economic risks associated with sustainable supply chain [10].
Yip and Boken (2018)	Development of sustainable business models for banking industry	Presentation of sustainable models for Hong Kong banking industry [11].
Ecer, & Pamucar (2022)	Evaluation of bank sustainability performance	This paper designed a performance evaluation model for sustainable development of Turkish banks using multi-criteria decision-making models [12].
Galletta et al., (2022).	Gender diversity and sustainability performance in the banking industry	This study addressed the effect of female managers on the sustainability performance in the banking industry and, by using panel data model across 48 countries in the world and 880 instances, it demonstrated that female managers were interested in the social dimension and involvement with stakeholders more than male managers [13].
Muhammad, & Nugraheni, (2022).	Sustainability of Islamic banking human resources in Indonesia	This study proposed development of accounting and auditing curriculum for Islamic banking in higher education institutes in Indonesia to provide bank human resources sustainability [14].
Grinko (2019)	Evaluation of sustainable supply chain of banking deposit strategy in Russia and the European Union	Evaluation of supply chain sustainability for banks was formulated. The behavioral nature of variations was explored in stability of long-term and demand deposits during the world crisis the banks experienced. Results indicated a significant effect between bank supply chain and economic status [15].
Pakorar et al. (2019)	The effect of integrating supply chain and internal control on financial performance in Jordan's banking sector	Proposing a practical framework for banks and developing a tool for managers to determine the effects of internal and external integrations and internal control on financial performance [16].
Cao et al. (2019)	Financing preferences and performance for an emission-dependent supply chain: Supplier vs. bank	Regardless of the fact that investment in carbon reduction is taken into consideration, the suppliers' trade credit functions as a unique financial balance for manufacturers [17].
Nizam et al. (2019)	Effect of social and environmental sustainability on financial performance: Global analysis of the banking sector	This paper investigated the effect of access to financial resources and environmental financing on financial performance of the banking sector at a global level. Access to financial resources has several positive effects on financial performance of banks in most control estimation models for banks [18].

In reviewing banking services system dynamics modeling studies, Parvit and Hamrut (2010) presented an exploratory model of a dynamic system of coordinated execution of bank operations for the first time. This model is used as a scenario generator for modeling and dynamic analysis of exploratory system to analyze and deal with deep ambiguities about the subject and its modeling [19]. Hussein et al. (2017) modeled and simulated the system dynamics for e-banking in Egypt and designed a dynamic decision support system to improve the quality of e-banking services. The results of system dynamics showed that customer relationship management was a dimension that increased the quality of electronic services and customer satisfaction [20]. Mirzaei et al. (2018) designed a dynamic model of banking transparency system and indicated that revenues and expenses were the most important issues of an Iranian bank in managing bank transparency and the way out of them was transparent management of these two factors [21]. Nakazato and Kuhda (2019) analyzed the management behavior in the Japanese banking industry using system dynamics [23]. Faton and Mariana (2019) designed a dynamic model of the banking system assets-liabilities and proposed banking system's risk management policies [24].

In a study entitled "Simulation of Profitability Paradox in Iranian Commercial Banks", Bastan et al. (2019) designed and suggested a suitable solution for developing profitability and sustainable value creation for shareholders, changing the bank's business model from credit and loan structure to commission and revenue earning structure through providing bank customer service [25]. Paiva et al. (2020) identified a sustainability strategy in the banking industry using fuzzy cognitive maps and system dynamics to help decision makers analyze the dynamics of cause-and-effect relationships between the determinants of sustainable banking and long-term project scenarios [28].

RESEARCH METHODOLOGY:

This study modeled the dynamics of the banking services supply chain system in order to identify sustainability strategies for it. System dynamics methodology involves a number of steps. First Step: Problem identification and definition: The most important step in modeling is identifying and defining the problem (problem framing). Second step: Identification of dynamic hypotheses: When the problem is defined and an appropriate time horizon is determined for it, modelers propose hypotheses called dynamic hypotheses. Third step: One: conceptual model (causal loop diagram): After identification of dynamic hypotheses, development of the conceptual model (causal loop diagram) states the relationship between the phenomena. Third step: Two: Drawing the model's flow chart; Fourth step: Model simulation and validation. Fifth step: Defining different scenarios, and selecting and implementing the appropriate solution [29]. By applying these policies to the behavior model, the behavior of key variables was examined and finally the selected banking services supply chain sustainability management policies were presented. The model data were collected based on the documents and transparency reports of Mehr Iran Bank over 2011-2019 and the participation of decision makers and sustainable development planners from this bank.

ANALYSIS OF RESEARCH DATA AND FINDINGS:

Statement of the Problem: Based on the research problem, first, after reviewing the literature of the bank services chain and the dimensions of economic, social, and environmental sustainability, the key factors affecting the stability of the bank services chain were identified with the participation of Bank Iran Mehr planners. Then, the ten-year trend of the main variables of banking services supply chain was examined and the key variables were selected as reference variables. Accordingly, the structure of the banking services supply chain system was identified. Figure (1) shows the interaction between the components of the dynamic relationship model of the banking system sustainable supply chain. Given the stability dimensions and the identified subsystems of the model, using the bank's expert opinion, effective variables, i.e. endogenous and exogenous variables, as well as variables that do not play a significant role in the model dynamics, were extracted and the causal loop diagram was drawn
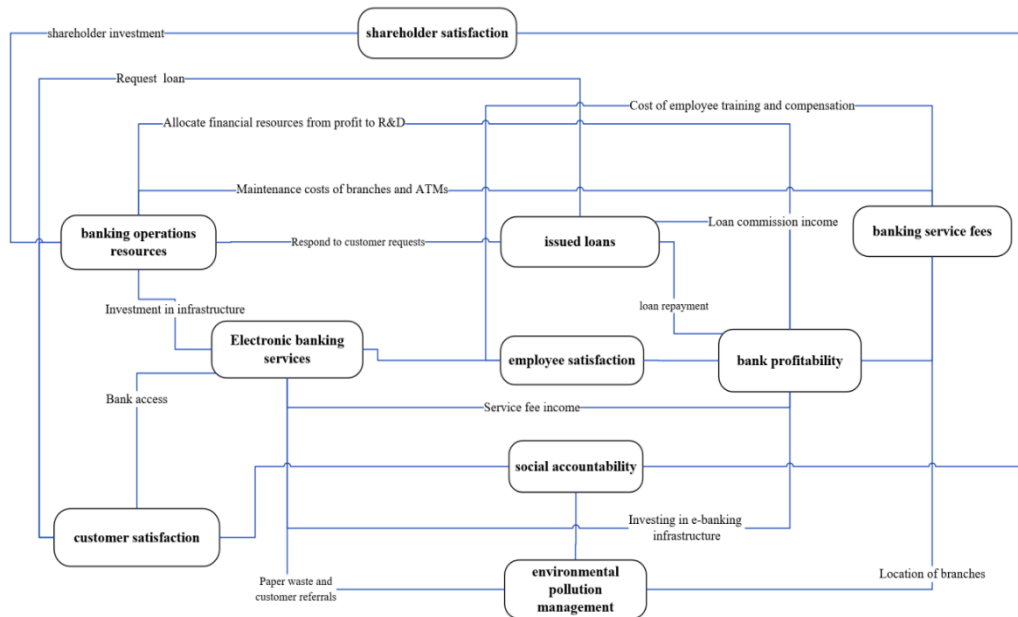

FIGURE 1
BANKING SERVICES SUPPLY CHAIN MODEL SUBSYSTEMS AND THE INTERACTION BETWEEN ITS COMPONENTS

CAUSAL LOOP DIAGRAM:

The literature and research background, as well as bank expert opinion, the behavior of reference variables, and fundamental behavioral patterns were used in dynamics in order to determine the causal relationships of the problem. Figure (2) illustrates the causal loop diagram of the banking services supply chain sustainability management dynamics. To raise the understanding of the system's complex structure, some of the model's loops are introduced and analyzed later in Table (2).
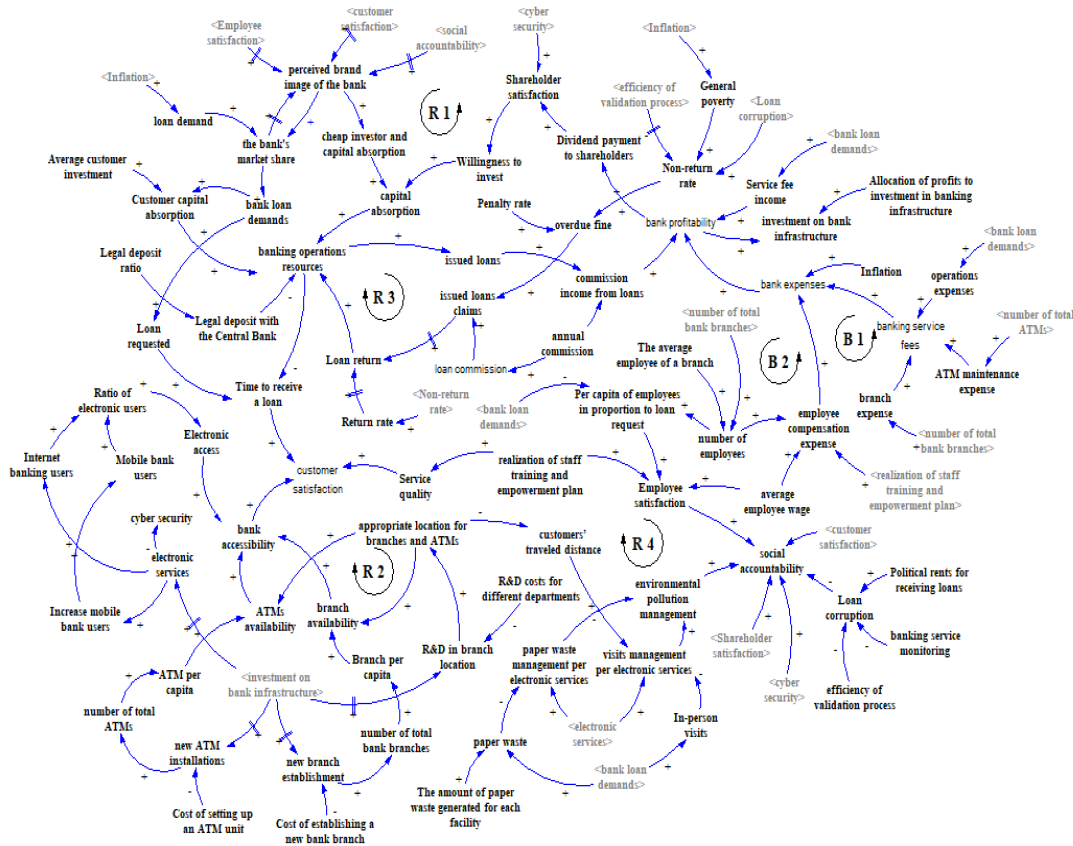

FIGURE 2

STATE-FLOW DIAGRAM OF BANKING SERVICES SUPPLY CHAIN SUSTAINABILITY DYNAMIC MODEL

The structure of the model's feedback loops was determined after drawing the causal loop diagram. Identification of new variables and parameters in addition to already identified variables in the causal loop diagram was required for simulation of the flow model so that calculation of the mathematical relations between the variables would be facilitated. To create the flow model, participation of experts and planners from Mehr Iran Bank and quantitative data and documentation from the bank were used. As illustrated in Figure (3), the stock flow model of banking services supply chain sustainable management is modeled based on the structure of sub-systems and the causal loop diagram. Table (3) presents some of the most important mathematical relations of the model.

TABLE 2
MATHEMATICAL RELATIONS OF BANKING SERVICES SUPPLY CHAIN SUSTAINABILITY MODEL VARIABLES

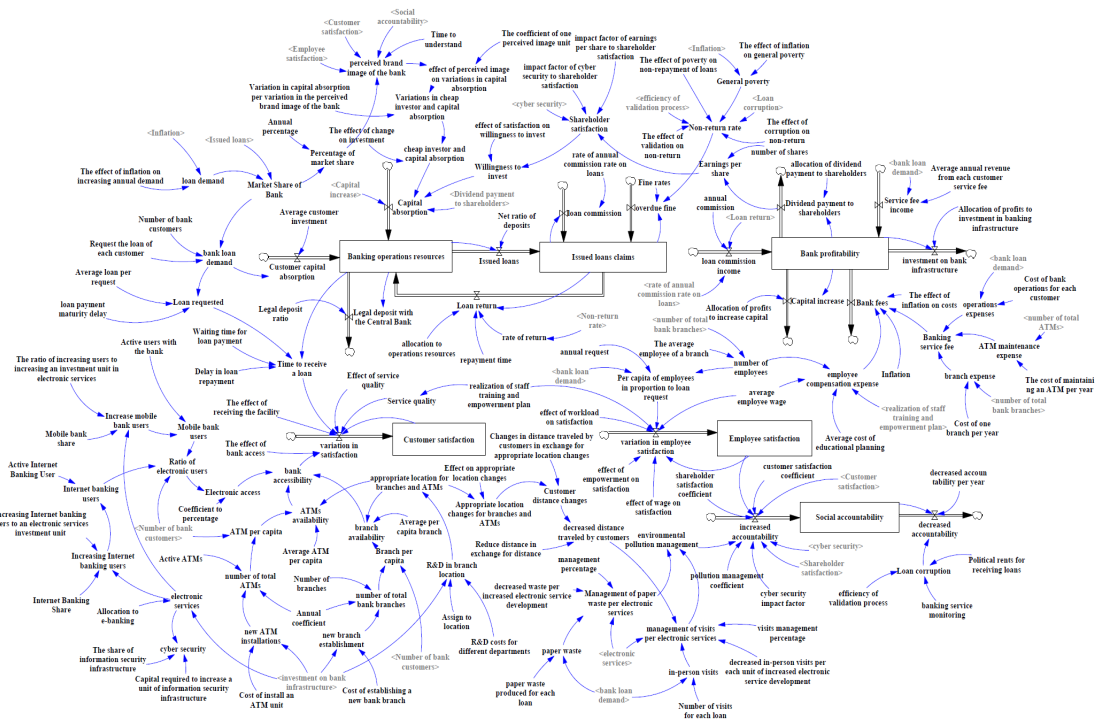| Reinforcing/Balancing Loop	Loop Description
Social Accountability Reinforcing Loop	increased social accountability - increased perceived brand image of the bank - increased cheap investor and capital absorption - increased capital absorption - increased banking operations resources - increased issued loans - increased commission income from loans - increased bank profitability - increased investment on bank infrastructure - increased R&D in branch location - increased appropriate location of branches and ATMs - decreased customers' traveled distance - increased visits management per electronic services - increased environmental pollution management - increased social accountability
Reinforcing loop of appropriate location for branches and ATMs	Increased appropriate location of branches and ATMs - increased branch availability - increased bank accessibility - increased customer satisfaction - increased social accountability - increased perceived brand image of the bank - increased cheap investor and capital absorption - increased banking operations resources - increased issued loans - increased commission income from loans - increased bank profitability - increased investment on bank infrastructure - increased R&D in branch location - increased appropriate location of branches and ATMs
Reinforcing loop of banking operations resources	Increased banking operations resources - increased issued loans - increased commission income from loans - increased bank profitability - increased investment on bank infrastructure - increased electronic services - increased paper waste management per electronic services - increased environmental pollution management - increased social accountability - increased perceived brand image of the bank - increased cheap investor and capital absorption - increased capital absorption - increased banking operations resources
Reinforcing loop of environmental pollution management	Increased environmental pollution management - increased social accountability - increased perceived brand image of the bank - increased effect of the perceived image on variations in capital absorption - increased cheap investor and capital absorption - increased capital absorption - increased banking operations resources - increased issued loans - increased bank's market share - increased bank loan demands - increased paper waste - increased paper waste management per electronic services - increased environmental pollution management
Balancing loop of employee compensation expense	Increased employee compensation expense - increased bank expenses - decreased bank profitability - decreased investment on bank infrastructure - decreased new branch establishment - decreased number of total bank branches - decreased number of employees - decreased employee compensation expense

FIGURE 3
STATE-FLOW DIAGRAM OF BANKING SERVICES SUPPLY CHAIN SUSTAINABILITY DYNAMIC MODEL

TABLE 3
MATHEMATICAL RELATIONS OF BANKING SERVICES SUPPLY CHAIN SUSTAINABILITY MODEL VARIABLES

Variable	Mathematical relations	Unit
Banking operations resources	INTEG (((loan return + capital absorption + customer capital absorption - issued loans - legal deposit with the Central Bank)), 297736)	billion rial
bank profitability	INTEG ((loan commission income + service fee income - capital increase - investment on bank infrastructure - bank fees- dividend payment to shareholders), 200000)	billion rial
Variations in cheap investor and capital absorption	variation in capital absorption per variation in the perceived brand image of the bank (effect of perceived image on variations in capital absorption)	dmnl
Loan return	DELAY1 (allocation to operations resources × issued loans claims × rate of return, repayment time)	billion rial/year
Customer capital absorption	average customer investment × bank loan demand	billion rial/year
Earnings per share	dividend payment to shareholders/number of shares	billion rial/year
Willingness to invest	shareholder satisfaction × effect of satisfaction on willingness to invest	dmnl
Market Share of Bank	issued loans/loan demand	dmnl
Shareholder satisfaction	((cyber security × impact factor of cyber security to shareholder satisfaction × impact factor of earnings per share to shareholder satisfaction))	percent
Capital absorption	(capital increase + (willingness to increase investment × dividend payment to shareholders) + (cheap investor and capital absorption)	billion rial/year
Loan commission income	loan return × rate of annual commission rate on loans × annual commission	billion rial/year
Dividend payment	bank profitability × allocation of dividend payment to shareholders	billion rial/year
Issued loan claims	(INTEG issued loans + overdue fine + loan commission - loan return, 225586)	billion rial
Banking service fee	branch expenses + ATM maintenance expenses + operations expenses	billion rial/year
Customer satisfaction	(INTEG variation in satisfaction, 50)	percent
Employee satisfaction	INTEG (variation in employee satisfaction, 60)	percent
Social accountability	INTEG (increased accountability - decreased accountability, 50)	percent
Increased accountability	(cyber security×cyber security impact factor)+(shareholder satisfaction×shareholder satisfaction coefficient)+ (customer satisfaction×customer satisfaction coefficient)+(employee satisfaction×employee satisfaction coefficient)+(environmental pollution management×pollution management coefficient)	percent/year
Loan corruption	political rents for receiving loans - banking services monitoring - efficiency of validation process	percent
Per capita of employees in proportion to loan request	bank loan demand × annual request/number of employees	request/person
Variation in employee satisfaction	employee satisfaction×((average employee wage × effect of wage on satisfaction) - (per capita of employees in proportion to loan request × effect of workload on satisfaction) + (realization of staff training and empowerment plan × effect of empowerment on satisfaction))	percent/year
Decreased accountability	loan corruption× decreased accountability × social accountability	percent/year
Service quality	realization of staff training and empowerment×0.8	percent
Environmental pollution management	(management of paper waste per electronic services + management of visits per electronic services)/2	percent
Management of paper waste per electronic services	(paper waste - (electronic services × decreased waste per increased electronic service development))/paper waste × management percentage	percent
Management of visits per electronic services	((((in-person visits-electronic services × decreased in-person visits per each unit of increased electronic service development)/(in-person visits × visits management percentage))+(decreased distance traveled by customers)))	percent
Paper waste	bank loan demand × paper waste produced for each loan	ton/year

To validate the model, structural and behavioral validity tests, including the model's structure and dimensions compatibility test, the integration error test, the boundary conditions test, and the behavior reproduction test, were performed in addition to gaining expert approval. For the model's behavior reproduction test, RMSPE, as one of the statistical methods of behavior approval, was calculated based on Equation 1. This index measures the root mean square of the difference between the actual

data (At) and the simulated data (St). This index must be smaller than 0.1 to approve the system behavior. Table (4) and Figure (4) illustrate the behavior reproduction test results of some model variables.

$$\text{RMSPE} = \sqrt{1/n \sum_{t=1}^{n} \left(\frac{St-At}{At}\right)^2} \qquad (1)$$

TABLE 4
BEHAVIOR REPRODUCTION VALIDATION TEST RESULTS OF SOME MODEL VARIABLES

| Indicator	2011	2012	2013	2014	2015	2016	2017	2018	2019	RMSPE
ATMs	178	323	554	670	711	845	971	969	940	0.04
Simulation	200	350	570	650	750	880	968	957	965	
Banking operations resources	11165	17346	24887	35732	46210	61498	110046	170364	297736	0.1
Simulation	10767	20766	30887	45165	56516	71678	126055	184571	283456	
Annual loans	8930	12606	16414	26570	29794	43469	82060	130432	225586	0.09
Simulation	8580	11964	15673	22830	26239	46798	84720	140627	209961	
mobile banking users	0	264	4665	14096	25573	49976	151701	366988	623176	0.07
Simulation	0	250	4500	15600	25400	41240	149560	358110	612980	
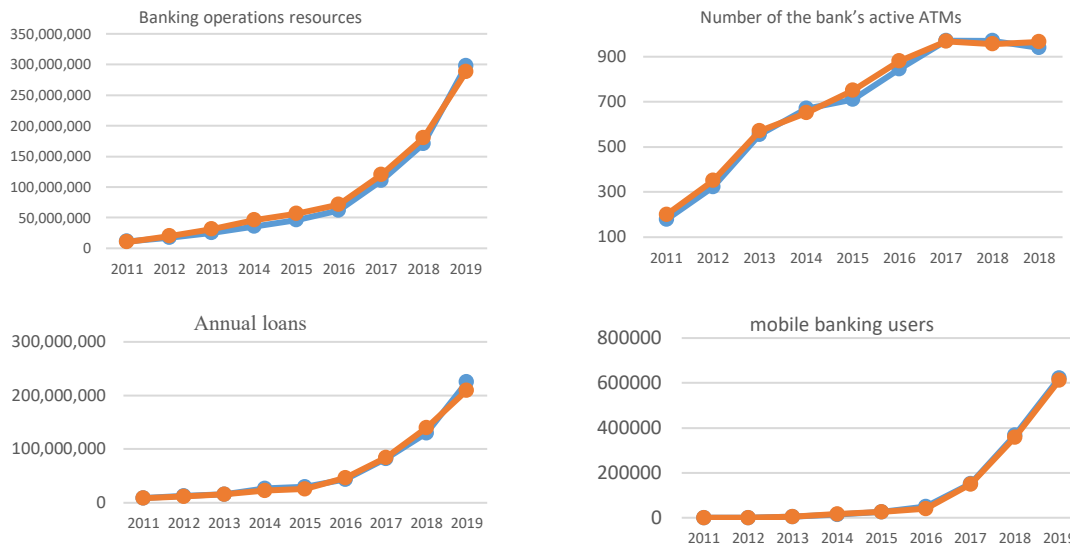
FIGURE 4
BEHAVIOR REPRODUCTION VALIDATION TEST RESULTS OF SOME MODEL VARIABLES

Given the performed calculations, RMSPE was obtained 0.08 in this simulation, which is smaller than 0.1 and confirms the model's behavioral validity. Figure (5) illustrates the behavior of the model's key variables after the initial simulation over the 10-year horizon.

SENSITIVITY ANALYSIS OF MODEL

Sensitivity analysis is the study of susceptibility of the calculated output variables to input variables of a mathematical model. Behavioral changes of the target variable in a sensitivity analysis indicate the model's sensitivity to values of exogenous variables. According to the results of the model sensitivity analysis, the variables causing the widest range of variations and the so-called leverage points of the model were identified. It is noteworthy that the model was considered to have very little or no sensitivity to other exogenous variables compared to the main target variable, including customer satisfaction.

POLICY-MAKING:

After reviewing the results of sensitivity analysis and finding the leverage points of the model and the purpose of modeling in this stage, three categories of solutions were identified with the help of relevant organizational data and participation of experts.
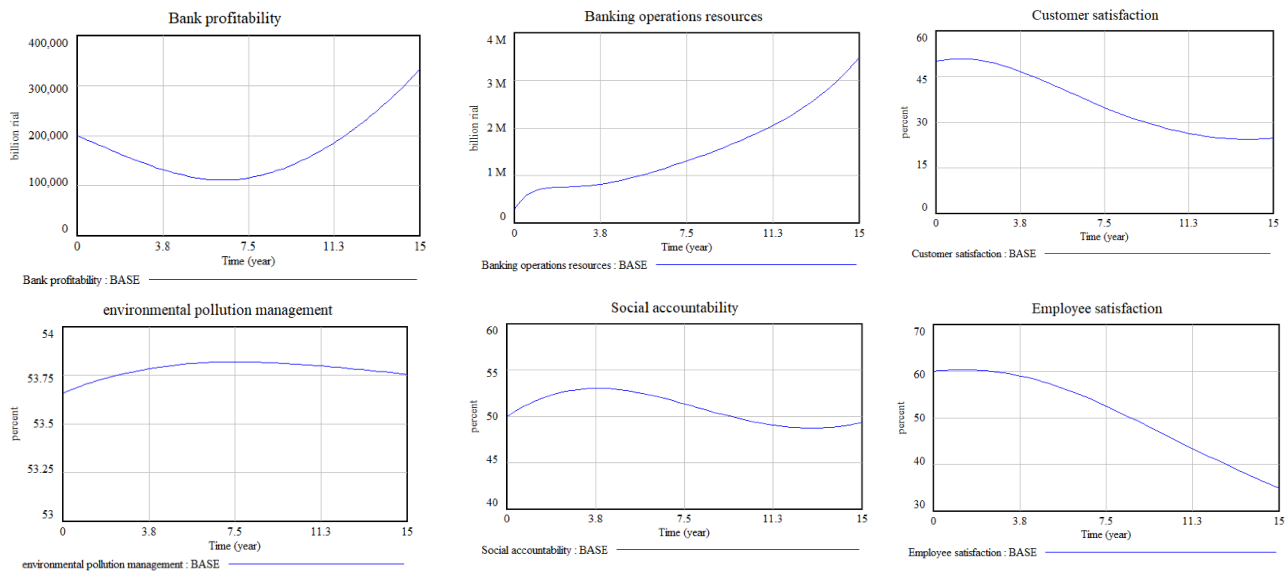
FIGURE 5
INITIAL SIMULATION OF THE MODEL'S KEY VARIABLES OVER THE 10-YEAR SIMULATION HORIZON

These solution categories included the banking services supply chain economic sustainability strategy, the banking services supply chain social sustainability strategy, and the banking services supply chain environmental sustainability strategy, each of which will be described in the following. Given the results of sensitivity analysis on exogenous variables of bank sustainability dynamic model, the sensitivity level of the model's target variable was measured considering the possible range of variations for each variable. Then the main and target variables of the model, including bank profitability, customer satisfaction, environmental pollution management, and employee satisfaction, showed a high level of sensitivity to variations in exogenous variables, including loan repayment time, realization of employee training programs, allocations from bank profit to investment on infrastructure, allocation of infrastructure's financial resources to electronic banking, and banking services monitoring in receiving loans. On the other hand, the model showed less sensitivity to other exogenous variables: Internet bank share, mobile bank share, annual commission fee, and average training planning expenses. Of course, such variations were explored within the possible and desirable range systematically, and must also be investigated for feasibility of implementation.

Over the next stages, the bank's planners and decision-makers were asked to identify systems that would lead to banking services supply chain sustainability taking into account the literature on the subject of bank sustainability and the model's sensitivity analysis results. The solutions proposed by these participants were later studied, and every banking system supply chain sustainability solution was measured eventually considering the relative agreement among bank experts; therefore, a set of desirable solutions were identified. It is noteworthy that the variations applied on the model were considered based on the scenario predicting the country's future baking system process. According to this scenario, no variations were made in the systematic structure of the banking system business, and the banking system supply chain sustainability was taken into consideration in line with the ongoing trend of macroeconomic variables. Hence, a set of desirable solutions from the perspective of bank supply chain sustainability were identified in three solution categories: economic sustainability, social sustainability, and environmental sustainability. The strategies, policies, and variations applied to the flow model will be addressed in details as follows.

BANKING SERVICES SUPPLY CHAIN ECONOMIC SUSTAINABILITY STRATEGY

In general, this strategy focuses on the bank's economic sustainability and on the bank's assets and expenditures, the first policy being provision of special mechanisms for collecting debts, leading to decreased overdue loan fees and increased loan repayment fees. In fact, a reduction in overdue debts of the bank increases its power to offer loans and results in increased banking operations resources. Modifying regulations, increasing provinces and branches' authority, and collecting debts in an incentive system, as well as activating collecting companies, could be considered as the executive mechanisms of this policy. The second policy is managing and reducing the bank expenses by providing process agility and also monitoring and controlling

the bank expenditures and expenses. In fact, paying attention to profitability and efficiency by revisiting the bank's internal processes and creating professionalism and agility makes one of the policies of this strategy so that it can lead to decreased bank expenses. The third policy concerns increasing the efficiency of the proper customer validation process in order to prevent overdue debts. The fourth policy was considered to be increasing commission incomes on banking services. Increasing the resources allocated to developing electronic banking infrastructure with the aim of increasing variety in the banking services offered to a customer results in increased commission incomes on banking services. The fifth policy of economic sustainability concentrates on competitiveness and cheap investor and capital absorption so that it makes the bank's financial resources economically sustainable based on increased shareholder willingness to invest and decreased shareholder willingness to withdraw deposits. Table (5) presents variations applied to the model under economic sustainability strategy.

BANKING SERVICES SUPPLY CHAIN SOCIAL SUSTAINABILITY STRATEGY

Generally, this strategy focuses on social sustainability with an emphasis on accountability and satisfaction of the key beneficiaries of the banking services. Accordingly, the first policy was considered increasing investment on customer information security infrastructure in order to increase cyber security and social accountability of the bank. The second policy concentrates on realization of employee training and empowerment programs in order to increase employee and customer satisfaction. The third policy addresses homogenization of the number of employees based on the average per capita of employees in a branch considering the amount of banking services offered in branches. The fourth policy prevents political rents and loan corruption by increasing monitoring on loan procedures in order to increase social accountability. The fifth policy paves the way for higher customer satisfaction by increasing electronic services to increase bank accessibility. Table (5) presents variations applied to the model under social sustainability strategy.

BANKING SERVICES SUPPLY CHAIN ENVIRONMENTAL SUSTAINABILITY STRATEGY

The banking services supply chain environmental sustainability strategy generally involves mitigating environmental risks stemming from banking services. To this end, the first policy is proper location of branches and ATMs to reduce the traveled distance for customers and increase bank accessibility. The second policy is raising customer awareness and promoting the bank's electronic services to manage in-person visits to the bank, and the third policy is considered managing paper waste by increasing electronic services of the bank. Table (5) presents variations applied to the model under environmental sustainability strategy.

The desired systemic and proportional values of the service supply chain of Mehr Iran Bank were identified, as can be seen in Table (5). Some of these changes are beyond the scope of one year in terms of operational feasibility; therefore, in order to implement the changes, changes applied to the model were adjusted in proportion to the rate of realization during the year using the banking system expert opinion and the goals of plans available in the organization, and these changes were made in the model. In the following, the results of the applied changes of each strategy are examined separately by applying the identified policies.

1. Banking Services Supply Chain Economic Sustainability Strategy: Model simulation in the form of identified policies: By applying the policy changes of this strategy to key economic variables such as bank operations resources and bank profitability, the simulation made little change until the seventh year, and after a slight upward trend from the twelfth year, a considerable upward trend can be seen; this suggests that this strategy leads to bank supply chain economic sustainability. On the other hand, it can be inferred from the improvements in social variables, such as social accountability, that due to the increase in loans paid to customers, social satisfaction was achieved and the increase in loan demands also refers to this issue. Applying this strategy did not significantly change shareholder and employee satisfaction states. In addition, the performance of the bank's environmental pollution management grew weaker; hence, this strategy alone does not lead to the bank supply chain sustainability.

2. Banking Services Supply Chain Social Sustainability Strategy: Model simulation in the form of identified policies: By applying the policy changes of this strategy to key economic variables such as employee satisfaction, social accountability was significantly improved. However, customer satisfaction and shareholder satisfaction behaved differently. Although improvement is observed in these two variables, the expected level of improvement is not achieved, which is due to the economic instability of the bank, evidently observed in bank profitability behavior. There is no significant improvement in environmental sustainability. Therefore, it can be concluded that the social sustainability strategy alone does not lead to the bank supply chain sustainability.

TABLE 5
SELECTED COMBINATION OF STRATEGIES OF BANKING SERVICES SUPPLY CHAIN MANAGEMENT

Strategy	Changes applied to the model	
Economic Sustainability	**Policy 1:** Developing special mechanisms for collecting debts	Applying depreciation factor of 20% of loan overdue fine
	Policy 2: Managing a 5% reduction in bank expenses through making agile processes as well as monitoring and controlling bank expenditure and expenses	Applying depreciation factor of 2% of agility and 2% of monitoring and control
	Policy 3: Quadrupling the efficiency of the customer validation process and monitoring bank loan offering services in order to prevent overdue debts	Applying quadruple increase in the efficiency of validation process and debt return over 2 years
	Policy 4: Increasing commission incomes on banking services: Tripling resource allocation to electronic banking infrastructure development in order to increase variety in banking services offered to customers	Increasing investment on bank infrastructure by a factor of 1.5 and doubling financial resources of electronic services
	Policy 5: Competitiveness in cheap investor and capital absorption based on increased shareholder willingness to deposit and decreased investor willingness to withdraw	Marketing and branding with the purpose of enhancing the perceived brand image of the bank and key shareholder satisfaction
Social sustainability	**Policy 1:** Doubling investment on customer's information security infrastructure in line with cyber security and social accountability	Applying incremental factor of 2 to investment on information security infrastructure over the 4-year plan
	Policy 2: Realizing employee empowerment and training programs to increase employee and customer satisfaction	Applying incremental factor of 50% to realization of training programs
	Policy 3: Balancing the number of employees based on the average employee per capita of a branch considering the load of banking services offered in branches	Applying incremental factor of 30% to the average number of employees in a branch
	Policy 4: Increasing monitoring over loan procedures in order to prevent political rents and loan corruption toward increasing social accountability	Applying incremental factor of 2 to monitoring banking services and depreciation factor of 50% to political rents over the 4-year plan
	Policy 5: Increasing banking services with the purpose of increasing bank accessibility in line with customer satisfaction	Increasing investment on bank infrastructure by a factor of 1.5 and doubling financial resources of electronic services
Environmental sustainability	**Policy 1:** Proper location of branches and ATMs toward reducing the traveled distance of customers and increasing bank accessibility	Doubling R&D financial resources for locating bank branches and ATMs
	Policy 2: Raising customer awareness and promoting bank electronic services to manage in-person visits to the banks	Investing on training and promotion in order to increase Internet bank and mobile bank users
	Policy 3: Managing paper waste by increasing banking electronic services	Reducing paper waste production for each loan issued by 10% and a 50% decrease per increasing investment by a factor of 1.5 on development of bank electronic services

3.Banking Services Supply Chain Environmental Sustainability Strategy: Model simulation in the form of identified policies: By implementing the policies of environmental sustainability strategy, given the focus of this strategy on reducing environmental pollution caused by bank in-person visits and paper waste, as well as the proper location of branches, the bank's environmental pollution management was properly improved. On the other hand, due to the increase in bank accessibility, we are witnessing an improvement in social accountability and customer satisfaction. Finally, due to the lack of improvement in profit and bank operations resources variables, this strategy alone will not provide the necessary function. Figure (6) illustrates

a graph comparing the behavior of the main model variables between the three strategies. As can be seen, the bank's profitability, employee and customer satisfaction, and pollution management charts suggest that none of the strategies alone will lead to services supply chain sustainability. Hence, a combination of strategies and policies was applied to the model, and finally the selected combination of policies was considered as the best policy, as will be described below.
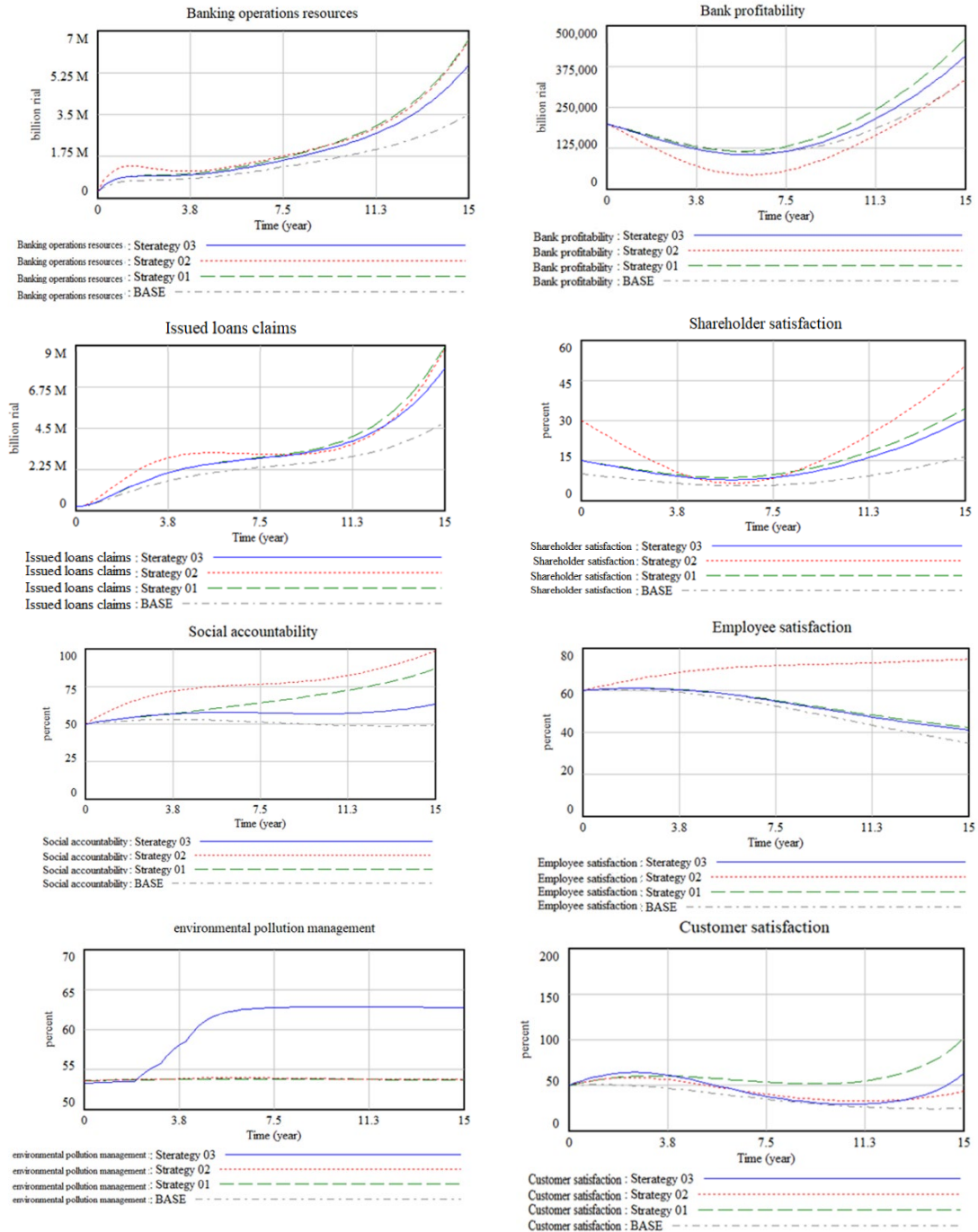
FIGURE 6
A COMPARISON BETWEEN BANKING SERVICES SUPPLY CHAIN SUSTAINABILITY STRATEGIES OVER THE SIMULATION HORIZON (2019-2029)

4. Selected Combined Strategies of Banking Services Supply Chain Sustainability:

As observed, each of the economic, social, and environmental sustainability strategies failed to fully sustain the bank's supply chain due to a focus on one subsystem. Banking services supply chain sustainability requires a combination of three strategies: economic, social and environmental. Then the combined strategies were applied to the model. The combined strategies, including a combined strategy of three solution categories were considered simultaneously. In general, the combination of policies of economic, social, and environmental sustainability strategies was found to be the best after comparison with the rest of combinations. In order to find a selection of hybrid policies in all the three strategies, the best policies that further improved the model variables were presented as the selected policies. Afterwards, the selected policies of banking services supply chain sustainability were presented after a test on the model. The behavior of the key variables of the model is presented in Figure (7). The policies of the selected strategy are defined in Table (6):

TABLE 6
THE SELECTED COMBINED POLICIES OF BANKING SERVICES SUPPLY CHAIN SUSTAINABILITY AND THE CHANGES APPLIED TO THE MODEL

Strategy	Policies	Applied changes
The combined strategies from selected policies	**Policy 1:** Managing a 5% reduction in bank expenses through making agile processes as well as monitoring and controlling bank expenditure and expenses	Applying depreciation factor of 2% of agility and 2% of monitoring and control
	Policy 2: Quadrupling the efficiency of customer validation process and monitoring bank loan offering services in order to prevent overdue debts	Applying quadruple increase in the efficiency of validation process and debt return over 2 years
	Policy 3: Increasing commission incomes on banking services: Tripling resource allocation to electronic banking infrastructure development in order to increase variety in banking services	Increasing investment on bank infrastructure by a factor of 1.5 and doubling financial resources of electronic services
	Policy 4: Realizing employee empowerment and training programs to increase employee and customer satisfaction	Applying incremental factor of 50% to realization of training programs
	Policy 5: Balancing the number of employees based on the average employee per capita of a branch considering the load of banking services offered in branches	Applying incremental factor of 30% to the average number of employees in a branch
	Policy 6: Increasing banking services with the purpose of increasing bank accessibility in line with customer satisfaction	Increasing investment on bank infrastructure by a factor of 1.5 and doubling financial resources for electronic services
	Policy 7: Properly locating branches and ATMs toward reducing the traveled distance of customers and increasing bank accessibility	Doubling R&D financial resources for locating bank branches and ATMs
	Policy 8: Raising customer awareness and promoting bank electronic services to manage in-person visits to banks	Investing on training and promotion in order to increase Internet bank and mobile bank users

The results of the selected strategy policies in comparison with the best combined strategies of the model are shown in Figure (7). Considering the behavior of the key variables of the model, it can be concluded that the selected combination of policies made the most improvement in the key variables of the three subsystems of the model. Therefore, they are introduced as Mehr Iran Bank's banking services supply chain sustainability policies.

Conclusions and Recommendations

Presently, a number of banks follow social and environmental indicators to some extent in order to present a proper image in the community, picturing banks as supporters of the environment and society; however, less attention is paid to economic indicators in terms of banking services supply chain sustainability, with none of the banks comprehensively considering the three aspects (Mohaqer et al., 2019). Mehr Iran Bank is a social bank working in collaboration with large and governmental banks functioning without any business activities and with emphasis on Islamic banking and on empowerment of economic power of people at different levels of society. This study modeled and simulated banking services sustainable supply chain management using the system dynamics approach. To this end, the dynamic model of banking services sustainable supply chain was designed using the system dynamics approach and supply chain sustainability development policies of Mehr Iran Bank. For this purpose, first, the system dynamics model was designed using the time series of bank data and the participation of decision makers, and after validation, the model was simulated over a ten-year horizon.

Considering the behavior of the variables and the model's sensitivity analysis over the simulation horizon, some policies were designed in line with banking services supply chain management in economic, social, and environmental sustainability aspects and were applied to the model both in separate and in integrative manners, and the results of comparisons and behaviors were then analyzed. According to the findings of the model simulation, by applying the policies of the first strategy to the system dynamics model, a sustainable improvement was created in the banking services supply chain to some extent, and the second strategy led to economic instability.

Given the level of social accountability and employee satisfaction, the second strategy provided the most improvement; however, as for customer satisfaction, the first strategy was given priority due to the amount of loans paid to customers. Pollution management will only improve with an environmental sustainability strategy. After that, due to the fact that each economic, social, and environmental sustainability strategy alone did not fully succeed in stabilizing the banking services supply chain sustainability, a combination of policies was applied to the model, and the selected combination of policies included the following: Policy 1- Managing a 5% reduction in bank expenses by making processes agile as well as monitoring the bank's expenditures and expenses; Policy 2 - Quadrupling the efficiency of the customer validation process and supervision of bank loan offers in order to prevent overdue debts; Policy 3 - Increasing the commission incomes from banking services: tripling resource allocation to development of electronic banking infrastructure in order to increase the diversity of banking services; Policy 4 - Implementing employee empowerment and training programs to increase employee and customer satisfaction; Policy 5 - Balancing the number of employees based on the average per capita of employees of a branch according to the volume of bank services provided in the branches; Policy 6- Increasing electronic services in order to increase bank accessibility toward customer satisfaction; Policy 7 - Properly locating branches and ATMs to reduce the distance traveled by customers and increase bank accessibility; and Policy 8 - Raising customer awareness and promoting electronic services in order to manage in-person visits to the bank. These were presented as the best policies for the banking services supply chain sustainability. In this study, an attempt was made to model and simulate the dynamics of banking services supply chain in order to find strategies for the sustainability of banking services, and to provide grounds for the development of banking services supply chain models.

Since the literature did not consider a system dynamics model of the banking services supply chain sustainability, there are no precise references to compare the results with. However, because the previous approaches generally focused on bank sustainability performance models using multi-criteria decision-making models or on economic or social dimensions in isolation using statistical analyses and also limited system dynamics, identification of banking services sustainability dynamics inclusively (economic, social and environmental sustainability) using a systemic approach and provision of policies based on banking services system dynamics model distinguishes this study from other studies. Considering that the researcher faced limitations in the research process and the fact that Mehr Iran Bank also provides special types of banking services, it is suggested that, in future research, a model be also developed according to the business dynamics of governmental and non-governmental commercial banks. In addition, the development of other strategies, such as agile supply chain strategy and lean supply chain in banking services supply chain, is also recommended for future research.

MANAGERIAL INSIGHTS

Banks do not directly contribute to sustainable development but play an undeniable role indirectly. The banking industry sustainability is highly relevant both for banking services supply chain sustainability and for economic sustainability. On the path toward sustainable banking and designing banking services supply chain strategies, identification of dynamics and complexities of sustainable banking system in an inclusive and holistic manner based on system dynamics modelling allows testing policies and their implications over time in addition to understanding banking services system sustainability complexities.
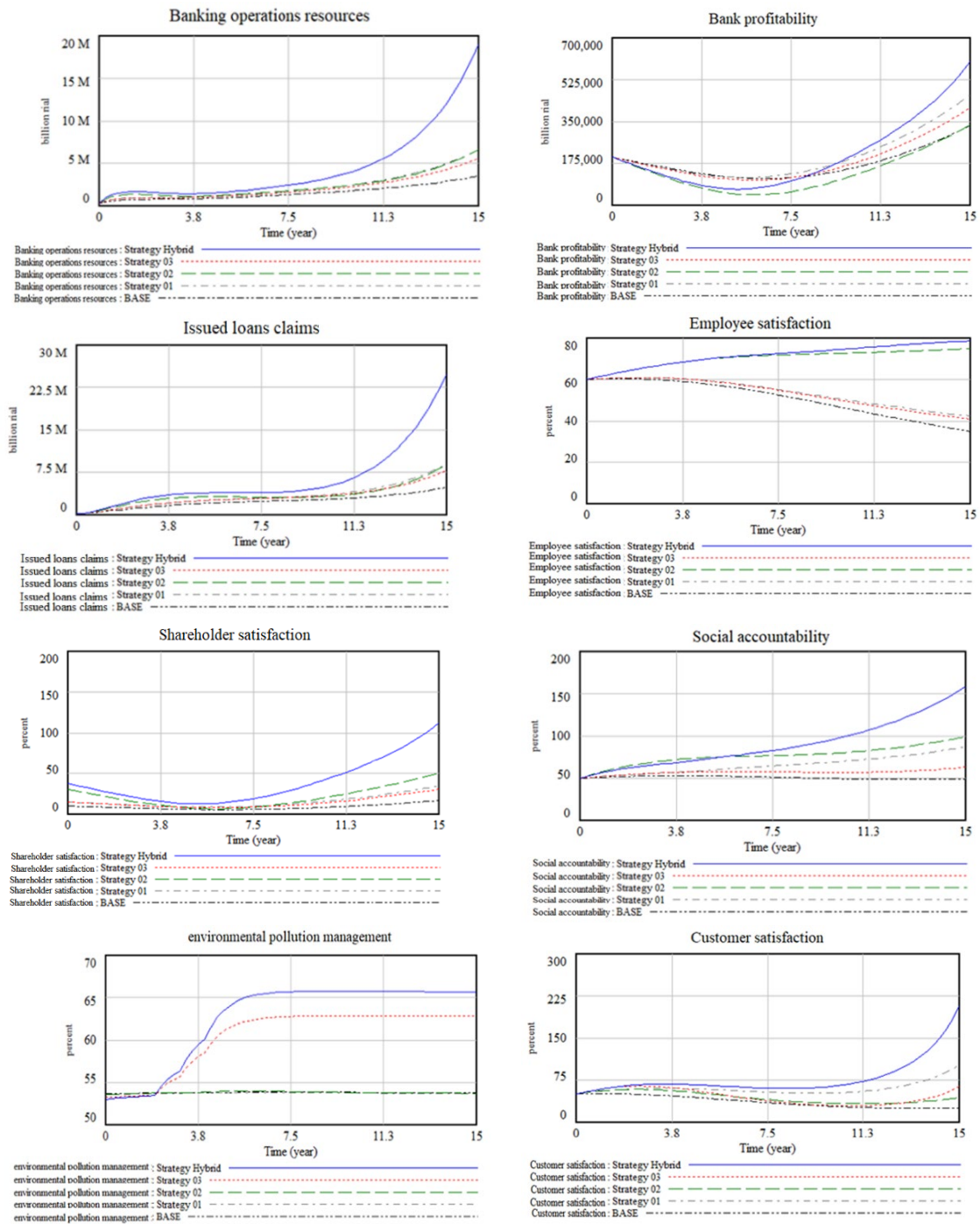
FIGURE 7
THE SELECTED COMBINED STRATEGIES OF BANKING SERVICES SUPPLY CHAIN SUSTAINABILITY COMPARED TO OTHER STRATEGIES

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