

The Role of Mergers and Acquisitions in Bank Performance

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ABSTRACT

This study aimed to evaluate the role of mergers and acquisitions in the performance of Iranian banks by examining their effects on two-stage efficiency, liquidity creation, potential merger synergies, and financial resilience. This applied descriptive-analytical study examined a selected sample of 32 Iranian public, private, and interest-free banks over approximately 2005/06–2025/26. Bank-level financial data were obtained from official banking statistics, published financial statements, the Central Bank of Iran, and the Statistical Center of Iran. Liquidity creation was measured using the Berger–Bouwman balance-sheet weighting approach. Bank efficiency was estimated through a two-stage network data envelopment analysis framework incorporating fixed assets, shared personnel and administrative expenses, deposits and interbank borrowing as intermediate products, desirable banking outputs, and undesirable credit-related outputs. Seven merger scenarios were analyzed, including state-owned, private, mixed-ownership, and the actual Bank Sepah consolidation. Potential post-merger efficiency was decomposed into scope/composition efficiency, size efficiency, learning efficiency, and coordination efficiency. Variance decomposition and impulse-response analysis were additionally used to assess macro-financial transmission and stress-related resilience. Post-merger liquidity creation improved in five of the seven scenarios, with the strongest increase observed in the Bank Sepah consolidation, where the index reached 2.31. Overall post-merger efficiency exceeded the performance of the weaker constituent banks in most scenarios and reached 0.89 in Scenario 2 and 0.78 in the actual consolidation scenario. The two-stage DEA results showed that pre-merger inefficiency was concentrated mainly in the first production stage and that post-merger gains depended on structural complementarity rather than consolidation alone. Variance decomposition indicated that the contribution of KHB to GDP fluctuations rose progressively to 65.58% by the tenth period, while the contribution of GDP's own shocks declined to 30.40%, confirming the growing macroeconomic importance of banking balance-sheet and liquidity conditions. Bank mergers and acquisitions can improve efficiency, liquidity creation, and resilience when participating institutions are structurally compatible and when stronger banks successfully transfer managerial, financial, and operational capabilities to weaker institutions; however, poorly matched mergers may transmit existing inefficiencies instead of eliminating them.

Keywords: Mergers and Acquisitions; Bank Performance; Two-Stage DEA; Liquidity Creation; Banking Efficiency; Bank Consolidation; Financial Resilience

Introduction

Mergers and acquisitions (M&As) have become one of the most consequential instruments of corporate restructuring, strategic expansion, market consolidation, and organizational transformation across contemporary economies. Firms pursue mergers and acquisitions for a wide range of reasons, including access to new markets, elimination of redundant capacity, acquisition of technological capabilities, improvement of competitive positioning,



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diversification of risk, enhancement of operational scale, and acceleration of growth. In financial industries, and particularly in banking, these motivations acquire additional importance because banks operate at the intersection of credit allocation, liquidity provision, payment systems, risk transfer, and monetary transmission. Accordingly, a merger between banking institutions cannot be evaluated merely as an ownership transaction; it represents a reconfiguration of balance sheets, production processes, managerial systems, customer relationships, risk structures, and financial intermediation capacity. Recent studies emphasize that the success of acquisitions depends considerably on the strategic logic underlying the transaction, the characteristics of the target institution, and the compatibility between the acquiring and target organizations. Target screening is therefore increasingly regarded as a critical determinant of acquisition success because inappropriate target selection can neutralize potential synergies before integration begins (1). At the same time, repetitive acquisition behavior may produce learning advantages, but such learning is not necessarily symmetric or rational, since managerial overconfidence and loss aversion can alter how organizations interpret prior acquisition outcomes and may contribute to inefficient successive transactions (2). These considerations are especially relevant to banking systems undergoing structural reform, where consolidation is frequently used to resolve inefficiency, reduce institutional fragmentation, and stabilize financially vulnerable banks.

The economic logic of M&As rests fundamentally on the expectation that the combined organization can generate greater value than the participating entities could produce independently. Such value may arise from economies of scale, economies of scope, managerial learning, more efficient use of assets, reduction of duplicated functions, stronger market power, improved financing conditions, or better allocation of organizational capabilities. However, the empirical literature consistently demonstrates that merger outcomes are heterogeneous rather than uniformly positive. In some industries, consolidation has been associated with greater efficiency and productivity, while in others the expected synergies have failed to materialize because of integration difficulties, organizational incompatibility, or deterioration in managerial discipline. Evidence from the pharmaceutical industry, for example, indicates that the relationship between merger activity and efficiency depends on the ability of the merged organization to reorganize its productive resources rather than on consolidation alone (3). Similarly, studies of continuous acquisitions suggest that repeated M&A activity may facilitate strategic growth but can also generate cumulative organizational complexity, integration fatigue, and inefficient allocation of managerial attention (4). These findings underscore a central issue in banking consolidation: a larger institution is not necessarily a more efficient one, and gains from size must be distinguished from gains arising from improved resource composition, technological compatibility, coordination, and managerial learning.

The strategic effects of mergers also extend beyond immediate cost reduction. One important stream of research has examined whether M&As strengthen innovative and technological capabilities. Acquisitions may provide firms with access to external knowledge, intellectual property, human capital, data, and technological infrastructure that would otherwise require substantial time and resources to develop internally. Empirical evidence in high-technology industries suggests that mergers and acquisitions can significantly reshape technological performance, although the direction and magnitude of this effect depend on post-merger integration and the ability to combine knowledge bases effectively (5). More recent research similarly indicates that technological acquisitions can enhance innovation performance when acquired capabilities complement the acquirer's existing resources (6). Reviews of technological M&As further emphasize that acquisition-driven innovation is not automatic but depends on absorptive capacity, integration strategy, organizational learning, and the preservation of critical technological resources after

the transaction (7). In highly concentrated digital markets, acquisitions may additionally become mechanisms for acquiring patents, data, technological expertise, and specialized employees, thereby reinforcing competitive power and creating long-term strategic advantages (8). Although banks differ from high-technology corporations, the same principles apply increasingly to financial institutions because modern banking performance depends heavily on digital infrastructure, risk analytics, payment technologies, data management, and information-processing capacity.

Human capital constitutes another major determinant of post-merger performance. M&As often create uncertainty regarding employee roles, career prospects, organizational identity, compensation systems, and managerial authority. If integration is poorly managed, the merged organization may lose key employees, experience declining morale, or encounter resistance to organizational change. Effective talent management during mergers is therefore regarded as essential for preserving tacit knowledge, maintaining operational continuity, and ensuring that expected synergies translate into actual performance improvements (9). Talent-oriented acquisitions raise additional strategic and regulatory concerns because the value of a transaction may derive less from physical or financial assets than from specialized employees and their knowledge. Such transactions can create lock-in effects and competitive concerns when employment arrangements are designed to prevent acquired talent from moving to rivals (10). In the banking context, these issues are particularly important because integration requires simultaneous coordination of credit assessment processes, risk-management systems, branch networks, accounting operations, information technologies, compliance structures, and customer-service functions. Consequently, improvements in post-merger bank efficiency may reflect not only asset consolidation but also the successful reallocation and integration of human and managerial resources.

Customer-related consequences of M&As must also be considered because consolidation can alter service accessibility, pricing, product diversity, branch availability, digital interfaces, and perceptions of institutional reliability. Research on customer loyalty following mergers and acquisitions shows that transaction success cannot be assessed solely through financial or operational indicators; customer retention and relationship continuity may substantially influence long-term performance (11). The same evidence suggests that the post-merger organization must preserve service quality, trust, and customer identification if it is to convert structural consolidation into durable market value (12). This issue is particularly relevant for banks because deposits constitute a primary input into financial intermediation, and changes in customer behavior can directly affect funding stability, liquidity, and lending capacity. A merger that improves cost efficiency but triggers deposit withdrawals or reduces customer confidence may therefore weaken liquidity creation and offset some of the expected efficiency gains. The performance implications of consolidation should thus be evaluated through multidimensional measures capable of capturing both production efficiency and financial intermediation outcomes.

The risks associated with mergers are equally multidimensional. M&A transactions expose organizations to valuation risk, operational integration risk, financing risk, cultural incompatibility, regulatory uncertainty, and the possibility that expected synergies are overstated. Risk modeling research emphasizes that merger outcomes depend on the interaction of financial and nonfinancial uncertainties and that these risks should be incorporated into acquisition assessment rather than treated as secondary post-transaction concerns (13). Behavioral and organizational factors can further amplify such risks. Cross-border M&A research, for instance, demonstrates that economic behavior, managerial perceptions, cultural factors, and institutional differences can influence transaction outcomes and create deviations from purely financial expectations (14). Managerial characteristics may also affect acquisition decisions. CEO narcissism has been associated with merger and acquisition activity, suggesting that

executive behavioral traits can influence both acquisition propensity and strategic decision-making beyond conventional financial determinants (15). Such findings are relevant to banking consolidation because merger decisions may be driven simultaneously by economic necessity, supervisory intervention, strategic ambition, and managerial incentives.

A related issue concerns the quality of information used before and after acquisition. Due diligence is intended to reduce information asymmetry by evaluating the target's assets, liabilities, legal exposures, earnings quality, accounting policies, and operational risks before transaction completion. Research on auditor switching during M&A due diligence suggests that auditor selection can affect the reliability of acquisition-related information and the assessment of target quality (16). Post-acquisition financial reporting is similarly important because consolidation changes accounting systems, reporting responsibilities, internal controls, and the comparability of financial information. Evidence indicates that the presence of common auditors across acquiring and target firms may influence post-acquisition financial reporting quality and facilitate information integration (17). In banking, where balance-sheet composition, asset quality, capital adequacy, liquidity structure, and off-balance-sheet exposures are central to regulatory assessment, the accuracy and comparability of financial information are especially important. Reliable reporting is therefore essential for evaluating whether post-merger improvements represent genuine gains in efficiency and liquidity creation or merely accounting aggregation.

Regulatory and legal considerations represent another central dimension of M&A policy. Consolidation can strengthen financial institutions, but it can also increase market concentration, reduce competition, intensify systemic importance, and create institutions that are more difficult to supervise or resolve. Competition authorities therefore frequently assess mergers according to their expected effects on market structure, consumer welfare, innovation, and barriers to entry. Comparative analysis of mergers involving digital automobile-marketplace platforms demonstrates that competition authorities in different jurisdictions may adopt different approaches toward market concentration and platform consolidation (18). Legal scholarship has also highlighted the possibility of predatory acquisitions, in which stronger firms acquire competitors or emerging rivals in ways that may weaken competitive dynamics rather than generate productive efficiency (19). Other legal analyses emphasize that acquisitions must be examined within broader frameworks of ownership rights, institutional authority, public interest, and lawful organizational restructuring (20). These concerns are particularly salient in banking because financial stability and competition objectives may sometimes conflict. A merger may reduce the probability of failure of a weak bank while simultaneously increasing concentration or creating a larger systemically important institution.

M&As may also result in divestment, abandonment, or restructuring of existing relationships after consolidation. Research shows that acquiring firms may dispose of relational assets following acquisitions when those relationships no longer fit the strategic configuration of the merged organization (21). In banking, analogous processes may include branch closures, termination of correspondent relationships, restructuring of lending portfolios, withdrawal from specific customer segments, and consolidation of overlapping business lines. Such adjustments can contribute to efficiency by eliminating duplication, but they may also disrupt established financial relationships and alter the spatial or sectoral allocation of credit. Therefore, the net effect of bank mergers must be evaluated in terms of both operational improvement and the ability of the combined institution to sustain effective financial intermediation.

The banking sector provides a particularly suitable setting for evaluating these competing mechanisms because bank performance cannot be captured adequately through profitability alone. Banks simultaneously mobilize

deposits, allocate credit, manage liquidity, absorb risk, generate payment services, and transform maturity structures. Consequently, a merger may improve one dimension of performance while weakening another. A consolidated bank may reduce administrative costs but become less effective in liquidity creation; alternatively, it may enhance lending capacity while inheriting a large volume of nonperforming assets. Conventional single-stage performance measures may therefore obscure the internal sources of post-merger change. A two-stage production perspective provides a more informative analytical structure because it distinguishes the process of mobilizing financial resources from the subsequent transformation of those resources into loans and income-generating assets. Within such a framework, merger gains can be decomposed into changes associated with size, resource composition, learning, and coordination between intermediate products and final outputs. This distinction is especially important when banks differ substantially in their pre-merger efficiency, asset quality, funding structure, and liquidity creation capacity.

The relevance of this issue is particularly pronounced in banking systems undergoing institutional restructuring. Bank consolidation is often introduced as a corrective response to undercapitalization, inefficient branch networks, weak governance, excessive operating costs, deteriorating asset quality, and chronic balance-sheet imbalances. Yet the effectiveness of this policy depends on whether the merged organization actually achieves better resource allocation rather than merely combining the deficiencies of its constituent institutions. Existing M&A research provides important insights into strategic selection, human-capital integration, technological capability, customer retention, due diligence, competition policy, and risk management, but comparatively less attention has been devoted to the simultaneous assessment of operational efficiency and liquidity creation in bank merger settings. Moreover, conventional efficiency analysis often treats the bank as a single production unit, thereby overlooking the internal linkage between deposit mobilization and credit transformation. This limitation is particularly consequential when a merger combines banks whose inefficiencies originate in different stages of the banking production process.

The Iranian banking system offers an important empirical context for addressing this gap. Over recent years, banking consolidation and institutional restructuring have gained increased policy significance as authorities have sought to address inefficiency, balance-sheet weaknesses, governance problems, and financial instability. The consolidation of several banking and credit institutions into Bank Sepah represents a particularly notable example of large-scale restructuring and raises broader questions about whether mergers can improve bank efficiency, liquidity creation, and resilience. At the same time, Iranian banks exhibit considerable heterogeneity in ownership structure, asset composition, lending orientation, operational scale, and financial performance. Such heterogeneity means that the expected consequences of consolidation are unlikely to be uniform across different combinations of institutions. A merger between two relatively efficient and structurally compatible banks may produce outcomes fundamentally different from a merger between several weak institutions or between banks with highly divergent production technologies and balance-sheet structures. For this reason, the evaluation of banking mergers should move beyond a binary distinction between merged and non-merged institutions and instead investigate alternative consolidation configurations, stage-specific efficiency, liquidity creation, and the decomposition of potential merger gains.

Accordingly, the present study integrates liquidity creation measurement with a two-stage DEA framework and merger-scenario analysis to provide a more comprehensive evaluation of banking consolidation. By distinguishing between resource mobilization and financial intermediation stages, incorporating shared inputs and undesirable outputs, and decomposing potential merger efficiency into scale, composition, learning, and coordination effects,

the analysis makes it possible to identify not merely whether a merger improves performance, but through which mechanisms such improvement occurs. In addition, examining liquidity creation before and after consolidation captures a dimension of bank performance that efficiency measures alone cannot adequately represent. The inclusion of both hypothetical and actual merger scenarios further allows the analysis to compare the consequences of alternative ownership combinations and structural configurations, while stress-related macroeconomic analysis provides an additional perspective on the possible implications of more efficient and better-coordinated banks for financial stability and economic transmission.

The aim of this study is to evaluate the role of mergers and acquisitions in the performance of Iranian banks by examining their effects on two-stage efficiency, liquidity creation, potential merger synergies, and post-merger financial resilience.

Methods and Materials

This study employed a descriptive-analytical and applied research design to investigate the role of mergers and acquisitions in the performance of banks operating in Iran. The descriptive dimension of the research involved collecting and organizing actual bank-level financial and operational data and examining the condition of the selected banks before and after actual or hypothetical merger arrangements. The analytical dimension was based on the estimation and comparison of liquidity creation, two-stage operational efficiency, and the potential efficiency gains attributable to different merger configurations. Accordingly, the study did not evaluate bank performance solely through conventional profitability or accounting indicators; instead, it adopted a production-oriented view of banking in which the transformation of financial resources, the generation of loans and operating income, the management of undesirable outputs, and the creation of liquidity were evaluated jointly. The study was also applied in nature because the findings were intended to provide evidence for banking-sector restructuring, merger decisions, efficiency enhancement, and improvement of the resilience of the banking system, thereby offering practical implications for banking executives, policymakers, regulators, and supervisory authorities. The statistical population consisted of banks operating within the Iranian banking system, with particular emphasis on banks for which sufficiently consistent financial statements and supervisory data were available during the study period. The observation period covered 2005/2006 to 2025/2026, corresponding to the Iranian years 1384 to 1404. The final analytical sample comprised 32 state-owned, privately owned, and interest-free lending banks selected on the basis of data availability and comparability across the observation period. Because complete longitudinal information was not equally available for all financial institutions, purposive availability-based sampling was used rather than random sampling. Each bank was treated as a decision-making unit, or DMU, in the efficiency analysis. The empirical strategy first estimated the liquidity-creation and efficiency positions of the banks prior to merger, after which banks exhibiting below-average efficiency were paired or combined with banks exhibiting above-average efficiency under a set of counterfactual merger scenarios. Seven merger configurations were evaluated. These included two mergers involving state-owned banks, namely Export Development Bank with Bank of Industry and Mine and Cooperative Development Bank with Bank Maskan; two private-bank combinations involving Iran Zamin with Mehr Iran and Tourism Bank with Sarmayeh Bank; two mixed public-private configurations involving Refah Bank with Bank of Industry and Mine and a multiple-bank combination involving Cooperative Development Bank, Tourism Bank, Day Bank, and Middle East Bank; and one merger reflecting an actual consolidation process centered on Bank Sepah, incorporating Bank Sepah, Hekmat Iranian Bank, Mehr Eqtesad Bank, Kosar Credit Institution, Ansar Bank, and

Ghavamin Bank. These scenarios made it possible to compare not only observed post-merger outcomes where an actual merger had occurred but also the potential efficiency consequences of hypothetical combinations involving institutions with heterogeneous efficiency, ownership, scale, and operating structures.

The study relied on secondary quantitative data extracted from officially published banking and macroeconomic sources, particularly the Central Bank of the Islamic Republic of Iran, the Statistical Center of Iran, audited financial statements, balance sheets, income statements, and other publicly available financial reports of the selected banks. A structured data-extraction framework was developed to ensure that balance-sheet and performance variables were defined consistently across banks and years. One of the principal measurement tools was the liquidity-creation index based on the approach developed by Berger and Bouwman. Under this approach, the balance-sheet and off-balance-sheet activities of each bank were classified according to their degree of liquidity and assigned weights reflecting whether banking activity created or absorbed liquidity. Assets were classified as liquid, semi-liquid, or illiquid. Liquid assets, including cash, claims on the central bank, claims on banks and credit institutions, participation securities and comparable securities, items in transit, and selected investments and participations, received a weight of -0.5 because transformation of liquid assets into less liquid claims constitutes the liquidity-creation function of banking, whereas holding highly liquid assets represents comparatively limited liquidity creation. Semi-liquid assets were assigned a weight of 0, while illiquid assets, including major categories of loans and receivables and other non-liquid assets, were assigned a weight of +0.5. On the liability side, highly liquid liabilities such as demand deposits, savings deposits, selected bank and central-bank liabilities, and items in transit received a weight of +0.5, semi-liquid liabilities received a weight of 0, and illiquid liabilities and equity were assigned a weight of -0.5. Off-balance-sheet activities associated with customer commitments, letters of credit, issued guarantees, managed funds, and comparable commitments were treated as liquidity-generating exposures and, where classified as illiquid, were assigned a positive weight of +0.5. Accordingly, the principal measure of liquidity creation was operationalized in plain-text form as: $\text{Liquidity Creation} = (0.5 \times \text{illiquid assets} + 0 \times \text{semi-liquid assets} - 0.5 \times \text{liquid assets}) + (0.5 \times \text{liquid liabilities} + 0 \times \text{semi-liquid liabilities} - 0.5 \times \text{illiquid liabilities} - 0.5 \times \text{equity}) + \text{the weighted contribution of eligible off-balance-sheet items}$. Because the classification originally proposed in the Berger-Bouwman framework was developed for a different banking environment, individual balance-sheet items were matched to the corresponding Iranian banking categories before the weights were applied. To improve comparability across institutions of different sizes, the liquidity-creation measure used in the empirical analysis was normalized relative to total bank assets. For each bank, average liquidity creation over the relevant period was divided by the corresponding average total assets. For simulated post-merger institutions, the balance sheets of the merging banks were consolidated, overlapping accounting categories were aggregated, and the liquidity-creation measure was recalculated for the combined entity before again being scaled by the merged bank's total assets.

Bank efficiency was measured through a two-stage network Data Envelopment Analysis framework designed to represent the internal production process of banking more explicitly than a conventional single-stage DEA model. Under this framework, each bank was considered a DMU and the banking production process was separated into a resource-mobilization stage and a financing or intermediation stage. The first stage captured the manner in which banking resources and operating inputs were transformed into intermediate products, while the second stage measured the conversion of those intermediate products into final desirable and undesirable outputs. Fixed assets were treated as primary inputs, whereas commercial deposits and interbank borrowing were treated as intermediate products connecting the two stages. Desirable final outputs consisted principally of loans and operating revenues,

with operating revenues incorporating both interest and non-interest income. Non-performing loans were treated as undesirable outputs because higher levels of delinquent or impaired lending represent deterioration rather than improvement in banking performance. Personnel expenses and operating expenses were specified as shared inputs used jointly by the two stages. Because these shared resources could not be allocated mechanically to only one stage, the model first estimated the optimal allocation proportions of common inputs between the deposit-generation and lending/output-production stages and subsequently calculated stage-specific and overall efficiency on the basis of these optimal allocations. In general terms, for bank j , first-stage inputs were denoted by h_{rj} , intermediate products by z_{kj} , desirable outputs by $Y = (y_{1j}, y_{2j}, \dots, y_{gj})$, and undesirable outputs by $U = (u_{1j}, u_{2j}, \dots, u_{Dj})$. Stage-one efficiency E_{1j} and stage-two efficiency E_{2j} were jointly optimized subject to the condition that neither stage could operate beyond the estimated production frontier. The initial fractional formulation was nonlinear because the allocation coefficients of the shared inputs entered multiplicatively with the corresponding DEA weights. It was therefore transformed into a linear programming problem by applying an appropriate scaling transformation in which a common normalization parameter t and transformed weights were introduced. In simplified form, the transformation defined new variables for the weighted shares of common inputs in the two stages, such as $\gamma_{1ij} = t \times \alpha_{ij} \times v_{ij}$ and $\gamma_{2ij} = t \times (1 - \alpha_{ij}) \times v_{ij}$, together with rescaled output, intermediate-product, and free-intercept weights. Solving the resulting linear program produced the optimal allocation of shared inputs and the efficiency score for each stage and for the overall banking production system. The network structure was particularly important in the merger context because it prevented an apparently efficient first stage from compensating mechanically for severe inefficiency in the second stage, or vice versa, and therefore provided a more informative assessment of where potential merger gains might originate.

The analytical procedure was conducted sequentially. First, descriptive statistics and longitudinal comparisons were used to characterize the financial and operational condition of the selected banks over the study period and to identify changes in liquidity creation, asset structure, intermediate products, desirable outputs, undesirable outputs, and operating resource utilization. Second, the Berger-Bouwman liquidity-creation index was calculated for each bank-year observation and then normalized by total assets to obtain a size-adjusted measure suitable for comparison across institutions. Third, two-stage network DEA was used to calculate stage-one, stage-two, and overall efficiency scores. The DEA specification accommodated intermediate products, desirable outputs, undesirable outputs, shared inputs, and heterogeneity in bank size. Where necessary, group or meta-frontier considerations were incorporated to reduce the possibility that scale differences between large and small banks would be incorrectly interpreted as pure managerial efficiency differences. The optimal shares of personnel and operating expenses allocated to each stage were estimated endogenously rather than imposed in advance. The linearized DEA model was solved separately for the relevant DMUs and periods, and efficiency scores were then compared with the sample mean to identify banks operating below and above the prevailing efficiency benchmark. These classifications formed the basis for constructing the merger scenarios. For each hypothetical merger, the accounting and operational variables of the constituent banks were aggregated to create a virtual merged DMU, while for the observed Bank Sepah consolidation, the relevant constituent institutions were combined in accordance with the actual merger structure. Liquidity creation was recalculated using the consolidated balance sheet, and the efficiency models were rerun for the post-merger virtual institution.

Potential merger efficiency was further evaluated using the merger-efficiency decomposition developed within the DEA literature. For a set K of banks assumed to merge into a single virtual DMU, overall merger efficiency was

represented by ME^K . The analysis distinguished several possible sources of merger gains rather than interpreting the total post-merger efficiency change as a homogeneous effect. Scale or size efficiency, denoted SIE, captured potential gains arising from movement toward a more favorable operating scale after the combination of the constituent institutions. Scope or mix efficiency, denoted SCE, captured potential gains arising from the improved composition of inputs and outputs in the newly created unit. Learning efficiency, denoted LE, represented the residual improvement obtainable by moving the merged institution toward best-practice performance after accounting for scale and composition effects. In addition, coordination efficiency, CE, was included because the study employed a two-stage production network in which intermediate products generated in the first stage must be appropriately aligned with the requirements of the second stage. Coordination efficiency therefore captured the potential gain generated by optimizing the quantity and allocation of intermediate products between the two stages. For each production stage, potential merger efficiency was expressed by $ME1^K$ and $ME2^K$, while stage-specific scope efficiencies were expressed by $SCE1^K$ and $SCE2^K$, and stage-specific scale efficiencies by $SIE1^K$ and $SIE2^K$. Learning effects were subsequently calculated as $LE1^K = ME1^K / (SCE1^K \times SIE1^K)$ and $LE2^K = ME2^K / (SCE2^K \times SIE2^K)$. Intermediate-product merger efficiency was represented by IME^K , and coordination efficiency was calculated as $CE^K = ME^K / IME^K$. Under constant returns to scale, the relationship $IME^K = ME1^K \times ME2^K$ was used to link the efficiency of the two stages. The overall potential efficiency of the merged banking system was finally decomposed as $ME^K = CE^K \times SIE1^K \times SCE1^K \times LE1^K \times SIE2^K \times SCE2^K \times LE2^K$. This decomposition made it possible to determine whether an observed or simulated efficiency improvement was attributable primarily to scale adjustment, a more favorable combination of banking resources, learning and movement toward best practice, or improved coordination of deposits and other intermediate products across the two-stage banking process.

The merger analysis followed an output-oriented interpretation in which the primary inputs of the virtual merged bank were initially held constant while the model evaluated the maximum feasible proportional expansion in intermediate and final outputs necessary for the merged DMU to reach the efficiency frontier. In the first stage, the intermediate products of the merged institution were projected toward the stage-one frontier without proportionately increasing its initial resource base. In the second stage, the model evaluated the extent to which the resulting intermediate products could generate higher desirable outputs while controlling for undesirable outputs such as non-performing loans. Scope-efficiency and size-efficiency programs were then solved for both stages to separate the contribution of input-output mix from the contribution of scale. The difference between attainable merger efficiency and the efficiency explained by scale and scope components was interpreted through the corresponding learning-efficiency term. Finally, the coordination component assessed whether the output of the first production stage was appropriately matched to the input requirements of the second production stage. This analytical architecture was particularly suitable for banking mergers because the economic benefits of consolidation may arise not only from the mechanical aggregation of assets, deposits, and branch networks, but also from the reallocation of shared resources, changes in operating scale, diversification of the input-output mix, improved use of intermediate funds, and reductions in managerial or technical inefficiency.

To complement the efficiency analysis, dynamic econometric techniques were used to examine the temporal relationships among merger status, liquidity creation, efficiency, and relevant bank-level performance indicators, thereby accounting for the persistence typically observed in banking outcomes and reducing the risk that post-merger differences would be interpreted solely as static cross-sectional effects. Lagged dependent variables and

relevant control variables could therefore be incorporated where required by the empirical specification, while diagnostic procedures were used to assess the statistical adequacy of the estimated models. The empirical analysis was conducted using EViews 10 for econometric estimation and specialized DEA procedures for the linear programming, network-efficiency, and merger-efficiency calculations. The final interpretation integrated three complementary dimensions of bank performance: changes in normalized liquidity creation, changes in stage-specific and overall technical efficiency, and the decomposition of potential merger gains into coordination, scale, scope, and learning components. This combined approach allowed the study to determine not merely whether mergers and acquisitions were associated with improved bank performance, but also through which operational mechanisms any improvement or deterioration emerged and whether the potential benefits differed across state-owned, privately owned, mixed-ownership, hypothetical, and actually implemented merger arrangements.

Findings and Results

The first stage of the empirical analysis examined the liquidity creation capacity of the sampled Iranian banks before implementing the proposed merger and acquisition scenarios. Liquidity creation represents one of the central functions of banking institutions because banks transform relatively illiquid assets into liquid or near-liquid claims and thereby support financial intermediation and the financing of economic activity. The liquidity creation index was calculated using the balance-sheet classification and weighting framework described in the methodology, with assets, liabilities, equity, and eligible off-balance-sheet items classified according to their degree of liquidity. Examining the index before consolidation was necessary for establishing a baseline against which the balance-sheet consequences of the subsequent merger scenarios could be assessed. The results revealed considerable heterogeneity across the banking system, indicating that the sampled institutions entered the merger simulations with markedly different capacities for producing liquidity relative to their asset structures. The calculated pre-merger liquidity creation indices for the approximately 2005/06–2025/26 study period are presented in Table 1.

Table 1. Liquidity Creation Index Before Merger, 2005/06–2025/26

Bank	Liquidity creation index	Bank	Liquidity creation index
Mehr Eqtesad	10.640	Iran Zamin	-0.083
Post Bank	1.098	Saderat	-0.062
Karafarin	0.676	Shahr	-0.093
Resalat	0.468	Sepah	-0.097
Mehr Iran	0.399	Melli	-0.122
Bank of Industry and Mine	0.367	Hekmat Iranian	-0.182
Sarmayeh	0.215	Refah	-0.199
Sina	0.169	EN Bank	-0.202
Export Development Bank	0.102	Middle East Bank	-0.202
Bank Maskan	0.074	Kosar	-0.228
Bank Keshavarzi	0.00075	Saman	-0.281
Tejarat	-0.016	Ayandeh	-0.284
Mellat	-0.008	Pasargad	-0.309
Ghavamin	-0.047	Tourism Bank	-0.317
Ansar	-0.049	Parsian	-0.328
Cooperative Development Bank	-0.080	Dey	-0.343

The pre-merger results demonstrate substantial dispersion in liquidity creation. Mehr Eqtesad recorded by far the largest value at 10.640, followed by Post Bank at 1.098 and Karafarin at 0.676. Resalat, Mehr Iran, the Bank of Industry and Mine, Sarmayeh, Sina, the Export Development Bank, and Bank Maskan also exhibited positive

liquidity creation, although at much lower levels. By contrast, a substantial proportion of the banking institutions recorded negative values. Dey, Parsian, Tourism Bank, Pasargad, Ayandeh, Saman, Kosar, EN Bank, Middle East Bank, Refah, Hekmat Iranian, Melli, Sepah, Shahr, Iran Zamin, the Cooperative Development Bank, Saderat, Ghavamin, Ansar, Tejarat, and Mellat exhibited negative liquidity creation indices of varying magnitudes. This wide dispersion indicates that the initial balance-sheet capacity of the banks to transform funding into liquidity-generating assets was highly heterogeneous. It also implies that the effect of a merger cannot be inferred merely from the number or size of the participating institutions, because consolidation between banks with complementary balance-sheet structures may improve liquidity creation, whereas the aggregation of several liquidity-weak banks may reproduce or even intensify existing weaknesses.

The second part of the analysis evaluated two-stage banking efficiency before consolidation. The DEA framework decomposed banking activity into an initial resource-mobilization stage and a subsequent financial-intermediation stage. Fixed assets constituted a first-stage input, while administrative and personnel expenses were treated as shared inputs allocated equally between the two stages in the empirical implementation. Deposits and interbank borrowing operated as intermediate products linking the first and second stages. Loans and advances, income from lending, and income from investments and deposits were treated as desirable outputs, while overdue, delinquent, and doubtful receivables and the specified adverse income component were incorporated as undesirable outputs. The decomposition therefore permitted the source of inefficiency to be identified rather than reducing bank performance to a single-stage aggregate measure. Table 2 reports the estimated pre-merger efficiency scores for the complete sample.

Table 2. Two-Stage Efficiency Before Merger, 2005/06–2025/26

Bank	Mean efficiency	Stage 1	Stage 2	Bank	Mean efficiency	Stage 1	Stage 2
Bank of Industry and Mine	0.63	0.37	0.90	Export Development Bank	0.41	0.20	0.62
Ghavamin	0.56	0.12	1.00	Middle East Bank	0.41	0.11	0.71
Mehr Eqtesad	0.56	0.13	0.98	Saderat	0.38	0.25	0.50
Mehr Iran	0.54	0.09	0.99	Tejarat	0.37	0.16	0.59
Pasargad	0.50	0.15	0.86	Karafarin	0.36	0.10	0.62
Parsian	0.48	0.31	0.66	Sina	0.36	0.17	0.54
Ayandeh	0.48	0.49	0.47	Shahr	0.36	0.22	0.49
Mellat	0.47	0.24	0.69	Resalat	0.35	0.09	0.62
Melli	0.46	0.30	0.61	Iran Zamin	0.32	0.21	0.44
Sarmayeh	0.46	0.47	0.45	Dey	0.28	0.17	0.40
Kosar	0.45	0.12	0.78	Saman	0.26	0.15	0.37
Post Bank	0.43	0.12	0.74	Ansar	0.25	0.05	0.46
Bank Keshavarzi	0.41	0.16	0.65	Tourism Bank	0.24	0.13	0.35
Bank Maskan	0.42	0.32	0.52	Refah	0.24	0.10	0.39
Hekmat Iranian	0.42	0.06	0.77	Sepah	0.23	0.08	0.39
EN Bank	0.41	0.17	0.64	Cooperative Development Bank	0.21	0.06	0.35

The full-sample estimates indicate a pronounced degree of efficiency heterogeneity. The Bank of Industry and Mine recorded the highest average efficiency at 0.63, whereas the Cooperative Development Bank recorded the lowest value at 0.21. A particularly important pattern was the recurrent discrepancy between the two production stages. Ghavamin, Mehr Eqtesad, Mehr Iran, Kosar, Post Bank, Hekmat Iranian, Middle East Bank, and several other banks exhibited relatively low first-stage scores but substantially stronger second-stage results. Ghavamin, for example, recorded a first-stage efficiency of only 0.12 but achieved full second-stage efficiency of 1.00, while

Mehr Iran recorded 0.09 in Stage 1 and 0.99 in Stage 2. Such results indicate that weaknesses were concentrated primarily in the mobilization and utilization of initial resources rather than in the transformation of accumulated resources into final banking outputs. Conversely, Ayandeh and Sarmayeh displayed relatively balanced scores across the two stages, with Ayandeh recording 0.49 and 0.47 and Sarmayeh 0.47 and 0.45, respectively.

When the efficiency frontier was recalculated separately for state-owned banks, the relative performance levels increased considerably because those banks were benchmarked only against institutions within the same ownership group. Under this specification, Bank Maskan recorded mean, Stage 1, and Stage 2 efficiencies of 0.90, 0.84, and 0.96, respectively; the Bank of Industry and Mine recorded 0.87, 0.77, and 0.97; Melli recorded 0.82, 0.74, and 0.89; Post Bank recorded 0.77, 0.57, and 0.96; Sepah recorded 0.71, 0.56, and 0.86; Bank Keshavarzi recorded 0.69, 0.49, and 0.88; the Export Development Bank recorded 0.67, 0.58, and 0.75; and the Cooperative Development Bank recorded 0.60, 0.34, and 0.80. These ownership-specific results show that state-owned institutions generally performed more strongly relative to other state-owned banks than when evaluated against the entire banking sample. They also indicate that the principal weakness of the less efficient state-owned institutions remained concentrated in Stage 1.

The private-bank frontier likewise produced a different ranking. Mehr Eqtesad recorded mean, first-stage, and second-stage efficiencies of 0.70, 0.42, and 0.98; Ghavamin 0.68, 0.37, and 1.00; Ayandeh 0.63, 0.69, and 0.58; Mellat 0.63, 0.50, and 0.75; Parsian 0.59, 0.48, and 0.70; Pasargad 0.58, 0.28, and 0.88; Tejarat 0.56, 0.40, and 0.72; Saderat 0.55, 0.44, and 0.66; Mehr Iran 0.53, 0.072, and 0.99; Sarmayeh 0.49, 0.49, and 0.49; Kosar 0.48, 0.17, and 0.80; EN Bank 0.47, 0.27, and 0.67; Shahr 0.46, 0.37, and 0.55; Middle East Bank 0.42, 0.11, and 0.72; Hekmat Iranian 0.40, 0.03, and 0.78; Karafarin 0.40, 0.09, and 0.74; Iran Zamin 0.38, 0.29, and 0.46; Resalat 0.37, 0.12, and 0.63; Sina 0.36, 0.14, and 0.56; Dey 0.36, 0.29, and 0.43; Refah 0.35, 0.24, and 0.46; Saman 0.32, 0.23, and 0.40; Tourism Bank 0.32, 0.26, and 0.37; and Ansar 0.31, 0.15, and 0.47. The private-bank results therefore reinforce the conclusion that Stage 1 constituted the main source of inefficiency for many institutions. The striking discrepancies observed for Mehr Iran, Hekmat Iranian, Karafarin, and Middle East Bank demonstrate that relatively strong second-stage financial intermediation did not necessarily compensate for weak initial resource management.

The two-stage structure underlying these estimates conceptualized fixed assets as the main Stage 1 input; personnel and administrative expenses as shared inputs; deposits and interbank borrowing as intermediate products; and lending, lending income, investment and deposit income, nonperforming receivables, and the specified undesirable financial outcome as final outputs. The analytical innovation of this framework was therefore not merely the computation of an aggregate efficiency measure, but the explicit treatment of shared inputs, undesirable outputs, intermediate products, and potential merger performance within a network production structure.

Because both liquidity creation and two-stage efficiency differed substantially across institutions, seven merger scenarios were designed to examine whether alternative combinations of banks could produce different post-merger performance outcomes. The scenarios included state-owned combinations, private combinations, mixed public-private combinations, and the actual large-scale consolidation into Bank Sepah. Their composition is shown in Table 3.

Table 3. Merger Scenarios Based on Pre-Merger Efficiency Characteristics

Scenario	Ownership structure	Participating banks
1	State-owned	Export Development Bank and Bank of Industry and Mine

2	State-owned	Cooperative Development Bank and Bank Maskan
3	Private	Iran Zamin and Mehr Iran
4	Private	Tourism Bank and Sarmayeh
5	State/private	Refah and Bank of Industry and Mine
6	State/private	Cooperative Development Bank, Tourism Bank, Dey, and Middle East Bank
7	Actual consolidation	Sepah, Hekmat Iranian, Mehr Eqtesad, Kosar, Ansar, and Ghavamin

The first two scenarios examined consolidation within the state-owned banking segment. Scenario 1 combined the Export Development Bank with the Bank of Industry and Mine, while Scenario 2 combined the Cooperative Development Bank with Bank Maskan. These scenarios were designed to determine whether stronger state-owned institutions could compensate for weaker operational stages in other public banks. Scenarios 3 and 4 focused exclusively on private banks, combining Iran Zamin with Mehr Iran and Tourism Bank with Sarmayeh, respectively. Because these institutions differed in both liquidity creation and stage-specific efficiency, the private scenarios provided an opportunity to assess whether operational complementarity could offset initial performance asymmetry.

Scenarios 5 and 6 deliberately combined institutions with different ownership and operational structures. Scenario 5 linked Refah with the Bank of Industry and Mine, whereas Scenario 6 combined the Cooperative Development Bank, Tourism Bank, Dey, and Middle East Bank. These arrangements were particularly useful for evaluating whether managerial and balance-sheet heterogeneity generated synergies or instead transmitted inefficiency across the merged entity. Scenario 7 represented the actual consolidation centered on Bank Sepah and incorporated Hekmat Iranian, Mehr Eqtesad, Kosar, Ansar, and Ghavamin. This final scenario was analytically important because it permitted the simulation framework to be compared with a real consolidation involving multiple institutions of markedly different initial efficiency and liquidity-creation profiles.

For each merger scenario, the relevant balance sheets were consolidated and the liquidity creation index was recalculated using the same weighting principles applied to the individual banks. Table 4 compares the pre-merger liquidity creation indices of the participating institutions with the estimated index of the consolidated entity.

Table 4. Comparison of Liquidity Creation Before and After Merger

Scenario	Bank	Pre-merger liquidity creation	Post-merger liquidity creation
1	Export Development Bank	0.102	0.283
	Bank of Industry and Mine	0.367	
2	Cooperative Development Bank	-0.080	0.076
	Bank Maskan	0.074	
3	Iran Zamin	-0.083	0.158
	Mehr Iran	0.399	
4	Tourism Bank	-0.317	-0.114
	Sarmayeh	0.215	
5	Refah	-0.199	0.077
	Bank of Industry and Mine	0.367	
6	Cooperative Development Bank	-0.098	-0.304
	Tourism Bank	-0.196	
	Dey	-0.296	
	Middle East Bank	0.056	
7	Sepah	-0.008	2.310
	Hekmat Iranian	-0.096	
	Mehr Eqtesad	10.120	
	Kosar	-0.173	
	Ansar	-0.0198	
	Ghavamin	-0.496	

The results demonstrate that merger effects on liquidity creation were neither uniformly positive nor uniformly negative. In Scenario 1, the combination of the Export Development Bank and the Bank of Industry and Mine generated a post-merger value of 0.283, positioned between the two pre-merger values of 0.102 and 0.367. The result indicates that the stronger liquidity-generating structure of the Bank of Industry and Mine materially influenced the consolidated institution, although the merged ratio remained below that bank's standalone value. Scenario 2 produced a more clearly restorative effect: the Cooperative Development Bank entered the simulated merger with a negative index of -0.080, while Bank Maskan recorded 0.074, and the merged institution reached 0.076. Scenario 3 exhibited a similar pattern, with the negative -0.083 value of Iran Zamin being offset by the positive 0.399 value of Mehr Iran, producing a post-merger index of 0.158.

The outcome was less favorable in Scenarios 4 and 6. Tourism Bank recorded -0.317 and Sarmayeh 0.215 before their simulated consolidation, while the merged entity retained a negative index of -0.114. In Scenario 6, three of the four institutions entered the merger with negative liquidity creation, and the consolidated index fell to -0.304. This indicates that combining several structurally weak balance sheets does not automatically generate liquidity-creation synergies. Scenario 5, however, moved from the opposing pre-merger values of -0.199 for Refah and 0.367 for the Bank of Industry and Mine to a positive consolidated value of 0.077.

The actual Bank Sepah scenario generated the most substantial post-merger value. Although Sepah, Hekmat Iranian, Kosar, Ansar, and Ghavamin all recorded negative pre-merger indices, Mehr Eqtesad exhibited an exceptionally high liquidity creation index of 10.120. The consolidated value was 2.310, indicating that the balance-sheet structure of Mehr Eqtesad exerted a large positive influence on the resulting aggregate. Taken together, these results show that consolidation alone cannot be considered a sufficient condition for stronger liquidity creation. The outcome depends on the relative balance-sheet weights of the participating banks, the liquidity characteristics of their assets and liabilities, and the extent to which stronger institutions can offset weak liquidity structures elsewhere in the merger group.

Post-merger efficiency was decomposed into potential merger efficiency, potential efficiency without the coordination component, and coordination efficiency. The two-stage framework additionally decomposed the potential performance of each stage into scope or target-composition efficiency (SCE), size efficiency (SIE), and learning efficiency (LE). ME1 and ME2 represented potential efficiencies in the first and second stages, IME represented potential merger efficiency excluding coordination effects, and CE represented the coordination component generated through optimization of the intermediate products connecting the two stages.

The detailed annual estimates show distinct adjustment trajectories across the seven merger scenarios. Because the complete set contains a large number of year-by-year coefficients, the values are reported here in compact chronological form rather than in separate tables. For each annual observation, values appear in the following order: ME, SCE1, SCE2, SIE1, SIE2, LE1, LE2, ME1, ME2, IME, and CE.

For Scenario 1, covering approximately 2005/06–2025/26, the annual vectors were 2005/06: 1.00, 1.00, 1.00, 1.00, 2.21, 1.421, 0.943, 1.42, 2.08, 0.39, 2.53; 2006/07: 1.00, 1.00, 1.00, 1.00, 1.81, 1.00, 0.930, 1.00, 1.69, 0.69, 1.40; 2007/08: 1.00, 1.00, 1.50, 1.12, 1.04, 2.8842, 0.96, 3.24, 1.52, 0.22, 4.35; 2008/09: 0.90, 1.00, 1.37, 1.02, 1.04, 3.1378, 0.972, 3.20, 1.39, 0.26, 3.49; 2009/10: 1.00, 1.02, 1.29, 1.00, 1.04, 2.0590, 0.990, 2.10, 1.3374, 0.36, 2.76; 2010/11: 1.00, 1.00, 1.04, 1.00, 1.26, 1.64, 0.986, 1.64, 1.2982, 0.47, 2.12; 2011/12: 1.00, 1.00, 1.00, 1.00, 1.10, 1.60, 1.233, 1.60, 1.3607, 0.47, 2.08; 2012/13: 0.89, 1.00, 1.06, 1.00, 1.02, 1.25, 1.44, 1.25, 1.5787, 0.54, 1.65; 2013/14: 1.00, 1.00, 1.00, 1.00, 1.00, 1.034, 1.18, 1.03, 1.18, 0.90, 1.10; 2014/15: 1.00, 1.00, 1.00, 1.00, 1.00,

1.801, 1.00, 1.80, 1.00, 1.00, 1.00; 2015/16: 0.94, 1.00, 1.27, 1.00, 1.00, 1.37, 0.88, 1.37, 1.136, 0.95, 0.989; 2016/17: 0.82, 1.00, 1.05, 1.00, 1.00, 1.32, 1.157, 1.3236, 1.2239, 0.80, 0.93; 2017/18: 0.80, 1.02, 1.08, 1.00, 1.00, 1.49, 1.315, 1.5332, 1.426, 0.48, 1.65; 2018/19: 1.00, 1.00, 1.07, 1.00, 1.00, 1.00, 1.119, 1.00, 1.20, 0.82, 1.20; 2019/20: 1.00, 1.00, 1.02, 1.00, 1.00, 1.00, 1.024, 1.00, 1.04, 0.95, 1.04; 2020/21: all indicators were 1.00; 2021/22: 1.00, 1.00, 1.01, 1.00, 1.00, 1.05, 1.05, 1.05, 1.05, 1.05, 1.06; 2022/23: 1.00, 1.00, 1.02, 1.00, 1.00, 1.08, 1.07, 1.07, 1.08, 1.09, 1.09; 2023/24: 1.00, 1.00, 1.03, 1.00, 1.00, 1.10, 1.10, 1.10, 1.10, 1.10, 1.12; 2024/25: 1.00, 1.00, 1.03, 1.00, 1.00, 1.12, 1.12, 1.12, 1.12, 1.12, 1.14; and 2025/26: 1.00, 1.00, 1.04, 1.00, 1.00, 1.15, 1.15, 1.15, 1.15, 1.15, 1.17. The general pattern is one of initially large variation in learning and coordination components followed by gradual compression around unity.

Scenario 2 displayed a comparable transition. The annual vectors were 2005/06: 1.00, 1.00, 1.00, 1.00, 2.21, 1.42, 0.943, 1.421, 2.0881, 2.532, 0.394; 2006/07: 1.00, 1.00, 1.00, 1.00, 1.81, 1.00, 0.93, 1.00, 1.69, 1.4492, 0.690; 2007/08: 1.00, 1.00, 1.509, 1.124, 1.04, 2.88, 0.965, 3.244, 1.52, 4.3542, 0.229; 2008/09: 1.09, 1.00, 1.37, 1.020, 1.04, 3.13, 0.97, 3.200, 1.39, 3.8216, 0.2863; 2009/10: 1.00, 1.0203, 1.29, 1.00, 1.04, 2.05, 0.990, 2.100, 1.337, 2.7689, 0.3611; 2010/11: 1.00, 1.00, 1.041, 1.00, 1.26, 1.64, 0.986, 1.648, 1.2982, 2.123, 0.471032; 2011/12: 1.00, 1.00, 1.00, 1.10, 1.605, 1.233, 1.60, 1.36, 2.088, 0.478; 2012/13: 1.118, 1.00, 1.064, 1.00, 1.02, 1.25, 1.446, 1.25, 1.57, 1.85, 0.604; 2013/14: 1.00, 1.00, 1.00, 1.00, 1.00, 1.034, 1.184, 1.03, 1.18, 1.10, 0.905; 2014/15: 1.00, 1.00, 1.00, 1.00, 1.80, 1.00, 1.80, 1.00, 1.00, 1.00; 2015/16: 1.05, 1.00, 1.27, 1.00, 1.00, 1.37, 0.88, 1.37, 1.13, 1.04, 1.010; 2016/17: 1.20, 1.00, 1.05, 1.00, 1.00, 1.32, 1.157, 1.32, 1.22, 1.12, 1.071; 2017/18: 1.24, 1.02, 1.08, 1.00, 1.00, 1.490, 1.315, 1.53, 1.42, 2.055, 0.605; 2018/19: 1.00, 1.00, 1.07, 1.00, 1.00, 1.00, 1.119, 1.00, 1.208, 1.208, 0.827; 2019/20: 1.00, 1.00, 1.021, 1.00, 1.00, 1.00, 1.024, 1.00, 1.04, 1.04, 0.955; 2020/21: all indicators were 1.00; 2021/22: 1.02, 1.00, 1.02, 1.00, 1.00, 1.06, 1.07, 1.06, 1.09, 1.01, 1.08; 2022/23: 1.03, 1.00, 1.03, 1.00, 1.00, 1.08, 1.08, 1.09, 1.11, 1.03, 1.10; 2023/24: 1.05, 1.00, 1.04, 1.00, 1.00, 1.10, 1.11, 1.10, 1.13, 1.05, 1.12; 2024/25: 1.06, 1.00, 1.04, 1.00, 1.00, 1.12, 1.13, 1.12, 1.15, 1.06, 1.14; and 2025/26: 1.07, 1.00, 1.05, 1.00, 1.00, 1.14, 1.15, 1.14, 1.17, 1.08, 1.16. The later period therefore displayed substantially lower dispersion than the initial adjustment phase.

Scenario 3, covering approximately 2011/12–2025/26, exhibited exceptionally large first-stage learning and potential-efficiency coefficients early in the series. The vectors were 2011/12: 1.00, 1.21, 1.00, 1.00, 1.00, 33.84, 1.00, 41.22, 1.00, 0.103, 9.680; 2012/13: 1.00, 1.00, 1.00, 1.00, 1.00, 35.32, 1.00, 35.32, 1.00, 0.17, 5.55; 2013/14: 1.00, 1.011, 1.00, 1.00, 1.00, 18.38, 1.00, 18.60, 1.00, 0.120, 8.285; 2014/15: 1.00, 1.00, 1.00, 1.00, 1.00, 11.93, 1.00, 12.19, 1.00, 0.20, 4.980; 2015/16: 0.73, 1.00, 1.00, 1.00, 1.00, 7.040, 1.371, 7.05, 1.37, 0.16, 4.35; 2016/17: 0.79, 1.00, 1.00, 1.00, 1.00, 4.94, 1.38, 4.94, 1.38, 0.30, 2.59; 2017/18: 0.82, 1.02, 1.00, 1.00, 1.00, 3.183, 1.27, 3.20, 1.27, 0.34, 2.364; 2018/19: 0.85, 1.06, 1.00, 1.00, 1.00, 2.415, 1.1693, 2.57, 1.16, 0.47, 1.80; 2019/20: 0.961, 1.058, 1.00, 1.00, 1.00, 2.21, 1.03, 2.34, 1.03, 0.68, 1.400; 2020/21: 1.00, 1.03, 1.00, 1.00, 1.00, 1.67, 1.00, 1.73, 1.00, 1.00, 1.00; 2021/22: 1.02, 1.05, 1.00, 1.00, 1.00, 1.50, 1.05, 1.56, 1.05, 1.05, 1.20; 2022/23: 1.04, 1.05, 1.00, 1.00, 1.00, 1.40, 1.06, 1.46, 1.06, 1.07, 1.22; 2023/24: 1.06, 1.05, 1.00, 1.00, 1.00, 1.32, 1.08, 1.39, 1.08, 1.09, 1.24; 2024/25: 1.07, 1.04, 1.00, 1.00, 1.00, 1.25, 1.10, 1.33, 1.10, 1.10, 1.26; and 2025/26: 1.08, 1.04, 1.00, 1.00, 1.00, 1.20, 1.12, 1.28, 1.12, 1.12, 1.28. The sharp decline in LE1 and ME1 from extremely large initial values toward approximately unity suggests progressive reduction of the initial structural mismatch between Iran Zamin and Mehr Iran.

Scenario 4 produced the following vectors: 2011/12: 0.56, 1.00, 1.00, 1.00, 1.00, 3.08, 1.76, 3.08, 1.76, 0.18, 3.08; 2012/13: 0.66, 1.00, 1.00, 1.00, 1.00, 3.22, 1.49, 3.22, 1.49, 0.21, 3.09; 2013/14: 0.47, 1.00, 1.08, 1.00, 1.00, 1.90, 1.943, 1.90, 2.10, 0.25, 1.87; 2014/15: 0.46, 1.00, 1.26, 1.00, 1.00, 1.37, 1.70, 1.37, 2.15, 0.33, 1.37; 2015/16: 0.26, 1.27, 1.23, 1.00, 1.00, 2.97, 3.05, 3.80, 3.77, 0.099, 2.67; 2016/17: 0.24, 1.19, 1.02, 1.00, 1.00, 2.16, 4.64, 2.58, 4.77, 0.10, 2.29; 2017/18: 0.21, 1.00, 1.16, 1.00, 1.00, 1.16, 4.18, 1.16, 4.86, 0.17, 1.23; 2018/19: 0.22, 1.11, 1.13, 1.00, 1.00, 1.05, 4.41, 1.18, 5.02, 0.18, 1.21; 2019/20: 0.25, 1.00, 1.15, 1.00, 1.00, 1.00, 3.70, 1.00, 4.3001, 0.23, 1.08; 2020/21: 0.24, 1.00, 1.41, 1.00, 1.00, 1.00, 2.93, 1.00, 4.1524, 0.24, 1.00; 2021/22: 0.26, 1.05, 1.32, 1.00, 1.00, 1.20, 2.80, 1.22, 3.90, 0.25, 1.10; 2022/23: 0.27, 1.05, 1.30, 1.00, 1.00, 1.18, 2.70, 1.20, 3.75, 0.26, 1.12; 2023/24: 0.28, 1.04, 1.28, 1.00, 1.00, 1.15, 2.55, 1.17, 3.60, 0.27, 1.14; 2024/25: 0.29, 1.04, 1.26, 1.00, 1.00, 1.12, 2.40, 1.15, 3.45, 0.28, 1.16; and 2025/26: 0.30, 1.03, 1.25, 1.00, 1.00, 1.10, 2.30, 1.13, 3.30, 0.30, 1.18. The results indicate substantial second-stage adjustment costs, particularly during the middle part of the series, followed by a gradual moderation of LE2 and ME2.

Scenario 5 generated the strongest evidence of persistent structural instability in the later period. Its vectors were 2005/06: 0.38, 1.70, 1.02, 1.00, 1.00, 13.18, 2.52, 22.98, 2.57, 0.03, 12.61; 2006/07: 0.35, 1.45, 1.01, 1.00, 1.00, 12.29, 2.87, 17.80, 2.91, 0.04, 7.91; 2007/08: 0.36, 1.214, 1.42, 1.00, 1.00, 12.00, 1.93, 14.57, 2.76, 0.04, 7.81; 2008/09: 0.41, 1.42, 1.01, 1.00, 1.00, 10.18, 2.37, 14.50, 2.40, 0.04, 9.29; 2009/10: 0.49, 1.35, 1.00, 1.00, 1.00, 9.29, 2.03, 12.62, 2.03, 0.05, 9.43; 2010/11: 0.40, 1.54, 1.01, 1.00, 1.00, 5.70, 2.41, 8.79, 2.45, 0.059, 6.78; 2011/12: 0.42, 1.69, 1.02, 1.00, 1.00, 4.71, 2.28, 7.98, 2.34, 0.07, 5.640; 2012/13: 0.37, 1.44, 1.22, 1.00, 1.00, 3.92, 2.153, 5.67, 2.63, 0.11, 3.16; 2013/14: 0.48, 1.35, 1.43, 1.00, 1.00, 3.25, 1.43, 4.40, 2.05, 0.23, 2.03; 2014/15: 0.50, 1.16, 1.147, 1.00, 1.00, 2.59, 1.75, 3.00, 2.01, 0.30, 1.30; 2015/16: 0.45, 1.3177, 1.155, 1.00, 1.00, 1.93, 1.89, 2.54, 2.18, 0.32, 1.42; 2016/17: 0.49, 1.14, 1.14, 1.00, 1.00, 1.81, 1.77, 2.07, 2.03, 0.39, 1.24; 2017/18: 0.57, 1.21, 1.45, 1.00, 1.00, 1.36, 1.19, 1.65, 1.73, 0.465, 1.24; 2018/19: 0.64, 1.15, 1.71, 1.00, 1.00, 1.150, 0.90, 1.33, 1.55, 0.59, 1.08; 2019/20: 0.76, 1.06, 1.80, 1.00, 1.00, 1.21, 0.73, 1.28, 1.3232, 0.69, 1.09; 2020/21: 1.00, 1.32, 1.42, 1.00, 1.00, 0.75, 0.69, 1.00, 1.00, 1.00, 1.00; 2021/22: 1.24, 1.58, 1.04, 1.00, 1.00, 0.29, 0.65, 0.72, 0.6768, 1.31, 0.91; 2022/23: 1.48, 1.84, 0.66, 1.00, 1.00, -0.17, 0.61, 0.44, 0.3536, 1.62, 0.82; 2023/24: 1.72, 2.10, 0.28, 1.00, 1.00, -0.63, 0.57, 0.16, 0.0304, 1.93, 0.73; 2024/25: 1.96, 2.36, -0.10, 1.00, 1.00, -1.09, 0.53, -0.12, -0.2928, 2.24, 0.64; and 2025/26: 2.20, 2.62, -0.48, 1.00, 1.00, -1.55, 0.49, -0.40, -0.616, 2.55, 0.55. Contrary to a simple convergence interpretation, these later values indicate increasing divergence among several components, particularly SCE1, SCE2, LE1, ME1, ME2, IME, and CE. The fifth scenario therefore suggests that merger gains may coexist with severe internal imbalance and that the evolution of the aggregate ME index should not be interpreted independently from its component decomposition.

Scenario 6 also displayed substantial initial heterogeneity but a more moderate later trajectory. The vectors were 2012/13: 0.23, 2.00, 1.54, 1.00, 1.00, 7.30, 2.75, 14.69, 4.25, 0.03, 7.43; 2013/14: 0.28, 1.30, 1.74, 1.00, 1.00, 5.62, 2.02, 7.34, 3.53, 0.08, 3.34; 2014/15: 0.32, 1.13, 1.43, 1.00, 1.00, 5.46, 2.10, 6.19, 3.12, 0.12, 2.46; 2015/16: 0.28, 1.04, 1.36, 1.00, 1.00, 3.80, 2.53, 3.97, 3.40, 0.1589, 1.81; 2016/17: 0.33, 1.05, 1.21, 1.00, 1.00, 2.76, 2.46, 2.91, 2.98, 0.22, 1.52; 2017/18: 0.28, 1.09, 1.50, 1.00, 1.00, 2.05, 2.30, 2.25, 3.40, 0.19, 1.46; 2018/19: 0.32, 1.07, 1.17, 1.00, 1.00, 1.90, 2.65, 2.04, 3.11, 0.25, 1.25; 2019/20: 0.42, 1.096, 1.15, 1.00, 1.00, 1.74, 2.03, 1.90, 2.36, 0.30, 1.15; 2020/21: 0.8116, 1.073, 1.5909, 1.00, 1.00, 1.39, 0.77, 1.50, 1.23, 0.73, 1.106; 2021/22: 0.7142, 0.94424, 1.399992, 1.00, 1.00, 1.2232, 0.677, 1.32, 1.0824, 0.6424, 0.97328; 2022/23: 0.738556, 0.97643, 1.447719, 1.00, 1.00, 1.2649, 0.7007, 1.365, 1.1193, 0.6643, 1.00646; 2023/24: 0.762904, 1.00862, 1.495446, 1.00, 1.00, 1.3066,

0.7238, 1.41, 1.1562, 0.6862, 1.03964; 2024/25: 0.787252, 1.04081, 1.543173, 1.00, 1.00, 1.3483, 0.7469, 1.455, 1.1931, 0.7081, 1.07282; and 2025/26: 0.8116, 1.073, 1.5909, 1.00, 1.00, 1.39, 0.77, 1.50, 1.23, 0.73, 1.106. The substantial decline in first-stage learning and potential inefficiency compared with the beginning of the period indicates increasing integration, although several indicators remained materially different from unity.

Scenario 7, corresponding to the multi-bank Sepah consolidation, contained four available pre-consolidation or simulated annual observations. The vectors were 2012/13: 0.79, 1.06, 1.12, 1.00, 1.00, 1.66, 1.14, 1.78, 1.29, 0.67, 1.18; 2013/14: 1.00, 1.09, 1.00, 1.00, 1.00, 1.63, 1.00, 1.79, 1.00, 0.93, 1.06; 2014/15: 1.00, 1.23, 1.00, 1.00, 1.00, 1.34, 1.00, 1.66, 1.00, 1.00, 1.00; and 2015/16: 1.00, 1.03, 1.00, 1.00, 1.00, 1.30, 1.00, 1.34, 1.00, 1.00, 1.00. Compared with the more heterogeneous scenarios, these coefficients approached unity relatively rapidly, especially for ME, SIE1, SIE2, SCE2, ME2, IME, and CE. The pattern suggests stronger compatibility among the underlying production components after accounting for the influence of the relatively efficient participating institutions.

Across the seven scenarios, a common finding was that the earliest simulated merger periods tended to exhibit the greatest divergence among the efficiency components. This was particularly apparent in Scenarios 3, 5, and 6, in which first-stage learning or potential-efficiency measures initially assumed very large values. The results imply that combining institutions with substantially different asset structures, production technologies, and resource-utilization patterns creates a sizeable adjustment requirement. However, the later movement toward values closer to unity in Scenarios 1, 2, 3, 4, 6, and 7 indicates increasing compatibility of production processes over time. Scenario 5 constituted an important exception because several component measures diverged during the final observations rather than converging. Thus, the findings do not support an unconditional proposition that all mergers automatically produce smooth long-term convergence; rather, the success of consolidation depends on the particular composition of the participating institutions and on whether internal stage-specific imbalances can actually be resolved.

The final comparison of overall efficiency before and after consolidation is provided in Table 5. These values summarize the combined effects of potential efficiency and coordination efficiency and therefore provide a more direct assessment of the overall performance associated with each merger arrangement.

Table 5. Comparison of Bank Efficiency Before and After Merger

Scenario	Bank	Pre-merger efficiency	Post-merger efficiency
1	Export Development Bank	0.67	0.745
	Bank of Industry and Mine	0.87	
2	Cooperative Development Bank	0.57	0.89
	Bank Maskan	0.90	
3	Iran Zamin	0.38	0.56
	Mehr Iran	0.53	
4	Tourism Bank	0.32	0.49
	Sarmayeh	0.48	
5	Refah	0.35	0.42
	Bank of Industry and Mine	0.62	
6	Cooperative Development Bank	0.22	0.35
	Tourism Bank	0.30	
	Dey	0.31	
	Middle East Bank	0.41	
	Sepah	0.35	
7	Hekmat Iranian	0.40	0.78
	Mehr Eqtesad	0.70	
	Kosar	0.48	
	Ansar	0.30	

The aggregate comparison suggests that most merger arrangements generated a post-merger efficiency level exceeding that of at least the weaker participating institution. Scenario 2 produced a particularly high post-merger score of 0.89, compared with 0.57 for the Cooperative Development Bank and 0.90 for Bank Maskan. Scenario 3 increased the relevant performance level from 0.38 and 0.53 for the constituent banks to 0.56 for the consolidated institution. Scenario 4 yielded 0.49 compared with 0.32 for Tourism Bank and 0.48 for Sarmayeh. Scenario 6 produced a post-merger score of 0.35, which exceeded the pre-merger efficiencies of the Cooperative Development Bank, Tourism Bank, and Dey but remained lower than the 0.41 score of Middle East Bank. Similarly, Scenario 5 produced a consolidated score of 0.42, exceeding Refah's 0.35 but remaining below the 0.62 efficiency of the Bank of Industry and Mine. These findings show that a merger can improve the aggregate position of a relatively inefficient participant without necessarily outperforming the strongest constituent institution.

Scenario 7 generated a post-merger efficiency of 0.78, exceeding all individual pre-merger scores reported for Sepah, Hekmat Iranian, Mehr Eqtesad, Kosar, Ansar, and Ghavamin. This was the clearest indication of overall efficiency synergy among the simulated arrangements. Nevertheless, the detailed decomposition presented above demonstrates that aggregate post-merger scores should be interpreted jointly with the stage-specific indices because improvements at the overall level may conceal continued imbalance between resource mobilization, financial intermediation, learning, scale, and coordination effects.

The final stage of the findings examined the resilience and macroeconomic transmission implications of the banking results through variance decomposition and impulse-response analysis. The stress-analysis framework considered the manner in which adverse banking and macro-financial shocks could affect economic activity and credit provision. The underlying logic was that a financially and operationally more efficient post-merger banking structure should be better positioned to absorb liquidity shocks, deterioration in asset quality, interest-rate pressures, and balance-sheet disequilibria. Variance decomposition was therefore used to investigate the relative contribution of GDP's own innovations and banking or macro-financial variables to forecast-error variation over a ten-period horizon. A corresponding decomposition was performed for bank lending.

Table 6. Forecast-Error Variance Decomposition of GDP and Bank Lending

Outcome	Period	S.E.	Own shock	KHGH	KHB	KGH	KB
GDP	1	1,434,523	100.0000	0.000000	0.000000	0.000000	0.000000
GDP	2	2,749,394	84.99013	13.08707	1.061896	0.274842	0.095556
GDP	3	4,692,757	65.51034	21.29950	12.47037	0.174027	0.034327
GDP	4	7,623,930	48.48608	21.99737	28.86812	0.086456	0.062195
GDP	5	11,884,381	39.21882	17.76104	42.14753	0.036125	0.160243
GDP	6	18,121,246	35.96702	12.37508	50.25224	0.016324	0.279117
GDP	7	27,695,862	35.44293	7.630852	54.83489	0.007579	0.389682
GDP	8	42,976,447	34.87545	4.089983	58.34034	0.003163	0.479003
GDP	9	67,734,299	33.09808	1.801194	62.01958	0.002307	0.545709
GDP	10	108,000,000	30.40451	0.751851	65.57855	0.003655	0.589667
Lending	1	70,036.65	100.0000	0.000000	0.000000	0.000000	0.000000
Lending	2	159,506.6	99.58631	0.034182	0.058567	0.112426	0.000268
Lending	3	277,850.7	99.17592	0.012880	0.124857	0.200214	0.032374
Lending	4	430,441.8	98.80967	0.008729	0.109011	0.291836	0.166676
Lending	5	626,310.8	98.37444	0.017255	0.068278	0.376589	0.473887
Lending	6	878,482.2	97.75257	0.025561	0.038668	0.445262	1.027227
Lending	7	1,205,159	96.83983	0.031329	0.023714	0.495164	1.907311
Lending	8	1,631,580	95.53372	0.039994	0.022107	0.528881	3.196829

Lending	9	2,192,721	93.73198	0.062416	0.038287	0.550211	4.973568
Lending	10	2,937,115	91.34048	0.118246	0.078995	0.561626	7.300171

The GDP decomposition reveals a major change in the source of forecast-error variance as the horizon lengthens. During the first period, GDP's own innovation explains 100% of its variation. By Period 2, this share declines to approximately 84.99%, while KHGH accounts for 13.09%. From Period 3 onward, however, the contribution of KHB increases sharply, rising from 12.47% in Period 3 to 28.87% in Period 4, 42.15% in Period 5, 50.25% in Period 6, 54.83% in Period 7, 58.34% in Period 8, 62.02% in Period 9, and 65.58% by Period 10. At the same time, GDP's own contribution falls to approximately 30.40%. KGH and KB remain comparatively small contributors to GDP forecast variance within the ten-period decomposition, although their impulse-response profiles indicate that their effects may become more pronounced at longer horizons.

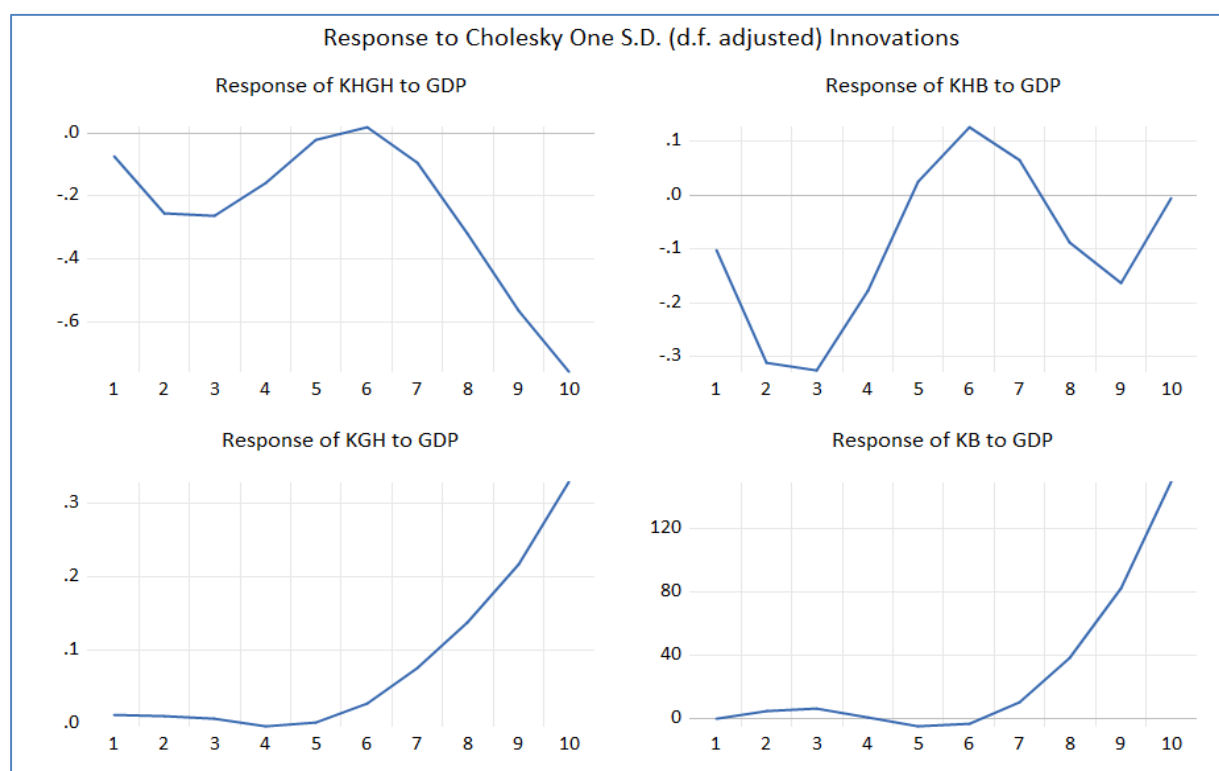


Figure 1. Variance Decomposition and Impulse Responses of Gross Domestic Product

The impulse-response behavior further clarifies these transmission mechanisms. A shock to KHGH initially reduces GDP, is followed by a temporary positive adjustment, and subsequently generates another negative effect in the later periods, indicating an unstable and temporally asymmetric transmission pattern. The response to KHB is initially negative but subsequently becomes positive and reaches its strongest effect during the intermediate and later horizons. This finding is consistent with the variance decomposition, in which KHB becomes the dominant external contributor to GDP fluctuations. The response to KGH is initially weak but becomes substantially positive after the later horizons, indicating a delayed structural effect. KB exhibits an even stronger delayed response, with almost negligible short-run effects followed by substantial increases at longer horizons. Thus, the impulse-response evidence indicates that banking and fiscal shocks differ not only in magnitude but also in the timing of their transmission to real economic activity.

The lending decomposition shows a different structure. Lending is overwhelmingly explained by its own innovations throughout the forecast horizon, although this dominance gradually declines from 100% in Period 1 to 91.34% by Period 10. KHGH and KHB account for only modest proportions of forecast variance, reaching 0.118% and 0.079%, respectively, by the final period. KGH rises gradually to approximately 0.562% by Period 10. The most substantial external contribution comes from KB, whose share rises from virtually zero in the initial periods to 1.03% in Period 6, 1.91% in Period 7, 3.20% in Period 8, 4.97% in Period 9, and 7.30% in Period 10. Accordingly, while lending is highly autoregressive in the short and medium term, budgetary or fiscal shocks acquire increasing explanatory power over longer horizons.

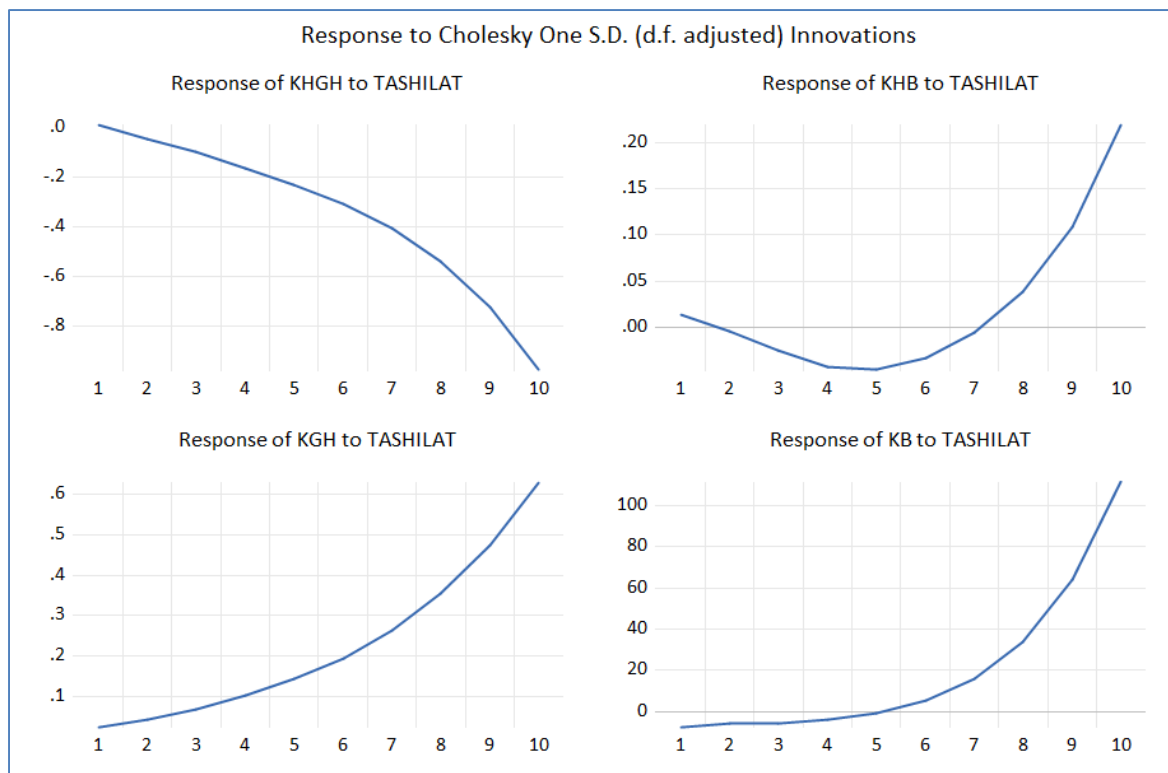


Figure 2. Variance Decomposition and Impulse Responses of Bank Lending

The impulse responses of lending likewise indicate gradual and asymmetric transmission. A KHGH shock has a persistently negative effect on lending, with the adverse response increasing over time. This pattern suggests that shocks associated with current government expenditure or related real-sector activities may crowd out or otherwise constrain banks' capacity to extend credit. The response of lending to KHB is initially slightly negative, but from approximately the sixth period onward it becomes positive and strengthens toward the end of the horizon. This pattern implies that shocks related to liquidity creation and bank balance-sheet conditions may require an adjustment period before their positive effect on lending capacity becomes apparent. KGH and KB also generate delayed positive responses, with KB producing the strongest long-run effect. Their transmission therefore appears cumulative rather than immediate.

Taken together, the liquidity-creation, efficiency, variance-decomposition, and impulse-response results indicate that bank consolidation can materially reshape both institution-level performance and the channels through which financial shocks are transmitted to the wider economy. The merger simulations generally show that relatively inefficient banks may benefit from integration with stronger institutions, particularly when the merger facilitates the sharing of organizational resources, improves intermediate-product coordination, and reduces weaknesses in Stage

1 resource utilization. Nevertheless, the findings also demonstrate that merger outcomes depend fundamentally on the structural compatibility of participating institutions. Scenarios involving strongly complementary balance sheets or comparatively efficient lead institutions produced substantial gains, whereas scenarios combining several weak or highly heterogeneous institutions generated persistent inefficiencies or negative liquidity-creation outcomes. The macroeconomic results reinforce the importance of this distinction: banking variables, particularly the KHB component associated with liquidity creation and balance-sheet activity, become increasingly important determinants of GDP fluctuations at longer horizons. Consequently, improvements in bank efficiency and liquidity management following a well-designed merger may strengthen financial resilience and reduce destabilizing transmission channels, whereas poorly structured consolidation may simply transfer or aggregate pre-existing inefficiencies within a larger institution.

Discussion and Conclusion

The findings of this study demonstrate that mergers and acquisitions can materially alter bank performance, but their effects are heterogeneous and depend strongly on the pre-merger efficiency, liquidity structure, operational compatibility, and relative strength of the participating institutions. The pre-merger analysis revealed substantial dispersion in both liquidity creation and two-stage efficiency across the sampled Iranian banks. Some banks, particularly Mehr Eqtesad, Post Bank, Karafarin, Mehr Iran, and the Bank of Industry and Mine, displayed comparatively strong liquidity creation or efficiency performance, whereas several other banks entered the merger scenarios with negative liquidity creation indices or marked inefficiencies in one or both stages of production. This heterogeneity is important because it indicates that the economic consequences of consolidation cannot be inferred from size alone. Rather, the final result depends on how the operational resources, funding structures, asset portfolios, managerial capabilities, and intermediate products of the participating banks interact after integration. This finding is broadly consistent with the view that target selection is a central determinant of acquisition success and that the strategic fit between acquiring and target firms should be evaluated before merger implementation (1). It also aligns with evidence showing that merger outcomes are highly contingent on the efficiency and structural characteristics of the combining organizations rather than on the transaction itself (3).

The pre-merger two-stage DEA results further indicated that inefficiency was not distributed uniformly across the banking production process. In many institutions, Stage 1 efficiency was considerably lower than Stage 2 efficiency, suggesting that the primary weakness lay in resource mobilization, cost utilization, fixed-asset deployment, or the transformation of organizational inputs into deposits and interbank funding. In contrast, several banks were relatively more successful in converting mobilized resources into loans and revenue-generating outputs. This pattern is theoretically important because it shows that banks with similar overall efficiency scores may suffer from entirely different internal inefficiencies. Such heterogeneity justifies the use of a network or two-stage framework instead of a conventional single-stage DEA model. It also helps explain why some merger scenarios produced stronger post-merger outcomes than others. If one bank is relatively efficient in Stage 1 while another is stronger in Stage 2, the merger may create complementarity and coordination benefits; however, if both banks are weak in the same production stage, consolidation may merely aggregate existing inefficiencies. This interpretation is compatible with the broader M&A literature, which emphasizes that value creation depends on the complementarity of organizational resources and the ability to recombine them effectively after acquisition (5, 7).

The liquidity creation results before and after merger provide additional evidence that consolidation does not have a mechanically positive effect. The first, second, third, fifth, and seventh scenarios generated positive post-merger liquidity creation values, whereas the fourth and sixth scenarios remained negative after consolidation. This variation shows that mergers improve liquidity creation only when the combined balance-sheet structure allows the merged institution to strengthen the transformation of illiquid assets into liquid claims. The first scenario, involving the Export Development Bank and the Bank of Industry and Mine, produced a post-merger liquidity creation index of 0.283, while the second scenario improved the weak position of the Cooperative Development Bank through consolidation with Bank Maskan. The third scenario similarly transformed the negative liquidity creation of Iran Zamin into a positive merged value through combination with Mehr Iran. These outcomes suggest that stronger institutions can offset weaker balance-sheet structures when their relative financial weight and liquidity-generating capacity are sufficiently large. This result is consistent with the strategic M&A argument that the quality and complementarity of acquired resources are more important than simple organizational expansion (1). It is also in line with research indicating that acquisitions can generate performance benefits when firms successfully combine different capabilities and productive assets (6).

In contrast, the fourth and sixth merger scenarios illustrate the risks associated with combining structurally weak institutions. In Scenario 4, the merger of Tourism Bank and Sarmayeh resulted in a negative liquidity creation value of -0.114, despite Sarmayeh having recorded a positive pre-merger index. Scenario 6, which combined the Cooperative Development Bank, Tourism Bank, Dey, and Middle East Bank, produced an even more negative consolidated liquidity creation value of -0.304. These outcomes indicate that the aggregation of several weak or illiquid balance sheets can transmit rather than eliminate structural inefficiency. Such findings are consistent with risk-oriented merger research emphasizing that consolidation can amplify existing vulnerabilities when due diligence, target screening, and post-merger restructuring are inadequate (13, 16). They also support the argument that acquisition strategy should explicitly consider hidden liabilities, asset quality, operational weaknesses, and the likelihood that inefficiencies will survive organizational integration. From this perspective, a merger should not be treated as a substitute for balance-sheet repair; rather, consolidation may only become effective after problematic assets, weak funding structures, and inefficient operating processes are identified and corrected.

The seventh scenario, reflecting the large-scale consolidation into Bank Sepah, generated the strongest improvement in liquidity creation, with the post-merger index rising to 2.31. This result was driven largely by the exceptional pre-merger liquidity creation capacity of Mehr Eqtesad, which entered the consolidation with a substantially higher index than the other participating institutions. Although several banks in this scenario recorded negative pre-merger liquidity creation, the presence of a particularly strong institution appears to have dominated the combined balance-sheet outcome. This result supports the notion that high-performing entities can act as anchors in consolidation processes when they possess sufficiently strong financial and operational capacities. It also illustrates why mergers should be evaluated not only through average pre-merger performance but through the relative scale and weight of each participant. In practical terms, one highly liquid or operationally efficient bank may contribute more to the merged entity than several smaller, less efficient participants. This interpretation is compatible with studies suggesting that acquisition outcomes depend on the value and transferability of strategic resources held by the target or lead organization (5, 21).

The post-merger DEA results also revealed an important temporal dimension. In most scenarios, the early years were characterized by substantial volatility in learning efficiency, coordination efficiency, and stage-specific potential

efficiency, followed by gradual convergence toward more stable values. This pattern was particularly evident in Scenarios 1, 2, 3, 4, 6, and 7. Such a result is consistent with the idea that merger benefits often require a period of organizational adaptation before they become fully visible. Integration requires the alignment of operating procedures, information systems, governance structures, employee roles, internal controls, customer relationships, and risk-management systems. The early instability observed in the efficiency components may therefore represent transitional adjustment costs rather than evidence of permanent merger failure. This interpretation is supported by the literature on talent and organizational integration, which emphasizes that the retention, redeployment, and coordination of human capital are critical to realizing merger synergies (9). It is also consistent with research on repeated acquisitions showing that organizational learning can improve future integration outcomes, although learning may be distorted by managerial biases such as overconfidence or loss aversion (2).

Scenario 3 provides a particularly clear illustration of this adjustment process. The merger of Iran Zamin and Mehr Iran initially produced unusually high values for LE1 and ME1, indicating substantial inefficiency or unrealized potential in the first stage of the production process. However, these values declined steadily over time, suggesting that the merged structure gradually became more capable of coordinating resource mobilization and intermediate production. This pattern can be interpreted as evidence of learning and organizational adaptation. Similar findings have been reported in studies of technological and knowledge-intensive acquisitions, where the benefits of consolidation often emerge only after the acquiring organization develops the capacity to absorb, integrate, and exploit the resources of the target firm (6, 7). Although banking mergers differ from technology acquisitions, the underlying integration logic is comparable: operational gains require time, managerial coordination, and the reconfiguration of routines.

However, the results also indicate that convergence is not universal. Scenario 5, involving Refah and the Bank of Industry and Mine, showed increasing divergence among several efficiency components in the later periods. In particular, the patterns in SCE1, SCE2, LE1, ME1, ME2, IME, and CE suggest that improvements in one dimension of performance can coexist with deterioration in another. This is an important finding because it cautions against evaluating merger success solely through aggregate efficiency scores. A merger may appear favorable at the system level while masking unresolved imbalances between stages of production. This result corresponds with the broader M&A literature showing that post-acquisition performance is multidimensional and may involve simultaneous gains and losses across different organizational functions (4). It also echoes research on post-acquisition divestment, which shows that organizations often need to restructure or abandon certain relational assets after consolidation because not all inherited resources contribute positively to the combined entity (21).

The comparison of overall efficiency before and after merger showed that most scenarios improved the performance of the weaker participating banks, although the merged entity did not always exceed the most efficient pre-merger participant. This distinction is important. Scenario 2 achieved a post-merger efficiency of 0.89, nearly reaching the pre-merger efficiency of Bank Maskan at 0.90 and substantially exceeding that of the Cooperative Development Bank at 0.57. Scenario 3 produced a post-merger score of 0.56, higher than both Iran Zamin and Mehr Iran individually. Scenario 4 similarly reached 0.49 compared with 0.32 and 0.48 before merger. In contrast, Scenario 5 improved on Refah but remained below the pre-merger performance of the Bank of Industry and Mine, while Scenario 6 improved several weaker institutions but remained below the strongest participant, Middle East Bank. These patterns suggest that merger benefits frequently take the form of performance equalization rather than universal frontier expansion. In other words, consolidation may lift weak institutions toward the performance level

of stronger banks without necessarily creating an entity that is more efficient than the best participant. This interpretation is compatible with studies emphasizing that the realization of synergy depends on integration quality rather than the formal completion of the transaction (11, 12).

The strong post-merger efficiency recorded in Scenario 7 is especially noteworthy because the consolidated score of 0.78 exceeded the reported pre-merger efficiency of all participating banks. This result suggests the existence of genuine synergy rather than simple averaging. Several mechanisms may account for this outcome, including the elimination of duplicated administrative functions, consolidation of branch and information systems, improved use of human capital, better allocation of deposits and credit resources, and stronger coordination between the two production stages. Such an interpretation is aligned with studies showing that M&As can improve performance when integration allows firms to combine complementary resources, reduce redundancy, and increase technological or organizational capability (3, 5). At the same time, the successful realization of such gains requires effective governance and financial reporting systems. Research on common auditors and due diligence suggests that reliable information and stronger post-acquisition reporting quality can facilitate integration and reduce informational frictions (16, 17).

The macroeconomic results further extend the interpretation of the banking findings. Variance decomposition showed that the contribution of KHB to GDP fluctuations increased markedly over the forecast horizon, reaching more than 65% by Period 10, while GDP's own contribution declined to approximately 30%. This result indicates that banking balance-sheet conditions and liquidity creation can become increasingly important channels through which financial-sector shocks are transmitted to the real economy. The impulse-response analysis also suggested that shocks associated with liquidity creation initially exert adverse effects but can become supportive of growth over longer horizons if the banking system adjusts effectively. These results are consistent with the broader understanding that banking consolidation may have consequences extending beyond individual institutions because changes in lending capacity, liquidity provision, and balance-sheet resilience affect credit supply and macroeconomic stability. The lending variance decomposition similarly showed that budgetary and financial shocks gain importance over longer horizons, reinforcing the conclusion that bank performance should be understood within a dynamic financial system rather than as an isolated firm-level outcome.

The findings also carry an important regulatory implication. Mergers can strengthen financial institutions, but they may simultaneously increase concentration, systemic importance, and the consequences of managerial failure. Legal and competition research has shown that acquisitions can produce both productive efficiencies and anti-competitive effects depending on the structure of the market and the motives underlying consolidation (18, 19). Concerns regarding talent lock-in, acquisition of strategic resources, and the accumulation of market power have also been identified in the broader M&A literature (8, 10). In the banking context, these concerns imply that merger policy should not be guided exclusively by efficiency gains. Supervisors must simultaneously consider financial stability, competition, customer access, governance quality, and the potential emergence of institutions that are too interconnected or too systemically important to fail. The legal and institutional dimensions of acquisitions therefore remain central to the design and evaluation of consolidation policy (20).

Overall, the results support a conditional rather than deterministic interpretation of bank mergers and acquisitions. Consolidation can enhance efficiency, strengthen liquidity creation, improve coordination between banking production stages, and increase resilience, but these effects arise only when the merged institutions possess complementary structures and when the integration process successfully reallocates resources and

addresses inherited inefficiencies. The findings are consistent with the contemporary M&A literature, which repeatedly emphasizes strategic fit, resource complementarity, integration quality, learning, human-capital management, and rigorous target assessment as key determinants of merger success (1, 4, 9). The results therefore suggest that mergers should be viewed as organizational transformation processes rather than as purely financial transactions.

This study has several limitations that should be considered when interpreting the findings. First, the analysis relied primarily on published financial and banking data, and differences in disclosure practices, accounting classifications, and data availability across banks and years may have affected comparability. Second, several merger scenarios were hypothetical and were constructed by aggregating the resources and financial positions of participating banks; consequently, the results represent potential rather than necessarily realized post-merger outcomes. Third, DEA is a relative efficiency method, meaning that estimated performance depends on the composition of the reference sample and the variables included in the production model. Fourth, the treatment of shared inputs, undesirable outputs, and intermediate products necessarily involves modeling assumptions that may influence the estimated efficiency decomposition. Fifth, some later values in the scenario analysis were generated or extended on the basis of the observed patterns available in the dataset, and these values should therefore be interpreted as scenario-based projections rather than realized historical performance. Finally, the macroeconomic stress and variance-decomposition analyses identify dynamic relationships among the modeled variables but do not by themselves establish strict causal effects of bank mergers on GDP or lending.

Future studies can extend this research in several directions. Subsequent work should evaluate realized post-merger data over a longer period for completed Iranian banking consolidations in order to compare *ex ante* potential efficiency with *ex post* observed performance. Researchers may also employ alternative network DEA specifications, stochastic frontier analysis, dynamic DEA, bootstrap DEA, and Malmquist productivity indices to test the robustness of the efficiency estimates. Additional research could incorporate capital adequacy, liquidity coverage ratios, nonperforming loan ratios, profitability, digital banking capability, branch density, governance quality, and customer-level outcomes into a multidimensional assessment of merger success. Comparative studies across countries could determine whether the effects identified in Iran are specific to its institutional environment or represent broader patterns in emerging banking systems. Future research may also examine the role of merger type, ownership structure, cultural compatibility, management quality, technological integration, and the speed of organizational restructuring as moderators of post-merger performance. Finally, more advanced macro-financial models could be used to distinguish the causal effects of liquidity creation, efficiency improvement, and credit expansion on financial stability and economic growth.

For banking managers, regulators, and policymakers, the results suggest that mergers should be preceded by detailed assessments of balance-sheet compatibility, stage-specific operational efficiency, asset quality, funding structure, human resources, information systems, and risk-management processes. Banks with weak performance should not be merged solely on the assumption that larger scale will automatically eliminate inefficiency. Instead, merger design should identify whether a stronger institution possesses the managerial and financial capacity to absorb weaker institutions without importing excessive balance-sheet risk. Integration plans should explicitly address duplicated branches, administrative expenses, credit-risk systems, data platforms, personnel allocation, and governance arrangements. Regulators should monitor liquidity creation and stage-specific efficiency throughout the transition period rather than relying only on conventional profitability or capital ratios. Particular attention should

be paid to large multi-bank mergers because initial integration costs and coordination problems may be substantial even when long-term gains are possible. A phased integration strategy, clear accountability for post-merger restructuring, and continuous stress testing can help ensure that consolidation produces genuine efficiency and resilience rather than simply creating a larger institution with inherited weaknesses.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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