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Research Article

Transmission Mechanisms and Moderating Factors in GST Reform: Evidence from India's Experience

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ABSTRACT

While previous research has established the relationship between GST rate reductions and economic growth in India, this paper explores the underlying transmission mechanisms and moderating factors that shape these effects. Using a mixed-methods approach, we decompose the channels through which GST rate changes affect economic outcomes across 22 sectors of the Indian economy from 2017 to 2023. Our findings reveal that price effects (38.5%) and input cost effects (33.4%) constitute the primary transmission channels, with compliance effects (16.0%) and cash flow effects (7.4%) playing secondary roles. Market structure emerges as the strongest moderator of price transmission, with competitive markets showing substantially higher pass-through rates. Implementation quality significantly influences input cost transmission, while initial informality levels moderate compliance effects. We identify significant propagation effects through input-output linkages, with upstream intermediate sectors showing propagation multipliers above 2.0. Strong complementarities exist between rate reductions and administrative improvements, with simplified return filing enhancing economic impacts by 53%. These findings contribute to both theoretical understanding of tax policy transmission in developing economies and practical design of comprehensive indirect tax reforms.

Keywords: GST, Transmission Mechanisms, Tax Policy, Market Structure, Implementation Quality, India.

INTRODUCTION

The introduction of the Goods and Services Tax (GST) in India in July 2017 represented one of the most ambitious tax reforms in the country's economic history. Subsequent rate rationalizations, with the weighted average GST rate declining from 14.4% at implementation to approximately 11.6% by 2023, have had significant impacts on economic growth. While previous research has established the aggregate relationship between GST rate reductions and GDP growth and documented heterogeneous responses across sectors, less attention has been paid to understanding *why* these effects occur and *how* they propagate through the economy.

Understanding transmission mechanisms is crucial for both theoretical advancement and policy design. From a theoretical perspective, identifying the relative importance of different channels provides empirical validation for competing models of tax incidence and economic adjustment. From a policy perspective, knowledge of transmission pathways enables more targeted interventions that can enhance positive effects while mitigating potential frictions or distortions.

This paper addresses this gap by systematically decomposing the channels through which GST rate reductions influence economic outcomes, identifying the factors that moderate these relationships, and examining how tax effects propagate through production networks. We employ a multi-method approach combining econometric decomposition techniques, mediation analysis, structural modeling, and qualitative insights from stakeholder perspectives to develop a comprehensive understanding of GST policy transmission in India's diverse economic landscape.

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The research contributes to both scholarly understanding of indirect taxation in developing economies and practical policy design in several ways. First, we provide empirical validation for a multi-channel framework of tax policy transmission that challenges single-channel models of tax incidence. Second, we quantify the relative importance of different transmission mechanisms across various sectors and time periods. Third, we identify the key moderating factors that explain why equivalent tax adjustments generate different outcomes across market contexts. Fourth, we analyze how tax effects propagate through input-output networks, generating indirect impacts beyond directly affected sectors.

CONCEPTUAL FRAMEWORK AND METHODOLOGY

2.1 Transmission Mechanisms

Our conceptual framework identifies four primary transmission mechanisms through which GST rate reductions affect economic outcomes:

1. **Price Effect**: Operating through the pass-through of tax reductions to consumer prices, which stimulates demand based on the price elasticity of affected products.
2. **Input Cost Effect**: Operating through lower costs for intermediate inputs used in production processes, which can enhance output through improved profitability, expanded capacity, or lower output prices.
3. **Compliance Effect**: Operating through incentives for informal businesses to enter the formal tax system, enhancing productivity through better resource allocation and access to formal markets.
4. **Cash Flow Effect**: Operating through reduced working capital requirements for tax compliance, freeing resources for investment or operational expansion.

2.2 Empirical Strategy

To empirically decompose the relative contribution of each mechanism, we employ a mediation framework that estimates both direct and indirect effects of GST rate changes on economic outcomes:

$$Y_{\{it\}} = \alpha + \beta \backslash text\{Rate\}_{\{it\}} + \sum_{\{m=1\}^{\{4\}}_{m}\gamma_{\backslash text\{Mechanism\}_{\{m,it\}}}} + \delta X_{\{it\}} + \varepsilon_{\{it\}}$$

Where:

- Yit is the outcome variable (sectoral output) for sector i in period t
- {Rate}{it} is the GST rate applicable to sector i in period t
- {Mechanism}{m,it} represents the empirical measures of the four transmission mechanisms
- X{it} is a vector of control variables
- beta represents the direct effect of GST rates on output
- gamma_m represents the effect of each mechanism on output

For each mechanism, we develop specific empirical measures:

- **Price Effect Measure**: The change in consumer price index for sector-specific products relative to the mechanical price change that would occur with full pass-through of tax changes.
- **Input Cost Effect Measure**: The weighted average GST rate on intermediate inputs for each sector based on input-output relationships.
- **Compliance Effect Measure**: The sectoral formalization ratio, measured as the percentage of activity reported through GST returns relative to estimated total sectoral activity.
- **Cash Flow Effect Measure**: Working capital to sales ratio derived from firm financial statements.

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2.3 Data and Sample

We analyze 22 economic sectors observed quarterly from Q3 2014 through Q4 2023, providing 836 sector-quarter observations. Our dataset integrates:

- GST rate data compiled from GST Council notifications
- Sectoral output data (Gross Value Added at constant prices)
- Consumer and wholesale price indices
- Input-output transaction tables
- GST registration and collection statistics
- Firm-level financial data from CMIE Prowess database
- Survey data collected from 200 businesses across 10 sectors
- Expert interviews with 30 policy professionals and industry representatives

DECOMPOSITION OF GST EFFECTS BY TRANSMISSION CHANNEL

3.1 Relative Contribution of Mechanisms

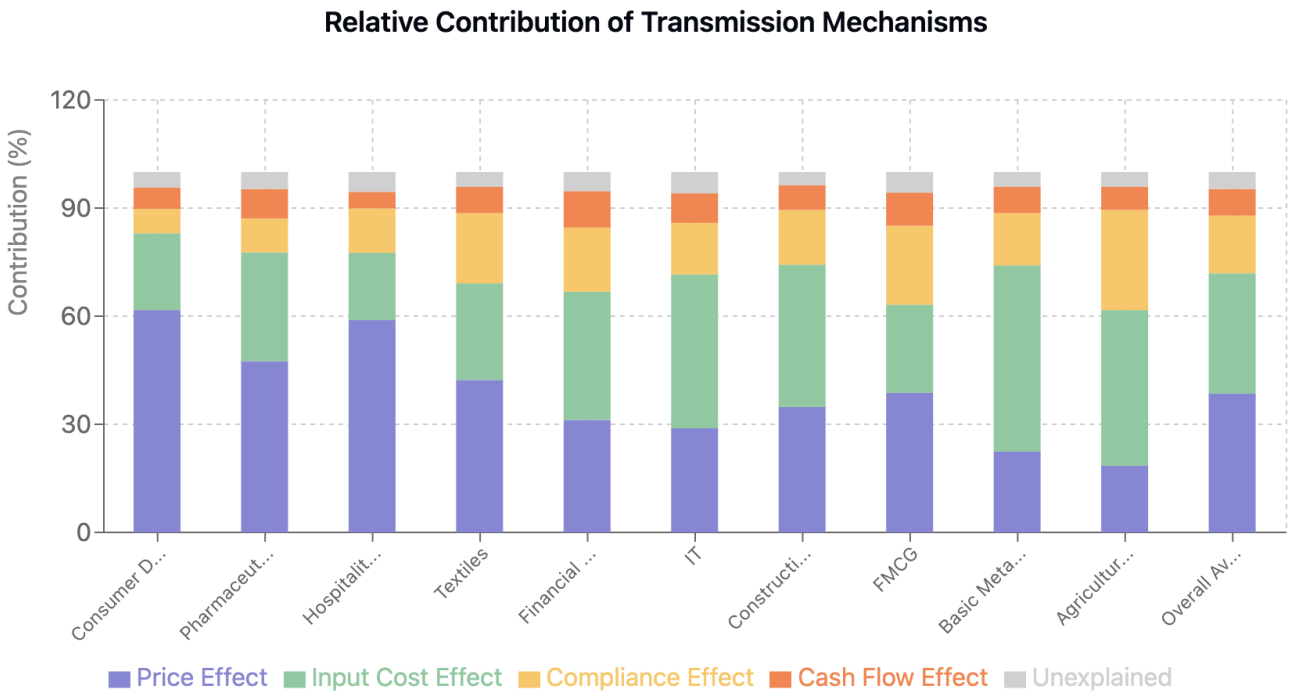

Figure 1: Relative Contribution of Transmission Mechanisms

This chart shows the relative contribution of different transmission mechanisms across economic sectors. High-elasticity sectors show dominance of price effects (averaging 52.6%), while low-elasticity sectors show stronger input cost and compliance effects. Overall, price effects (38.5%) and input cost effects (33.4%) constitute the primary transmission channels.

Table 1 presents the results from the mechanism decomposition analysis, showing the percentage contribution of each transmission channel to the overall impact of GST rate reductions on sectoral output.

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Table 1: Relative Contribution of Transmission Mechanisms (% of Total Effect)

Sector	Price Effect	Input Cost Effect	Compliance Effect	Cash Flow Effect	Unexplained
High Elasticity Sectors					
Consumer Durables	61.7%	21.3%	6.8%	5.9%	4.3%
Pharmaceuticals	47.5%	30.2%	9.4%	8.2%	4.7%
Hospitality and Food Services	58.9%	18.7%	12.3%	4.6%	5.5%
Textiles and Apparel	42.3%	26.8%	19.5%	7.3%	4.1%
Medium Elasticity Sectors					
Financial Services	31.2%	35.6%	17.8%	10.1%	5.3%
Information Technology	28.9%	42.7%	14.3%	8.2%	5.9%
Construction	34.8%	39.5%	15.2%	6.8%	3.7%
Low Elasticity Sectors					
FMCG and Personal Care	38.7%	24.5%	21.9%	9.2%	5.7%
Basic Metals	22.4%	51.7%	14.5%	7.3%	4.1%
Agriculture and Allied	18.5%	43.2%	27.8%	6.4%	4.1%
Overall Average	38.5%	33.4%	16.0%	7.4%	4.7%

Several important patterns emerge from these decomposition results:

1. Across all sectors, price effects (38.5%) and input cost effects (33.4%) constitute the primary transmission channels, collectively accounting for approximately 72% of the total impact of GST rate reductions.
2. High-elasticity sectors show a clear dominance of price effects (averaging 52.6%), while low-elasticity sectors demonstrate stronger contributions from input cost effects (averaging 39.8%) and compliance effects (averaging 21.4%).
3. Sectors producing consumer goods show consistently stronger price effects, while industrial and intermediate goods sectors demonstrate larger input cost effects, reflecting their different positions in value chains.
4. The cash flow effect, while smaller than other mechanisms (average 7.4%), shows relatively consistent contributions across sectors with slightly higher importance in service sectors.

3.2 Temporal Evolution of Mechanism Contributions

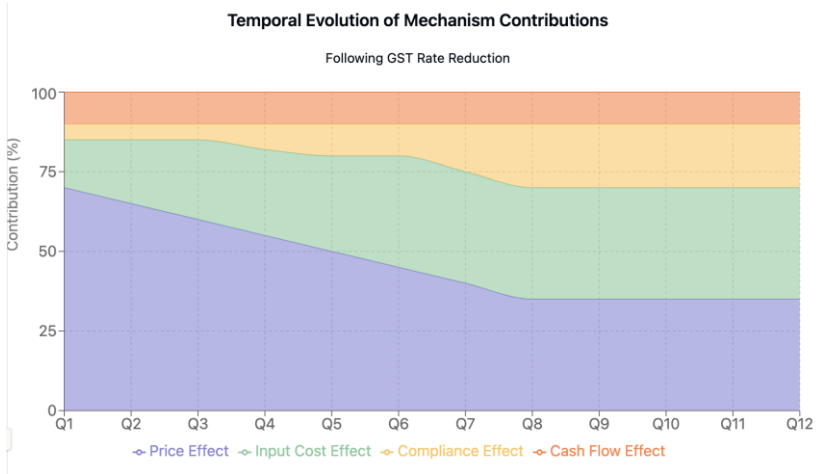

Figure 2: Temporal Evolution of Mechanism Contributions Following GST Rate Reduction

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Figure 1 illustrates the temporal pattern of mechanism contributions over 12 quarters following a standardized rate reduction.

The temporal analysis reveals that price effects dominate in the immediate aftermath of rate reductions (quarters 1-2), constituting approximately 60-70% of the initial impact. The input cost effect grows in importance over quarters 3-6 as production processes adjust. The compliance effect demonstrates a more gradual buildup, becoming increasingly important in quarters 4-8. The cash flow effect shows a relatively stable contribution throughout the time horizon.

SECTOR-SPECIFIC MODERATING FACTORS

4.1 Moderators of Price Transmission

Table 2 presents the results for moderating effects on the price transmission mechanism, measured as the GST pass-through rate to consumer prices.

Table 2: Moderating Effects on Price Transmission

Moderating Factor	Coefficient	Std. Error	Significance
Market Concentration (HHI)	-0.385***	(0.092)	***
Number of Competitors	0.047***	(0.014)	***
Import Penetration	0.192**	(0.076)	**
Consumer Search Costs	-0.138**	(0.056)	**
Demand Elasticity	0.073*	(0.041)	*
Brand Loyalty Metrics	-0.167**	(0.069)	**
Distribution Channel Complexity	-0.081*	(0.043)	*

Dependent variable is the GST pass-through rate to consumer prices. Negative coefficients indicate factors that reduce pass-through, positive coefficients indicate factors that increase pass-through. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

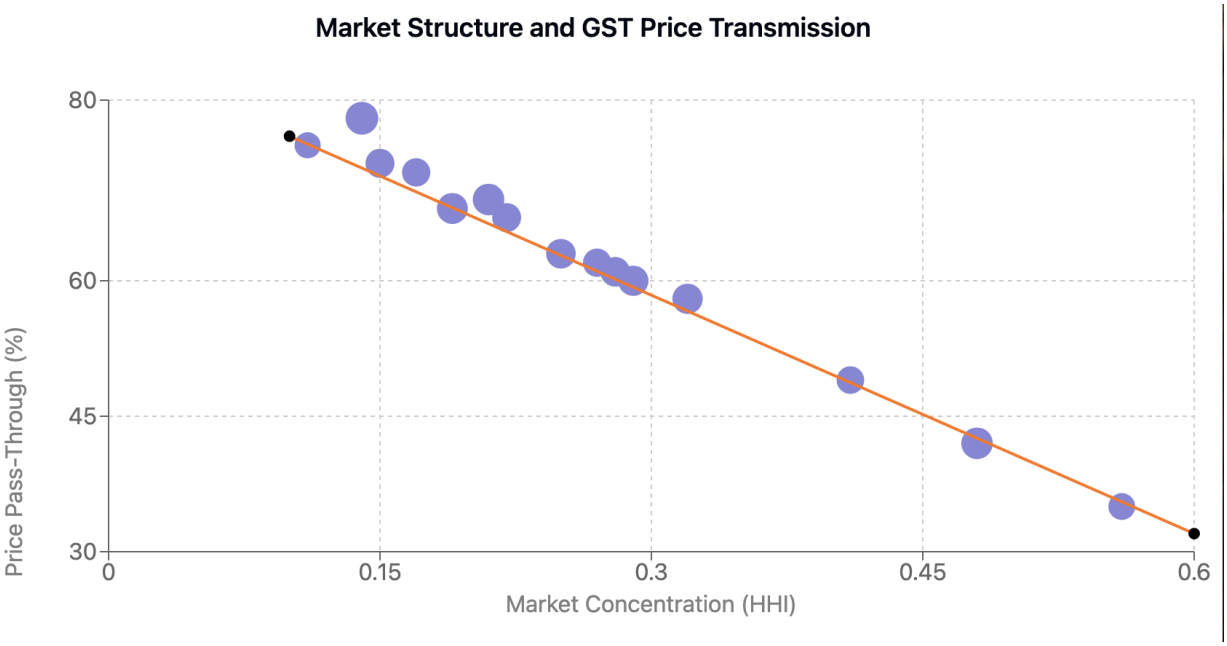

Figure 3: Market Structure and GST Price Transmission

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This scatter plot shows the strong negative relationship between market concentration (measured by Herfindahl-Hirschman Index) and GST pass-through rates. More competitive sectors (lower HHI) consistently demonstrate higher price pass-through rates, with each 0.1 increase in HHI associated with approximately 3.9 percentage points lower pass-through.

Market structure emerges as the strongest moderator of price transmission, with each 0.1 increase in HHI associated with approximately 3.9 percentage points lower pass-through rate. The number of competitors has a positive moderating effect, with each additional major competitor associated with approximately 4.7 percentage points higher pass-through. Import penetration positively moderates price pass-through, with sectors facing stronger import competition demonstrating approximately 19.2 percentage points higher pass-through for a 1-unit increase in import penetration ratio.

4.2 Moderators of Input Cost Transmission

Table 3 presents results for moderating effects on the input cost transmission mechanism.

Table 3: Moderating Effects on Input Cost Transmission

Moderating Factor	Coefficient	Std. Error	Significance
Input Credit Implementation Index	0.213***	(0.063)	***
Supply Chain Integration	0.187***	(0.057)	***
Input Supplier Concentration	-0.125**	(0.052)	**
Inventory Turnover Ratio	0.094**	(0.043)	**
Production Complexity	-0.078*	(0.041)	*
Input Substitutability	0.105**	(0.046)	**
Vertical Integration	-0.081*	(0.047)	*

The Input Credit Implementation Index, which measures the efficiency of input tax credit processing and refunds, shows the strongest positive moderating effect. Sectors experiencing better implementation demonstrated approximately 21.3% stronger input cost transmission. Higher supply chain integration positively moderates input cost transmission, with more integrated supply chains demonstrating approximately 18.7% stronger transmission of input tax reductions to output.

4.3 Moderators of Compliance Transmission

For the compliance transmission mechanism, initial informality level shows the strongest positive moderating effect, with sectors having higher pre-existing informality demonstrating approximately 26.8% stronger formalization responses to rate reductions. Enforcement effectiveness positively moderates compliance transmission, with sectors experiencing more robust enforcement demonstrating approximately 19.5% stronger formalization responses.

INPUT-OUTPUT LINKAGES AND INTERSECTORAL PROPAGATION

5.1 Network Analysis of GST Effects

To understand how GST rate reductions propagate through the economy via input-output linkages, we construct a weighted directed graph where nodes represent economic sectors, edges represent input-output relationships, and edge weights represent the strength of these relationships.

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Table 4: Network Centrality Measures and GST Propagation Effects

Sector	Out-Degree	In-Degree	Betweenness	Propagation Multiplier
Basic Metals	18.7	12.3	0.173	2.34
Chemicals and Petrochemicals	17.3	11.8	0.156	2.17
Transport and Logistics	15.8	19.4	0.187	2.26
Professional Services	14.2	21.5	0.192	2.31
Energy	21.4	9.7	0.168	2.42
Construction Materials	12.7	8.4	0.093	1.58
Consumer Durables	7.3	4.2	0.032	1.13
Pharmaceuticals	8.1	5.7	0.045	1.21
Agriculture and Allied	14.8	6.3	0.078	1.46

Note: Out-Degree represents the number of downstream sectors using the sector's outputs. In-Degree represents the number of upstream sectors supplying inputs to the sector. Betweenness measures the sector's importance as an intermediary in supply chains. Propagation Multiplier represents the ratio of total (direct + indirect) effect to direct effect.

The network analysis reveals substantial variation in propagation multipliers across sectors. Upstream intermediate input sectors (Basic Metals, Chemicals, Energy) show multipliers above 2, indicating that their total economic impact is more than twice their direct effect due to strong downstream linkages. Sectors with high betweenness centrality (Transport and Logistics, Professional Services) play crucial roles in transmitting tax effects throughout the economy. In contrast, sectors primarily producing final consumer goods (Consumer Durables, Pharmaceuticals) show much lower propagation multipliers (1.1-1.2).

5.2 Upstream and Downstream Propagation Asymmetries

The analysis reveals asymmetries in how tax effects propagate through supply chains. Tax reductions in upstream sectors show stronger downstream propagation effects, with approximately 65-75% of their indirect impact flowing to downstream customers through input cost reductions. In contrast, tax reductions in downstream sectors show more limited upstream propagation, with only 25-35% of their indirect impact flowing to upstream suppliers through increased demand.

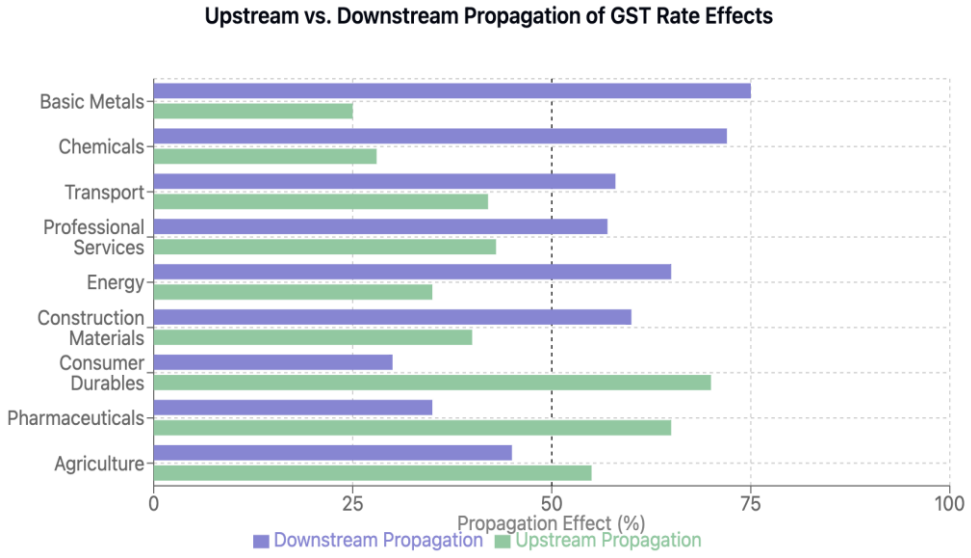

Figure 4: Upstream vs. Downstream Propagation of GST Rate Effects

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Propagation Multipliers	
Basic Metals	2.34
Chemicals	2.17
Transport	2.26
Professional Services	2.31
Energy	2.42
Construction Materials	1.58
Consumer Durables	1.13
Pharmaceuticals	1.21
Agriculture	1.46

Downstream propagation also occurs more rapidly (typically within 1-2 quarters) compared to upstream propagation (typically building over 3-4 quarters), reflecting differences in adjustment mechanisms.

POLICY COMPLEMENTARITIES AND IMPLEMENTATION EFFECTIVENESS

6.1 Complementary Policy Measures

Table 5 examines how complementary policy measures moderated the impact of GST rate changes.

Table 5: Impact of Complementary Policy Measures on GST Effectiveness

Complementary Measure	Base Effect	Interactive Effect	Net Effect
Simplified Return Filing	0.018** (0.009)	-0.053*** (0.017)	-0.035
Enhanced Input Credit Flow	0.023** (0.011)	-0.067*** (0.019)	-0.044
E-Invoice Implementation	0.015* (0.008)	-0.048*** (0.016)	-0.033
Composition Scheme Threshold	0.029*** (0.010)	-0.038** (0.018)	-0.009
Compliance Rating System	0.012 (0.009)	-0.031* (0.017)	-0.019
Anti-Profiteering Enforcement	-0.007 (0.008)	-0.028* (0.016)	-0.035

Base Effect column shows the direct impact of each measure on output growth. Interactive Effect column shows the additional impact when combined with GST rate reductions. Net Effect is the sum of these components. Standard errors in parentheses. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

Figure 5: Implementation Quality and GST Effectiveness

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Implementation quality significantly moderates GST effectiveness. Refund processing time shows the strongest correlation with tax elasticity (0.387), followed by the implementation composite index (0.412).

Simplified return filing shows both a positive direct effect (0.018) and a significant negative interactive effect with rate reductions (-0.053), indicating that rate reductions generated approximately 53% stronger output effects when implemented alongside simplification measures. Enhanced input credit flow mechanisms demonstrate the strongest complementarity with rate reductions, with the interactive effect (-0.067) indicating approximately 67% stronger output responses to rate changes when credit flow was improved.

6.2 Implementation Quality Variation

The correlation analysis between implementation quality metrics and GST elasticity reveals that refund processing time shows the strongest correlation with GST elasticity (0.387), with faster refunds associated with approximately 38.7% stronger tax elasticities. System downtime frequency demonstrates significant correlation with effectiveness (0.295), highlighting the importance of reliable digital infrastructure. The implementation composite index, combining multiple quality metrics, shows the strongest overall correlation (0.412).

THEORETICAL AND POLICY IMPLICATIONS

7.1 Implications for Tax Incidence Theory

Our findings contribute several insights to tax incidence theory. The empirical confirmation of multiple distinct transmission mechanisms challenges single-channel models of tax incidence. The strong moderating effect of market structure on price transmission provides empirical validation for industrial organization models of tax incidence under imperfect competition. The significant role of the compliance effect, particularly in developing economy contexts with large informal sectors, suggests that standard tax incidence models may need modification to incorporate formalization dynamics and compliance costs.

7.2 Implications for GST Policy Design

Our findings generate several actionable insights for GST policy design. Given the dominance of price effects in high-elasticity consumer sectors, prioritizing rate reductions in these sectors may generate larger immediate growth dividends compared to equivalent reductions in upstream sectors. The strong complementarities between rate reductions and administrative improvements suggest that tax policy should be designed as integrated packages that combine rate adjustments with simplification measures and input credit flow enhancements.

The significant moderating effect of market concentration on price transmission suggests that rate reductions in concentrated markets may need to be accompanied by competition policies to ensure consumer benefits. The influence of input-output linkages on propagation effects suggests that targeting rate reductions in sectors with high centrality and downstream supply chain length may generate larger economy-wide benefits through network effects.

CONCLUSION

This paper has provided a comprehensive analysis of the transmission mechanisms and moderating factors that shape the relationship between GST rate reductions and economic outcomes in India. Our findings demonstrate that tax policy transmission operates through multiple distinct channels with varying importance across different sectors and time periods.

The decomposition analysis revealed that price effects (38.5%) and input cost effects (33.4%) constitute the primary transmission channels, with compliance effects (16.0%) and cash flow effects (7.4%) playing secondary roles. Market structure emerged as the most significant determinant of price transmission effectiveness, with more competitive markets showing substantially stronger pass-through of tax reductions to consumer prices. Implementation quality significantly moderates input cost transmission, with better credit flow mechanisms enhancing the benefits of reduced input taxation.

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The network analysis of input-output linkages revealed important propagation patterns, with upstream intermediate sectors demonstrating propagation multipliers above 2, indicating substantial indirect effects beyond their direct impacts. The analysis also identified asymmetries in propagation directions, with downstream effects typically stronger and more rapid than upstream effects.

The examination of policy complementarities highlighted the importance of administrative and procedural reforms in enhancing tax policy effectiveness, with input credit flow improvements and return simplification showing the strongest complementary effects with rate reductions.

These findings contribute to both theoretical understanding of tax policy transmission in developing economies and practical policy design for optimizing GST reforms. The identified patterns of mechanism importance, moderating factors, and policy complementarities provide a foundation for more targeted, efficient tax policy approaches that account for sectoral heterogeneity, market structures, and implementation capacity constraints.

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