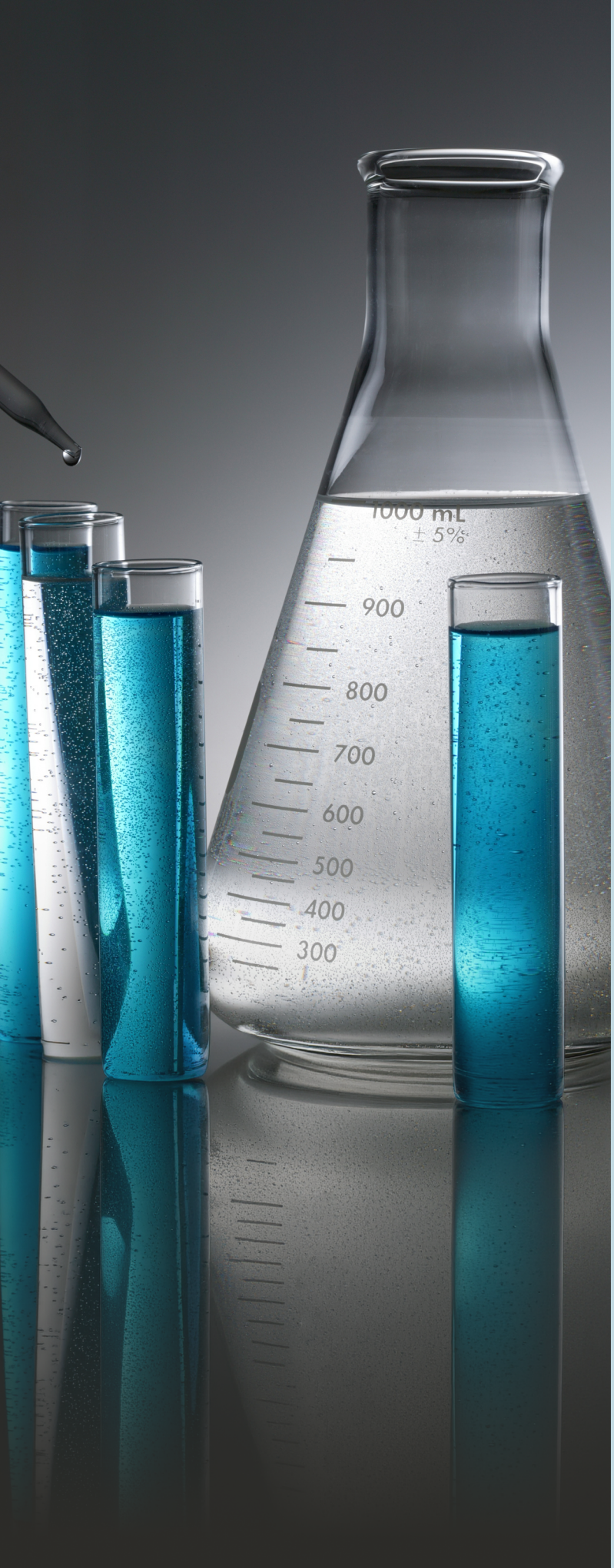

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Quality Control Orders in India's Chemical Sector

Supply-Chain Pressures and Firm-Level Outcomes

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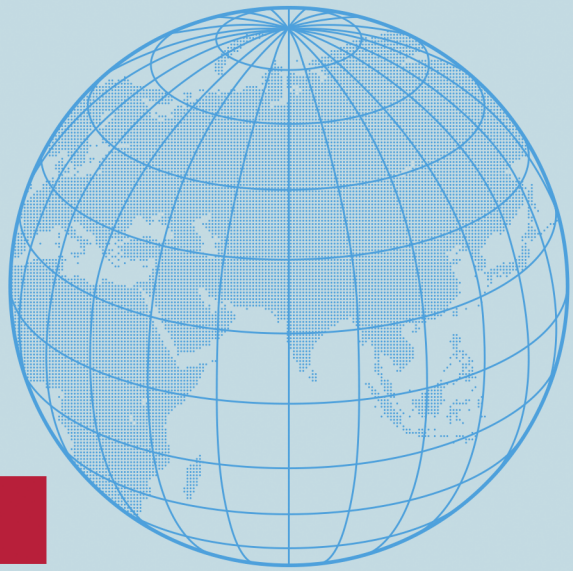

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Quality Control Orders in India's Chemical Sector

Supply-Chain Pressures and Firm-Level Outcomes

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Abbreviations

ASI	Annual Survey of Industries
BIS	Bureau of Indian Standards
CPC	Central Product Classification
CRGO	Cold-Rolled Grain-Oriented Steel
GVA	Gross Value Added
GVC	Global Value Chain
IHS	Inverse Hyperbolic Sine
MFN	Most Favoured Nation
MOSPI	Ministry of Statistics and Programme Implementation
MSME	Micro, Small and Medium Enterprises
NIC	National Industrial Classification
NPCMS	National Product Classification for Manufacturing Sector
QCO	Quality Control Order
UNSD	United Nations Statistics Division
WTO	World Trade Organization

Executive Summary

Towards the end of 2025, there was a policy decision to revoke several Quality Control Orders (QCOs), and it received mixed responses from the industry. While for some, it signals policy uncertainty, for others, it is a welcome step as it reduces the excessive compliance burdens.

Nevertheless, the revocation represents a policy move in the right direction and is likely to encourage a more streamlined approach toward QCOs in the pipeline. Such reassessment could be led by the same factors that led to the recent withdrawals, enabling a more calibrated and evidence-based framework.

The decision to revoke QCOs was largely driven by concerns around their application to intermediate goods, which was one of the key observations in Prabhakar (2025). While the likely supply-chain disruptions arising from QCOs on intermediate goods have been recognised, it is important to empirically substantiate this concern. Moreover, many QCO-affected sectors are characterised by high firm concentration, making it possible that QCOs could further aggravate this concentration. These issues require deeper investigation. In this context, this paper makes an important contribution by providing firm-level evidence on the supply-chain and competition implications of QCOs.

- The paper uses firm-level data and maps existing QCOs to both the outputs produced by firms and the inputs used in production over the full panel period from financial year (FY) 2015 to FY 2024.
- It focuses on chemical-using firms to analyse the impact of QCOs on regulated inputs and outputs, and their effects on firms' gross value addition, production, and profits.
- The analysis disaggregates these impacts across firm sizes to capture heterogeneity in the effects of QCOs.

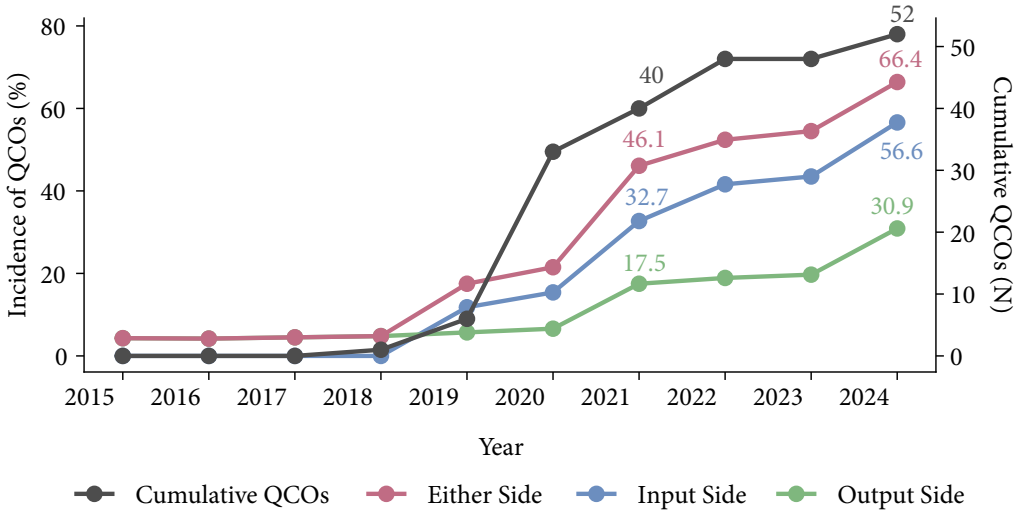
Supply-Chain Implications

QCOs have increasingly shaped India's manufacturing supply chains, particularly by targeting intermediate goods, an issue that has driven strong industry pressure and led to the revocation of several QCOs. About 46% of QCOs in force by December 2024 applied to intermediate inputs, raising concerns about downstream production disruptions. Against this backdrop, this paper focuses on one critical manufacturing input, i.e., chemicals.

Using panel data from the Annual Survey of Industries (ASI), this study identifies firms using chemical inputs and assesses the impact of QCOs on both inputs and firm output. Over the past decade, around 2,731 firms have reported using chemical inputs. Chemical inputs are most intensively used within the chemical sector itself, followed by rubber and plastics, pharmaceuticals, and electronics.

The analysis shows a sharp expansion of QCO coverage after 2018. Chemical-related QCOs increased from virtually none before 2018 to 52 by 2024, resulting in 56.6% of chemical-using firms being affected on the input side and 66.4% on either the input or output side.

Figure ES–1: Proportion of Quality Control Order-Impacted Firms in the Chemical-Using Sector (in per cent)



Source: Authors' calculations based on data from the Annual Survey of Industries.

Note: QCO = quality control order.

Regression Results: Understanding the Impact of Quality Control Orders on Firm Performance

The impact of QCOs is assessed using three performance indicators—gross value added (GVA), profits, and production—across two broad dimensions: the overall impact and heterogeneous effects differentiated between small and large firms. The key results are as follows:

Overall Impact

- Production value increases by 9.6% as a consequence of QCOs on inputs, which may be reflective of higher prices of output, as firms pass on some of the increased input costs to consumers.
- Firms exposed to QCOs on inputs experience a 37% decline in GVA.
- Overall, the results suggest that in the case of input QCOs, firms expand production even as efficiency deteriorates.
- Output-side QCOs show no statistically significant effects on GVA, profits, or production, indicating that they do not improve firm-level production as intended by these regulations.

Heterogeneous Effects

- The combined effect of input and output QCO exposure is negative and statistically significant for small firms across all three outcomes, i.e., production, GVA, and profits.
- The combined effects for large firms are positive in magnitude for production, at 12.3%, and are not statistically significant for GVA and profits.
- Among larger firms, exposure to input QCOs is associated with an increase in production value by 9.6%, reflective of higher product prices passed on to consumers. Consequently, there is a sharp decline in GVA, which falls by 37%.
- For smaller firms, while input QCOs have no significant impact on production and GVA, they lead to a significant decline of 47.6% in their profitability due to high-cost burdens.
- Output QCOs hit smaller firms even harder across margins, with GVA declining by 44% and profits by 58.9%, while remaining insignificant for larger firms' efficiency and profitability.

The key takeaway from the results is that input-side QCOs lead to an increase in production, but are associated with significant declines in efficiency, as reflected in reduced GVA. Output-side QCOs, in contrast, show no meaningful impact on firm performance across outcomes. The effects are highly uneven across firms and also vary according to whether a QCO is on the input side, the output side, or both. Larger firms expand output but with a decline in GVA, while smaller firms face sharp declines in all firm-level performance indicators.

Overall, QCOs appear to increase production without improving value added and firm-level competitiveness, with disproportionately adverse effects on smaller firms.

Policy Suggestions

To address these distortions, the QCO framework must be reformed along two dimensions: introduction and implementation. New QCOs should be imposed strictly on quality grounds, with clearly articulated objectives. Intermediate goods should be regulated with particular caution, given their systemic role in production. Before imposing QCOs, policymakers must assess domestic production capacity and ensure adequate testing and certification infrastructure.

Revamping the QCO regime requires consistent, evidence-based reassessment of existing QCOs and thorough examination of upcoming ones. Reducing the regulatory burden on Micro, Small and Medium Enterprises (MSMEs) and safeguarding supply-chain efficiency are essential for strengthening competitiveness and enabling India's integration into Global Value Chains (GVCs).

1. Introduction

India's rampant use of QCOs has attracted considerable attention from key stakeholders, including the domestic industry and importers. Upholding the principles of National Treatment within the framework of World Trade Organization (WTO) rules, these regulations require both domestic manufacturers and importers to ensure that their products meet all testing and certification requirements before being sold in the market. QCOs are conceptualised by the respective line ministries and enforced by the Bureau of Indian Standards (BIS).

Voluntary standards already existed in Indian manufacturing before QCOs were introduced. However, under Section 16 of the BIS Act, 2016, these standards were made mandatory through QCOs, which significantly disrupted production processes and supply chains across the economy (BIS Act, 2016; Kant & Mittal, 2025).

The number of QCO-impacted products increased sharply from 88 in 2019 to 765 in 2024; the majority of QCOs apply to intermediate goods or raw materials, placing supply chains at risk. The recent withdrawal of several QCOs (Ministry of Chemicals and Fertilizers, 2025; Ministry of Textiles, 2025) is therefore a welcome step to prevent the disruptions these regulations have caused to supply chains and to the overall competitiveness of Indian manufacturing. This momentum needs to be sustained by revoking QCOs on key inputs and carefully assessing those in the pipeline against criteria such as the availability of domestic substitutes and whether the products are intermediate or final goods. Given that QCOs affect a range of intermediate goods, it is essential to assess their supply-chain implications by examining the impact on user industries that rely on QCO-affected inputs.

Another concern regarding QCOs relates to firm concentration, both as a motivation for imposing these regulations and as a consequence of their implementation. For instance, sectors dominated by QCOs, including metals, chemicals, and textiles, exhibit high firm concentration, and imposing stringent quality regulations in such contexts risks further intensifying market concentration (Prabhakar, 2025). In such cases, even if production gains occur, it becomes essential to understand how these gains are distributed across firms of different sizes to assess whether the benefits accrue uniformly to the domestic economy or disproportionately to large incumbents. It is also important to assess whether these gains translate into value addition and profits, which are actual indicators of net gains.

In this context, the paper focuses on firms that use a critical manufacturing input, i.e., chemicals, and examines their exposure to QCOs through regulations imposed both on the inputs and on the outputs produced by the firms. The analysis assesses how QCOs on chemical inputs, as well as on final outputs, affect firm-level outcomes such as GVA, profits, and production (proxied by a firm's output expressed in rupee value), and evaluates whether these effects differ across firm sizes, categorised as micro, small, medium, and large.[1]

[1] Firm-size categories are constructed based on turnover (total output), following the post-2020 MSME definition. Firms are classified as micro: < ₹5 crore; small: ₹5–50 crore; medium: ₹50–250 crore; and large: > ₹250 crore.

Section 2 discusses the supply-chain implications of QCOs by examining preliminary data trends on QCO incidence among chemical-using firms. Section 3 outlines the methodology adopted for mapping the QCOs with the firm-level data and the econometric analysis. Section 4 presents the regression results, and Section 5 concludes the analysis and explores the associated policy implications and potential reform options.

2. Supply-Chain Implications of Quality Control Orders

QCOs, when applied to intermediate goods, generate spillover effects across the entire supply chain. This has been a key reason behind industry pressure on the government to reconsider these orders, ultimately leading to the revocation of several QCOs. According to Prabhakar (2025), around 46% of existing QCOs as of December 2024 apply to intermediate goods, which can have adverse implications for downstream production.

The paper focuses on chemical-using industries as chemicals are a key intermediate input to a wide range of downstream manufacturing activities, like plastics, pharmaceuticals, electronics, and non-metallic minerals. As most QCOs broadly target intermediate goods, focusing on chemicals can help in understanding how input-specific regulations cascade through the supply chains and affect firm-level performance. The chemical sector was among the top five QCO-impacted sectors, notified as of 2024 (Prabhakar, 2025). Approximately 33[2] QCOs in the chemicals sector were withdrawn in 2025, leaving 28 QCOs still in force (Department of Chemicals and Petrochemicals, Government of India, 2025a, 2025b). Moreover, chemical-using sectors account for a large share of organised manufacturing firms in the ASI data, ensuring that results are relevant for policy decisions. In terms of tariff protection, the Most Favoured Nation (MFN) average tariff on chemicals was increased from 9.5% in 2017 to 10.2% in 2018, and remained around that level thereafter (10.27% in 2023).

Panel data from ASI were used to identify all firms that use chemicals as inputs (details in Section 3). Once this sample was constructed, the impact of QCOs on chemicals and on the output produced by these firms was assessed through an empirical exercise (more details on the empirical framework are provided in Section 3).

Output-side QCOs impose stricter quality requirements, raising compliance and certification costs, which are reflected in higher production costs and, ultimately, higher prices. This can lead to lower production (and profits and GVA), particularly for smaller firms operating on thin margins. Larger firms are likely better positioned to absorb these output-related costs without significant declines in production, profits, or GVA, as brought out in stakeholder consultations in Prabhakar (2025).

[2] Excluding the five textile-related QCOs.

Input-side QCOs can restrict the supply of intermediate inputs by limiting access to imported and uncertified domestic suppliers. As a result, firms are forced to reallocate sourcing and absorb higher input costs. While input quality may improve, these higher costs are transmitted through the production chain, leading to higher final output prices. Through multiplier effects, this can have a disproportionately disruptive impact on output, especially for smaller firms. Importantly, the resulting cost escalation can be detrimental to firm profitability and GVA, affecting not only smaller firms but even larger firms that rely on cost-efficient input sourcing.

The data include approximately 2,731 firms that have reported using chemical inputs over the last decade. The distribution of these firms across broad sectors, as of 2024, is presented in Table 1. As expected, upstream chemical products are used in downstream chemical processes, making the chemical sector the largest user segment of chemical inputs, accounting for 29% of firms, followed by the rubber and plastic products manufacturing industry (18.3%), pharmaceuticals (12.6%), and electronics manufacturing industries (6.7%).

Table 1: Sectoral Composition of Chemical-Using Manufacturing Firms, 2024

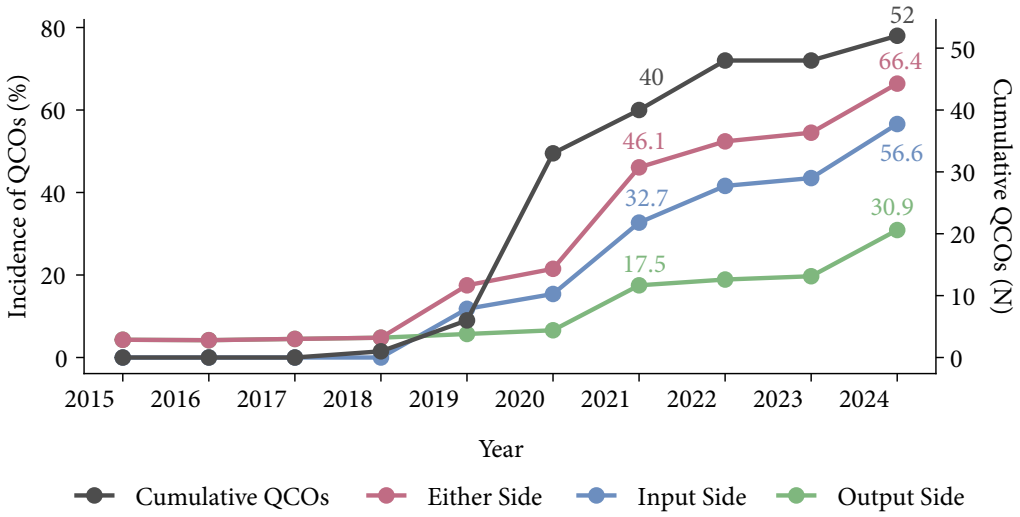
Rank	NIC code	Sector	%
1	20	Chemicals and chemical products	29.0
2	22	Rubber and plastic products	18.3
3	21	Pharmaceuticals, medicinal chemicals, and botanical products	12.6
4	27	Electrical equipment	6.7
5	23	Other non-metallic mineral products	3.9

Source: Authors' calculations based on data from the Annual Survey of Industries and the Ministry of Statistics and Programme Implementation.

Note: NIC = National Industrial Classification.

Figure 1 sets out the proportion of chemical-using firms across sectors that are affected by the incidence of QCOs on either their inputs or outputs. As of 2015, there were about 52 QCOs notified across sectors (Prabhakar, 2025), but the first QCO on chemicals was introduced only in 2018. Consistent with this, there was no exposure for chemical-using firms on the input side until 2018, whereas about 4.5% of chemical-using firms experienced QCO incidence on their outputs. The cumulative number of chemical-related QCOs then rose sharply, from 6 in 2019 to 52 in 2024, and the share of chemical-using firms affected on the input side increased steadily over this period. By 2024, 56.6% of all firms using chemicals as inputs were impacted, and 66.4% of chemical-using firms faced QCO incidence from either the input or the output side.

Figure 1: Proportion of Quality Control Order-Impacted Firms in the Chemical-Using Sector (in per cent)

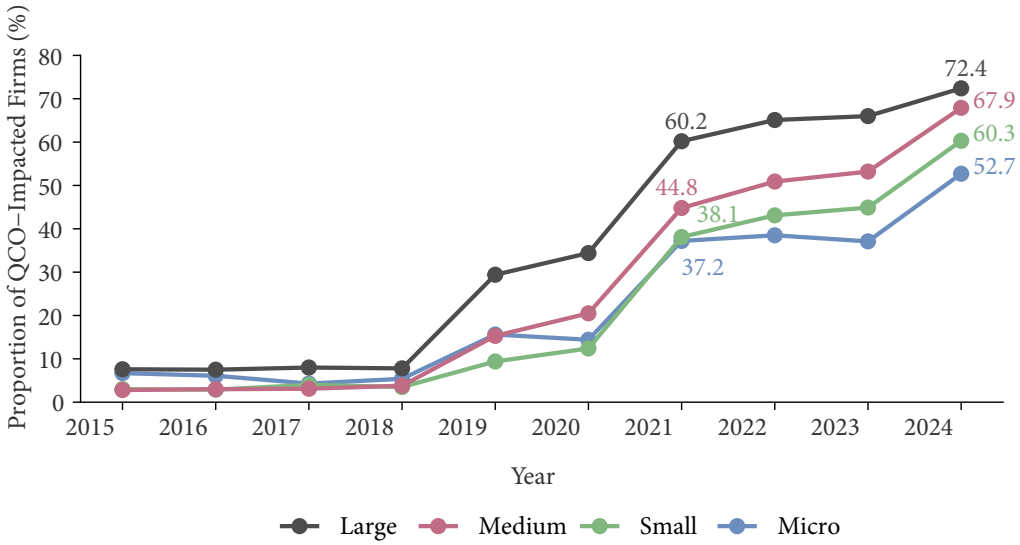


Source: Authors' calculations based on data from the Annual Survey of Industries.

Note: QCO = quality control order.

Figure 2 reports the share of QCO-impacted firms in each size category (micro, small, medium, and large) as a proportion of total firms in that size group, for each year from 2015 to 2024. Understanding QCO exposure across different firm sizes shows that, as of 2024, large firms account for about 72.4% of all chemical-using firms impacted by QCOs, followed by 67.9% of medium, 60.3% of small, and 52.7% of micro firms (Table 3). For the period prior to 2019, the impact of QCO exposure on chemical-using firms is observed only through the output channel, since the first QCO on chemicals was introduced in 2018.

Figure 2: Proportion of Quality Control Order-Impacted Firms Across Various Sizes



Source: Authors' calculations based on data from the Annual Survey of Industries.

Note: QCO = quality control order.

A comparison of annual growth rates[3] of production between QCO-impacted and non-impacted firms indicates that micro and small enterprises subject to QCOs tend to perform worse than those not covered by these regulations. For instance, among micro chemical-using firms, QCO-impacted firms experience a sharper slowdown in production growth, a decline of 5.7%, compared to non-QCO firms (-4.7%). Similarly, small QCO-impacted firms record production growth of only 0.5%. In contrast, large chemical-using firms perform better under the QCO regime. Production for non-QCO large firms grows at a rate of 11.3%, while QCO-impacted firms exhibit a higher growth rate of around 12.7% over the period 2019–2024 (Table 2).[4]

[3] Annual firm-level growth was computed as the first difference of the natural logarithm of output between consecutive years. For each year, average growth rates were calculated separately by firm size and QCO exposure status. Table 2 reports the simple arithmetic mean of these annual firm-size wise growth rates over the period FY 2019–FY 2024.

[4] Similar growth trends for GVA and profits could not be computed because growth rates derived from logarithmic values would exclude observations with negative GVA or profits. This would substantially reduce the sample size, resulting in an incomplete picture based on a smaller set of firms and making the results incomparable with production-level trends. This limitation is addressed in the regression analysis through the use of appropriate transformations that allow for the inclusion of zero and negative values.

Table 2: Growth in Production for Quality Control Order and Non-Quality Control Order Chemical-Using Firms (Financial Years 2019 and 2024)

Chemical-Using Firms	Total Output	
	No QCO on input side (%)	QCO on input side (%)
Micro	-4.74	-5.7
Small	3.52	0.52
Medium	8.12	8.24
Large	11.32	12.67

Source: Authors' calculation.

Note: QCO = quality control order.

While these descriptive statistics indicate the possible impact of QCOs on inputs and outputs on the production of chemical-using firms, a more sophisticated econometric analysis is required to account for other confounding factors and to provide robust evidence.

3. Empirical Methodology

The analysis begins by constructing a national concordance between India's QCOs and manufacturing products. About 765 products were under the ambit of QCOs, introduced through 166 government notifications, as of December 2024 (Goyal, 2025). Each of these 765 products was systematically linked to a seven-digit National Product Classification for Manufacturing Sector (NPCMS) code. The NPCMS, developed by the Ministry of Statistics and Programme Implementation (MOSPI), is harmonised with the United Nations Statistics Division's (UNSD) five-digit Central Product Classification (CPC), ensuring international comparability of product definitions and facilitating consistent mapping of regulatory measures to manufacturing output. The year in which each QCO was notified was also recorded.

Firm-level exposure to QCOs was identified using microdata from ASI for FY 2015–FY 2024, compiled annually by MOSPI. Firms were classified as chemical users based on their top-reported input products (based on the highest rupee value of expenditure), either sourced domestically or imported. Consequently, the presence of a QCO on any of these top inputs reflects the firm's intensity of exposure to QCOs. To align regulatory timing with firm-year outcomes, each QCO notification year was mapped to the subsequent FY (for example, a 2023 notification was treated as binding in FY 2024), reflecting typical implementation lags of 1–3 months or longer in some cases, and ensuring that the QCO was in force for most months within the corresponding FY.

Input-side QCO exposure is measured by mapping each firm's input NPCMS codes to the QCO database, constructing a dummy equal to one if any of the input products

were covered by at least one QCO for that firm in a given year. Output-side exposure was defined analogously, with the dummy set to one if any of the primary output NPCMS codes fell under the ambit of a QCO in the same year. Three composite indicators were then formed: QCO on inputs only, QCO on outputs only, and QCO on both sides, to enable a clean separation of upstream (input-cost channel) and downstream (demand or compliance channel) effects in subsequent regressions.

A balanced firm-level panel was constructed for 2,731 chemical-using firms, spanning FY 2015–FY 2024. Outcome variables include total output, total input, GVA, profits, fixed capital, and labour (measured as the number of workers), all drawn directly from the ASI dataset for these chemical-using firms.

Firms were classified into four size categories using turnover (total output), following the post-2020 MSME definition: micro (< ₹5 crore), small (₹5–50 crore), medium (₹50–250 crore), and large (> ₹250 crore) (MSME, 2020). The empirical strategy interacted QCO exposure indicators with firm-size dummies to estimate differential QCO impacts across these categories. For simplicity within the regression analysis, firms were further grouped into two size classes: "small" firms (combining micro and small) and "large" firms (combining medium and large).

Table 3 shows the distribution of 2,731 chemical-using firms from ASI data across size categories based on turnover in 2024, with 3% missing information. Medium-sized firms dominate the sample at 991 firms (36.3%), followed closely by large firms at 941 (34.5%), together comprising 70.8% of the sample. In contrast, micro and small firms represent 26.2% of the sample (226 micro firms, or 8.2%; 491 small firms, or 18.0%).

Table 3: Distribution of Quality Control Order-Impacted Firms Across Various Sizes

Firm Category	Criteria	Chemical-Using Firms	
		Number of firms	%
Micro	Turnover less than ₹5 crore	226	8.2
Small	Turnover between ₹5 crore and ₹50 crore	491	18.0
Medium	Turnover between ₹50 crore and ₹250 crore	991	36.3
Large	Turnover above ₹250 crore	941	34.5
Missing	Turnover information is not available	82	3.0
Total	-	2,731	100.0

Source: Authors' calculations based on data from the Annual Survey of Industries.

The analysis examined how QCOs affect firms' production, value added, and profits. The value of a firm's total output is used as a proxy for gross production. By

comparison, GVA is used as the primary indicator of efficiency, since it measures the additional value created over and above intermediate inputs and thus captures a firm's true contribution to economic output.

The analysis is based on firm-level panel data, and the specification employs a regression model with year and industry fixed effects, along with QCO exposure and firm-size dummy variables. Year fixed effects account for aggregate shocks common to all firms in a given year (such as macroeconomic conditions or nationwide policy changes), while industry fixed effects absorb time-invariant sectoral characteristics, including technology, average mark-ups, and capital intensity. Together, these fixed effects account for unobserved heterogeneity across industries and over time, ensuring that the estimated coefficients on the QCO exposure variables are not driven by broad macro or sectoral trends but by within-industry, over-time variation in firms' regulatory exposure.[5]

The regression model looks at firms' GVA, measured using the inverse hyperbolic sine (IHS) transformation (Bellemare & Wichman, 2020), to accommodate negative and zero values in the data for GVA. Subsequent models estimate the effects of QCOs on firms' profits and production, proxied by firm total output expressed in rupee value. Coefficients from IHS-transformed regressions should strictly be interpreted as changes in the transformed outcomes rather than as exact elasticities.

The regression model below (equation 1) estimates the association between input- and output-side QCO exposure and firm performance, while controlling for time and industry effects. The model incorporates interaction terms between QCO exposure and firm size to capture heterogeneous effects across firms. This specification allows for the impact of input- and output-side QCOs to vary between small and large firms, thereby disentangling policy-induced effects from underlying differences in firm size.

$$IHS(Y_{it}) = \beta 1 QCO_{Input_{it}} + \beta 2\, QCO_{Output_{it}} + \beta 3\, FS_{it} + \beta 4\, (QCO_{Input_{it}} X\, FS_{it}) + \beta 5\, (QCO_{Output_{it}} X\, FS_{it}) + \gamma_t + \delta_j + \varepsilon_i \quad (1)$$

Here,

Y_{it} : Firm performance indicators (production, GVA, or profit);

$QCO_{Input_{it}}$: Dummy equal to 1 if any inputs used by firm *i* are subject to a QCO in year *t*;

$QCO_{Output_{it}}$: Dummy equal to 1 if any outputs produced by firm *i* are subject to a QCO in year *t*;

[5] The analysis did not add the firm fixed effects as key regressors because the QCO exposure dummies are time-varying at the firm–industry–year level and vary little within firms over the short 10-year panel (2015–2024), leading to severe collinearity and loss of degree of freedom. Industry fixed effects already control for persistent sectoral differences (e.g., capital intensity, technology), while year fixed effects absorb common shocks, ensuring the coefficients identify policy effects from within-industry, over-time variation in QCO exposure.

FS_{it} : Firm size dummy equal to 1 for small firms and 0 for large firms;

γ_t : Year fixed effects, capturing aggregate shocks common to all firms (e.g., macroeconomic conditions, policy changes, commodity price cycles);

δ_j : Industry fixed effects, controlling for time-invariant sectoral characteristics (e.g., capital intensity, technology);

ε_i : Error term, with standard errors clustered at the firm level.

In addition, the analysis is extended across alternative firm performance indicators by sequentially using IHS (production), IHS (GVA), and IHS (profits) as the dependent variable, while retaining the same set of explanatory variables and fixed effects. This ensures a consistent comparison of how QCO exposure affects firms' production, GVA, and profitability.

A series of robustness checks was conducted to assess the stability of the baseline results (given in Appendix Tables A–1, A–2, and A–3). First, the regressions were re-estimated for the unbalanced panel to account for firm entry and exit over time, with the estimated coefficients remaining quantitatively and qualitatively consistent with the baseline findings. Second, in specifications where production was used as the dependent variable, labour and capital inputs were explicitly included to account for the underlying production function. Finally, the regressions were re-estimated after excluding firms that reported negative GVA in all 10 years of the sample period. Across all these alternative specifications and sample restrictions, the results remain closely aligned with the baseline estimates, supporting the robustness of the findings. The large number of observations and the use of robust standard errors support the statistical reliability of the estimated relationships. The analysis captured contemporaneous effects, given the short study period (10 years) for examining long-term QCO impacts.

The regression models were assessed for standard econometric issues, including autocorrelation and heteroskedasticity, and heteroskedasticity–robust standard errors were employed where appropriate. Panel unit root tests indicate that all main variables used in the analysis, including value added, profits, and output, are stationary. Accordingly, the discussion in Section 4 focuses on results obtained from these regression specifications.

4. Results

This section presents the regression results on the impact of QCOs on firm performance in the chemical-using segments. The discussion first summarises the overall impact of QCOs on these alternative performance measures and then draws out the cross-cutting implications for how such regulations reshape the structure of organised manufacturing.

Table 4 presents the estimated effects of QCO exposure on firm performance across output, GVA, and profits. It also reports the baseline coefficients from the fixed-effects specification. Table 5 presents linear combinations derived from coefficients in equation 1, using their values from Table 4. The calculation criteria for these linear combinations are given in Appendix Table A–4.

The model indicates a positive association between input QCOs and production value by 9.6% (significant at the 1% level). This is possibly reflective of increased output prices due to high input costs. It is supported by the negative impact of input QCOs on GVA. The estimates suggest that input-side QCOs are associated with sizeable declines of 37% (significant at the 5% level) in value added for chemical-using firms, while output-side QCOs show no statistically significant effects on any performance measure. This pattern points to higher output prices due to high-cost inputs, implying that the high costs are passed on to the consumers.

The heterogeneous effects of firm size are captured by interaction variables in the model to test for heterogeneity in QCO impacts by firm size. The regression results reveal a sharp distributional pattern.

Table 4: Effect of Quality Control Orders on Firm Production, Gross Value Added, and Profit by Size

Dependent Variable:	IHS (Production)	IHS (GVA)	IHS (Profit)
QCO on input	9.61*** (1.42)	-37.0** (14.9)	-22.1 (14.2)
QCO on output	2.69 (1.77)	5.02 (22.2)	6.23 (20.6)
Small firm	-70.2*** (3.46)	-23.6 (17.7)	-57.8*** (16.6)
Small × QCO on input	-14.1*** (3.30)	17.0 (19.0)	-25.5 (17.7)
Small × QCO on output	-6.36 (4.05)	-49.0* (27.1)	-65.1*** (25.2)
Year FE	✓	✓	✓
Sector FE	✓	✓	✓
Observations	26,479	26,478	26,478

Source: Authors' analysis.

*Note: Firm size dummy = 1 for small firms and 0 for large firms. Entries are coefficients (in per cent). Robust standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.*

GVA = gross value added; IHS = inverse hyperbolic sine; FE = fixed effects; QCO = quality control order.

Table 5: Linear Combinations (Marginal Effects) of Quality Control Order Effects on Firm Output, Gross Value Added, and Profit

Dependent Variable	Firm Size	QCO on Input	QCO on Output	Combined QCO Effect
IHS (Production)	Large firms	9.61*** (1.42)	2.69 (1.77)	12.30*** (0.0221)
	Small firms	-4.54 (3.19)	-3.67 (3.77)	-8.20* (4.49)
IHS (GVA)	Large firms	-37.0** (14.9)	5.02 (22.2)	-32.02 (26.33)
	Small firms	-20.07 (15.36)	-44.00** (19.02)	-64.08*** (23.17)
IHS (Profit)	Large firms	-22.1 (14.2)	6.23 (20.6)	-15.92 (24.63)
	Small firms	-47.69*** (14.29)	-58.89*** (18.58)	-106.57*** (22.09)

Source: Authors' analysis.

*Note: Entries are coefficients (in per cent). Robust standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.*

GVA = gross value added; QCO = quality control order; IHS = inverse hyperbolic sine.

Table 5 provides a clearer picture of the net effects by firm size. The combined effect of input and output QCO exposure is negative and statistically significant for small firms across all three outcomes, i.e., production, GVA, and profits, indicating a broad contractionary impact on firm performance. In contrast, the combined effects for large firms are positive in magnitude for production value, at 12.3% (significant at the 5% level), and generally not statistically significant beyond production.

Among larger firms, exposure to input QCOs is associated with an increase in production by 9.6% (significant at the 1% level). However, this expansion in output is accompanied by a sharper decline in GVA, which falls by 37%, significant at the 5% level. This trend mirrors the overall patterns reported in Table 4, indicating that the aggregate results are largely driven by large firms. These firms pass on increased input costs to consumers through higher output prices.

QCOs increase the cost of key intermediate inputs, and larger firms, due to their significantly larger scale of production and input usage, experience a disproportionately larger increase in input costs. While these firms continue to expand or maintain output levels (as reflected in the positive output coefficients), the increase in intermediate input costs outweighs the gains from higher output, leading to a larger decline in GVA.

For smaller firms, while input QCOs have no significant impact on production and GVA, they do lead to a significant 47.6% decline in profitability due to huge cost burdens.

Output QCOs hit smaller firms even harder across margins, with GVA declining by 44% (at the 5% significance level) and profits by 58.9% (at the 1% significance level), while remaining insignificant for larger firms' efficiency and profitability.

These results underscore that input regulations impose universal efficiency costs but allow bigger players to expand production at the cost of smaller firms that operate on extremely thin margins, potentially accelerating manufacturing concentration. These patterns align with evidence that non-tariff measures like QCOs disproportionately burden MSMEs by raising input costs and limiting import access, potentially consolidating market share toward larger players and hindering organised manufacturing's breadth (Gupta, 2023). This highlights the importance of accounting for firm heterogeneity when designing and implementing regulatory standards, particularly in sectors characterised by significant size-based differences in compliance capacity.

5. Policy Recommendations and Conclusion

The pace at which QCOs have been implemented has been overwhelming for industry, largely due to inadequate preparedness and significant supply-chain disruptions. Despite their well-intentioned objectives, QCOs became problematic because of the wide product coverage, high frequency of notifications, and complex compliance requirements.

The government should therefore be commended for its recent withdrawals, as it acknowledged the challenges faced by the Indian industry and revoked several QCOs in the second half of 2025. Evidence from Prabhakar (2025) highlights the potentially disruptive impact of these regulations, noting that a large share of existing QCOs apply to intermediate goods that are critical for production supply chains. While these measures have led to a decline in imports, they have not been accompanied by corresponding export gains. It is essential that both existing QCOs and those in the pipeline are systematically reassessed to safeguard the domestic economy, especially in a period of global economic uncertainty.

This paper focuses on two key trends related to QCOs. First, QCOs that target intermediate goods pose the highest risks to supply chains. Second, since many QCO-affected sectors are characterised by high firm concentration and dominated by large incumbents, such regulations risk further intensifying market concentration, potentially disadvantaging smaller firms, and weakening overall competitiveness.

Against this backdrop, the paper examines the impact of QCOs on a key manufacturing input, chemicals, and their effects on firms' GVA, profit, and production levels. For these input-using industries, the impact of QCOs imposed on their own outputs is also assessed. Further, the analysis disaggregates these effects across small and large firms to better understand the differential impact of QCOs across firms.

The key takeaway from the results is that input-side QCOs lead to an increase in production value (as higher prices absorb the high input costs), but are associated with significant declines in efficiency, as reflected in reduced GVA. Output-side QCOs, in contrast, show no meaningful impact on firm performance across

outcomes. The effects are highly uneven across firms and also vary according to whether a QCO is on the input side, the output side, or both: larger firms expand output but with a decline in GVA, while smaller firms face sharp declines in all firm-level performance indicators. Overall, QCOs appear to increase production without improving firm-level competitiveness, with disproportionately adverse effects on smaller firms.

As highlighted in Prabhakar (2025), many sectors covered under QCOs already exhibit high levels of firm concentration. This implies that these dominant firms influence the implementation of these regulations in their respective sectors. According to Herghelegiu (2018), the participation of national business groups at the Ministerial Conferences, the highest authority of the WTO, is positively associated with the probability of adopting non-tariff measures, lending support to the argument that large firms drive the adoption of these measures.

The findings of the analysis in this paper suggest that QCOs may be further intensifying this concentration, with adverse implications for competition and long-term manufacturing competitiveness.

To rectify the situation, QCOs need to be rethought from two broad perspectives: the introduction of such QCOs and their implementation.

With regard to the introduction, it is important to understand how the criteria for introducing QCOs are determined, particularly in cases where the objective of ensuring product quality must be balanced against maintaining supply-chain efficiency and cost competitiveness in the domestic market.

In terms of implementation, it is clear that MSMEs, being crucial suppliers within many production value chains, need targeted support to comply with QCO requirements. Ensuring smoother compliance processes will be essential to prevent supply-chain disruptions and to maintain the competitiveness of smaller firms.

- ***Clearly Identify the Criteria for Quality Control Order Implementation***

QCOs should be implemented purely for quality-related reasons and not as a means to address price disadvantages, as there are other policy tools available to deal with such issues. For quality purposes, it is essential to clearly specify the intended quality objectives of the product, similar to how this is done under European Union regulations. A well-researched rationale should be provided to justify the need for a QCO on any product, strictly on quality grounds.

In this regard, it is recommended that QCO notifications clearly specify the rationale for imposing a QCO on a given product, explicitly indicating the quality or safety objective being targeted, such as protection of human, animal, or plant health; environmental protection; child safety; or the prevention of unfair trade practices (as laid out by BIS, 2021).

- ***Limit Quality Control Orders on Intermediate Goods***

Around 45.7% of QCOs have been imposed on intermediate goods, posing a risk of disrupting supply chains. The top QCO-impacted sectors include metals, chemicals, and textiles, which are critical upstream industries whose disruption can have significant spillover effects across the entire supply chain. For instance, a firm-level assessment of chemical-using firms reveals that the share of QCO-impacted firms in this category increased from 0% in FY 2018 to around 56% in FY 2024, indicating a substantial rise in regulatory exposure over time.

Some of the chemical-using sectors, like textiles, are impacted adversely, and the share of QCO-impacted firms has increased from 0% in FY 2018 to 77% in FY 2024, which signals a regulatory burden that risks undermining these firms' competitiveness, specifically because there are several MSMEs in this sector.

- ***Assess Domestic Capability to Produce the Affected Products***

It is important to assess whether the country has adequate availability of critical intermediate goods. As highlighted through the example of cold-rolled grain-oriented steel (CRGO) in Prabhakar (2025), inadequate domestic capacity in such key intermediates can have wider consequences. CRGO shortages, for instance, affected the power sector and thereby hampered overall economic activity.

This calls for caution when designing quality measures. If imports of key intermediates are restricted, it is important to ensure that domestic production capacity is adequate to meet supply-chain requirements in domestic production.

- ***Understand Compliance Capability***

Due to the rising number of QCOs, firms are required to meet stringent compliance requirements, which in turn demand adequate technical expertise and testing infrastructure. This calls for a detailed assessment of the existing technical infrastructure, as the absence of it can lead to longer lead times and higher compliance costs, proving to be detrimental to manufacturing competitiveness. Strengthening the domestic ecosystem for testing, standards, and certification is therefore important to help firms, especially MSMEs, meet QCO requirements without disrupting production and trade.

The recent revocation of several QCOs is a positive signal for the economy. However, rather than relying on reversals, existing QCOs must be systematically reassessed based on clear criteria. Frequent reversals can impose adjustment costs on firms and may signal policy uncertainty to potential foreign investors.

With the growing recognition of the adverse impact of QCOs on small firms, QCOs on critical inputs should be prioritised for review, and more importantly, those in the pipeline should be carefully reassessed before implementation. Greater competition has been a key driver enabling several economies to integrate more effectively into GVCs, and India's regulatory approach must similarly balance quality objectives with competitiveness and supply-chain efficiency.

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Appendix

Table A–1: Regression Results for Chemical-Using Firms for Unbalanced Panel

Dependent Variable	IHS (Production)	IHS (GVA)	IHS (Profit)
QCO on input	9.71*** (1.43)	-35.7** (15.0)	-21.2 (14.2)
QCO on output	2.57 (1.77)	4.69 (22.2)	5.96 (20.6)
Small firm	-70.2*** (3.45)	-24.1 (17.7)	-57.8*** (16.5)
Small × QCO on input	-14.4*** (3.29)	15.7 (19.0)	-27.6 (17.7)
Small × QCO on output	-6.36 (4.03)	-48.7* (27.0)	-62.2*** (25.3)
Year FE	✓	✓	✓
Sector FE	✓	✓	✓
Observations	26,514	26,514	26,514

Source: Authors' analysis.

Note: FE = fixed effects; GVA = gross value added; IHS = inverse hyperbolic sine; QCO = quality control order.

*Firm size dummy = 1 for small firms and 0 for large firms. Entries are coefficients (%). Robust standard errors are in parentheses. *** p < 0.01; ** p < 0.05; * p < 0.1.*

Table A–2: Regression Results for Chemical-Using Firms Along With Main Macro Indicators

Dependent Variable	IHS (Production)	IHS (GVA)	IHS (Profit)
IHS (Labour)	4.36*** (1.66)	-9.97 (12.4)	-46.5*** (11.5)
IHS (Capital)	8.35*** (1.40)	-2.74 (6.61)	-5.40 (6.61)
QCO on input	7.63*** (1.27)	-36.5** (15.0)	-20.3 (14.1)
QCO on output	0.07 (1.52)	5.62 (22.1)	9.00 (20.6)
Small firm	-57.8*** (3.19)	-26.7 (18.0)	-70.1*** (16.7)
Small × QCO on input	-11.9*** (2.92)	16.4 (19.0)	-27.6 (17.8)
Small × QCO on output	0.39 (3.46)	-50.6* (27.1)	-72.2*** (25.3)
Year FE	✓	✓	✓
Sector FE	✓	✓	✓
Observations	26,479	26,478	26,478

Source: Authors' analysis.

Note: FE = fixed effects; GVA = gross value added; IHS = inverse hyperbolic sine; QCO = quality control order.

*Firm size dummy = 1 for small firms and 0 for large firms. Entries are coefficients (in per cent). Robust standard errors are in parentheses. *** p < 0.01; ** p < 0.05; * p < 0.1.*

Table A–3: Regression Results for Chemical-Using Firms: Exclusion of Firms With Persistently Negative Gross Value Added

Dependent Variable	IHS (Production)	IHS (GVA)	IHS (Profit)
QCO on input	8.75*** (1.86)	-22.2 (23.6)	-13.8 (22.5)
QCO on output	0.78 (2.35)	20.1 (35.1)	11.1 (32.8)
Small firm	-70.9*** (3.91)	-28.8 (22.1)	-78.8*** (20.5)
Small × QCO on input	-11.1*** (3.34)	17.0 (26.4)	-39.4 (24.9)
Small × QCO on output	-5.43 (4.44)	-75.7** (37.7)	-74.5** (34.9)
Year FE	✓	✓	✓
Sector FE	✓	✓	✓
Observations	19,679	19,678	19,678

Source: Authors' analysis.

Note: FE = fixed effects; GVA = gross value added; IHS = inverse hyperbolic sine; QCO = quality control order.

*Firm size dummy = 1 for small firms and 0 for large firms. Entries are coefficients (in per cent). Robust standard errors are in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.*

Table A–4: Calculation of Linear Combinations (Marginal Effects) Based on Regression Results in Table 4

Firm Size	QCO on Input	QCO on Output	Combined QCO Effect
Large firms	β_1	β_2	$\beta_1+\beta_2$
Small firms	$\beta_1 + \beta_4$	$\beta_2 + \beta_5$	$\beta_1+\beta_2+\beta_4+\beta_5$

Source: Authors' analysis.

Note: β_1 = coefficient for QCO on input; β_2 = coefficient for QCO on output; β_4 = coefficient for Small × QCO on Input; β_5 = coefficient for Small × QCO on Output; QCO = quality control order.

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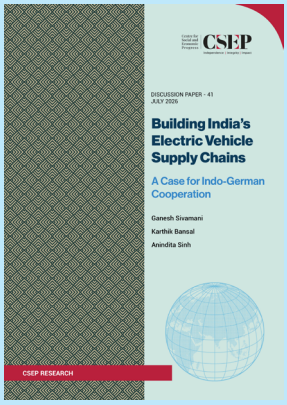

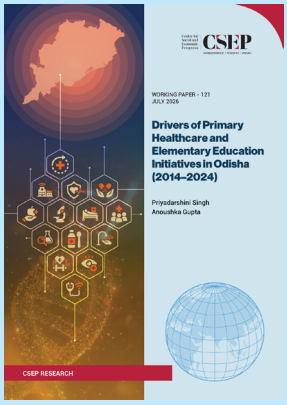

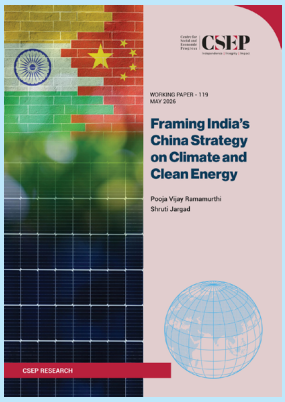

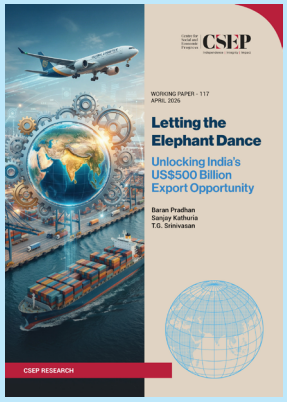

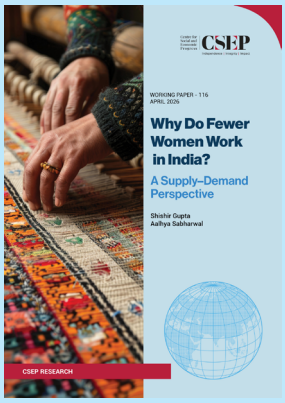

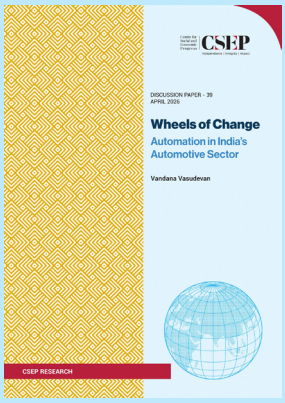

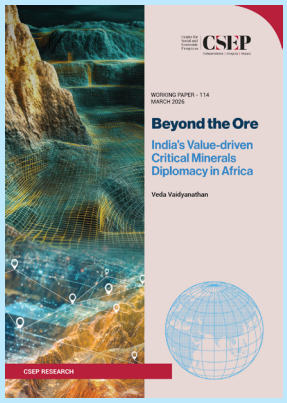

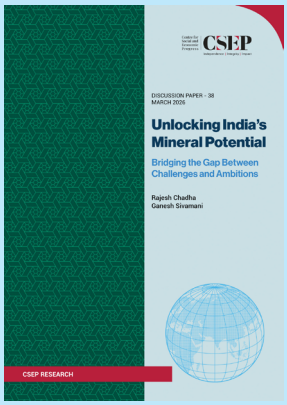

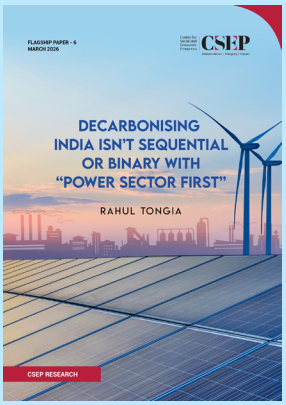

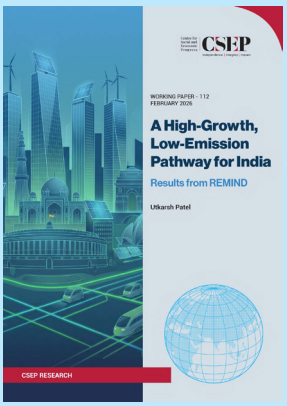

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