The Decline of the Labor Share in India*

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Abstract

India's labor share of income declined by seven percentage points between 1980 and 2007, a sharper fall than observed in many advanced economies. Decomposing this decline using disaggregated industry data, I show that 55 percent is driven by falling labor shares within industries, while changes in industry value-added shares account for 14 percent, and their covariance with within-industry labor shares explains the remaining 31 percent. To quantify the mechanisms behind these patterns, I develop a multi-sector general equilibrium model that allows structural transformation to interact with two leading explanations from the global literature: declines in the relative price of investment goods (RPI) and changes in markups. Using Indian firm-level data and sectoral KLEMS-RBI accounts, I show that a decline in RPI closely replicates both the magnitude of the aggregate labor share decline and its decomposition, whereas increases in markups primarily affect within-industry labor shares and fail to reproduce the observed structural reallocation patterns.

Keywords: *Labor share, Structural Change, Capital Labor Substitution*

JEL classification: *E23, E25, J21, J23, O5*

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1 Introduction

The labor share of income in India declined from 55 percent in 1980 to 48 percent thirty years later.[1] Many countries experienced a decline in labor's share over this period,[2] but the magnitude of the decline has been particularly pronounced in India. Over the same decades, India underwent a substantial transformation in the structure of its economy. Unlike many countries that industrialized through a transition from agriculture to manufacturing, India moved directly from an agricultural economy toward a service-based economy.

The coincidence of these two trends i.e., declining labor's share and rapid structural transformation raises a central puzzle. In light of growing concern that automation may displace labor (Acemoglu and Restrepo (2019)), the expansion of employment in the services sector, despite a decline in that sector's labor share, is particularly striking. Why has labor's share of income fallen so sharply in India, and through which channels has this decline occurred?

Answering this question requires understanding not only changes in labor shares within sectors, but also how shifts in the composition of economic activity interact with these within-sector changes.

This paper addresses these questions using a combination of industry-level data and a multi-sector general equilibrium model. First, I use disaggregated data from India KLEMS to document sectoral patterns in labor shares and value-added and to decompose the change in the aggregate labor share into within-industry effects, structural change, and a covariance component. Second, motivated by the empirical importance of structural change, I develop a three-sector general equilibrium model with agriculture, manufacturing, and services sectors to study how changes in technology and market power affect labor shares both within sectors and through shifts in the economy's sectoral composition.

The model focuses on the interaction of structural change and two mechanisms emphasized in the global literature: changes in the relative price of investment goods (RPI) and changes in markups. A broader literature has proposed several additional explanations for the global decline in labor's share, including decline in the relative price of investment goods (Karabarbounis and Neiman (2013)), automation and task-replacing technological change (Acemoglu and Restrepo (2018), Acemoglu and Restrepo (2020)), the increasing importance of intangible capital (Koh et al. (2020)), the rise of superstar firms and market concentration (Autor et al. (2020)), and globalization and offshoring dynamics (Elsby et al. (2013)). This paper does not attempt to model all such channels simultaneously. Instead, it focuses on two mechanisms that are both prominent in the global literature and directly relevant for India: the substantial decline in the relative price of investment goods and the potential role of markups. While the decline in RPI is clearly documented in Indian data, the magnitude of changes in markups remains more uncertain. The framework developed here allows an evaluation of whether plausible changes in markups, alongside observed investment-price movements, can account for the magnitude and composition of India's labor share decline.

Using KLEMS data, I document three key empirical facts. First, while manufacturing's value-added share remained close to 15 percent of GDP throughout the sample period, agriculture's share fell from 35 percent to 20 percent, and services rose from 50 percent to 65 percent. Second, the labor share declined by approximately seven percentage points in services and by twelve percentage points in manufacturing, while agriculture maintained a high and relatively stable labor share of roughly 55 percent.

Motivated by these patterns, I decompose the change in the aggregate labor share into three components: (i) changes in labor shares within industries, (ii) changes due to shifts in industry value-added shares (structural transformation), and (iii) a covariance term capturing the co-

[1] According to the Penn World Table (PWT), the labor share of income in India fell even more sharply—from 74% to 51% over the same period. I compute a more conservative decline using industry-level data from KLEMS. The difference arises from alternative treatments of mixed income in the computation of labor shares.

[2] I find that the labor share fell from 62% in 1980 to 58% in 2010 in the United States, and from 60% in 1980 to 56% in 2008 in Canada. In the literature, Karabarbounis and Neiman (2013) document a decline of five percentage points in the global corporate labor share, from 64% in 1975 to 59% in 2012.

movement between changes in industry labor shares and changes in industry value-added shares. Using data for twenty-seven industries from the KLEMS dataset,[3] and abstracting from the effects of the Great Recession by focusing on the period ending in 2007,[4] I find that 55 percent of the aggregate decline in labor's share is due to falling labor shares within industries. Structural change is needed to account for the remainder: 14 percent is explained by changes in value-added shares alone, and 31 percent by the covariance term, indicating that industries with declining labor shares are expanding in size.

In the light of these findings, I develop a three-sector general equilibrium model to quantify how structural transformation interacts with changes in the relative price of investment goods and markups. Sectors differ in their capital-labor elasticities of substitution, and households exhibit non-homothetic preferences. I introduce exogenous shifts in the relative price of investment and in markups and evaluate the resulting changes in labor shares and sectoral value-added composition.

A decline in RPI affects factor prices and induces capital-labor substitution within sectors, with the magnitude of substitution differing across sectors due to heterogeneous elasticities. Markups directly reduce labor's share by shifting income toward profits. While cheaper investment goods raise capital accumulation and output, higher markups suppress output. With non-homothetic preferences, changes in aggregate income also alter expenditure patterns, leading to shifts in sectoral value-added shares. The model therefore captures the interaction between within-sector labor share movements and economy-wide structural change.

While declining relative prices of investment and rising markups are leading explanations for global labor share declines, the mechanisms underlying India's experience remain unsettled. Studies such as Goldar (2013), Ahsan and Mitra (2014), Maiti (2019), and more recently Basu and Veeramani (2025), Basu and Veeramani (2022) provide industry- and firm-level evidence on labor share dynamics in India, emphasizing the roles of trade exposure, market concentration, and structural reallocation. These contributions rely primarily on shift-share decompositions and reduced-form regressions. They document important correlations but do not embed these forces within a general equilibrium framework that jointly disciplines prices, sectoral composition, and factor substitution.

This paper takes a complementary approach by evaluating the roles of the relative price of investment (RPI) and markups within a three-sector general equilibrium model that allows for heterogeneous capital–labor elasticities and non-homothetic demand. This framework permits a quantitative assessment of whether observed movements in investment prices and market power can jointly account for the magnitude and composition of India's labor share decline.

The decline in India's RPI has been substantial. Johri and Rahman (2022) attribute part of this decline to the post-1991 liberalization reforms, which reduced tariffs and quantitative restrictions on capital goods. Using data from the Penn World Table and the PIRIC series from the Federal Reserve Bank of St. Louis, I estimate that India's RPI fell by approximately 50 percent between 1980 and 2011. This decline is large by international standards and suggests that capital-deepening forces may have played a central role.

Assessing the role of markups is more challenging due to limited historical data. I estimate manufacturing markups using firm-level data from the Annual Survey of Industries (ASI) beginning in 1998, following the production-function-based approach in the markup literature. This exercise yields an average markup of approximately 22 percent over 2003–2007. I am not the first to estimate markups or study market power in the Indian context. Ahsan and Mitra (2014) analyze trade liberalization and rent-sharing in Indian firms, De Loecker et al. (2016) estimate markups in the context of Indian trade reforms, and Basu and Veeramani (2025) examine market concentration and labor share dynamics at the firm level.

The contribution of this paper is not to establish the existence of market power in India, but to evaluate its aggregate implications within a structural multi-sector framework. Rather than

[3] KLEMS refers to data on capital, labor, energy, materials, and service inputs at the industry level. India KLEMS is prepared by the Reserve Bank of India (RBI).

[4] I focus on the period ending in 2007 for two reasons. First, to abstract from the effects of the Global Financial Crisis, which introduced substantial short-run volatility in factor shares. Second, changes in survey methodology and revisions in national accounts and industry-level data collection after 2007 affect the comparability of labor share measures across time. Restricting the sample ensures consistency in measurement over the period analyzed.

testing whether higher markups are associated with lower labor shares, I ask whether plausible increases in markups can simultaneously match (i) the aggregate decline in labor's share, (ii) the sectoral decomposition into within- and between-industry components, and (iii) the covariance term observed in the data.

Given data constraints for the early 1980s, I consider two benchmark scenarios in the quantitative exercises: (i) constant markups at 22 percent throughout the sample period, and (ii) a rise in markups from zero in the early 1980s to 22 percent by the mid-2000s. The latter is intentionally extreme and serves as an upper bound on the potential role of rising market power.

The quantitative results indicate that while increases in markups can generate substantial within-sector declines in labor shares, they do not reproduce the observed structural decomposition unless markup increases are implausibly large. By contrast, a decline in RPI alone closely matches both the magnitude of the aggregate decline and the covariance patterns in the data. These findings suggest that investment-price dynamics, interacting with sectoral heterogeneity and non-homothetic demand, provide a more coherent explanation of India's labor share decline than large increases in markups alone.

In the constant-markup scenario combined with a 50 percent decline in RPI, the model generates a 6.5 percentage point decline in the aggregate labor share, closely matching the 6.8 percentage point decline observed in the data. The covariance term accounts for 15.6 percent of the decline, nearly identical to the 16.4 percent contribution in the three-sector aggregation of the data. In contrast, when markups rise sharply alongside the RPI decline, the model generates a smaller aggregate decline and attributes nearly all of it to within-sector labor share changes, understating the role of structural change observed in the data.

Overall, the results indicate that while both mechanisms matter, the decline in RPI better matches India's experience. The RPI-only scenario reproduces the magnitude of the aggregate decline, the importance of the covariance term, and the observed reallocation of labor from agriculture to services, whereas large increases in markups distort these patterns.

This paper contributes to three related strands of the literature. First, it advances the literature on declining labor shares and investment prices. A large body of work, including Karabarbounis and Neiman (2013), attributes a substantial portion of the global decline in labor's share to falling investment prices in representative-sector settings. I extend this framework by introducing sectoral heterogeneity in capital–labor substitution and non-homothetic demand. Differences in elasticities across agriculture, manufacturing, and services imply heterogeneous responses to a common decline in the relative price of investment (RPI). As a result, investment-price movements affect aggregate labor share not only through within-sector substitution but also through endogenous structural transformation.

Second, the paper contributes to the literature on structural change by quantifying how shifts in sectoral composition interact with within-sector labor share dynamics in general equilibrium. While existing work documents the importance of structural transformation in shaping income shares, this paper shows that investment-price dynamics can themselves induce reallocation across sectors, thereby altering the aggregate labor share through both substitution and composition effects.

Third, the paper contributes to the literature on labor share dynamics in India. Studies such as Goldar (2013), Ahsan and Mitra (2014), Maiti (2019), and Basu and Veeramani (2025) document declining labor shares and emphasize the roles of trade exposure, market concentration, and market-share reallocation using industry- and firm-level data. These contributions provide important reduced-form evidence. This paper takes a complementary approach. Rather than estimating correlations between concentration, trade, and labor shares, I embed sectoral heterogeneity within a structural multi-sector general equilibrium framework and evaluate whether observed movements in investment prices and markups can quantitatively replicate both the magnitude and the decomposition of India's labor share decline.

In addition, the paper contributes to the markup literature by providing new estimates of markups for India using firm-level ASI data and complementary industry-level measures constructed from KLEMS. I do not claim to be the first to estimate markups in the Indian context

- related work includes Ahsan and Mitra (2014) and De Loecker et al. (2016). The contribution instead lies in evaluating the aggregate implications of markup changes within a disciplined structural framework.

The model highlights that the aggregate effect of investment-price movements depends critically on sectoral heterogeneity and structural transformation. Because sectors differ in capital–labor substitutability, reallocation across sectors can amplify or dampen aggregate labor share responses.

The remainder of the paper is organized as follows. Section 2 describes the data sources and construction. Section 3 details the markup estimation procedure. Section 4 presents the model. Section 5 discusses calibration and quantitative results. Section 6 concludes.

2 Data

2.1 Labor Share and Value-Added Shares

In this section, I describe the data that I use to compute the aggregate labor share of India and I decompose the change in the aggregate labor share of income due to changes in the within-sector labor share of income, changes in value-added shares of the sectors and the interaction of the two changes. The data that I use is provided by the Reserve Bank of India to the World KLEMS database. KLEMS is data on capital, labor, energy, material and service inputs at the industry level. India KLEMS provides industry-level data on variables such as gross output, value-added, labor share, employment, and wages that are computed following the KLEMS approach. The disaggregated data covers Agriculture, Mining, Manufacturing sub-industries such as Paper, Electrical Components, Transport Equipment, Textiles etc., services sub-industries such as Education, Hospitality etc. and Public Administration. The variables I use are Gross Value Added at constant (2005) prices by each industry and the labor income share in Gross Value Added by the industry from 1980 to 2011. I compute the aggregate labor share of income for the Indian economy at period t (LS_t) as the weighted average of within-industry labor shares ($LS_{i,t}$) using the share of value added by that industry in the GDP ($VAS_{i,t}$) as the respective weights i.e.

$$\text{LS}_t = \sum_i \text{LS}_{i,t}\text{VAS}_{i,t} \tag{1}$$

where,

$$\text{VAS}_{i,t} = \frac{\text{value added by industry i}}{\text{GDP}} = \frac{VA_{i,t}}{\sum_i VA_{i,t}}$$

The labor share of income fell from 55.47% in 1980 to 48.5% in 2011. While the economy experienced a 6.9 percentage point decline over the period, not all industries experienced a decline or the same decline. Utilities, Hotels and Public Services experience an increase in the labor share of income. At the same time, the Wholesale and Retail industry and the Agriculture sector observe a <1 percentage point decline in the labor share of income. The labor share of income fell from 50.6% to 28.7% in Finance and Business Services during the same period. At the same time, the combined value-added share of the Finance and Business Services grew by 364.5% from 1980 to 2011, from 3% to 14% of GDP. I further investigate the fall in the aggregate labor share of income in India to quantify how much of the fall is owing to a decline in within-industry labor share changes and how much is due to the structural changes in the economy, i.e., if the aggregate labor share is declining due to an increase in value-added shares of sectors with low within sector labor shares. The decomposition of the total fall is into the following three effects - Labor share effect, Value added effect and the covariance term i.e.

$$\text{Total Change} = \text{VA effect} + \text{LS effect} + \underbrace{\sum_i (LS_t^i - LS_0^i)(VAS_t^i - VAS_0^i)}_{\text{Covariance Term}} \tag{2}$$

where, the VA effect is the change in aggregate labor share keeping within industry labor shares constant at 1980 values.

$$\text{VA Effect} : \sum_i LS_0^i VAS_t^i - \sum_i LS_0^i VAS_0^i, \tag{3}$$

LS effect is the change in the aggregate labor share, keeping the structure of the economy constant at 1980 values.

$$\text{LS Effect} : \sum_i LS_t^i VAS_0^i - \sum_i LS_0^i VAS_0^i, \tag{4}$$

The additional term is the covariance between the change in value-added share in an industry and the change in the labor share of income in that industry. Using the data on the 27 industries, I get the following decomposition of the change in the aggregate labor share of income with 1980-84 as the initial period.

	% of the total change
VA Effect	14
LS Effect	55
Covariance Term	31
Total decline	6.9 % points

Table 1: Decomposed change in labor share of income

Of the total decline of 6.8 percentage points in the aggregate labor share of income in India, the change in the labor shares of income within industries explains half of the total decline. Structural change is necessary to explain the remaining half. Nearly one-third of the drop comes from the cross term, i.e., value-added shares of industries went up within which the labor share of income fell. Change in the value-added share of industries alone, with no change in within-industry labor shares of income, explains 14% of the total change in the aggregate labor share of income. The graph below shows the VA effect and the LS effect over time. The decomposed labor shares for three scenarios - actual (*blue, solid line*), keeping within industry labor share constant (*red, dashed line*), and keeping value-added shares of the industries constant at 1980 values (*yellow, dotted line*).

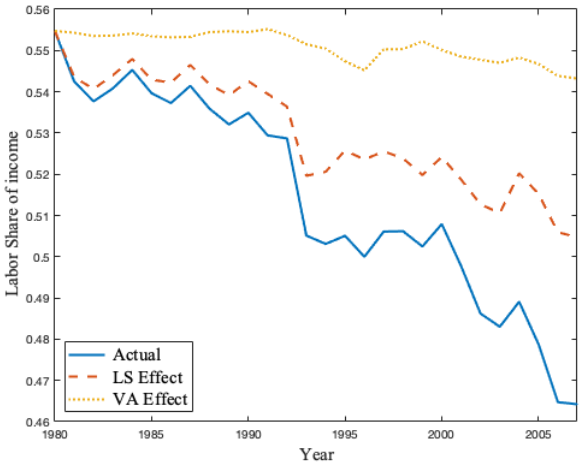


Figure 1: Decomposed labor share of income

The LS effect curve is the time series of the weighted average of the labor share of income within industries, keeping the weights, i.e., the respective value-added share of the industries constant at

1980 value. It represents the trend in the aggregate labor share of income that comes only from changes in the within-industry labor share of income. The VA Effect curve is the time series of the weighted average of the within-industry labor share of income, allowing only the weights to change. It, therefore, represents the changes in the aggregate labor share of income accruing to only the structural change in that period. The LS Effect curve closely follows the actual labor share of income till the early 90s. In that period, the VA Effect curve is almost constant. Post the mid-90s, the gap between the LS Effect curve and the Actual curve increases and there is a decline in the VA Effect curve.

From Figure 1, we can see that changes in within-industry labor shares alone cannot explain the changes in the aggregate labor share of income. From Table 1, the covariance term shows that the labor share of income was declining in industries that were increasing in their relative size in the GDP. This contributed to 31% of the decline in the aggregate labor share of income in that period.

Three-sector data

In light of these empirical findings, I use a multi-sector model to include the effects of structural change in changes in the aggregate labor share of income in the economy. For tractability in the use of the model, I aggregate the labor shares and the value-added shares in the 27 sectors available in KLEMS into three broad sectors - Manufacturing, Agriculture and Services using the relation -

$$LS_{i,t} = \sum_j LS_{i,j,t}\ VAS_{i,j,t}$$

i.e., the labor share in sector i at time t is the weighted average of labor share in sub-industry j in sector i at time t, where the weights are the value added by sub-industry j in sector i, as a share of the total value added by the sector

$$VAS_{i,j,t} = \frac{VA_{i,j,t}}{\sum_j VA_{i,j,t}}$$

Value added share of sector i at time t, i.e., $VAS_{i,t}$ is the sum of value added of the sub-industry j in sector i, as a share of the GDP.

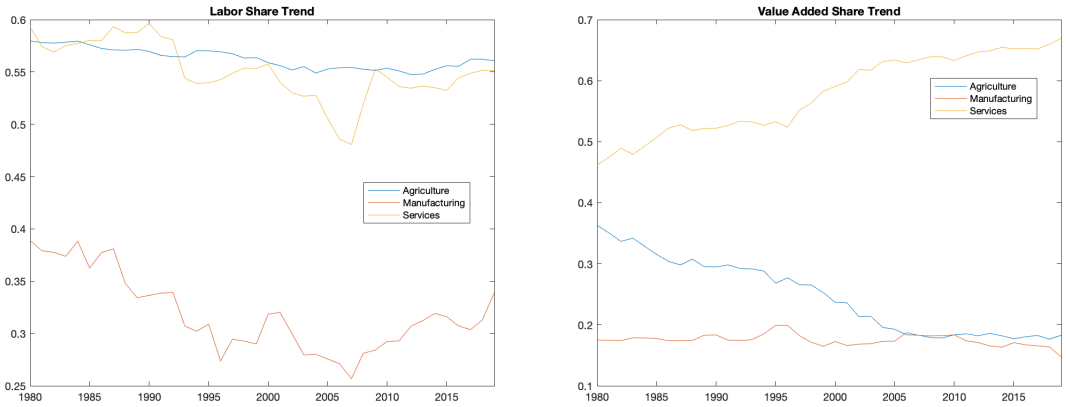
$$VAS_{i,t} = \frac{\sum_j VA_{i,j,t}}{\sum_i \sum_j VA_{i,j,t}}$$

Following are the value added and the labor shares that I compute for the three sectors in India

	Labor Share		Value Added Shares	
	1980-84	2003-07	1980-84	2003-07
Agriculture	.55	.54	.36	.18
Manufacturing	.46	.34	.14	.16
Services	.56	.49	.50	.66

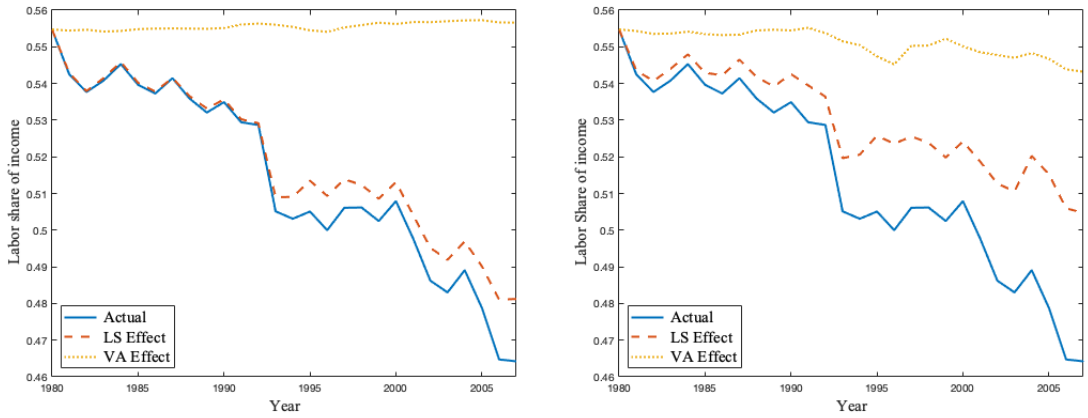
Table 2: Aggregated Data for the three sectors

The value-added share of Agriculture fell from an average of 35.6% to 18.4% from 1980-84 period to 2003-07. This decline is compensated by a much larger increase in the value-added share of the Services sector, from 49.9% to 66%, and an increase in the Manufacturing sector from 14.5% to 15.6%. This aggregation captures $\sim$ 50% of the interaction term, i.e., the sectors in which the labor share of income is falling (Manufacturing and Services) have increasing relative size in the GDP. The labor share of income in Manufacturing fell from an average of 46% in 1980-84 to 33.8% in 2003-07 and from 56.2% to 49% in the Services sector. The sharp secular decline in the



(a) Labor shares (b) Value Added shares

Figure 2: Three sector data



(a) Three sector data (b) Industry level data

Figure 3: Decomposition of Trend in Labor Share of Income in Aggregated v/s Disaggregated data

value-added share of agriculture is accompanied by a relatively stable labor share of income in that sector.

Table 3 and Figure 3 below compare the decomposition into LS and VA effect for the aggregated and disaggregated data. The table gives the share of contribution of each of the three components in the total decline of the aggregate labor share of income. This aggregation gives half of the covariance term (change in within-sector labor share and change in value-added share of the sector) as in the disaggregated data. $\sim 80\%$ of the decline in the aggregate labor share of income can be explained by a within-sector decline in labor shares. In the absence of change in within-sector labor shares, changes in value-added shares of the three sectors do not contribute to the decline in the overall labor share of income.

	3 Sector (%)	Disaggregated Data (%)
VA Effect	0	14
LS Effect	84	56
Covariance Term	16	31

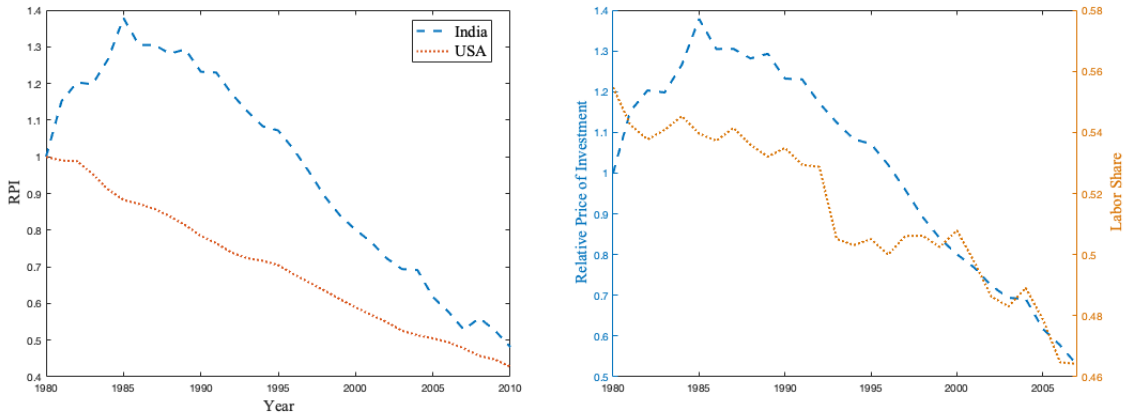
Table 3: Comparison of the three-sector aggregation with the disaggregated data.

2.2 Relative price of investment goods

The relative price of investment goods is price of investment goods, relative to price of consumption goods. In this section, I measure the series of RPI for India using data from Penn World Data (PWT) Growth and Centre (2023), and the Federal Reserve Economic Data (FRED). PWT provides a database with information on relative levels of income, output, input and productivity, covering 183 countries between 1950 and 2019. The variables of interest for the purpose of this paper are the relative price of consumption,and investment goods $pl_i_{jt} \in \{C, I\}$ for country j in year t. These price levels are relative to the world benchmark for the respective category of goods. Therefore, the ratio of the two series for a country would be how the relative price of goods in a country is moving relative to the world relative price. In order to recover the absolute value of RPI for India, I use the RPI series for the US from FRED.[5] I do the following conversion to get the series of RPI for India:

$$\frac{pl_i_{India,t}/pl_c_{India,t}}{pl_i_{US,t}/pl_c_{US,t}} \times \text{RPI}_{US,t}{}^{6} \tag{5}$$

The Figure 4 shows the series of RPI for both India and the US starting in 1980 with a normalized value of 1. RPI in India increased in the '80s with a peak in 1985. The RPI in India falls sharply in the late 90s and early 2000s, with some increases during the Great Recession. For the calibration and counterfactual exercise in section 6 of the paper, I use the average value of 1.16 in the period 1980-84 in the first steady state, and the average value of 0.62 in the period 2003-07 as the second steady state.



(a) Relative Price of Investment Goods

(b) India: RPI and Labor Share

Figure 4: Relative Price of Investment Goods

[5]This series in the FRED database is named as PIRIC, DiCecio (Dec 2022).

[6]All the relative series is normalized to 1 in the process. The RPI series that I create can be used for within country, over time comparison but not for cross-country comparison. For more details, please see appendix A.1.

2.3 Markup

Markups are important in determining the labor share of income and, as a result, changes in markups over time could play an important role in changes in the labor share (De Loecker and Eeckhout (2018)). To obtain a quantitative evaluation of the causes for labor share declines, having a good sense of markups is therefore crucial. I use firm-level data to estimate markups using the production function estimation (Olley and Pakes (1996) (OP)) method. This method deals with the endogeneity problem in production function estimation by including a productivity shock in the estimating equation. The productivity shock evolves according to Markov Process and each firm has a unique history of productivity shocks. This requires a panel data set and the data set that I use is the Annual Survey of Industries (ASI), collected annually by the Ministry of Statistics and Program Implementation (MOSPI), Government of India. The data set is covered under two categories - Census Firms covering data for all firms with more than 200 workers and Sample Firms covering data for a sample of smaller firms. It contains detailed information on firms' working capital, capital stock, employment details, inputs and gross output. Unfortunately, the same firms are not included in the Sample set every year which takes away the panel feature that I need from the data. On the other hand, Census firms are followed on a complete enumeration basis and hence, I use firms in this sample set for the estimation process. While the ASI does not provide unique firm IDs to follow a firm over a period of time, the ASI incorporated time-invariant variables from 1998-1999 onward that can be used to create firm IDs across time. I use the methodology described in Bollard et al. (2013) to match observations across years to create unique firm IDs. Through my matching algorithm, I create panel data of around 12,000 census firms on average for each year for the period 2000 - 2018. The matching algorithm gives a match rate of $\sim$ 36 % on average per year. Details of the matching algorithm are provided in Appendix A.2.

To estimate the parameters of the production function through the Olley Pakes method, the relevant variables of interest in the ASI are Gross Sale Value, Net Value of (sub-total) Capital, Investment of (sub-total) capital during the year, and Cost of Production. The Gross Sale Value is the reported value of all sales made by the firm during the year from all its products. The gross sale value of a firm in the sample is, on average, 1.75b INR($\sim$ 21m USD). However, the data is highly skewed where a firm in the 50^{th} percentile has a gross sale value of 0.2b INR, and a firm in the 75^{th} percentile has a gross sale worth 0.8b INR. The top 1% of the firms have a gross sale value of 20b INR or more. ASI provides data on different fixed assets - land, plant and machinery, transport equipment, etc. I picked the sub-total category, which includes all fixed assets except Land and Capital work in progress. The data provides both year-opening and closing values of the net value of capital. I use the net value of capital at the beginning of the year. While the average value of capital is 450m INR, a firm in the 50^{th} percentile owns capital worth 30m INR. The top 1% of firms own assets worth 6b INR or more.

The bottom 10% of the firms do not invest annually on average. While the mean investment is 85m INR, the median firm invests 2.5m INR on average. Lastly, the total Cost of Production includes wages, the value of indigenous and imported inputs consumed, and costs such as rent paid for land/buildings, repair costs, insurance charges etc. The average cost of production in the period was 1.3b INR, wherein a median firm spent 152m INR on production, and the top 1% of the firms spent 15b INR. The table below gives some descriptive statistics of the variables above.

Variable	Mean	Median	Std dv.
Gross Sale Value	1.75b	221m	23.2b
Net Value of capital	451m	27.8m	5.72b
Investment	102m	4.7m	1.79b
Cost of Production	1.3b	152m	19b

Table 4: Descriptive Statistics of key variables.

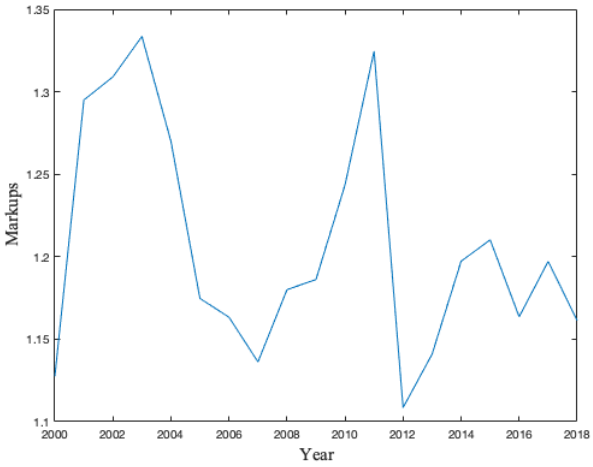


Figure 5: Markups

Using the production function estimation approach, I use this panel data to compute markup values for the manufacturing sector from 2000 - 2018[7] (Olley and Pakes (1996)). Details of the estimation process are explained in section 5. I compute an average markup of 1.21 for the period 2000 - 2018. The Figure 5 shows the annual markup computed for each year. Although there was a sharp fall in markups during the Great Recession, there does not seem to be a clear upward or downward trend after 2000.

2.4 Post-2007 Labor Share Trends (Descriptive)

Although the main analysis focuses on the period ending in 2007 due to changes in survey methodology and the Global Financial Crisis, it is informative to briefly examine labor share dynamics over the extended sample. Figure 6 plots the aggregate labor share from 1980 to 2021. The pre-2007 period is characterized by a sustained decline, whereas the post-2007 period exhibits a noticeable shift in trend relative to the earlier downward trajectory. A formal analysis of this later period is beyond the scope of the present paper. Restricting the sample to the pre-2007 period ensures consistency in measurement and allows the analysis to focus on the long-run structural forces emphasized in the model.

3 Markup Estimation

In this section, I describe the estimation process used in this paper to compute markup levels in India. I first use the Olley Pakes (OP) Production Function Estimation method to estimate the parameters of a Cobb-Douglas production function. The Olley Pakes (1996) is a two-stage estimation method with the following estimating equation:

$$y_{i,t} = \alpha + \beta_k k_{i,t} + \beta_x x_{i,t} + \omega_{i,t} + \eta_{i,t}$$

where, k_{it} is a dynamic input decided at period $t-1$, $x_{i,t}$ is a static variable input decided at period t. $\omega_{it,}$ is the productivity shock and $\eta_{i,t}$ is the measurement error. Firm-specific productivity shock addresses the endogeneity problem between the output and the inputs. The method assumes that the productivity shock evolves according to the first-order Markov process:

$$\omega_{i,t} = E(\omega_{i,t}|\omega_{i,t-1}) + u_{i,t} = g(\omega_{i,t-1}) + u_{i,t}$$

[7]The data prior to 1999 does not include the time-invariant variables necessary to match and create unique firm IDs.



Figure 6: Labor Share in India, 1980–2021. The vertical dashed line marks 2007, the final year included in the main quantitative analysis.

The OP process assumes that investment in period t is a function of capital in period t and the productivity shock in period t i.e.

$$inv_{i,t} = inv(k_{i,t}, \omega_{i,t})$$

, and that it is invertible

$$\omega_{i,t} = h(inv_{i,t}, k_{i,t})$$

I use the *prodest* function in STATA to get estimates of the variable inputs' parameters. Following Baqaee and Farhi (2020), I use the Gross Sale Value of each firm as the dependent variable $y_{i,t}$, value of Total Capital as the dynamic input $k_{i,t}$, Cost of Production as the static input $x_{i,t}$ and Investment as the instrumental variable. I use the estimate of the static variable parameter to compute markup following Hall(1998) [8] i.e.

$$\mu_i = \frac{\partial log y_i / \partial x_{i,t}}{\Omega_i} = \frac{\beta_x}{\Omega_i}$$

where Ω_i is the firm's expenditure on the cost of production relative to the firm's turnover. Following Baqaee and Farhi (2020), I use a three-year rolling window to estimate the production function parameters for any given year, i.e., markup for year t has been estimated using data for periods $t-1$, t, $t+1$.

Markups were at 1.13 at the start of the 2000s and increased to 1.33 before the Great Recession. After the fall in 2006, there is no clear pattern in the levels, and with the most recent data available, the markup in 2018 was 1.16.

4 Model

In this section, I build a standard three-sector model and use the data described in section 2 to calibrate crucial parameters such as the elasticity of substitution of labor and capital in the production function. The model is then used to run a counterfactual to compare the contribution of the decline in the relative price of investment goods and the increase in markups to the decline in the aggregate labor share of income. The three sectors in the model are Agriculture, Manufacturing and Services.[9] Each sector has an intermediate goods producer and a final goods

[8] The paper assumes Hicks-Neutral technology.

[9] Herrendorf et al. (2015) have three broad sectors - Agriculture, Manufacturing and Services. In the data, they treat Construction and Mining as a part of the Manufacturing sector, while currently, these industries are included in the Services Sector in my classification.

producer. The manufacturing sector has two final goods producers - Final Manufacturing Goods Producer and Investment Goods Producer. The Investment Goods Producer linearly transforms manufacturing goods into investment goods. All the Services final goods producers take inputs from the intermediate goods producers - z_m, z_a, z_o, and use CES technology to produce Y_m, Y_a, Y_o, respectively. Intermediate goods producers, on the other hand, use labor and capital as inputs. They use CES technology to produce, which differs in capital shares and elasticities of substitution between capital and labor for the three sectors.

I add mark-ups in the model following Karabarbounis and Neiman (2013), i.e., the intermediate goods producers face monopolistic competition within the sector, while the final goods producers are perfectly competitive. In this model, markups are determined by the demand sensitivity of the intermediate goods by the final goods producer. Therefore, any change in mark-ups in a sector comes from a change in the elasticity of substitution between inputs in the final goods production function.[10]

The households in this environment own and supply capital and labor to the intermediate goods producers. They are also the firms' owners and earn profits from the intermediate goods firms.

4.1 Manufacturing Sector

The manufacturing sector comprises of the final manufacturing goods producer, the investment goods producer, and the manufacturing intermediate goods producer. The intermediate goods producer uses labor and capital to produce the output used as inputs by the final goods produce. The final goods produce aggregates the inputs into final output. The final output is sold to households as manufacturing consumption goods and to the investment goods producer as input to produce investment goods. A detailed set up of the three producers in the manufacturing sector is as follows.

Final Goods Producer The final goods producer in the manufacturing sector combines a continuum of intermediate inputs $z_m \in [0, 1]$ and produces the final food Y_m. The final good is either sold to households for consumption or used by the investment goods producer as input. Manufacturing good is produced using the following technology:

$$Y_{m,t} = \Big(\int_0^1 y_t(z_m)^{\frac{\epsilon_m - 1}{\epsilon_m}} dz_m \Big)^{\frac{\epsilon_m}{\epsilon_m - 1}} \tag{6}$$

where $y_t(z_m)$ is the quantity of input z_m used in the production of the manufacturing good, and ϵ_m is the elasticity of substitution between inputs. Manufacturing goods producers buy the inputs at price $p_t(z_m)$ from the intermediate goods producers and sell their output at price $P_{m,t}$ which is normalized to 1. Under perfect competition, firms equate marginal cost to price, and we get the following:

$$P_{m,t} = \Big(\int_0^1 p_t(z_m)^{1-\epsilon_m} dz_m \Big)^{\frac{1}{1-\epsilon_m}} = 1$$

First order condition from cost-minimization implies the following input demand function:

$$y_t(z_m) = (p_t(z_m)/P_{m,t})^{-\epsilon_m} Y_{m,t}$$

Investment Goods Producer The investment goods producer linearly transforms some of the manufacturing goods into investment goods using the following technology:

$$X_t = Y_{m,t}^x A_{x,t} \tag{7}$$

[10] An alternate source of changes in average mark-ups in an industry is a change in the distribution of mark-ups amongst firms within the industry. Symmetry in intermediate goods and in their treatment in the production function of the final goods sector implies that the model abstracts from these causes of change in average mark-ups.

where A_x is exogenously given, investment-specific production efficiency. The price of the investment good is q, and from the producer's profit maximization problem, we have

$$q_t = \frac{1}{A_{x,t}} \tag{8}$$

i.e., q is inverse of the production technology. In the paper, the change in the relative price of investment good q is assumed to have come from an exogenous change in this technology.

Intermediate Goods Producer The intermediate goods producers face monopolistic competition and take the demand function from the final goods producers as given $y_t(z_m) = p_t(z_m)^{-\epsilon_m} Y_{m,t}$. The intermediate goods producer chooses how much capital $k_t(z_m)$ and labor $l_t(z_m)$ to hire, how much to produce $y_t(z_m)$ and what price to charge $p_t(z_m)$. Their maximization problem is:

$$\underset{y_t(z_m), p_t(z_m), k_t(z_m), l_t(z_m)}{max} \Pi_t(z_m) = p_t(z_m) y_t(z_m) - R_t k_t(z_m) - W_t l_t(z_m) \tag{9}$$

s.t.

$$y_t(z_m) = p_t(z_m)^{-\epsilon_m} Y_{m,t}$$

&

$$y_t(z_m) = F^m(k_t(z_m), L_t(z_m))$$

where, $F^m(k_t(z_m), L_t(z_m))$ is the production function of the intermediate goods producer. I assume a CES production function wherein $y_t(z_m)$ for intermediate good producer of type z_m has the following production function:

$$F^m(k_t(z_m), L_t(z_m)) = \left(\alpha_m k_t(z_m)^{\frac{\sigma_m - 1}{\sigma_m}} + (1 - \alpha_m) L_t(z_m)^{\frac{\sigma_m - 1}{\sigma_m}}\right)^{\frac{\sigma_m}{\sigma_m - 1}} \tag{10}$$

and, the marginal products are:

$$F^m_{k_t(z_m)} = \alpha_m \left(\frac{y_t(z_m)}{k_t(z_m)}\right)^{\frac{1}{\sigma_m}}$$

$$F^m_{L_t(z_m)} = (1 - \alpha_m) \left(\frac{y_t(z_m)}{L_t(z_m)}\right)^{\frac{1}{\sigma_m}}$$

The first-order conditions from the profit maximization problem yield the following prices:

$$p_t(z_m) F^m_{k_t(z_m)} = \mu_m R_t$$

$$p_t(z_m) F^m_{L_t(z_m)} = \mu_m W_t$$

where μ_m is the markup:

$$\mu_m = \frac{\epsilon_m}{\epsilon_m - 1}$$

4.2 Agricultural Sector

The agricultural sector consists of final agricultural goods producers and intermediate agricultural goods producers. The final agricultural goods producer buys the output of the intermediate goods producer and households purchase the final goods.

Final Goods Producer The final goods producer in the agricultural sector combines a continuum of intermediate inputs $z_a \in [0,1]$ and produces the final food Y_a. Agricultural good is produced using the following technology:

$$Y_{a,t} = \Big(\int_0^1 y_t(z_a)^{\frac{\epsilon_a - 1}{\epsilon_a}} dz_a \Big)^{\frac{\epsilon_a}{\epsilon_a - 1}} \tag{11}$$

where $y_t(z_a)$ is the quantity of input z_a used, and ϵ_a is the elasticity of substitution between inputs. Agricultural final goods producers buy the inputs at price $p_t(z_a)$ from the intermediate goods producers and sell their output to households at price $P_{a,t}$. Under perfect competition, firms equate marginal cost to price, and we get the following:

$$P_{a,t} = \Big(\int_0^1 p_t(z_a)^{1-\epsilon_a} dz_a \Big)^{\frac{1}{1-\epsilon_a}}$$

First order condition from cost-minimization implies the following input demand function:

$$y_t(z_a) = (p_t(z_a)/P_{a,t})^{-\epsilon_a} Y_{a,t}$$

Intermediate Goods Producer The intermediate agricultural goods producers use labor and capital as inputs and produce the intermediate goods $z_a \in [0,1]$ using CES production technology. They are monopolistically competitive and set price $p_t(z_a)$ for their output. They take the price of inputs - W_t, R_t, the price of final agricultural goods $P_{a,t}$ and aggregate demand for $Y_{a,t}$ as given. Their profit maximization problem is:

$$\max_{y_t(z_a), p_t(z_a), k_t(z_a), l_t(z_a)} \Pi_t(z_a) = p_t(z_a) y_t(z_a) - R_t k_t(z_a) - W_t l_t(z_a) \tag{12}$$

s.t.

$$y_t(z_a) = \big(p_t(z_a)/P_{a,t}\big)^{-\epsilon_a} Y_{a,t}$$

&

$$y_t(z_a) = F^a(k_t(z_a), L_t(z_a))$$

where, $F^a(k_t(z_a), L_t(z_a)))$ is the production function of intermediate good producer of type z_a. The function takes the following form:

$$F^a(k_t(z_a), L_t(z_a)) = \big(\alpha_a k_t(z_a)^{\frac{\sigma_a - 1}{\sigma_a}} + (1-\alpha_a) L_t(z_a)^{\frac{\sigma_a - 1}{\sigma_a}}\big)^{\frac{\sigma_a}{\sigma_a - 1}} \tag{13}$$

and, the marginal products are:

$$F^a_{k_t(z_a)} = \alpha_a \Big(\frac{y_t(z_a)}{k_t(z_a)}\Big)^{\frac{1}{\sigma_a}}$$

$$F^a_{L_t(z_a)} = (1-\alpha_a) \Big(\frac{y_t(z_a)}{L_t(z_a)}\Big)^{\frac{1}{\sigma_a}}$$

First-order conditions from the intermediate goods producer's maximization problem yield the following prices:

$$p_t(z_a) F^a_{k,t}(z_a) = \mu_a R_t$$
$$p_t(z_a) F^a_{l,t}(z_a) = \mu_a W_t$$

where μ_a is the markup:

$$\mu_a = \frac{\epsilon_a}{\epsilon_a - 1}$$

4.3 Services Sector

Like the agricultural sector, the services sector consists of final goods producers and intermediate goods producers. Households buy the final agricultural goods, and the producer of those buy intermediate goods to produce the final output.

Final Goods Producer The final goods producer buys a continuum of inputs $z_s \in [0,1]$ at price $p_t(z_s)$. The producer assembles the final goods using the following technology:

$$Y_{s,t} = \Big(\int_0^1 y_t(z_s)^{\frac{\epsilon_s - 1}{\epsilon_s}} dz_s \Big)^{\frac{\epsilon_s}{\epsilon_s - 1}} \tag{14}$$

where, $y_t(z_s)$ is the quantity of input z_s used in the production of the final good, and ϵ_s is the elasticity of substitution between inputs. Firms take price $P_{s,t}$ as given. Cost minimization yields the following condition:

$$y_t(z_s) = (p_t(z_s)/P_{s,t})^{-\epsilon_s} Y_{s,t}$$

The final good is competitively produced. This implies that firms choose to produce quantity such that the marginal cost of production is equal to the price i.e.:

$$P_{s,t} = \Big(\int_0^1 p_t(z_s)^{1-\epsilon_s} dz_s \Big)^{\frac{1}{1-\epsilon_s}}$$

Intermediate Goods Producer There are $z_s \in [0,1]$ types of intermediate goods in this sector. Each producer uses capital and labor as inputs using CES production technology. These are monopolistically competitive firms that set price $p_t(z_s)$. They take the price of inputs: wage rate W_t, rental rate R_t, price of final good $P_{s,t}$, and demand final output $Y_{s,t}$ as given. The profit maximization problem for each producer is the following:

$$\underset{y_t(z_s), p_t(z_s), k_t(z_s), l_t(z_s)}{max} \Pi_t(z_s) = p_t(z_s) y_t(z_s) - R_t k_t(z_s) - W_t l_t(z_s) \tag{15}$$

s.t.

$$y_t(z_s) = \big(p_t(z_s)/P_{s,t}\big)^{-\epsilon_s} Y_{s,t}$$

&

$$y_t(z_s) = F(k_t(z_s), L_t(z_s))$$

where, $F(k_t(z_s), L_t(z_s))$ is a CES production function of the intermediate good producer of type z_s. The function takes the following form: and, the marginal products are:

$$F^s(k_t(z_s), L_t(z_s)) = \big(\alpha_s k_t(z_s)^{\frac{\sigma_s - 1}{\sigma_s}} + (1-\alpha_s) L_t(z_s)^{\frac{\sigma_s - 1}{\sigma_s}}\big)^{\frac{\sigma_s}{\sigma_s - 1}} \tag{16}$$

$$F^s_{k_t(z_m)} = \alpha_s \Big(\frac{y_t(z_s)}{k_t(z_s)}\Big)^{\frac{1}{\sigma_s}}$$

$$F^s_{L_t(z_s)} = (1-\alpha_s) \Big(\frac{y_t(z_s)}{L_t(z_s)}\Big)^{\frac{1}{\sigma_s}}$$

First-order conditions from the maximization problem yield the following prices:

$$p_t(z_s) F^s_{k,t}(z_s) = \mu_s R_t$$

$$p_t(z_s) F^s_{l,t}(z_s) = \mu_s W_t$$

where μ_s is the markup:

$$\mu_s = \frac{\epsilon_s}{\epsilon_s - 1}$$

4.4 Household Sector

There is an infinitely lived representative household that buys investment goods for renting out as capital and consumption goods (C_m, C_a, C_s) from the three sectors in the economy. The household owns the firms in the economy and also supplies labor to the intermediate goods producers. It, therefore, has three sources of income - (i) labor income, (ii) rental income, and (iii) profit. Households derive utility from the consumption goods and discount the future at the rate of β. In the specification, households have a non-homothetic utility function in order to capture change in expenditure shares as the household becomes richer. Household's maximization problem is defined in the following:

$$\max_{C_{m,t}, C_{a,t}, C_{s,t}, K_{t+1}, L_t} \sum_{t=0}^{\infty} \beta^t u(C_{m,t}, C_{a,t}, C_{s,t}) \tag{17}$$

subject to the budget constraint

$$C_{m,t} + P_{a,t}C_{a,t} + P_{s,t}C_{s,t} + q_t X_t \leq R_t K_t + w_t L_t + \sum_{i=m,a,s} \pi_{i,t}$$

The law of motion of aggregate capital is given by:

$$X_t = K_{t+1} - (1-\delta)K_t$$

where the initial level of capital in period 0: K_0 is given. Capital can move across the sectors over time. Household is assumed to have the following utility function:

$$U(C_a, C_m, C_s) = \sum_t \beta^t (C_{a,t} - \bar{a})^{\gamma_a} C_{m,t}^{1-\gamma_a-\gamma_s} C_{s,t}^{\gamma_s} \tag{18}$$

where households consume minimum subsistence level of consumption of agricultural goods $\bar{a}$. Solving the household's problem we get the following expenditure shares:

$$\frac{p_{a,t}C_{a,t}}{m_t} = \frac{p_{a,t}\bar{a}}{m_t} + \gamma_a \frac{m_t - p_{a,t}\bar{a}}{m_t}$$

$$\frac{C_{m,t}}{m_t} = (1-\gamma_a-\gamma_s)\frac{m_t - p_{a,t}\bar{a}}{m_t}$$

$$\frac{p_s C_{s,t}}{m_t} = \gamma_s \frac{m - p_{a,t}\bar{a}}{m_t}$$

where m_t is the total income of the household in period t. This functional form assumption allows for variation in consumption expenditure shares with varying income. This change in demand creates structural transformation in the model over time. From the household's problem, we also get the Euler equation:

$$R_{t+1} = \frac{q_t}{\beta} \frac{\frac{\partial U_{t,m}}{\partial C_m}}{\frac{\partial U_{t+1,m}}{\partial C_m}} - q_{t+1}(1-\delta)$$

4.5 Equilibrium

Steady-state equilibrium in the economy is described by quantities { Y_m, Y_a,Y_s, Y_m^x ,$y(z_m)$, $y(z_a)$, $y(z_s)$, K, K_m, K_a, K_s, L_m, L_a, L_o, C_m, C_a, C_o} and prices {P_m, P_a,P_s, p_m, p_a, p_s, w, R} such that they satisfy the maximization problems in sections 3.1 - 3.4 and the following market clearing conditions:

1. Labor Market

$$L_m + L_a + L_s = 1$$

2. Capital Market

$$K_m + K_a + K_s = K$$

where, $K_m = \int_0^1 k(z_m)dz_m$, $K_a = \int_0^1 k(z_a)dz_a$, and $K_s = \int_0^1 k(z_s)dz_s$

3. Manufacturing Goods Market:

$$Y_m = C_m + Y_m^x$$

4. Agricultural Goods Market

$$Y_a = C_a$$

5. Services Goods Market

$$Y_s = C_s$$

4.6 Labor Share of Income

The total income generated in a sector is the sum of the labor share of income, capital share and profit share across all the intermediate goods producers. Following Karabarbounis and Neiman (2013), I assume intermediate goods producers in each sector are symmetric. The three shares of income in sector i at time t are:

$$s_{i,L,t} = \frac{1}{\mu_{i,t}} \frac{w_t L_{i,t}}{R_t K_{i,t} + w_t L_{i,t}}$$

$$s_{i,k,t} = \frac{1}{\mu_{i,t}} \frac{R_t K_{i,t}}{R_t K_{i,t} + w_t L_{i,t}}$$

$$\begin{aligned} s_{i,\pi,t} &= 1 - s_{i,L,t} - s_{i,K,t} \\ &= \frac{1}{\mu_{i,t}} \end{aligned}$$

Using the first-order conditions from the intermediate goods producer's problem, we can get the following expression for labor share of income:

$$s_{i,L,t} = \frac{1}{\mu_{i,t}} \left[1 - \alpha_i^{\sigma_i} \left(\frac{p_{i,t}}{\mu_{i,t} R_t}\right)^{\sigma_i - 1}\right] \tag{19}$$

From the equation above, the labor share of income is negatively related to the level of mark-ups regardless of elasticity of substitution ($\frac{\partial s_{i,L,t}}{\partial \mu i,t} < 0$). Increasing mark-ups increases profit share and reduces both labor and capital share of income.

However, the effect of change in the relative price of investment q depends on the substitutability or complementarity of labor and capital in production. From the Euler equation at steady state, rental rate R is increasing in q. If the two are substitutes ($\sigma > 1$), the labor share of income falls with a decline in the relative price of an investment, other things constant. In the case of complementarity ($\sigma < 1$), the labor share of income goes up with the decline in the relative price of investment goods. The decline in the relative price of investment increases the wage rate. Firms' demand for capital goes up with the decline in the rental rate, but with the complementarity in the production function, they have to buy the more expensive input, labor, as well. This leads to an increase in the labor share of income. This is contrary to the case with $\sigma > 1$, wherein a firm can substitute the now more expensive input labor for cheaper capital. This mechanism is the same as in Karabarbounis and Neiman (2013).

5 Quantitative Results

In this section, I investigate the relative contribution of two factors in the decline of the labor share of income - (i) a decline in the relative price of investment goods, (ii) a rise in profit shares. The decline of the relative price of investment goods is generated through improvement in technology in investment goods production, i.e., an exogenous increase in A_x. From section 4.1, we have that the relative price of investment goods q and production technology A_x are related by $q = 1/A_x$ in the model. Therefore, an improvement in the production technology A_x leads to a decrease in RPI in the model. For increasing market share in the model, I exogenously increase the mark-ups μ_i in each sector.

I consider multiple alternative calibrations - (i) with change in RPI only, (ii) with change in both RPI and mark-ups. Section 2 documents that markups have been stable at around 20% after 2000. However, due to a lack of data before 2000, there is uncertainty as to whether markups have increased substantially since 1980. For the model with a change in RPI and markups, I consider two extreme scenarios to cover the set of possibilities with respect to markups. In the first case, I use the average markup levels in the period 2003-07, i.e., $\mu_i = 1.22\ \forall i$ and assume that there has been no change in markups since the period 1980-84, i.e., $\mu_i = 1.22\ \forall i$ in the 1980-84 period as well. In the second case, I assume markups have changed since 1980-84 from an extreme value of no markups, i.e., $\mu_i = 1\ \forall i$.[11]

5.1 Decline in RPI

In the first exercise, I allow for a change in RPI only, keeping the values of markups constant for all sectors. I compare two steady states - the first one as 1980-84 and the second as the 5-year period before the Great Recession, i.e., 2003-07. With the calibrated model, I compute the aggregate labor share of income in the two steady states and decompose the change as described in section 2. I find that the model with no change in markups and only change in RPI matches the decomposition well i.e. gives the same contribution of the covariance term as observed in the data.

5.1.1 Calibration

I calibrate the discount factor to match the average value of the capital-output ratio for India of 2.8 in the period 1980-2007. The values for the α_i in each sector have been calibrated to match the average labor share of income in the 1980-84 period for each sector. The household sector's utility function is a non-homothetic utility function, with subsistence consumption of agricultural goods. Therefore, as the household income rises, the share of agricultural goods in the household expenditure tends to γ_a. I take the US economy as the benchmark with the highest per-capita income and set the value of $\gamma_a = 0.016$ as the average share of the agriculture sector in the US in that period was 1.6%. I calibrate the subsistence consumption $\bar{a}$ to target the value-added share of agriculture in 1980-84 in India ($\sim 36\%$). The manufacturing sector has two final goods - manufacturing consumption goods and investment goods. I use the depreciation rate to target the manufacturing sector's value-added share in 1980-84 ($\sim 14\%$). γ_s has been calibrated to match the value-added share of the Services sector in 1980-84.

Assuming that the change in labor share is coming entirely from a decline in the relative price of an investment, I calibrate the elasticity of substitution σ_i in each sector to match the change in the labor share of that sector from 1980-84 to 2003-07. The table below gives all the values of the parameters and the targets.

[11] De Loecker and Eeckhout (2018) compute a markup value of 1 for India in 1980 using linear extrapolation from their estimated series of markups. I have preliminary estimates of markups from 1980 - 2007 for the whole economy using industry-level data from KLEMS. See Appendix A.4.

Parameter	Value	Target
δ	.54	Average share of Manufacturing in 1980-84
β	.93	Average capital-output ratio in India
$\bar{a}$	.5	Average share of Agriculture in 1980-84
γ_a	.016	Average share of Agriculture in US $\sim$ 1.6%
γ_s	.93	Average share of Services in 1980-84
α_m	.34	Average LS in Manufacturing in 1980-84
α_a	.32	Average LS in Agriculture in 1980-84
α_o	.27	Average LS in Services in 1980-84
σ_m	1.4	Change in LS in Manufacturing from 1980-84 to 2003-07
σ_a	1.05	Change in LS Agriculture from 1980-84 to 2003-07
σ_s	1.3	Change in LS Services from 1980-84 to 2003-07

Table 5: Calibration: Change in RPI

5.1.2 Results

The elasticity values I get show that labor and capital are substitutes in all three sectors. However, the Manufacturing and the Services sectors have much higher elasticities of substitution, and the elasticity of substitution in the Agriculture sector is close to 1. As the relative price of investment decreases, labor becomes more expensive. Firms substitute labor for cheaper capital, and the labor share of income falls. A higher elasticity value in manufacturing 1.4 is needed to justify within the model the larger decline in the labor share of income in the sector, i.e., by ten percentage points. Meanwhile, the labor share of income falls by seven percentage points in the services sector, giving an elasticity of substitution value of 1.3. The table 6 below gives the labor share and value-added share of the three sectors in the two steady states, both as I get in the model and as observed in the data.

	Model		**Data**	
	1980-84	2003-07	1980-84	2003-07
q	1.16	0.62	1.16	0.62
μ_i	1.22	1.22	-	1.22
LS_m	.46	.36	.46	.34
LS_a	.55	.54	.55	.54
LS_s	.56	.49	.56	.49
VA_m	.14	.18	.14	.16
VA_a	.36	.21	.36	.18
VA_s	.50	.61	.50	.66
LS	.542	.476	.544	.476
LS change	**-.066**		**-.068**	

Table 6: Results from Change in RPI

The labor share of income in the data falls by 6.8 percentage points, while in the model, it falls by 6.6 percentage points. The aggregate labor share of income is computed as the weighted

average of the labor share of income in the three sectors. While the change in within-sector labor share is targeted, the value-added shares are non-targeted.

The 47% decline in the relative price of investment goods increases the equilibrium stock of capital. With more capital, the economy's aggregate output and income increase, which changes the relative demand of the three consumption goods by households due to non-homotheticity. As income increases, the household sector's expenditure on agricultural consumption goods falls. As a result, the value-added share of agricultural goods falls from 36% to 21%. Households demand more Services goods than manufacturing goods, and hence, the value-added share of the Services sector goes up by 11 percentage points, and the value-added share of manufacturing goes up by only four percentage points, most of which comes from an increase in the production of investment goods.

With a lower RPI and higher capital stock, the wage rate goes up. As the three sectors have different elasticities of substitution, intermediate goods producers in the three sectors change their input mix differently. The capital-labor ratio goes up the most in the manufacturing sector, followed by the Services sector and least in the agriculture sector in the model. In the data, the capital-labor input ratio goes up the most in manufacturing and the least in Services.

Table 7 shows the distribution of the two factors - capital and labor, across the three sectors as computed in the model and as observed in KLEMS data.[12] Both in the data and the model, the ratio of workers employed in Agriculture goes down by 13 percentage points and up by 12 percentage points in the Services sector.

	Model		**Data**	
	1980-84	2003-07	1980-84	2003-07
L_m	.12	.13	.10	.11
L_a	.37	.24	.69	.56
L_s	.51	.63	.21	.33
K_m/K	.19	.24	.16	.26
K_a/K	.35	.18	.21	.12
K_s/K	.46	.59	.63	.62

Table 7: Labor and Capital share movements

While the capital stock increases, total labor is assumed to be the same, i.e., $L = 1$ in the two steady states. In the data, the value of capital increases by $\sim$ 300% and in the model, it goes up by $\sim$ 400%. The model does not do as well in matching the movement of the ratio of capital across sectors. In the model, I find that the ratio of total capital employed moves from Agriculture towards the Manufacturing and Services sector. While the ratio of capital goes down by 18 percentage points in the Agriculture sector, the ratio goes up by 5 percentage points in the Manufacturing sector and by 13 percentage points in the Services sector. In the data, ratio of capital in Agriculture sector goes down by 9 percentage points, and up by 10 percentage points in the Manufacturing sector.

Table 8 below compares the within-sector labor share changes v/s changes in value-added shares in the data with the model. As in the data, 80% of the change in the aggregate labor share comes from changes in the within-sector labor shares. The covariance terms in both are close to 16%, i.e., sectors with declining labor share of income were increasing in relative size in the economy. However, the change in value-added shares alone does not significantly contribute to the decline in the aggregate labor share of income.

[12]Labor in the data is measured in terms of number of persons, and capital stock is expressed in dollars.

	Model	Data
	(%)	(%)
VA Effect	4	0
LS Effect	80	84
Covariance Term	16	16
Total Decline	.07	.07

Table 8: Within-sector / VA share effects

5.2 The decline in RPI and Rise in Mark-ups

In the next exercise, I make the same change in RPI as in previous case. In addition to that, I add the extreme case of increase in markup i.e. zero markup in all sectors in the 1980-84 period to an average of 22% in the 2003-07. Following the calibration strategy as used before - I target the labor shares of income in the two steady states, the value added shares in the first steady state and compute the change in aggregate labor share of income in the second steady state. I find that the model in this case does not generate a big enough covariance term in the decomposition of the change in aggregate share of income, i.e., does not produce the contribution of the structural change in the decline of the labor share of income in India. Moreover, the resultant structural change in this scenario has the opposite impact on the aggregate labor share of income, i.e. prevents the labor share from falling even further.

In addition to this, I also do a counterfactual exercise to compare the contribution of RPI and markup in the decline of the aggregate labor share of income in India. I find that the calibrated values of elasticities of substitution changes significantly in this case which reverses the effect of the decline in RPI i.e. the decline in RPI prevents the aggregate from falling more than it did.[13]

5.2.1 Calibration

I follow the same calibration strategy as before. The discount rate β is calibrated to target the average capital-output ratio from 1980 - 2007. The household utility function parameters γ_a and γ_s target the average share of Agriculture and Services sectors, respectively, in during 1980-84. The subsistence level of agriculture consumption in the utility function $\bar{a}$ is set at 0.016 as the share of Agriculture in the same period in US GDP (1.6%). Since the demand for manufacturing goods comes from both consumption and investment goods, I use the depreciation rate to target the share of the manufacturing sector in the economy. A 4% depreciation rate targets the manufacturing sector's 14% average share in the first steady state. The capital share parameter in the production function is calibrated to target the labor shares in the respective sectors.

I calibrate the elasticities of substitution by matching the post-change labor share values computed in the model to the average labor share values in the respective sector post-2000. Labor share is now affected by both the relative price of investment goods (relative wage rate) and markups. From equation 19, the labor share of income is a function of -

$$s_{i,L,t} = \frac{1}{\mu_{i,t}}\Big[1 - \alpha_i^{\sigma_i}\Big(\frac{p_{i,t}}{\mu_{i,t}R_t}\Big)^{\sigma_i - 1}\Big]$$

[13]This result departs from Karabarbounis and Neiman (2013) in that their estimate of elasticity of substitution stays the same with or without markups that leads them to maintain their conclusion that decline in RPI explains half of the decline in the global average of labor share of income. The difference arises due to the degree of change in the markups. In Appendix A.3 I document results from varying levels of markup and varying degrees of changes in markup. I find that the level of markup does not matter but the degree of change in markup does.

Parameter	Value	Target
δ	.04	Average share of Manufacturing in 1980-84
β	.92	Average capital-output ratio in India
$\bar{a}$	1.4	Average share of Agriculture in 1980-84
γ_a	.016	Average share of Agriculture in US $\sim$ 1.6%
γ_o	.98	Average share of Services in 1980-84
α_m	.44	Average LS in Manufacturing in 1980-84
α_a	.79	Average LS in Agriculture in 1980-84
α_o	.53	Average LS in Services in 1980-84
σ_m	1.2	Change in LS in Manufacturing from 1980-84 to 2003-07
σ_a	.59	Change in LS in Agriculture from 1980-84 to 2003-07
σ_s	.85	Change in LS in Services from 1980-84 to 2003-07

Table 9: Calibration: Change in RPI and Markups

5.2.2 Results

The model generates a 5.8% decline in the aggregate labor share of income. The labor share of income in the Manufacturing sector falls from 46% to 34%. This fall can be accounted for by both the decrease in the relative price of investment goods through the substitution effect and by the increase in markups by 22%. With an elasticity of substitution value of 1.2, labor and capital are substitutes, and the decrease in the relative price of investment goods increases the wage rate, and firms substitute labor for capital. This decreases the labor share of income in the Manufacturing sector. In both Agriculture and Services sectors, however, labor and capital are complements with the elasticity of substitution values as 0.59 and 0.85, respectively. The labor share of income falls by only 2 percentage points in the agriculture sector and 7 percentage points in the Services sector. While the increase in markups puts downward pressure on the labor share of income, the decrease in the relative price of investment goods compensates for the fall. As the price of capital gets cheaper, firms hire both more capital and labor as they are complements in the production function. This compensates for the decline of labor share because of the increase in markups. As the decline of labor share is higher in the services sector than agriculture, the degree of complementarity is less in the services sector ($\sigma_s = 0.85$), than in agriculture ($\sigma_a = 0.59$).

	Model		Data	
	1980-84	2003-07	1980-84	2003-07
q	1.16	0.62	1.16	0.62
μ_i	1.0	1.22	1.0	1.22
LS_m	.46	.34	.46	.34
LS_a	.55	.53	.55	.54
LS_s	.56	.49	.56	.49
VA_m	.15	.11	.14	.16
VA_a	.36	.27	.36	.18
VA_s	.50	.63	.50	.66
LS	.543	.484	.544	.476
LS change	**-.058**		**-.068**	

Table 10: Results from changes in RPI and Markups

Table 10 compares the pre- and post-change periods in the model with the data. The value-added shares in the three sectors in the second column of the model are non-targeted. The calibration exercise leads to a four percentage point decline in the value-added share of the manufacturing sector compared with a two percentage point increase in the data. The fall in the value-added share of agriculture is less than as observed in the data. For the Services sector, the increase in its value-added share is less than in the data. The increase in markups suppresses output and the change in value-added shares via changes in household consumption demand is not as much as in the case when there is no change in markups. Manufacturing's value-added share goes up because the demand for investment goods goes up with a lower RPI. In the scenario of a decline in RPI and an extreme increase in markups by 22%, the model does not match the value-added shares with the data as well as the scenario where the markups do not change.

The input mix in the three sectors changes differently. As in the case of no change in markups, the capital to labor input ratio increases the most in the manufacturing sector, and the least in the agriculture sector. The model overstates the growth of capital in Services and does not show growth in the share of capital in the manufacturing sector. The model with a huge increase in markups also does not match the changes in the distribution of labor across the three sectors. It shows a decline in the share of labor in Manufacturing by 5 percentage points, in Agriculture by 7 percentage points and an increase in Services by 12 percentage points. These changes do not match the changes observed in the data. Table 11 shows changes in the shares of input across sectors.

	Model		Data	
	1980-84	2003-07	1980-84	2003-07
L_m	.12	.08	.11	.11
L_a	.36	.29	.69	.56
L_s	.52	.63	.21	.33
K_m/K	.17	.16	.16	.25
K_a/K	.35	.23	.21	.12
K_s/K	.48	.61	.63	.62

Table 11: Labor and Capital movements

Table 12 below compares the contribution of changes in the within-sector labor shares and the contribution of changes in value-added shares in the data with the model results. All of the decline in the aggregate labor share of income in the model comes from changes in the within-sector labor shares. The structural change in the economy in the absence of changes in the labor shares of income would have led to an increase in the aggregate labor share of income as the Services sector, the sector with the highest initial share of labor income increases in its value-added share in the GDP, and manufacturing goes down in size. The covariance term, however, pushes the aggregate labor share of income down.

With a 20% increase in markups, all of the labor share decline is attributed to within-sector changes and there is no contribution of structural change. On the contrary to data, a very high increase in markups reduces the within sector labor shares by so much that the aggregate labor share would have fallen by even more had there been no structural change.

	Model	Data
	(%)	(%)
VA Effect	-9	0
LS Effect	104	84
Covariance Term	5	16
Total Decline	.06	.07

Table 12: Within-sector / VA share effects

Counterfactual

In the counterfactual exercise, I use the calibrated model here to compute the impact of the decline in RPI and increase in markups separately. The first column in Table 13 is the values of the labor share and the value-added shares of the three sectors during the first steady state (1980-84). In the second column are results from the experiment where RPI goes down by 47% from an average of 1.16 to 0.62 while keeping the markup at 1. From these results, had markups not risen in the Indian Economy, access to cheaper investment goods would have increased the labor share of income to 60%. This is owing to the elasticity of substitution between labor and capital is less than one in both Agriculture and Services. With cheaper capital, firms in the two sectors hire both more capital and more workers (at a higher relative wage rate). This increases labor share in the agriculture sector from 55% to 69%, and in the Services sector from 56% to 64%. Moreover, with higher capital in the economy, aggregate income in the economy goes up, and with the non-homothetic utility function, demand for consumption goods from the three sectors changes differently. While the value-added share of the agriculture sector goes down from 36% to 23%, the value-added share of the Services sector goes up from 50% to 64%. On the other hand, the labor share in the manufacturing sector falls as the elasticity of substitution between labor and capital is > 1, and the value-added share of the manufacturing sector declines from 15% to 13%. These changes result in an overall increase in the labor share of income in the economy.

q	1.16	0.62	1.16	0.62
μ_i	1.0	1.0	1.22	1.22
LS_m	.46	.39	.39	.34
LS_a	.55	.69	.41	.53
LS_s	.56	.62	.45	.49
VA_m	.15	.13	.13	.11
VA_a	.36	.23	.42	.27
VA_s	.50	.64	.46	.63
LS	.54	.60	.43	.48

Table 13: Results from Counterfactuals

The results change when we allow markups to increase and keep the relative price of investment goods at the 1980-84 level. The markup increase leads to a decline in labor share in all three sectors (column 3 above). The increase in markups suppresses demand and income in the economy. With lower income, households consume less of all three goods. However, due to the non-homothetic utility function with a subsistence level of agriculture goods consumption and high weight on services goods consumption ($\gamma_s = 0.93$), the share of income spent on agriculture goes up, and the share of income spent on manufacturing goods and services sector goes down. With lower income, investment also goes down, which suppresses the value-added share of the manufacturing sector even further. As a result, the value-added share of the agriculture sector goes up from 36% to 42%. The share of the manufacturing sector goes down to 13% and of the services sector to 46%. The overall effect is a fall in aggregate labor share of income from 54% to 43% due to an increase in markups.

The last column of the table above is the result of both changes in the RPI and changes in markups for comparison. From the counterfactual exercise, I find that the decline in RPI mitigates the effect of the increase in markups on the labor share of income and prevents it from falling even further when both changes in RPI and markups are incorporated into the model. Had there been no increase in markups, the decline in the relative price of investment goods would have increased the aggregate income. At the same time, the aggregate labor share of income would have gone up by six percentage points instead of the six percentage points decline.

5.3 Comparison: RPI v/s Markups

From the exercise above, the scenario in which the relative price of investment goods falls by 47% and India had a constant level of markups at 1.22 matches some of the variables in the data better than the scenario in which there is a huge increase in markups. In the first scenario, the model generates 96% of the decline as observed in the data, while the decline in RPI with a large increase in markups can generate 84% of the decline. While the within-sector labor shares are targeted, the value-added shares post-exogenous changes are not. When there is no increase in markups, the value-added shares generated in the model match the shares as observed in the data. The changes in the within-sector labor shares, along with the changes in the value-added shares, give a value of 16% to the covariance term in the decomposition of the total decline. Table 14 below compares the decomposition of the aggregate labor share of income in the two scenarios along with the data.

	Only RPI (1)	RPI and Markup (2)	3 sector Data
LS Effect	81	104	84
VA Effect	4	-9	0
Covariance Term	16	5	16

Table 14: Decomposition of total decline
(in %)

Scenario 1 also matches the shifts in the labor employment shares across sectors. While in both scenarios, a higher share of workers are in Services than in the data (see table 15), the scenario with no increase in markups generates the same percentage change as in the data (Table 16). Moreover, in the first scenario, the share of capital employed in Manufacturing, relative to the other sectors, increases over time, while in the second scenario, it decreases. The decline in RPI increases demand for investment goods produced in the manufacturing sector. A huge increase in markups reduces aggregate demand and output in the economy and, hence, reduces demand for capital. The total stock of capital increases in both scenarios, though the first case overestimates the increase in capital stock (by $\sim 400\%$), and in the second scenario, it grows by $\sim 120\%$. In the data, capital grew by 260% during the period 1980 - 2007.

Overall, a decline in the relative price of investment goods along with no or very small increase in markups explains the decline in the aggregate labor share of income better than the extreme case of an increase in markups from no markup to 22%. The former is more consistent with the sectoral changes observed in the data, along with some other input-mix related variables.

	(1)	(2)	3 sector Data
Manufacturing	12	12	10
Agriculture	37	36	69
Services	51	52	21

Table 15: Initial share of Labor employment (in percentage)

	(1)	(2)	3 sector Data
Manufacturing	1	-5	1
Agriculture	-13	-7	-13
Services	12	12	12

Table 16: Change in share of Labor employment (in percentage points)

	(1)	(2)	3 sector Data
Manufacturing	19	17	16
Agriculture	35	36	21
Services	46	52	63

Table 17: Initial share of capital employment (in percentage)

	(1)	(2)	3 sector Data
Manufacturing	5	-2	9
Agriculture	-18	-12	-9
Services	13	14	-1

Table 18: Change in share of capital employment (in percentage points)

6 Conclusion

This paper studies the decline in labor's share of income in India between 1980 and 2007 and evaluates the roles of structural transformation, investment-price movements, and markups. Using

disaggregated data from India KLEMS, I show that roughly half of the aggregate decline is driven by falling labor shares within industries, while the remainder reflects structural change and a positive covariance between expanding sectors and declining labor shares.

To interpret these patterns, I develop a three-sector general equilibrium model with heterogeneous capital–labor elasticities and non-homothetic demand. The model allows investment-price movements and markups to affect labor shares both within sectors and through reallocation across sectors.

Quantitatively, a decline in the relative price of investment goods closely matches both the magnitude of the aggregate decline and its decomposition into within- and between-sector components. In contrast, increases in markups generate substantial within-sector declines but fail to reproduce the observed structural reallocation patterns unless implausibly large changes are assumed. These findings indicate that investment-price dynamics, interacting with sectoral heterogeneity and structural transformation, are central to understanding India's labor share decline. In particular, capital-deepening forces associated with falling investment prices appear to have played a dominant role.

More broadly, the results underscore that aggregate labor share dynamics cannot be fully understood without accounting for structural transformation and sectoral composition. Incorporating sectoral heterogeneity is therefore essential when evaluating labor share movements in developing economies.

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A Appendix

A.1 Relative price of investment goods (PWT)

The Penn World Tables uses detailed prices available in the International Comparisons Program (ICP) to create relative prices of goods in the category of consumption goods, investment goods, government expenditure goods, imported goods and exported goods. These prices are relative to the reference prices $\pi_{i,t}$ that PWT creates for each of these categories of goods. The relative price of consumption, investment and government expenditure goods $pl_i_{jt} \in \{C, I, G\}$ for country j in year t is computed using the following in the PWT[14]:

$$pl_i_{jt} = \left(\frac{p_{ijt}q_{ijt}}{\pi_{it}q_{ijt}}\right)/\epsilon_{jt} \quad i \in \{C, I, G\}$$

where, $p_{i,j,t}$ is the price of good i in country j at time t, $q_{i,j,t}$ is the quantity of the respective goods, and $\epsilon_{j,t}$ is the exchange rate of the local currency of country j with the reference currency (USD).

In order to obtain the relative price of investment goods for India, I first divide the price series of investment goods with that of consumption goods for India which gives the relative price of investment goods to consumption goods for India relative to the world benchmark RPI in that period. RPI of country j relative to the world benchmark can be computed using the following:

$$\frac{pl_i_{jt}}{pl_c_{jt}} = \left(\frac{p_{ijt}q_{ijt}}{p_{cjt}q_{cjt}}\right)/\left(\frac{\pi_{it}q_{ijt}}{\pi_{ct}q_{cjt}}\right) = \frac{\text{RPI}_{j,t}}{\text{RPI}_{world,t}}$$

I create this series for both India and the US. Additionally, I use the RPI data for the US from Federal Reserve Economic Data and do the following to retrieve the series of RPI for India:

- Get $RPI_{world,t}$ using RPI_{US} from FRED

$$RPI'_{world,t} = RPI_{US}/\left(\frac{pl_i_{US,t}}{pl_c_{US,t}}\right)$$[15]

- Get $RPI_{india,t}$ from price ratio in PWT and $RPI_{world,t}$ from above

$$RPI_{india,t} = \left(\frac{pl_i_{india,t}}{pl_c_{india,t}}\right) \times RPI'_{world,t}$$

Figure 7 below show the relative price of investment goods in India, the US, and world benchmark. Note, all the series have been normalized to 1 for the year 1980.

A.2 Matching Algorithm

The data in ASI is collected annually. For each year, the data is collected in several blocks (A-I). Each firm is assigned a unique DSL number for the year, which is maintained across the blocks. I use this DSL variable to merge the data from different blocks into one file for each year. To maintain anonymity, these DSL values are not maintained across time. Therefore, to create a true panel, I use time-consistent variables available for each year and match some of those to create firm IDs across time. These time-consistent variables were available from 1998 onward; hence, a panel can be created only post that period.

Along with the variables of interest mentioned in 2.2 in the section, I keep the following variables:

1. NIC 5 digit industry code

[14] See Feenstra et al. (2015) for detailed documentation

[15] Since the quantities are different, RPI_{world} is different from the Indian than obtained from the series using US prices.

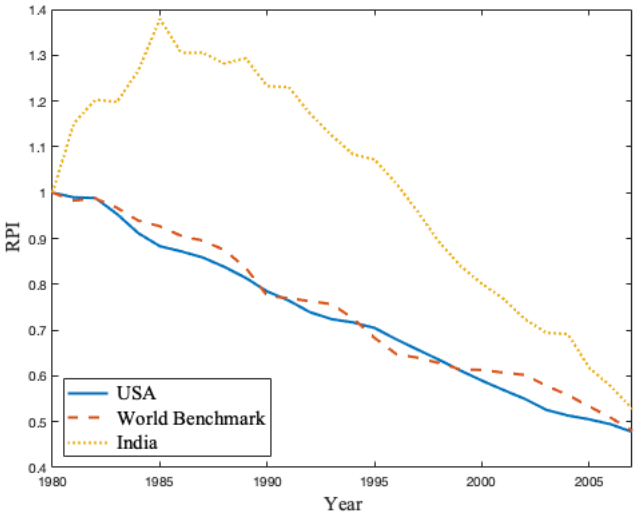


Figure 7: Relative Price of Investment goods

2. Year of initial Production
3. State Code
4. Rural/Urban location dummy
5. Type of Organization

and year opening and closing values of -

6. Outstanding loan
7. Assets
8. Subtotal Capital

I first clean the data, removing negative values of Gross Sale Value, Investment, Capital, Wages, and Cost of production. With the possibility of inconsistent data collection, I also removed all firms with initial years of production before 1947, when India gained independence. With this data set, I first group firms with the same values: NIC 5-digit code, Year of initial production, State code, Rural/Urban status and Type of Organization. Within each group, I assign a matching value of 1 for each loan, asset, and capital if the opening and closing values of the variables rounded to 10^6 are equal. I assign the same firm ID if the observations belong to the same group value and have a matching value of 1 for at least one of the three variables. I drop a firm if I have multiple entries with the same year and the same assigned firm ID.

A.3 Alternate changes in markup

In order to understand the role of markups in the model, I perform a series of calibrations and make a comparison similar to Karabarbounis and Neiman (2013) for India. Karabarbounis and Neiman (2013) find that the fall in the relative price of investment goods contributes to half of the fall in the global labor share of income. They find no significant change in their estimates of elasticities of substitution when they add a 5% increase in markups starting with no markups. The paper, therefore, concludes that a decline in RPI caused half of the decline in the labor share of income globally. In this section, I test the effect of varying initial levels of markup and varying degrees of changes in markups on the labor share of income and the estimates of the elasticity of

substitution between capital and labor. Additionally, I compare the decomposition of the decline in the aggregate labor share of income in the different scenarios.

The time periods I use in this exercise are 1980 values for the first steady state and 2011 values for the second steady state. The calibration strategy is the same as before. I calibrated the discount factor to match the average capital-output ratio in that period for India. Parameters α_i are calibrated to match the labor shares of income in sector i in 1980, and the elasticity of substitution values are calibrated to target the labor share values in 2011. Depreciation rate δ is calibrated to target the value-added share of the manufacturing sector in 1980. γ_a is set to 0.016 to match the share of the agriculture sector in the US, and $\bar{a}$ is calibrated to target the value-added share of the agriculture sector in India.

Table 19 below shows the values of the elasticity of substitution for the different calibrations. The first column is the case when there are no markups in the economy; the second column is when markups increase by 5% point, starting with no markups in the first steady state. Column 3 has calibrated values when there is a 5% point increase in the markups but with a higher starting level of 30%. I calibrate the model in the last column with a markup change from 30% to 60%. The markup increase from 1.3 to 1.6 is taken from De Loecker et al. (2020), which is their estimate of markups for the US from 1980-2016. The table also compares the decomposition of the decline in the aggregate labor share.

	no markup	$1 \to 1.05$	$1.3 \to 1.35$	$1.3 \to 1.6$	3 sector Data
σ_m	1.26	1.25	1.43	1.26	-
σ_a	1.005	0.96	0.95	0.36	-
σ_o	1.16	1.12	1.25	0.65	-
LS Effect	81%	86%	86%	104%	81%
VA Effect	-7%	-6%	$\sim 0\%$	-6%	-3%
Covariance Term	26%	20%	14%	1%	22%

Table 19: Result Comparison

The elasticities of substitution do not change much if there are no or small changes in markups. However, a large markup increase puts a large downward pressure on the labor share. The decline in the relative 'price of investment goods has to compensate for this downward pressure. As a result, we get complementarity between labor and capital. The decline in the relative price of investment goods and the complementarity between labor and capital increases the labor share of income as firms cannot substitute labor for capital.

No or 5% change in markups gives a decomposition of the aggregate labor share changes that are similar to the data. The LS Effect in the first three columns is close to the 81% change as in the data. A higher percentage change in markups increases the effect of changes in within-sector labor share on the change in the aggregate labor share of income, as a higher profit share in a sector directly reduces the labor share of income in that sector. Additionally, the higher percentage change in markup reduces the positive impact of cheaper investment goods on output. As a result, the value-added shares of the three sectors do not change such that we get a big enough covariance term.

While the markup level does not seem to matter, a big increase in markup reduces the contribution of structural change on changes in the aggregate share of income. Moreover, a large enough increase in markups changes the calibrated values of elasticities of substitution by a lot. From the counterfactual exercise (as in section 5.2.2), a large increase in markup also reverses the impact of the decline in RPI on the aggregate labor share of income in the model.

A.4 Markups: 1980 - 2007

In the paper, all results are based on markup levels estimated using the Annual Survey of Industry data, which covers data for manufacturing firms and post-2000s only. In this section, I attempt to

get estimates of markups for the entire economy from 1980 - 2007. I use the industry-level data provided by KLEMS to create the panel data necessary for the estimation process. The estimating equation is the same as before, i.e.

$$y_{i,t} = \alpha + \beta_k k_{i,t} + \beta_x x_{i,t} + \omega_{i,t} + \eta_{i,t}$$

where, $y_{i,t}$ is the value of the gross output of industry i at time t. As before, the dynamic input decided in period $t-1$ is $k_{i,t}$ i.e. the capital stock owned by an industry i, $\omega_{i,t}$ is the productivity shock (following first-order Markov process) and $\eta_{i,t}$ is the measurement error. As regards to the static variable, $x_{i,t}$ I estimate using two different variables available in the data - Labor Employment (LABEMP) and Intermediate inputs (II). For lack of data on investment in KLEMS, I use alternate variables as Intermediate Energy Income (IIE) and Intermediate Material Income (IIM) following Petrin et al. (2004) as proxy variables to learn about the productivity shock $\omega_{i,t}$.

I use the *prodest* function in STATA to get estimates of the variable inputs' parameters. A difference here than before in section 3 is that I use the Levinsohn Petrin (LP)[16] method in the *prodest* function instead of Olley Pakes (OP). I use the Gross Output in each industry as the dependent variable $y_{i,t}$, the value of the capital stock as the state variable $k_{i,t}$, LABEMP or II as free variables $x_{i,t}$ and IIM or IIE as the instrumental variable. I use the estimate of the free variable parameter to compute markup following Hall(1998), i.e.,

$$\mu_i = \frac{\partial log y_i / \partial x_{i,t}}{\Omega_i}$$

where Ω_i is the industry's expenditure on labor relative to the firm's turnover in cases where labor is used as the free variable and the industry's expenditure on intermediate inputs when the intermediate inputs are used as the free variable.

Free	Proxy	1980-84	2003-07
LABEMP	IIM	1.32	1
LABEMP	IIE	1.46	1.1

Table 20: Result Comparison

The results vary depending on the combination of inputs used in the estimation process[17], however, my early estimates do not support a huge increase in markups, further strengthening the paper's conclusion that . In the future, I can refine the process for Indian data and get better markup estimates. I plan to use aggregate economy-level markups for the calibration.

[16] Petrin et al. (2004)

[17] Raval (2023) argues that markups using labor and materials do not give the same markup distribution, contrary to what is assumed in the production approach to markup estimation.