Elasticity of Substitution between Capital and Labour Inputs in Manufacturing Industries of the Indian Economy

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Abstract

Elasticity of substitution among factors of production is an important parameter of manufacturing industries. Differences in the elasticity of substitution across the manufacturing industries have significant implications for tax policy. Elasticity of substitution is an important determinant of sustainability of growth rate as well as movements in factor income shares over time. Despite the importance of this parameter, in the last twenty years, there have been very few studies on the elasticities of substitution in manufacturing industries in India. A set of estimates of elasticity of substitution for different manufacturing industries would provide useful parameters for building computable general equilibrium (CGE) models for the Indian economy.

In this paper, the elasticity of substitution between capital and labour inputs is estimated for 22 manufacturing industries (2-digit, NIC-2004) of the Indian economy. The estimation is done on the basis of a constant elasticity of substitution (CES) production function, using annual time-series data for the period 1980-81 to 2007-08 from the Annual Survey of Industries, Central Statistical Office. The SURE method has been applied for estimation of elasticity of substitution based on the SMAC functions. The ARDL model has also been applied. This provides estimates of long-term elasticity of substitution. The results indicate that the elasticity of substitution is commonly less than one, with some variation across manufacturing industries of the Indian economy. There are indications of significant labour-saving technical change in most manufacturing industries.

1. Introduction

1.1 In developing countries, capital accumulation is often the prime source of economic growth. It not only affects the rate of output growth but also the labour productivity and thus determines the demand for labour. The relationship between capital and labour is a complex dynamic phenomenon. For simplicity of empirical purposes, in general, it is measured in terms of elasticity of substitution[2] between labour and capital. The capital-labor substitution elasticity is a key parameter in quantifying the welfare effects of policy shocks (Balistreri et al. 2003).

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[2] Elasticity of substitution measures the ease with which one factor can be substituted for another. The concept has relevance because various factors of production have alternative use (Arya, 1985)

1.2 The elasticity of substitution is relevant to a number of other problems as well, in both developed and developing countries (Morawetz, 1976). A higher elasticity of substitution between labor and capital may result in a higher level of labor productivity in the steady-state (Klump and de La Grandville, 2000). If the elasticity of substitution between factors of production is high, it implies that there prevails flexibility to adjust the factors of production in response to changes in factors' prices and/or growth in demand for products of the industry emanating from any external or internal reasons. The fast growing factor may be substituted for slow growing factor or the factor having higher productivity may be substituted for the factor having low productivity. Therefore, the estimate of factor substitution elasticity has wide applicability including their use in policy making, and a study of factor substitution elasticity is important.

1.3 In the CGE modeling, the value of elasticity of substitution is an important parameter. It may be applied for assessing the efficacy of policy changes that aims to use taxes, tariffs and price mechanism. To give an example, through a CGE study, Zuccollo (2011) has investigated the impact of tariffs reduction on economic growth by using elasticity of substitution between factors as parameters. An increase in the relative cost of labor makes the firm use relatively more capital than before, at any scale of production. Therefore, the elasticity of substitution between capital and labour may be applied to explain the capital accumulation as a growth driver for real unit labour costs (Lebrun and Perez, 2011).

1.4 There have been a number of studies on the elasticity of substitution since introduction of the concept by Hicks in 1932. The wide range of estimates found in the literature spanning several decades reveals a lack of consensus concerning the magnitude of the capital-labor substitution elasticity (Balistreri et al., 2003). The variation in the estimates of the capital-labour substitution mainly depends on the type of capital data used (i.e. aggregate, panel, etc), and the type of production function used (i.e. Constant Elasticity of Substitution (CES), Translog, etc). The estimates of elasticities of substitution may differ considerably across different countries and in the same country during different time periods (Morawetz, 1976). Therefore, the purpose and the nature of study on the elasticity becomes a very relevant issue.

1.5 There have been some multi-country or cross-country studies on the elasticity of substitution between capital and labour in which India is included. Mallick (2007), for instance, has estimated the elasticity of substitution at the aggregate economy level separately for different countries for the period 1950 to mid-1990s by employing a normalized CES production function. The estimates of elasticity of substitution obtained in Mallick's study for some major developing countries are as follows: 0.515 for India, 0.548 for China, 0.112 for Argentina, 0.126 for Brazil, 0.087 for Mexico, 0.197 for Thailand, 0.075 for Philippines, 1.139 for Indonesia and 1.522 for Malaysia. The estimates suggest that the elasticity of substitution between capital and labour at the aggregate economy level is generally low among developing countries.

1.6 Inter-industry variation in the elasticity of substitution has been less attended by researchers. In a survey five CGE studies, Chirinko (2002) observes that all have assumed one common elasticity of substitution for the entire economy. In a two-country model, Roeger et al. (2002) considers same elasticity of substitution for both countries. However, there are studies in which differences across sectors have been considered. In a CGE study with 19 industries, Fullerton and Rogers (1993) has taken different elasticity of substitution for each industry.

1.7 For examining differences in elasticity of substitution across the US industry-level, Caballero et al. (1995) have estimated elasticity of substitutions for 2-digit SIC manufacturing industries using plant-level data from 1972 to 1988. The range of the estimated elasticity of substitutions is 0.01 to 2.00. Balisteri et al. (2003) have estimated elasticity of substitution for 28 US industries using data from 1947 to 1999. Their framework does not capture bias in technical change. Young (2013) has estimated the elasticity of substitution separately for 35 industries (2-digit SIC) from 1960 to 2005. He has observed considerable variation in the elasticity of substitution across industries but the values are uniformly less than unity.

2. Earlier Estimates of Capital-Labour Substitution Elasticity in Indian Industries

2.1 Estimates of the elasticity of substitution between labour and capital in Indian industries are available in a number of studies (e.g., Benerjee, 1971, 1973; Narasimhan and Fabrycy, 1974; Bhasin and Seth,1980; Goldar, 1986; Dhananjayan & Muthulakshmi, 1989; Ahluwalia, 1991; Chadha, et al., 1996; Upender, 2009; Virmani and Hashim, 2009).

2.2 Banerjee (1971) observed that the elasticity of substitution between labour and capital in the manufacturing sector in the period 1946 -1964 was not significantly different from unity. The estimates thus indicated sufficient capital-labour substitution possibilities existing in Indian manufacturing during the above mentioned period. In another study on five selected Indian industries (viz. Cotton Textile, Jute Textile, Sugar, Paper and Bicycle), Banerjee (1973) has found that the elasticity of substitution between capital and labour in these industries is significantly different from one. Similarly, in a study on estimation of production functions for Indian manufacturing industries for the period 1950-1965, Bhasin and Seth (1980) observed that the CES production function is a more appropriate specification than the Cobb-Douglas production function in most of the industries[3] since the estimate of the elasticity of substitution is often less than one.

2.3 Dhananjayan and Muthulakshmi (1989) have shown for three-digit non-traditional products manufacturing industries for a period 1973-74 to 1979-80 that there exists a significant variation in the elasticity of substitution across the industries. The numerical value of the elasticities of substitution in majority of industries at disaggregate levels has been observed to be greater than zero but less than one. In a study of 28 manufacturing industries, Gujrati (1966) has observed that the elasticity of substitution between capital and labour at aggregate level is one for the year 1958. On the basis of a cross section data for 26 major Indian industries for the year 2004-05, Upender (2009) has observed a positive and more than unity elasticity of substitution between capital and labour.

[3] This observation is based on the explanatory power of the model reflected in the value of R^2.

2.4 For entire manufacturing sector, Narasimhan & Fabrycy (1974) have observed the elasticity of substitution to be 0.78 for the CES model. Diwan & Gujrati (1968) has also found that the substitution between labour and capital is close to one, based on CES production function for a period 1946-58. Sanker (1970) and Kazi (1976) have also obtained similar estimates.

2.5 Goldar (1986) found the elasticity of substitution in Indian manufacturing to be about 0.7, less than unity. The estimates of Ahluwalia (1991) are, however, closer to unity. The estimates are about 0.9. The estimate of elasticity of substitution in Indian manufacturing made by Virmani and Hashi (2009) is about 0.64. This estimate again indicates that the elasticity of substitution in Indian manufacturing is less than one. Indeed, a number of studies undertaken in the past suggest that the elasticity of substitution between capital and labour in Indian industries is less than one.

2.6 The studies on elasticities of substitution pertaining to Indian industries clearly indicate that there exists variation in the magnitude of the elasticity across the industries. The reasons of this variation may be many but it also points towards the dynamic structure of the relationship between factors of production in Indian industries. Therefore, it is pertinent to have fresh estimates for the elasticity of substitution between capital and labour in manufacturing industries of India.

3. Objective of the Study

3.1 The object of this study is to estimate the elasticity of substitution between capital and labour input for manufacturing industries of the Indian economy. The estimates of the elasticity of substitution estimation have been obtained by estimating a constant elasticity of substitution (CES) production function from annual time series data for the period 1980-81 to 2007-08. The estimation of the elasticity has been done for 22 manufacturing industries of the Indian Economy shown in Table 1.

4. Data and Methodology

4.0 As stated above, the estimates of the elasticity of substitution between capital and labour input in Indian manufacturing industries have been obtained by estimating the parameters of a CES production function from annual time series data for the period 1980-81 to 2007-08. Further details on data and methodology are provided below.

4.1 Data and variables

4.1.1 The main source of data for the study is the *Annual Survey of Industries* brought out by the Central Statistical Office (CSO), Government of India. Number of employees is taken as the measure of labour input (L). Net fixed capital stock at constant prices is taken as the measure of capital input (K). Deflated gross value added has been taken as the measure of output (Y).[4] Trend growth rates in output, labour and capital in the 22 industries covered in the study are shown in Table 2.

[4] Some details of output and capital measurement are provided in Goldar (2012).

4.2 Production Function Specification: CES Production Function

4.2.1 The specification of production function plays a significant role in the empirical studies aimed to understand the growth processes and contribution of factors of production. If constant-returns-to-scale is assumed, an increase in wages may result in an appropriate adjustment of labour relative to capital. The extent of adjustment depends upon the elasticity of substitution between the labour and capital.

4.2.2 There are a range of possible forms of the production function, with each form possessing different mathematical properties and implications. The Cobb-Douglas production function assumes that the elasticity of substitution between capital and labour inputs is one, which implies that a unit increase in the ratio of wages to rental prices is followed by a unit increase in the capital-to-labour ratio. In the Leontief production function, it is assumed that there is no substitution possibility between factors of production. These two production functions are the specific cases of the constant elasticity of substitution production functions in which the elasticity of substitution is constant and varies between zero and infinity.

4.2.3 The assumption of unit elasticity of substitution underlying the Cobb-Douglas production function has been widely rejected by researchers (Chirinko, 2008, p. 683). Researchers have tried to find out whether the elasticity of substitution between capital and labour is greater or less than one. The variation in the value of the elasticity of substitution between capital and labour from unity may have important policy implications. A high elasticity of substitution between capital and labour may give rise to potential gains from tax reforms (Chirinko, 2002). If the elasticity of substitution between capital and labour differs significantly across industries then certain tax policy may lead to distorted inter-industry patterns of capital accumulation (Young, 2013).

4.2.4 In the initial phase of studies on production function, the Cobb-Douglas production was widely applied but subsequently the Constant Elasticity of Substitution production function has found preference among researchers due to its flexibility. Empirically, it has been observed that elasticity of substitution may not be one in the real world. Raval (2011) has observed no supporting evidence for the Cobb- Douglas production function in US manufacturing firms. Chirinko et al. (2004) have estimated the elasticity to be 0.4 rather than unity. Barnes et al. (2008) have also observed that, in the UK, the estimated elasticity is approximately 0.4 using firm-level data. Lebrun and Perez (2011) have found that the elasticity is approximately 0.7. Upender (2009) has shown the strong evidence in favour of the CES formulation in a study of Indian industries.

4.2.5 Therefore, in the present study CES production function has been used. The mathematical expression of CES production function is

$$Y = Ae^{\lambda t}[\delta K^{-\rho} + (1-\delta)L^{-\rho}]^{\frac{-\nu}{\rho}} \quad \dots (1)$$

where Y, K, L and t represent output, capital, labour and time respectively and A, λ, δ, ρ and ν are parameters. The return to scale parameter is ν and the elasticity of substitution parameter σ is related to ρ by the equation: $\sigma = [1/(1+\rho)]$.

4.2.6 Under the assumption of constant return to scale and perfect competition, one can derive the following two equations which are based on the marginal productivity conditions.

$$\log\left(\frac{Y}{L}\right) = \sigma \log[A^{\rho}(1-\delta)^{-1}v^{-1}] + \sigma logW + (\sigma\rho\lambda)t \quad \ldots (2)$$

$$\log\left(\frac{Y}{K}\right) = \sigma \log[A^{\rho}(\delta)^{-1}v^{-1}] + \sigma logR + (\sigma\rho\lambda)t \quad \ldots (3)$$

In these equations, W and R represent Real Product Wage Rate and Real Product Rental Rate respectively. These equations will hereafter be called the SMAC functions. The two equations can be estimated jointly by using the SURE method.

4.2.7 The discussion on methodology above has not considered two issues. There are (a) non-neutral technical change, and (b) non-stationarity of time series. To address the first issue, a factor augmentation form of the CES production function is considered. This gives rise to equations similar to (2) and (3) above except that the coefficients of time in the two equation are not equal. Under the assumption of constant returns to scale, the equations to be estimated are obtained as:

$$\log\left(\frac{Y}{L}\right) = \sigma \log[A^{\rho}(1-\delta)^{-1}v^{-1}] + \sigma logW + (\sigma\rho\lambda_L)t \quad \ldots (4)$$

$$\log\left(\frac{Y}{K}\right) = \sigma \log[A^{\rho}(\delta)^{-1}v^{-1}] + \sigma logR + (\sigma\rho\lambda_K)t \quad \ldots (5)$$

4.2.8 In these equations, λ_L and λ_K are the rates of labour augmenting and capital augmenting technical change. Thus, an alternate set of estimates of the elasticity of substitution has been obtained by estimating equations (4) and (5) by the SURE method, imposing the constraint that the coefficient of log (W) in equation (4) is equal to the coefficient of log (R) in equation (5), but not imposing any restriction on the coefficients of the time variable. Given the estimate of the estimated coefficients of equations (4) and (5), the rates of labour augmenting and capital augmenting technical change can be obtained.

4.2.9 As regards the issue of non-stationarity, Dickey-Fuller test and Augmented Dickey-Fuller test have been done to ascertain the order of integration of the time series on log(Y/L), log(W), log(Y/K) and log(R). Then, equations (4) and (5) have been estimated separately by applying the Auto-regressive distributed lag (ARDL) model. The estimated models give an estimate of the long run coefficients. Also, this approach makes it possible to test for co-integration.

4.2.10 The Dickey-Fuller and Augmented Dickey-Fuller test results for each of the 22 industries are presented in the Annex. The results are not discussed in detail in the paper. Suffice it to note that, in general, the test results indicate that the four series, log(Y/L), log(W), log(Y/K) and log(R), are integrate of order one, i.e. the series are I(1). Accordingly, one would be justified in applying the ARDL model to equations (4) and (5) for estimation of parameters.

5. Results: Estimates of Elasticity of Substitution

5.1 Estimates of elasticity of substitution between capital and labour input in various two-digit manufacturing industries are presented in Table 3. These estimates are based on the SMAC functions. The standard errors of the estimates are also shown in the table. The coefficients of *t* in the equations (4) and (5) may be restricted to be the same in the regression by SURE method.

5.2 Two alternate estimates of the elasticity of substitution have been shown in Table 3. Column (3) represents the estimate of the elasticity of substitution based on the regression which restricts the variation the coefficients of *t* while column (4) represents the estimate of the elasticity of substitution based on the regression which allows variation in the coefficients of *t*. Both types of estimates of elasticity of substitution are positive and mostly in the range of 0.5 to one. These findings are broadly consistent with findings in earlier studies (e.g. Bhasin and Seth, 1980; Narasimhan & Fabrycy, 1974; Diwan & Gujrati, 1968). The values in column (3) are higher than that of column (4) except for tobacco products and other transport equipment. The elasticity of substitution for 'other transport equipment' industry has been observed negative (i.e. -0.05) by the SURE method which restricts the variation in the coefficients of *t*.

5.3 The finding that there are significant variation in the elasticity of substitution between capital and labour across industries is similar to findings of Banerjee (1973), Bhasin & Seth (1980) and Dhananjayan and Muthulakshmi (1989). Drawing on the results of column (4) which is based on a more general model, the range of the value of elasticity of substitution between capital and labour is 0.54 to 0.97. Less than unitary elasticity of substitution estimates indicate that there is relatively low possibility of substitution labour and capital in Indian manufacturing industries. Lowest substitution possibilities has been observed in the industries of leather and basic metals (0.54 and 0.56 respectively) while highest substitution possibilities has been found in industries of wood, food and printing (0.97, 0.94, and 0.93 respectively).

5.4 Table 4 shows the trend of labour augmenting and capital augmenting technical change in the different manufacturing industries. It clearly indicates that in all manufacturing industries the labour augmenting technical change rate is positive while capital augmenting technical change rate is negative except in certain cases. It implies that manufacturing industries in India are adopting, in general, labour saving technological change. A similar result has been observed by Virmani and Hashim (2009) in their study on manufacturing industries in India during 1973-74 to 2000-01.

5.5 Table 5 presents the short run and long run estimates of elasticity of substitution between capital and labour in manufacturing industries in India. The long-run elasticity estimates are based on the ARDL model. In the cases where long run estimates of the elasticity of substitution between capital and labour could be obtained, it is observed that though the long run and short run elasticity estimates differ from industry to industry, the short and long run elastsicities are close to one another in many cases.

5.6 Considering the estimates presented in Tables 3 and 5, it is observed that the estimates of elasticity of substitution between capital and labour in manufacturing industries in India are often not equal to one. In many cases, the estimated elasticity is less than one. Therefore, the findings indicate that the production structure in Indian manufacturing industries follow the CES production function rather than the Cobb-Douglas production function. Virmani and Hashim (2009) have also come up with similar finding for Indian manufacturing industries.

6. Conclusion

6.1 The estimation of elasticity of substitution between input factors in an industry has many applications for policy analysis and research. In the present endeavour, the elasticity of substitution between capital and labour input for 22 manufacturing industries has been estimated on the basis of constant elasticity of substitution production function (i.e. SMAC function) by SURE and ARDL regression methods. In a majority of Indian manufacturing industries, the elasticity of substitution between capital and labour is less than one which implies that the possibility of substitution is relatively low in these industries. There is variation in the elasticity of substation between capital and labour across different manufacturing industries. It indicates that different tax policies may be applied for different manufacturing industries. In general, manufacturing industries has been found to adopt labour saving technological change. The long run and short run estimates are different for different industries but the both are close to one another is many cases.

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Table 1: Description of Industries covered in the study

Sl. No.	Industry Code (2-digit, NIC -2004)	Description of Industries
1	15	Manufacture of food products and beverages
2	16	Manufacture of tobacco products
3	17	Manufacture of textiles
4	18	Manufacture of wearing apparel; dressing and dyeing of fur
5	19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
6	20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plating materials
7	21	Manufacture of paper and paper products
8	22	Publishing, printing and reproduction of recorded media
9	23	Manufacture of coke, refined petroleum products and nuclear fuel
10	24	Manufacture of chemicals and chemical products
11	25	Manufacture of rubber and plastics products
12	26	Manufacture of other non-metallic mineral products
13	27	Manufacture of basic metals
14	28	Manufacture of fabricated metal products, except machinery and equipment
15	29	Manufacture of machinery and equipment n.e.c.
16	30	Manufacture of office, accounting and computing machinery
17	31	Manufacture of electrical machinery and apparatus n.e.c.
18	32	Manufacture of radio, television and communication equipment and apparatus
19	33	Manufacture of medical, precision and optical instruments, watches and clocks
20	34	Manufacture of motor vehicles, trailers and semi-trailers
21	35	Manufacture of other transport equipment
22	36	Manufacture of furniture; manufacturing n.e.c.

Table 2: Trend growth rates in output, capital stock and labour input, Manufacturing Industries of the Indian economy, 1980-81 to 2007-08

Industry Code (2-digit, NIC -2004)	**Trend growth rate (% p.a.)**			**Industry Code** (2-digit, NIC -2004)	**Trend growth rate (% p.a.)**		
	Output	**Labour Input**	**Capital Stock**		**Output**	**Labour Input**	**Capital Stock**
15	6.63	0.86	6.32	26	7.89	1.41	7.54
16	5.71	1.26	6.47	27	6.87	0.17	5.28
17	5.75	-0.11	6.24	28	7.61	2.6	6.35
18	13.6	10.03	14.84	29	5.08	0.26	4.59
19	6.79	3.65	7.26	30	11.81	-1.39	8.48
20	0.11	-1.23	4.52	31	7.81	1.48	4.99
21	5.47	1.78	5.1	32	14.89	1.78	9.9
22	1.73	-1.05	5.68	33	9.71	2.37	6.05
23	9.99	2.4	9.93	34	9.26	3.01	8.78
24	8.18	2.32	6.04	35	6.33	-2.25	2.76
25	9.8	4.13	8.96	36	12.53	5.9	9.04

Source: Authors' computations

Table 3: Estimation of Elasticity of Substitution by SMAC Function

Industry Code (2-digit)	Description of Industries	Elasticity of Substitution (Std. Err.; P>|t|)	
		Variation in coefficients of t restricted	Variation in coefficients of t allowed
(1)	(2)	(3)	(4)
15	Manufacture of food products and beverages	1.09 (0.04; 0.00)	0.94 (0.01; 0.00)
16	Manufacture of tobacco products	0.63 (0.14; 0.00)	0.64 (0.04; 0.00)
17	Manufacture of textiles	1.02 (0.07; 0.00)	0.64 (0.06; 0.00)
18	Manufacture of wearing apparel; dressing and dyeing of fur	0.77 (0.02; 0.00)	0.66 (0.02; 0.00)
19	Tanning and dressing of leather; manufacture of luggage, handbags, addler, harness and footwear	0.94 (0.06; 0.00)	0.56 (0.07; 0.00)
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plating materials	1.02 (0.01; 0.00)	0.97 (0.02; 0.00)
21	Manufacture of paper and paper products	1.00 (0.06; 0.00)	0.73 (0.03; 0.00)
22	Publishing, printing and reproduction of recorded media	1.02 (0.06; 0.00)	0.93 (0.04; 0.00)
23	Manufacture of coke, refined petroleum products and nuclear fuel	1.05 (0.07; 0.00)	0.84 (0.02; 0.00)
24	Manufacture of chemicals and chemical products	1.10 (0.07; 0.00)	0.88 (0.03; 0.00)
25	Manufacture of rubber and plastics products	1.15 (0.03; 0.00)	0.80 (0.03; 0.00)
26	Manufacture of other non-metallic mineral products	1.33 (0.05; 0.00)	0.81 (0.04; 0.00)
27	Manufacture of basic metals	0.91 (0.16; 0.00)	0.54 (0.05; 0.00)
28	Manufacture of fabricated metal products, except machinery and equipment	1.09 (0.03; 0.00)	0.81 (0.05; 0.00)
29	Manufacture of machinery and equipment n.e.c.	1.13 (0.03; 0.00)	0.87 (0.03; 0.00)
30	Manufacture of office, accounting and computing machinery	1.25 (0.07; 0.00)	0.73 (0.05; 0.00)
31	Manufacture of electrical machinery and apparatus n.e.c.	1.04 (0.08; 0.00)	0.73 (0.03; 0.00)
32	Manufacture of radio, television and communication equipment and apparatus	0.99 (0.04; 0.00)	0.82 (0.05; 0.00)
33	Manufacture of medical, precision and optical instruments, watches and clocks	0.79 (0.02; 0.00)	0.74 (0.02; 0.00)
34	Manufacture of motor vehicles, trailers and semi-trailers	1.19 (0.03; 0.00)	0.86 (0.02; 0.00)
35	Manufacture of other transport equipment	-0.05 (0.16; 0.75)	0.71 (0.06; 0.00)
36	Manufacture of furniture; manufacturing n.e.c.	0.96 (0.03; 0.00)	0.87 (0.01; 0.00)

Source: Authors' computations

Note: For estimation, the SURE technique has been applied to equations (4) and (5)

Table 4: Rate of Technical Change

Industry Code (2-digit)	Description of Industries	Rate of Technical Change	
		Labour Augmenting (λ_L)	Capital Augmenting (λ_K)
(1)	(2)	(3)	(4)
15	Manufacture of food products and beverages	0.30	-0.11
16	Manufacture of tobacco products	0.13	-0.04
17	Manufacture of textiles	0.10	-0.04
18	Manufacture of wearing apparel; dressing and dyeing of fur	0.03	-0.01
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	0.04	-0.02
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plating materials	0.30	-0.22
21	Manufacture of paper and paper products	0.08	-0.02
22	Publishing, printing and reproduction of recorded media	0.37	-0.31
23	Manufacture of coke, refined petroleum products and nuclear fuel	0.33	-0.03
24	Manufacture of chemicals and chemical products	0.26	-0.04
25	Manufacture of rubber and plastics products	0.10	-0.01
26	Manufacture of other non-metallic mineral products	0.19	-0.04
27	Manufacture of basic metals	0.11	0.00
28	Manufacture of fabricated metal products, except machinery and equipment	0.11	-0.02
29	Manufacture of machinery and equipment n.e.c	0.13	-0.04
30	Manufacture of office, accounting and computing machinery	0.23	-0.01
31	Manufacture of electrical machinery and apparatus n.e.c.	0.12	0.00
32	Manufacture of radio, television and communication equipment and apparatus	0.24	-0.01
33	Manufacture of medical, precision and optical instruments, watches and clocks	0.06	0.04
34	Manufacture of motor vehicles, trailers and semi-trailers	0.21	-0.06
35	Manufacture of other transport equipment	0.20	-0.06
36	Manufacture of furniture; manufacturing n.e.c.	0.18	-0.03

Source: Authors' computations

Note: The estimates of λ_L and λ_K have been derived from estimates of equations (4) and (5).

Table 5: Estimates of Elasticity of Substitution, Alternate set of estimates

Industry	SMAC Functions allowing for non-neutral technical change	Eq. (4) by ARDL model		Eq(5) by ARDL model	
	Elasticity of Substitution (Std. Err.)	Elasticity of Substitution (Std. Err.)	Max. lag taken in the Model [F-stat for existence of long-run relationship]	Elasticity of Substitution (Std. Err.)	Max. lag taken in the Model [F-stat for existence of long-run relationship]
15	0.94 (0.01)	0.86(0.38)	2[10.08]@$	0.78(0.03)	1[10.11]@$
16	0.64 (0.04)	0.90(0.18)	3[38.18]@$	0.84(0.05)	3[231.22]@$
17	0.64 (0.06)	0.51(0.20)	1*	—	—
18	0.66 (0.02)	1.32(2.69)	1[1.28]##$$	0.61(0.08)	1[1.66]##$$
19	0.56 (0.07)	—	—	—	—
20	0.97 (0.02)	0.97(0.12)	1*	0.88(0.10)	1[2.26]##$$
21	0.73 (0.03)	0.83(0.44)	1[8.37]@$	0.78(0.11)	1[2.74]##$
22	0.93 (0.04)	0.62(0.16)	1*	0.84(0.09)	3[6.95]#$
23	0.84 (0.02)	0.07(0.66)	2[3.57]##$	0.93(0.02)	1[11.25]@$
24	0.88 (0.03)	0.67(0.70)	1[2.82]##$	0.62(0.07)	4[9.20]@$
25	0.80 (0.03)	1.66(0.45)	2[8.07]#$	0.89(0.11)	1[6.97]@@#
26	0.81 (0.04)	0.40(0.26)	1*	0.85(0.10)	1[2.33]##$
27	0.54 (0.05)	0.10(0.30)	1[7.13]@@$	0.69(0.14)	1[2.89]##$
28	0.81 (0.05)	0.39(0.25)	1[3.82]##$	0.83(0.23)	1[0.99]##$$
29	0.87 (0.03)	0.55(0.31)	2[4.85]##$	1.34(0.35)	4[9.09]@$$
30	0.73 (0.05)	0.00(0.30)	1*	0.77(0.18)	1[1.64]##$$
31	0.73 (0.03)	0.06(0.27)	2[7.39]@@$	0.57(0.08)	4[6.68]#$
32	0.82 (0.05)	0.59(0.09)	1*	1.04(0.36)	1[0.89]##$$
33	0.74 (0.02)	0.19(1.38)	4[1.07]##$$	0.80(0.04)	3[7.25]@@$
34	0.86 (0.02)	0.63(0.52)	3[9.88]@$	0.85(0.04)	2[3.87]##$
35	0.71 (0.06)	2.47(0.73)	4[4.38]##$	0.61(0.18)	4[5.79]##$
36	0.87 (0.01)	1.40(0.25)	1*	0.76(0.02)	1*

Source: Authors' computations

Note: SMAC function: Equations (4) and (5) jointly estimated by SURE method. Variation in coefficients of t is allowed.

@ F-statistics exceeds upper bound at 95% level of confidence.

@@ F-statistics exceeds upper bound at 90% level of confidence.

F-statistics between upper and lower bound at 90% level of confidence.

F-statistics is below lower bound at 90% level of confidence.

$ ECM term in the error correction model is negative and statistically significant.

$$ ECM term in the error correction model is negative but not statistically significant.

— Results unsatisfactory, hence not reported.

*The error correction does not exist

Appendix

ADF Test: Manufacturing Industries

Table A1: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 15

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	-4.06* -3.20*	-3.56* -1.68	-0.94 -0.66	-0.88 -0.71
	First difference	-4.04* -2.90*	-4.18* -3.97*	-4.91* -3.99*	-4.93* -3.67*
An intercept but not a trend	Level	-2.57 -2.38	-3.87* -2.71	-3.72* -3.92*	-3.92* -3.97*
	First difference	-4.65* -3.40*	-4.66* -4.65*	-4.77* -3.85*	-4.85* -3.60*
An intercept and a linear trend	Level	-4.62* -4.59*	-6.59* -6.46*	-4.03* -4.11*	-3.72* -3.79*
	First difference	-4.63* -3.30	-4.12* -4.10*	-4.67* -3.66*	-4.77* -3.48

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A2: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 16

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	-1.87 -2.16*	-0.42 -0.56	-3.04* -2.57*	-0.60 -0.45
	First difference	-6.87* -5.02*	-12.94* -7.55*	-6.44* -5.23*	-5.84* -5.83*
An intercept but not a trend	Level	-2.18 -1.65	-4.80* -3.20*	-3.34* -2.93	-5.03* -3.16*
	First difference	-7.45* -6.05*	-12.65* -7.32*	-6.31* -5.11*	-5.69* -5.68*
An intercept and a linear trend	Level	-4.61* -3.85*	-5.48* -3.80*	-4.39* -3.98*	-5.59* -3.72*
	First difference	-7.45* -6.11*	-12.41* -7.02*	-6.32* -5.27*	-5.55* -5.60*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A3: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 17

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	-1.96* -2.14*	-2.44* -3.15*	-0.26 -0.20	-0.57 -0.63
	First difference	-5.27* -3.61*	-4.43* -2.19*	-6.30* -6.80*	-6.43* -6.86*
An intercept but not a trend	Level	-7.30* -7.15*	-5.87* -3.19*	-6.18* -6.66*	-6.49* -7.14*
	First difference	-4.65* -3.40*	-4.66* -4.65*	-4.77* -3.85*	-4.85* -3.60*
An intercept and a linear trend	Level	-4.34* -3.60*	-3.04 -2.27	-2.78 -2.59	-3.59 -3.61*
	First difference	-7.20* -7.06*	-5.68* -3.12	-6.05* -6.60*	-6.33* -6.92*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A4: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 18

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	-2.34* -2.28*	-2.74* -2.23*	-0.67 -0.68	-0.06 -0.06
	First difference	-4.75* -2.80*	-3.67* -2.57*	-4.78* -2.92*	-5.31* -2.93*
An intercept but not a trend	Level	-2.15 -2.11	-0.29 -0.35	-1.28 -1.33	-1.23 -1.16
	First difference	-4.88* -2.93	-4.40* -3.45*	-4.68* -2.86	-5.20* -2.87
An intercept and a linear trend	Level	-1.59 -1.50	-2.38 -3.08	-1.84 -1.81	-1.74 -1.62
	First difference	-5.11* -3.10	-4.34* -3.36	-4.71* -2.81	-5.43* -2.95

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A5: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 19

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	-2.06* -2.32*	-1.58 -1.66	-0.57- 0.56	-0.41 -0.59
	First difference	-8.04* -6.12*	-5.12* -4.23*	-6.92* -5.66*	-7.96* -6.33*
An intercept but not a trend	Level	-2.67 -2.02	-0.62 -0.44	-3.54* -2.87	-5.22* -4.03*
	First difference	-8.26* -6.92*	-5.47* -4.90*	-6.78* -5.56*	-7.84* -6.28*
An intercept and a linear trend	Level	-5.15* -3.66*	-2.19 -2.08	-3.92* -3.42	-5.13* -3.95*
	First difference	-8.15* -7.02*	-5.46* -4.88*	-6.66* -5.43*	-7.68* -6.19*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A6: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 20

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	-1.38 -1.20	-067 -0.72	-0.16 0.27	0.10 0.44
	First difference	-7.31* -5.60*	-5.54* -3.67*	-6.83* -4.76*	-7.56* -5.44*
An intercept but not a trend	Level	-3.25* -2.31	-1.91 -1.73	-1.78 -1.24	-2.32 -1.48
	First difference	-7.25* -5.67*	-5.49* -3.65*	-6.76* -4.77*	-7.43* -5.38*
An intercept and a linear trend	Level	-3.53 -2.58	-1.91 -1.73	-2.77 -2.01	-3.45 -2.37
	First difference	-7.09* -5.54*	-5.38* -3.60*	-6.60* -4.67*	-7.25* -5.26*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A7: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 21

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	-0.97 -0.69	-0.86 -0.74	-0.31 -0.28	-0.31 -0.34
	First difference	-6.31* -4.94*	-3.85* -2.87*	-7.14* -5.38*	-7.42* -5.80*
An intercept but not a trend	Level	-1.34 -1.04	-1.00 -1.07	-3.10* -2.55	-2.94* -2.42
	First difference	-6.69* -5.63*	-3.94* -3.05*	-7.05* -5.34*	-7.41* -5.85*
An intercept and a linear trend	Level	-3.62 -3.54	-1.91 -2.13	-3.27 -2.70	-3.61 -3.16
	First difference	-6.57* -5.43*	-3.75* -2.76	-6.85* -5.17*	-5.65* -5.65*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A8: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 22

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	-0.20 0.33	-0.30 -0.35	0.60 0.69	0.13 0.24
	First difference	-6.32* -3.52*	-5.38* -3.56*	-5.07* -3.11*	-7.03* -4.51*
An intercept but not a trend	Level	-0.47 0.10	-2.59 -2.46	-1.35 -1.24	-2.31 -1.68
	First difference	-6.73* -3.96*	-5.28* -3.51*	-5.18* -3.24*	-6.92* -4.45*
An intercept and a linear trend	Level	-2.74 -1.88	-2.44 -2.30	-1.78 -1.68	-2.81 -2.08
	First difference	-6.82* -4.07*	-5.26* -3.49	-5.14* -3.20	-6.81* -4.38

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A9: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 23

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	0.63 0.82	-1.01 -0.97	-0.81 -0.74	-0.46 -0.46
	First difference	-5.47* -4.03*	-4.90* -4.07*	-5.64* -4.37*	-5.74* -4.51*
An intercept but not a trend	Level	-1.33 -1.13	-2.15 -2.13	-2.28 -2.10	-2.41 -2.20
	First difference	-5.77* -4.47*	-5.02* -4.24*	-5.53* -4.28*	-5.64* -4.43*
An intercept and a linear trend	Level	-2.71 -2.57	-1.15 -1.12	-2.23 -2.05	-2.36 -2.15
	First difference	-5.65* -4.36*	-6.05* -5.68*	-5.40* -4.18*	-5.51* -4.32*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A10: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 24

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	1.69 1.35	-3.95* -3.36*	-1.62 -1.65	-1.51 -1.55
	First difference	-4.17* -3.32*	-3.75* -2.07*	-5.13* -4.53*	-5.15* -4.45*
An intercept but not a trend	Level	-1.40 -1.44	-1.83 -1.90	-2.45 -2.39	-2.10 -2.05
	First difference	-5.43* -5.44*	-5.34* -3.17*	-5.32* -4.99*	-5.39* -4.97*
An intercept and a linear trend	Level	-2.45 -2.27	-3.31 -3.15	-2.80 -2.69	-2.53 -2.40
	First difference	-5.47* -5.75*	-5.39* -3.22	-5.27* -5.12*	-5.36* -5.10*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A11: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 25

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	-0.40 -0.27	-4.63* -5.01*	-1.13 -1.57	-1.03 -1.57
	First difference	-5.95* -2.10*	-3.91* -2.21*	-9.36* -3.01*	-9.27* -3.17*
An intercept but not a trend	Level	-1.90 -2.42	-0.86 -0.52	-4.50* -3.15*	-4.99* -4.30*
	First difference	-7.97* -3.07*	-7.00* -5.00*	-9.45* -3.07*	-9.38* -3.21*
An intercept and a linear trend	Level	-3.99* -2.39	-3.29 -2.65	-4.84* -3.13	-5.58* -4.13*
	First difference	-8.12* -3.12	-6.92* -4.87*	-9.16* -2.87	-9.14* -2.90

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A12: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 26

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	-1.03 -1.01	-2.24* -2.19*	-0.85 -0.95	-1.01 -1.18
	First difference	-4.72* -3.13*	-4.36* -2.78*	-6.54* -3.25*	-6.25* -3.42*
An intercept but not a trend	Level	-0.76 -0.68	-1.24 -1.21	-1.96 -1.32	-2.06 -1.63
	First difference	-5.80* -4.63*	-5.01* -3.42*	-6.49* -3.25*	-6.28* -3.50*
An intercept and a linear trend	Level	-3.70* -3.62*	-1.66 -1.67	-1.90 -1.17	-2.41 -2.04
	First difference	-5.64* -4.46*	-5.03* -3.48	-6.76* -3.44	-6.34* -3.50

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A13: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 27

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	1.21 1.69	-1.23 -1.26	-0.76 -0.94	-0.75 -1.06
	First difference	-5.64* -3.06*	-4.93* -2.91*	-7.26* -3.51*	-7.33* -3.56*
An intercept but not a trend	Level	-0.17 0.18	-1.27 -1.19	-1.79 -0.76	-1.48 -0.52
	First difference	-6.65* -4.06*	-5.05* -3.04*	-7.29* -3.58*	-7.43* -3.70*
An intercept and a linear trend	Level	-4.03* -3.37	-1.92 -1.87	-3.13 -2.03	-3.66 -2.53
	First difference	-6.60* -4.07*	-4.91* -2.96	-7.37* -3.69*	-7.44* -3.76*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A14: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 28

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	0.52 0.39	-3.28* -2.23*	-1.16 -1.30	-1.22 -1.62
	First difference	-4.50* -2.23*	-2.97* -2.47*	-5.72* -3.70*	-6.25* -3.19*
An intercept but not a trend	Level	0.54 1.23	0.14 -0.06	-.044 0.32	-0.48 0.64
	First difference	-6.63* -4.16*	-3.77* -3.49*	-5.91* -3.96*	-6.62* -3.53*
An intercept and a linear trend	Level	-2.28 -1.32	-1.32 -1.70	-1.41 0.63	-1.91 -0.78
	First difference	-6.97* -4.64*	-3.79* -3.52*	-6.35* -4.55*	-6.98* -3.91*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A15: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 29

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	0.60 0.92	-2.02* -2.62*	-1.01 -0.93	-1.10 -0.93
	First difference	-5.55* -3.42*	-5.93* -3.47*	-4.27* -3.27*	-4.02* -3.37*
An intercept but not a trend	Level	-0.43 -0.05	-1.07 -0.86	-1.45 -2.28	-0.88 -1.61
	First difference	-6.66* -4.78*	-6.93* -4.63*	-4.28* -3.31*	-4.09* -3.48*
An intercept and a linear trend	Level	-3.86* -3.41	-3.74* -2.96	-1.57 -2.35	-1.48 -2.40
	First difference	-6.56* -4.73*	-6.78* -4.52*	-4.32* -3.34	-4.14* -3.54*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A16: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 30

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	0.51 1.08	-4.03* -6.44*	-1.62 -1.70	-0.87 -1.38
	First difference	-6.53* -3.35*	-5.04* -1.27	-8.90* -7.01*	-8.82* -6.82*
An intercept but not a trend	Level	-1.17 -0.96	-0.32 0.12	-3.14* -2.02	-2.66 -1.85
	First difference	-8.41* -6.32*	-10.20* -3.27*	-8.90* -7.56*	-8.88* -7.62*
An intercept and a linear trend	Level	-5.08* -3.49	-2.59 -1.18	-5.92* -4.19*	-5.07* -3.30
	First difference	-8.28* -6.15*	-9.96* -3.21	-8.70* -7.40*	-8.71* -7.49*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A17: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 31

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	1.44 1.76	-2.92* -3.32*	-1.61 -1.60	-1.30 -1.36
	First difference	-5.13* -3.63*	-5.18* -2.71*	-4.97* -3.89*	-5.08* -4.08*
An intercept but not a trend	Level	-0.56 -0.15	-1.16 -1.15	-1.27 -1.20	-1.25 -1.11
	First difference	-6.24* -5.35*	-6.61* -3.72*	-5.11* -4.16*	-5.21* -4.35*
An intercept and a linear trend	Level	-3.61 -3.32	-2.39 -1.87	-2.30 -2.51	-2.43 -2.55
	First difference	-6.20* -5.41*	-6.44* -3.61*	-5.08* -4.16*	-5.17* -4.35*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A18: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 32

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	1.72 1.96	-3.81* -3.16*	-2.20* -2.38*	-2.17* -2.64*
	First difference	-5.05* -2.36*	-3.50* -1.72	-5.61* -3.01*	-6.02* -3.55*
An intercept but not a trend	Level	0.05 0.68	1.40 2.07	-0.61 -0.16	-1.24 -1.01
	First difference	-7.97* -4.79*	-5.42* -3.20*	-6.36* -3.71*	-6.90* -4.49*
An intercept and a linear trend	Level	-2.87 -1.45	-0.63 0.05	-2.08 -1.46	-3.28 -2.71
	First difference	-8.08* -5.01*	-6.37* -4.22*	-6.42* -3.77*	-6.74* -4.31*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A19: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 33

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	1.47 1.65	-4.77* -4.05*	-1.51 -1.69	-1.04 -1.36
	First difference	-5.42* -2.84*	-2.21* -0.91	-6.15* -3.86*	-6.95* -4.36*
An intercept but not a trend	Level	0.19 0.39	-0.17 -0.21	-0.42 0.01	-1.06 -0.41
	First difference	-7.57* -4.70*	-4.44* -3.54*	-6.53* -4.32*	-7.10* -4.59*
An intercept and a linear trend	Level	-2.29 -1.42	-3.75* -3.83*	-1.62 -1.11	-1.95 -1.25
	First difference	-7.73* -4.78*	-4.15* -3.20	-6.82* -4.56*	-7.36* -4.84*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A20: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 34

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	1.21 0.74	-4.59* -3.50*	-0.53 -0.49	-0.42 -0.34
	First difference	-3.90* -2.90*	-3.29* -2.19*	-4.23* -2.48*	-4.31* -2.61*
An intercept but not a trend	Level	-0.59 -0.63	-1.06 -1.05	-1.89 -2.51	-1.79 -2.29
	First difference	-4.41* -3.54*	-5.03* -3.95*	-4.13* -2.39	-4.23* -2.52
An intercept and a linear trend	Level	-2.69 -3.51	-3.04 -3.22	-1.89 -2.49	-2.05 -2.62
	First difference	-4.30* -3.45	-4.92* -3.86*	-4.06* -2.34	-4.15* -2.46

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A21: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 35

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	-0.23 0.11	-2.23* -4.25*	-1.43 -1.63	-1.43 -1.82
	First difference	-6.33* -2.91*	-7.46* -2.72*	-5.46* -3.58*	-5.93* -4.68*
An intercept but not a trend	Level	-018 0.75	-0.50 -0.01	-1.33 -0.96	-1.05 -0.57
	First difference	-8.43* -4.68*	-10.45* -4.95*	-5.69* -3.89*	-6.32* -5.58*
An intercept and a linear trend	Level	-2.45 -1.51	-4.00* -1.86	-2.94 -2.63	-3.69 -3.12
	First difference	-8.59* -5.07*	-10.23* -4.84*	-5.55* -3.79*	-6.20* -5.54*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value

Table A22: Dickey-Fuller and Augmented Dickey-Fuller Tests: Industry 36

		Log(Y/L)	Log (W)	Log(Y/K)	Log (R)
No intercept, no trend	Level	-2.10* -1.99*	-1.79 -2.01*	-1.75 -1.73	-0.83 -0.97
	First difference	-5.80* -3.25*	-5.40* -3.17*	-6.53* -3.81*	-6.69* -4.02*
An intercept but not a trend	Level	-2.00 -1.85	-1.84 -1.79	-2.68 -2.27	-2.72 -2.26
	First difference	-6.19* -3.62*	-6.24* -3.98*	-6.61* -3.93*	-6.75* -4.12*
An intercept and a linear trend	Level	-2.75 -2.37	-2.76 -2.41	-2.92 -2.34	-3.05 -2.42
	First difference	-6.46* -3.91*	-6.76* -4.53*	-6.77* -4.14*	-6.87* -4.31*

Note: In each cell, the upper value is the DF statistic, and the lower value is ADF(1) statistic.
*exceeds simulated critical value