Policy Reform and Labour Demand in Branches of Sri Lankan Manufacturing Industry

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Abstract

Many policy reforms in developing countries aim to remove factor market distortions. Whether such reforms will reduce unemployment depends partly on the substitution possibilities between labour and other factors of production. This paper examines labour demand in seven branches of Sri Lankan manufacturing industry, using data on 4-digit industrial categories over the 1990-97 period. The Box-Cox transformation is used to allow for flexible, and data-dependent, elasticities. The elasticity of capital-labour substitution varies widely across the branches of industry and is usually variable rather than constant. The average, long-run own-wage elasticity of labour demand for the manufacturing sector is estimated as –0.80, so factor price policy should have an important effect on labour demand in this setting.

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I. Introduction

Sri Lanka is one of the most open economies in the developing world and it now appears to be enjoying the benefits of a switch to export-oriented industrialisation since 1977 (Athukorala and Jayasuriya, 2000). For example, unemployment fell during the 1990s from around 16% to only 8% in 1999, while the manufacturing sector increased its share of total employment from 13% at the start of the decade to over 16% by 1997. This growth in manufacturing employment was due both to the growth in manufactured output and also to the tight control over wages, which after initially rising in the early 1990s have now fallen to be lower in real terms than in 1990 (Athukorala, 1996). The transformation of the economy is also evident in the rising share of manufactures in exports (excluding petroleum products), up from only 6% at the time of the 1977 reforms to 73% by 1998.[1]

But despite these achievements, there is some disquiet about the industrial sector in Sri Lanka. A single industry, textiles and clothing, accounts for more than two-thirds of the value of exports, and these exports have a high import content, averaging 70% (Athukorala and Rajapatirana, 2000). This dependency on imports weakens backward linkages so some commentators suggest that the labour absorptive capacity of Sri Lankan manufacturing is lower than that of other rapidly industrialising Asian economies (Kelegama and Wignaraja, 1991). The continued reliance on textiles and clothing also distinguishes Sri Lanka from other industrialising economies, which display greater diversification and technological upgrading of their manufactured exports (Wignaraja, 1998). The belief that 'footloose' manufacturing activities have failed to establish a sustainable industrial base in the country has heightened calls for a more activist industrial policy that targets particular activities and promotes greater domestic value added and employment (Lall, *et al*., 1996).

There is also debate about the extent of remaining factor market distortions because the decline in real wages was not the result of a well-conceived labour market reform process, but instead was due to reduced political power of the union movement since 1977 (Athukorala and Rajapatirana, 2000). In fact, an extensive body of labour regulations contributes to market rigidities, with over 45 laws concerning wages and service conditions, industrial safety and health, industrial relations, social security, and employment of women, young persons and foreigners (Bandusena, 1998). Thus the private sector faces difficulties in generating large-scale employment (Kelegama and Tiruchelvam, 1995), which are exacerbated by the existence of some price distortions that persisted after the initial burst of liberalisation. These distortions include an over-valued exchange rate, a tariff policy that results in the under-pricing of capital goods, and other incentives for the importation of machinery.

Hence, policies to remove factor price distortions could contribute to higher employment and also to a better overall utilisation of scarce capital resource through the adoption of more appropriate technologies of production. But the results of such reforms will depend on the degree to which labour can be substituted for capital in the production process. The higher is the elasticity of substitution, the greater the increase in labour absorption that can be achieved by removing factor price distortions and lowering the ratio of wages to the rental price of capital. Numerous studies of the elasticity of substitution between labour and capital have appeared in developing countries in recent years but to the best of our knowledge, Sri Lankan policy makers are not guided by local estimates of such elasticities in their policy deliberations.

Therefore, in this paper we provide estimates of long-run labour demand functions for branches of Sri Lankan manufacturing industry. The substitution and own-price elasticities reported here may provide some factual underpinning to debates about factor price distortions and industrial policies. We also improve upon the methods used in previous studies in developing countries by using an econometric approach that allows for variable elasticities to be estimated even with quite limited data.

Section II of the paper discusses the degree of labour absorption in the manufacturing sector since the 1977 reforms. Section III presents the empirical methods and data while Section IV contains estimation results. In Section V, sensitivity analyses are reported and the final section includes the summary and implications.

II. Labour Absorption in Sri Lankan Industry

A major weakness of the import-substitution strategy in place prior to the 1977 reforms was the failure to generate sufficient employment, with 24% of the labour force recorded as unemployed in 1973 (Korale, 1992). Consequently, a prominent place was given in the reforms to employment generation, especially in the manufacturing sector. In the immediate aftermath of the reforms, unemployment came down substantially, from around 20% to 11% by 1981/82. But this happened mainly on account of a large exodus of workers to Middle-East countries, repatriation of Indian estate workers, and new employment opportunities created by the expanded service and construction sectors. With a diminishing effect of these one-off changes, unemployment rose again to 21% by 1985 and stayed at approximately 18-20% for the rest of the 1980s. The secessionist war and insurgent activities in the country also considerably retarded investment and employment creation during this period.

But with the gradual waning of these shocks and further liberalisation from 1990 onwards, the high unemployment rate was reversed, with the recovery this time mainly brought about by a rise in private sector industrial employment. In addition to rising employment, the rapidly growing export-oriented manufacturing sector also enjoyed an improvement in capacity utilisation, which had varied between 60-67% during the import-substitution era but rose to 70-76% after the reforms (Karunatilake, 1987) and by the first quarter of 1999 capacity utilisation was 83%.

Despite the improved rate of employment growth, it has not kept up with the growth in industrial output, which has been growing at around 9% per year compared with 4% growth in industrial employment. Thus, average labour productivity appears to be rising, with one recent study suggesting a compound annual rate of productivity improvement of 7.5 per cent from 1981 to 1993 (Dept. of National Planning, 1996, p. 34). Given this background of stable or declining real wages and increasing labour productivity, industrialists might be expected to demand more labour. But whether industrial labour demand could be made even higher, by removing some of the remaining factor market distortions, depends on the nature of substitution possibilities, which is the subject of this study.

III. Methods and Data

A general specification of the long-run labour demand function of an industry is:[2]

$$L = f(Y, w, t) \tag{1}$$

where L is the labour employed, Y is real output or value added, w is the real wage rate and t is a time trend representing technological change (see, for example, Hsing, 1989). As long as the industry is small relative to the whole economy, the elasticity of labour supply can be treated as infinite and this framework allows one to study the effect of exogenous changes in wages on the amount of labour that employers seek to use.[3]

But to estimate equation (1) a functional form must be chosen and this can entail unwarranted assumptions about the nature of the production technology in the industry. For example, variants of the log-linear functional form:

$$\ln L = b_0 + b_1 \ln Y + b_2 \ln w + b_3 t + u \qquad (2)$$

where the b_i are estimated coefficients and u is a random error, are widely used in labour demand studies because of the convenience of interpreting the coefficients directly as elasticities.[4] However, equation (2) implies that the industry uses Constant Elasticity of Substitution (CES) production technology:[5]

$$Y = g e^{ft} \left[a L^{-r} + (1-a) K^{-r} \right]^{-u/r} \qquad (3)$$

where γ is the efficiency parameter, f is the rate of Hicks-neutral technical progress, α is the distribution parameter, ρ is the substitution parameter, the scale parameter υ=1 if there are constant returns to scale and $g, u > 0, 0 < a < 1,$ and $r \geq -1.$ The coefficient b_2 in equation (2) estimates the elasticity of substitution between labour and capital, $s = 1/(1+r)$, and forces this to be a constant.[6] Similarly, the b_1 coefficient implies that the returns to scale do not vary, which is also an untested restriction. Another feature of equation (2) is that the estimated coefficient on the wage rate has to be adjusted to give the usual constant-output own-wage elasticity of labour demand h_{LL}. Specifically:

$$h_{LL} = -[1-m]s \qquad (4)$$

where m is the share of labour in total costs or total revenue (Hamermesh, 1986: 433).

In contrast to the restrictive nature of CES production, there are many reasons for expecting σ to vary. New technologies may allow easier substitution of one factor for the other, while it may be harder to make further substitutions of capital for labour the higher is the capital-to-labour ratio. Hence, the trend in the literature is towards decreasingly restrictive ways of depicting labour demand, which allow complete flexibility in the degree of substitution between factors (Hamermesh, 1986). In many studies, this flexibility is achieved with translog functions (Christensen, *et. al*, 1971), which are second order approximations to arbitrary production functions and allow variable substitution and output elasticities. But there can be multicollinearity problems when estimating these functions because of the need to form cross-product terms between all inputs (Hsing, 1993). Moreover, in many developing countries the full range of data on industrial input prices are not readily available, which limits the practical application of the translog cost function approach.

Another approach to allowing variable substitution elasticities is to use the general Box-Cox (1964) transformation of variables,[7] so that equation (1) becomes:

$$\frac{L^q - 1}{q} = b_0 + b_1\left(\frac{t^l - 1}{l}\right) + b_2\left(\frac{Y^l - 1}{l}\right) + b_3\left(\frac{w^l - 1}{l}\right) + e \tag{5}$$

where $\infty^- \leq q,\ l \leq \infty^+$. Depending on the different values of θ and λ estimated from the data, equation (5) covers a variety of functional forms, including log-linear when $q = l = 0$, linear when $q = l = 1$, semi-log when $q = 0$, $l = 1$, and reciprocal when $q = 1$, $l = -1$. The elasticity with respect to any independent variable, X_i is given by:

$$h_i = (\partial L/\partial X_i)\cdot(X_i/L) = b_i X_i^l L^{-q} \tag{6}$$

which depends on the values of b_i, X_i, L, q, and l.[8] Only in the special case where $q = l = 0$, does the elasticity reduce to a constant of b_i. Hence, equation (5) allows variable output, substitution and wage elasticities, while needing no more data than is used by the standard log-linear model. Therefore, we use equation (5) to estimate labour demand functions for Sri Lankan industry. To the best of our knowledge, this is the first developing country application of Box-Cox labour demand functions.

The data are from the Annual Survey of Industries (ASI), which is a total enumeration of industrial establishments with 25 or more employees and a random sample of establishments with 5-24 employees. Although this survey covers over 2000 establishments per year, the data on individual establishments are not available because of confidentiality restrictions. The usual alternative estimation strategy, of using a time-series of averages for specified industries,[9] is also not available because the survey has been conducted only since 1983, so the sample would be too small to give reliable estimates of equation (5). Instead, we follow the approach of Gajanan and Ramaiah (1996) and create a pooled time-series cross-sectional database of sub-industries observed across different years. Specifically, data were gathered on 59 UNSIC 4-digit industrial categories, over the 1990-97 period. We assume that the production technologies are the same among sub-industries within a specific two-digit industry division but they may differ across divisions, so equation (5) is estimated separately for each branch of manufacturing industry.[10]

Estimates are made for only seven of the nine branches of Sri Lankan manufacturing industry, because there are insufficient sub-industry observations in Division 37 (Basic

Metal Industries) and Division 39 (Other Manufacturing Industries). This exclusion should not be too serious because these two branches contain only 3.6% of the employees and contribute only 2.7% of the value-added for the manufacturing sector. Table 1 gives the branch names and sample sizes, which range from 32 to 112, and reports the share of total manufacturing employment for each branch included in the analysis. The dominance of the clothing and textiles and food manufacturing industries in manufacturing employment is apparent so the employment elasticities for those branches of industry should have a major effect on overall labour absorption.

The annual Survey of Industries report allows the total number of workers and average employee remuneration for each sub-industry in each year to be calculated.[11] Output was measured by value-added, so the implicit production technology considered is one where labour and capital are combined to add value to raw materials and other inputs.[12] An implicit price deflator for GDP in the manufacturing sector, which was supplied by the Central Bank of Sri Lanka, was used to convert all monetary values into real terms (in 1982 prices).

IV. Estimation Results

Table 2 presents a summary of the results for the unrestricted Box-Cox models and hypothesis tests for the specific functional forms that can be derived from restrictions on the λ and θ parameters. It appears that the log-linear model, which can be derived from CES technology and is widely used in previous studies of labour demand, is the appropriate functional form for only two branches of Sri Lankan industry: metal products and chemicals. The restricted Box-Cox model, with $\lambda=\theta$, is the appropriate functional form for another three branches of industry: textiles, wood products, and non-metallic products, while the unrestricted Box-Cox model ($\lambda \neq \theta$) is the appropriate functional form for food manufacturing and paper products. The linear functional form is decisively rejected by the data.

Table 3 contains the estimation results, using the specific functional form for each branch of industry that the hypothesis tests in Table 2 indicate as most appropriate. The coefficient on value-added (b_2) and on the real wage rate (b_3) have the expected signs and are statistically significant at the $p<0.01$ level for all seven branches of industry. The time variable shows a positive sign in all but one branch but is statistically significant in only the chemicals and metal products industries. This lack of a significant time trend may just reflect the short time-series covered by the data.

The only coefficients that can be interpreted directly as elasticities in Table 3 are for Divisions 35 and 38, where the restriction that $\lambda=\theta=0$ holds. These estimates of the (constant) elasticity of substitution suggest that it is easier to substitute capital for labour in the chemicals industries than it is in the metal products and machinery sector. The output elasticities are also significantly less than 1.0, so a 10% rise in value-added would cause labour demand to rise by only 8.5% (Division 35) or by only 6.6% (Division 38). Because the output elasticity is the inverse of the elasticity indicating returns to scale, this less-than-proportionate rate of labour absorption suggests that there are increasing returns to scale in these two sectors.

The output and substitution elasticities in the other five branches of industry vary over time and across sub-industries, and are computed according to equation (6). To summarise these variable elasticities, the averages for each branch of industry are reported in Table 4. The averages in the first and last years of the sample are also plotted in Figure 1, so that any tendency for the production technology and labour demand to become more flexible may become apparent.

The elasticity of substitution varies widely between the branches of Sri Lankan industry, with the substitution of capital for labour appearing relatively easy in the food processing and non-metallic mineral industries, but relatively hard in the metal products, paper and wood products industries. In the food, beverage and tobacco sector, the high value of σ combines with the low share of labour in value-added to give a highly elastic response of long-run labour demand to own-wage $(h_{LL} = -1.24)$. The own-wage elasticities in the other branches of industry range from around –0.8 in chemicals and non-metallic mineral products to around –0.4 in the machinery, metal, wood and paper products industries. The employment-weighted average of the own-wage elasticities is –0.80, so a 10% fall in the real wage would be expected to lead to an 8% increase in industrial employment in the long-run.

The output elasticities, shown in the final column of Table 4, indicate that the constant returns to scale assumption is appropriate only in the textiles, apparel and paper products industries. In the other branches of industry, the output elasticity is between 0.66 and 0.86, so a 10% rise in value-added will lead to a slightly less than proportionate rise in labour demand. This tendency for output to rise more than inputs indicates increasing returns to scale.

How are these elasticities changing over time? Figure 1 shows that from the beginning of the sample period in 1990 until the end in 1997, there was a marked increase in the output elasticity for the paper products sector. But because this branch of industry employes only 3% of the industrial workforce, the overall labour absorptive capacity is unlikely to have fallen by much, especially because there were only slight changes in the output elasticity in the two sectors where most employment is located: food processing and textiles and apparel. There were also small increases in the own-wage elasticity (i.e., more elastic) in Divisions 31, 33 and 36, which were offset by slight falls in Divisions 32 and 38. Hence, there is no consistent trend for labour demand to become more or less own-wage elastic over the period studied.

V. Sensitivity Analyses

The results reported above are based on an econometric approach that is designed to allow flexible substitution and wage elasticities even with quite limited data. However, the Box-Cox model used here does imply some properties of the regression disturbances that econometricians may sometimes disagree with (Davidson and MacKinnon, 1993). Therefore it is worth checking to see whether the substantive results about the elasticities would change if a different modelling approach was used. To carry out this robustness check, the log-linear labour demand function given by equation (2) was used for all branches of industry and the employment-weighted average elasticities were re-calculated. Using the log-linear functional form, the average elasticity of substitution for the manufacturing sector is calculated as 1.06 and the average own-wage elasticity of labour demand as –0.78. These values are quite close to the results reported in Table 4, so this may give some grounds for confidence that the results do not just reflect the particular functional forms used.

A second sensitivity analysis was to include a cross-price effect (for capital services) in the labour demand equation because the empirical labour demand literature is evenly divided between studies and include and those that exclude this cross-price (Hamermesh, 1986, Table 8.2). To carry out this analysis, an approximate rental price of capital, p_K was calculated (for the stock in vehicles, plant and machinery and buildings) following an approach used by Jha *et.al.* (1993):

$$p_K = M_{it}(d_{it} + r_t)$$

where M_{it} is the value of fixed capital stock at constant prices and d_{it} is the rate of depreciation in the sub-industry and year concerned while r_t is the Weighted Average Prime Lending Rate published by the Central Bank of Sri Lanka.[13] The Box-Cox transformed labour demand function was then estimated and the tests of functional forms and calculation of the elasticities proceeded in the same manner as before.

The results of the sensitivity analysis in Table 5 show that one effect of including the proxy for the rental price of capital is that for two more branches of industry, the constant elasticity functional form appears appropriate (Table 5). Adding the rental price of capital to the model also usually made the estimated own-wage elasticities larger (that is, more elastic) although not by much. This small change is consistent with the finding of Hamermesh (1986) that the own-wage elasticity of labour demand does not vary much between those studies that include the price of capital and those that do not. Another effect of adding the price of capital was to further reduce the output elasticities, providing further indications of the increasing returns to scale. The cross-price elasticity of labour demand with respect to the rental price of capital appears to be small in all branches of industry except for chemical products, although it was statistically significant in all but two branches.

VI. Summary and Implications

Although Sri Lanka appears to have made a successful transition to an open economy, with rapid growth in manufactured exports and falling unemployment, there are still grounds for concern about some policy settings. In particular, the fall in the real wage rate that is likely to have contributed to the rising employment was not the result of any fundamental reform of the labour market and instead reflected political factors that may be easily reversed in future. There are also remaining distortions that act to artificially lower the cost of capital.

The contribution of this paper has been to show whether there is scope for factor market reforms to have any impact on industrial labour demand. The results suggest that there is a high, albeit variable, degree of substitutability between capital and labour in the branches of Sri Lankan manufacturing industry. Thus, removing distortions that act to raise the cost of labour relative to the cost of capital would be expected to have a significant effect on labour demand. Such reforms may be needed because the results also show that the rate of labour absorption in the Sri Lankan manufacturing sector is rather lower than the rate of growth of either output or value-added. Thus, simply relying on further expansions of the leading export sectors such as textiles may not produce further reductions in unemployment.

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Table 1: Descriptions of the Manufacturing Industries Included in the Analysis

Division code	Division Title	Number of observations	Share of total employment
31	Food, beverages and tobacco	96	19.5
32	Textiles, wearing apparel and leather	80	52.8
33	Wood and wood products	32	2.6
34	Paper and paper products	32	3.2
35	Chemicals, petroleum, rubber and plastic	80	8.4
36	Non-metallic mineral products	40	5.8
38	Fabricated metal products, machinery	112	4.1

Note: The employment shares do not add to 100 because of the exclusion of Divisions 37 and 39.

Table 2: Test Statistics for Alternative Functional Forms

	Industry Branch						
	31	32	33	34	35	36	38
Unrestricted Box-Cox (l ¹ q)							
λ	-0.20	0.16	-0.17	-0.04	-0.18	-0.41	-0.08
θ	0.04	0.13	-0.03	-0.27	-0.04	-0.19	-0.08
LLF	-864.81	-682.66	-251.46	-254.66	-657.16	-347.46	-816.49
Restricted Box-Cox (l =q)							
$\lambda = \theta$	-0.01	0.12	-0.17	-0.16	-0.07	-0.27	-0.08
LLF	-867.75	-684.40	-252.47	-257.86	-658.32	-347.70	-816.49
LR test	5.87	3.46^{+}	2.02^{+}	6.39	2.31^{+}	0.49^{+}	0.01^{+}
Log-linear (l =q=0)							
LLF	-867.77	-689.14	-254.65	-259.05	-659.02	-350.04	-817.51
LR test	5.91	12.94	6.39	8.78	3.73^{+}	5.17	2.05^{+}
Linear (l =q=1)							
LLF	-995.20	-815.34	-281.89	-288.99	-752.66	-381.09	-896.89
LR test	260.77	265.36	60.86	68.66	190.99	67.28	160.81

Note: LLF is the maximised value of the log of the likelihood function and LR test is the likelihood ratio test (distributed as χ^2) used to compare the unrestricted Box-Cox model ($\lambda \neq \theta$) against the restricted versions ($^{+}$indicates that the estimated restricted model is not statistically significantly different from the unrestricted one at the 0.05 test level).

Table 3: Estimation Results for Selected Functional Forms of Employment Demand Equations

	Industry Branch						
	31	32	33	34	35	36	38
b_0	2.734	7.817	3.464	2.699	5.205	2.670	5.202
	(2.96)**	(20.16)**	(59.25)**	(36.51)**	(13.61)**	(21.84)**	(25.88)**
b_1	0.175	0.191	0.037	0.017	0.188	-0.005	0.168
	(0.97)	(1.52)	(1.08)	(1.06)	(1.96)+	(0.29)	(2.79)**
b_2	3.380	1.439	0.357	0.156	0.855	0.350	0.656
	(14.04)**	(58.55)**	(11.34)**	(18.42)**	(16.12)**	(7.81)**	(17.12)**
b_3	-3.039	-2.092	-0.224	-0.087	-1.075	-0.243	-0.590
	(9.64)**	(10.64)**	(4.02)**	(2.60)*	(8.76)**	(9.12)**	(4.83)**
R^2	0.73	0.98	0.89	0.93	0.81	0.77	0.79
N	96	80	32	32	80	40	112
θ	0.037	0.116	-0.174	-0.268	0.000	-0.275	0.000
λ	-0.201	0.116	-0.174	-0.043	0.000	-0.275	0.000

Note: Absolute value of asymptotic conditional t-statistics in parentheses; +significant at 10%; *significant at 5%; ** significant at 1%. When $\lambda=\theta=0$, the functional form is log-linear.

Table 4: Average Values of Estimated Elasticities

Division code	Elasticity of substitution (s)	Labour share of value-added (m)	Own-wage elasticity (h_{LL})	Output elasticity (h_{LY})
31	1.44	0.14	-1.24	0.74
32	1.01	0.31	-0.70	1.00
33	0.67	0.39	-0.41	0.70
34	0.62	0.34	-0.41	0.98
35	1.07	0.20	-0.86	0.86
36	1.24	0.32	-0.82	0.72
38	0.59	0.32	-0.40	0.66
Average	1.08	0.27	-0.80	0.90

Note: The average uses weights based on the share of each division in total industrial employment.

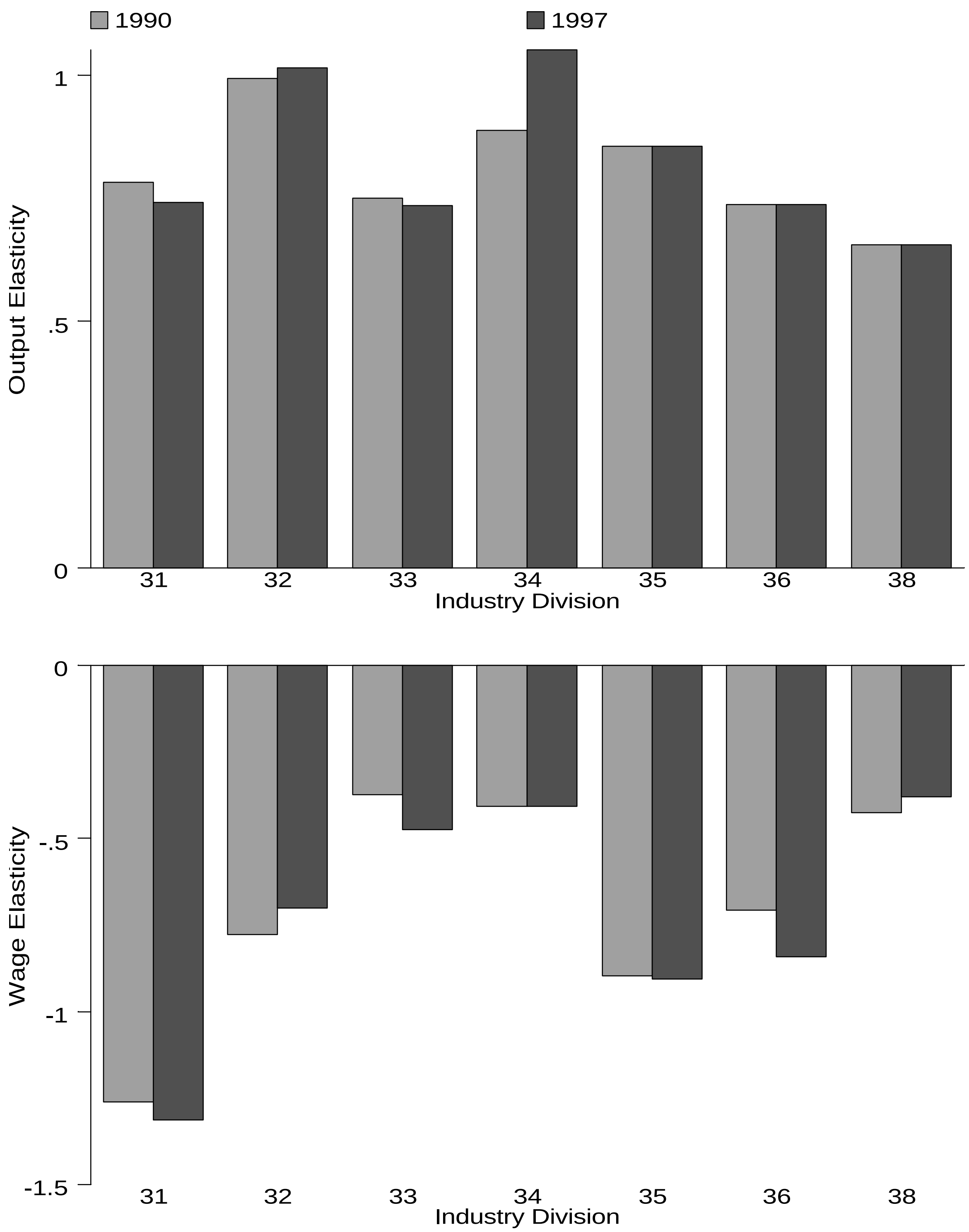
Table 5: Estimation Results With Cost of Capital Variable Added to the Model

	Industry Branch						
	31	32	33	34	35	36	38
$\bar{\eta}_{LL}$	-1.12	-0.99	-0.57	-0.59	-0.94	-1.23	-0.63
$\bar{\eta}_{LK}$	0.22	0.12	0.19	0.05^{+}	0.42	-0.10^{+}	0.18
$\bar{\eta}_{LY}$	0.55	0.87	0.53	0.93	0.51	0.76	0.50
θ	0.000	0.088	-0.173	-0.260	0.000	0.000	0.000
λ	0.000	0.088	-0.173	-0.040	0.000	0.000	0.000

Note:

$^{+}$indicates that the estimated elasticity (or the regression coefficient when the elasticity is variable) is not statistically significantly different from zero at $p<0.05$).

Figure 1: Estimated Elasticity of Labour Demand with Respect to Output (Value Added) and Real Wages, 1990 and 1997



Notes

[1] The real wage index for workers in industry and commerce is 16% lower in 1998 than it was in the base period of 1978. All statistics on wages, employment, unemployment and exports come from the Central Bank of Sri Lanka.

[2] This static approach ignores the role of adjustment costs and the distinction between the amount of labour used and the intensity of its use (employment versus hours per period). But lags in the adjustment of labour demand to its long-run equilibrium do not appear to be very long, so the parameters derived from long-run labour demand equations can be applied even to short-run policy questions (Hamermesh, 1986).

[3] In our data, the largest industry is Wearing Apparel (UNSIC 3220), with approximately 180,000 employees. However, this represents less than 3.5% of the total employment in Sri Lanka so the assumption of infinitely elastic labour supply should be reasonable in this context.

[4] Examples of studies that use log-linear labour demand functions include Turner and Bowden (1997) and Lane, Hakim and Miranda (1999).

[5] For further description of this function, see, for example, Heathfield (1971), pp.64-68.

[6] Equation (2) can be derived from (3) by noting that the dual CES cost function, when constant returns to scale are not imposed (see Hamermesh, 1986: 437) is $C = Y^{a}\left[a^{s} w^{1-s} + [1-a]^{s} r^{1-s}\right]^{1/(1-s)}$. Note that the efficiency parameter is ignored to save clutter and that Ferguson (1969: 166) gives the detailed derivation for a linearly homogeneous CES function. Applying Sheppard's Lemma to the cost function and then taking logs gives $\ln L = s \ln a - s \ln w + a \ln Y$.

[7] Examples of labour demand studies using this approach include Hsing (1989, 1989a), Bairam (1993) and Hsing and Mixon (1995).

[8] Note that the elasticity with respect to the wage rate is the elasticity of substitution, σ and that the own-wage elasticity of labour demand must be computed by substituting the variable elasticity from equation (6) into equation (4).

[9] Jha, Murty, Paul and Rao (1993) give an example of this approach.

[10] This assumption is commonly made in cross-sectional studies of the manufacturing sector. See, for example, Laumas and Williams (1981).

[11] The wage rate is computed by dividing employees remuneration by the total manhours. The total manhours is obtained by multiplying the number of workers by 2000, the average total of the hours worked during the year. A similar approach is used by Kwon and Williams (1982).

[12] We do not have information on the price and quantity of output for each industry so the use of value-added in the specification is based on the assumption that output prices are the same across the units of observation (Freeman and Medoff, 1982: 222). Because of the finely disaggregated nature of our sub-industries and the use of deflated values, this assumption may not be too objectionable.

[13] This interest rate varies only across time and not across industries.