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The Impact of International Outsourcing on the Skill Structure of Employment: Empirical Evidence from German Manufacturing Industries

by

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Abstract

The Impact of International Outsourcing on the Skill Structure of Employment: Empirical Evidence from German Manufacturing Industries*

In recent publications it has been argued that the change of the skill structure of industrial employment is caused by biased technical progress rather than by increasing international trade with low wage countries. However, in linking prices for final goods with prices of primary factors, most empirical studies have only dealt with international trade in final goods and have thereby neglected the impact of international outsourcing. In this paper it is argued that outsourcing can be understood as a substitution of imported intermediate inputs for domestic value added, and that such substitution may have an impact on the skill structure of domestic employment in favor of skilled labor. The empirical evidence for German manufacturing industries supports this hypothesis.

Keywords: International Outsourcing, Trade, Wages, Employment.

JEL Classification: F10, J31.

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1. Introduction

Over the past two decades, unskilled workers in high-income countries have incurred losses in their economic fortunes relative to skilled workers, either in terms of wages or in terms of employment. The traditional neoclassical trade theory offers two conflicting hypotheses which could explain this development: increasing trade with low wage countries (Stolper-Samuelson effect) or exogenous technical progress biased against unskilled labor. The majority of recent empirical studies on this subject has argued that biased technical progress rather than international trade per se is the main factor. To substantiate this conclusion, perhaps the most often used approach is a regression of goods prices on factor income shares ("Baldwin-Cain approach"). This approach is based on the familiar 2x2x2 Heckscher-Ohlin model with zero-profit conditions and makes it possible to calculate those (hypothetical) relative factor price changes mandated by world market price changes that are consistent with full employment.[1]

However, these empirical studies have been criticized for various reasons: First, the assumptions of the Heckscher-Ohlin model are questioned, e.g. with respect to problems emerging in higher-dimensional models.[2] Second, the specification of technical progress, its potential bias and its impact on final goods prices is disputed.[3] In particular, it has been argued that the observed within-industry substitution away from unskilled labor, despite drops in its relative wage, is inconsistent with the Stolper-Samuelson effect. As an alternative explanation, it is suggested that skill-biased technological change was pervasive (i.e., affecting

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1 The seminal paper is Baldwin and Cain (1997), which has been circulated as manuscript since 1994; for a recent survey and empirical results for OECD countries see Lücke (1999).

2 E. g., Deardorff (1998).

3 E. g., Feenstra and Hanson (1995), Leamer (1996), Haskel and Slaughter (1998).

many developed countries simultaneously, not only the single economy under consideration as in the Baldwin-Cain approach), increasing both the skill premium and the relative demand for skilled labor within industries.[4]

Another less often emphasized shortcoming is that the Baldwin-Cain approach, at least in its most often used implementation, implicitly assumes that only final goods are traded internationally, i.e., international outsourcing[5] is neglected. The main argument to consider international outsourcing is that, due to increasing import competition from low wage countries, those stages of the production process in advanced countries are deployed to other countries that are relatively unskilled-labor intensive. Hence, domestic goods prices are affected not only by world market prices for competing final goods but also by the changes in prices of imported inputs and the resulting substitution of imported inputs for domestic value added. This causes the domestic production process (i.e., the remaining value adding stages) to change its factor intensity, and this also affects domestic factor prices. In contrast, most of the studies mentioned above attribute higher skill intensity only to technology which could be mistaken if outsourcing is important. Hence, international outsourcing could possibly provide an explanation for unskilled-labor saving technical progress, hitherto treated as exogenous.

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4 E.g., Berman et al. (1997)

5 Outsourcing ("outside resource using") refers to the fragmentation of a production process in sequential stages (i. e., the opposite of vertical integration) and the development of new input-output relations, either with other firms or other locations within the same firm. Note that this definition is not restricted to purchases by multinational corporations from foreign subsidiaries. Moreover, the stage outsourced could be either a service activity (e. g., maintenance, logistics) or a production activity (e.g., in the case of intermediate inputs). Various synonyms have been introduced to the theoretical literature, e.g., "slicing-up of the value-added chain" (Krugman 1995), "vertical trade" (Jones 1996) or "fragmentation" (Deardorff 1998).

The impact of international outsourcing on factor prices has only recently been examined in theoretical work: Deardorff (1998) uses a conventional Heckscher-Ohlin model of international trade with many goods. He finds that the effects on relative factor prices depend on the factor intensities both of the fragments and of the initial (unfragmented) technology, and that fragmentation does not necessarily lead to factor price equalization. Other models are proposed by Venables (1999) and Dluhosch (1998). However, an easily applicable modification of the Baldwin-Cain approach has not yet been proposed.

In this paper, an alternative method is introduced to achieve a measure of the relative importance of international outsourcing as compared to exogenous technical progress. For this purpose, sectoral cost functions are estimated, where the underlying production process now uses both primary factors and intermediate inputs. Moreover, actual wage data are used in the estimations, in contrast to the Baldwin-Cain approach in which only mandated wage changes are calculated. Since separability between intermediate inputs and domestic value added is not assumed ex ante, different substitution elasticities between imported inputs and the various domestic primary factors are possible. This is an important issue since international outsourcing is believed to affect unskilled labor particularly hard. Based on the empirical results, it will be assessed whether the explanatory power of technical progress, typically proxied by a time trend variable, with respect to the observed skill upgrading can be reduced.

In section 2 and 3, the magnitude of international outsourcing is described, and previous studies on the effect of outsourcing on relative wages are reviewed. Section 4 provides a production theoretic framework for the empirical analysis. The database is described in section 5, and empirical results for German manufacturing industries are presented in section 6. Section 7 concludes.

2. Magnitude of international outsourcing

Only little insight on outsourcing can be gained directly from international trade statistics. The only information that can be derived either relates to intra-industry trade or to trade in raw materials and semi-finished products. However, intra-industry trade is only weakly related to outsourcing since it includes trade in differentiated final goods. Similarly, trade in semi-finished products is only a poor indicator for outsourcing activities because final and intermediate goods are not separated systematically in trade classification systems (Yeats 1998). FDI statistics are too broad in that substantial shares of FDI are done to penetrate foreign markets directly rather than to supply inputs for domestic production and at the same time too narrow in that non-equity forms of outsourcing are not included. Information on non-equity forms of FDI is fragmentary: some information is available from statistics on licensing and patents activities, whereas data on subcontracting are incomplete since only those outward processing activities are covered which are supported by trade policy concessions (Härtel et al. 1996).

Hence, only input-output tables provide direct information on outsourcing, at least for those countries where the information on intermediate input flows is disaggregated in domestic products and imports.[6] Based on this source of information, various studies have shown that international outsourcing is quite important (OECD 1996, Campa and Goldberg 1997, Hummels et al. 1998). The outsourcing indicator introduced in Table 1 is the cost share of imported inputs in the value of gross production; data are derived from national input-output tables. An increase of the indicator could be interpreted as an indication of

6 These are input-output tables of type D, according to a UN classification. For countries which do not publish input-output tables of this type only proxies can be calculated, based on the assumption that all sectoral import ratios of intermediate inputs of a certain type are the same as the total import ratio, both for final and intermediate goods.

international outsourcing. Over the last twenty years, the share of imported intermediate goods has increased significantly in several industrial countries. The notable exception is Japan, where the cost shares have been low over the entire period and where increases can be observed only in certain industries. The reason for that is probably the higher relevance of deployment of total production processes to neighboring countries. The observation of low cost shares coincides with relatively low shares of Japanese imports from developing countries in apparent consumption (UNCTAD 1999, Table 7.1).

Although the indicator in Table 1 is probably the best available indicator of international outsourcing as defined in this paper, it is still insufficient. First, it is based on values rather than volumes of inputs. Hence, the degree of outsourcing is probably underestimated because imported inputs can be assumed to be cheaper than those domestically produced components that they substitute. Second, outsourcing of the final stage of production[7] is not captured by the indicator since this form of international outsourcing is not reflected in the input-output sub-table on intermediates; third, intra-industry shifts of the output mix towards skill-intensive goods also cause the indicator to increase.

A more satisfactory data source is available for Germany. Here, two trends can be observed for the period 1978-1990 (Table 2): First, the cost share of material inputs increased only in some industries (e.g., road vehicles, leather products and clothing). At first sight, this seems to support the hypothesis that outsourcing of formerly domestically located production activities did not play a role. However, outsourcing of service activities to specialized domestic suppliers, which causes the share of non-material inputs to increase, provides an alternative explanation (Klodt 1997). Second, the cost share of imported material inputs in total material

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7 This is meant to include subcontracting to foreign countries, i. e., exports of semi-finished products and re-import of the final goods manufactured thereof.

inputs has increased during the same period, in several industries by more than 10 percent (e.g., plastic products, office machinery, leather products). The reason for this increase is suggestively the decrease of the price of imported inputs relative to domestic inputs (last column in table 2). In spite of the overall price decrease, the correlation between the change of the input mix and relative price changes seems to be weak. A second puzzle emerges for office machinery, where the share of imported inputs increased from 26 percent to 42 percent whereas the average price for imported inputs increased by almost 30 percent relative to domestic inputs. The reason for these puzzling facts is probably the high degree of differentiated inputs in some industries and the product quality increase in the computer industry.

In summary, international outsourcing seems to have become an increasingly important issue for German manufacturing industries, at least during the 1980's. Hence, the question arises how this has influenced relative wages and the structure of employment by skills.

3. The effect of outsourcing on relative wages: evidence from previous studies

Empirical approaches to analyze the impact of outsourcing on relative factor prices and/or employment have been employed only recently.

Feenstra and Hanson (1995) approximate international outsourcing by the share of imported intermediate inputs in total intermediate inputs; however, they did not use information from input-output tables but overall import penetration ratios (i.e., total imports for domestic demand, not only of intermediate inputs) weighted by the respective share of different goods in total intermediate inputs. This proxy, together with computer purchases as another "additional variable", is introduced into a translog cost function with factor prices as "core variables".

The estimated coefficients are then used to decompose a dual (i.e., unit cost related) measure of TFP into components related to the two "additional variables". Finally, they use a modified Baldwin-Cain regression to derive the mandated wage changes related to each of these two components. From empirical results for the U.S. in the period 1972-1990, they conclude that international outsourcing may explain up to 50 percent of the increase in non-production wages relative to production wages, especially in the 1980's.

Machin, Ryan and Van Reenen (1996) use the ratio of imports to value added as indicator for foreign competition. The method is based on a restricted translog cost function with capital and wages of non-production and production workers as "core variables" and industry-specific R&D expenditures as an additional variable to account for technological change; it has to be noted that they use only differences between two years in a cross section of industries and assume identical changes in relative wages for all industries. From empirical results for the U.S., UK, Denmark and Sweden in the period 1979-1991, they conclude that "the role of [labor market] institutions, rather than changes in international competition, is probably the main competing hypothesis with the skill biased technological change story" (p. 28).

Anderton and Brenton (1999) basically employ the same approach as Machin et al. (1996) but with an important modification: they use only imports from low-wage countries for the foreign competition indicator. Moreover, they pool only few industries which are highly disaggregated (six subsectors of the textile industry and 5 subsectors of the machinery industry) and include actual wage data. From empirical results for the UK in the period 1971-1986 they conclude rather vaguely that "outsourcing may have damaged the economic fortune of the less-skilled in the UK" and that low-skill intensive industries such as textiles "are more likely to be influenced by outsourcing" (p. 18) than high-skill intensive industries.

Steiner and Wagner (1997) choose a totally different approach: they estimate the substitution elasticity between skilled and unskilled labor without using an indicator for outsourcing; instead, they make separate estimates for three groups of industries (low, middle and high import competition), based on a CES labor demand function with two types of labor ("skilled" and "unskilled" as measured by formal education) and separate levels of labor market experience. From empirical estimates for Germany[8] in the period 1975-1990, they concluded that the relative employment of unskilled workers in industries with high import shares has declined more strongly than in those industries which were less affected by international competition, but that "the size of this effect is not dramatic" (p. 20).

In summary, it is puzzling and likewise unsatisfactory that all these approaches use volume indicators to assess the impact of international outsourcing, although it would have been suggestive in a cost function framework to use relative prices for imported intermediate inputs. Moreover, imported inputs are not separated clearly from other imports. Hence, it remains unclear whether the measured impact can be attributed to international outsourcing or to increasing international trade in general. The approach proposed and tested in this paper aims at overcoming these shortcomings.

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8 The database used is a 1 percent random sample from the employment register of the Federal Labor Office ("IAB-Beschäftigtenstichprobe" = IAB employment sample) which comprises about 200,000 individual-level earnings and employment information.

4. A production theoretic framework

Our empirical analysis is twofold: one approach is to estimate a complete system of equations for a multi-factor cost function, the other is to use the ratio of two types of labor (skilled and unskilled) in a single factor demand equation.[9]

The first approach is based on a translog production function with five variable inputs (skilled labor, unskilled labor, energy, imported non-energy intermediate inputs and domestic non-energy intermediate inputs) and one quasi-fixed input (capital). The reason for treating capital as quasi-fixed[10] is that the assumption of cost minimization with respect to user costs of capital does not hold in every period since the adjustment of the capital stock to changed prices takes some time. Moreover, industry-specific data for user costs of capital are not available.

Cost minimization with respect to all other inputs implies that the cost function derived from the translog production function can be transformed to the following equations, which can be estimated directly:

$$S_{i,t} = a_i + b_{i1}\log\left(W_{u,t}\right) + b_{i2}\log\left(W_{s,t}\right) + b_{i3}\log\left(P_{dom,t}\right) + b_{i4}\log\left(P_{imp,t}\right) + b_{i5}\log\left(P_{e,t}\right) + g_i\log\left(K_t\right) + d_i\log\left(Y_t\right) + l_i t$$

where S_i is the share of input i in total production costs excluding user costs of capital, W_s and W_u the wage rate for skilled (unskilled) labor, P_{dom} and P_{imp} the price for domestic (imported) intermediate inputs, P_e the price for energy, K the sectoral capital stock, Y the real output of the sector and t the time index. The time variable t is used as a proxy for technological change, which is assumed to shift the respective input cost share at a constant annual rate.

Moreover, the coefficients are subject to the following a-priori restrictions:

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9 See Hamermesh (1993, p. 68-74) for a discussion of alternative estimation methods.

10 For a similar approach, though without intermediate inputs, see Fitzenberger and Franz (1997). For a production function with intermediate inputs see Hansen and Lindner (1988).

$$\Sigma a_i = 1, \ \sum_i b_{ij} = 0 \text{ for all } j, \ \sum_j b_{ij} = 0 \text{ for all } i, \text{ and } b_{ij} = b_{ji} \text{ for all } i, j.$$

The first two equations, the adding-up restrictions, are due to the fact that the cost shares of each sector have to sum up to 100 percent. The third equation is due to the assumption of linear homogeneity in all input prices. Usually, homogeneity is only assumed with respect to a cost function where all input prices are introduced as explanatory variables. Although capital is treated as a quasi-fixed input in this paper, this restriction does not necessarily cause a problem.[11] This allows to drop one input price from the equation and to measure all other input prices relative to this price. Here, this numeraire price is the price for domestic intermediate inputs; hence, the coefficient for e.g. the price of imported inputs measures the effect of changing relative intermediate input prices. The fourth equation is due to the symmetry of the original cost function.

Obviously, a translog function is a generalization of the Cobb-Douglas function which is the special case in which all coefficients are zero except for the a_i. The main advantages of this functional form are, first, that the empirical estimation is easy (linear equation!) and, second, that the various elasticities of substitution are allowed both to differ between factors and to vary over time. The estimated coefficients can be interpreted as follows:[12]

Coefficients $b_{ij}(i \neq j)$ can be transformed into the respective substitution elasticities between the *i-th* and *j-th* input; for instance, $b_{ij} = 0$ is equivalent to a substitution elasticity of 1. $b_{ij}(i \neq j)$ can also be transformed into cross-price elasticities of the *i-th* input demand with respect to the j-th factor whereas direct price elasticities can be derived from b_{ii}; for instance, $b_{ij} = 0$ is equivalent to a

11 Apparently, Fitzenberger and Franz (1997) take a different view on this.

12 For the following see Christensen et al. (1973) and Hamermesh (1993), pp. 40-42.

cross-price elasticity equal to the cost share of the *j-th* input and $b_{ii} = 0$ is equivalent to a direct price elasticity that is equal to the cost share of the *i-th* input minus 1. The coefficient d_i measures scale effects on factor demand. Finally, it is to be noted that l_i is the sectoral bias, not the rate of sectoral technological change. This coefficient is a weighted average of the rates l_j^* of factor-augmenting technical progress with respect to factor *j*: $l_i = \sum_j b_{ij} l_j^*$.

The basic hypotheses for *i* = unskilled labor are:

a) In industries where outsourcing is an important phenomenon, unskilled labor and imported intermediate inputs are close substitutes (b_{i4} positive) whereas skilled labor and imported intermediate inputs are moderate substitutes at best. In this case, a decline of relative import prices leads to international outsourcing of low-skill intensive activities and hence to a lower demand for unskilled labor.

b) An increase of the relative wage for unskilled labor leads to a lower demand for unskilled labor (b_{i1} negative). However, this effect could be weak if skill upgrading within the category of (relatively) unskilled labor takes place in periods with rising wages, so that the employment share of unskilled labor does not decrease with higher relative wages.

b) An increase of the relative wage for unskilled labor leads to a lower demand for unskilled labor (b_{i1} negative). However, this effect could be weak if skill upgrading within the category of (relatively) unskilled labor takes places in periods with rising wagegs, so that the employment share of unskilled labor does not decrease with higher relative wages.

c) An increase of the sectoral capital stock leads to lower relative demand for unskilled labor[13] (necessary condition: $g_i < g_j$ for j = skilled labor).

d) Technical progress is biased against unskilled labor ($l_i < l_j$ for j = skilled).

The second approach is based on a two-factor CES production function with unskilled labor as the only factors of production:

$$\log\left(\frac{L_{u,t}}{L_{s,t}}\right) = a + b \log\left(\frac{W_{u,t}}{W_{s,t}}\right)$$

The main advantage of this approach is that b provides a direct estimate for the substitution elasticity. However, this equation is unable to analyze the impact of intermediate input prices, changes of the sectoral capital stock and potential scale effects.[14] Thus, the following ad hoc specification[15] has been estimated:

$$\log\left(\frac{L_{u,t}}{L_{s,t}}\right) = a + b_1 \log\left(\frac{W_{u,t}}{W_{s,t}}\right) + b_2 \log\left(\frac{P_{imp,t}}{P_{dom,t}}\right) + g \log\left(\frac{K_t}{Y_t}\right) + l\,t$$

where $L_u(L_s)$ are the number of unskilled (skilled) workers for labor inputs, and all other variables are defined as in the first approach. The modification of the hypotheses stated above is straightforward: $b_1 < 0$ in the case of a normal price factor price response, $b_2 > 0$ if international outsourcing is biased against unskilled labor, $g < 0$ in the case of capital-skill complementarity, and $l < 0$ in the case of exogenous technical progress biased against unskilled labor.

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13 This is the so-called capital-skill complementarity; see e. g. Bergström and Panas (1992).

14 The capital-output ratio is taken as an explanatory variable (rather than capital and output as separate variables) to avoid problems caused by multicollinearity of these two variables.

15 In a production theoretic framework, the labor income shares are now affected by the relative price of intermediate inputs, the capital intensity and a time trend.

In related empirical papers, sectoral import penetration ratios have been used to account for the impact of international outsourcing.[16] This specification is open to criticism: first, it is unclear how such a volume indicator can be interpreted in a production function, in contrast to a price indicator like the relative price of imported inputs; second, the import penetration ratio indicates the degree of import competition not only for intermediate inputs related to international outsourcing but also for final goods, since it is based on all imports of the sector. However, this variable has been included as an alternative variable to make the results in this paper comparable to other papers. In that case, the specification of the factor demand equation is slightly changed to:

$$\log\left(\frac{L_{u,t}}{L_{s,t}}\right) = a + b_1 \log\left(\frac{W_{u,t}}{W_{s,t}}\right) + b'_2 \log\left(\frac{M_t}{P_t Y_t + M_t - X_t}\right) + g \log\left(\frac{K_t}{Y_t}\right) + l t$$

where $M_t(X_t)$ is the value of imports (exports) of goods produced in the respective industry, and the related hypothesis is to be restated as: $b'_2 < 0$ if the impact of import competition on employment is biased against unskilled labor.

In principle, both these methods (cost functions and factor demand equations) can be used for estimations with time series data for individual industries or for a cross section of industries at a certain point of time. However, since elasticities can be expected to differ substantially between industries, the interpretation of estimation results for cross-section data is subject to greater ambiguity. Estimation in first differences is not able to fully solve this problems; however, the spurious regression caused by large intersectoral differences in the explanatory and endogenous variables can be avoided. Hence, the models are estimated both in levels and in difference for cross-section data.

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16 E. g., Anderton and Brenton (1999), Feenstra and Hanson (1995).

5. Data

The two models are estimated separately for ISIC 3-digit manufacturing industries[17] spanning German manufacturing, using annual data for the period of 1970 to 1993. Two different data sets are used for employment and wages:

The first data set comprises data for wage earners ("Arbeiter") and salaried employees ("Angestellte") in 28 industries for the period 1970-1993. Obviously, this is only a crude approximation to unskilled and skilled labor but there are two reasons for this approach: First, time series data on employment by skill level are not available in a manner consistent with industrial census data.[18] Second, this approach has produced robust and plausible results in many empirical studies for other countries.[19] In the empirical literature, particularly on the U.S., the differentiation between "production workers" and "non-production workers" is often used. The German classification is not fully comparable since it is solely based on the labor contract. In the following, the terms production workers and non-production workers are used nevertheless for the group of wage earners and salaried employees, respectively.

The second data set comprises data for employment and wages grouped by actual on-the-job skill requirements of wage earners and salaried employees as reported by the employer. For example, the lowest skill category for wage earners is defined as "simple activities, for which no formal training is required", and the lowest skill category for salaried employees is defined as "simple activities, for which only a few years job experience is required; other employees are not to be

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17 See table in the appendix. Three manufacturing industries (mineral oil refining, shipbuilding, and production of aircraft and spacecraft) have been omitted due to lack of price data.

18 The IAB-Sample provides supposedly reliable data on earnings by skill level, but information on employment is limited; see Steiner and Wagner (1997) for further qualifications.

19 For an overview see Hamermesh (1993). See also the references in Berman et al. (1997).

supervised by them". These skill categories are probably the best approximation of skilled and unskilled labor. Unfortunately, such wage structure surveys are available only for a few years (1978 and 1990), and the coverage is not complete (only 18 manufacturing industries; see appendix for details).

Price indices for intermediate inputs are calculated as a weighted average of sectoral import prices and domestic producer prices, respectively, but only for manufactures and raw materials; the constant weights are taken from the 1978 input-output table. This is possible since all intermediate input flows in the German input-output table are disaggregated by domestic and foreign origin. It could be argued that international outsourcing (in the narrow sense) of a specific industry is only determined by relative prices for inputs produced by this industry itself, since all other inputs are only substituting intermediate inputs that have been provided by other industries before. However, the broad concept of international outsourcing employed in this paper also includes the substitution of foreign suppliers for domestic suppliers. Anyway, the weight of intermediate inputs produced in the same sector is very high, so that it makes almost no difference whether single price series are used in the regressions or the price indices described above.

Cost data in current prices are taken from the industrial census.[20] The costs of services inputs are included in the cost share of domestic non-energy intermediate inputs, while services are neglected in the calculation of the price indices, mainly due to the lack of price data. This can be justified by the assumption that the demand for services inputs is not determined by prices for

[20] For further details see the appendix on data sources.

other inputs and vice versa. Hence, a separate price for services was not used. Moreover, only little international outsourcing takes place to these industries.[21]

The import penetration ratio is calculated as the share of domestic demand (i.e., domestic production plus total imports minus total exports) for the output of the respective industry accounted for by imports from non-OECD countries. Trade data disaggregated according to ISIC have been rearranged to the German industry classification system for the manufacturing industries (SYPRO; see table in the appendix) and converted into DM values with average annual US$ exchange rates.

6. Empirical results

With respect to the first data set, some sample characteristics are presented in Table 3, from which two trends clearly emerge. First, the employment share of production workers has decreased by 5 to 10 percentage points in most industries, and by 14 percent or more in three industries (electrical engineering, office machinery, leather industry). However, it is unclear whether this shift can be interpreted as a trend against unskilled workers or whether it mirrors only a shift in the preferences for labor contract types, both for the skilled and the unskilled. Second, the wage of production workers has decreased relative to non-production workers in all but three industries (office machinery,[22] pulp and paper and food). This seems to imply that wage costs cannot be the only cause

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21 Prominent examples of international outsourcing of business services are the production of software and the processing of accounting data. Although little is known about the scope of these outsourcing activities, it seems plausible that most of them are undertaken by domestic services (rather than manufacturing) industries. This is supported by information given in input-output tables, where imports of services, as intermediate inputs for manufacturing industries, are negligible.

22 The huge increase by more than 20 percent and the large shift in favor of non-production workers in this industry is perhaps only due to legal changes of the labor contracts.

for the observed change of the employment structure, so that either technical progress was biased against production workers, or the increasing importance of international outsourcing has led to layoffs of production workers.

With respect to the second data set, some sample characteristics are presented in Tables 4 and 5, from which a somewhat different picture to that stated above in Table 3 emerges. First, the employment share of unskilled workers both in the group of production and non-production workers has decreased by 3 to 8 percentage points in almost any industry, while it increased only in a few industries (e.g., production workers in the rubber processing industry, non-production workers in the textiles industry). Hence, the presumed employment shift in favor of skilled workers is not fictitious. However, this can be the result of layoffs of unskilled workers or of skill acquirements of formerly low-skilled workers. Second, the wage of unskilled relative to skilled production workers has increased in most industries and declined only in a few industries (mechanical engineering, road vehicles, paper products); for non-production workers the relative wage changes are almost evenly distributed, ranging between -6 percent (road vehicles) and +6 percent (wood products). In line with other empirical studies,[23] this supports the hypothesis that the wage dispersion between skill groups has decreased over the period 1978-1990 whereas the dispersion within skill groups (e.g., skilled non-production workers vs. skilled production workers) has increased. Hence, the employment shift in favor of skilled workers is consistent with the observed relative wage changes in the group of production workers. By contrast, the picture is unclear for the group of non-production workers: Either, skill upgrading is more important for non-production workers or the bargaining power of unskilled non-production workers is relatively high.

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23 See e. g. Fitzenberger and Franz (1997) with further references.

a) Production vs. non-production workers (1970-1993, annual data)[24]

Regression results for the factor demand function are presented in Table 6a, 6b. In general, the empirical results support the hypotheses stated above (section 4): (1) For the regressions with a time trend variable included (right half of the table), the fit was relatively good (adjusted R^2 80 percent or more) with the exception of a few industries. The estimated coefficient for the time trend variable is negative for almost all industries, i.e., technical progress is biased against unskilled labor. In roughly one half of the industries, the adjusted R^2 increases significantly after the inclusion of a time trend variable. This supports the hypothesis that the bias against unskilled labor is due to exogenous technical progress in these industries. In those industries where the adjusted R^2 does not increase, this bias is probably due to globalization. Among these industries are labor intensive industries (e.g., clothing, leather, toys) but also some capital or skill intensive industries (e.g., mechanical engineering, printing).

(2) The coefficient for the relative wage of production workers (column "rw prodw"), i.e., the estimated value of the substitution elasticity between production and non-production workers, is always statistically significantly negative or insignificant if the time trend variable is included (right half of the table). By comparison with the results for the regressions without a time trend variable (left half of the table), the importance of accounting for a possible factor bias of technical progress becomes obvious: in that case, many coefficients were positive (complementarity between the two employment groups). Hence, the second hypothesis is clearly corroborated.

(3) The coefficient for the capital-output ratio (column "cap-out ratio") is negative and statistically significant for almost all industries. These findings

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24 All functions have been estimated with a constant (a) included, however, the respective results are not reported in the tables.

suggest that a higher capital-output ratio leads to a lower share of production workers in the sectoral labor force ("capital-skill complementarity").

(4) With respect to the effect of international outsourcing, the picture is ambiguous. In one third of all industries, a lower price for imported intermediate inputs relative to domestic inputs leads to a higher share of production workers (negative coefficient in column "rp forinp" in Table 6a). Only in five out of 28 industries, including the leather, the textiles and the clothing industry, the presumed effect could be corroborated (positive coefficient), whereas for almost half of all industries the effect of input price changes does not have a significant impact on the composition of the labor force. This result is surprising at first sight, given the anecdotal evidence on cost-related outsourcing activities in many other industries (e.g., cars production, electrical engineering). However, it is likely that other explanatory variables in the regression have been influenced by increasing incentives for international outsourcing in such a way that the impact of the outsourcing indicator on the employment structure has been compensated by an immediate change of these other variables. For example, the wage bargaining behavior within an industry is not independent of the threat to relocate production activities or parts thereof to foreign countries.

Moreover, this result may be due to the inclusion of a time trend variable as can be seen from a comparison with the left half of the table. Without a time trend variable included, the presumed positive effect holds for five more industries, among them the manufacturing of road vehicles. This difference supports the hypothesis that international outsourcing could be misidentified as technical progress. However, excluding the time trend variable from the regression leads to implausible results for other coefficients (see above) so that the time trend variable should remain in the regression. Hence, there remains an identification problem unless technical progress can be identified directly.

By contrast, the coefficient for the import penetration ratio shows the expected negative sign in roughly one half of the industries (negative coefficient in column "imp pen ratio" in Table 6b) and is insignificant in all other but three. These results seem to be quite robust, since the adjusted R^2 is high, and the estimated coefficients for the other explanatory variables are broadly in line with the estimates presented in Table 6a. Hence, the results from this alternative specification seems to imply that the import penetration ratio is a better indicator for globalization pressures than the relative import price indicator. However, the results are puzzling for six industries if compared to the previous specification: the estimated coefficient for the import penetration ratio is statistically significant but has the same sign as the coefficient for the relative price indicator, i.e., the two indicators support the respective opposite hypothesis. For example, the results of the regressions in Table 6b suggest that higher imports have a positive impact on the employment share of production workers in the leather and clothing industries (which is implausible), whereas the opposite is suggested for the impact of lower relative import prices (Table 6a). There seems to be no simple explanation for these differences, but one possible factor might be the prevalence of intra-industry trade.

Anderton and Brenton (1999) offer another explanation, based on their results for the UK in the period 1970-1986. They estimated similar factor demand functions with pooled time series data for 11 subsectors of the textiles and the non-electrical machinery industry, but none of the coefficients for relative import prices were statistically significant, in stark contrast to the coefficient for the import penetration ratio. The explanation offered by the authors points to product quality factors: "the correlation between changes in import prices and changes in imports of low-wage-country products might be weak whereas the import penetration term provides a more accurate measure of how successfully low-wage country products are competing with UK products " (Anderton and Brenton 1999, p. 19). However, problems related to the pooling of heterogeneous industries might be an alternative explanation in this case.

In order to show the relative importance of the explanatory variables, a decomposition of the endogenous variable was performed.[25] The results for both specifications are presented in Table 6c, where column 2 to 5 refer to the first specification with the relative price of imported intermediates and the last four columns to the specification with the import penetration ratio. The first column indicates the change of the endogenous variable[26] in the factor demand equations, i.e. log (production workers/non-production workers), between 1970 and 1993. In the other columns, this change is decomposed into a wage effect ($b_1 \Delta \log\left(\frac{W_u}{W_s}\right)$), an import price effect ($b_2 \Delta \log\left(\frac{P_{imp}}{P_{dom}}\right)$) (first specification) or an import penetration effect $b_2' \Delta \log\left(\frac{M}{PY+M-X}\right)$ (second specification), a capital deepening effect ($g \Delta \log\left(\frac{K}{Y}\right)$), and a technological change effect ($l \Delta t$). In general, the percentages do not add up to 100 percent, since the effects are related to the actual change of the endogenous variable, not to the hypothetical change explained by the estimated regression equation. However, the relative importance of the effects clearly emerge from these figures:

On average, technological change was the most important determinant of the downward trend in the share of production workers in total employment, explaining more than 50 percent of the change in 23 industries. Capital deepening

25 See Betts (1997) for this technique.

26 It has to be noted that, in contrast to the other columns, these figures are not percentages of the employment ratio (which are presented in Table 3), but the log differences thereof.

comes next, although the variance of the explanatory power is quite large. The wage effect is negative in most industries, i.e., the impact of the actual changes of the relative wage was biased in favor of production workers. In a technical sense, this is not surprising, since the estimated coefficient for the relative wage is negative and wage dispersion has increased over the whole period (as has already been stated at the beginning of this section). However, the negative contribution should not be interpreted in the sense that the wage dispersion has increased by too much since the decomposition reveals only partial effects thereby neglecting possible interrelations between explanatory variables. In general, the import price effect is only moderate. Only in four industries (ceramic goods, wood working, leather and clothing), more than 20 percent of the actual change of the employment structure can be attributed to changing import prices. By contrast, the import penetration effect is much stronger: increasing import penetration was responsible for more than 20 percent of the actual change of the employment structure in eight industries, e.g., road vehicles and electrical engineering.

Regression results of the translog cost functions[27] are presented in Tables 7a,b and 8a,b. In general, these results do not support all hypotheses, but most of the results are in line with the regression results for factor demand functions.

(1) With an adjusted R^2 of at least 70 percent, the fit was relatively good, except for one industry (cold rolling mills). The estimated coefficient for the time trend variable in the regression for production workers' cost function is negative

27 Due to the cross-equation restrictions mentioned in the previous section, it would have been necessary to use the method of seemingly unrelated regressions (SUR). However, since time series data are only available for two cost shares (skilled labor and unskilled labor), these two equations are estimated with OLS. In addition, results for a complete system of translog cost share equations, which has been estimated with SUR for a cross section of manufacturing industries, suggest that this is a reasonable procedure since the estimated coefficients are close to the respective coefficients estimated with OLS.

(Table 7a,b) and substantially larger in absolute value than the respective coefficient in the regression for non-production workers' cost shares (Table 8a,b), i.e., technical progress is biased against unskilled labor, in only about half of the industries.[28] This supports the hypothesis that exogenous technical progress with a bias against unskilled labor is widespread in the manufacturing sector though not pervasive. Among the industries without a significant skill-bias are labor intensive industries (e.g., leather, toys) but also some capital or skill intensive industries (e.g., mechanical engineering, non-ferrous metals), just like in the case of factor demand functions. It has to be noted, that the absolute size of these coefficients cannot be compared to the respective coefficients in the factor demand functions, since the dependent variables are completely different. Moreover, the inclusion of the energy price index as an explanatory variable in the cost functions may have reduced the explanatory power of the time trend.

(2) The coefficient for the deflated own wage (column "rw prod" in Table 7a,b; column "rw nonprod" in Table 8a,b) is statistically insignificant in most industries. This yields an own-price elasticity of labor demand close to minus 1. Hence, the second hypothesis is clearly corroborated.

(3) The coefficient for the real value of capital (column "real capital") in the regression for non-production workers' cost function is positive (Table 8a,b) and significantly larger in absolute value than the respective coefficient in the regression for production workers' cost functions (Table 7a,b) in almost half of the industries. These findings suggest that a higher real value of capital leads to a higher cost share of non-production workers and a lower ratio of production workers to non-production workers ("capital-skill complementarity"). Among

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28 These results are virtually independent of the outsourcing indicator used in the regressions (e.g., Table 7a versus Table 7b).

the industries where the hypothesis of capital-skill complementarity is refuted are stone and earths products, ceramic goods, iron and steel, and printing.

(4) With respect to the effect of international outsourcing, the picture is ambiguous. In almost two thirds of all industries (i.e., 16 out of 28), the estimated coefficient for the price index of imported intermediate inputs relative to the price index for domestic inputs(column "rp forinp") is statistically insignificant. That is, the cross-price elasticity of labor demand equals the cost share of imported intermediate inputs in these industries, and the implied substitution elasticity between foreign inputs and the respective labor category equals 1 (Cobb-Douglas technology). Since the cost share of intermediate inputs has increased over the whole observation period (see Table 2), the estimated cross-price elasticity is steadily increasing over time.[29] However, the respective coefficient in the cost functions for production workers is statistically significantly negative in 12 industries, including plastic products, stone and earths product, finished metal products and textiles, so that the implied cross-price elasticity is virtually zero, i.e., foreign inputs are only weak substitutes for production workers. In addition, the implied substitution elasticity between non-production workers and foreign inputs is not substantially lower in most industries. Hence, the presumed effect can be corroborated only for a few manufacturing industries, and even there the substitution elasticity is not as large as expected (never exceeding 1 in absolute value).

Surprisingly, the estimated coefficient for the import penetration ratio (column "imp pen rat") is statistically insignificant in even more industries. This is in

29 This is in line with results by Hansen and Lindner (1988) who found that aggregate labor and intermediate inputs are substitutes for the manufacturing sector a whole, and that the cross price elasticity increased substantially after each of the two oil price shocks (1973/74 and 1979/80). However, it is to be noted that they did not disaggregate inputs by origin.

contrast to the results for the factor demand functions, where the import penetration ratio had a statistically significant effect on the skill structure of employment in more industries than the relative price of foreign inputs.

b) Unskilled workers vs. skilled workers (1978 and 1990)

Again, two different indicators for international outsourcing have been used in these regressions, a price-related indicator (the relative price of imported intermediate inputs, as before) and a volume-based indicator. However, the volume-based indicator has been slightly modified to give a more accurate picture of international trade in intermediate inputs. It is calculated as the sectoral ratio of total costs for imported intermediate inputs to total costs for domestic intermediate inputs from the manufacturing sector, based on data from the input-output tables for 1978 and 1990, respectively.[30]

The factor demand equation has been estimated both in levels and in differences. For the first regression, 1978 and 1990 data for all 18 industries covered by the wage structure survey are pooled. A dummy variable for 1990 is used as a proxy for technical progress, which is assumed to be identical across industries. For the second regression, all variables have been transformed to first differences. Hence, the constant in the second regression can be interpreted as a common trend in the development of the employment structure which is similar for all industries. Both specifications are estimated separately within the subaggregates of production workers and of non-production workers, and for aggregate employment. Regression results for the factor demand function are presented in Tables 9a and 9b.

30 This indicator is not available in time series since input-output tables are not compiled for every year. Moreover, data from German input-output tables for the years before 1978 are not comparable to those for 1978 and onwards due to a change in the classification system.

With respect to the estimation in levels, the fit was only moderate (adjusted R^2 at most 30 percent) but this is typical for regressions with cross-section data.

The estimated coefficient for the dummy variable is negative for all but one specification, i.e., technical progress is biased against unskilled labor, and the adjusted R^2 increases significantly after the inclusion of the dummy variable, irrespective of the aggregation level. Moreover, the coefficient for the price-based outsourcing indicator is statistically insignificant in all specifications (upper half of Table 9a, column "x"), while the coefficient for the volume-based indicator shows the wrong sign (lower half of Table 9a, column "x"). Accordingly, a higher share of imported intermediate inputs is estimated as having caused a higher share of production workers. This seems to support the hypothesis that the bias against unskilled labor is due to exogenous technical progress rather than due to international outsourcing. However, this result may simply be due to the estimation across industries (see the disaggregate results in the previous subsection) and to the estimation in differences (see below).

The coefficients for the relative wage of unskilled workers (column "rw unskilled"), i.e., the estimated value of the substitution elasticity between production and non-production workers, is statistically significant (and negative) only for the specification with aggregate skilled and unskilled workers (line "total employment"). This can be interpreted in the sense that substitution between skilled and unskilled labor is not restricted to take place only in the respective subaggregates (i.e., production and non-production workers). Finally, the estimated coefficient for the capital-output ratio (column "cap-out ratio") is statistically insignificant for all specifications, even in the regression in differences (Table 9b). This supports the hypothesis that capital-skill complementarity is not an issue for the employment structure by actual skill categories. With this exception, the results from these cross-section regressions are broadly in line with the results presented in the previous subsection.

However, the estimated coefficients are subject to potentially large distortions due to the estimation in levels across industries with different levels of explanatory variables. A priori, these problems can be avoided by estimation in differences. The results from this approach are presented in Table 9b. At first sight, outsourcing now has a relatively large impact on the skill structure of employment: the coefficients for both the price-based and the volume-based indicator are statistically significant and show the expected sign if technical progress (proxied by the common trend; see column "constant") is excluded from the list of explanatory variables, but they are insignificant if the potential impact of technical progress is not ruled out. This supports the hypothesis that the time trend variable to a large extent absorbs the explanatory power of the outsourcing indicator, that is, the impact of outsourcing is misidentified as technical progress. Moreover, the estimated coefficient for the relative wage is statistically insignificant or shows the wrong sign. Given the fact that relative wage trends were relatively similar across industries whereas the skill structure has changed differently, this is not implausible. However, the fit of this regression is very weak (negative adjusted R^2 in all but one specification). Hence, the results from both the estimation in levels and in differences should not be taken at face value, although the results of an F-test show that the hypothesis of jointly insignificant coefficients can be refuted.

Regression results for the translog cost functions are presented in Tables 10a-d. In general, they lend only little support to the hypotheses stated above.

(1) The fit was relatively good (adjusted R^2 between 40 and 60 percent), except for the cost share equation for unskilled production workers. In contrast to the factor demand functions, the inclusion of a time trend variable had virtually no

effect on the estimated coefficients and did not lead to an improvement of the fit (Table 10b compared to Table 10a). Moreover, the estimated coefficient for the time trend variable is insignificant for almost all specifications, i.e., technical progress is not biased in favor or against skill groups. The cost share of unskilled production workers in the lower half of Table 10b is a notable exception. Accordingly, technical progress is biased against unskilled production workers, if the volume-based indicator for outsourcing is used.

(2) Most of the estimated coefficients for the deflated wage of the four skill groups (columns "rw .....") are statistically insignificant, i.e., the hypothesis of a production technology that is of the Cobb-Douglas type with respect to the four types of labor cannot be refuted. A notable exception is the coefficient for the wage of unskilled production workers in the cost share equation for non-production workers, which is estimated as significantly negative. However, no explanation could be found for this implausible result.

(3) The coefficient for the real value of capital (column "real capital") is statistically insignificant except in the cost share equation for skilled production workers. Paradoxically, these findings suggest that the cost share of skilled production workers is affected negatively by higher investment, relative to the other three skill groups. This is in contrast to the hypothesis of capital-skill complementarity.

(4) Most of the estimated coefficients for the outsourcing indicator (column "x") are statistically insignificant, irrespective whether the price-based indicator or the volume-based indicator are used in the regression. Moreover, the statistically significant coefficients are rather implausible: accordingly, decreasing relative prices for imported inputs lead to a lower cost share of skilled non-production workers, and increasing import dependence for intermediate inputs leads to a higher cost share for unskilled production workers.

In summary, the factor demand function seems to be flexible enough for the analysis of all potential impacts on the skill structure of employment. The regressions based on this approach yield plausible results with respect to traditional explanatory variables (relative wages, capital-output ratio) although the specification remains to some extent ad hoc. By contrast, the results for the translog cost functions were largely disappointing. Moreover, the available data base is not sufficient to estimate a complete system of cost functions (SUR method) which is a serious qualification from the methodological point of view.

The results for the first data set (production vs. non-production workers) supports to some extent the basic hypothesis about the impact of international outsourcing which suggests that imported inputs are a substitute for unskilled workers. On average, technological change (proxied by a time trend) is found to be the most important determinant of the downward trend in the share of production workers in total employment, followed by capital deepening. In general, the estimated impact of import prices for intermediate inputs is only moderate. Only in four industries (ceramic goods, wood working, leather and clothing), more than 20 percent of the actual change of the employment structure can be attributed to changing import prices. By contrast, the estimated impact of import penetration from non-OECD countries is much stronger: increasing import penetration was responsible for more than 20 percent of the change of the employment structure in eight industries, among them road vehicles.

One may argue that the disaggregation in production and non-production workers in Germany is not suited for the analysis of a potential skill bias of technical progress and international outsourcing. A priori, the second data set (cross section for actual skill level groups) provides a more reasonable disaggregation. However, all attempts to gain statistically significant results from the second data set failed. Probably, this failure is mainly due to general methodological problems since the pooled industries are very heterogeneous with respect to the economic variables used in the regression. Hence, the results for the first data set are the only robust and plausible results for the time being.

7. Conclusions

The majority of empirical studies dealing with the "trade and wages" topic has argued that skill-biased technical progress rather than international trade per se is the main factor behind the increasing skill premium in wages. The analytical foundation for these studies is provided by the Stolper-Samuelson effect. Accordingly, only trade in final goods has been considered as relevant whereas the potential impact of international outsourcing has been neglected. In this framework, increasing international outsourcing, i.e., the substitution of imported intermediate inputs for domestic value added, is indistinguishable from unskilled-labor saving technical progress, hitherto treated as exogenous.

Only a few empirical studies have dealt explicitly with the role of international outsourcing for the development of wages and employment in manufacturing industries. International outsourcing was found to have played only a limited role. However, it is unsatisfactory that these studies used volume-based indicators (e.g., sectoral import penetration ratios) to assess the potential role of international outsourcing. Therefore, an alternative method has been introduced in this paper to achieve a measure for the impact of international outsourcing on the skill structure of employment. Sectoral factor demand functions and cost functions are estimated, where the underlying production process uses both primary factors and intermediate inputs. Sector-specific price indices for imported relative to domestic intermediate inputs are used as indicator for international outsourcing whereas the import penetration ratio of imports from non-OECD countries is used as an alternative indicator only to make the results in this paper comparable to those of other papers. Moreover, actual wage data are used in the estimations, in contrast to the Baldwin-Cain approach in which only mandated wage changes are calculated.

The empirical results for German manufacturing industries in the period 1970 to 1993 support the view that outsourcing has an impact on the skill structure of industrial employment, measured as ratio of the number of production workers to that of non-production workers. In some industries, among them the leather and the clothing industry, more than 20 percent of the actual change of the employment structure can be attributed to changing import prices of intermediate inputs. By contrast, the estimated impact of import penetration from non-OECD countries is much stronger: more than 20 percent of the change of the employment structure was attributed to increasing import penetration ratios in eight industries, among them road vehicles and electrical engineering. However, since imported inputs could not be separated from other imports, it remains unclear whether this result can be attributed to international outsourcing or to import competition in final goods markets.

As expected, the explanatory power of technical progress is reduced by the inclusion of an outsourcing indicator, but technical progress proxied by a time trend still explains the largest share of the observed decrease of production workers' share in employment. This seems to support the hypothesis that technical progress is more important than globalization. However, such a conclusion is perhaps too strong, given that technical progress is only proxied by a linear time trend variable in the regressions, thus functioning as catch-all variable for all time trends.

A final remark is in place with respect to the estimated impact of international outsourcing. International outsourcing is only one possible strategy to react to perceived globalization pressures. Some manufacturing industries may have chosen other adjustment strategies which are not reflected in the explanatory variables. For example, increased efforts to develop process innovations within the industry can be assumed to lead to higher employment of skilled workers of that industry whereas wage restraint of low-skilled workers or successful bargaining for import protection probably leads to a slowdown of the changing skill structure of employment.[31] This may provide an explanation for the statistically insignificant impact of outsourcing indicators in most industries.

31 See Wagner and Bellman (1987) for similar conclusions from an empirical analysis of skill structure and import pressure in German manufacturing industries in the period 1976-1983.

Annex: Source and definition of data used

All data are from German Federal Statistical Office (Statistisches Bundesamt).

Capital stock data are taken from the special long-run collection of industrial census results in "Ergebnisse für Wirtschaftsbereiche (Branchenblätter), 1960-1994" (Fachserie 18, Reihe S.19, 1995), where capital stock is defined as the value of machinery and buildings at constant prices of 1991. Note that rented assets (e.g., leased machinery) are not included.

Nominal output data are taken from the same source, where output is defined as the value of gross production; this has been deflated by sectoral producer prices.

Total intermediate input costs and value added components are also taken from this source. However, disaggregated data on intermediate inputs by origin (sector and country) can only be found in the bi-annual input-output tables (Fachserie 18, Reihe 2, various issues). Employment and wage data are taken from two different sources: With regard to salaried employees and wage earners, data are from the annual census "Beschäftigung, Umsatz und Energieversorgung der Unternehmen im Bergbau und im Verarbeitenden Gewerbe" (Fachserie 4, Reihe 4.1, various issues), where employment is total employment (not adjusted for part-time employment) and wages are calculated as average annual labor cost per capita in the respective group. With regard to employment by actual skill requirements, data are from the non-periodical wage structure survey "Gehalts- und Lohnstrukturerhebung" (1990 survey: Fachserie 16, 1994; 1978 survey: Arbeitsunterlage 1982), where employment is defined as full-time employment and wages are defined as average annual compensation of employees (excluding employers' contribution to social insurance) in the respective skill category.

Domestic price data are taken from "Preise und Preisindizes für gewerbliche Produkte (Erzeugerpreise)" (Fachserie 17, Reihe 2, various issues), where prices are defined as producer price indices for domestic sales net of VAT. Import price data are taken from "Preisindizes für die Ein- und Ausfuhr" (Fachserie 17, Reihe 8, various issues) where prices are cif and net of tariffs and VAT. These price data have been used to calculate aggregate domestic and imported input price indices for each industry which are based on disaggregated import prices for manufactures, where the original price data are weighted with the industry specific input share as reported in the 1978 input-output table.

Energy prices are taken from "Preisindex für den Wareneingang des Produzierenden Gewerbes" (Fachserie 17, Reihe 3, various issues), where prices are defined as energy input prices for the whole manufacturing sector net of VAT. Accordingly, the energy price index is a weighted average of prices for electricity, coal, gas and mineral fuels, both from domestic and foreign suppliers.

Trade data are based on bilateral trade data from an OECD database, disaggregated according to SITC at the 5-digit level, which have been converted to data disaggregated according to ISIC at the 4-digit level. All data are US$ values. Thanks are due to Paul Brenton (CEPS, Brussels) who provided this data set to all participants of the TSER project on "Globalisation and Social Exclusion".

Manufacturing industries covered by the German wage structure survey

SYPRO	ISIC (Rev. 2)	Industry	1978	1990
24, 40	351, 352	Chemical industry	(*)	(*)
25	ex2, 369	Stone and earths products	(*)	(*)
27	ex371	Iron and steel	*	*
28	ex372	Non-ferrous metals	)	)
29	ex371/2	Foundries	} (*)	} (*)
30	ex37/38	Cold rolling mills etc.	)	)
31	ex381	Structural metal products	*	*
32	ex382	Mechanical engineering	*	*
33	ex384	Road vehicles	*	(*)
34	384.1	Shipbuilding	*	--
35	384.5	Aircraft, spacecraft	*	--
36	383	Electrical engineering	*	*
37	385	Optical instruments etc.	*	*
38	ex381	Finished metal products	*	(*)
39	39	Toys, jewelry etc.	*	--
50	382.5	Office machinery and computers	*	--
51	361	Ceramic goods	*	--
52	362	Glass and glass products	*	*
53	ex331	Wood working	*	--
54	ex33	Wood products	*	*
55	341.1	Pulp, paper and paperboard	*	--
56	341.2/.9	Paper and paperboard products	*	*
57	342	Printing and duplicating	*	*
58	356	Plastic products	*	*
59	355	Rubber products	(*)	(*)
61, 62	323, 324	Leather and leather goods	*	--
63	321	Textiles	*	*
64	322	Clothing	*	*
68	311-313	Food and beverages	*	}*
69	314	Tobacco	*	)

*: exact coincidence with industrial census; (*): good coincidence, i.e., small subsector missing; --: no information available.

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Table 1 — Cost Share of Imported Intermediate Inputs[a] in Manufacturing Industries of Industrial Countries

	United States		Canada		United Kingdom		Germany		Japan	
	1975	1995	1974	1993	1974	1993	1978	1990	1974	1993
Manufacturing	4.1	8.2	15.9	20.2	13.4	21.7	13.1	15.2	8.2	4.1
Chemicals	3.0	6.3	9.0	15.1	13.1	22.5	12.8	16.7	5.2	2.6
Machinery	4.1	11.0	17.7	26.6	16.1	31.3	7.6	10.3	2.1	1.8
Road vehicles	6.4	15.7	29.1	49.7	14.3	32.2	8.9	14.0	1.8	2.8
Electrical products	4.5	11.6	13.2	30.9	14.9	34.6	8.3	11.8	3.1	2.9
Leather products	5.6	20.5	12.6	21.8	15.0	35.6	16.1	24.2	3.6	2.6
Clothing	1.3	3.2	17.9	21.6	15.7	24.2	18.4	24.6	4.6	4.8

[a]Percent of gross output value; only inputs of manufactures. Except for Germany, imports of intermediate inputs are crude estimates based on total intermediate input coefficients (domestic and imported inputs) and the respective input sectors' import shares in apparent consumption.

Source: Campa/Goldberg (1997); own calculations for Germany.

Table 2 — Manufactured Intermediate Inputs, West German Manufacturing Industries 1978 and 1990

	Share of manuf. inputs in gross output			Share of imports in intermediate inputs			Rel. imp.input price change 1978-1990
	1978	1990	difference	1978	1990	difference	
Chemical products	44.2	44.4	0.2	22.6	25.8	3.2	-1.9
Plastic products	44.1	42.8	-1.3	19.2	30.3	11.1	-14.7
Rubber products	27.9	27.6	-0.3	27.0	31.2	4.2	-10.3
Stone and earths products	30.7	26.8	-3.8	15.8	18.6	2.7	-3.0
Ceramic goods	16.5	16.2	-0.3	29.4	32.9	3.6	2.1
Glass and glass products	29.4	30.5	1.1	19.6	25.6	6.0	-2.5
Iron and steel	69.6	60.1	-9.6	5.7	6.5	0.9	-7.0
Non-ferrous metals	49.8	50.8	0.9	36.2	38.4	2.2	-1.1
Foundries	24.3	25.6	1.3	21.5	20.7	-0.8	-10.4
Cold rolling mills etc.	45.6	39.3	-6.2	20.2	25.3	5.1	-1.5
Structural metal products	41.6	39.7	-1.9	18.5	22.6	4.1	-4.9
Mechanical engineering	42.7	38.1	-4.6	13.3	18.4	5.1	-7.0
Office machinery	34.2	31.3	-2.9	26.2	41.6	15.4	28.4
Road vehicles	45.8	50.0	4.2	16.2	22.6	6.4	-10.5

(continued)

(Table 2 continued)

	Share of manuf. inputs in gross output			Share of imports in intermediate inputs			Rel. imp.input price
	1978	1990	difference	1978	1990	difference	change 1978-1990
Electrical engineering	33.7	34.3	0.6	21.0	25.0	4.0	-9.8
Optical instruments etc.	25.9	27.6	1.8	23.3	28.5	5.1	-17.8
Finished metal products	38.0	36.7	-1.4	20.4	28.3	7.9	-7.7
Toys, jewellery etc.	32.6	31.7	-0.9	38.3	44.0	5.7	-3.0
Wood working	26.6	27.5	1.0	20.5	35.2	14.7	7.9
Wood products	38.0	37.6	-0.4	17.1	21.5	4.5	-18.1
Pulp and paper	39.2	42.0	2.8	43.1	58.0	14.9	6.7
Paper products	51.7	51.5	-0.2	18.7	28.0	9.3	-19.5
Printing	32.7	32.9	0.2	24.0	30.9	6.9	-13.8
Leather, leather products	34.9	40.4	5.5	34.0	47.9	13.8	1.0
Textiles	43.0	42.3	-0.7	30.5	32.0	1.5	-8.6
Clothing	43.9	46.0	2.1	26.4	25.6	-0.8	-14.3
Food and beverages	29.8	29.7	-0.1	13.1	19.4	6.2	-8.7
Tobacco products	4.8	7.9	3.1	21.5	20.2	-1.3	1.1
Total manufacturing	40.6	39.7	-0.9	17.6	23.8	6.2	n.a.

Source: Statistisches Bundesamt (Input output tables for 1978 and 1990; Price Statistics); own calculations.

Table 3 — Production and Non-production Workers in West German Manufacturing Industries 1970-1993

	Employment share of production workers			Labor cost share of production workers			Rel.wage prod. w.
	1970	1993	difference	1970	1993	difference	change 1970-1993
Chemical products	61.3	53.1	-8.2	51.7	36.3	-15.4	-25.4
Plastic products	77.8	72.8	-5.1	69.4	61.7	-7.7	-6.9
Rubber products	78.6	72.1	-6.5	72.0	60.4	-11.5	-15.5
Stone and earths products	79.7	71.3	-8.4	77.1	63.8	-13.3	-17.1
Ceramic goods	81.0	78.0	-3.0	74.2	67.1	-7.1	-14.8
Glass and glass products	83.2	75.4	-7.8	78.3	66.1	-12.2	-13.0
Iron and steel	79.1	73.1	-6.0	74.7	63.7	-11.0	-17.0
Non-ferrous metals	76.1	69.7	-6.4	70.5	60.4	-10.1	-11.8
Foundries	82.3	77.6	-4.6	79.1	68.6	-10.5	-22.9
Cold rolling mills etc.	80.5	75.0	-5.5	76.9	64.6	-12.2	-24.1
Structural metal products	74.5	70.0	-4.5	70.7	61.2	-9.5	-17.9
Mechanical engineering	69.2	59.9	-9.3	63.2	48.7	-14.5	-16.8
Office machinery	63.8	27.3	-36.5	47.1	18.9	-28.2	22.8
Road vehicles	81.0	73.9	-7.1	75.3	63.6	-11.6	-13.3

(continued)

(Table 3 continued)

	Employment share of production workers			Labor cost share of production workers			Rel.wage prod. w.
	1970	1993	difference	1970	1993	difference	change 1970-1993
Electrical engineering	70.7	57.0	-13.6	59.4	42.0	-17.4	-10.2
Optical instruments etc.	74.0	62.1	-11.8	64.3	48.3	-16.0	-10.1
Finished metal products	78.5	71.5	-7.0	72.2	60.6	-11.6	-13.8
Toys, jewellery etc.	78.3	69.1	-9.2	71.2	57.6	-13.5	-10.9
Wood working	80.0	78.0	-2.0	78.4	71.1	-7.4	-24.0
Wood products	80.3	76.1	-4.2	76.8	68.7	-8.1	-15.1
Pulp and paper	61.3	53.1	-8.2	75.7	65.5	-10.2	3.1
Paper products	78.8	72.7	-6.1	70.7	62.3	-8.4	-4.4
Printing	78.6	67.8	-10.8	74.3	60.3	-14.0	-8.2
Leather, leather products	84.6	70.0	-14.6	77.7	57.5	-20.1	-8.2
Textiles	80.4	71.0	-9.4	72.5	59.8	-12.8	-5.6
Clothing	84.2	73.2	-10.9	75.7	58.1	-17.6	-13.6
Food and beverages	69.8	65.5	-4.3	61.3	57.5	-3.9	3.7
Tobacco products	77.4	64.3	-13.1	63.1	47.1	-16.0	-0.7
Total manufacturing	75.0	66.4	-8.6	67.5	55.1	-12.4	-10.5

The terms production and non-production workers, respectively, refer to wage earners and employees, i.e., the type of work contract.

Source: Statistisches Bundesamt (Industrial Census); own calculations.

Table 4 — Low-skilled Production Workers in West German Manufacturing Industries 1978 and 1990

	Employment share of unskilled workers[a]			Labor cost share of unskilled workers[a]			Relative wage[b]
	1978	1990	difference	1978	1990	difference	change 1978-1990
Chemical products	10.3	12.6	2.3	7.7	9.5	1.8	0.3
Plastic products	29.3	26.8	-2.5	24.5	23.3	-1.2	4.9
Rubber products	20.1	27.1	6.9	16.8	24.2	7.4	5.7
Stone and Earths products	12.2	7.9	-4.3	10.7	7.0	-3.7	0.9
Glass and glass products	21.8	20.0	-1.7	17.4	16.8	-0.6	5.1
Iron and steel	13.3	8.1	-5.2	11.9	7.5	-4.5	2.9
Structural metal products	6.4	4.0	-2.4	5.0	3.1	-1.9	0.4
Mechanical engineering	11.3	8.7	-2.5	9.3	7.0	-2.3	-2.5
Road vehicles	10.4	4.2	-6.2	9.5	3.7	-5.8	-2.9
Electrical engineering	32.5	25.8	-6.7	28.1	22.1	-6.0	0.3
Optical instruments etc.	28.5	19.6	-8.9	23.2	16.2	-7.0	3.5
Finished metal products	29.5	23.5	-6.0	24.5	20.0	-4.5	3.6
Wood products	21.8	14.8	-7.0	18.1	12.6	-5.4	4.2
Paper products	19.9	14.4	-5.5	16.6	11.3	-5.3	-4.6
Printing	7.4	10.5	3.1	5.3	8.2	3.0	6.5
Textiles	25.6	23.1	-2.5	23.0	21.0	-1.9	2.2
Clothing	15.8	11.8	-4.0	14.5	10.9	-3.6	1.4
Food and beverages	34.6	20.8	-13.8	27.0	16.6	-10.4	5.9

[a]Shares in the respective value for all production workers. — [b]Wage of lowest skill group relative to average wage of other skill groups.

Source: Statistisches Bundesamt (Wage structure surveys for 1978 and 1990; Industrial Census); own calculations.

Table 5 — Low-skilled Non-production Workers in West German Manufacturing Industries 1978 and 1990

	Employment share of unskilled workers [a]			Labor cost share of unskilled workers [a]			Relative wage [b]
	1978	1990	difference	1978	1990	difference	change 1978-1990
Chemical products	19.2	16.5	-2.8	12.4	10.0	-2.4	-3.1
Plastic products	22.4	15.5	-6.8	14.2	10.2	-4.0	4.5
Rubber products	18.0	15.4	-2.6	12.2	10.0	-2.3	-2.7
Stone and Earths products	21.6	14.4	-7.3	14.0	8.9	-5.1	-0.6
Glass and glass products	23.3	15.4	-7.9	15.5	9.3	-6.2	-3.6
Iron and steel	12.9	6.6	-6.3	7.4	3.7	-3.7	0.2
Structural metal products	16.6	13.9	-2.7	9.9	8.5	-1.4	2.2
Mechanical engineering	19.4	15.0	-4.5	12.2	9.4	-2.8	1.3
Road vehicles	14.2	5.3	-8.8	9.4	3.1	-6.3	-6.3
Electrical engineering	17.7	12.2	-5.5	10.9	7.1	-3.8	-1.9
Optical instruments etc.	27.1	18.7	-8.3	18.4	11.9	-6.5	-2.0
Finished metal products	23.1	18.5	-4.6	15.2	12.0	-3.2	0.7
Wood products	24.1	13.0	-11.1	15.6	8.7	-6.9	6.0
Paper products	22.2	16.4	-5.8	14.7	10.3	-4.4	-2.0
Printing	26.2	13.1	-13.1	18.2	8.0	-10.1	-4.6
Textiles	25.8	27.0	1.2	17.3	18.6	1.4	1.8
Clothing	29.1	22.2	-6.8	19.8	15.3	-4.6	2.6
Food and beverages	30.0	31.9	1.9	19.5	19.9	0.5	-3.2

Notes: See Table 4, except that shares are now the shares in the respective value for all nonproduction workers.

Source: Statistisches Bundesamt (Wage structure surveys for 1978 and 1990; Industrial Census); own calculations.

Table 6a — Factor Demand Equations for West German Manufacturing Industries 1970-1993 (Indicator: relative price of foreign inputs)

	rw prodw (b_1)	rp forinp (b_2)	cap-out ratio (g)	adj. R^2	rw prodw (b_1)	rp forinp (b_2)	cap-out ratio (g)	time trend	adj. R^2
Chemical products	-0.633*	0.335	1.116*	0.69	-0.931*	-0.129	-0.197*	-0.027*	0.98
Plastic products	0.517*	-0.217	-0.712*	0.65	-1.365*	-0.306*	-0.518*	-0.010*	0.88
Rubber products	0.488*	0.173	-0.538*	0.62	-0.758*	-0.074	-0.392*	-0.014*	0.95
Stone and earths products	1.862*	0.127	-0.042	0.76	-1.059*	-0.418*	-0.665*	-0.028*	0.94
Ceramic goods	-0.507*	1.589*	-0.707*	0.65	-0.736*	1.409*	-0.405*	-0.005*	0.75
Glass and glass products	0.977*	0.553	-0.736*	0.69	-0.913*	-0.473*	-0.558*	-0.021*	0.98
Iron and steel	1.116*	0.188	0.249*	0.74	-0.426*	0.246*	-0.140*	-0.017*	0.95
Non-ferrous metals	0.487	-0.473*	0.489*	0.49	-0.564*	-0.235*	0.230*	-0.011*	0.79
Foundries	-0.645*	0.046	-0.636*	0.62	-0.965*	0.066	-0.571*	-0.004*	0.67
Cold rolling mills etc.	0.939*	-0.178	-0.447*	0.48	-0.681*	0.206	-0.757*	-0.018*	0.76
Structural metal products	-0.278	0.556*	-0.129	0.32	-1.638*	0.072	-0.171*	-0.019*	0.53
Mechanical engineering	0.784*	0.274*	-0.229*	0.94	0.710	0.252	-0.236*	-0.001	0.94
Office machinery	-1.106	1.635*	0.647*	0.86	-0.329	-0.092	0.281*	-0.072*	0.97
Road vehicles	0.119	1.401*	-0.138	0.73	-0.376	-0.480	-0.081	-0.018*	0.86
Electrical engineering	2.962*	0.121	-1.037*	0.89	-0.164	-0.372*	-0.808*	-0.021*	0.95

(continued)

(Table 6a continued)

	rw prodw (b_1)	rp forinp (b_2)	cap-out ratio (g)	adj. R^2	rw prodw (b_1)	rp forinp (b_2)	cap-out ratio (g)	time trend	adj. R^2
Optical instruments etc.	1.556*	0.600	-0.177	0.73	-0.123	0.074	0.134	-0.021*	0.93
Finished metal products	0.477*	0.307*	-0.585*	0.92	-0.677*	0.087	-0.560*	-0.010*	0.97
Toys, jewellery etc.	-0.085	0.350*	-0.473*	0.90	-0.583*	0.026	-0.233*	-0.012*	0.92
Wood working	-0.021	-0.616*	-0.196*	0.39	-0.026	-0.537*	-0.216*	-0.004*	0.52
Wood products	0.874*	-0.366*	-0.003	0.51	-0.510	-0.579*	0.003	-0.013*	0.76
Pulp and paper	-0.532	-0.131	0.505*	0.18	-0.917*	-0.320*	-0.183*	-0.018*	0.94
Paper products	-0.509*	0.115	-0.521*	0.94	-0.622*	0.001	-0.455*	-0.003	0.95
Printing	0.134	-0.008	-1.238*	0.91	-0.736*	-0.320*	-0.568*	-0.019*	0.95
Leather, leather products	-0.892*	1.891*	-0.734*	0.91	-0.930*	1.435*	-0.137	-0.019	0.91
Textiles	2.050*	1.173*	-0.739*	0.78	-0.881*	0.230*	-0.471*	-0.018*	0.98
Clothing	0.256	1.828*	-0.788*	0.95	-0.346	1.498*	-0.540*	-0.01	0.95
Food and beverages	-1.316*	-0.275*	-1.041*	0.65	-1.088*	-0.352*	-0.563*	-0.005*	0.82
Tobacco products	-0.968*	-0.073	-1.306*	0.93	-1.020*	-0.212*	-0.692*	-0.024*	0.95

Dependent variable: logarithm of the ratio of production to non-production workers. All explanatory variables are in logarithms, except for the time trend. — Coefficients significant at the 10 percent level are marked by *.

Source: Statistisches Bundesamt (Industrial Census; "Branchenblätter"; Price Statistics); own calculations.

Table 6b - Factor Demand Equations for West German Manufacturing Industries 1970-1993 (Indicator: import penetration ratio)

	rw prodw (b_1)	imp pen rat (b'_2)	cap-out ratio (g)	adj. R^2	rw prodw (b_1)	imp pen rat (b'_2)	cap-out ratio (g)	time trend	adj. R^2
Chemical products	-0.746*	-0.425*	0.377*	0.85	-0.935*	-0.123*	-0.231*	-0.023*	0.99
Plastic products	-0.948*	-0.089*	-0.572*	0.78	-1.604*	0.076	-0.580*	-0.016*	0.86
Rubber products	-0.712*	-0.161*	-0.225*	0.92	-0.768*	0.002	-0.417*	-0.014*	0.95
Stone and earths products	0.816*	-0.127*	-0.275	0.85	-0.916*	-0.034	-0.797*	-0.024*	0.94
Ceramic goods	-0.327	0.061*	-0.897*	0.51	-0.633*	0.141*	-0.473*	-0.020*	0.77
Glass and glass products	0.573*	-0.226*	-0.430*	0.93	-1.007*	0.050	-0.613*	-0.024*	0.97
Iron and steel	-0.038	-0.141*	0.136*	0.88	-0.561*	0.061	-0.182*	-0.022*	0.93
Non-ferrous metals	0.995*	-0.054	0.188	0.35	-0.475	-0.073	0.048	-0.012*	0.77
Foundries	-0.644*	-0.028*	-0.577*	0.69	-0.794*	-0.051	-0.564*	-0.002	0.69
Cold rolling mills etc.	0.353	-0.141*	-0.520*	0.76	-0.587*	-0.084*	-0.619*	-0.009*	0.79
Structural metal products	-0.259	-0.061*	-0.211*	0.42	-1.437*	-0.022	-0.208*	-0.016*	0.56
Mechanical engineering	0.858*	-0.005	-0.318*	0.93	0.319	0.058	-0.363*	-0.008*	0.94
Office machinery	-0.870	-0.266*	0.267	0.85	-0.337	-0.012	-0.266*	-0.069*	0.97
Road vehicles	-0.328	-0.169*	-0.221*	0.86	-0.476	-0.082*	-0.126	-0.009*	0.88
Electrical engineering	0.671*	-0.131*	-0.652*	0.99	0.647*	-0.130*	-0.651*	-0.000	0.99

(continued)

(Table 6b continued)

	rw prodw (b_1)	imp pen rat (b'_2)	cap-out ratio (g)	adj. R^2	rw prodw (b_1)	imp pen rat (b'_2)	cap-out ratio (g)	time trend	adj. R^2
Optical instruments etc.	0.690*	-0.157*	-0.240*	0.96	0.330	-0.113*	-0.106	-0.008*	0.97
Finished metal products	-0.374*	-0.103*	-0.316*	0.97	-0.664*	-0.056*	-0.421*	-0.006*	0.97
Toys, jewellery etc.	-0.378	-0.182*	-0.291*	0.90	-0.604*	-0.033	-0.219*	-0.011*	0.92
Wood working	-0.035	-0.205	-0.133	0.34	-0.035	-0.209	-0.132*	0.000	0.30
Wood products	-0.388	-0.117*	-0.006	0.70	-0.266	-0.150*	0.005	0.004	0.69
Pulp and paper	-0.723*	-0.227*	-0.093	0.71	-0.754*	-0.056*	-0.182*	-0.015*	0.93
Paper products	-0.437	-0.000	-0.516*	0.94	-0.763*	0.010	-0.459*	-0.003*	0.95
Printing	-0.085	-0.062	-1.041*	0.91	-0.802*	-0.144*	-0.830*	-0.025*	0.96
Leather, leather products	-0.845	-0.272	-0.141	0.71	-1.016*	0.285*	0.255	-0.068	0.87
Textiles	0.264	-0.282*	0.050	0.85	-1.032*	0.034	-0.463*	-0.022*	0.97
Clothing	1.367*	-0.151	0.114	0.80	-1.784*	0.217*	-0.436	-0.045*	0.91
Food and beverages	-1.084*	-0.187*	-0.982*	0.81	-0.940*	-0.171*	-0.634*	-0.003*	0.87
Tobacco products	-0.943*	-0.060*	-1.161*	0.94	-0.987*	-0.058*	-0.955*	-0.006	0.94

Dependent variable: logarithm of the ratio of production to non-production workers. All explanatory variables are in logarithms, exept for the time trend. — Coefficients significant at the 10 percent level are marked by *.

Source: Statistisches Bundesamt (Industrial Census; "Branchenblätter"; Price Statistics); own calculations.

Table 6c — Contribution of Explanatory Variables to Actual Change of Employment Structure 1970-1993

	Actual change of endogenous var.	rw prodw	rp forinp	cap-out ratio	time trend	rw prodw	imp pen ratio	cap-out ratio	time trend
Chemical products	-0.34	-81*	-4	-16*	185*	-82*	31*	19*	158*
Plastic products	-0.27	-36*	-14*	43*	84*	-42*	-58	48*	135*
Rubber products	-0.35	-36*	-2	42*	92*	-37*	-1	45*	92*
Stone and earths products	-0.46	-43*	-12*	0*	140*	-38*	15	0*	120*
Ceramic goods	-0.18	-65*	83*	106*	63*	-56*	-264*	124*	252*
Glass and glass products	-0.18	-2*	-13*	36*	101*	-29*	-20	40*	116*
Iron and steel	-0.48	-24*	4*	-6*	118*	-32*	-31	-7*	153*
Non-ferrous metals	-0.33	-22*	-3*	18*	78*	-18	-7	4	85*
Foundries	-0.29	-87*	4	131*	32*	-71*	19	129*	16
Cold rolling mills etc.	-0.32	-58*	9	-6*	129*	-50*	70*	-5*	64*
Structural metal products	-0.23	-144*	10	17*	194*	-126*	30	21*	163*
Mechanical engineering	-0.41	32	19	36*	6	14	-25	55*	45*
Office machinery	-1.55	4	-2	17*	107*	5	3	-16*	103*
Road vehicles	-0.41	-13	-26	12	101*	-17	39*	18	50*
Electrical engineering	-0.60	-3	-16*	32*	81*	12*	63*	25*	0

(continued)

(Table 6c continued)

	Actual change of endogenous var.	rw prodw	rp forinp	cap-out ratio	time trend	rw prodw	imp pen ratio	cap-out ratio	time trend
Optical instruments etc.	-0.55	-2	3	-10	88*	6	51*	8	34*
Finished metal products	-0.38	-27*	4	55*	61*	-26*	39*	42*	37*
Toys, jewellery etc.	-0.48	-14*	1	39*	57*	-15*	7	36*	53*
Wood working	-0.12	-6	83*	-55*	78*	-8	110	-34*	0
Wood products	-0.25	-34	-14*	-1	121*	-18	143*	-1	-37
Pulp and paper	-0.53	5*	-3*	2*	79*	4*	14*	2*	66*
Paper products	-0.33	-9*	0	86*	21	-10*	-8	86*	21*
Printing	-0.56	-11*	-11*	54*	79*	-12*	56*	78*	103*
Leather, leather products	-0.86	-9*	30*	-11	51	-10*	-82*	-20	182
Textiles	-0.52	-10*	6*	16*	80*	-11*	-10	16*	98*
Clothing	-0.67	-8	28*	35*	35	-39*	-67*	28	156*
Food and beverages	-0.20	20*	-24*	42*	59*	17*	-13*	48*	35*
Tobacco products	-0.64	-1*	-13*	61*	86*	-1*	10*	84*	21

First column: log(wage earners/salaried employees), change 1970-93; other columns: estimated coefficients from Tables 6a and 6b multiplied with actual change 1970-93 of the respective variable, in percent of the first column. — Results from significant coefficients are marked (*).

Source: Tables 6a, Tables 6b, own calculations.

Table 7a — Translog Cost Functions for Production Workers, West German Manufacturing Industries 1970-1993

	rw prod (b_{p1})	rw nonprod (b_{p2})	rp forinp (b_{p4})	rp energy (b_{p5})	real capital (g_p)	real output (d_p)	time trend (l_p)	adj. R^2
Chemical products	0.051*	0.022*	-0.023	-0.036*	-0.020	-0.068*	-0.001*	0.99
Plastic products	-0.024	0.076	-0.177*	-0.021*	0.032	-0.029*	-0.004*	0.94
Rubber products	0.024	0.024	-0.057*	-0.031*	0.049*	0.033	-0.006*	0.97
Stone and earths products	0.042	0.022	-0.156*	0.012	0.110*	-0.028	-0.004*	0.99
Ceramic goods	0.015	-0.027	0.033	-0.068*	0.311*	-0.036	-0.008*	0.98
Glass and glass products	0.051	-0.029	-0.098	-0.076*	0.128*	-0.015	-0.007*	0.98
Iron and steel	0.031	0.088	0.006	-0.017	0.050*	-0.076*	-0.004*	0.83
Non-ferrous metals	0.086*	-0.005	-0.033	0.008	-0.035	-0.071*	-0.001	0.85
Foundries	0.169*	0.012	0.021	-0.073*	-0.025	-0.056*	-0.006*	0.87
Cold rolling mills etc.	-0.128	-0.035	-0.067	0.067	-0.171	0.159	0.000	0.20
Structural metal products	0.173*	-0.122*	0.050	-0.010	0.013	-0.079*	-0.001	0.94
Mechanical engineering	0.210*	-0.132	0.031	-0.024	0.036	-0.058*	-0.002	0.89
Office machinery	0.014	0.055	0.007	-0.015	-0.071	-0.015	-0.003	0.99
Road vehicles	0.080	-0.028	-0.064	0.022*	-0.011	-0.023	-0.002	0.92
Electrical engineering	0.052	0.045	0.030	-0.013	-0.145*	0.105*	-0.003*	0.98

(continued)

(Table 7a continued)

	rw prod (b_{p1})	rw nonprod (b_{p2})	rp forinp (b_{p4})	rp energy (b_{p5})	real capital (g_p)	real output (d_p)	time trend (l_p)	adj. R^2
Optical instruments etc.	0.125	-0.035	-0.000	0.003	-0.320*	-0.015	0.006	0.95
Finished metal products	-0.171*	0.111	-0.075*	-0.035*	0.176*	0.005	-0.006*	0.96
Toys, jewellery etc.	-0.028	0.006	-0.089*	0.055*	-0.026	0.030	-0.000	0.77
Wood working	0.058*	-0.012	-0.070*	0.039*	0.004	-0.006	-0.001*	0.97
Wood products	0.037	-0.039	-0.050*	0.021	0.016	0.014	-0.001	0.71
Pulp and paper	0.054*	0.031	-0.132*	-0.038*	0.015	-0.076*	-0.003*	0.95
Paper products	0.111*	-0.010	-0.023	-0.022*	-0.030	-0.040*	-0.003*	0.97
Printing	-0.112*	0.116*	-0.172*	-0.059*	0.192*	-0.053	-0.011*	0.99
Leather, leather products	-0.113*	0.007	-0.083	0.039*	0.021	-0.009	-0.003	0.96
Textiles	0.004	0.130*	-0.066*	-0.009	-0.060	-0.026*	-0.007*	0.98
Clothing	-0.010	0.014*	0.058	-0.032*	0.160	-0.033	-0.003*	0.99
Food and beverages	0.056*	-0.024	-0.016*	-0.014*	0.009	0.008	-0.001	0.78
Tobacco products	0.004	0.022	-0.044*	0.053*	-0.055	-0.037*	-0.003*	0.96

Dependent variable: share of production workers' wage bill in total wage bill plus intermediate input costs; all price variables (rw, rp) are deflated by the price index for domestic intermediate inputs. All explanatory variables are in logarithms, except for the time trend. — Coefficients significant at the 10 percent level are marked by *.

Source: See Table 6.

Table 7b — Translog Cost Functions for Production Workers, West German Manufacturing Industries 1970-1993

	rw prod (b_{p1})	rw nonprod (b_{p2})	imp pen. rat (b'_{p4})	rp energy (b_{p5})	real capital (g_p)	real output (d_p)	time trend (l_p)	adj. R^2
Chemical products	0.055*	0.026*	-0.002	-0.035*	-0.024	-0.072*	-0.001*	0.99
Plastic products	-0.021	0.129	0.006	-0.066*	0.039	-0.041	-0.005*	0.86
Rubber products	0.025	0.047	-0.023*	-0.047*	0.053*	-0.007	-0.003*	0.98
Stone and earths products	-0.054	0.044	0.004	-0.046*	-0.040	-0.018	-0.004*	0.98
Ceramic goods	0.161*	-0.002	-0.010	-0.029	0.119	-0.073*	-0.007*	0.97
Glass and glass products	0.017	-0.010	0.016*	-0.098*	0.155*	-0.018	-0.009*	0.98
Iron and steel	0.015	0.103*	0.007	-0.020	0.044*	-0.067*	-0.005*	0.83
Non-ferrous metals	0.114*	-0.012	0.008	-0.015	-0.037	-0.059*	-0.002*	0.86
Foundries	0.147*	0.109*	0.002	-0.060*	-0.087	-0.060*	-0.006*	0.88
Cold rolling mills etc.	-0.084	-0.025	-0.112*	0.089*	0.466	0.153	0.004	0.39
Structural metal products	0.082	-0.021	0.005*	0.010	-0.009	-0.078*	-0.002	0.95
Mechanical engineering	0.141	-0.015	0.014*	-0.030*	-0.020	-0.043*	-0.003*	0.91
Office machinery	0.009	0.058	-0.003	-0.019	-0.072*	-0.016	-0.004*	0.99
Road vehicles	0.168*	-0.019	-0.013	0.009	-0.057	-0.040*	0.001	0.93
Electrical engineering	0.142*	-0.023	-0.017	-0.009	-0.080	0.059*	-0.004*	0.98

(continued)

(Table 7b continued)

	rw prod (b_{p1})	rw nonprod (b_{p2})	imp pen. rat (b'_{p4})	rp energy (b_{p5})	real capital (g_p)	real output (d_p)	time trend (l_p)	adj. R^2
Optical instruments etc.	0.327*	-0.059	-0.017	-0.023*	-0.122	-0.084*	0.001	0.95
Finished metal products	-0.096	0.052	-0.034*	-0.036*	0.255*	-0.017	-0.005*	0.96
Toys, jewellery etc.	0.049	0.031	0.016	0.033	-0.041	-0.000	-0.001	0.71
Wood working	0.060*	-0.005	-0.012	-0.008	0.011	-0.020	-0.001	0.95
Wood products	-0.004	0.004	0.023*	0.009	0.024	0.013	-0.002*	0.70
Pulp and paper	0.095*	0.021	-0.018	-0.013	0.002	-0.039	-0.004*	0.95
Paper products	0.083	0.032	-0.001	-0.033*	-0.024	-0.031*	-0.005*	0.96
Printing	-0.027	0.183*	0.005	-0.084	0.157	-0.017	-0.014*	0.96
Leather, leather products	-0.127*	-0.002	-0.026	0.029*	0.073	-0.001	0.001	0.96
Textiles	0.005	0.137*	-0.018*	-0.027*	-0.007	-0.042*	-0.006*	0.98
Clothing	-0.050	0.024	0.005	-0.025*	0.186*	-0.029	-0.003*	0.99
Food and beverages	0.016	-0.021	-0.010*	-0.014*	0.025	0.006	0.000	0.76
Tobacco products	0.002	0.008	-0.006	0.025*	-0.102*	-0.050*	-0.003	0.95

Dependent variable: share of production workers' wage bill in total wage bill plus intermediate input costs; all price variables (rw, rp) are deflated by the price index for domestic intermediate inputs. All explanatory variables are in logarithms, except for the time trend. — Coefficients significant at the 10 percent level are marked by *.

Source: See Table 6.

Table 8a — Translog Cost Functions for Non-production Workers, West German Manufacturing Industries 1970-1993

	rw prod (b_{np1})	rw nonprod (b_{np2})	rp forinp (b_{np4})	rp energy (b_{np5})	real capital (g_{np})	real output (d_{np})	time trend (l_{np})	adj. R^2
Chemical products	0.052*	0.049*	-0.037	-0.045*	0.062*	-0.108*	0.001*	0.99
Plastic products	0.009	0.025	-0.008*	-0.008	0.076*	-0.062*	-0.002*	0.90
Rubber products	-0.004	0.026	-0.035	-0.013	0.045*	-0.034*	-0.001*	0.70
Stone and earths products	0.057*	-0.010	0.026	-0.025*	0.058*	-0.057*	0.000	0.96
Ceramic goods	-0.115*	-0.004	-0.244*	-0.007	0.201*	-0.075*	-0.001*	0.85
Glass and glass products	0.002	-0.006	-0.037	-0.021*	0.100*	-0.042*	-0.001*	0.90
Iron and steel	-0.021	0.084*	0.000	-0.012*	0.031*	-0.047*	-0.001*	0.98
Non-ferrous metals	0.042	0.009	-0.027*	0.015	-0.025	-0.051*	0.000	0.90
Foundries	0.097	-0.013	0.001	-0.027*	0.011	-0.082*	-0.002*	0.78
Cold rolling mills etc.	-0.048	-0.018	-0.030	0.031	0.040	0.030	0.001	-0.30
Structural metal products	0.093	-0.088*	-0.008	-0.034*	0.139*	-0.074*	-0.001	0.80
Mechanical engineering	0.037	-0.010	-0.028	-0.007	0.132*	-0.096*	-0.001*	0.98
Office machinery	-0.066	0.176	-0.032	0.012	-0.005	-0.038	-0.003	0.60
Road vehicles	0.047	-0.009	-0.013	-0.023*	-0.002	-0.038*	0.001	0.83
Electrical engineering	-0.058	0.160*	0.073	-0.001	0.073	-0.035	-0.004*	0.94

(continued)

(Table 8a continued)

	rw prod (b_{np1})	rw nonprod (b_{np2})	rp forinp (b_{np4})	rp energy (b_{np5})	real capital (g_{np})	real output (d_{np})	time trend (l_{np})	adj. R^2
Optical instruments etc.	-0.035	0.111*	0.012	0.013	0.043	-0.037	-0.003	0.68
Finished metal products	-0.127*	0.112*	-0.044*	-0.020*	0.015*	-0.050*	-0.003*	0.85
Toys, jewellery etc.	0.003	0.022	-0.042	0.040*	-0.045	-0.001	0.002	0.92
Wood working	-0.004*	0.017*	-0.016*	0.023*	0.007	-0.008	-0.000	0.92
Wood products	0.005	0.014	-0.001	0.002	0.031*	-0.013*	-0.000	0.93
Pulp and paper	0.040*	0.019*	-0.035*	-0.012*	0.011	-0.060*	0.000	0.93
Paper products	0.044*	0.012	-0.016	-0.002	-0.001	-0.054*	-0.000	0.94
Printing	-0.105*	0.042	-0.120*	0.012	0.063	-0.062*	0.001	0.85
Leather, leather products	0.044*	0.013	-0.067*	0.016*	-0.144*	-0.092*	-0.004*	0.89
Textiles	0.027	0.061*	-0.078*	0.004	-0.018	-0.057*	-0.003*	0.91
Clothing	-0.035	0.053*	-0.101*	0.003	0.061*	-0.033*	-0.001*	0.77
Food and beverages	0.036*	-0.011	-0.008*	-0.008*	0.028*	-0.014*	-0.000	0.93
Tobacco products	-0.012	0.022	-0.018	0.023	0.107*	-0.076*	-0.003*	0.82

Dependent variable: share of production workers' wage bill in total wage bill plus intermediate input costs; all price variables (rw, rp) are deflated by the price index for domestic intermediate inputs. All explanatory variables are in logarithms, except for the time trend. — Coefficients significant at the 10 percent level are marked by *.

Source: See Table 6.

Table 8b — Translog Cost Functions for Non-production Workers, West German Manufacturing Industries 1970-1993

	rw prod (b_{np1})	rw nonprod (b_{np2})	imp pen rat (b'_{np4})	rp energy (b_{np5})	real capital (g_{np})	real output (d_{np})	time trend (l_{np})	adj. R^2
Chemical products	0.061*	0.054*	0.003	-0.049*	0.060*	-0.121*	0.001*	0.99
Plastic products	0.017	0.047	-0.001	-0.032*	0.083*	-0.070*	-0.002*	0.76
Rubber products	0.004	0.041*	-0.014	-0.022*	0.042*	-0.062*	0.000	0.61
Stone and earths products	0.052*	-0.006	0.002*	-0.017*	0.045*	-0.058*	0.000	0.97
Ceramic goods	-0.029	0.025	0.001	-0.047*	0.025	-0.072*	-0.002*	0.75
Glass and glass products	-0.006	-0.001	-0.002	-0.028*	0.113*	-0.049*	-0.001	0.89
Iron and steel	-0.022	0.083*	0.000	-0.013*	0.032*	-0.047*	-0.001*	0.98
Non-ferrous metals	0.072*	-0.001	0.014*	-0.004	-0.027*	-0.037*	-0.001*	0.94
Foundries	0.008	0.074*	0.008*	-0.020*	0.062	-0.064*	-0.002*	0.80
Cold rolling mills etc.	-0.020	-0.014	-0.049*	0.040*	0.280*	0.025	0.002*	-0.01
Structural metal products	0.073*	-0.041	0.003*	-0.029*	0.122*	-0.078*	-0.001	0.84
Mechanical engineering	0.005	0.051	0.006*	-0.017*	0.145*	-0.094*	-0.002*	0.99
Office machinery	-0.080	0.261*	0.008	0.024	-0.081	-0.038	-0.009	0.68
Road vehicles	0.090*	-0.010	-0.007*	0.016*	-0.032	-0.046*	0.003*	0.85
Electrical engineering	-0.016	0.141*	-0.006	-0.004	0.067	-0.085*	-0.002*	0.95

(continued)

(Table 8b continued)

	rw prod (b_{np1})	rw nonprod (b_{np2})	imp pen rat (b'_{np4})	rp energy (b_{np5})	real capital (g_{np})	real output (d_{np})	time trend (l_{np})	adj. R^2
Optical instruments etc.	0.052	0.119*	0.001	-0.007	0.042	-0.078*	-0.003	0.72
Finished metal products	-0.117*	0.086*	-0.011*	-0.027*	0.020*	-0.055*	-0.002*	0.84
Toys, jewellery etc.	0.013	0.073*	0.013	0.026*	-0.007	-0.036*	0.000	0.91
Wood working	-0.004*	0.018*	0.001	0.016*	0.002	-0.002	-0.000	0.90
Wood products	-0.034*	-0.012*	0.016*	-0.015*	0.078*	-0.018*	-0.001*	0.97
Pulp and paper	0.042*	0.017*	-0.005	-0.009	0.005	-0.053*	0.000	0.91
Paper products	0.032	0.032	-0.002	-0.012*	0.054*	-0.049*	-0.002*	0.89
Printing	-0.033	0.099	-0.008	-0.005	0.065	-0.039	-0.001	0.65
Leather, leather products	0.048	0.002	0.002	-0.005	-0.149*	-0.108*	-0.004*	0.79
Textiles	0.019	0.078*	-0.016*	-0.014*	0.030	-0.071*	-0.002*	0.85
Clothing	0.005	0.060	0.005	-0.014*	-0.015	-0.034*	-0.002*	0.62
Food and beverages	0.028	-0.007	-0.002	-0.010*	0.028*	-0.013	-0.000	0.90
Tobacco products	0.003	0.021	0.002	0.014	0.069*	-0.091*	-0.002*	0.84

Dependent variable: share of production workers' wage bill in total wage bill plus intermediate input costs; all price variables (rw, rp) are deflated by the price index for domestic intermediate inputs. All explanatory variables are in logarithms, except for the time trend. — Coefficients significant at the 10 percent level are marked by *.

Source: See Table 6.

Table 9a — Factor Demand Equations[a] for a Cross Section of West German Manufacturing Industries 1978 and 1990

	rw unskilled	variable x	cap-out ratio	dummy for 1990	adj. R^2
<u>x = rp imported inputs:</u>					
production workers	-1.22	1.25	0.11		-0.07
-- " --	-0.70	-2.32	0.03	-0.43	-0.05
non-production workers	2.16	2.08	-0.10		0.05
-- " --	1.55	-2.79	-0.21	-0.48**	0.23
total employment	-2.16**	1.62	0.05		0.01
-- " --	-2.06**	-2.75	-0.03	-0.53**	0.10
<u>x = imp.inputs/dom.inputs:</u>					
production workers	-1.07	0.36*	0.20		-0.02
-- " --	-0.40	0.55**	0.27	-0.46**	0.06
non-production workers	1.77	0.10	-0.13		0.01
-- " --	-0.21	0.42**	-0.04	-0.54**	0.31
total employment	-1.92*	0.30*	0.11		0.05
-- " --	-2.02**	0.50**	0.21	-0.49**	0.24

[a]Dependent variable: logarithm of the ratio unskilled to skilled workers in the respective group (production workers, non-production workers or total employment). All explanatory variables are in logarithms, except for the time trend. 36 observations. — Coefficients significant at the 20 % (10 %) level are marked by * (**).

Source: See Table 4.

Table 9b — Factor Demand Equations[a] for a Cross Section of West German Manufacturing Industries 1978 and 1990

	rw unskilled	variable x	cap-out ratio	constant	adj. R^2
x = rp imported inputs:					
production workers	1.57	3.47**	-0.22		-0.20
-- " --	3.30*	0.61	-0.05	-0.33**	-0.02
non-production workers	1.69	3.28**	-0.59		-0.99
-- " --	0.20	-2.22*	-0.37	-0.56**	0.07
total employment	1.98	2.85**	-0.34		-0.63
-- " --	0.87	-0.63	-0.20	-0.35**	-0.12
x = imp.inputs/dom.inputs:					
production workers	2.49	-1.03**	0.10		-0.08
-- " --	3.40*	-0.34	0.03	-0.28*	-0.00
non-production workers	0.60	-1.10**	-0.29		-0.37
-- " --	0.58	-0.12	-0.40	-0.36**	-0.06
total employment	1.60	-0.89**	-0.06		-0.21
-- " --	1.15	-0.29	-0.15	-0.22*	-0.10

[a]Dependent variable: log-difference (1990 vs. 1978) of the ratio unskilled to skilled workers in the respective group (production workers, non-production workers or total employment). All explanatory variables are in log-differences, except for the constant. 18 observations. — Coefficients significant at the 20 percent (10 percent) level are marked by * (**).

Source: See Table 4.

Table 10a — Translog Cost Functions[a] for a Cross Section of West German Manufacturing Industries 1978 and 1990

	rw unskprod	rw skprod	rw unsknonp	rw sknonp	x	real capital	adj. R^2
x = rp imported inputs:							
unskilled prod. workers	-0.026	-0.039	0.044	-0.003	0.042	0.005	0.17
skilled prod. workers	0.082	0.131**	0.089	-0.198	0.153	-0.029**	0.58
unskilled nonprod. workers	-0.046**	0.015*	0.021	0.007	-0.005	0.000	0.51
skilled nonprod. workers	-0.190**	0.065	-0.004	0.243**	0.195*	0.002	0.30
x = imp. inputs/dom. inputs:							
unskilled prod. workers	0.011	-0.046	-0.018	0.014	0.012*	0.005	0.22
skilled prod. workers	0.064	0.134**	0.091	-0.192	-0.007	-0.034**	0.57
unskilled nonprod. workers	-0.045**	0.014*	0.019	0.007	0.001	0.001	0.51
skilled nonprod. workers	-0.203**	0.067	-0.017	0.255**	-0.005	-0.003	0.42

[a]Dependent variable: share of unskilled (skilled) workers' wage bill in total wage bill plus intermediate input costs; all price variables (rw, rp) are deflated by the price index for domestic intermediate inputs. All explanatory variables are in logarithms. — Coefficients for relative energy price and for real output are not reported since they were always insignificant. Coefficients significant at the 20 percent (10 percent) level are marked by * (**).

Source: Ssee Table 4.

Table 10b — Translog Cost Functions[a] for a Cross Section of West German Manufacturing Industries 1978 and 1990

	rw unskprod	rw skprod	rw unsknonp	rw sknonp	x	real capital	time trend [b]	adj. R^2
x = rp imported inputs:								
unskilled prod. workers	-0.023	-0.042	0.045	0.004	0.030	0.004	-0.0004	0.14
skilled prod. workers	0.100	0.114	0.090	-0.165	0.005	-0.035**	-0.0020	0.58
unskilled nonprod. workers	-0.048**	0.017*	0.021	0.003	0.001	0.001	0.0002	0.49
skilled nonprod. workers	-0.186**	0.061	-0.004	0.251**	0.182	0.001	-0.0005	0.28
x = imp. inputs/dom. inputs:								
unskilled prod. workers	0.041	-0.063*	-0.031	0.044	0.017**	0.002	-0.0017*	0.24
skilled prod. workers	0.112	0.107	0.070	-0.144	0.001	-0.038**	-0.0028	0.57
unskilled nonprod. workers	-0.048**	0.017*	0.021	0.003	-0.000	0.001	0.0002	0.49
skilled nonprod. workers	-0.174**	0.051	-0.030	0.284**	-0.000	-0.006	-0.0017	0.24

[a]Dependent variable: share of unskilled (skilled) workers' wage bill in total wage bill plus intermediate input costs; all price variables (rw, rp) are deflated by the price index for domestic intermediate inputs. All explanatory variables are in logarithms, except for the time trend. — [b]Annualized coefficient for the dummy for 1990. — Coefficients for relative energy price and for real output are not reported since they were always insignificant. Coefficients significant at the 20 percent (10 percent) level are marked by * (**).

Source: See Table 4.

Table 10c — Translog Cost Functions[a] for a Cross Section of West German Manufacturing Industries 1978 and 1990

	rw unskprod	rw skprod	rw unsknonp	rw sknonp	x	real capital	adj. R^2
x = rp imported inputs:							
unskilled prod. workers	-0.038	-0.145	0.152	-0.164	0.027	0.015	0.27
skilled prod. workers	0.966**	-0.243	0.009	-0.741**	-0.134	-0.101**	0.40
unskilled nonprod. workers	-0.159**	0.044*	0.045	-0.001	-0.095	0.002	0.60
skilled nonprod. workers	-0.561**	0.072	-0.103	0.796**	0.257	0.037*	0.71
x = imp. inputs/dom. inputs:							
unskilled prod. workers	0.108	-0.172*	-0.069	0.011	0.047**	0.019	0.36
skilled prod. workers	0.865**	-0.224	0.182	-0.787**	-0.032	-0.101**	0.41
unskilled nonprod. workers	-0.132**	0.039	0.021	0.00	0.009*	0.005	0.59
skilled nonprod. workers	-0.632**	0.085	-0.039	0.792**	-0.025	0.029*	0.70

[a]Dependent variable: share of unskilled (skilled) workers' wage bill in total wage bill; all price variables (rw, rp) are deflated by the price index for domestic intermediate inputs. All explanatory variables are in logarithms, except for the time trend. — Coefficients for relative energy price and for real output are not reported, since they were always insignificant. Coefficients significant at the 20 percent (10 percent) level are marked by * (**).

Source: See Table 4.

Table 10d — Translog Cost Functions[a] for a Cross Section of West German Manufacturing Industries 1978 and 1990

	rw unskprod	rw skprod	rw unsknonp	rw sknonp	x	real capital	time trend [b]	adj. R^2
x = rp imported inputs:								
unskilled prod. workers	-0.034	-0.149	0.152	-0.156	0.014	0.013	-0.0005	0.24
skilled prod. workers	1.000**	-0.275	0.011	-0.674*	-0.244	-0.112**	-0.0040	0.38
unskilled nonprod. workers	-0.179**	0.063**	0.044	-0.039	-0.032	0.008	0.0023**	0.64
skilled nonprod. workers	-0.556**	0.067	-0.103	0.805**	0.246	0.036*	-0.0005	0.70
x = imp. inputs/dom. inputs:								
unskilled prod. workers	0.185	-0.216**	-0.104	-0.033	0.061**	0.011	-0.0045	0.37
skilled prod. workers	0.870**	-0.227	0.179	-0.782**	-0.031	-0.102**	-0.0003	0.38
unskilled nonprod. workers	-0.173**	0.062**	0.039	-0.041	0.002	0.010*	0.0023**	0.64
skilled nonprod. workers	-0.620**	0.078	-0.044	0.805**	-0.023	0.027	-0.0007	0.69

[a]Dependent variable: share of unskilled (skilled) workers' wage bill in total wage bill; all price variables (rw, rp) are deflated by the price index for domestic intermediate inputs. All explanatory variables are in logarithms, except for the time trend. — [b]Annualized coefficient for the dummy for 1990. — Coefficients for relative energy price and for real output are not reported since they were always insignificant. Coefficients significant at the 20 percent (10 percent) level are marked by * (**).

Source: See Table 4.