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REAL TRADE COSTS, FRAGMENTATION AND EMPLOYMENT

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Abstract:
This paper attempts to quantify the impact of fragmentation on employment. Factor demand functions for labour and intermediates and mark up price equations derived from a *Generalized Leontief* cost function at industry level are estimated. Import prices and output prices influence the price of intermediates via a technology matrix from input – output tables. A decrease in import prices (real trade costs) has a twofold impact on labour demand: (i) substitution of domestic employment by partly imported intermediates (= outsourcing or fragmentation) (ii) increased employment due to higher demand caused by an increase in price competitiveness.

Key words: fragmentation, outsourcing, real trade costs,Generalized Leontief cost functions.

JEL Code: F11, F15, D20

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1. Introduction

Globalization has become a main issue in economic analysis of international trade and intensified economic integration in the sense of world wide search and arbitrage of price and cost advantages by firms and individuals. Traditional trade theory mainly dealt with that from a final goods or consumption goods perspective. An important new phenomenon is fragmentation of the value added chain and outsourcing of parts of the production process from high wage economies to low wage countries. The literature on fragmentation has engaged in different aspects concerning conditions and causes as well as consequences of the phenomenon. Fragmentation must yield a cost advantage, as the extra costs of splitting up the production process and applying the ‚fragmented' instead of the ‚integrated' technology must be compensated by lower costs due to factor price and/or technological differences. This is the starting point of the analysis on fragmentation to identify trade liberalization, improvement in transport and communication technologies (decrease in transportation and communication costs) and FDI as possible driving forces behind the process of increasing fragmentation. Actually most of the existing studies on the causes of fragmentation have been engaged in theoretical analysis mostly in traditional frameworks of trade theory like the Heckscher-Ohlin model. Only recently one finds some empirical studies about the role of different factors on outsourcing in Europe as Görg (2000) and Egger and Egger (2001). Görg (2000) analyses the driving forces behind attracting the production of fragmented components in a country. He looks at the FDI stock together with wages and comparative advantages at a sectoral level for US fragmentation into Europe. He finds evidence contradicting theory as far as the wage rate is concerned, what

might simply mean that US firms source out high skill (and thereby high wage) production parts to Europe due to other factors, especially comparative advantages. Egger and Egger (2001) set up a theoretical model, where a high wage country exporting to the world market has an incentive for outsourcing, when real trade costs in trade with a neihgbouring low wage country decrease due to integration and trade liberalization. They apply this theoretical framework to Austrian manufacturing, where parts of the value added chain has been sourced out to Eastern European countries. Their results reveal important consequences in a skill - segmented labour market in the high wage country depending on the labour market mechanisms at work (competitive or wage bargaining).

A literature survey (Egger, Pfaffermayr, Wolfmayer (2000)) shows that there is another larger part of the literature dealing with the consequences of fragmentation for the labour market and for welfare. The most prominent examples, which according to Kohler (2000) to a certain extent represent different views are the studies of Arndt (1997,1999) and Feenstra, Hanson (1996,1999). Arndt (1997,1999) treats fragmentation as part of a sector specific specialization strategy of countries with different factor price levels. He starts from the Lerner-Pearce diagram for the input mix (labour and capital) in the production of two goods, where world market prices are given. Fragmentation allows to split up the production process in the production of one good and combine cheaper intermediates with the remaining part of the value added chain. Arndt (1999) deals with the case of a developing country, but his results are symmetrically valid for the outsourcing high wage industrial country. Fragmentation shifts the production possibility frontier outwards so that welfare increases, which can be seen as some sort of technological improvement effect (see: Kohler (2000)).

Feenstra, Hanson (1996,1999) on the other hand look at fragmentation as equivalent to factor-biased technological progress between skill groups of labour. They find that fragments of low skill intensity are moved abroad from the US to Mexico, so that the skill intensity in the US

increases. If the outsourced phases of production are on the upper bound of skills in Mexico, the skill intensity raises there too.

Fragmentation in this setting is factor and cost saving, where the factor saving effect works like an increase in endowment of the factor and cost saving is welfare increasing. As Egger, Pfaffermayr, Wolfmayr-Schnitzer (2000) show fragmentation has consequences for the output and employment structure as far as it is factor saving. In a framework with exogenously given (world market) prices, factor prices do not change due to the factor saving effect, but the output and employment structure adjusts. The cost saving effect of fragmentation induces changes in factor prices in order to fulfill the zero profit condition at given output prices. In a framework with capital and labour the factor price impact depends on the production phase, that is sourced out. If it is the labour intensive fragment, the effect is the same as technological progress , i.e. a relative wage increases. Another feature can be added by allowing for different skill groups of labour. In that case the cost saving impact of outsourcing is a change in the relative wage of skilled to unskilled as in the Feenstra-Hanson (1996) study equivalent to the impact of factor-biased technological progress. The combination of the factor savings and the cost savings effect in a framework of low and high skilled labour depends on the skill intensity of the industry, in which fragmentation occurs (see: Egger, Pfaffermayr, Wolfmayr-Schnitzer (2000)). In general we can conclude from the studies that simultaneous reactions of the employment and output structure as well as the relative wages will occur as a consequence of outsourcing, where the relative wage effect will have repercussions on employment again. All these results generally have been derived for exogenous output prices, which was motivated by the ‚small country assumption'.

In a more recent study Feenstra, Hanson (1999) assume that goods prices can be influenced to a certain extent, what they call the ‚large country assumption'. Fragmentation can then be treated together with technological change as a factor determining TFP growth and output price changes. Via this influence on TFP growth fragmentation has a welfare increasing impact. The

welfare consequences might be seen as similar in the different approaches, but the labour market consequences are rather different. The analysis becomes more complex in a setting of more goods than factors and where fragmentation ‚across the cones' might occur (see: Egger, Pfaffermayr, Wolfmayr-Schnitzer (2000)).

This paper looks at fragmentation from a cost function perspective at industry level including price setting/price taking behaviour and tries to quantify the employment effects at sectoral level. Multiple goods are produced with three production factors: labour, intermediates and capital. This framework allows to account for the set of different technologies of integrated and fragmented production. The economy analysed is a small open economy (Austria) with low wage neighbouring countries as destinations of fragmentation and exporting mostly to European (high wage) markets. In these markets and in the home market output prices are not treated as given, which from our point of view is no contradiction to the ‚small economy assumption'. It simply accounts for some sector specific price setting power due to specialization. In the recent past parts of manufacturing have been sourced out already to Eastern European countries and this trend will continue, when real trade costs further decrease after EU enlargement.
The framework of the study is laid down in section 2 and consists of extended *Generalized Leontief* cost functions, which have been estimated for industrial activities in Austria. Output prices are not exogenously given by world market prices, but are specified as a ‚mark up' on marginal costs derived from the cost function. The difference (‚mark up') between ountput prices and marginal costs can be seen as a measure of price setting power above the full competitive case. In section 3 output prices and the price of intermediates are linked according to the input – output structure of the economy. Output prices together with exogenous import prices determine the price of intermediates via a fixed technology matrix derived from an input – output table. By this channel a change in real trade costs (import prices) has a direct impact on the demand for intermediates (fragmentation) and thereby changes costs and price

competitiveness. Section 4 presents results of a simulation example, where real trade costs (import prices) decrease by 10 percent. This number was chosen according to the Baldwin, Francois, Portes (1997) study on the real trade costs impact of EU enlargement. At an exogenously given wage rate the input of employment per unit of output decreases through this real trade costs effect. This can be seen as the part of the employment effect equivalent to the sector specific factor-biased technological progress as in Feenstra, Hanson (1996). The decrease in costs increases price competitiveness and in accordance to the price elasticity of demand also the level of demand. Demand and import equations have not been added to the model. Instead two different assumptions have been made concerning the price elasticity of demand (-0.5 and –1.0) and the import effect of outsourcing via additional intermediate demand. The simultaneous analysis of import and output prices also allows tentative conclusions for a terms of trade effect. As a consequence to increased price competitiveness output and employment increase, which is equivalent to the positive welfare effect due to an outward shift of the production possibility curve. The disaggregated approach taken up here allows to identify employment effects by industries compared to their labour intensity. Below the level of sectoral employment effects there will be a (hidden) labour shift between skills in the sectors with corresponding wage movements, which is not analysed explicitly in this paper.

2. Input Demand and Output Prices

Industrial organizations literature generally treats price setting behaviour of firms in an overall model of goods and factor markets. The seminal paper for this approach is Appelbaum (1982), a recent empirical application for various industrial sectors in Austria can be found in Aiginger, Brandner, Wüger (1995). Besides that numerous studies treating with factor demand derived from cost functions also included a price equation, which was estimated simultaneously with the factor demand equations in one system.

Important examples for this line of research mainly using the flexible cost functions ‚*Translog*' and ‚*Generalized Leontief*' are Berndt – Hesse (1986), Morrison (1989, 1990), Meade (1998) and Conrad - Seitz (1994). The price setting equations combined with the factor demand equations differ in these studies. Some start from the perfect competition assumption, so that prices equal marginal costs as is the case in Berndt – Hesse (1986), Morrison, (1988, 1990) and Meade (1998). An example for a ‚mark up pricing' equation combined with factor demand corresponding to the market form of monopolistic competition can be found in Conrad - Seitz (1994).

An interesting common feature of the cited studies is the treatment of the capital stock as a fixed or quasi – fixed factor. The theoretical reasoning behind this assumption is the existence of a short and a long run cost function (s.: Meade (1998), who shows the relationship between these cost functions). In the short run (during one period) the capital stock is fixed and can only be adjusted in the next period. This approach allows two extensions: the derivation of a capacity utilization measure (Morrison (1990), Meade (1998)) and the inclusion of an investment

equation in the model, where investment describes the adjustment process of the actual to the desired capital stock (Allen, Hall (1997)).

Starting from that approach total costs C of an industry are made up of variable costs G for the use of variable inputs and the fixed costs, $Z_k X_k$, for the fixed inputs X_k as is described in (1). Here Z_k stands for the ‚shadow price' of the fixed input k , which must be equal to the impact of the input quantity of k on variable costs as derived in (2). The ‚shadow price' measures cost savings for variable inputs brought about by an unit increase in the input quantity of the fixed factor.

(*1*) $$C = G + \sum_k Z_k X_k$$

(*2*) $$Z_k = -\frac{\delta G}{\delta X_k}$$

In this study the variable factors are the inputs of intermediate demand of an industry, V, with price p_v and labour input L with wage rate w and capital stock K is the fixed factor.

The price p for gross output Y shall be determined by a constant mark up μ on variable costs as in Conrad, Seitz (1994), which corresponds to the model of monopolistic competition in the markets. At perfect competition the price would equal marginal costs (p=MC) like in Berndt, Hesse (1986) and Meade (1998).

(*3*) $$G = p_v V + wL \quad ; \quad C = p_v V + wL + Z_k K \quad ; \quad p = (1 + \mu)\left(\frac{p_v V}{Y} + \frac{wL}{Y}\right)$$

In this study an extension of the *Generalized Leontief* – cost function, which is based on the work of Morrison (1990) is used. The original *Generalized Leontief* – cost function was first proposed by Diewert (1971). Different concepts of extending the function for technical progress variables and fixed factors have been developed since then. Morrison (1989, 1990) has

developed an extension by technical progress and fixed factors with variable factors indexed i,j and the fixed factor k :

$$(4) \qquad G = Y\left[\sum_i \sum_j \alpha_{ij}(p_i p_j)^{1/2} + \sum_i \delta_{it} p_i t^{1/2} + \sum_i g_{tt} p_i t\right] + Y^{1/2}\left[\sum_i \beta_{ik} p_i x_k^{1/2} + 2\sum_i \gamma_{tk} p_i t^{1/2} x_k^{1/2}\right] + \sum_i p_i \gamma_{kk} x_k$$

This function describes the variable costs part with a deterministic trend (*t*) for technical progress. The use of Shephard's Lemma yields factor demand , as the partial derivatives of the cost function to factor prices (p_v , w) give the input quantities (V, L) :

$$(5) \qquad \left(\frac{V}{Y}\right) = \alpha_{VV} + \alpha_{VL}\left(\frac{w}{p_v}\right)^{1/2} + \delta_{Vt} t^{1/2} + \gamma_{tt} t + \beta_{VK}\left(\frac{K}{Y}\right)^{1/2} + 2\gamma_{tK} t^{1/2}\left(\frac{K}{Y}\right)^{1/2} + \gamma_{KK}\left(\frac{K}{Y}\right)$$

$$(6) \qquad \left(\frac{L}{Y}\right) = \alpha_{LL} + \alpha_{VL}\left(\frac{p_v}{w}\right)^{1/2} + \delta_{Lt} t^{1/2} + \gamma_{tt} t + \beta_{LK}\left(\frac{K}{Y}\right)^{1/2} + 2\gamma_{tK} t^{1/2}\left(\frac{K}{Y}\right)^{1/2} + \gamma_{KK}\left(\frac{K}{Y}\right)$$

and for optimal capital stock *K**:

$$K^* = \frac{Y[\beta_{VK} p_v + \beta_{LK} w + 2\gamma_{tK} t^{1/2}(p_v + w)]^2}{4[p_K + (p_v + w)\gamma_K]^2}$$

Symmetry concerning α_{VL} is assumed ($\alpha_{VL} = \alpha_{LV}$). Other restrictions apply for one parameter for technical progress (γ_{tt}), the parameter for the interaction term of the fixed factor and technical progress (γ_{tK}) as well as for one parameter for the fixed factor (γ_{KK}) which are forced to be the same in the two factor demand equations.

Outsourcing is described as a reaction in the factor demand functions (5) and (6) due to changes in the right hand side variables. Due to data limitations the demand for total intermediates (i.e. from domestic and imported sources) is treated here as one input demand equation. Obviously

for the analysis of international outsourcing this is only a second best measure. One could further think of differentiating between the own industry-inputs and all other inputs, as the own industry-inputs are more directly influenced by outsourcing than for example energy. All these limitations indicate that this approach can be seen as a first empirical approach to outsourcing in a multisectoral cost function framework. The main influence on the substitution between production of value added in the own firm with labour and input of outsourced phases via intermediates are the corresponding factor prices. In the next section we will derive the influence of real trade costs (via import prices) on the price of intermediates, p_v. Another influence on technology used will come from capital intensity (K/Y) , which may affect intermediates differently as labour and therefore induce outsourcing. This may be seen as not so relevant in this study, as we only look at the short term results without adjustment of the capital stock.

The derived result is that outsourcing due to a decrease in the intermediates price might have a cost saving effect. In the theoretical model with full competitive markets the zero profit condition could lead to an adjustment of the wage rate. The assumption of perfect competition in the markets would imply that prices equal marginal costs ($p = \delta G/\delta X$). This hypothesis is not followed here as we look at an economy exporting and producing for the home market in the high wage/high skill segment. Instead a fixed mark up μ on marginal costs is introduced representing the model of monopolistic competition. As an alternative one could work with a variable mark up μ set on marginal costs implicitly including the ‚conjectual variations' of the oligopolistic model (s.: Aiginger, Brandner, Wüger (1995)). This variable mark up then would depend on the competitive price (usually approximated by the import price p_m), and the input prices p_v and w.

Marginal costs $\delta G/\delta X$ are in our case given with:

(7) $dG/dX = \alpha_{VV}p_v + \alpha_{LL}w + 2\alpha_{VL}(p_v w)^{½} + \delta_{vt}p_1 t^{½} + \delta_{Lt}p_2 t^{½} + \gamma_{tt}(p_v + w)t + ½\beta_{VK}p_v\left(\frac{K}{Y}\right)^{½} + \beta_{LK}w\left(\frac{K}{Y}\right)^{½} + 2\gamma_{tK}(p_v + w)t^{½}\left(\frac{K}{Y}\right)^{½}$

Applying a fixed mark up therefore we get the following output price equation:

(8) $p = [1 + \mu]\,[\alpha_{VV}p_v + \alpha_{LL}w + 2\alpha_{VL}(p_v w)^{½} + \delta_{vt}p_1 t^{½} + \delta_{Lt}p_2 t^{½} + \gamma_{tt}(p_v + w)t + ½\beta_{VK}p_v\left(\frac{K}{Y}\right)^{½} + \beta_{LK}w\left(\frac{K}{Y}\right)^{½} + 2\gamma_{tK}(p_v + w)t^{½}\left(\frac{K}{Y}\right)^{½}]$

Therefore outsourcing in this setting lowers output prices and as a consequence allows to expand output and employment.

The model could be complemented by an explicit demand function as in Appelbaum (1982) and Aiginger, Brandner, Wüger (1995) with a macroeconomic income variable *E*, output price p_i and a determinitic trend *t*:

(9) $Y_i = Y_i\,(E, p_i, t)$

An explicit formulation of this function with total demand *E* ($E = \sum_i Y_i$ with $i = 1 \ldots n$ industries) and the compound price index p^* of *E* would be:

(10) $\ln Y_i = \alpha_{1i} + \alpha_{2i}\ln\left(\frac{p_i}{p^*}\right) + \alpha_{3i}\ln\left(\frac{E}{p^*}\right)$

The total employment impact of outsourcing in terms of total differentiation therefore can be seen as the sum of the factor substitution effect $\delta(L/Y)Y$ and the output effect $(L/Y)\delta Y$. As

there is no explicit treatment of the labour market in this study, we assume a perfectly adjusting labour supply in each industry, so that employment effects are fully determined from the demand side and no wage repercussions must be expected. In the initial situation without outsourcing we might have unemployment due to wages above the market clearing level. That might be motivated by some sort of efficiency wages regime in all industries.

From the Generalized Leontief – functions one can derive cross- and own price elasticities. The relationship between the traditional cross- and own price elasticities and the ‚Allen elasticities of substitution' (AES) $\sigma(ij)$ is given with $\varepsilon(ij) = \sigma(ij)\, S_j$, where S_j represents the cost share of factor j. For AES the symmetry condition: $\sigma(ji) = \sigma(ij)$ holds. As microeconomic theory states, that the compensated price elasticities must sum up to zero, in this 2 factor model we have: $\varepsilon(LL) = -\varepsilon(LV)$ and $\varepsilon(VV) = -\varepsilon(VL)$. Elasticities can be directly derived from the input – output equations (5) and (6), where the inputs of V and L are functions of input prices w and p_v . This gives for cross- and own - price elasticities:

(11) $\varepsilon(LL) = -(\alpha_{VL}/2)\,(Y/L)\,(p_v/w)^{1/2}$

$\varepsilon(VV) = -(\alpha_{VL}/2)\,(Y/V)\,(w/p_v)^{1/2}$

$\varepsilon(VL) = (\alpha_{VL}/2)\,(Y/V)\,(w/p_v)^{1/2}$

$\varepsilon(LV) = (\alpha_{VL}/2)\,(Y/L)\,(p_v/w)^{1/2}$

3. Import and Input Prices

The price of intermediate demand an industry faces is determined by the output prices of the other industries in the home country and abroad as described in the traditional input – output price model. In the input – output price model for given technical coeffient matrizes for domestic and imported inputs the vector of domestic prices (**p**) is determined by domestic output prices themselves (**p**) and the vector of import prices ($\mathbf{p_m}$):

(12) $\mathbf{p} = \mathbf{p\,A(d)} + \mathbf{p_m\,A(m)} + \mathbf{w\,L/Y} + \mathbf{c}$

where **c** is a vector of residual income and **w L/Y** is labour cost per unit of output as before in vector notation. Here the technical coefficients matrix is split up into a domestic (**A(d)**) and an imported (**A(m)**) matrix.

From input – output tables we know, that total intermediate demand of industry i, V_i , equals the sum of inputs produced by other domestic industries ($V_{ji}(d)$) and imported inputs ($V_{ji}(m)$):

Industry (i,j)

1 .....n

1

.

. V_{ji}

.

n

Σ V_1 .....V_n

The input coefficient along the column of an industry (V_i / Y_i), which was modelled in the last section with the help of the *Generalized Leontief* function is given as the total of the two column sums for *i* of technical coefficient matrizes (derived from input – output tables) for domestic and imported goods (**A(d)** , **A(m)**).

From the traditional input – output – price model we can now write the intermediate input coefficient at current prices (p_vV/Y) as a matrix multiplication of a row vector of domestic prices **p** and a row vector of import prices $\mathbf{p_m}$ with **A(d)** and **A(m)** to get the the row vector $\mathbf{p_v V/Y}$:

(13) $(\mathbf{p_v V/Y}) = (\mathbf{p_m}\ \mathbf{A(m)} + \mathbf{p}\ \mathbf{A(d)})$

In analogy to that we can introduce the input – output level of disaggregation in the factor demand equations described in the last section by treating the column sum V/Y as a bundle of *n* inputs. Assuming a constant structure for the *n* inputs within V/Y given by matrizes Φ with elements V_{ji}/V_i each for domestic (d) and imported (m) inputs, $\mathbf{p_v}$ becomes:

(14) $\mathbf{p_v} = (\mathbf{p_m}\ \mathbf{F(m)} + \mathbf{p}\ \mathbf{F(d)})$

This relationship now introduces the feedback of output price changes on output prices. Equation (14) solves exactly for the input – output years, in other years the price index of National Accounts for $\mathbf{p_v}$ may deviate from the value calculated with (14) using fixed matrices of the base year for **F (m)** and **F (d)** . With fixed matrizes **F** derived from the i – o table 1990 and time series (1976 – 94) of the vectors **p** and $\mathbf{p_m}$ a vector representing the price – index of intermediate demand $\mathbf{p_v^*}$ according to (14) was constructed.

Simple regressions for the elements of $\mathbf{p_v^*}$ have been used to explain $p_{v,t}$, where a time index is introduced and u_t is the residual with the usual statistical properties:

(15) $(p_{v,t} - p_{v,t-1}) = a_0 + a_1 (p^*_{v,t} - p^*_{v,t-1}) + u_t$

In this model the price of intermediate demand has been endogenized with exogenous import prices p_m and exogenous intermediate demand structures given by fixed matrizes $\mathbf{F}$.

3. Estimation results

The system consisting of (5), (6) and (8) has been estimated for 12 manufacturing industries of the Austrian economy, which represent the industries 8 to 21 (excluding 13 and 20 due to lack of reliable time series data) in the classification of 32 industries used in the E3ME model (Barker, et.al. (1999)).

The system to estimate could have been enlarged by the output demand equation (10) and some experiments for several sectors showed promising results. On the other hand such an enlargment of the partial model outlined in a general equilibrium direction would have made necessary other extensions too. If we treat intermediates in general taking together imported and domestic goods the impact on demand of home firms and households for domestic and imported goods should have been differentiated. On the demand side we should have further made a distinction between production for the home market and for exports, probably with different price setting/price taking behaviour. We found all these extensions beyond the scope of this study, that concentrates on factor demand and output price impacts in a multi-industry framework.

The data for gross output, value added and investment at current and constant prices have been taken from the National Accounts databank of the Austrian Statistical Office. Capital stock by industry has been approximated by cumulated investment. A system estimator (SURE) has been applied to time series data (1976 – 94) using *Eviews 3.1*. .

Table 1 shows the cross – price elasticities derived from the parameter estimates and calculated with the sample means of Y/V, Y/L, w/p_v and p_v/w . All elasticities have the expected signs and summing up to zero is also fulfilled. The magnitude of the elasticities differs

significantly between industries for the two factors V and L but can in general be described as rather low. We think that this result is linked to the high level of aggregation of intermediates without differentiating between own-industry inputs and components on the one hand and imported and domestic on the other hand. Table 1 also includes the average elasticities over all industries, which have just been averaged, i.e. no total manufacturing system has been estimated. The overall labour intensity is a weighted average of the labour intensity of all industries. As an important criterion for the propensity to source out low wage/low skill production phases in a in a high wage country the theoretical literature would suggest the labour intensity of the sectors. Table 1 suggests a certain correlation between labour intensity and the own price elasticity of labour (= minus the cross price elasticity labour/intermediates) with some exceptions like non-metallic mineral products, rubber&plastic products and other manufactures (mainly wood and furniture), where a relatively high labour intensity is combined with a relatively low price elasticity of labour demand. Labour intensive industries with ‚long' value added chains as transport equipment, textiles/clothing and metal products reveal a coincidence of labour intensity and price elasticity of labour demand. Labour demand reactions due to a change in the intermediates price in two of these sectors can be seen as different types of outsourcing. The first case is outsourcing of the low skill labour intensive phase in a high wage/high skill industry, which corresponds to labour demand reactions in transport equipment. The other case is outsourcing of the low-skill labour intensive phase in a low wage/low skill industry corresponding to labour demand reactions in textiles/clothing.

Table 1: Cross price elasticities between V (intermediate demand) and L (labour)

The estimation results, which cannot be fully reproduced here in general yield significant parameter estimates, especially for the price parameters α_{VL}. That means that the elasticities

presented in Table 1 all rely on significant parameter estimates. In some industries the restrictions for the fixed factor and technological progress parameters, especially for γ_{tt} and γ_{tK} raised some problems. Experiments have shown, that in some but not all of these cases a less restrictive approach gave better results.

Another important result are significant mark up parameters in all industries with reliable magnitudes for the implicit mark up ranging from about 15 to 35 percent.

4. Simulations of a Real Trade Costs Shock

The model presented in the last sections can now be used for a simulation example of the employment impact of a change in real trade costs (import prices) via fragmentation. As Egger and Egger (2001) we see outsourcing in Austria to Eastern European countries as the main phenomenon, induced by decreasing real trade costs. Estimates of Baldwin, Francois, Portes (1997) on the real trade costs impact of EU enlargement quantify this effect with 10 percent. In order to get a plausible estimate for the spillover to Austrian import prices, this number had to be weighted with Austrian import shares by countries. Another development accompanying EU enlargment will be an increase in FDI of Austria in Eastern Europe, which can be seen as an additional channel for outsourcing. Therefore we found a reasonable simulation experiment to consist in a decrease of import prices by 10 percent for each good. We carried out an *ex post* simulation for the period 1990 to 1994 and show the 5^{th} period results here in terms of the difference to historical data.

The first impact is on the price of intermediates and with an exogenously given wage rate on the input of employment and intermediates per unit of output. This first employment effect can be seen as the equivalent to the sector specific factor saving impact. The industries become less labour intensive by this effect and - what this study not shows - also the skill structure of labour will change in the industries.

The decrease in costs increases price competitiveness for a given mark up. Therefore output prices also decrease, which again has an input – output multiplier effect on the price of intermediates, as costs of domestic intermediates decrease. Table 2 shows, that a uniform 10 percent decrease in import prices over all goods (=industries) has a rather different impact on intermediates and output prices across industries. The (weighted) average of 3.8 percent reduction for total manufacturing in the price of intermediates comes about by much higher price

reductions up to 10 percent in some industries. These differences can be mainly explained by different *imported* intermediate input coefficients across industries. Output prices are reduced almost in the same amount with an (weighted) average reduction effect of 3.3 percent for total manufacturing. If we assume, that export prices react in the same way as output prices, this means a slightly positive terms of trade effect.

The input coefficients show the expected reactions of an increase of intermediates inputs for total manufacturing (weighted average) of 0.4 percent and a decrease of labour inputs for total manufacturing of 1.0 percent.

Table 2: Price and factor demand effects of an import price shock (- 10 percent)

The output price changes further might change the level of demand according to the price elasticity of demand. This study puts the emphasis on the production side and therefore demand and import equations have not been added to the model. Instead two different assumptions have been made concerning the price elasticity of demand, namely an elasticity of -0.5 and alternatively of –1.0. Total demand in a sector Q_i is defined by the sum of imports, M_i and domestic output Y_i: $Q_i = Y_i + M_i$.

We assume that the change in demand δQ_i is given by the price elasticity and the change in imports δM_i is given by the additional intermediates demand: $\delta M_i = \delta(V_i / Y_i)\, \delta Y_i$.

Obviously this additional equation system can only be solved simultaneously as output Y_i is the difference between demand and imports and imports again depend on output Y_i via the intermediate demand coefficient. The assumption on imports is equivalent to treating total outsourcing induced by real costs decrease as outsourcing abroad, although the cost function does not differentiate between domestic and imported intermediates. As a consequence of this goods demand effect output and employment increase, which is equivalent to the positive

welfare effect due to an outward shift of the production possibility curve. We can now decompose the two effects of outsourcing on industry employment as is shown in Table 3. The pure factor saving effect is derived by simply multiplying the new intermediate input coefficient after reactions in factor demand and prices with the original output level (= *without output change*). Employment decreases due to this partial effect in all industries in the range of about 6.500 persons in total, which is 1.0 percent of total manufacturing employment and identical to the pure input coefficient effect.

The reaction to the factor savings effect in this framework comes about by demand reactions to an increase in price competitiveness. For this case we analyse two cases with a price elasticity of demand of –0.5 and –1.0. Already in the case of inelastic demand (price elasticity: -0.5) the overall employment effect becomes positive in the range of 2.600 persons or 0.4 percent of total manufacturing employment. Actually in the labour intensive sectors with high factor demand elasticities (metal products, transport equipment and textiles/clothing&footwear) the demand increase is not sufficient in this case to compensate for the pure factor saving impact, so that employment results remain negative in these industries. In all the other industries even with inelastic demand the output effect on employment more than compensates the pure factor savings effect. In the case of elastic demand (-1.0) also the labour intensive sectors with high factor demand elasticities exhibit positive employment effects, the total manufacturing employment effect then amounts to + 1.9 percent or 12.800 persons.

Table 3: Employment effects of an import price shock (- 10 percent)

We have assumed perfectly elastic labour supply , so that the employment effects fully pass through to the labour market. The literature cited in the introduction would suggest that within the sectors important labour shifts take place between different skill groups. Evidence from

large Austrian firms also reveals that persons laid off by outsourcing are not identical to persons employed afterwards, when output expands. These labour shifts will have consequences for the relative wages of skilled, that are not treated in this study. That might be important due to possible repercussions from wages on employment. Even in a framework without different skill groups the cost savings effect together with a zero profit condition would change the wage/rental ratio. In our model the cost savings effect is passed on to prices, so that for a given nominal wage the real wage rate rises. For high enough goods demand elasticities this implicit real wage rate rise is compensated by expanding output.

5. Concluding Remarks

This study treats fragmentation in a framework of extended *Generalized Leontief* cost functions for single industries in Austria with different price setting/price taking behaviour. The small open economy assumption is from our point of view consistent with some sector specific price setting power due to specialization. Output prices, import prices and the price of intermediates are linked according to the input – output structure of the economy. A change in real trade costs (import prices) has a direct impact on the demand for intermediates (fragmentation) and thereby changes costs and price competitiveness. Labour demand is reduced in a first step by this factor saving effect. In a second step the factor saving effect has repercussions on output and employment, which in our model come about by increased price competitiveness. This is the equivalent in our model to the positive welfare effect due to an outward shift of the production possibility curve. The disaggregated approach taken up here shows that large factor savings effects in labour intensive industries accompanied by relatively small increases in price competitiveness only yield positive employment effects, if goods demand is elastic. These labour intensive industries with high factor demand elasticities are partly high wage/high skill industries (transport equipment) and partly low wage/low skill industries (textiles, clothing&footwear). Beyond the level of analysis of this study labour shifts of skills within the sectors with corresponding wage movements will occur.

An important shortcoming of the study is the overall treatment of intermediates without differentiating between domestic and important goods and the assumption of fully flexible labour supply, so that no labour market repercussions on the wage rate take place. These features remain open for promising future research.

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Table 1: Cross price elasticities between V (intermediate demand) and L (labour)

	e(LL)	e(VL)	Labour intensity
8 Ferrous & Non Ferrous Metals	-0,217	0,077	0,418
9 Non-metallic Mineral Products	-0,108	0,058	0,765
10 Chemicals	-0,164	0,034	0,362
11 Metal Products	-0,425	0,218	1,048
12 Agricultural & Industrial Machines	-0,292	0,119	0,685
13 Office Machines			0,893
14 Electrical Goods	-0,257	0,100	0,608
15 Transport Equipment	-0,431	0,149	0,724
16 Food, Drink & Tobacco	-0,137	0,032	0,548
17 Textiles, Clothing & Footwear	-0,629	0,281	1,205
18 Paper & Printing Products	-0,098	0,041	0,590
19 Rubber & Plastic Products	-0,243	0,139	0,963
21 Other Manufactures	-0,220	0,097	1,026
Total Manufacturing	-0,268	0,112	0,696

Table 2: Price and factor demand effects of an import price shock (- 10percent) :

(percentage changes)

			input Coefficients	
	P_v	p	V/X	L/X
8 Ferrous & Non Ferrous Metals	-3,8	-3,9	0,4	-1,2
9 Non-metallic Mineral Products	-2,1	-1,7	0,1	-0,3
10 Chemicals	-9,7	-9,5	0,5	-1,4
11 Metal Products	-1,3	-0,8	0,3	-0,5
12 Agricultural & Industrial Machines	-4,1	-4,0	0,6	-1,4
13 Office Machines	0,0	0,0	0,0	0,0
14 Electrical Goods	-1,9	-1,7	0,2	-0,5
15 Transport Equipment	-1,9	-1,6	0,3	-1,0
16 Food, Drink & Tobacco	-0,8	-0,7	0,0	-0,1
17 Textiles, Clothing & Footwear	-4,0	-3,1	1,2	-2,9
18 Paper & Printing Products	-10,2	-8,2	0,5	-1,3
19 Rubber & Plastic Products	-8,1	-7,5	1,4	-2,2
21 Other Manufactures	-3,1	-2,7	0,4	-0,8
Total Manufacturing	-3,8	-3,3	0,4	-1,0

Table 3: Employment effects of an import price shock (- 10percent) :

(changes in persons)

	without output change	including ***price elasticity*** ***-0,5***	output change ***of demand*** ***-1,0***
8 Ferrous & Non Ferrous Metals	-387	103	639
9 Non-metallic Mineral Products	-116	222	582
10 Chemicals	-454	916	2342
11 Metal Products	-327	-177	57
12 Agricultural & Industrial Machines	-878	342	1699
13 Office Machines	0	0	0
14 Electrical Goods	-283	142	616
15 Transport Equipment	-332	-26	318
16 Food, Drink & Tobacco	-102	87	286
17 Textiles, Clothing & Footwear	-1623	-696	507
18 Paper & Printing Products	-657	869	2500
19 Rubber & Plastic Products	-541	385	1438
21 Other Manufactures	-806	422	1785
Total Manufacturing	-6505	2589	12771

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