IHS Economics Series
Working Paper 145
November 2003

Sectoral Adjustment of Employment: The Impact of Outsourcing and Trade at the Micro Level

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Impressum

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Title:
Sectoral Adjustment of Employment: The Impact of Outsourcing and Trade at the Micro Level

ISSN: Unspecified

2003 Institut für Höhere Studien - Institute for Advanced Studies (IHS)
Josefstädter Straße 39, A-1080 Wien
E-Mail: office@ihs.ac.at
Web: www.ihs.ac.at

145

Reihe Ökonomie

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Abstract

This paper analyzes the effects of trade and outsourcing on the transition probabilities of employment between sectors, using a dynamic multinomial logit framework with fixed effects. The data contain individual Austrian male workers over the period 1988-2001. Our results strongly support the view that international economic forces are important determinants of labor market turnover. Increases in imports, terms of trade and, especially, in the outsourcing share negatively affect the probability of staying in or changing into the manufacturing sector, even more so for industries with a comparative disadvantage.

Keywords
Labor market turnover, outsourcing, dynamic discrete choice, fixed effects panel estimation

JEL Classification
F16, J63, C23, C25

Comments

Peter Egger thanks Rudolf Winter-Ebmer and workshop participants in Innsbruck for valuable comments.

Contents

1 Introduction

The impact of increasing trade volumes and intensified foreign competition on the labor market has been of growing concern in the last years. International trade theory suggests that import competition (Wood, 1995) and, especially, international outsourcing (Feenestra and Hanson, 1999) hurt unskilled workers by lowering their relative wages. Krugman (1995), emphasizes that the composition of goods trade, rather than the volume of trade matters. In particular, he shows that the degree of outsourcing measured by the share of intermediate goods trade produces adverse labor market reactions. However, these conclusions are based on static general equilibrium models which capture long run effects. The corresponding short run transitory dynamics are less understood but a major research topic in labor economics. Here, the nature of adjustment processes in the labor market induced by increasing trade volumes is of particular interest. At the individual level the trade related shocks may lead to job losses. Since the experience of unemployment exhibits persistent effects due to human capital loss, the labor market adjustment processes may be delayed or even prevented. In this case it is not sufficient to investigate the long run wage effects only but the short run transition probabilities are of particular interest.

Empirical research on short run labor market dynamics has followed two routes (see Klein et al., 2003b, for an overview). One strand of the literature assesses the impact of trade-related variables, most prominently the real exchange rate, on the levels or changes in *net* employment at an aggregate level. Early research looks at the consequences of real appreciation of the US $ on the US labor market (Grossman, 1986; Ravenga, 1992).[1] Most of the available results point to a negative impact of an exchange rate appreciation on employment and wages.

The second strand of the literature investigates the consequences of increasing trade volumes on *gross* flows of jobs or workers. Prominent examples of job flow studies comprise Davis et al. (1996), Gourinchas (1998) and Klein et al. (2003b), who look at job creation and job destruction. Their findings indicate that an impact of international factors on job flows is hard to detect, specifically if low frequency data are used. In contrast, the worker flow approach "has the advantage of identifying the impact of international factors on gross labor flows at a more fundamental level ... than job flows" (Klein et al., 2003a, p. 22). Goldberg et al. (1999) and Kletzer (2002) are the earliest examples following

[1] Burgess and Knetter (1998) were the first in assessing this effect in a larger cross-section of countries (the G-7). More recent studies are Campa and Goldberg (2001) and Goldberg and Tracy (2001).

this approach, concentrating on US data throughout. Goldberg et al. (1999) find that an exchange rate appreciation affects the probability of losing jobs whereas a depreciation does not. Distinguishing between export and import exchange rates they show that an appreciation of the export exchange rate is associated with a lower likelihood of changing jobs, whereas an import exchange rate appreciation tends to increase this likelihood. Kletzer (2000, 2002) finds that higher export sales reduce displacement rates, but import competition does not seem to affect displacement rates significantly.

The present paper takes a closer look at the impact of trade on employment in a worker flow approach and concentrates on the short run employment dynamics. Using a detailed database of individual Austrian male workers over the period 1988-2001, we investigate whether and how growth in goods imports, exports, outsourcing, and technical change affect individual transition probabilities between six different states of employment and unemployment/out of labor force.

Austria is a prime example for studying the impact of trade liberalization from the European perspective (Aiginger et al., 1996; Hofer and Huber, 2003). Due to the opening up of Eastern Europe we observed a marked increase in trade and outsourcing volumes during the last decade. In addition the Austrian labor market is characterized by highly centralized wage bargaining. Given these circumstances labor market turnover is the main channel of adjustment to external industry specific shocks.

The contribution of this paper is twofold. First, in contrast to the previous literature, which concentrated on the impact on job loss or displacement rates mostly in a cross section, we formulate a more concise model, which also incorporates the longitudinal dimension. In this setup it is possible to model the full transition matrix between states/sectors. Furthermore, we are able to assess the impact of international trade and outsourcing on job creation in the manufacturing sector, controlling for unobserved individual characteristics of workers. Thereby we distinguish between comparative advantage (CA)manufacturing industries and those with a comparative disadvantage (CDA). The individual perspecitve is especially important, since trade displaced workers may differ in terms of their labor market adjustment patterns. Kletzer (2000, p. 26f) argues that "the source of the difficulty is their otherwise disadvantaged characteristics, not the characteristics of the displacement industry". The estimation of the transition matrix between labor market states leads to a dynamic multinomial logit model, for which Honoré and Kyriazidou (2000) propose a fixed effects estimator. With this estimation methodology it is possible reduce the bias from unobservable individual specific influences (like ability), part of which may be state specific.

Second, we offer a generalization of the Honoré Kyriazidou estimation procedure by allowing for heterogeneous effects of the explanatory variables depending on the state of origin. With this more general model we can investigate whether the impact of trade on labor market transitions depends on the previous labor market state.

2 A model for individual labor market transitions

We model employment adjustment by individual labor market transitions. The aim is to estimate the impact of outsourcing and trade on those transitions. In our model, we consider direct transitions between industry sectors as well as transitions which take unemployment or out of labor force as an intermediate step. Therefore we distinguish between 6 different labor market states:

- employment in the service sector
- employment in sales sector
- employment in CA manufacturing sector
- employment in CDA manufacturing sector
- unemployment
- out of labor force.

Comparative advantage is defined according to the revealed comparative advantage index, $RCA_{it} = ln[(x_{it}/m_{it})/(X_t/M_t)]$. Where x_{it} (m_{it}) are imports (exports) of a country's industry i at time t and X_t (M_t) are the country's overall exports (imports) at time t. We classify an industry as having a comparative advantage (disadvantage), if $RCA_{it} > 0$ ($RCA_{it} < 0$) for all t.

An important aspect that should be considered in modeling individual labor market transitions is state dependence. For labor market states, like for many other situations, we observe that an individual, who has experienced an event in the past, is more likely to experience that event in the future than an individual, who has not. Heckman (1981) discusses two explanations for this phenomenon. The first one is the presence of "true state dependence", in the sense that the lagged state enters the model in a structural way as an explanatory variable.

The second explanation is that individuals differ in some unmeasured propensity to experience the event and this propensity is either stable over time, or the values of the propensity are autocorrelated. Heckman calls the latter source of serial correlation "spurious state dependence". To disentangle both effects it is necessary to have longitudinal information on an individual basis. We model transitions in a first order Markov chain[2] and allow for unobserved heterogeneity, thus capturing the spurious state dependence.

We further include time varying explanatory variables. To assess the importance of increased trade openness and import competition on worker flows and sectoral adjustment, we include growth in goods imports and exports as explanatory variables. These variables directly affect labor demand and the pace and structure of job creation and destruction. The set-up follows Kletzer (2000, 2002), who provides a comprehensive discussion of the role of trade variables in explaining changes in employment. Regarding the use of imports as an explanatory variable for job destruction, Kletzer (2000) notes that - depending on the supply elasticities and the competitiveness of domestic firms relative to foreign ones - increasing imports may be associated with falling or rising import shares. Davidson and Matusz (2002, p. 5) note that a surge of imports reduces employment, but that only "changes in trade flows, not levels of trade flows, cause changes in turnover rates" and, accordingly, in the transition probabilities in employment between sectors. Following Goldberg et al. (1999), we use the terms of trade, defined as export prices divided by import prices in common currency (as a real exchange rate measure), in an alternative specification. An increase in this measure of import competition (i.e., a real appreciation) is usually found to reduce labor demand, hence, to rise the probability of losing jobs.

In all model specifications, we also account for the share of outsourcing in an industry. Previous research on international factors of job destruction predominantly focuses on overall (final plus intermediate) goods trade. We know from the recent trade and wages debate that components trade (cross-border fragmentation of production or international outsourcing) significantly affects wages and accounts for part of the rise in the US skilled-to-unskilled workers' wage gap. But to the best of our knowledge, Kletzer (2000, 2002) is the first to distinguish between final goods and input trade in a worker flow approach. Trade theory is unequivocal about the effects of outsourcing on employment at the

[2]Magnac (2000) and D'Addio and Honoré (2002) model duration dependence in a second order Markov model. As we only consider transitions at an annual frequency, we argue that a first order framework should be sufficient.

sectoral level. Heckscher-Ohlin based work á la Arndt (1997) supports the view that outsourcing of labor (rather than capital) intensive production stages leads to an expansion of the labor intensive sector in terms of both output and employment. Thereby, complete intersectoral mobility of all production factors is assumed, which makes the approach more suited for analyzing long run effects. Viewing capital as sector-specific in the short or medium run, Kohler (2001) illustrates that outsourcing of a sector's labor intensive production stages is associated with a decline of this sector's employment. The results in Kletzer (2000, 2002) are in line with the latter reasoning. She provides evidence for the US that outsourcing is indeed positively related to job loss.

Additionally, we introduce labor productivity as an - admittedly crude - indicator of technical change. From a theoretical point of view, the impact of labor productivity on labor demand and, hence, on job flows is not clear a priori.[3] On the one hand, we would expect that an increase in labor productivity reduces labor demand. On the other hand, if the increase is higher than that of the competing firms or industries abroad, domestic industries should be able to gain market shares, all else equal. Since we also control for terms of trade effects, the former effect should be relevant and we expect a negative impact on worker flows in a sector, which has been witnessing productivity gains. Furthermore, the productivity variable should pick up the long term trends, like employment growth in the services sector and a reduction in the other sectors. Lastly, we control for age effects by introducing 3 age classes with age class > 35 years forming the reference group to account for less mobility of older people.

In contrast to the trade and wages studies at the industry level (Feenestra and Hanson, 1999; Ravenga, 1992) all industry specific variables enter our model as exogenous variables. We are less worried about endogeneity of the trade variables because reactions at the individual level are unlikely to exert an impact on industry aggregates.

To formulate the model, let us adopt the latent propensity framework á la McFadden (1974). At each period, the latent variable y^*_{kit} describes the propensity level to be in state k out of states $0, ..., m$ for individual i at time t. In our case states are out of labor force $k = 0$, unemployment, and employment in four different sectors $k = 1, ..., m$ with $m = 5$. We observe N individuals i at $T + 1$

[3] See Stoneman (1983) for an early statement of the argument, and Vivarelli et al. (1996) for a more recent one.

points in time $t = 0, ...T$. The propensity function is determined by

$$y^*_{kit} = x_{kit}\beta_k + z_{it}\gamma_k + \sum_{j=0}^{m} \delta_{jk}\mathbf{1}\{y_{i(t-1)} = j\} + \alpha_{ki} + \epsilon_{kit} \tag{1}$$

where x_{kit} is a vector of state specific individual characteristics (in our case trade and technology), and z_{it} is a vector of person specific individual characteristics (age groups), $\mathbf{1}$ is the indicator function, $y_{i(t-1)}$ indicates the lagged state, $y_{i(t-1)} = j$ if the individual was in state j at $t-1$, α_{ki} is an unobservable individual specific effect and ϵ_{kit} is an unobservable error term. Note that we model unobserved individual heterogeneity depending on the state and each individual has a specific propensity for each alternative. The parameters of interest to be estimated are $\beta = (\beta_0, \ldots, \beta_m)$ and $\gamma = (\gamma_0, \ldots, \gamma_m)$ which give the influence of observed covariates on the propensity of being in each state, and δ the coefficient on the lagged endogenous variable. The parameter δ is allowed to depend upon both the lagged state and the current state, so that there are in total m^2 feedback parameters and δ_{jk} is the feedback effect if the state j at $t-1$ is followed by the state k at time t, where $j, k \in 0, ..., m$.

The link between the latent and the observed variables is given by the device that the observed state has maximal propensity:

$$y_{it} = k \text{ if } y^*_{kit} = \max_l (y^*_{lit})$$

As a consequence, if we assume that the underlying errors ϵ_{kit}, are independent across alternatives and over time conditional on $(x_i, z_i, \alpha_i, y_{i0})$ and identically distributed according to the Type 1 extreme value distribution, the probability of individual i of being in state k at time t, is given by

$$P(y_{it} = k | y_{i(t-1)} = j, x_i, z_i, \alpha_i) = \frac{\exp(x_{kit}\beta_k + z_{it}\gamma_k + \delta_{jk} + \alpha_{ki})}{1 + \sum_{l=1}^{m} \exp(x_{lit}\beta_l + z_{it}\gamma_l + \delta_{jl} + \alpha_{li})} \tag{2}$$

with $\alpha_i = \{\alpha_{ki}\}_{k=1}^m$ and $x_i = \{\{x_{kit}\}_{k=1}^m\}_{t=0}^T$, $z_i = \{z_{it}\}_{t=0}^T$. This implies that the transition matrix of this first order Markov process is heterogeneous between individuals.

The model so far assumes that the effects of the exogenous variables are homogeneous with respect to the state of origin from which the transition is made. For example, a change in outsourcing in the CA manufacturing sector has the same effect for all individuals entering into this sector irrespective of whether they were previously unemployed, out of labor force, or employed in any of the sectors. As an extension we specify a more general model in which the parameters on the state specific exogenous variables β are allowed to depend on the state of origin. Specifically, we consider the following generalization to (2)

$$P(y_{it} = k | y_{i(t-1)} = j, x_i, z_i, \alpha_i) = \frac{\exp(x_{kit}\beta_{jk} + z_{it}\gamma_k + \delta_{jk} + \alpha_{ki})}{1 + \sum_{l=1}^{m} \exp(x_{lit}\beta_{jl} + z_{it}\gamma_l + \delta_{jl} + \alpha_{li})}. \quad (3)$$

with $\beta_k = (\beta_{0k}, \ldots, \beta_{mk})$ giving the influence of the observed covariates on the probability of being in state k for each lagged state.

3 Econometric estimation approach

When specifying and estimating (2) or (3) one has the choice of whether to take a random effects approach or a fixed effects approach. There is a trade off between these two settings: In the random effects model, one specifies the distribution of (α_i, δ_{0i}). The main advantage of this approach is that it delivers a completely specified model. As a consequence all probabilities of interest under any "what-if" scenario can be estimated, provided that the model remains true. One has, however, to make assumptions about the interrelation of the distribution of (α_i, δ_{0i}) with the time varying explanatory variables in all periods, which may be inconsistent with the distribution of these variables. Further there is the initial conditions problem which requires to specify the distribution of (α_i, δ_{0i}) conditional on (y_{0i}, x_i, z_i).[4] In a multinomial framework, like ours, random effects specification leads to the evaluation of multiple integrals which is a major computational challenge. The fixed effects approach attempts to estimate the $(\beta, \gamma)'s$ and $\delta's$ without making any assumptions on the distribution of (α_i, δ_{0i}), and on the way they depend on (x_i, z_i). Only in special cases it is possible to estimate nonlinear models with fixed effects. The estimation method we use here, proposed by Honoré and Kyriazidou (2000), places restrictions on the support of the time-varying explanatory variables. Drawbacks of this approach are, first, that the semi-parametric nature of fixed effects models may lead to estimates that are much less precise than the corresponding random effects estimates. Second, the parameter estimates by this approach do not allow one to calculate objects such as the average effect of the explanatory variables on the probability that y_{it} equals a certain state, because this will depend on the distribution of (α_i, δ_{0i}). In this paper we pursue the fixed effects approach.

[4]See Honoré (2002) for a discussion of these points.

The individual fixed effects parameters α_{ik} in models (2) and (3) cannot be estimated consistently. Unlike in linear models the problem of incidental variables cannot be overcome by differencing. The idea applied by Chamberlain (1984) for fixed effects logit estimation was to derive a set of conditional probabilities that do not depend on the individual effects. Honoré and Kyriazidou (2000) pick up this approach and present a method for the estimation of panel data fixed effects discrete choice models if the explanatory variable set includes strictly exogenous variables, lags of the endogenous dependent variable as well as unobservable individual specific effects. Their estimation method is also extended to the case of multinomial discrete choice variables, and so covers our model of labor market transitions. Honoré and Kyriazidou (2000) regard events where the state variable y switches from say state k to state l or vice-versa between two points in time, say s and t with $1 \leq t < s \leq T-1$. Conditional on such a switch and on the constancy of the explanatory variables in the following periods $(x_{i(t+1)}, z_{i(t+1)}) = (x_{i(s+1)}, z_{i(s+1)})$, the probabilities of the events are independent of the individual effects. The likelihood function for model (2) is given in Appendix A. Appendix B gives the likelihood for the generalized model (3) with origin-specific effects of the exogenous regressors.

Honoré and Kyriazidou (2000) show that the estimator is consistent and asymptotically normally distributed, with a rate of convergence $\sqrt{n\sigma_n^k}$, where k is the dimensionality of x_{it}.

The method allows only for time varying exogenous variables x, z with $P((x_{it} - x_{is}) = 0) > 0, P((z_{it} - z_{is}) = 0) > 0$. For this reason time dummies are excluded. Further no constant can be estimated in the model and therefore it is impossible to calculate the probabilities in the transition matrix with the estimated parameters.

The estimator defined by minimizing (4) depends on a bandwidth and a kernel to be chosen. The choice of the kernel is usually less critical than the choice of the bandwidth in applications of semi- and nonparametric methods. We choose the Epanichnikov kernel given by

$$K(u) = \max\{0, 1 - u^2\}$$

$K(.)$ has a bounded support which implies that many terms in the objective function are 0. Since the choice of the bandwidth is more important than the choice of the kernel, we will experiment with different values of the bandwidth.

4 Data

We use a random sample of males drawn from the Austrian social security records. The social security authority collects detailed information on all workers in Austria, with the exception of self-employed, civil servants and marginal workers. These data contain information on the labor market status of the individuals on a daily basis covering the years 1988 to 2001. We distinguish between the states employed, unemployed and out of the labor force (e.g., education, maternity leave, etc.). For individuals with regular employment we also know the employer's industry sector on a 4 digit level according to NACE classification. We classify employment by 4 different industrial sectors. Specifically, we distinguish between 2 types of manufacturing (CA versus CDA industries), sales, and service sector. To establish a consistent classification, we consider only those manufacturing industries, which did not switch from comparative advantage to comparative disadvantage within the whole period.[5]

For the analysis, we evaluate the labor market status on May 31st of each year.[6] We exclude all individuals from the sample who were never employed during the whole period. Further, individuals who are younger than 16 in 2001 and older than 64 in 1988 are excluded. We are only interested in analyzing movements between industrial sectors, allowing for intermediate steps in unemployment or out of labor force. Transitions from education to the labor force or transitions to retirement should therefore not be considered. For any individual above the age of 55, we define a series of observations in state out of labor force which reaches the end year 2001 as retirement. Analogously, for an individual below the age 27, we define a series of out or labor force observations which starts in the first year (1989) as education. Those observations are excluded from the estimation. After all, we obtain an unbalanced panel of 38.349 male workers.

Table 1 shows the distribution of individuals over the defined states in the first and the last year of the sample. Employment is largest in the service sector. About 32% of the manufacturing sector employment is in comparative advantage industries.[7] We can see a slight employment shift over time from the manufacturing to the service sector. But this has to be interpreted with caution as the age distribution of individuals is not representative over the sampling period.[8]

[5]We should like to thank Deborah Swenson for this suggestion. However, the results regarding the impact of outsourcing on transition probabilities prove also robust, if we relax this condition.

[6]This implies that all movements within a year are left out.

[7]Manufacturing with comparative disadvantage also includes the construction industry.

[8]The exact sampling procedure is the following: Random samples of 50,000 individuals

Table 2 gives annual transition probabilities between the states. There appears to be a high persistence in all employment states. To a large extent, transitions from unemployment and out of labor force occur to the service sector, while transitions to CA manufacturing are relatively rare. There are direct transitions between the sectors, but unemployment or out of labor force as an intermediate step seems to be quite frequent. A comparison of transition probabilities over time again suffers from the non-representative age distribution. Persistency in all states increases, as a consequence of the ageing sample population. But apart from that no big shifts can be detected.

Next, we match the information on individual labor market states and industrial sectors with industry level trade data from Statistics Austria. They comprise goods imports and exports in nominal terms, unit values and imports of intermediate products reclassified from Standard International Trade Classification 5-digit level to the 3-digit NACE level. We use the annual nominal import growth, export growth, terms of trade, and the share of intermediate goods imports in total imports as a measure of outsourcing. We also consider technical change measured as real value added over employment. Sector specific figures on value added and employment are available on a 2 digit level only. The time-path of mean values of the trade variables and the technical progress (productivity) variable is shown in Figure 1.

5 Empirical implementation and results

In the empirical analysis we estimate model (2) with labor market states as the dependent variable, and the set of trade and technical change variables as the determinants of interest. To account for the age structure in the panel we add dummy variables for three age groups as further explanatory variables (an alternative would have been to estimate separate models for age groups). As the reference category we choose the out of labor force state. Age is a person specific explanatory variable in the sense that it does not depend on the state the individual is in. The trade variables are, however, alternative specific exogenous determinants. Therefore, for every individual at every point in time a vector $x_{it} = (x_{1it}, ..., x_{mit})$ has to be defined. For state k the individual is actually in at period t, we use the sector specific trade variable defined by the employer's industry. For the remaining states these variables remain unobserved hence we

each were drawn from the social security records for the years 1992 and 1996. All these individuals were followed from 1984 to 2001. Of course this leads to an age bias in the panel, e.g., too many young workers at the beginning and older workers over-represented at the end of the period.

impute the expected values (state specific mean values over all individuals). Note that the trade variables refer to goods transactions and they are only available for the manufacturing industries. We have to assume that in the other industries no goods trade takes place and, therefore, set the trade variables equal to zero in these industries. As a consequence β coefficients are not identified in the alternatives unemployment, service, and sales.[9] The variable for labor productivity is set to the (individual) mean value over all industries if the state is unemployment or out of labor force. To assess whether there is a significant impact of trade on individual movements between sectors we test the hypothesis $\beta = 0$. A natural test would be the Wald test. Such a test will be justified in the sense that it will have the usual χ^2-distribution under the null, even if the bandwidth is a fixed constant (see D'Addio and Honoré, 2002).

Table 3 reports the estimation results of the basic specification, while Table 4 presents the results of an alternative specification using the terms of trade variable instead of import and export growth. There are two corresponding specifications given in Table 5, which only consider transitions to the two manufacturing sectors by adding all remaining transitions to the reference group. Further, we consider the robustness of the results in Tables 3 and 4 by looking at alternative kernel bandwidths of 0.05 and 0.20 and by using the sign of the industry specific trade balance in all periods as an alternative criterion to define CA and CDA, respectively. The corresponding estimates of the trade and technical change impact on transition probabilities for the two types of models as in Tables 3 and 4 are given in Table 6.[10] In all specifications the trade and technical change variables are jointly significant according to the Wald test. Since the estimation results prove robust in all essential respects, it suffices to use Tables 3 and 4 to discuss our findings.

In line with the literature, we find a negative impact of increased import competition on the inflows of workers into manufacturing as compared to the baseline (out of labor force). However, the coefficient of import growth in Table 3 is only significantly different from zero for the CDA industries. The coefficient on export growth turns out negative, but insignificant. Similar to imports, the terms of trade variable is significantly negative for the comparative disadvantage industries, indicating that all else equal the probability for job changers to find a job in these industries is significantly lower than to go out of labor force

[9] We have trade information for some of the industries in the service sector with nonzero values for about 10% of individuals. Alternative estimation results for $\beta \neq 0$ in the service sector are available upon request.

[10] Of course, a substantial reduction of the kernel bandwidth results in a considerable decline in the number of observations.

or to find a job in the comparative advantage industry. A negative terms of trade or import growth impact is in line with other studies, which to a large extent use higher aggregated data. Ravenga (1992) finds for the US that changes in import prices primarily affect employment rather than wages. She argues that the reason for this evidence is that workers are relatively mobile between industries. Kletzer (2000, p. 9) notes that in unionized labor markets the employment effect may eventually be dampened, since "the presence of rents may leave room for wage concessions". The latter should be particularly relevant for countries with a high degree of unionization such as Austria.

As a second robust result, we find a significant negative impact of outsourcing on the transition probabilities to the CDA manufacturing sector. With the exception of Kletzer (2000, 2002), who finds a positive effect on displacements, the impact of outsourcing on workers' mobility has not been previously considered. In a sense, our short run result squares with the long run Heckscher-Ohlin view of outsourcing, but supports Kohler's (2001) specific factors model view. Note, there is no significant impact of outsourcing on the CA industries.

Lastly, there are pronounced negative effects of increased labor productivity, specifically in CA industries, which are all significant. One reason for this finding might be that technical progress is primarily labor augmenting and capital and labor are complementary in the CDA industries but substitutive in their CA counterparts. Since we observe a negative impact of technical progress on almost all sectors, the significant impact on unemployment is a natural consequence. Technical progress or investment in capital, materialized in an increased labor productivity, reduces the probability to find a job relative to the probability of moving out of labor force. By the same argument technical progress increases the likelihood of becoming unemployed.

Tables 7 and 8 display the results from models with state of origin dependent effects of trade and technology on transition probabilities. For both the trade and technical change variable we test parameter homogeneity across all states of origin. For instance it turns out that the Null of identical origin-specific effects on the transitions into CDA industries is rejected for export growth, terms of trade and outsourcing. See the tables for more details on productivity. The most important results may be summarized as follows.

First, import growth hurts workers in the CDA industries. According to Table 7, their likelihood to stay is significantly reduced (relative to transitions of men out of labor force in these industries). At the same time, their probability to be employed in a CA industry tends to rise, though not significantly. Rising export growth favors transitions of the unemployed into the CDA sector. However, to some extent, this seems to crowd out previous workers in these industries (at least, their likelihood to stay declines).

Second, rising terms of trade (i.e. a loss in competitiveness) mainly is at the expense of transitions in CDA manufacturing industries. It seems that especially previously unemployed workers try to find jobs in the CA industries instead of their CDA counterparts. To see this, compare the different signs of the terms of trade impact on transition probabilities of the unemployed in Table 8.

Third, outsourcing significantly reduces the probability of transitions into the CDA manufacturing industries, and especially so for men out of labor force, the unemployed and workers previously employed in a CDA industry. In contrast, outsourcing does not impede transition into or staying in the CA industries.

Fourth, technical change in terms of rising labor productivity tends to harm transitions to CA manufacturing industries and to increase the likelihood of being unemployed (see the negative signs of the effects in the third coefficient column as compared to the first one in Tables 7 and 8). Furthermore, men out of labor force or unemployed ones are less likely to find jobs in CA manufacturing, sales or service industries, if technical progress raises the productivity of all workers in the market.

6 Conclusion

This paper investigates the consequences of increasing trade and, especially, of outsourcing on gross flows of workers. In contrast to the literature which concentrates on static long run effects, we investigate the short run labor market dynamics. In particular, we estimate the transition probabilities of employment into both other sectors and unemployment/out of labor force, using a dynamic multinomial logit framework with fixed effects of Honoré and Kyriazidou (2000). In this way, we are able to explicitly take care of individual heterogeneity as well as of state dependence. Furthermore, we generalize the model to account for origin-specific effects of the trade variables. The database contains information on individual Austrian male workers over the period 1988-2001.

Our results strongly support the view that international factors are important for labor market turnover, and even more so for industries with a comparative disadvantage (net importing industries). Increases in imports, terms of trade and, especially, in the share of outsourcing in total trade negatively affect the probability of staying in or changing into the manufacturing sector. First, in each and any estimated model the reduction in the transition probability parameters is largest for outsourcing, irrespective of whether we additionally control for other sources of changes in labor productivity. Second, in all cases the reductions in transition probabilities are lower for employment in the comparative advantage group of manufacturing industries. For the latter class of industries, we do not find a negative impact of import growth, rising terms of trade or outsourcing. This finding points to a relative low elasticity of substitution between domestic output and imports. To some extent our results support the findings in previous empirical research, based on static econometric specifications.

In a more general model, with the impact of trade and technology on labor market transitions depending on the lagged labor market state, we find that rising import competition and outsourcing particularly reduce the probability of workers in a comparative disadvantage industry to stay there. Technical progress tends to exert a negative impact on transitions in the industries with a comparative disadvantage, irrespective of the previous labor market state. However, it tends to significantly reduce the likelihood of men being out of labor force or being unemployed to find jobs in the comparative advantage, sales or service industries.

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Appendix A: Likelihood function for the dynamic multinomial logit model with fixed effects

Define the binary variable $y_{hit} = 1$ if the individual is in state $h \in \{0, 1, \ldots, m\}$ in period t and zero otherwise. The estimation of model (2) with fixed individual effects can be based on the maximization of the following likelihood function:

$$
\begin{aligned}
L \; = \; & \sum_{i=1}^{N} \sum_{1 \le t < s \le T-1} \sum_{k \ne l} \mathbf{1}\{y_{kit} + y_{kis} = 1\}\mathbf{1}\{y_{lit} + y_{lis} = 1\} \\
& \mathbf{1}\{z_{i(t+1)} = z_{i(s+1)}\} K\left(\frac{x_{i(t+1)} - x_{i(s+1)}}{\sigma_n}\right) \ln \frac{\exp(D_1)}{1 + \exp(D_1)} \mathbf{1}\{s - t = 1\} \\
+ \; & \sum_{i=1}^{N} \sum_{1 \le t < s \le T-1} \sum_{k \ne l} \mathbf{1}\{y_{kit} + y_{kis} = 1\}\mathbf{1}\{y_{lit} + y_{lis} = 1\} \\
& \mathbf{1}\{z_{i(t+1)} = z_{i(s+1)}\} K\left(\frac{x_{i(t+1)} - x_{i(s+1)}}{\sigma_n}\right) \ln \frac{\exp(D_2)}{1 + \exp(D_2)} \mathbf{1}\{s - t > 1\}
\end{aligned} \tag{4}
$$

with

$$
\begin{aligned}
D_1 \; = \; & (x_{kit} - x_{kis})\beta_k - (x_{lit} - x_{lis})\beta_l + (z_{it} - z_{is})(\gamma_k - \gamma_l) \\
+ \; & \delta_{y_{i(t-1)}k} + \delta_{kl} + \delta_{ly_{i(s+1)}} - \delta_{y_{i(t-1)}l} - \delta_{lk} - \delta_{ky_{i(s+1)}}
\end{aligned}
$$

and

$$
\begin{aligned}
D_2 \; = \; & (x_{kit} - x_{kis})\beta_k - (x_{lit} - x_{lis})\beta_l + (z_{it} - z_{is})(\gamma_k - \gamma_l) \\
+ \; & \delta_{y_{i(t-1)}k} + \delta_{ky_{i(t+1)}} + \delta_{y_{i(s-1)}l} + \delta_{ly_{i(s+1)}} \\
- \; & \delta_{y_{i(t-1)}l} - \delta_{ly_{i(t+1)}} - \delta_{y_{i(s-1)}k} - \delta_{ky_{i(s+1)}}
\end{aligned}
$$

In the objective function $K(.)$ is a kernel and σ_n is a bandwidth which approaches 0 as the number of observations increase to ∞, $x_{it} = (x_{1it}, ..., x_{mit})$. We impose the following identification restrictions:

$$
\begin{aligned}
(\beta_0, \gamma_0) \; &= \; 0 \\
\delta_0 \; &= \; (\delta_{00}, \ldots, \delta_{m0}) = 0 \\
\delta_{0k} \; &= \; 0 \;\; \forall\, k = 1, \ldots, m \\
\alpha_{i0} \; &= \; 0 \;\; \forall\, i = 1, \ldots, N
\end{aligned} \tag{5}
$$

which means that all parameters with respect to the reference state $k = 0$ are equal to zero.

Appendix B: Likelihood function for the model with origin-specific effects of exogenous variables

Here we present a generalization of likelihoodfunction of the dynamic multinomial logit model proposed by Honoré and Kyriazidou (2000) for the case where the effect of the time-varying exogenous variables is allowed to depend on the state of origin. Recall that the generalized model is

$$P(y_{it} = k | y_{i(t-1)} = j, x_i, z_i, \alpha_i) = \frac{\exp(x_{kit}\beta_{jk} + z_{it}\gamma_k + \delta_{jk} + \alpha_{ki})}{1 + \sum_{l=1}^{m} \exp(x_{lit}\beta_{jl} + z_{it}\gamma_l + \delta_{jl} + \alpha_{li})}$$

For this model the expressions for D_1 and D_2 in the likelihood function (4) are given by

$$\begin{aligned}
D_1 &= x_{kit}\,\beta_{y_{i(t-1)}k} + x_{lis}\,\beta_{kl} + x_{y_{i(s+1)}i(s+1)}\,\beta_{ly_{i(s+1)}} \\
&- x_{lit}\,\beta_{y_{i(t-1)}l} + x_{kis}\,\beta_{lk} + x_{y_{i(s+1)}i(s+1)}\,\beta_{ky_{i(s+1)}} \\
&+ (z_{it} - z_{is})(\gamma_k - \gamma_l) \\
&+ \delta_{y_{i(t-1)}k} + \delta_{kl} + \delta_{ly_{i(s+1)}} - \delta_{y_{i(t-1)}l} - \delta_{lk} - \delta_{ky_{i(s+1)}}
\end{aligned}$$

and

$$\begin{aligned}
D_2 &= x_{kit}\,\beta_{y_{i(t-1)}k} + x_{y_{i(t+1)}i(t+1)}\,\beta_{ky_{i(t+1)}} \\
&+ x_{lis}\,\beta_{y_{i(s-1)}l} + x_{y_{i(s+1)}i(s+1)}\,\beta_{ly_{i(s+1)}} \\
&- x_{lit}\,\beta_{y_{i(t-1)}l} - x_{y_{i(t+1)}i(t+1)}\,\beta_{ly_{i(t+1)}} \\
&- x_{kis}\,\beta_{y_{i(s-1)}k} + x_{y_{i(s+1)}i(s+1)}\,\beta_{ky_{i(s+1)}} \\
&+ (z_{it} - z_{is})(\gamma_k - \gamma_l) \\
&+ \delta_{y_{i(t-1)}k} + \delta_{ky_{i(t+1)}} + \delta_{y_{i(s-1)}l} + \delta_{ly_{i(s+1)}} \\
&- \delta_{y_{i(t-1)}l} - \delta_{ly_{i(t+1)}} - \delta_{y_{i(s-1)}k} - \delta_{ky_{i(s+1)}}
\end{aligned}$$

Figure 1: Trade variables, labor productivity yearly mean values (individual level)

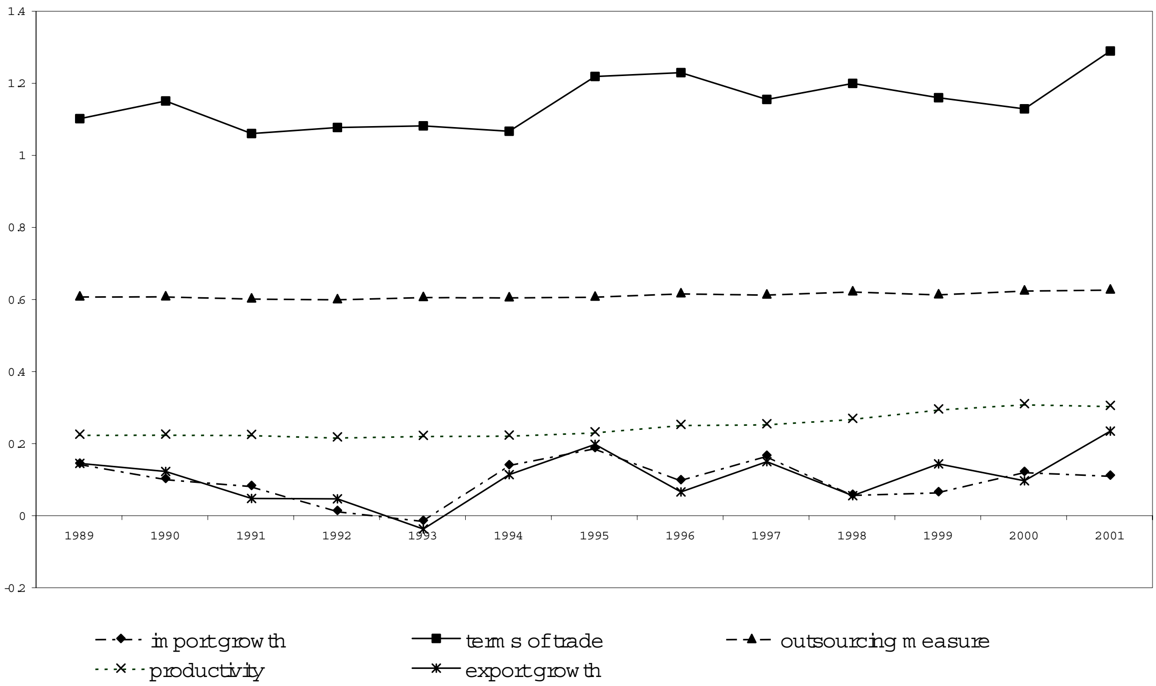

Table 1: Descriptive Statistics, Austrian males by labor market states

Years	1989		2001	
	N	%	N	%
Out of labor force	2,992	10.13	5,842	18.57
Unemployed	1,162	3.93	1,803	5.73
Manufacturing CDA	7,851	26.57	6,649	21.13
Manufacturing CA	3,931	13.30	3,294	10.47
Sales	3,431	11.61	3,274	10.41
Service	10,183	34.46	10,600	33.69
Total	29,550	100	31,461	100

Notes: CA comparative advantage manufacturing industry;
CDA comparative disadvantage manufacturing industry

Table 2: Estimated transition probabilities, Austrian males, yearly transitions

1989-1990

Destination state	Olf	Unempl.	Manuf. CDA	Manuf. CA	Sales	Service
Origin state						
Olf	0.72	0.05	0.09	0.02	0.03	0.8
Unemployed	0.22	0.39	0.12	0.04	0.07	0.15
Manufacturing CDA	0.04	0.02	0.88	0.02	0.02	0.02
Manufacturing CA	0.02	0.02	0.03	0.89	0.02	0.02
Sales	0.03	0.02	0.03	0.01	0.87	0.03
Service	0.03	0.02	0.01	0.01	0.01	0.93

2000-2001

Destination state	OLF	Unempl.	Manuf. CDA	Manuf. CA	Sales	Service
Origin state						
Olf	0.85	0.04	0.02	0.01	0.02	0.06
Unemployed	0.13	0.56	0.07	0.02	0.05	0.16
Manufacturing CDA	0.03	0.03	0.89	0.01	0.01	0.02
Manufacturing CA	0.02	0.02	0.02	0.91	0.01	0.01
Sales	0.03	0.03	0.03	0.02	0.86	0.03
Service	0.03	0.02	0.01	0.01	0.01	0.91

Notes: CA comparative advantage manufacturing industry; CDA comparative disadvantage manufacturing industry;
number of individuals: 29,151 in 1989/1990; 30,498 in 2000/2001

Table 3: Reference model version 1, yearly transitions 1989-2001

Destination State	Unempl.	Manuf. CDA	Manuf. CA	Sales	Service
Origin state					
Unemployment	1.663	0.701	1.141	1.051	1.299
	(0.116)	(0.327)	(0.964)	(0.368)	(0.225)
Manufacturing CDA	1.262	5.307	3.353	1.444	1.852
	(0.172)	(0.383)	(1.165)	(0.589)	(0.416)
Manufacturing CA	1.394	2.693	8.365	2.414	2.168
	(0.324)	(0.889)	(0.969)	(1.025)	(0.919)
Sales	1.322	2.024	2.476	5.070	1.754
	(0.244)	(0.704)	(1.846)	(0.451)	(0.484)
Service	1.482	1.977	2.502	1.452	4.623
	(0.157)	(0.492)	(1.139)	(0.511)	(0.244)
Trade variables					
Import growth		-1.972	-1.044		
		(0.731)	(2.638)		
Export growth		-1.262	-1.097		
		(0.745)	(2.699)		
Outsourcing		-2.600	-0.441		
		(0.283)	(0.892)		
Technical progress					
Productivity	3.398	-0.021	-5.164	-1.413	-0.489
	(6.330)	(0.479)	(0.869)	(0.891)	(0.064)
Age					
Age <25	1.518	1.432	1.245	0.928	0.217
	(0.661)	(1.023)	(3.365)	(1.392)	(0.702)
Age 25-30	0.731	0.674	0.193	0.807	-0.093
	(0.519)	(0.867)	(2.997)	(1.193)	(0.566)
Age 30-35	0.246	0.148	-0.050	0.157	-0.341
	(0.405)	(0.615)	(1.815)	(0.946)	(0.462)

Mean log-likelihood	-0.0544317
Number of individuals	38349
Number of cases	57136
Wald test $\chi^2(11)$	225.775

Notes: fixed effects logit model estimated with conditional ML, Austrian males;
standard errors in parentheses;
Wald test for joint significance of trade and technical change variables.

Table 4: Reference model version 2, yearly transitions 1989-2001

Destination State	Unempl.	Manuf.CDA	Manuf.CA	Sales	Service
Origin state					
Unemployment	1.905	0.538	0.959	0.930	1.329
	(0.056)	(0.136)	(0.357)	(0.150)	(0.107)
Manufacturing CDA	1.381	4.346	2.330	1.105	1.684
	(0.080)	(0.124)	(0.365)	(0.229)	(0.182)
Manufacturing CA	1.737	2.136	6.691	1.899	1.910
	(0.167)	(0.324)	(0.404)	(0.398)	(0.354)
Sales	1.418	1.289	1.720	4.225	1.431
	(0.106)	(0.261)	(0.501)	(0.145)	(0.202)
Service	1.535	1.457	1.698	1.092	4.206
	(0.075)	(0.191)	(0.492)	(0.210)	(0.104)
Trade variables					
Terms of trade		-0.714	-0.621		
		(0.064)	(0.291)		
Outsourcing		-1.938	0.047		
		(0.137)	(0.315)		
Technical progress					
Productivity	15.055	0.766	-3.402	-1.708	-0.398
	(3.320)	(0.213)	(0.344)	(0.376)	(0.029)
Age					
Age <25	0.572	1.007	-0.109	1.233	0.095
	(0.316)	(0.442)	(1.125)	(0.582)	(0.336)
Age 25-30	0.174	0.551	-0.458	1.146	-0.184
	(0.264)	(0.381)	(1.014)	(0.509)	(0.283)
Age 30-35	-0.004	0.070	0.251	0.686	-0.282
	(0.202)	(0.292)	(0.788)	(0.429)	(0.227)

Mean log-likelihood	-0.107351
Number of individuals	38349
Number of cases	102886
Wald test $\chi^2(9)$	813.487

NOTE: fixed effects logit model estimated with conditional ML, Austrian males;
standard errors are in parentheses;
Wald test for joint significance of trade and technical change variables.

Table 5: Reference model version 1 and 2, transitions to the manufacturing industries only, yearly transitions 1989-2001

	Model version 1		Model version 2	
Destination State	Manuf. CDA	Manuf. CA	Manuf. CDA	Manuf. CA
Origin state				
Unemployment	-0.239	-0.046	-0.351	-0.168
	(0.254)	(0.698)	(0.114)	(0.281)
Manufacturing CDA	4.733	2.788	3.947	1.882
	(0.336)	(1.058)	(0.112)	(0.325)
Manufacturing CA	2.042	8.722	1.536	6.398
	(0.817)	(0.834)	(0.302)	(0.382)
Sales	-0.526	-0.158	-0.713	-0.686
	(0.338)	(0.986)	(0.154)	(0.345)
Service	-0.801	-0.386	-0.747	-0.693
	(0.274)	(0.764)	(0.127)	(0.314)
Trade variables				
Import growth	-1.720	-0.655		
	(0.701)	(2.496)		
Export growth	-0.903	-0.952		
	(0.688)	(2.434)		
Terms of trade			-0.602	-0.407
			(0.061)	(0.255)
Outsourcing	-2.509	-0.654	-1.889	-0.174
	(0.257)	(0.840)	(0.125)	(0.296)
Technical progress				
Productivity	-0.086	-5.767	0.521	-3.512
	(0.384)	(0.813)	(0.201)	(0.316)
Age				
Age <25	1.482	1.312	1.229	0.343
	(0.894)	(3.063)	(0.398)	(1.028)
Age 25-30	0.807	0.226	0.729	-0.145
	(0.759)	(2.821)	(0.343)	(0.925)
Age 30-35	0.324	0.057	0.221	0.283
	(0.557)	(1.653)	(0.264)	(0.703)
Mean log-likelihood	-0.121524		-0.207556	
Number of individuals	38349			
Number of cases	57136		102886	
Wald test	192.181		664.728	

NOTE: fixed effects logit model estimated with conditional ML, Austrian males; standard errors are in parentheses;
Wald test for joint significance of trade and technical change variables.

Table 6: Robustness checks: varying bandwidths and manufacturing classifications

	Model version 1			Model version 2			
	Terms of trade	Outsourcing	Productivity	Imp.growth	Exp. growth	Outsourcing	Productivity
RCA, bandwidth=0.05	30,413 cases			9,417 cases			
Manufacturing CDA	-0.812	-2.851	1.861	-5.196	-3.697	-3.849	-0.322
	(0.129)	(0.257)	(0.444)	(4.353)	(4.860)	(1.328)	(3.095)
Manufacturing CA	-0.479	-0.131	-3.944	-6.544	-0.629	-0.473	-8.696
	(0.597)	(0.619)	(0.708)	(26.292)	(28.163)	(10.221)	(13.693)
RCA, bandwidth=0.20	189,985 cases			209,169 cases			
Manufacturing CDA	-0.627	-1.572	0.530	-1.291	-0.700	-2.152	-0.073
	(0.039)	(0.085)	(0.130)	(0.300)	(0.238)	(0.113)	(0.179)
Manufacturing CA	-0.644	0.060	-3.400	0.540	-0.028	-0.193	-3.812
	(0.166)	(0.190)	(0.205)	(0.711)	(0.472)	(0.283)	(0.273)
Trade balance, bandwidth=0.10	103,037 cases			34,518 cases			
Manufacturing CDA	-0.765	-1.435	0.572	-1.967	-1.907	-2.155	0.000
	(0.065)	(0.122)	(0.210)	(0.890)	(0.984)	(0.323)	(0.554)
Manufacturing CA	-0.802	-0.302	-3.361	0.398	-2.359	-1.071	-4.849
	(0.321)	(0.519)	(0.427)	(4.463)	(4.495)	(1.820)	(1.562)

NOTE: fixed effects logit model estimated with conditional ML, Austrian males, yearly transitions 1989-2001; standard errors are in parentheses.

Table 7: Origin specific effects of trade and technical change variables, model version 1

Destination State	Unempl.	Manuf.CDA	Manuf.CA	Sales	Service
Origin state					
Import growth					
Olf		-0.829	-4.797		
		(2.858)	(5.559)		
Unemployed		-0.775	1.521		
		(1.897)	(14.164)		
Manuf. CDA		-2.237	4.105		
		(1.415)	(16.358)		
maunf CA		-2.285	-0.853		
		(30.208)	(8.205)		
Sales		-2.704	-7.999		
		(8.655)	(25.265)		
Services		-5.261	-3.638		
		(10.277)	(21.015)		
Wald test $\chi^2(5)$		0.605	0.509		
Export growth					
olf		-0.278	1.633		
		(1.853)	(5.640)		
Unemployed		3.222	4.642		
		(1.736)	(15.853)		
Manuf. CDA		-2.988	-11.099		
		(0.952)	(13.044)		
maunf CA		-2.500	-1.425		
		(24.584)	(8.137)		
Sales		4.622	0.423		
		(5.959)	(17.557)		
Services		-1.494	-11.390		
		(6.364)	(28.708)		
Wald test $\chi^2(5)$		11.146	1.143		
Outsourcing					
Olf		-2.387	0.828		
		(0.587)	(1.395)		
Unemployed		-3.673	2.323		
		(0.739)	(5.634)		
Manuf. CDA		-3.722	0.858		
		(0.560)	(3.079)		
maunf CA		0.619	-1.643		
		(4.710)	(2.557)		
Sales		-0.710	-0.787		
		(2.088)	(7.476)		
Services		0.611	-4.404		
		(1.54)	(5.587)		
Wald test $\chi^2(5)$		11.151	1.632		
Productivity					
Olf	11.579	0.603	-6.261	-1.279	-1.163
	(7.753)	(1.121)	(1.260)	(1.673)	(0.125)
Unemployed	-0.652	-0.347	-27.721	-4.601	-7.355
	(7.504)	(1.579)	(14.018)	(2.172)	(0.220)
Manuf. CDA	9.710	-0.147	-7.404	1.744	0.157
	(11.822)	(0.665)	(6.867)	(3.564)	(0.581)
maunf CA	8.441	-6.991	-3.449	2.948	-2.815
	(25.337)	(14.395)	(2.620)	(8.529)	(2.090)
Sales	6.821	-0.884	-8.974	-2.016	0.197
	(15.245)	(1.431)	(12.177)	(1.494)	(0.597)
Services	7.732	1.611	-29.060	0.785	-0.528
	(9.423)	(3.569)	(25.836)	(2.582)	(0.113)
Wald test $\chi^2(5)$	3.680	1.196	4.952	4.128	810.703
Mean log-likelihood	-0.0520432				
Number of individuals	38349				
Number of cases	57136				

Notes: see table 8

Table 8: Origin specific effects of trade and technical change variables, model version 2

Destination State	Unempl.	Manuf.CDA	Manuf.CA	Sales	Service
Origin state					
Terms of trade					
Olf		-0.409	0.448		
		(0.131)	(0.559)		
Unemployed		-0.789	2.013		
		(0.178)	(1.609)		
Manuf. CDA		-0.947	-0.005		
		(0.104)	(1.044)		
maunf CA		-0.500	-0.905		
		(0.745)	(0.435)		
Sales		0.370	3.304		
		(0.531)	(2.433)		
Services		-0.965	0.630		
		(0.200)	(1.503)		
Wald test $\chi^2(5)$		16.356	8.272		
Outsourcing					
Olf		-3.582	0.127		
		(0.235)	(0.550)		
Unemployed		-2.388	-2.161		
		(0.344)	(1.116)		
Manuf. CDA		-1.864	1.505		
		(0.249)	(1.044)		
maunf CA		1.203	-0.083		
		(1.653)	(0.701)		
Sales		-0.797	-0.980		
		(0.881)	(1.658)		
Services		0.956	-1.937		
		(0.589)	(1.616)		
Wald test $\chi^2(5)$		70.820	7.454		
Productivity					
Olf	22.126	1.396	-4.991	-1.813	-2.366
	(4.236)	(0.470)	(0.602)	(0.653)	(0.062)
Unemployed	0.383	1.521	-16.305	-3.148	-4.812
	(3.973)	(0.611)	(2.850)	(0.933)	(0.088)
Manuf. CDA	17.515	0.162	-3.350	0.222	0.233
	(7.430)	(0.353)	(1.248)	(1.301)	(0.148)
Maunf. CA	15.271	-1.145	-1.519	1.873	-2.766
	(15.636)	(1.743)	(0.606)	(2.654)	(0.686)
Sales	15.363	-3.073	-12.172	-2.041	0.160
	(8.324)	(0.934)	(3.744)	(0.611)	(0.242)
Services	16.329	2.652	-4.618	-1.400	-0.399
	(5.318)	(1.231)	(1.561)	(1.176)	(0.053)
Wald test $\chi^2(5)$	31.676	26.027	42.005	6.718	2198.563
Mean log-likelihood	-0.103613				
Number of individuals	38349				
Number of cases	102886				

Notes: fixed effects logit model estimated with conditional ML, Austrian males, yearly transitions 1989-2001; standard errors are in parentheses;
Wald tests for equality of origin specific effects, critical value 11.07.

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Title: Sectoral Adjustment of Employment: The Impact of Outsourcing and Trade at the Micro Level

Reihe Ökonomie / Economics Series 145

Editor: Robert M. Kunst (Econometrics)
Associate Editors: Walter Fisher (Macroeconomics), Klaus Ritzberger (Microeconomics)

ISSN: 1605-7996

ISSN: 1605-7996