Intra-industry Trade Expansion and Reallocation Between Sectors and Occupations

Manuel Cabral * and Joana Silva**

Abstract

In the present paper we re-examine the relation between trade and labour market adjustment costs by considering the effects of occupational mobility. We study the hypothesis that intra-industry trade expansion entails lower adjustment costs (Smooth Adjustment Hypothesis - SAH). This paper presents two important contributions. First, the introduction of a new adjustment variable that considers reallocation between sectors and occupations. Second, it tests the SAH using a multiple linear regression panel data model with relevant trade and non-trade control variables, which overcomes some of the methodological limitations of former studies The results suggest a confirmation of the SAH and stress the importance of considering the effects of worker moves between occupations in the study of trade induced adjustment cost.

Contents:

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* Escola de Economia e Gestão, Universidade do Minho
** University of Nottingham

1. Introduction

In recent decades the reduction of trade barriers was accompanied by increasing concerns about the political, social and economic impact of trade liberalization. Moreover, particular attention has been paid to the short run costs associated with the transition between the pre- and the post-liberalization economic equilibrium. In this context, the claim first made by Balassa (1966) that trade expansion of intra-industry type entails lower adjustment costs than trade expansion of inter-industry type – "Smooth Adjustment Hypothesis" (SAH) is of great importance.

The discussion of the impact of trade in the labour markets motivated a large number of recent studies that followed the development of the Marginal Intra-industry Trade (MIIT) indexes by Brülhart (1994)[1]. The results of these studies were inconclusive. Here we argue that this may result from both inadequate estimation methods and inappropriate adjustment costs measures.

To test the SAH one needs to confront dynamic trade variables with a dependent variable that reflects adjustment costs in a complete and unbiased way. Most former studies used simple correlation analysis and very crude measures of adjustment cost[2]. Rather than confronting the validity of the SAH, these focused in discussing which trade variables were better suited to reflect that adjustment costs are lower with intra-industry trade.

Here we focus instead in improving the adjustment variable. We argue that trade expansion may imply, not only a variation on the total labour demand of the industry, but also on the composition of labour demand of each industry. That is, a variation on the relative demand of services of different occupational groups in the industry. Recent labour economics empirical studies suggest that this *composition effect* may entail important adjustment costs, arguing that that the adjustment costs associated with labour movements may be mostly related to the costs of occupational change[3].

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[1] Brülhart and Elliot (1998), Sarris et al (1999); Tharakan and Calfat (1999), Brülhart et al. (1999), Porto and Costa (1999), Rossini and Burratoni (1999), Smeets and Reker (1999), Kol and Kuijpers (1999), Harfi and Montet (1999), Brülhart (2000), Cristóbal (2001), Brülhart and Elliott (2002), Brülhart et al. (2003).

[2] The adjustment variables used in most of the studies measure only variations in total labour of a sector, a very limited adjustment variable that should no be expected to have any significant relation with the trade variables used to test the SAH.

[3] Haynes et al. (2002) show that labour movements between industries that do not involve change of occupation do not imply higher adjustment costs than labour movements within an industry that involve a change of occupation.

In this paper we propose a new measure of labour market adjustment costs capable of assessing both effects. Our adjustment variable is based on the occupational changes in each industry, measuring not only total changes in employment level but also changes in composition of the labour force of each industry (in the number of workers in each occupational group). Therefore, it measures in a more complete way the total (adjustment costs) effect of a trade expansion.

By focusing in measuring labour reallocation in a more appropriate way, we follow the same line of the recent studies of Elliott and Lindley (2003) and Brülhart et al. (2004). Both introduced important improvements in the adjustment variables, by considering labour movements between industries, using individual workers data for the UK. Brülhart et al. (2004) also considers a separate variable for movements of workers between occupations.

The new variable that we suggest here considers both types of labour reallocation and manages to do so eliminating movements of individual workers that are not expected to be related with changes in labour demand induced by trade, which is appropriate when the purpose is testing the SAH. Our variable also allows to consider together the effects of movements between occupations and sectors, giving a complete picture of the adjustment induced in each sector that can be compared with its trade expansion to test the SAH.

The labour reallocation measure is used as dependent variable in a multiple linear regression model that considers trade and non-trade control variables, using Portuguese data. The econometric results strongly support the SAH. This is an important contribution, given the shortage of studies that use relevant adjustment variables or regression models capable of testing the relationship between marginal intra-industry trade and adjustment predicted by the SAH in a appropriate way.

The rest of the paper goes as follows. Section 2 presents a review of the relevant empirical literature on SAH and a critic overview of the adjustment variables used in former studies. Section 3 presents our adjustment variable. Section 4 provides a description of the data set used to calculate the proposed variable and some descriptive evidence on its advantages. Section 5 outlines the econometric model. Section 6 presents the key results of our empirical study of the SAH based on our new variable. Section 7 concludes.

2. Adjustment variables used to test the SAH.

The hypothesis that matched trade expansion leads to less adjustment costs than net trade expansion - (SAH) - is almost as old as intra-industry trade itself (e.g. Balassa 1966, and Krugman, 1981). This hypothesis soon became an assumption[4], which managed to survive a long time without being exposed to empirical test.

The development of dynamic intra-industry trade measures, particularly the Marginal Intra-Industry Trade (MIIT) index, suggested by Brülhart (1994), motivated the numerous studies about intra-industry trade adjustment costs. Earlier studies that followed Brülhart (1994) analyzed correlations between adjustment cost and different intra-industry trade variables. The first studies that used an econometric method suited to test the SAH were those of Brülhart and Elliott (1998), Brülhart *et al* (1998), Sarris *et al.* (1999) and Tharakan and Calfat (1999). But the adjustment variables used in these studies are very limited or not even in accordance with the hypothesis. In this context, the contradictory and weak results obtained were not surprising[5]. The adjustment variable used, implied that these results could not be interpreted as an empirical confirmation of the SAH[6].

Most former studies used as a labour market adjustment costs variable either the change in total industry-level employment (ΔL_j) or the share of intra-industry job turnover in an industry's total job turnover (WHITHIN$_j$) – see table 1.

Change in total industry employment

The industry level of employment changes (ΔL_j) was considered an inverse proxy for adjustment costs. The higher/lower this variable the lower/higher the adjustment costs. This variable is based on the assumption that the lower the employment loss implied by trade the lower the adjustment costs. As Brülhart and Elliott (1998) argue, net sector employment change is a measure of net employment performance rather than adjustment costs.

4 Using the smooth adjustment hypothesis as an assumption, several authors argued that economic integration would be smoother between countries with similar level of development, since in these countries intra-industry trade flows tend to dominate trade (e.g. Krugman 1987, Greenaway and Hine 1991).

5 In most cases the correlation coefficients were not statistically significant and its signs are rarely according with the predictions.

6 The limitations associated with the adjustment variable harms the validity of the statistic inference about the SAH done from the obtained results.

Table 1: - Adjustment costs variables considered in former SAH studies

Adjustment Variables	Definition	Studies
ΔL_j	$\frac{L_j^{n_f} - L_j^{n_i}}{(L_j^{n_f} + L_j^{n_i}) * 0,5} * 100$ where $L_j^{n_f}$ and $L_j^{n_i}$ are, respectively, the number of workers in sector j in the initial (n_i) and final (n_f) year of the period under analysis.	Hine et al. (1994)[(a)]; Brülhart (1995)[(a)]; Brülhart and McAleese (1995)[(a)]; Brülhart et al. (1999)[(a)]; Porto and Costa (1999)[(a)]; Rossini e Burratoni (1999)[(a)]; Smeets and Reker (1999) [(a)]; Kol and Kuijpers (1999)[(a)]; Harfi and Montet (1999) [(a)]; Brülhart and Elliott (1998) [(b)]; Sarris et al (1999)[(b)]; Tharakan and Calfat (1999)[(b)]
$\lvert \Delta L_j \rvert$	$\frac{\lvert L_j^{n_f} - L_j^{n_i} \rvert}{(L_j^{n_f} + L_j^{n_i}) * 0,5} * 100$	Cristobal (2001)[(b)]
$WITHIN_j^n$	$\frac{(POS_j^n + NEG_j^n) - \lvert POS_j^n - NEG_j^n \rvert}{POS_j^n + NEG_j^n}$ where, $POS_j^n = \sum_i (L_i^n - L_i^{n-1}) \ if \ L_i^n - L_i^{n-1} > 0$ $NEG_j^n = \sum_i \lvert L_i^n - L_i^{n-1} \rvert \ se \ L_i^n - L_i^{n-1} < 0$ Where i stands for firm and j stands for industry.	Brülhart et al. (1998 and 2003)[(c)]; Brülhart (2000)[(c)].
$DURATION_j$	Average duration of the period of unemployment of the unemployed workers dismissed from the industry j.	Brülhart and Elliott (2002)[(b)]
$WAGEVAR_j$	Standard deviation of the real wage of the industry.	Brülhart and Elliott (2002)[(b)]
$CWAGEVAR_j$	Standard deviation of the real wage of the industry calculated through the estimated coefficients of the sectoral Phillips curve.	Brülhart and Elliott (2002) [(b)]
INTRA- and INTER SECTORAL MOVER	Registers the change in firm or industry of employment for each individual. Does not consider changes in occupations.	Elliott and Lindley (2003)
$INDMOVE_j$	$\frac{\sum_x m_{xj}}{L_j^{n_i}}$ = share of industry moves with *m_{xj}=1* if the worker *x* of industry *j* moved to a different industry between *n* and *n+1*, and *m=0* if the worker stayed.	Brülhart et al. (2004)
$OCCMOVE_j$	$\frac{\sum_x z_{xj}}{L_j^{n_i}}$ = share of occupation moves with *z=1* if the worker *x* of industry *j* moved to a different occupation between *n* and *n+1,* and *z=0* if the worker remained the same occupation.	

Notes: a), b) and c) denotes, respectively, studies that use only simple correlations; studies where an equation was estimated using cross section single equation models; studies where an equation was estimated employing fixed-effect panel model.

The measures of employment performance should not be expected to be related with the type of trade expansion. So no clear relation can be predicted between $MIIT_j$ and ΔL_j. As Greenaway and Milner (1986, p. 80) have pointed out, "*the exchange of differentiated products (IIT) by a country with the rest of the world can change without any change in its production structure and therefore without affecting specialization*". Consequently, matched trade expansion may not affect the total production of each sector leaving the respective size of the labour force unaltered. Therefore, higher levels of Marginal Intra-Industry Trade are expected to be associated with lower levels of variation on the total employment of each sector, while in industries where the inter-industry component of trade expansion is dominant (industries with lower MIIT indexes) the net change of the total employment can be either positive (on industries with net export expansion) or negative (on industries with net import expansion) and so either larger or smaller than in industries where the intra-industry component of trade expansion is dominant[7].

To surpass this problem Cristóbal (2001) uses an alternative proxy for adjustment costs earlier suggested by Brülhart and Elliott (1999) and Brülhart (1999) - the absolute value of total employment changes ($|\Delta L_j|$). According to the SAH the relation between this variable and MIIT is negative.

This variable, although more correct, still has two problems, that shares with the previous one (ΔL_j). First, it is very limited because is based in a restrictive understanding of reallocation adjustment costs. For example, in an industry where 10,000 operatives are dismissed and 10,000 managers or engineers are admitted this variable would register no adjustment costs. This vision of adjustment costs abstracts from the microeconomic costs (faced by individuals) of dismissal. Recent works in the labour literature (e.g. Kletzer 1998 and Haynes *et al.* 2002) emphasise the importance of these costs suggesting that changing occupation can be the major cause of adjustment costs.

Second, it is biased towards the confirmation of the hypothesis, since it counts only variations in total employment, ignoring the effects of changes in the composition of each industry's labour force, that may result from openness to trade. One may admit that net trade expansion will affect (either positively or negatively) the total production of the sector, and consequently mainly the total employment. Matched trade expansion on the opposite will tend to have smaller effects on total demand of each sector and on its respective total employment, but may affect the composition of the labour requirements of each sector. In particular, we would expect this to happen in the case of exchanges of varieties of different

7 This criticism was considered by Harfi and Montet (1999), Cristóbal (2001), Brülhart and Elliott (2002).

levels of quality, since the level of quality and the factor requirements of the production replaced by imports may differ from that of the matching expanding exports[8]. In this case intra-industry trade may induce important adjustments in the labour markets that would be ignored by the variable ($|\Delta L_j|$).

Job turnover

A different variable used was based in job turnover – WITHINj. Brülhart et al. (1998 and 2003) and Brülhart (2000) used this measure, initially proposed by Davis and Haltiwanger (1992), in the context of the SAH. It reflects the importance of labour reallocation within an industry. This variable is based on the idea, confirmed by Strobl (1996) and Davies et al. (1996), that the degree of job reallocation is well beyond the net aggregate employment creation and destruction and job flows across sectors.

Nevertheless, job turnover may be higher in sector A than in sector B for at least two different types of reasons. One is when the sector is firing one type of workers (say operatives) and hiring another type of workers (e.g. engineers). In this case it is associated with higher adjustment costs. Other type of reasons that may explain higher job turnover in one sector is because intra-sectoral job reallocation is easier. But the reasons for this tend to be linked to sector specificities[9] which should not be expected to be influenced by the share of matched trade flows in trade expansion.

The empirical studies that used variables based in job turnover assume that these reflect lower adjustment costs. The argument goes that changing jobs within the same sector implies less adjustment costs than changing between sectors, so sectors with a large $WITHIN_t$ will have less adjustment. We accept the first part of the argument as reasonable, but not the link with the second. First, because not changing firm may have even less adjustment costs than changing between firms of the same sector. Second, because a large number of people being accepted and fired in the same sector does not mean that it is the same people moving within the sector. It could be a result of people with lower qualifications being expelled from the sector while more qualified workers are being employed. In this case, bigger $WITHIN_{jt}$ would reflect bigger adjustment costs. Just the

[8] Note that recent studies reveal that matched trade flows of varieties of different level of quality are the dominant type of intra-industry trade. Theory, namely the Falvey (1981) model, predicts that these may include the exchange of varieties produced with different input requirements.

[9] For example, sectors where the skills are more firm specific may have less job turnover than sectors where these are sector specific. The role of institutional factors, such as union membership, and type of contracts, may also influence job turnover, as well as the characteristics of the labour requirements of the sector. These

opposite of the argument assumed. Furthermore, Haynes *et al.* (2002) collected evidence that supports the idea that labour transfers between sectors maintaining the same occupation/job do not imply higher adjustment costs than labour transfers within the same sector involving occupation/job change. Under this setting, labour reallocation costs arise essentially because of occupational change, not sectoral change.

More interesting are the three new adjustment variables based on wages variations and unemployment duration by sector introduced by Brülhart and Elliott (2002). These variables are an important contribution, namely in assessing the adjustment costs due to market failure. In this paper, we acknowledge this, but follow a different path, focusing in reallocation costs.

Individual-level data

The recent studies of Elliott and Lindley (2003) and of Brülhart et al. (2004) also focus on improving the measuring of reallocation costs. These authors study the relationship between intra-industry trade and labour reallocation using individual-level data on manufacturing worker moves in the United Kingdom. Brülhart et al. (2004) estimate the impact of different types of trade flows on worker moves both between industries and between occupations. This is a very important contribution since worker moves between occupations were ignored in former SAH studies. They conclude that "*intra-industry trade does have the stipulated attenuating effect on worker moves, both between occupations and between industries*" Brülhart et al. (2004, p1).

Brülhart et al. (2004) use two types of dependent variables, one for worker moves between industries and another that considers worker moves between occupations. Here we follow the same line, considering both moves between occupations and between industries, but we construct an industry level variable that allow us to aggregate occupation and sector moves in one adjustment variable. This is important to test the SAH, since it gives a measure of total adjustment costs that one can relate with marginal IIT variables.

In the regressions Elliott and Lindley (2003) and Brülhart et al. (2004) consider individual observations for each worker included in the *Quarterly Labour Force Survey* in two different years. The use of individual worker data has the advantage of increasing the number of observations. But it also means that a large number of worker moves may be motivated by individual reasons rather than by industry adjustment to trade expansion.

may be influenced by exposure to trade, but the theory does not predict that share of matched trade flows in trade expansion, would play a clear role.

Brülhart et al. (2004, p. 17) note that an important limitation is that they are unable to "*distinguish between voluntary and involuntary moves*".

Another limitation of using individual level data is that one cannot distinguish moves that are motivated by changes in the sector from those that result from individual reasons. Workers may move from one sector or occupation to another for two groups of reasons. One is because the relative demand of labour of the different sectors or the occupational requirements of each sector may change. In this case it is mandatory that some workers will be forced to move between sectors and occupations. Another group of reasons might arise from characteristics or decisions of each individual worker. Workers might be promoted to a new occupation, or fired by their own incompetence, or move to a different job and sector because they fell more motivated to do so, change occupation or industry for health or familiar reasons.

While the first group of reasons should be expected to be related to trade expansion[10] and to involuntary moves, the second includes worker movements that should not be expected to be related to trade changes, but rather with individual workers and job characteristics[11], which include both voluntary and involuntary moves.

The inclusion of this two types of moves might be one of the reasons why Brülhart et al. (2004, p1) conclude that the effect of trade variables is *relatively small compared to other determinants of labour reallocation*[12], such as age, working in a large firm, working part time, being married or a home owner.

Our variable, although considering both movements between occupations and between industries, considers only movements of workers that are related to changes in the size of labour force of each sector or to the relative occupational requirements of each sector, excluding in this manner worker moves motivated only by individual reasons. The inclusion of these movements may create a problem of omitted variable bias[13] and overstate the adjustment costs resulting from trade expansion[14].

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[10] Trade expansion, as well as changes in demand and in technology, might affect the relative size and occupational requirements of the different sectors.

[11] Such as willingness to take risks, level of qualifications, career prospects offered by the job or firm size.

[12] Brülhart et al. (2004) also note that the low degree of import penetration of the UK may also explain the low relative importance of the effect of trade variables. This might differ for the Portuguese case since the weight of import penetration in the Portuguese national income is twice that of the UK.

[13] If we consider that the proxy control variables only capture a part of the individual workers motivations.

[14] If 100 plant operators are replaced by 100 plant operators in sector A, because the first voluntarily moved industry or because their performance was unsatisfactory, and in sector B the employment of 100 plant operators just disappears, the measures of adjustment suggested by Brülhart et al. (2004) give that adjustment costs in the first case were twice those of the second. However, factor reallocation that occurred in the first case cannot be plausibly correlated with the pattern of *change* in trade flows (no job extinction was involved). In this sense this variable may overestimate the labour market adjustment costs associated with trade expansion of some sectors.

3. A New Adjustment Costs Variable That Considers Occupation Moves

In this section we propose a new variable that surpasses most of the limitations and problems discussed in the previous section. This variable includes the effect of both sector moves and occupational moves. The first results from changes in the dimension of each sector (in terms of employment) while the second of results from changes in the composition of occupations required by each sector.

The total (reallocation) effect (*TE_j*) is equal to the sum of the net variations of workers in each occupational group[15] (in absolute value) weighted by the average total employment of the industry in the period[16]. This effect is measured by

$$TE_j = DE_j + CE_j = \frac{|L_j^{n_f} - L_j^{n_i}|}{(L_j^{n_i} + L_j^{n_f}) * 0{,}5} + \frac{(\sum_k |L_{jk}^{n_f} - L_{jk}^{n_i}|) - |L_j^{n_f} - L_j^{n_i}|}{(L_j^{n_i} + L_j^{n_f}) * 0{,}5} = \frac{\sum_k |L_{jk}^{n_f} - L_{jk}^{n_i}|}{(L_j^{n_i} + L_j^{n_f}) * 0{,}5}$$

where $L_{jk}^{n_i}$ e $L_{jk}^{n_f}$ are, respectively the number of workers in the industry *j* that belong to the professional group *k* in the initial (*n_i*) and final (*n_f*) year of the period under analysis.

This variable aggregates the variation in total labour demand of the industry – the variation of the industry's employment level - Dimension Effect (*DE_j*) – with the variation in the relative demand of different occupational groups, that do not affect the total demand of labour of the industry – changes in the composition (in terms of occupations) of the labour force of each industry - Composition Effect (*CE_j*). It is equal to zero when the number of workers in each professional group and industry does not change during the period. The higher the value assumed by *TE_j*, the higher the employment reallocation and thus the higher the adjustment costs.

This adjustment variable has important advantages, when compared with those used in the former SAH studies.

a) It is more informative: Former studies ignored the adjustment effects of changes in the occupational structure of employment in each industry[17]. As we show in section 4 changes in the composition of the employment are a very important. By ignoring this, former

[15] Note that two workers belong to the same professional group if they have the same job/occupation.
[16] Dividing for average total employment of the industry in the period corresponds to scaling for the dimension of each industry. In the contest of the SAH this methodological option is necessary because the same volume of changes in the number of employees induced by trade expansion in industries with different dimension implies adjustment costs of different magnitude.
[17] The exception being the recent study of Brülhart el al. (2004).

variables may underestimate adjustment costs and will in some cases rank sectors according to adjustment in a wrong way.

b) It is not biased: Another advantage of this variable for the test of the SAH is that it is not biased in relation to the type of trade flow. Variables like (ΔL_j) or even ($|\Delta L_j|$) will tend to measure manly the type of adjustments that one expects from unmatched trade expansion. The present variable counts these changes in exactly the same manner as it adds the changes in the occupational composition (that might be expected to result both from matched and unmatched trade expansion).

c) It is more in accordance with theory: The variable we use here measures changes in the size and composition of the labour force of each industry that can easily be related to trade changes. Although other factors, such as changes in apparent demand or in the state of technology may also affect labour demand, it is straightforward that trade changes will influence reallocation in the predicted way. This variable is also more in line with those considered in labour economics studies about individual worker adjustment costs - Jacobson *et al.* (1993), Shin (1997), Kletzer (1998). It is also in accordance with recent work of Greenaway *et al.* (2000) and Haynes *et al.* (2002) that suggest that occupational changes were the main cause of adjustment costs and with the studies about adjustment in transition economies that show that transition involved massive occupational changes – Campos and Dabusinskas (2002) – and that adjustment costs are strongly associated with qualifications - Brown and Earle (2002).

d) It requires only information at the industry level: The approach followed by Brülhart et al. (2004) also considers the occupational dimension of adjustment. But it requires the use of individual-level data, not always available. The variable presented here has the advantage of requiring only data at the industry-level. It also allows to aggregate the two reallocation movements (occupational and sectoral) in a sensible way, which seems more appropriate method to test the SAH. We argue that, by excluding worker moves that do not result form changes in the relative requirements of each sector, is more focused on measuring the reallocation costs imposed by trade expansion than the approach based on individual worker moves – being less exposed to omitted variable bias estimation problems.

4. Labour Adjustment: Data base and Descriptive Evidence

To calculate the adjustment variable, we use a large matched employer-employee data set "Quadros de Pessoal" collected by the Portuguese Office of Labour, Employment and Vocational Education Statistics (*DETEFP*). This data set covers all firms located in Portugal (around 200 thousand firms and more than 2 million workers in each year), providing information about the industry and occupational status of each worker. This data set is very comprehensive including information more than 80% of the Portuguese manufacturing worker[18]. We use data of manufacturing firms for the years 1995, 1997 and 1999 (a total of 832 156 workers per year), calculating the adjustment variable using 1 digit occupational groups[19] (8 groups in total) for 98 industries defined at the 3 digit level of NACE-Rev. 2.

Tables 2 and 3 provide summary information on the average total, dimension and composition reallocation effects for the two periods considered. It shows that measuring reallocation considering only the dimension effect seriously underestimates the adjustment costs. In both periods, on, average, more than 30% of the total changes in each sector consisted on changes of the relative weight of the different occupational groups that did not affect the total employment of the industry. Furthermore, the composition effect in high MIIT industries appears to be the dominant cause of the adjustment costs while in low MIIT industries the adjustment costs are specially connected with the dimensional effect.

Our measure of the total reallocation effect (TE_j), on average, is higher in low MIIT industries than in high MIIT industries. However, this evidence is not sufficient to conclude that the SAH is valid. Industries differ in trade flows but also on other characteristics that affect the level of labour adjustment costs. These should be controlled for. In the next section we investigate the relationship more carefully, by examining econometrically the impact of both trade and non-trade influences on adjustment costs.

[18] This high proportion contrasts with those that can be obtained in samples such as the QLFS – which includes 60,000 households representative of the UK labour force. This results from the provision of annual information on firms' characteristics and on their workforce being compulsory in Portugal.

[19] The professional groups were classified according with the national classification of occupations (CNP) that includes the 8 groups: Managers and Administrators; Professional occupations, scientists and teachers (Specialists); Technicians and professionals of intermediate level; Clerical, Secretarial occupations; Sales occupations; Plant operatives; Machine operators; Others.

Table 2: Summary Information, 1995-97 and 1997-99

Period	Total Effect (TE)	Dimension Effect (DE)	Composition Effect (CE)	% of ind. where CE is dominant
1995-97	0,30	0,184	0,116	43,9%
1997-99	0,237	0,164	0,073	38,8%

Table 3: Comparison of Average Adjustment in High and Low MIIT Industries

Type of Effect	Industries with low MIIT		Industries with high MIIT	
	1995-97	**1997-99**	**1995-97**	**1997-99**
Total Effect	0,337	0,26	0,218	0,182
Dimension Effect	0,221 *(65,5%)*	0,179 *(69,1%)*	0,103 *(47,2%)*	0,06 *(30,4%)*
Composition Effect	0,117 *(34,5%)*	0,08 *(30,9%)*	0,115 *(52,8%)*	0,127 *(69,6%)*

Note: High MIIT industries are defined as those with MIIT index above 50%; the values between brackets are the proportion of each effect on the total effect.

5. Empirical Model

We constructed an industry-level sample for the periods 1995-97 and 1997-99 and, then, a balanced panel of total effect, trade and other potentially relevant variables for Portuguese manufacturing sectors using three sources: Industry-level employment data by occupation and by qualification of "Quadros de Pessoal", "Firm Statistics – Manufacturing Industry" published by the Portuguese Statistical Office, and a "Data Set on International Trade" (BDCI) provided by the Portuguese Office of Studies and Economic Prospective (GEPE). The panel used for estimation consists of observations on 98 industries over two periods: 1995-1997 and 1997-1999. Following Oliveras and Terra (1997) we also analyse each period separately.

Neither trade or labour theory equip us with a fully specified model of labour market adjustment nor provide firm priors on what control variables should be included in a model aimed to test the SAH. In fact, this hypothesis has been mainly considered an empirical issue.

Nevertheless, former empirical and theoretical work gave interesting suggestions about the control variables that should be included. Lovely and Nelson (2002) model suggests that, to study the relationship between MIIT and adjustment costs one should control for changes in apparent demand. Cristóbal (2001) evidence that the association between MIIT and adjustment costs is stronger in industries more exposed to trade, lead to the inclusion of a trade exposure variable in this study and also in those of Brülhart and Elliott (2002) and Brülhart et al. (2004). We follow this suggestion, and also test an additional hypothesis introducing an interaction term between this variable and MIIT. This allow us to test the additional hypothesis that the more open an industry is, the more the structure of change in trade flows affects the adjustment costs in the way predicted by the SAH.

Labour economics literature on employment adjustment suggests that workers characteristics are important for mobility (see, e.g., Shin 1997, Jacobson et al. 1993, Greenaway et al. 1999 and 2002, Haynes et al. 2002). This literature suggests that unskilled manual workers with lower general skills tend to be less mobile between industries and occupations. We use the proportion of operatives in each sector to measure the unskilled labour intensity of the industry. According with this literature we expect that the higher this variable the higher the difficulty of adjustment (therefore the adjustment costs). However, this variable is also used in trade empirical studies (see, e.g. Brülhart et al. 2003) as an inverse proxy for technology-intensity that is argued to have a negative impact on employment adjustment. Therefore, the sign of the coefficient associated with this variable will depend on which of the effects is stronger.

Based on these priors we constructed and estimated the following models:

- Using a cross-section single equation, we estimated model (1):

$$lnTE_j = \alpha_1 + \alpha_2 MIIT_j + \alpha_3 OT_j + \alpha_4 OT\_MIIT_j + \alpha_5 \Delta AD_j + \alpha_5 S_j + u_j \qquad (1)$$

- Using panel data, we estimated models (2) and (3). Model (2) was estimated trough pooled OLS and model (3) was estimated using fixed-effects:

$$lnTE_j = \theta_1 + \theta_2 MIIT_j + \theta_3 OT_j + \theta_4 OT\_MIIT_j + \theta_5 \Delta AD_j + \theta_5 S_j + \theta_6 D9799 + v_j \qquad (2)$$

$$lnTE_{jt} = \lambda_1 + \lambda_2 MIIT_{tj} + \lambda_3 OT_{jt} + \lambda_4 OT\_MIIT_{jt} + \lambda_5 \Delta AD_{jt} + \lambda_5 S_{jt} + \lambda_6 D9799_t + z_{jt} \qquad (3)$$

The *j* subscripts identify the industry and the *t* subscripts identify the period (1995-97 or 1997-99). The dependent variable $lnTE_{jt}$ is the log of the total effect in industry *i* in period *t*, MIIT is the log of Brülhart's (1994) MIIT index (A_{jt}) [20], *OT* is the degree of trade

[20] Theory does not suggest a functional form of the relation between adjustment costs and MIIT. Therefore, we decided to regress, using panel fixed effects, $lnET_{jt}$ against a constant term and two explained variables: A_{jt} and lnA_{jt}. As the only statically significant coefficient was the one associated with lnA_{jt} we decide to use log-log specification. Moreover, we also estimated all the models using A_{jt} instead of lnA_{jt} and the results we very

exposure, OT_MIIT is the interaction term between openness to trade and marginal intra-industry trade, ΔAD is the change in apparent demand; S is the proportion of industrial works in each sector; and $D9799$ is a dummy variable taking the value 1 in the period 1997-99 (and 0 otherwise). u_j, v_j and z_{jt} are the disturbance terms. Definitions and methods of construction of these variables are given in Table 4. Summary statistics and the correlation matrix are shown in Appendix tables 1 and 2.

We expect the following signs for the coefficient of the variables:

$MIIT<0$, $OT>0$, $OT\_MIIT<0$, $\Delta AD<0$ *and* $S \gtrless 0$.

According to the SAH, we expect that the higher the proportion of the marginal trade to be intra-industry in type (and therefore, the lower the proportion of the marginal trade to be inter-industry in type) the lower the total (costly employment adjustment) effect.

The sign on the coefficient associated to the openness to trade is expected to be positive because higher exposure to trade means stronger competitive pressures, therefore higher necessity of firms and industries to adapt more frequently to changing competitive positions (see Brülhart, 2000) and also a diminish of the profit margin. Under the new circumstances firms and industries that were competitive before may stop being so after openness (see Bhagwati, 1998). As a result, an increase on trade openness is expected to be associated with higher employment adjustment (and therefore adjustment costs). According to our additional hypothesis the coefficient associated with the interaction term is expected to be negative.

Declines in apparent demand will be associated with reductions in aggregate demand for labour in the industry and therefore imply dimension effect, and thus, total effects. According with Lovely and Nelson (2000 and 2002) they may also imply a composition effect through the change in the demand of intermediates. Both effects may be smaller in the presence of increases in apparent demand. Some job vacancies may appear in these industries but due to the fact that matching process takes some time, the effects on employment in the short run may be smaller.

Finally, as suggested earlier, we do not have strong priors on the sign of the relation between the proportion of operatives in each sector and the adjustment costs.

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similar apart from the ones on the RESET test that were less robust.

Table 4 - Variables Description

Variable	Definitions	Method of construction
Ln TE	Total (costly employment adjustment) effect	$Ln\ TEjt = \ln\{\frac{\sum_k \lvert L_{jk}^{n_{f_t}} - L_{jk}^{n_{i_t}} \rvert}{(L_j^{n_{i_t}} + L_j^{n_{f_t}}) * 0{,}5}\}$ where $L_{jk}^{n_i}$ e $L_{jk}^{n_f}$ are, respectively the number of workers in the industry j that belong to the professional category k on the initial (n_{i_t}) and final (n_{f_t}) year of the period *t*.
MIIT	Log of the proportion of marginal trade of the intra-industry type	We calculated MIIT for tree digit NACE industries based on data fro four-digit NACE industries in order to avoid the categorical aggregation problem. $MIIT_{jt} = ln(A_{jt}) = ln\{\sum_{i=1}^{i}(W_{it} * A_{it})\}$ where $W_{it} = \frac{\lvert \Delta X \rvert_{it} + \lvert \Delta M \rvert_{it}}{\sum_{i=1}^{Ij}(\lvert \Delta X \rvert_{it} + \lvert \Delta M \rvert_{it})}$ and $A_{it} = 1 - \frac{\lvert \Delta X_{it} - \Delta M_{it} \rvert}{\lvert \Delta X_{it} \rvert + \lvert \Delta M_{it} \rvert}$ We have used the *j* subscripts to identify three-digit NACE-Rev. 2 industry, *i* subscripts to identify four-digit NACE-Rev. 2 industries. Each j industry includes *Ij* industries i. Δ is the difference operator. X and M denotes, respectively, exports and imports.
OT	Average proportion of total trade on output	$GAE_{jt} = \frac{[(X_j + M_j)_{n_{ft}} + (X_j + M_j)_{n_{it}}]}{OUTPUT_{jn_{f_t}} + OUTPUT_{jn_{it}}}$
ΔAD	Change in apparent demand	$\Delta AD_{jt} = \frac{(OUTPUT_j + M_j - X_j)_{n_{f_t}} - (OUTPUT_j + M_j - X_j)_{ni_t}}{[(OUTPUT_j + M_j - X_j)_{n_{i_t}} + (OUTPUT_j + M_j - X_j)_{n_{f_t}}] * 0{,}5}$
S	Share of operatives in total labour force	$S_{jt} = \frac{O_{jt}}{L_{jt}}$, where O refers to operatives and L refers to total number of workers.

6. Results

Table 5 reports cross-section estimates of model (1) (OLS 1995-97 and OLS 1997-99) and pooled OLS estimates for model (2) and the fixed-effects estimates for model (3).

Table 5. *Adjustment Costs and Marginal Intra-Industry Trade: Estimated Results*

	OLS 95-97		OLS 97-99		POOLED OLS		FIXED-EFFECTS	
Explanatory Variables	*Coef.*	*t-stat.*	*Coef.*	*t-stat.*	*Coef.*	*t-stat.*	*Coef.*	*t-stat.*
CONST	-1.71	-6.01***	-1.27	-4.14***	-1.42	-6.7***	-2.23	-3.51***
MIIT	-0.14	-4.3***	-0.07	-2.08**	-0.11	-4.6***	-0.28	-2.68***
OT	0.12	3.76***	0.07	2.91***	0.09	4.69***	0.05	1.01
OT_MIIT	0.01	1.86*	0.01	1.48	0.01	2.43**	0.02	2.06**
ΔAD	-0.39	-3.31***	-0.50	-1.87*	-0.42	-3.89***	-0.41	-4.88***
S	-1.12	-2.27**	-1.73	-3.32***	-1.35	-3.83***	-0.14	-0.12
D9799					-0.21	-2.11**	-0.17	-2.61***
R^2	0.38		0.20		0.28		0.31	
No. observations	98		98		196		196	
Adjusted R^2	0.34		0.16		0.26		0.27	
F (P-value)	11.13 (0,0%)		4.72 (0.0%)		12.38 (0.0%)		8.16 (0.0%)	
RESET test (P-value)	0.53 (66,5%)		0.34 (80%)		0.46 (70.9%)		0.28 (83.62%)	
WHITE test (P-value)	14.2 (77,2%)		20.33 (37.5%)		29.19 (25.6%)		8.55 (98.76%)	

Notes: Dependent variable = lnTE; lnTE=ln (Total Effect).
***Indicates statistical significance at 1% level of confidence (one-tail test),**Indicates statistical significance at 5% level of confidence (one-tail test),*Indicates statistical significance at 10% level of confidence (one-tail test).

The general performance of the models is clearly satisfactory. The F-test on the joint significance of the regressores is overwhelmingly statically significant. The misspecification bias does not seem pervasive, since the RESET-test statistic is never statically significant; in fact the P-values are always over 65%.

The results support the hypothesis that trade expansion of intra-industry type entails lower adjustment costs than trade expansion of inter-industry type - "Smooth Adjustment Hypothesis" (SAH). Moreover, this result holds in both periods and is robust to the inclusion of other trade and non-trade characteristics of industries even non-observed ones. The available statistic evidence permitted us to conclude that even controlling for all these factors, on average, if an industry has a proportion of marginal trade that is intra-industry in nature 10% higher than another, ceteris paribus, will experience a total (employment adjustment) effect 2.8% lower.

In addition, all the signs of the coefficients of the variables of control are the same in cross section and fixed-effects estimation. The coefficient associated with change in apparent demand has the expected sign and the variable is statically significant in all the models. Openness to trade coefficient also has the expect sign but its statistical significance does not hold when industry fixed effects are included. We also studied the existence of interactions between openness to trade and marginal intra-industry trade (MIIT), particularly, the hypothesis whether the higher the degree of trade exposure, the higher the negative impact of MIIT on adjustment costs. Although the correlation analysis suggested this, the regression analysis does not confirm hypothesis.

7. Conclusions

This paper presents two major contributions. First, it introduces a new measure of adjustment costs that considers the effects of reallocation between sectors and occupations, in an unbiased way. This variable is more in accordance with labour theory than most of those used in former studies and requires only industry level data, allowing for replication of the present methodology, namely in studies about different countries. Second, it presents a test of the SAH for the case of a small open economy (Portugal), using multiple regressions with control variables and fixed effects and an adjustment variable that allows valid conclusions about this hypothesis. The evidence obtained suggests a confirmation of the SAH for the Portuguese case.

We examine the adjustment implications of different types of trade expansion, suggesting an alternative approach to test the hypothesis that trade expansion of intra-industry type entails lower adjustment costs than trade expansion of inter-industry type. Although there are a large number of the former empirical studies that addressed the SAH, since Brülhart (1994) introduced the MIIT index, most of these used methods and adjustment variables that are inappropriate.

The important recent contributes of Elliott and Lindley (2003) and Brülhart et al. (2004) illustrate the insufficiencies of former work, and the need to improve the adjustment variables if the SAH is to be tested in a sensible way. Only the last of these papers considered the effects of changes in occupations on adjustment costs. An effect that our evidence suggests is of great importance to reallocation adjustment costs, particularly in the industries with high levels of MIIT.

Our adjustment variable is based on the occupational changes in each industry, measuring not only the total changes in the employment level but also the changes in the composition of the labour force of each industry. Therefore, we believe that it measures in a more complete way the total reallocation adjustment cost effects of a trade expansion.

We argue that our adjustment variable has important advantages, when compared with those used in the former SAH studies. First, it is more informative, second it is unbiased in relation to the type of trade flow, third it is sustained in a more complete and realistic view of the adjustment implications of trade expansion and forth it is more in accordance with the predictions of trade theory and aligned with the way adjustment costs has been measured in other type of studies – namely those of labour economics.

We use this variable in industry-level panel data model of Portuguese manufacturing, which includes trade and non-trade control variables to testing the SAH. The econometric results support the SAH. This is an important contribution, given the shortage of studies using appropriate methodologies. The relevance of this result is even more significant since the adjustment variable used is more complete and not biased

Finally, we believe that our study reveals considerable scope for future work. It would be interesting to conduct similar analysis for other countries and time periods, in order to establish the robustness of our results.

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Appendix Table 1: Summary Statistics (n=196)

	Mean	Std. Dev.
lnET	-1.67523	0.808437
MIIT	-2.73864	2.754274
OT	4.271868	5.15753
OT_MIIT	1.425321	2.344447
ΔAD	0.128689	0.462102
S	0.504456	0.146476

Appendix Table 2: Correlation Matrix

	lnET	MIIT	OT	OT_MIIT	ΔAD	S
lnET	1					
MIIT	-0.2909	1				
OT	0.2544	-0.0622	1			
OT_MIIT	-0.2446	0.4324	-0.8029	1		
ΔAD	-0.1955	-0.0091	0.0746	-0.045	1	
S	-0.1975	0.1143	0.2194	-0.1435	-0.0458	1