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Intra-industry Trade, Knowledge and Adjustment Costs

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Abstract: The international technology diffusions are associated with the changes in labour market. The empirical results show a negative correlation between the changes of employment and Marginal Intra-Industry Trade (MIIT). We also find a positive correlation between changes of employment and knowledge. The economic dimension and market structure are according to Smooth Adjustment Hypothesis (SAH).

Key words: Marginal intra-industry trade, labour market, innovation, panel data, portugal, JEL classification C33, F12

INTRODUCTION

During the last years there emerged in international economics literature a boom in research measuring labour market adjustment and intra-industry trade (Ferto, 2009; Brulhart *et al*., 2006; Elliott and Lindley, 2006; Erlat and Erlat, 2006). The reductions of trade barriers permit formulate new empirical models called Smooth Adjustment Hypothesis (SAH).

According to the literature of SAH, intra-industry trade has lower costs of labour markets than inter-industry trade (Jones, 1971).

The motivation for producing this study relates to the fact that Portugal became a member of European Economic Community (EEC) in 1986. With the reduction of trade barriers, i.e., trade liberalisation created important trade policy changes. Moreover, the changes in the labour market may be reflected in gains in knowledge and innovation. The literature does not have introduced the variable knowledge and innovation in the studies of structural adjustment. Following Eaton and Kortum (1996), we consider international patenting as a technology diffusion channel. This manuscript analyses Portuguese labour market adjustment in the manufacturing industry between Portugal and European Union (EU-27) over the period 1995-2006 using a panel data. The present paper test SAH in Portuguese industry, considering sectors and using Brulhart (2000) measure adjustment.

LITERATURE REVIEW AND EMPIRICAL STUDIES

The paradigm of intra-industry trade and labour costs adjustment begins with Balassa (1986). Intra-Industry Trade (IIT) has lower costs of factor endowment than inter-industry trade. Greenaway and Milner (1986) refered that adjustment costs in labour market causes temporary inefficiencies, as unemployment and factor price rigidity. Brulhart and Elliott (2002) demonstrate that mobility of labour could be greater within industries (IIT) than between industries (inter-industry trade, is to explain with comparative advantages).

The classic model of IIT as in Krugman (1979) considers only one factor (labour) with monopolistic competition. The framework of Krugman (1979) assumes that countries and industries have similar factor endowments. In other words, IIT occurs within similar countries and industries. In this study, we have smaller labour-adjustment costs.

The Smooth Adjustment Hypothesis (SAH) i.e., the impacts on symmetric or asymmetric demand shock within or between industries is to explain by trade-induced. Brulhart and Elliott (2002) apply the specific -factor model to explain SAH. The authors consider a small open economy, where labour can move between two sectors. Lovely and Nelson (2000) presented theoretical model that explain the relationship between Marginal Intra-Industry Trade (MIIT) and labour costs adjustments. The framework of Lovely and Nelson (2000) consider that all trade reallocation is inter-industry trade, when we have trade liberalisation. Two years latter, Lovely and Nelson (2002) showed that the reallocation is associated with intra-industry trade type.

In 1990s, international economics watched a new phenomenon. IIT is measured and explained with dynamic index. Hamilton and Kniest (1991) proposed the first index. Brulhart (1994) showed that the index of Hamilton and Kniest does not reflected the change of trade pattern. With this index new empirical models emerged. According to the literature the concept of marginal intra-industry trade is associated with labour market adjustment costs.

Recently, Ferto (2009) analyses the labour market adjustment and IIT to Hungarian food industry. Erlat and Erlat (2006) applied a static and dynamic panel. Ferto (2009) introduced as explanatory variable marginal IIT

(index of Brulhart) and the index proposed by Azhar and Elliott (2003). The framework of Azhar and Elliott (2008) showed that it is possible to separate the MIIT in horizontal and vertical differentiation. This contribution is important because it considers that MIIT can be explained by different changes in the quality standard.

Following Coe and Helpman (1995) and Coe *et al.* (1997), we consider international trade as a carrier of foreign technology embodied in capital goods. As in Eaton and Kortum (1996), we also consider that international patenting as another technology diffusion channel. Moreover, the changes in the labour market can promote the technology diffusion and create knowledge.

MEASURING INTRA-INDUSTRY TRADE AND MARGINAL INTRA-INDUSTRY TRADE

Traditional intra-industry trade index: The level of IIT is generally measured by Grubel and Lloyd (1975) index. They defined IIT as the difference between the trade balance of industry i and the total trade of this same industry. In order to make the comparison easier between industries or countries, the index is presented as a ratio in which the denominator is total trade:

$$IIT_i = 1 - \frac{|X_i - M_i|}{(X_i + M_i)} \Leftrightarrow IIT_i = \frac{(X_i + M_i) - |X_i - M_i|}{(X_i + M_i)}$$

The index is equal to 1 if all trade is of the intra-industry trade type. If IIT is equal to 0, all trade is inter-industry trade. Gurler *et al.* (2006) applied this index of IIT in the case of this article shows that Free Trade Agreements promotes the IIT.

The Grubel and Lloyd index is a static measure and as Hamilton and Kniest (1991) demonstrated the changes of this index over time do not adequately reflects the changes in trade partners.

Their measure did not eliminate the scale effect. For other words, their index did not allow the comparison between industries of different size. This problem was resolved by Brulhart (1994) Marginal IIT index (MIIT):

$$MIIT = 1 - \frac{|\Delta x - \Delta M|}{|\Delta X| + |\Delta M|}$$

The Brulhart (1994) index is a transformation of Grubel and Lloyd (1975) index. The MIIT index also takes the values 0 and 1. The value 0 indicates that the marginal trade in the industry is exclusively of the inter-industry trade and the value 1 represents that the marginal trade is entirely of the intra-industry.

MODELLING THE CHANGES IN EMPLYOMENT AND MARGINAL INTRA-INDUSTRY TRADE

We follow Brulhart and Thorpe (2000) and Erlat and Erlat (2006) and we consider the following function to account the changes in employment:

$$\Delta EMPL_{it} = f(\Delta CONS, \Delta PROD, \Delta MARK, MIIT, TRADE, INOV) \quad (1)$$

Where:

$$\partial f / \Delta CONS > 0, \partial f / \Delta PROD \succ 0, \partial f / \Delta MARK < 0, \\ \partial f / \partial MIIT \prec 0, \partial f / TRADE \succ 0, \delta f / INOV \succ 0 \quad (2)$$

where, ΔEMPL is the absolute change in employment in each industry; ΔCONS is the absolute change in apparent consumption; ΔPROD is the absolute change in labour productivity; ΔMARK is the absolute change in market structure; MIIT is the marginal intra-industry trade; TRADE is openness trade; INOV is the percentage of patents.

Econometric model: Following the literature our study applies a panel data. The dependent variable used is the absolute change in employment in industry i in the t time period. The source used for dependent variable was Portuguese National Institute of Statistics. The data for the explanatory variables is sourced form the OECD (STAN industrial database).

Dependent variable: Brulhart (2000) suggested the absolute value of employment changes (ΔEMPL|) as a proxy for adjustment cost:

$$\Delta EMPL = 2 \times \frac{(EMPL_t - EMPL_{t-1})}{(EMPL_t + EMPL_{t-1})}$$

Explanatory variables:

Hypothesis 1: There is a positive correlation between change in apparent consumption and change in employment. ΔCONS is the absolute value of the change in apparent consumption (C = Q+M-X) between t and t-n, Q being output.

Ferto (2009) found a positive, when the author analysed the effects of association on the Hungarian food industry. Brulhart and Thorpe (2000) also found a positive sign to Malaysian case.

Hypothesis 2: There is an ambiguous sign between change in labour productivity and change in sector employment. PROD is the absolute of the change in labour productivity. Erlat and Erlat (2006) found a negative sign, to the Turkey case.

Hypothesis 3: The market structure is negatively associated with employment changes. MARK is the absolute of the change in value added by four largest firms. The larger of firms have more capacity competitiveness when changes on employment occur. Brulhart (2000) and Ferto (2009) found a negative sign.

Hypothesis 4: The marginal intra-industry trade has the lower the adjustment cost. MIIT is marginal intra-industry trade is measured by the index of Brulhart (1994). According to smooth-adjustment hypothesis, SAH (Brulhart, 2000), we consider a negative relationship between Marginal intra-industry trade and the change in employment. We consider the correlation with MIIT and the change in employment, to reflect lower adjustment costs.

Hypothesis 5: The openness trade influences the competitiveness of firms. TRADE, is absolute value of the change in exports plus imports between t and t-n. There is a positive relationship between trade and the changes of employment Brulhart (2000). Cabral and Silva (2006) found a positive sign to Portuguese case.

Hypothesis 6: The change in employment promotes innovation and knowledge. We use the percentage of patents (INOV) to measure innovation and knowledge. A patent is an indicator that has been criticized. A patent is an intangible and technology is a tangible. A high percentage of patents are not commercialized, so they may not produce any technology. In order to overcome this problem we use the percentage of patents as the report suggests the European Innovation Scoreboard (2010: http://www.proinno-europe.eu/metrics). We expect a positive sign between this coefficient ant the change in sector employment.

Model Specification:

$$\begin{aligned}\text{Log}\left|\Delta EMPL\right|_{it} &= \beta_0 + \beta_1 \text{Log}\left|\Delta EMPL\right|_{it-1} + \beta_2 \text{Log}\,\Delta CONS + \beta_3 \\ &\text{LogAPROD} + \beta_4 \text{LogMARK} + \beta_5 \text{LogMIIT} + \beta_6 \\ &\text{LogTRADE} + \beta_7 \text{INOV} + \varepsilon_{it}\end{aligned} \quad (3)$$

where, $|\Delta EMPL|$ is absolute value of employment changes, X is a set of explanatory variables. All variables are in the natural log logarithm form; ε_{it} is a random disturbance assumed to be normal and identically distributed (IID) with $E(\varepsilon_{it}) = 0$; $Var(\varepsilon_{it}) = \sigma^2 > 0$.

EMPIRICAL STUDY

Table 1 provides information about the involve variables:

It appears that there is an important heterogeneity of the variables especially for Log|ΔEMPL| and LogMIIT. Thus, the estimation methodology should treat the bias that can be induced by such diversity in the data.

In Table 2, we can observe the adjustment costs using a OLS with time dummies to all period (1995-2006). Present analysis pretends to evaluate the signs of the coefficients and their significances. All explanatory variables are significant ($Log|\Delta EMPL|_{it-1}$, at 1%, LogΔCONS, at 1%, LogΔPROD, at 1%, LogΔMARK, at 5%, LogMIIT, at 5% , LogTRADE at 5% and LogINOV).

The lagged dependent variable ($Log|\Delta EMPL|_{it-1}$) presents a positive sign. Ferto (2009) and Erlat and Erlat (2006) also found a positive sign.

The absolute value of the change in apparent consumption (LogΔCONS) presents a negative sign. This result was not expected (Erlat and Erlat, 2006; Brulhart and Elliott, 2002). Ferto (2009) also found a negative correlation with this proxy and change of employment.

According to the study of Brulhart and Thorpe (2000), Erlat and Erlat (2006) and Ferto (2009) we can consider that the relationship between the absolute value of change in labour productivity and the changes in employment is ambiguous. Erlat and Erlat (2006) found a negative sign. The study of Ferto (2009) finds a positive sign. The variable (ΔPROD) presents a positive sign.

Table 1: IIT, knowledge and adjustment costs descriptive statistics

Variables	Mean	SD	Minimum	Maximum
Log|ΔEMPL|	-3.286	1.662	-10.379	0.334
LogΔCONS	5.528	1.263	1.876	10.426
LogΔPROD	-2.236	1.460	-6.221	3.014
LogΔMARK	3.514	1.392	-1.609	7.137
LogMIIT	-0.911	1.056	-8.872	-0.001
LogTRADE	5.478	1.334	1.400	10.461
LogINOV	2.043	0.108	1.851	2.198
N	393			

Table 2: IIT, knowledge and adjustment costs: OLS estimator with time dummies for all period

Variables	OLS	t-statistics	Significance	Expected sign
$Log\|\Delta EMPL\|_{it-1}$	0.137	5.22	***	+
LogΔCONS	-0.313	-3.26	***	+
LogΔPROD	0.305	6.47	***	+/-
LogΔMARK	-0.060	-2.17	**	-
LogMIIT	-0.105	-2.44	**	-
LogTRADE	0.192	2.26	**	+
LogINOV	1.155	2.27	**	
Constant	-4.086	-3.52	***	
N	351			
Adj. R^2	0.5928			

T-statistics (heteroskedasticity corrected) are in round brackets, ***/**-statistically significant, respectively at the 1 and 5% levels

The variable market structure (LogΔMARK) presents a negative correlation as expected, i.e., minimum efficient scale is negatively associated with employment changes. For other words, the competitiveness encourages a large number of firms and increasing openness trade. In relationship the proxy LogINOV we find a positive sign. We can refer that changes of employment produce innovation and knowledge.

According to the SAH, we expect a negative correlation between Marginal Intra-Industry Trade (MIIT) and the changes of employment. We find the expect sign, this result reflect that the higher of MIIT level causes lower adjustment cots. Following Brulhart and Elliott (2002) and Erlat and Erlat (2006) we introduce one trade control variable: (LogTRADE). Brulhart and Elliott (2002) defend a positive correlation between trade and employment change. The international trade (LogTRADE) permits that firms and industries obtain more competitiveness. Present result validates this hypothesis.

Brulhart (2000) analyzed the relationship between SAH and the MIIT index. The author concludes that the results are better based on yearly changes. Erlat and Erlat (2006) suggested three-yearly changes. We also consider three- yearly changes (1995-1996; 1999-2000; 2001-2006).

As show in Table 3, all explanatory variables are significant (Log|ΔEMPL|$_{it-1}$, at 1% LogΔCONS, at 1%, LogΔPROD at 1%, LogΔMARK at 5%, LogMIIT, at 5%, LogTRADE at 5% and LogINOV at 5%). The performance of model is similar, when we compare all period (Table 2) with three-year changes.

Other results relating to three-yearly changes: Lagged change employment (Log|ΔEMPL|$_{it-1}$): a positive sign was expected and the results confirm this; The absolute value of the change in apparent consumption (LogΔCONS): the expect sign is negative, and their result is contradictory.

Labour productivity (LogΔPROD): The expected sign is ambiguous. However, the result gives a positive sign, which confirms the study of Ferto (2009).

Market structure (minimum efficient sale, LogΔMARK): the dominant paradigm of a large number of firms predicts a negative sign. Present results gave a negative sign which confirms the paradigm.

Marginal intra-industry trade (LogMIIT): According to SAH study, we expected a negative sign, our result validate this hypothesis. Trade (LogTRADE): the expected sign is positive, which is confirmed by the estimation. The change in employment promotes innovation and knowledge, i.e., the proxy (LogINOV) finds a positive sign as expected.

Table 3: IIT, knowledge and adjustment costs: OLS estimator with time dummies for three-yearly changes

Variables	OLS	t-statistics	Significance	Expected sign
Log|ΔEMPL|$_{it-1}$	0.168	5.12	***	+
LogΔCONS	-0.307	-3.63	***	+
LogΔPROD	0.268	6.62	***	+/-
LogΔMARK	-0.062	-2.40	**	-
LogMIIT	-0.066	-2.31	**	-
LogTRADE	0.180	1.87	**	+
LogINOV	1.143	2.21	**	
Constant	-5.388	-5.13	***	
N	193.00			
Adj. R^2	0.5928			

T-statistics (heteroskedasticity corrected) are in round brackets, ***/**-statistically significant, respectively at the 1 and 5% levels

CONCLUSIONS

The objective of this study was to analyze labour market adjustment and intra-industry trade in manufacturing sector. Comparing our findings with other empirical studies, we obtained similar results. Econometric estimations supported the hypothesis formulated. Present results are robust with all period (1995-2006) and three- yearly changes.

The variable (LogΔCONS) used to evaluate changes in apparent consumption between trade presents a positive correlation on changes of employment. This result is contradictory to the study. Present results show that there are higher change in apparent consumption between Portugal and European trade partner.

In relationship the variable change in labour productivity (LogΔPROD) we find a positive sign. Using all period (1995-2006) and three-yearly change we find market structure has negative significant effects on the implicit adjustment costs. We also find a negative relationship between Marginal Intra-Industry Trade (MIIT) and the absolute employment changes. This result is according to the predictions of SAH. The correlation between trade openness and employment changes is according to the hypothesis formulated.

Present results also show a positive correlation between changes of employment and knowledge. International technology diffusions are associated with changes in labour market. This result is according to the literature.

However, this study has some limitations. In future we need to improve research on vertical and horizontal MIIT, because this type of trade is associated to two-way trade of different endowments and quality products (Azhar and Elliott, 2008). On the other hand there is the need to use a different method of estimation (GMM-System) proposed by Blundell and Bond (1998, 2000) as a way to solve some econometric problems such as endogeneity of some explanatory variables.

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