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Revisiting Marginal Intra-Industry Trade and Portuguese Labour Market

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Abstract

Objectives: This study aims to empirically test the smooth adjustment hypothesis (SAH) in the Portuguese labour market during 2000–2018, considering changes in employment, wage, productivity, consumption and the marginal intra-industry trade. **Research Design:** So, following the literature, a greater marginal intra-industry trade intensity should reduce adverse shocks expressed in temporary inefficiencies such as undesirable job search costs and workers' relocation and retraining. According to state of the art, our research strategy considered a battery of diagnosis tests about the random generating process of variables included in a dynamic panel data model. **Methods:** The extensive work developed in this paper is a further step to introduce recent techniques such as the Method of Moments Quantile Regression and the cointegration panel models to infer long-term dynamics.

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Results and Conclusions: Overall, the main point is that we find evidence confirming the hypothesis mentioned above, showing that mutual interactions reduce adverse shocks above mentioned. Thus, the study demonstrates that the marginal intra-industry trade promotes smooth adjustment in the Portuguese economy.

Keywords
Portugal, marginal intra-industry trade and adjustment cost, method of moments quantile regression, cointegration panel data, generalised moments method-System

Introduction

From the different schools of thought in international trade, it appears that intra-industry trade is a type of trade where exports and imports of the same field of activity coexist (Balassa, 1966; Greenaway et al., 1994; Grubel and Lloyd, 1975). This type of trade is associated with product differentiation and is explained, among other factors, through economies of scale, industrial concentration, different types of prices, quality and monopolistic competition. The issue of the intra-industry trade, which implies less structural adjustment costs in terms of the labour market, when compared to the inter-industry trade, was as referred by Brülhart (2000) introduced by Balassa (1966), having been referred to in the literature as smooth adjustment hypothesis (SAH). The intra-industry trade allows for a smoother reallocation of resources in the labour market (Brülhart and Elliot, 2002; Brülhart et al., 2006; Faustino, 2010). As it turns out, a negative labour market shock implies temporary inefficiencies such as unemployment and price rigidities (Brülhart, 1994; Greenaway and Chris Milner, 1986).

For instance, Brülhart et al. (2006) tested the relationship between marginal intra-industry trade (MIIT) and industries' job turnover. The empirical results demonstrate that MIIT encourages smooth adjustment costs in the labour market.

Over the years, the literature aims to analyse the measure more appropriate to evaluate the marginal intra-industry trade (MIIT). For example, Hamilton and Kniest (1991), Menon and Dixon (1997), and Brülhart (1994) showed that the adjustment costs are a dynamic process, and this is not possible to be considered by the static index of Grubel and Lloyd (1975). In this context, the measure suggested by Brülhart (1994) has been the most used.

It is observed that there are studies applied to several countries such as Brülhart and Thorpe (2000) for Malaysia, in the case of Ireland; Brülhart (2000) and Brülhart and Elliot (2002) for the United Kingdom stand out; in

Turkey, Erlat and Erlat (2006); for the Portuguese case Cabral and Silva (2006), Faustino (2010) and Faustino and Leitão (2012); Thorpe and Leitão (2012) for Australia; and more recently, the study by Pinto et al. (2019) for Brazil and Aggarwal and Chakraborty (2020) for the Indian case.

Empirical studies have used panel data to evaluate structural adjustment issues in the labour market and MIIT, namely, wage changes, productivity changes, consumption and marginal intra-industry trade on employment changes. However, most empirical studies (e.g. Aggarwal and Chakraborty, 2020; Pinto et al., 2019; Thorpe and Leitão, 2012; Faustino and Leitão, 2012) use the generalised method of moments (GMM–System) proposed by Blundell and Bond (1998, 2000) by evaluating the changes in the labour market.

Furthermore, they considered that the smooth adjustment hypothesis (SAH) involves a dynamic process. In this line, our empirical study revisits the marginal intra-industry trade and respective association with the labour market applied to the Portuguese economy. We also use the GMM–System for a recent period 2000–2018 and introduced as a novelty the Method of Moments Quantile Regression (MMQR) suggested by Machado and Silva (2019), and panel cointegration model FMOLS since it has not been used in this type of study of structural adjustment.

This study seeks to highlight a literature survey, assess the impact of marginal intra-industry trade on employment changes and test the SAH hypothesis and the effects of wages, productivity and consumption on employment changes. Besides, the article presents some contributions for economic policymakers.

The article presents the following structure: the literature review appears in the next section, followed by the methodology, statistical sources and hypotheses to be tested. Then, in section 4, the analysis of results and discussion appears. Finally, the main conclusions and some recommendations for policymakers are presented.

Literature Review

This section presents a selection of empirical studies on the marginal intra-industry trade (MIIT) and structural adjustment issues in the labour market. In the early 1990s, new proposals for measuring intra-industry trade emerged in international economics (Hamilton and Kniest, 1991; Menon and Dixon, 1997). The studies showed that the indicator by Grubel and Lloyd (1975) only allowed evaluating the intra-industry trade in a static term. Thus, Brülhart's (1994) proposal of the marginal intra-industry trade would expand the field of international economics analysis to questions of structural adjustment and the labour market.

Another significant contribution was the proposal by Greenaway et al. (1995) and Abdel-Rahman (1991) to disaggregate the horizontal intra-industry trade and vertical intra-industry trade, since this type of product differentiation via prices already had theoretical support in the models of Krugman (1979), Lancaster (1980), Brander (1981), Falvey and Rodney (1981), Falvey and Kierzkowski (1987), Shaked and Sutton (1984) and Flam and Helpman (1987).

It is consensual in the literature that the issues of MIIT and adjustment of the labour market started with Balassa (1966), Greenaway and Milner (1986) and Brülhart and Elliott (2002) report that adjustment costs in the labour market cause temporary inefficiencies, such as unemployment and rigid prices. Thus, smooth adjustment costs analysis aims to measure symmetries and asymmetries in employment changes (Lovely and Nelson 2000).

As we observed since the 2000s, several studies have emerged that reflect the problems of structural adjustment of the marginal intra-industry trade and the labour market. As a rule, various empirical studies use panel data for the manufacturing industry or a specific sector. However, it is observed that the studies that predominate are those applied to the manufactures of a particular country. Empirical studies by Brülhart and Thorpe (2000), Brülhart and Elliott (2002), Cabral and Silva (2006), Erlat and Erlat (2006), Brülhart et al. (2006), Fertő and Károly (2008), Faustino and Leitão (2012) and Faustino (2010) are some examples of empirical studies of smooth adjustment hypothesis (SAH). Therefore, MIIT and adjustment costs have been little discussed in the literature in recent years. Next, we present a set of studies that we have selected that support our econometric results.

When we achieved a meta-analysis, we observed that two types of empirical studies were developed: static models, where the authors did not use the lagged variable of employment changes (Cabral and Silva 2006; Brülhart et al. 2006; White and Chen 2012; Rasekhi and Ghaderi 2012); and the second type of studies where the authors used the lagged variable of employment (Aggarwal and Chakraborty 2020; Erlat and Erlat 2006; Faustino 2010; Faustino and Leitão 2012; Pinto et al. 2019; Thorpe and Leitão 2012). Furthermore, it should be referred that not all studies confirm the hypothesis SAH (smooth adjustment hypothesis). Regardless of these studies use static or dynamic panel data, neither all do validate the negative relationship between the marginal intra-industry trade and employment changes; demonstrating that MIIT, in this case, does not allow to reduce asymmetries and the rigidity in the labour market, thus prevailing the inter-industry trade.

Similarly, it is important to refer that the studies by Brülhart and Thorpe (2000), Erlat and Erlat (2006), Brülhart et al. (2006), Lin and Chang (2017), Pinto et al. (2019) and Aggarwal and Chakraborty (2020) are some of the examples that did not find a negative association between MIIT and

employment changes, demonstrating that the adjustment in Malaysia, Turkey, ASEAN countries, Brazil and India was not smooth.

Malaysian experience was investigated by Brülhart and Bond (2000) for 1970–1994. Considering a fixed-effects estimator, the authors found that productivity and marginal intra-industry trade positively impact employment changes, showing that Malaysia has a higher cost of adjustment costs. In addition, the variable of the interaction of MIIT and openness trade presents a positive effect on employment changes.

Previous studies by Porto and Costa (1999), Cabral and Silva (2006), Faustino (2010) and Faustino and Leitão (2012) assess the issues of the marginal intra-industry trade (MIIT) and the structural adjustment of the labour market for the Portuguese economy. In this context, Porto and Costa (1999) analyse the adjustment cost considering the employment changes and production changes for 1986 and 1989. The results demonstrated that MIIT positively impacts employment and production changes, revealing higher adjustment costs in the Portuguese economy.

Cabral and Silva (2006) explored the MIIT and adjustment costs for the Portuguese economy, considering two periods (1995–1997 and 1997–1999) using OLS estimator and fixed-effects estimator. As a result, the hypothesis of SAH is valid, that is, marginal intra-industry trade negatively impacts the change of employment. On the other hand, the variable of apparent consumption is negatively correlated with employment changes, and trade intensity positively affects employment changes with the fixed-effects estimator. In this line, the automobile industry was investigated by Faustino (2010), considering the fixed effects and GMM-System, and the author found SAH is valid with both estimators. Moreover, the consumption and trade intensity variables positively affect the employment of changes.

More recently, the empirical study of Faustino and Leitão (2012) examined the Portuguese MIIT and labour market adjustment considering three equations using dynamic panel data. The empirical results demonstrated that MIIT is negatively correlated with employment changes, supporting the SAH hypothesis. Besides, the variables of wages, industrial concentration and productivity negatively affect employment changes. The lagged variable of employment changes presents a positive effect in the long run; the last result is according to previous studies. In this context, we can refer some conclusions about earlier studies of the Portuguese economy about smooth adjustment costs. Porto and Costa's (1999) and Cabral and Silva (2006) study use static econometric models to consider adjustment issues in the labour market. However, the survey by Cabral and Silva (2006) allows us to conclude that at the end of the 1990s, Portugal followed the intra-industry trade type adjustment, where there are lower adjustment costs since there are economies of scale and innovation factors. Therefore, the empirical studies by Faustino (2010) and Faustino and Leitão (2012) follow a relatively different line, as

these empirical studies seek to assess the phenomenon of structural adjustment in the labour market via marginal intra-industry trade using dynamic models (GMM-System) and where it is possible to conclude, that the supply of labour increased through a smooth adjustment.

The Australian experience was investigated by Thorpe and Leitão (2012) using dynamic panel data for the period 1992–2000. The variable used to evaluate the adjustment cost showed that marginal intra-industry trade (MIIT) negatively affects changes in employment. On the other hand, the lagged variable of employment change demonstrated a positive effect in the long run; this result is according to the dominant literature, showing that the employment increased, and we assisted employment movements. The study also found a positive association with statistical significance between trade intensity, productivity and change of apparent consumption on change of employment.

The marginal intra-industry trade and Iranian adjustment costs were evaluated by Rasekhi and Ghaderi (2012) for manufacturing industries considering the period 2002–2006. The fixed-effect estimator's empirical results showed that the MIIT index negatively correlates with employment change, showing that SAH is valid. Therefore, the coefficient of change of productivity positively impacts the shift in employment, and economies of scale are negatively correlated with the evolution of jobs.

Lin and Chang (2017) applied MIIT and cost adjustment for China, Japan and Korea in the food sector. The authors present the results using the GMM-system and the GMM-DIF (generalised moments method with the first differences) in two steps for each country considered. When the authors used the GMM-System estimator, it was observed that lagged variable of employment changes has a positive long-term effect. On the other hand, the variable productivity found a negative impact on changes in employment, not confirming the dominant hypothesis. Regarding the sign for MIIT, an ambiguous result can be observed in the formulated equations. The authors also introduced explanatory variables of foreign direct investment and tariffs. For example, in China, the results demonstrated that FDI is negatively correlated with employment changes, and Lin and Chang (2017) concluded that foreign direct investment reduces the cost of adjustment. In addition, the authors showed that tariff also aims to reduce the labour cost adjustment in Japan and Korea.

The Brazilian experience was analysed by Pinto et al. (2019) using a static and dynamic panel from 1997 to 2008. The study did not find the smooth adjustment hypothesis between marginal intra-industry trade and changes in the labour market. However, the dynamic panel data demonstrate a positive correlation between trade intensity and employment changes and a positive long-term effect on employment changes.

Aggarwal and Chakraborty (2020) investigated the Indian experience using a GMM-system estimator. They found a negative correlation between wages and the change of employment. Besides, the lagged variable of employment change presents a positive effect in the long run. However, trade intensity and marginal intra-industry trade positively affect employment change, showing that the SAH hypothesis is not valid; this result is associated with an adverse shock in the labour market. Furthermore, the authors used the interaction variable of marginal industry trade and productivity, the interaction variable of MIIT and foreign direct investment and the interaction variable of productivity and FDI and workers' skills. The authors concluded that these interactions showed that the marginal intra-industry trade increased in the last years. However, it is necessary to improve employment, salaries and workers' skills in sectors less attractive for inflows of foreign direct investment (FDI) to have smooth adjustment costs. In this line, Varma and Issar (2017) also considered MIIT and adjustment cost for India. The authors formulated three equations: the first considers the changes in total employment; the second and third equations considered the changes in employment for males and females, respectively, using the OLS and GMM-System estimators. Regarding the method of generalised moments (GMM-System), it is observed for equation (3) (changes in female employment) the lagged variable has a positive long-term effect with statistical significance. Moreover, the wage variable positively affects employment changes in the three equations, and the labour regulation variable reduces labour market changes.

More recently, Fainstein (2020) considers the adjustment of the Estonian labour market and marginal intra-industry trade. The author applied dynamic panel data (GMM-System) for the period 2000–2015. The results do not validate SAH arguments. Fainstein (2020) concluded that expansion of trade in Estonia is not correlated with smooth adjustment costs in the labour market.

Methodology and Econometric Strategy

This section presents the methodology used to assess the impact of the marginal intra-industry trade, changes in consumption, productivity and wages on employment changes in the period 2000–2018. First, we reviewed the hypotheses underlying the SAH (smooth adjustment hypothesis) and the expected signs for the Portuguese economy. Subsequently, we performed unit root tests for panel data, namely, Levin-Lin-Chu (2002), Augment Dickey-Fuller—Fischer, Phillips–Perron suggested by Maddala and Wu (1999), Choi (2001) and Im et al. (2003) to analyse the properties of the variables used in this research and to understand whether they are stationary in levels or integrated with levels. We also realised the multicollinearity test and cross-section dependence before applying the econometric models. Since the adjustment of the labour market involves a dynamic process, we chose to use the

Method of Moments Quantile Regression (MMQR) suggested by Machado and Silva (2019) and dynamic panel data, method of generalised moments (GMM-SYS) proposed by Blundell and Bond (1998, 2000). In terms of post-estimation tests, we used the Wald test to assess the different quartiles, Arellano and Bond (1991) test to evaluate the serial correlation and the Sargan test to determine the specification of the econometric model.

Considering the previous studies of Brülhart and Thorpe (2000), Erlat and Erlat (2006), Faustino (2010), Thorpe and Leitão (2012), Pinto et al. (2019) and Aggarwal and Chakraborty (2020), the smooth adjustment hypothesis (SAH) is represented by the following equation

$$|\Delta EMPL| = f(MIIT,\ MIITxTrade,\ \Delta Cons,\ \Delta Prod,\ \Delta Wages) \tag{1}$$

$$\begin{aligned} Log|\Delta EMPL_{it}| = {} & \beta_0 + \beta_1 Log|\Delta EMPL_{it}|_{t-1} + \beta_2 LogMIIT_{it} \\ & + \beta_3 LogMIITxTrade + \beta_4 Log\Delta Cons + \beta_5 Log\Delta Prod \\ & + \beta_6 Log\Delta Wages + \delta_t + \eta_i + \varepsilon_{it} \end{aligned} \tag{2}$$

Based on equation (2), we can refer that t represents the period; the trend is δt – moreover, the specific effects by η_i and the random disturbance by ε_{it}.

In this study, we consider the dependent variable the employment changes in logarithm form, as suggested by Brülhart (2000), Faustino (2010) and Thorpe and Leitão (2012)

$$\Delta EMPL = 2 \times \frac{EMPL_t - EMPL_{t-1}}{EMPL_t + EMPL_{t-1}} \tag{3}$$

$Log|\Delta EMPL_{it}|$ – denotes the logarithm of absolute values of employment change. The data are compiled by OECD statistics – STAN Industrial analysis.

In the next step, we present the independent variables used in this research and the hypotheses that will be tested in the empirical study:

$Log|\Delta EMPL_{it}|_{t-1}$ – represents the lagged variable of employment changes.

H1: In the long run, labour mobility increases if costs of labour decrease.

According to previous studies, Erlat and Erlat (2006), Faustino (2010), Leitão (2021), Faustino and Leitão (2012), Thorpe and Leitão (2012), Pinto et al. (2019) and Aggarwal and Chakraborty (2020), we expected a positive sign. ($\beta_1 Log|\Delta EMPL_{it}|_{t-1} > 0$). This variable allows the long-run effects of changes in employment to be considered.

LogMIIT – The Logarithm of Marginal Intra-industry Trade Index Suggested by Brülhart (1994).

$$MIIT_{it} = 1 - \frac{|\Delta X_i - \Delta M_i|}{|\Delta X_i| + |\Delta M_i|}$$

ΔX_i – represents the variation of exports, and ΔM_i – signifies the variation of imports by sectors from OECD statistics. Based on the interpretation of marginal intra-industry trade index (*MIIT*), it is known that when $MIIT > 0.5$, marginal intra-industry trade prevails. However, when $MIIT < 0.5$, we observe marginal inter-industry trade. The data are collected from OECD statistics, structural analysis (STAN database) and bilateral trade by industry (ISIC Rev.4).

H2: Marginal intra-industry trade promotes lower adjustment costs in the labour market.

Following Brüllhart (1994) and Brüllhart (2000), a negative relationship between marginal intra-industry trade (MIIT) and employment changes (|ΔEMPLit|) is expected, showing that there are lower adjustment costs between MIIT and changes in employment ($\beta_2 LogMIIT_{it} < 0$).

*LogMIIT*x*Trade* – it is a control variable, which evaluates the interaction between marginal intra-industry trade and trade intensity in logarithmic form where

$$Trade = \frac{X_i + M_i}{GDP}$$

X_i – denotes the total exports, and M_i – indicates the total imports by Portuguese economy, *GDP* – income per capita expressed in US dollars from World Bank Indicators.

H3: Trade intensity stimulates an increase of marginal intra-industry trade.

According to empirical studies, Erlat and Erlat (2006) and Aggarwal and Chakraborty (2020) find a positive correlation between the interaction of MIIT and trade intensity and employment changes. However, Cabral and Silva (2006), Faustino (2010) and Pinto et al. (2019) refer that there is a negative association between the variables. In conclusion, we observe an ambiguous sign, ($\beta_3 LogMIIT$x$Trade < 0; > 0$). However, in our view, a positive interaction demonstrates that the intensity of trade promotes MIIT.

*Log*Δ*Cons* – the logarithm of changes in consumption compilated by OECD statistics – STAN Industrial analysis. Changes in the allocation of labour in Portugal may represent internal and external demand changes.

H4: Consumption is encouraged by the growth of demand.

Therefore, a positive correlation between changes in employment and changes in consumption is expected. Brüllhart and Thorpe (2000) note that the manufacturing sector in Malaysia has a positive relationship between changes in employment and changes in consumption, just as Fertö (2009) found this positive correlation in a study carried out on the food industry Hungarian ($\beta_4 Log\Delta Cons > 0$).

$Log\Delta Prod$ – the logarithm of changes in productivity sourced by OECD statistics – STAN Industrial analysis.

H5: An increase or decrease in productivity depends on workers and labour mobility.

There is an ambiguous signal between the change in labour productivity and the change in employment in the sector. While increased productivity may indicate an expanding industry, thus providing greater employability, the same increase may also reduce labour needs if production levels are already maintained. This relationship can assume a positive or a negative sign. Erlat and Erlat (2006), through a study from Turkey, found a negative relationship between changes in labour productivity and change in employment. But, Brüllhart and Thorpe (2000), through an analysation of Malaysia, Fertö and Karoly (2008) on Poland and Hungary cases and Thorpe and Leitão (2012) about Australia, found a positive relationship between these changes (i.e. cited studies found both signs: $\beta_5 Log\Delta Prod > 0; < 0$).

$Log\Delta Wages$ – the logarithm of changes in wages by OECD statistics – STAN Industrial analysis.

H6: Wages tend to decrease when employment increases.

Greenaway et al. (2020), Faustino and Leitão (2012) and Aggarwal and Chakraborty (2020) consider a negative sign between wages and employment changes ($\beta_6 Log\Delta Wages < 0$).

Table 1 presents a summary of expected signs based on the empirical literature.

Results and Discussion

In this part, we present and discuss the empirical results considering the underlying theoretical assumptions about the structural adjustment issues between changes in employment and the marginal intra-industry trade. First, we observe the property tests on the variables used in the econometric model (descriptive statistics, panel unit root test, multicollinearity test and cross-section dependence test, panel Granger Causality and panel cointegration test). Then, in regressions, we use the Fully Modified OLS cointegration

model, Method of Moments Quantile Regression and GMM-System. Moreover, the econometric models, namely, FMOLS and Method of Moments Quantile Regression, have not been used in this type of study.

The general statistics are shown in Table 2. The variables of productivity (ΔProd), wages (ΔWages) and employment changes (|ΔEMPL|) give the higher values of maximum. Furthermore, in the relationship, we observe that all variables have a negative skew, except the variable of employment changes. Finally, considering the kurtosis statistic, we keep that productivity (ΔProd) and wages (ΔWages) show the lower values.

The correlations between the variables used in this investigation are reported in Table 3. Considering the relationship between independent variables and dependent variable (|ΔEMPL), we observe that marginal intra-industry trade (MIIT), the interaction of trade intensity (MIITxTRADE), the changes of

Table 1. Summary of expected signs.

Variables	Expected Signs
|ΔEMPL|it-1	[+]: Represents an increase of employment changes.
MIIT	[-]: Lower costs of adjustment.
MIITxTrade	[-; +]: Ambiguous signs. However, a positive sign denotes that trade intensity encourages MIIT.
ΔCons	[+]: An increase in demand stimulates internal and external consumption.
ΔProd	[+;-]: There is a positive (negative) association between productivity and employment changes.
ΔWages	[-]: There is a link between wages and employment. If employment changes increase, the salaries tend to decrease.

Table 2. Descriptive Statistics.

Statistics	|ΔEMPL|	MIIT	MIITxTrade	ΔCons	ΔProd	ΔWages
Mean	1.929	−0.371	−0.172	2.969	3.9357	3.1686
Median	1.756	−0.219	−0.009	3.054	4.069	3.276
Maximum	3.560	−0.003	−0.001	3.237	4.361	3.686
Minimum	1.311	−2.697	−1.116	2.294	3.200	2.076
Std. Dev.	0.498	0.424	0.199	0.231	0.358	0.418
Skewness	1.825	−2.264	−2.255	−1.272	−0.886	−1.247
Kurtosis	6.761	9.518	8.944	4.573	2.459	3.753
Probability	0.000	0.000	0.000	0.000	0.000	0.000
Obs.	198	198	198	198	198	198

Note. All variables are expressed in logarithm form.

Table 3. Correlations Between Variables.

Statistics	|ΔEMPL|	MIIT	MIITxTrade	ΔCons	ΔProd	ΔWages
|ΔEMPL|	1.000					
MIIT	0.011	1.000				
MIITxTrade	0.063	0.993	1.000			
ΔCons	0.243	0.039	0.046	1.000		
ΔProd	0.111	0.038	0.044	0.377	1.000	
ΔWages	0.017	0.071	0.074	0.771	0.328	1.000

Note. All variables are expressed in logarithm form.

consumption (ΔCons), productivity (ΔProd) and wages (ΔWages) are positively correlated with the evolution of employment (|ΔEMPL).

Table 4 evaluates the stationarity and properties of changes in employment (|ΔEMPL|), the marginal intra-industry trade (MIIT), the interaction of MIIT with the openness trade (MIITxTrade), consumption (ΔCons), changes in productivity (ΔProd) and wages (ΔWages), using the Levin, Lin and the Chu, ADF–Fisher Chi-square, Phillips–Perron and Im–Pesaran–Shin tests. As shown in Table 4, the variables of MIIT interaction with openness trade (MIITxTRADE) and wages (ΔWages) are stationary in levels for the four tests under analysis. Regarding the remaining variables, changes in employment (|ΔEMPL|), the marginal intra-industry trade (MIIT), consumption and productivity are integrated at first difference.

Before proceeding with the estimation of results, it will be necessary to carry out two preliminary tests (multicollinearity test and cross-section dependence test). Table 5 reports the multicollinearity for the variables used in this research (employment changes, marginal intra-industry trade, variations of consumption, productivity and wages). According to the empirical studies (e.g. Leitão 2021; Fuinhas et al. 2021), if VIF (variance inflation factor) is lower than 5, the variables considered do not present problems multicollinearity (Table 6).

The Pesaran (2004) test aims to detect the existence of cross-section dependence. The results show that all variables considered in this research present cross-section dependence between them.

The relationship of causality between the variables is considered in Table 7, using the arguments of Panel Granger causality. We present only the connexion between variables where unidirectional or bidirectional causality exists in this context. It should refer that it is not common to assess the causal relationships between variables in this type of study. However, the Granger test allows us to verify that the variables influence each other.

Considering Table 7, it is possible to extract the information that consumption (ΔCons) presents a unilateral relationship with changes in

Table 4. MIIT and Portuguese Labour Market With Panel Unit Root Test.

Variables	Level		First Difference	
Employment changes	|ΔEMPL|		D|ΔEMPL|	
Method	Statistic	*p*-value	Statistic	*p*-value
Levin, Lin and Chu t	−2.882***	(0.002)	−10.393***	(0.000)
ADF – Fisher Chi-square	16.44	(0.793)	113.263***	(0.000)
PP – Fisher Chi-square	41.966***	(0.006)	300.861***	(0.000)
IPS-Im, Pesaran, Shin W-Stat	−0.217	(0.414)	−9.068***	(0.000)
Marginal intra-industry trade	MIIT		DMIIT	
Method	Statistic	*p*-value	Statistic	*p*-value
Levin, Lin and Chu t	−6.272***	(0.000)	−11.543***	(0.000)
ADF – Fisher Chi-square	65.840	(0.000)	120.677***	(0.000)
PP – Fisher Chi-square	117.506***	(0.000)	710.022***	(0.000)
IPS-Im, Pesaran, Shin W-Stat	−5.079***	(0.000)	−9.732***	(0.000)
MIIT (marginal IIT) x trade	MIITx trade		DMIITxTrade	
Method	Statistic	*p*-value	Statistic	*p*-value
Levin, Lin and Chu t	−5.643***	(0.000)	−9.976***	(0.000)
ADF – Fisher Chi-square	63.734***	(0.000)	114.206***	(0.000)
PP – Fisher Chi-square	117.506***	(0.000)	728.978***	(0.000)
IPS-Im, Pesaran, Shin W-Stat	−4.963***	(0.000)	−9.135***	(0.000)
Consumption	ΔCons		DΔCons	
Method	Statistic	*p*-value	Statistic	*p*-value
Levin, Lin and Chu t	7.528	(1.000)	1.765	(0.961)
ADF – Fisher Chi-square	18.106	(0.699)	75.235***	(0.000)
PP – Fisher Chi-square	73.061***	(0.000)	256.494***	(0.000)
IPS-Im, Pesaran, Shin W-Stat	0.458	(0.323)	−5.984***	(0.000)
Productivity	ΔProd		DΔProd	
Method	Statistic	*p*-value	Statistic	*p*-value
Levin, Lin and Chu t	−3.073***	(0.001)	−11.700***	(0.000)
ADF – Fisher Chi-square	27.383	(0.197)	125.431***	(0.000)
PP – Fisher Chi-square	82.692***	(0.000)	231.471***	(0.000)
IPS-Im, Pesaran, Shin W-Stat	−1.609*	(0.053)	−10.071***	(0.000)
Wages	ΔWages		DΔWages	
Method	Statistic	*p*-value	Statistic	*p*-value
Levin, Lin and Chu t	−10.281***	(0.000)	−13.646***	(0.000)
ADF – Fisher Chi-square	99.335***	(0.000)	126.111***	(0.000)
PP – Fisher Chi-square	63.564***	(0.000)	210.215***	(0.000)
IPS-Im, Pesaran, Shin W-Stat	−7.886***	(0.000)	−10.126***	(0.000)

Note. All variables are in logarithmic form. *** ($p<0.01$); * ($p<0.10$).

Table 5. Multicollinearity Test Considering OLS Estimator.

Variables	Variance inflation factor	1/VIF
|ΔEMPL|it-1	1.04	0.965
MIIT	1.01	0.994
ΔCons	2.48	0.403
ΔProd	1.19	0.841
ΔWages	2.41	0.415
Mean VIF	1.62	

Note. All variables are expressed in logarithm form.

Table 6. Cross-Section Dependence Test.

Variables	CD-Test	*p*-value
MIIT	10.755***	0.000
MIITxTrade	12.152***	0.000
ΔCons	31.464***	0.000
ΔProd	31.464***	0.000
ΔWages	31.463***	0.000

Note. All variables are expressed in logarithm form. *** (p<0.01).

Table 7. Pairwise Granger Causality Test.

Null hypothesis:	Obs.	F-statistics	Prob.
ΔCons does not Granger cause |ΔEMPL|	176	8.392***	(0.000)
ΔWages does not Granger cause |ΔEMPL|	176	5.569***	(0.004)
|ΔEMPL|does not Granger cause ΔWages	176	2.921*	(0.056)
ΔProd does not Granger cause |ΔEMPL|	176	12.714***	(0.000)
|ΔEMPL| does not Granger cause ΔProd	176	24.729***	(0.000)
MIIT x trade does not Granger cause MIIT	176	2.641*	(0.074)
MIIT does not Granger cause MIIT x trade	176	3.439**	(0.034)
ΔWages does not Granger cause ΔCons	176	15.924***	(0.000)
ΔCons does not Granger cause ΔWages	176	17.385***	(0.000)
ΔProd does not Granger cause ΔCons	176	8.082***	(0.000)
ΔCons does not Granger cause ΔProd	176	17.385***	(0.000)
ΔProd does not Granger cause ΔWages	176	5.051***	(0.008)
ΔWages does Granger cause ΔProd	176	6.2235***	(0.002)

Note. All variables are in logarithmic form. *** (p<0.01); * (p<0.10).

employment (|ΔEMPL|). However, the relationships between wages (ΔWages) and changes in employment (|ΔEMPL|), productivity (ΔProd) and changes in employment (|ΔEMPL|) have a bidirectional association. Furthermore, we highlight the bidirectional relationship between the MIIT interactive variable (MIITxTrade) and the marginal intra-industry trade (MIIT). It is also possible to observe that wages (ΔWages) promote consumption (ΔCons), with these variables showing a bidirectional relationship. A bidirectional relationship is kept in the remaining relationships between the poles.

The tests of panel cointegration proposed by Kao (2000) and Johansen and Fischer reported in Table 8 and Table 9 demonstrate the variables of: employment changes (|ΔEMPL|); marginal intra-industry trade (MIIT); the interaction between MIIT and openness trade (MIITxTrade); and variations in consumption (ΔCons), wages (ΔWages) and productivity (ΔProd) present a long-run relationship between them.

After performing the cointegration tests, Table 10 shows the Fully Modified Squares Estimator (FMOLS). In general, we can state that the cointegration estimator used supports the SAH hypotheses. Furthermore, in the variables under study, it is observed that the marginal intra-industry trade (MIIT), the interaction with MIIT, changes in consumption (ΔCons) and changes in wages (ΔWages) present statistical significance at 1%.

Table 11 depicts the results using the Method of Moments Quantile Regression (MMQR) suggested by Machado and Silva (2019). We use the lagged variable of employment changes to assess long-run effects, following previous empirical studies such as Thorpe and Leitão (2012), Faustino and Leitão (2012), Aggarwal and Chakraborty (2020) and Pinto et al. (2019) to assess the hypothesis of SAH. According to our results, the lagged variable of employment changes presents a positive sign in the three quantiles and is statistically significant at the 1% level. This result has support in the empirical studies.

Table 8. Kao Panel Cointegration Test.

	t-Statistic	Prob.
ADF	−2.226**	(0.013)
Residual variance	0.2.50	
Heteroskedasticity – and autocorrelation – consistent (HAC) variance	0.101	

**($p<0.05$).

Table 9. Johansen Fischer Panel Cointegration Test.

Hypothesised No. Of CE(s)	Fisher stat.* (From Trace Test)	Prob.	Fisher stat.* (From the Max-Eigen Test)	Prob.
None	15.25	0.8513	15.25	0.8513
At most 1	99.03***	(0.000)	117.5***	(0.000)
At most 2	202.6***	(0.000)	202.6***	(0.000)
At most 3	162.7***	(0.000)	160.0***	(0.000)
At most 4	38.48**	(0.016)	33.16*	(0.059)
At most 5	31.83*	(0.080)	31.83*	(0.080)

***($p<0.01$); * ($p<0.10$).

Table 10. MIIT and Portuguese Labour Market With Panel Fully Modified Least Squares.

Variables	Panel fully modified least squares
MIIT	−5.355*** (0.000)
MIITxTrade	11.489*** (0.000)
ΔCons	1.287*** (0.000)
ΔProd	0.073 (0.448)
ΔWages	−0.528*** (0.000)
Observations	187

Note. All variables are expressed in logarithm form. *** ($p<0.01$).

Table 11. MIIT and Portuguese Labour Market With Quantile Regression.

Quantile regressions: Dependent variable|ΔEMPL|			
Variables	Quantile 0.25	Quantile 0.50	Quantile 0.75
$\|\Delta EMPL\|_{it-1}$	0.195*** (0.000)	0.402** (0.022)	1.077*** (0.068)
MIIT	−2.017** (0.035)	−2.073* (0.079)	−2.998*** (0.000)
MIITxTrade	4.148** (0.034)	4.417* (0.073)	3.729 (0.115)
ΔCons	0.808*** (0.000)	1.108*** (0.000)	1.603*** (0.000)
ΔProd	−0.179*** (0.000)	−0.154** (0.012)	0.112 (0.631)
ΔWages	−0.369*** (0.000)	−0.398*** (0.000)	−0.865*** (0.000)
Constant	0.741*** (0.000)	−0.567 (0.221)	−2.423*** (0.011)
Observations	187	187	187
Wald test	6.66 (0.4650)	6.66 (0.4650)	6.66 (0.4650)
Adj. R^2	0.25	0.30	0.27

Note. All variables are expressed in logarithm form. *** ($p<0.01$); ** ($p<0.005$); * ($p<0.10$).

The coefficient of marginal intra-industry trade (MIIT) negatively impacts employment changes, and the variable is statistically significant at 5%, 10% and 1% levels, respectively, showing a smooth adjustment cost. The previous studies of Cabral and Silva (2006), Thorpe and Leitão (2012), Faustino (2010) and Faustino and Leitão (2012) also found the SAH hypothesis, that is, lower costs of adjustment costs.

The interaction between MIIT and trade openness (MIITxTrade) has a positive impact with statistical significance at 5% and 10% levels, revealing that liberalisation can promote MIIT (Erlat and Erlat 2006; Aggarwal and Chakraborty 2020). However, some of the literature (Cabral and Silva 2006; Faustino 2010; Pinto et al. 2019) demonstrates a negative association between the two variables, the dominant hypothesis.

As Brülhart and Thorpe (2000), Faustino (2010) and Thorpe and Leitão (2012) refer, an increase in employment changes aims into an increase in consumption. The variable of changes in consumption finds a positive sign as advanced by the literature, being statistically significant at the 1% level.

For the productivity variable (ΔProd), the literature indicates an ambiguous relationship since there are studies (Thorpe and Leitão 2012) that found a positive association between the variables and others that found a negative relationship. The results obtained demonstrate a negative association between productivity and changes in employment, supported by studies by Rasekhi and Ghaderi (2012), Faustino (2010) and Erlat and Erlat (2006).

The variable for wages (ΔWages) finds the negative sign advanced by several previous studies such as Greenaway et al. (1999); Faustino and Leitão (2012) and Aggarwal and Chakraborty (2020), with statistical significance at the 1% level. Finally, we can also refer that the Wald test demonstrates that the coefficients obtained are not constant for the three quartiles under analysis.

Table 12 reports the results using the GMM-System estimator. As we can visualise, the results obtained by the first and second steps are similar.

The model presents five variables with significance in the first and second steps ($|\Delta EMPL|_{it-1}$, MIIT, MIITxTRADE, ΔCons, ΔWages). As expected, the variable of employment changes ($|\Delta EMPL|_{it-1}$) positively affects the Portuguese economy, showing a positive correlation with changes in consumption, agreeing with the formulated hypothesis. Furthermore, the variable has statistical significance at 1%. The empirical works of Brüllhart and Thorpe (2000) and Fertö (2009) support this result.

As the previous studies by Brülhart and Elliot (2002), Brülhart (2000) and Faustino (2010) report, there is a negative association between MIIT (marginal intra-industry trade) and employment changes (|ΔEMPL|it-1).

The interaction between MIIT and trade openness coefficient (MIITx-Trade) has a positive impact on employment changes (|ΔEMPL|it-1), which found support in the alternative hypothesis tested by Erlat and Erlat (2006) and Aggarwal and Chakraborty (2020).

Table 12. MIIT and Portuguese Labour Market With GMM-System.

	First Step	Second Step
Variables	GMM-SYS	GMM-SYS
$\|\Delta EMPL\|_{it-1}$	0.206*** (0.000)	0.199*** (0.000)
MIIT	−5.526*** (0.000)	−5.969*** (0.000)
MIIT x trade	12.459*** (0.000)	13.352*** (0.000)
ΔCons	1.145*** (0.000)	1.091*** (0.001)
ΔProd	−0.014 (0.839)	−0.049 (0.811)
ΔWages	−0.489*** (0.000)	−0.439* (0.078)
Constant	−0.165 (0.653)	−0.031 (0.976)
Observations	187	187
AR_2		0.716
Sargan test		0.456

Note. All variables are expressed in logarithm form. *** (p<0.01); * (p<0.10).

Table 13. MIIT and Portuguese Labour Market With Panel ARDL Model.

Variables	Coefficient	Std. Error	t-Statistic	Prob
	Long run equation			
MIIT	−8.337***	0.803	−10.379	0.000
MIITxTrade	16.511***	1.551	10.642	0.000
ΔCons	2.043***	0.307	6.653	0.000
ΔProd	0.070	0.125	0.562	0.575
ΔWages	−1.130***	0.163	−6.917	0.000
	Short-run equation			
ECT (-1)	−0.651***	0.057	−11.539	0.000
D (MIIT)	−0.70	2.651	−0.266	0.790
D (MITxTrade)	1.758	5.5035	0.319	0.750
D (ΔCons)	−0.022	0.113	−0.1924	0.845
D (ΔProd)	−0.141***	0.045	−3.162	0.002
D (ΔWages)	0.254***	0.077	3.309	0.001
C	−0.724***	0.066	−11.036	0.000

Note. All variables are expressed in logarithm form. *** (p<0.01).

The variables of apparent consumption (ΔCons) and wages (ΔWages) follow the formulated hypotheses, as well as the studies by Thorpe and Leitão (2012), Greenaway et al. (2020), Faustino and Leitão (2012) and Aggarwal and Chakraborty (2020).

Finally, it is observed that the variables do not present serial correlation (AR_2) or specification problems according to the Sargan test results.

The pooled mean group (PMG) also designated by the panel ARDL model is presented in Table 13. We observe the short- and long-run effects. In this context, in the long run, all coefficients are statistically significant at a 1% level, except productivity which is not statistically significant. As our previous econometric results, the equation validates the hypotheses formulated.

Conclusions

This study evaluates structural adjustment issues in the Portuguese labour market considering changes in employment, wage, productivity, consumption and marginal intra-industry trade. Following the smooth adjustment hypothesis (SAH) literature, a greater marginal intra-industry trade intensity should reduce adverse shocks expressed in temporary inefficiencies such as undesirable costs of job search and workers' relocation and/or retraining. So, our primary purpose was to test the hypothesis that intra-industry trade expansion leads to significantly smaller labour adjustment costs. To test the SAH hypothesis, we followed the same methodology of previous studies (Erlat and Erlat 2006; Faustino 2010; Faustino and Leitão 2012; Thorpe and Leitão 2012; Pinto et al. 2019; Aggarwal and Chakraborty 2020) but using sequentially several regression methods based on a panel data for 2000–2018. Besides, our study used a complementary methodology as Panel Quantile Regressions Moments, Panel Fully Modified Least Squares and panel Granger causality.

The specified regression model contains employment as the dependent variable, including its lagged value as a regressor to consistently estimate dynamic adjustments and long-run effects parameters.

Empirically, we intended to analyse if there was a negative sign for the estimated parameter measuring the impact of marginal intra-industry trade on employment changes along the period under analysis. But, as we have noticed, there is still no consensus about such an expected signal once not all do validate the negative relationship between the marginal intra-industry trade and employment changes.

To assure consistency of estimators used, we followed a set of preliminary statistical tests before implementing the econometric procedure. We started by performing unit root tests for panel data, followed by tests for multicollinearity, panel cross-section dependence, panel Granger Causality and panel cointegration. In general, results suggest that we are in the presence of stationarity in first differences for all regressors, a condition to be fulfilled a

priori allowing an Ordinary Least Squares (OLS) type estimator as an efficient method regarding variance property. Furthermore, there is statistical evidence of consistency for linear OLS by rejecting the null hypothesis of multicollinearity. Then, the rejection of the null hypothesis of no cross-sectional dependence even at a 1% level of significance, an essential diagnosis before performing a panel data analysis, implies the use of more robust techniques for better precision in estimated signals of explanatory variables parameters.

Therefore, one of the methodological contributions of this investigation is the use of the Method of Moments Quantile Regression (MMQR), not used in empirical studies about SAH and the cointegration panel models. In this line, we also applied causality tests which allowed us to conclude long-term relations between regressors, confirming some of the expected results according to the literature, which is thus recommended to be included in the specified model as control variables (apparent consumption, productivity and wages). We also considered the absolute changes in employment as an empirical proxy of labour market adjustment cost, still used in recent literature on the subject. Our research confirmed that consumption, wages and productivity predict employment evolution allowing forecasts for the last variable with a lag of one period for a long-term horizon. The exact causal relation was confirmed regarding the long-term influence of intra-industry trade expansion on smaller labour adjustment costs, favouring SAH adherence in the Portuguese industrial sectors. In terms of interpretation of signs obtained through the econometric strategy put in practice, it is worthy of notice that we found evidence in favour of the smooth adjustment hypothesis.

As for the limitations of this investigation, we consider a complete functional specification of the econometric model to be relevant from the point of view of the control variables. There may be a specification problem associated with the model by default of an instrumental variable that captures asymmetric economic shocks, which may impact in a differentiated sectorial way on international trade flows and the structural components of the economy, to the point of being reflected in structure breaks; especially since we are working with long time series. This stems from the interaction between the regressors in the face of exogenous changes related to the economic cycle, which will interfere with the dynamics of international trade, private consumption, employment, wages and productivity. Besides, the period covered in our study involves a remarkable historical episode: the intervention of the Troika (2012–2014).

The change of political cycle in 2015 and the consequent replacement of austerity for new priorities – such as energy transition, business environment attractiveness for foreign direct investment and the reinforcement of innovation networks between universities and industries (supported by European Union structural funds) – induce new research issues to understand better the sectorial dynamics of the Portuguese economy in a long-term horizon; particularly in the face of complex institutional and technological changes.

In terms of public and economic policy recommendations, it seems that the increase in real wages associated with a more significant accumulation of human capital and an increase in labour productivity may strengthen the intensity of international trade flows. This research should move forward considering variables related to sectorial innovation dynamics, possibly distinguishing companies' size and ability to cooperate with R&D centres (knowledge spillovers) and adopt sustainable management practices (such as carbon footprint neutrality).

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