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Tariffs and Unemployment Causality: Evidence from a Panel Analysis of the EU

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Abstract

To investigate the direction of the relationship, (if exists), between tariffs and unemployment, this paper used the EU data, for the period 2000-2010, to conduct the causality test within the Vector Error Correction Model (VECM) framework. The data are divided into two groups, representing the members of the EU based on the per capita income, the richest and the rest. Our model is a four-variable system of unemployment rate as a dependent variable, U, and tariffs applied to the EU imports, $tariff_{EU}$, tariffs applied to the EU exports, $tariff_{TP}$, and trade flows,TF, as independent ones, for agricultural sector. The appropriate tests are employed to test for causality using GiveWin, Pc-Give. Our results indicate, for the whole sample, in the short-run, the existence of unidirectional causality between U and $tariff_{EU}$, implying that the single external tariff of the EU affects inversely on unemployment in the agricultural sector. Unidirectional causality also exists between unemployment, U, and trade flow, TF, inversely running from trade flow to unemployment. No causality is detected from unemployment to the third explanatory variable, $tariff_{TP}$. Regarding the richest group panel, it is shown that there is bidirectional causality between unemployment and the external tariff applied by the EU, with negative sign in the direction from $tariff_{EU}$ to unemployment, U, and positive sign in the other one, however, a unidirectional causality running from trade flow, TF, towards unemployment, U, is detected. There is no causal relationship between the tariffs applied by the EU trading partners and unemployment within this group. The rest group panel shows that there is bidirectional relationship between the external tariff applied by the EU, $tariff_{EU}$ and unemployment, U. A unidirectional causal relationship exists between trade flow, TF, and unemployment, U. They are the same results detected in the richest group. Also, there is no causal relationship detected between the tariffs applied by the EU trading partners, $tariff_{TP}$ and the unemployment, U. The error correction term (ECT) carries a negative, but not always statistically significant, coefficient, confirming that the variables in the model are indeed cointegrated when their coefficients are statistically significant.

Keywords: *EU, Agricultural sector, Panel data, Tariffs, Unemployment, Causality test, VECM.*

1. Introduction

"Tariffs Increase Employment".

(Stopler and Samuelson, 1941, in Appleyard et al., 2010, 258)

Is there a causal relationship between Unemployment and tariffs? This paper empirically, using panel data of EU, tries to investigate whether this relationship exists or not. And if it exists, is it unidirectional or bidirectional, i.e., does this relationship run from unemployment to tariffs or vice versa (or in both directions simultaneously)?

Despite it is considered as one of the greatest macroeconomic problems and one of the most tangible indicators of Economic activity, unemployment is mostly abstracted away from trade models. Belenkiy and Riker (2015, 2) argue that there is a significant disconnect between the policy debate on the trade policies impact on job and the traditional assumptions in the international trade models.

According to Dutt et al., (2008), most trade models are specified with full employment, which remains fixed, and fully flexible wages, i.e., any job destruction will be offset by job creation without any influence on the unemployment rates. Davidson et al., (1999, 272) stated that:

"The debate about trade policy among economists almost always ignores the impact of trade on employment. There are at least two reasons for this dichotomy. First, most international trade economists view trade as a microeconomic issue that focuses on the distribution of resources within an economic environment while they view unemployment as a macroeconomic concern related to the overall level of economic activity and other aggregate measures of economic performance. Second, the field of international trade has been, since inception, predominately a micro-based theoretical field relying on insights from mathematical models to draw conclusions about the impact of trade policies on real world economies".

In this regard, Davidson et al. (1999) clarified the different views of the public debate. These views focus on the impact of trade on employment. From one hand, it is argued that trade liberalisation lowers the costs of production and as a consequence of fewer regulations in other countries the foreign firms are allowed to out-compete domestic producers. This leads to less domestic output and fewer domestic jobs. On the other hand, it is argued that trade liberalisation expands the markets of export, resulting in an increase in the demand of domestic products, production and jobs.

The mentioned assumption of the full employment has been defended by Belenkiy and Riker (2015). They argue that this assumption is due to some reasons. The first reason is connected to the simplicity to specify economic models. The second one is tradition; where economic modelling is still built on past practice despite it is a field with constant methodological innovations. And finally, they argued that in the short run, aggregate demand factors, like monetary policy, determine unemployment and in the long run the natural rate of unemployment is the determinant, rather than industry-specific trade policies. Therefore, it is not important for unemployment to be included in trade models focusing on the long run. It is worth notable that almost all the studies, theoretically or empirically, on the relationship between trade liberalisation and unemployment, interested in the existence of this relationship. And if it exists, is it positive or negative? According to Belenkiy and Riker (2015, 4), the theoretical studies do not provide a general prediction for the positive or negative impact of international trade, trade liberalisation, on aggregate unemployment in a country. Moreover, based on some reviewed theoretical models, they found that the relationship between trade and aggregate unemployment is complex and ambiguous.

To the best of my knowledge, no study paid any attention to the direction of this relationship. Also, it is notable the absence of the European Union application in the empirical studies on the relationship between trade liberalisation and unemployment, despite, from my point of view based on some facts, it represents, empirically, the best case in this regards.

Started by a customs union of Belgium, The Netherlands, and Luxembourg in 1947, absorbed into the European Community in 1958, the European Union was established, officially, in 1993. According to Appleyard et al. (2010), since the first step of the EU establishment, tariffs have been eliminated on intra-EU trade and a single external tariff has been adopted abroad. As an example for this single external tariff, the EU tariff on agricultural products average 18%, representing over four times more than changes on other goods, moreover, in the same sector, the EU paid 1.0 billion euros in export subsidies, recorded in 2008, resulting in distorting competition, depressing in the prices of the world market, harming foreign farmers and lowering the wages for unskilled workers in agriculture, especially in developing countries where agricultural sector represents the main source of their national income and the largest sector accommodating the highest rate of total employment. Since its establishment and with the gradual removing of tariffs among the EU countries and adopting a common external tariff policy, unemployment should have been investigated.

According to Parker (2010), unemployment rates in Europe have increased since 1980 compared with the period 1950 until 1970. The mentioned period witnessed unemployment rate in most European countries averaged about 2% that has grown up to 8 and 12 % since 1980. In 1986 the average of the European unemployment rate fell to 10.89%, recording 10.42% in 1996. The unemployment rate averaged 10.8% from 1995 to 1997 before falling steadily to 7.4% in 2001 and rising to 7.7 % in 2002 and 8.2% in 2003. It became 8.8% in 2004 and 8.6% in 2005 (for more details see, Appleyard et al., 2010).

From 2008 unemployment climbed among the EU countries. Based on Eurostat., Greece and Spain recorded the steepest rises in unemployment, reaching 25.7% and 26.3, respectively, in 2014. Also, unemployment rate climbed substantially, from 2008, in Estonia, Hungary, Ireland, Portugal, the Slovak Republic, and Slovenia, recorded as a percentage of labour force, to 10.9%, 8.1%, 10.6%, 16.8%, 13.4%, and 13.1%, respectively, in 2014. Germany was the only country where unemployment fell among workers to reach 5.3% in 2014.

In their DNB working paper, Beyer and Stemmer (2015) see the European unemployment as "*a nightmare*" over the last three decades. They argue that a sharp rising of the EU unemployment rates occurred following the financial crisis in which the weighted average of unemployment increased from 7.5 % in 2007 to 11.9% in 2013. Eurostat estimates that 23.887 million men and women in the EU-28, of whom 18.204 million were in the euro area, were unemployed in Feb. 2015. The highest labour market heterogeneity is found in Belgium and Italy; the lowest in the Netherlands, Portugal and France.

Trying to find out the influence of trade liberalisation (tariffs reduction) on unemployment, i.e. whether tariffs reduction, to liberalise trade, results in or from unemployment, we contribute to the literature by applying granger causality test. Considering causality, when regarding the relationship between trade liberalisation (tariffs reduction) and unemployment, the remainder of this paper is organised as follows: the next section presents some theoretical models and applications of empirical studies on the relationship between trade liberalisation and unemployment.

Then, our causality model is specified within job search model incorporated into trade framework. Methodology is demonstrated in details for a sample of rich and poor countries of the European Union (panel data) for the period 2000-2010. Using GiveWin, Pc-Give, we will estimate our model to investigate the following tests (for more details about Pc-Give see Volume I-III of Doornik and Hendary, 2003): testing for stationarity; Cointgration test; Granger causality test under Vector Autoregressive model (VAR) or Vector Error Correction Model (VECM), depending on the results of the cointegration test. If cointegration is established, the Granger causality test will be based on VECM, and in case of the absence of cointegration, on VAR. And finally, we introduce our model results and conclude.

2. Unemployment and Tariffs: Theoretical Background and Empirical Evidence

Paying the attention to the relationship between trade liberalisation and unemployment, Stolper and Samuelson (1941) argued that, under the assumptions: two commodities produced in perfectly competitive conditions, with two factors of production, capital and labour, and the import is labour intensive commodity, a country can improve the real wages of its workers by levying a tariff on import. This protection will serve to increase the nominal wage rate by a greater percentage than that of the import commodity.

But it is notable that over the recent years, fifteen years ago, a significant growing of studies on the relationship between trade and unemployment are witnessed, theoretically and empirically, such as, Davidson et al. (1999), Moore and Ranjan (2005), Dutt et al. (2009), Felbermayr et al. (2009), Artuc et al. (2010), Hasan et al. (2010), Helpman and Itskhoki (2010), Helpman et al. (2010), Mitra and Ranjan (2010), and Felbermayr et al. (2013). Unemployment as a result of time consuming job search is modelled. It is considered as an important investigation of the new studies. Its insight is, in equilibrium search models, frictional unemployment appears due to labour market imperfect information and in the long run it persists.

By incorporating, theoretically, equilibrium job search into a model of international trade, Davidson et al. (1999) introduced unemployment modelled carefully. They compared their findings with the results of full employment models. They argued that some traditional results are too narrow and that some results do not generalize to models with unemployment. They show that in some important cases results do generalize and that their model allows to address issues that traditional models can't handle. Their model of trade shows that job creation and job destruction can be affected by search frictions in the labour market.

Also, the model predicts that, when trading with a smaller, relatively labour country, a relatively capital-abundant large country (having more efficient labour market) will have low unemployment rate and a comparative advantage in the high unemployment sector. This theoretical model was empirically analysed by Davidson and Matusz (2004). Consistently with Davidson et al (1999) theoretical model predictions, the empirical results are obtained. The year 2009 witnessed some attention to the issue (theoretically and empirically). In their empirical work of trade openness and structural rate of unemployment, Felbermayr et al. (2009) asked: ***"does exposure to international trade create or destroy jobs?".*** To answer this question, they documented robust facts about the relationship between the unemployment rate and trade by adding measures of trade openness into a regression framework established in the macro econometric literature on national rates of unemployment differences.

Using panel data from 20 OECD countries and cross-sectional data on a larger set of countries, 62, they found that a 10% increase in total trade openness reduces unemployment by about 1% point and the openness affects unemployment mainly through its effect on TFP and that labour market institutions do not appear to condition the openness effect. Another empirical work was introduced by Felbermayr et al. (2013). They asked: *How do changes in* *labour market institutions, like more generous unemployment benefits in one country, affect labour market outcomes of the other?*

To confirm their theoretical predictions, Felbermayr et al. (2013) used panel data for 20 rich OECD countries to estimate a two-country Armingtonian trade with frictions on the products and labour market. They controlled for institutions as well as for business cycle or economic cycle. Their results are: first, the effect of foreign institutions on domestic unemployment is about 10% of the effect of domestic ones; second, wage flexibility reduces the unemployment spillovers size; and finally, foreign trade expanding reduces the rates of unemployment. At the same year, 2009, two alternative models of trade and unemployment were empirically presented by Dutt et al. The first model is the Ricardian where using only factor of production, labour, and trade is based on relative technological differences. The second one is specified within a Hechscher-Ohlin framework, with two factors of production, labour and capital that are intersectorally mobile. Using cross-country data on various measures of trade policy, unemployment and a variety of controls, and controlling on endogeneity and measurement-error problems, they find strong evidence for the Ricardian prediction that there is a negative relationship between unemployment and trade openness. No support is found for the H-O prediction of this relationship between trade openness and unemployment changes from negative to positive as they move from labour-abundant to capital-abundant countries. As a significant contribution to the theoretical analysis of trade liberalisation and unemployment literature, Moore and Ranjan (2005) added workers of different skill levels to their theoretical model of trade and equilibrium job search. With ignoring the misused *"an",* written from their original work text, they state that (Moore and Ranjan, 2005, 409):

"In an skill-abundant economy characterised by search-generated unemployment, opening up to trade leads to a decrease in the unemployment rate of skilled labour and an increase in the unemployment rate of unskilled labour. Although the effect in the aggregate employment rate is theoretically ambiguous, in practice it is likely to increase. In addition, opening to trade will lead to an increase in inequality; the skilled real wage will increase and the unskilled real wage will decrease".

Their model has two factors of production, like the previous work of Davidson et al. (1999), however, the two factors, here, are skilled and unskilled labour, and two countries having different relative factor endowments that determine comparative advantage pattern. For the skill abundant country, trade openness raises the relative price of the skill intensive goods, reducing the skilled workers unemployed rate and raises the unskilled workers unemployed rate. Moreover, trade openness raises the real wage in one sector, skilled labour, and lowers the real wage for unskilled labour.

The year 2010, like 2009, witnessed a significant growing in the studies of trade liberalisation and unemployment. Some of these studies seem to be theoretical and others empirical ones. By conducting structural estimation of inter industry mobility costs for workers in the U.S., assuming competitive labour market, Artuc et al. (2010) estimated the temporary impact of trade liberalisation on employment. A dynamic labour adjustment model was estimated using the U.S. economy data. Their model has full employment. Given that, unemployment analysis was not the model interest. Their finding is that workers move slowly between sectors. However, wages move sharply.

For the case of India, Hasan et al. (2010), using a theoretical framework incorporating trade and search-generated unemployment, used state- and industry- level data on unemployment rates and trade protection to examine what the data say. Their finding is little evidence to support the view that unemployment rises due to trade liberalisation. On the contrary, as authors argue, the analysis suggests the existence of a statistically significant relationship, unemployment falls with trade liberalisation. The state-level analysis shows a decline of urban unemployment with trade liberalisation. Moreover, the industry-level analysis indicates that workers in industries, experiencing greater reductions in trade protection, were less to become unemployed, especially in net export industries.

Another contribution to the issue of interest in the year 2010, Helpman and Itskhoki (2010) and Helpman et al. (2010), an extension of the first work mentioned, incorporated, theoretically, job search and equilibrium unemployment into international trade models. The model of Helpman and Itskhoki (2010), to investigate the interaction of labour market rigidities and trade impediments in shaping welfare, trade flows, productiveity, and unemployment, has two sectors and two countries. One sector produces homogenous goods and the other produces differentiated ones, but both sectors are subject to search and matching frictions in the labour market and wage bargaining. As a consequence, some of searching workers are unemployed.

The frictions in the labour market, such as efficiency of matching and costs of posting vacancies, vary across the two countries, which can vary across the sectors as well. Firm heterogeneity and monopolistic competition prevail in the differentiated good industry. They predict that both countries gain from trade. With relatively lower frictions, a country in the differentiated good industry exports differentiated goods on net. Lowering frictions in the differentiated sector's labour market in one country, as stated by Helpman and Itskhoki (2010), benefits this country and harms its trading partner. Simultaneously, this lowering in both countries benefits both of them. The conclusion is that lower labour market frictions do not ensure lower unemployment, and unemployment and welfare can increase due to falling labour market frictions and trade costs.

Participating with Redding, in 2010, Helpman and Itskhoki added job-differences in worker ability to their above model. A new framework for examining the determinants of resource allocation and income distribution is developed, in which there is a response of both wage inequality and unemployment to trade. Helpman et al. (2010) introduced standard Diamond-Mortenses-Pissarides search and matching frictions into a Melitz (2003) model. Also, unlike previous work as they wrote, ex post match-specific heterogeneity in a worker's ability is introduced, as mentioned.

They argue that firms screen out low ability workers to improve the composition of their employees. They predict that in the closed economy, inequality in the sectoral wages distribution is increasing in firm productivity dispersion and in worker ability dispersion. Another prediction is that the opening of the closed economy to trade amplifies differences in composition of workforce across firms. One of their predictions, concerning the issue of interest, is that this opening has an ambiguous effect on sectoral unemployment rate.

By constructing a two sector general equilibrium model where labour is mobile and search frictions causes unemployment, Mitra and Ranjan (2010) investigate the effect of offshoring on unemployment rate. Their main finding is that wage increases and sectoral unemployment decreases as a result of offshoring. Productivity enhancing (cost reduction) effect of offshoring can explain this finding. When modifying their model for immobility of labour across sectors, the negative relative price effect on the sector where firm offshores some of its activities becomes stronger. As a consequence, this effect may offset the positive productivity effect, leading to a rise in unemployment.

3. The Model Specification

Our model specification, on analysing the relationship between trade liberalisation policy (tariffs reduction) and unemployment in the context of a causality test, is based on a theoretical framework of incorporating search-generated unemployment into a model of international trade indicated in the works of Hasan et al. (2010) and Dutt et al. (2008). Search theory analyses frictional unemployment resulting from job hunting by workers. Following Hasan et al. (2010, 4-9), a theoretical framework is presented through three subsections in the following lines to guide us in considering a simplified model on the relationship between unemployment and tariffs and analysing the empirical results.

3.1. Production Structure

Consider an economy that produces a single final good and two intermediate goods in which the final good is non-tradable, while the intermediate goods are tradable. The final good is denoted by Z and the two intermediate goods are denoted by X and Y. Denote the prices of X and Y in terms of the final good as p_x and p_y, respectively. The production function for the final good is as follows:

$$Z = \frac{AX^{1-\alpha}Y^{\alpha}}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}};0 < \alpha < 1 \tag{1}$$

Given the prices p_x and p_y of inputs, the unit cost for producing Z is given as follows:

$$c(p_x, p_y) = \frac{(p_x)^{1-\alpha}(p_y)^{\alpha}}{A} \tag{2}$$

Since Z is chosen as the numeraire, c (p_x, p_y) = 1, or

$$\frac{(p_x)^{1-\alpha}(p_y)^{\alpha}}{A} = 1 \tag{3}$$

The production function for Z implies the following relative demand for the two intermediate goods.

$$\frac{X^d}{Y^d} = \frac{(1-\alpha)p_y}{\alpha p_x} \tag{4}$$

Labor is the only factor of production. The total number of workers in the economy is L, each supplying one unit of labor inelastically when employed. A producing unit in intermediate goods production is a job-worker match. New producing pairs are created at a rate determined by a matching function of two measures of labor market participation, namely vacancies and unemployment. Job destruction is a response to idiosyncratic shocks to the productivity of existing job-worker matches. The production functions (in these one-worker firms) in the two intermediate goods sectors, once the matches are formed, are given by

$$x = h_x\, l_x;\ y = h_y\, l_y \tag{5}$$

If L_i is the total number of workers affiliated with sector-i, u_i the unemployment rate in sector-i, then the number of employed in sector-i is $(1 - u_i)\, L_i$. The aggregate production in each sector is given by

$$X = h_x\,(1 - u_x)\, L_x;\ Y = h_y\,(1 - u_y)\, Ly;\ L_x + L_y = L \tag{6}$$

The relative supply of the two intermediate goods is

$$\frac{X^s}{Y^s} = \frac{h_x(1-u_x)L_x}{h_y(1-u_y)L_y} \tag{7}$$

The total number of matches in the labor market is determined by the matching technology given as follows. Let v_i be the vacancy rate (i.e., the number of vacancies divided by the labor force) in sector-i. Define $\theta_i = v_i/u_i$ as a measure of market tightness, and let m_i be a scale parameter in the matching function. So, the flow of matches in each sector per unit time is written as follows:

$$M_i\,(v_i\, L_i,\, u_i\, L_i) = m_i\ (v_i)^{\gamma}\,(u_i)^{1-\gamma}\, L_i = m_i\,(\theta_i)^{\gamma}\, u_i\, L_i;\ 0 < \gamma < 1 \tag{8}$$

Where γ is a parameter capturing the vacancy intensity of this Cobb-Douglas matching function. The exit rate (from unemployment) for an unemployed searcher in sector-i is $\frac{M_i}{u_i L_i} = m_i \theta_i^{\gamma}$, and the rate at which vacant jobs are filled is $\frac{M_i}{v_i L_i} = m_i \theta_i^{\gamma-1}$.

The first is an increasing function of market tightness, and the second is a decreasing function of market tightness. Assume that the matches in sector-i are broken at an exogenous rate of λ_i per period. λ_i can be viewed as an arrival rate of a shock that leads to job destruction. Given the above description of labor market, the net flow into unemployment per period of time is

$$u_i = \lambda_i (1 - u_i) = m_i \theta_i^{\gamma} u_i \tag{9}$$

In the steady-state the rate of unemployment is constant. Therefore, the steady-state unemployment in sector-i is given by

$$u_i = \frac{\lambda_i}{\lambda_i + m_i \theta_i^{\gamma}} \tag{10}$$

Denote the recruitment cost in sector-i in terms of the final good by δ_i, the firing cost by F_i and the exogenous discount factor by e. The asset value of a vacant job, V_i is characterized by the following Bellman equation

$$\rho V_i = -\delta_i + m_i \theta^{\gamma-1} (J_i - V_i) \tag{11}$$

where J_i is the value of an occupied job. Free entry in job creation implies $V_i = 0$, which set from now on. Denoting the wage of workers in sector-i by w_i in terms of the numeraire, the asset value of an occupied job, J_i satisfies the following Bellman equation

$$\rho J_i = p_i h_i - w_i - \lambda_i (J_i + F_i) \tag{12}$$

when the job is destroyed, the firm not only losses J_i but also to pay the firing cost F_i. Free entry in job creation $(V_i = 0)$ implies the following from (11) above.

$$J_i = \frac{\delta_i}{m_i \theta^{\gamma-1}} \tag{13}$$

Equations (12) and (13) imply

$$p_i h_i - w_i - \lambda_i F_i = \frac{\delta_i (\rho + \lambda_i)}{m_i \theta^{\gamma-1}} \tag{14}$$

The above is also a zero profit condition which says that the value of a match equals the wage plus the expected hiring and firing costs.

3.2 Wage Determination

On the worker side, unemployed workers in each sector receive a flow benefit of b in units of the final good. This "benefit" includes the value of leisure as well as unemployment insurance payments. Let W_i denote the present discounted value of employment in sector-i and U_i the present discounted value of unemployment. The Bellman equations governing W_i and U_i are given by:

$$\rho W_i = w_i + \lambda_i (U_i - W_i) \tag{15}$$

$$\rho U_i = b + m_i \theta_i^{\gamma} (W_i - U_i) \tag{16}$$

Wage is determined through a process of Nash bargaining between the worker and the entrepreneur where the value of a job for an entrepreneur is given by J_i and the surplus of a worker from a job is $W_i - U_i$.

Denoting the bargaining power of workers byβ, Nash bargaining implies the following equation for wages:

$$W_i - U_i = \frac{\beta}{1-\beta} J_i \tag{17}$$

From (16) and (17) we get the following equation:

$$\rho U_i = b + \frac{\beta}{1-\beta} m_i \theta_i^{\gamma} J_i = b + \frac{\beta}{1-\beta} \delta_i \theta_i \tag{18}$$

where the last equality is obtained by using the expression for J_i in (13). By substituting out the expression for J_i, W_i, and U_i using (12), (15), and (18), respectively, in (17) we obtain,

$$w_i = (1 - \beta)b + \beta (p_i h_i + \delta_i \theta_i - \lambda_i F_i) \tag{19}$$

Now, a worker should be indifferent between searching in either sector. Therefore, the no arbitrage condition is given by

$$U_x = U_y \tag{20}$$

Which is turn implies from (18) that in equilibrium

$$\delta_x \theta_x = \delta_y \theta_y \tag{21}$$

That is, the market tightness in each sector is proportional to the recruitment cost.

The model is solved as follows. For any p_x / p_y the prices p_x and p_y in terms of the numeraire are obtained from equation (3). For this pair of prices p_x and p_y, equations (10), (14) and (19) determine w_i, θ_i, and u_i. It is easy to verify that an increase in p_x/p_y leads to an increase θ_x/θ_y. Therefore, we get an upward sloping relationship between p_x/p_y and θ_x/θ_y. Next, the no arbitrage condition (21) implies that θ_x/θ_y must equal δ_x/δ_y. We can obtain the corresponding p_x/p_y and the values of w_i, θ_i and u_i as described above. Next, the relative supply in (7) and the relative demand in (4) together with the aggregate resource constraint, $L_x + L_y = L$, determine L_i.

3.3 Impact of International Trade

When the country opens up to trade, the relative price changes, depending on the country's comparative advantage which in turn depends on *bi* and the labour market parameters m_i, δ_i, λ_i and F_i. Given the Ricardian nature of the model, if labour is completely mobile across sectors, then the country will completely specialize in the good in which it has a comparative advantage.

By gathering the relevant equations (10), (14), and (19), we can see the impact of trade on unemployment below.

$$p_i h_i - w_i - \lambda_i F_i = \frac{\delta_i(\rho + \lambda_i)}{m_i \theta^{\gamma-1}} \quad (22)$$

$$w_i = (1 - \beta)b + \beta(p_i h_i + \delta_i \theta_i - \lambda_i F_i) \quad (23)$$

$$u_i = \frac{\lambda_i}{\lambda_i + m_i \theta_i^{\gamma}} \quad (24)$$

Eliminate w_i from (22) and (23) to get

$$p_i h_i = b + \lambda_i F_i + \frac{\beta}{1-\beta}\delta_i \theta_i + \frac{\delta_i(\rho + \lambda_i)}{(1-\beta) m_i \theta^{\gamma-1}} \quad (25)$$

From (25) we can obtain,

$$\frac{\partial \theta_i}{\partial p_i} = \frac{(1-\beta)h_i}{\delta_i\left(\beta + \frac{(\rho+\lambda_i)(1-\gamma)\theta^{-\gamma}}{m_i}\right)} > 0 \quad (26)$$

Next, note from (24) that

$$\frac{\partial u_i}{\partial p_i} = \frac{-\lambda_i m_i \gamma \theta^{\gamma-1}}{\left(\lambda_i + m_i \theta^{\gamma}\right)^2}\frac{\partial \theta_i}{\partial p_i} = -\gamma u_i(1-u_i)\frac{1}{\theta_i}\frac{\partial \theta_i}{\partial p_i} < 0 \quad (27)$$

where that last equality follows from (26). The intuition is very simple: an increase in the price of a product leads to an increase in the value of the marginal product of labour *(VMP), equals P*MP,* involved in the production of the good. This leads to incentives for firms in that sector to increase the number of vacancies, demand for labour, they post relative to the number of workers searching for jobs.

According to Hasan et al. (2010,9), if the country has a comparative advantage in producing good *X*, trade will raise the relative price of *X*, implying an increase in p_x and a decrease in p_y. Given the Ricardian nature of the model, the no-arbitrage condition cannot be satisfied anymore and all labor will move to sector *X*. It is worth notable that in equation (27) the post-trade unemployment in sector *X* is lower than before. The impact on the economy-wide unemployment is ambiguous.

Trade reduces unemployment, including in the neutral case with symmetric search friction across sectors ($\delta_x = \delta_y$), in which case under autarky both sectors have the same unemployment rate. In multisectoral model, a tariff reduction in an import-competitive sector will result in an increase in the unemployment rate within this sector. The reason is that a tariff reduction results in a domestic price falling of the import-competitive good and, as a consequence, a reduction in the value of the marginal product of labor (VMP) within that sector.

In the context of the foregoing theoretical framework, to estimate the causality of trade protection and unemployment, our aggregate unemployment function is simply written as follows:

$$U = f(protection)$$

Or, it can be written with our main selected variables of interest that represent trade protection as follows:

$$U = f(Tariff_{EU}, Tariff_{TP}, TF)$$

Where, *U* is the unemployment rate, $Tariff_{EU}$ is the tariff applied by the EU to imports of its trading partners, $Tariff_{TP}$ is the tariff applied to the EU exports by its trading partners, and *TF* is the trade flows of the EU, represented by *(Export+ import)/GDP* to measure the impact of underlying trade policy instruments. And as our empirical work uses panel of 10-year averaged data starting in 2000 of the agricultural sector of the EU, the above function can be written with taking the logarithm, in detail, as follows:

$$\log U_{it} = \alpha_0 + \alpha_1 \log Tariff_{it\,EU} + \alpha_2 \log Tariff_{itTP} + \alpha_3 \log TF_{itEU} + \varepsilon_{it}$$

Where,

t is the period from 2000-2010, ε is independently distributed error term and i is for a country.

We apply panel data techniques to increase the number of observations and consequently, the power of the test and go beyond the traditional two-variable causality relationship and estimate a four-variable system to avoid any specification bias. Furthermore, the recently developed techniques in causality testing procedures are employed, as will be demonstrated subsequently. Therefore the causal relationship will be examined, as mentioned, among tariffs imposed by the EU to the agricultural imports, tariffs imposed by the EU trading partners to the EU agricultural exports, trade flows of the EU, represented by *(X+M)/GDP*, and Unemployment rate in the EU agricultural or rural sector in which 12 million (full time) farmers are accommodated, heavily dependent on the agriculture and the agri-foods industry. This sector represents 6% of the EU's GDP and comprises 15 million businesses, providing 46 million jobs (for more details, see European Commission available at europa.eu/rapid/press-release_MEMO-13-631_en.htm.

4. Methodology

We pool data from 28 EU countries for the period 2000-2010 and employ panel unit root tests and panel cointegration technique to establish the long-run relationship between tariffs and unemployment. Our data set comprises annual measures for EU28 countries. Our model is a four-variable system of *unemployment rate*, $tariff_{EU}$, $tariff_{TP}$, and *trade flows (TF)* for agricultural sector. Our procedures can be shown as follows:

4.1 Unit Root Test

When using non-stationary data, invalid inferences are drawn from the Granger causality test (for more details, see Negem, 2008). Im, Pesaran and Shin's (1998), IPS, panel unit root test technique is used to test for stationarity (determining the order of integration). The IPS test allows for heterogeneity in intercepts as well as in the slope coefficients. The IPS statistic is mainly an average of the individual ADF statistics computed as t-bar statistics. Any common time effects will be removed and the risk of correlation across countries will be reduced by regressing each variable on a set of time dummies and taking the residuals.

4.2 Panel Cointegration Test

After investigating the order of integration, the next step is to examine the presence or the absence of cointegration to capture the long-run relationships among the variables. It is noted that if there is no cointegration, the first difference of the data can capture these relationships, but if cointegration is present, they can not. The panel cointegration test can be specified in the context of the following form:

$$Y_{it} = \alpha_i + \beta_t + \delta_i X_{it} + \varepsilon_{it}$$

Where $tariff_{EU} rate$, $tariff_{TP} rates$, and TF_{EU} are represented by Y_{it}, and U is represented by X_{it}, α_i is country specific representing a fixed effect or individual-specific effect that is allowed to vary across individual cross-sectional units, β_t is a time-specific error term that captures either short-run external effects or long-run effects (both are global effects) that cause the variables of each country to move together over time and ε_{it} denotes an error term (for more details, see Negem 2008).

According to Pedroni (1999), both slope coefficients δ_i and the time effect β_t are modelled heterogeneously like intercept terms. A panel cointegration test developed by Pedroni (1999) is used to determine whether there is a stable long-run relationship. This technique allows for short run dynamics across countries under study. It also allows for heterogeneity of cointegrating vectors. The technique generates consistent estimates of the parameters in relatively small samples. Also, it controls for potential endogeneity of the regressors and serial correlation. We use the residuals of the above equation to construct an ADF based group mean panel cointegration test.

Pedroni's tests are based on the estimated residuals from the following long run model:

$Y_{it} = \alpha_i + \sum_{j=1}^{m} \beta_{ij} X_{ijt} + \varepsilon_{it}$ where $\varepsilon_{it} = \rho_i \varepsilon_{i(t-1)} + \upsilon_{it}$ are the estimated residuals from the panel regression. The Null hypothesis tested is that ρ_i is unity. All the statistics are normally distributed and can be compared to appropriate critical values, and if critical values are exceeded then the null hypothesis of no cointegration is rejected, implying that a long-run relationship between the variables does exist. Using the spirit of Pedroni's cointegration procedure, we can test if $\rho_i = 1$ or not. Two ways, depending on how ρ_i is estimated, are applied in this paper. The first one is a panel approach (Panel-ADF statistics) which involves restricting $\rho_i = \rho$ for all i and then using the pooled estimate of ρ as a statistic. The second way is the group mean approach, which involves estimating ρ_i separately for each unit i before combining them into a panel statistic.

The treatment of ρ_i differs in both tests in the sense that it has implications for the way a rejection is interpreted. A rejection by the group mean approach is usually interpreted as that $\rho_i < 1$ for at least one i, whereas, in the panel approach, it is interpreted as $\rho < 1$ for all i. Thus, a rejection of the null has different meanings depending on whether ρ_i is estimated separately or not.

4.3 Vector Autoregressive (VAR) Test Using Panel Data

In the absence of cointegration among variables we examine causal relationship between the above four variables using VAR. The VAR can be written as follows:

Denote V as a four-component vector where $V = (U, Tariff_{EU}, Tariff_{TP}, TF)$ for i= variable and j=country. So,

$$V_{ijt} = \delta_1 V_{ij,t-1} + \delta_2 V_{ij,t-2} + \delta_h V_{ij,t-h} + \mu_{ij} + \eta_{ijt}$$

Or it can be written for our model as follows:

$$\begin{bmatrix} V_{1jt} \\ V_{2jt} \\ V_{3jt} \\ V_{4jt} \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix} + \begin{bmatrix} \delta_{11}(g) & \delta_{12}(g) & \delta_{13}(g) & \delta_{14}(g) \\ \delta_{21}(g) & \delta_{22}(g) & \delta_{23}(g) & \delta_{24}(g) \\ \delta_{31}(g) & \delta_{32}(g) & \delta_{33}(g) & \delta_{34}(g) \\ \delta_{41}(g) & \delta_{42}(g) & \delta_{43}(g) & \delta_{44}(g) \end{bmatrix} * \begin{bmatrix} V_{1jt} \\ V_{2jt} \\ V_{3jt} \\ V_{4jt} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \end{bmatrix}$$

Where,

V_{ijt} represents our four endogenous variables, $\delta_{i,j}(g) = \sum_{t=1}^{p} \delta_{i,j} g^t$, δ_{ij} (g) polynominal degree , g is the lag operator, index j refers to the country, α_i *(i = 1,2,3,4)* are constants, ε_{1t}, ε_{2t}, ε_{3t}, ε_{4t} are the error terms following white noise process with zero mean and constant variance, and *t* refers to the time period (*t = 1,…,p*). The residuals of the model in the above equation reflect the relationships among the above variables. It is concluded that Y_{it} Granger causes Y_{jt} if and only if δ_{ji} (g) ≠ 0 and Y_{jt} Granger causes Y_{it} if and only if δ_{ij} ≠ 0. A bi-directional of feedback relationship occurs if Y_{it} Granger causes Y_{jt} and vice versa happens on the other direction at the same time. Y_{it} Granger causes Y_{jt} indirectly if Y_{it} Granger causes Y_{ht} and if Y_{ht} Granger causes Y_{jt} (Hsiao, 1987).

4.4 Vector Error Correction Model (VECM) Using Panel Data

As shown, once cointegration is detected, we have to determine the direction of causality within the context of a vector error correction model (VECM) (Granger, 1988). VECM represents a special case of VAR which imposes cointegration on its variables to allow distinction between short-run and long-run Granger causality. *ECT*s, included in VAR, enable misspecification to be avoided. For panel data the VECM model is specified as follows:

$$\Delta \log U_{it} = \alpha_1 + \psi_1 ECT_{i,t-1} + \sum_{j=1}^{p} \beta_{11j} \Delta \log U_{i,t-j} + \sum_{j=0}^{p} \beta_{12j} \Delta \log tariff_{EU\,i,t-j} + \sum_{j=0}^{p} \beta_{13j} \Delta \log tariff_{TPi,t-j} + \sum_{j=0}^{p} \beta_{14,j} \Delta \log TF_{i,t-j} + \mu_{1it}$$

$$\Delta \log tariff_{EU\,it} = \alpha_2 + \psi_2 ECT_{i,t-1} + \sum_{j=1}^{p} \beta_{21j} \Delta \log tariff_{EU\,i,t-j} + \sum_{j=0}^{p} \beta_{22j} \Delta \log U_{i,t-j} + \sum_{j=0}^{p} \beta_{23j} \Delta \log tariff_{TPi,t-j} + \sum_{j=0}^{p} \beta_{24,j} \Delta \log TF_{i,t-j} + \mu_{2it}$$

$$\Delta \log tariff_{TPit} = \alpha_3 + \psi_3 ECT_{i,t-1} + \sum_{j=1}^{p} \beta_{31j} \Delta \log tariff_{TPi,t-j} + \sum_{j=0}^{p} \beta_{32j} \Delta \log U_{i,t-j} + \sum_{j=0}^{p} \beta_{33j} \Delta \log tariff_{EU\,i,t-j} + \sum_{j=0}^{p} \beta_{34,j} \Delta \log TF_{i,t-j} + \mu_{3it}$$

$$\Delta \log TF_{it} = \alpha_4 + \psi_4 ECT_{i,t-1} + \sum_{j=1}^{p} \beta_{41j} \Delta \log TF_{i,t-j} + \sum_{j=0}^{p} \beta_{42j} \Delta \log U_{i,t-j} +$$
$$\sum_{j=0}^{p} \beta_{43j} \Delta \log tariff_{EU\,i,t-j} + \sum_{j=0}^{p} \beta_{44,j} \Delta \log tariff_{TPi,t-j} + \mu_{4it}$$

Where, Δ is the first-difference operator, the term $ECT_{i,t-1}$, (disequilibrium of the previous period) = $U_{it-1} - \hat{a}_i - \hat{\eta} tariff_{EU\,it-1} - \hat{\beta} tariff_{TPit-1} - \hat{\upsilon}$ TF_{it-1}, is the error correction term derived from the long run cointegrating relationship, i.e. residuals, as the existence of cointegrated relationship in the long run indicates that the residuals from the cointegration equation can be used as *ECT*, the coefficients of *ECT;* ψ_1, ψ_2, ψ_3, ψ_4 capture the adjustments of ΔU, Δ $tariff_{EU}$, Δ $tariff_{TP}$, and Δ *TF* towards long-run equilibrium.

In case of the presence of cointegration, it is found that at least one of the ψ parameters is significant, i.e, at least one of the coefficients ψ_{1i}, ψ_{2i}, ψ_{3i}, ψ_{4i} is non zero when there is a long run relationship among the variables under study. The importance of *ECT* is that while the error term ε_{it-1} (in the VAR equation) represents how far our variables are from the equilibrium relationship (disequilibrium), the error correction term estimates how this disequilibrium causes the variables to adjust towards equilibrium in order to keep the long run relationship intact.

To estimate VECM, two steps need to be followed:

1-Using Johansen's (1988) maximum likelihood procedure to estimate the long run relationship among *U,* $Tariff_{EU}$, $Tariff_{TP}$, and *TF* as formulated in the VAR and then,

2-Using the estimated cointegration relationship obtained from the previous step to construct the disequilibrium term, and then estimating VECM for each variable under consideration depending on the VECM equations stated above. The coefficients besides the *ECT* have to be negative, showing how the system converges to the long-run equilibrium.

4.5 Granger Causality Test Using Panel Data

Our question is, does *tariffs* Granger-cause *unemployment* or is the inverse true or is there feedback or bilateral causality, i.e. causality both from *tariffs* to *unemployment* and in the other direction from *unemployment* to *tariffs*? Since the cause always comes before its effect, when we say that one variable Granger- causes another variable, we actually mean that the current value of the latter is conditional on the past values of the former. That also means that the former variable helps explain and forecast the latter one. To understand the nature of causation, the Granger causality test is employed. We will simply specify the equation, as follows:

$$\Delta U_{it} = \gamma_h V_{h,t-1} + \alpha_1 \Delta U_{it} + \alpha_2 \Delta tariff_{EU\,it} + \alpha_3 \Delta tariff_{it} + \alpha_4 TF_{it} + \mu_{it}$$

We can use F-statistics to verify the joint hypothesis that the coefficients of the explanatory variables equal zero. A Joint Wald test, applied to the coefficient of each explanatory variable in the VECM, can examine the Granger causality.

5. Data and Empirical Results of Causality Test

To examine the causality test for unemployment and tariffs (trade protection), our empirical work in this paper uses panel data of the agricultural sector of the EU. We create a panel of 10-year average for the period 2000-2010. Our sample includes 28 European countries and their trading partners, shown in appendix 1, both the members and non-members in the European community. We divided the EU28 countries into two groups; the richest and the rest on the basis of their income levels and development (for more details, see appendix 1). Our main variables of interest, as indicated, are Unemployment, as a dependent variable, is represented by unemployment rate (as percentage of the labour force). This dependent variable is obtained from International Financial Statistics-IMF elibrary and European Commission available at www.ec.europa.eu/index_en.htm.

The explanatory variables are tariffs applied to the European Union imports, $tariff_{EU}$, and tariffs applied to the European Union exports by its trading partners (as an average of both members and non members trading partners), $tariff_{TP}$, both variables are obtained from database of Integrated Tariff European Community (TARIC), Eurostat., and World Integrated Trade Solution (WITS), as the computed weighted average of bilateral applied tariffs. In order to overcome the problems of the presence of a number of zeros in the tariff vectors, $tariff_{EU}$ and $tariff_{TP}$ are included by computing natural logarithm of *(1+tariff)*. The third explanatory variable is the trade flow measured by *(Exports+Imports)/GDP*. This variable, as a measure, summarises the effect of the underlying trade policy instruments. Real exports, real imports, and real GDP are used to compute this measure and obtained from World Development Indicators (WDI) and International Trade Centre available at www.intracen.org/itc/market-info-tools/trade-statistics/.

The appropriate tests, indicated in section 4, are employed to test for causality using GiveWin, Pc-Give, as mentioned. The results are analysed as follows.

5.1 Unit Root Test Results

Testing for causality between unemployment rate and tariffs (trade protection) using panel data, we first test for the order of integration in the $U, tariff_{EU}$, $tariff_{TP}$ and TF series to test whether or not unit root exists in the data. To check for the presence of a unit root for all variables, the IPS tests are conducted (both in levels and in first differences). For IPS panel unit root, individual ADF regressions, for each country in the group; the richest and the rest, are performed for $U, tariff_{EU}$, $tariff_{TP}$ and TF, including a constant and time trend. Then a *t*-

bar statistic is computed based on averaging individual ADF statistics. The results of unit root test are presented in the following table.

Table 1: Unit root test results (2000-2010)

	Level				*First Difference*			
	U	$tariff_{EU}$	$tariff_{TP}$	*TF*	*U*	$tariff_{EU}$	$tariff_{TP}$	*TF*
Full sample	-3.39*	-1.45	-1.96	-2.85	-4.43**	-4.85**	-7.12**	-6.96**
The richest	-2.97*	-3.26*	-2.14	-2.31	-6.71**	-8.32**	-5.42**	-4.98**
The rest	-1.62	-1.43	-2.25	-1.98	-4.84**	-10.63**	-12.93**	-9.62**

Notes: (1) *U is unemployment rate*, $tariff_{EU}$ is the tariff applied to EU imports, $tariff_{TP}$ is tariffs applied to EU exports by its trading partners (members and non members, and *TF* is trade flow represented by *(real exports+real imports/real GDP).*

(2) All data are in logarithmic form.

(3) For First Difference: the critical values at 5% and 1% significance level are -2.95 and -3.64, respectively.

(3) *and ** signifies the rejection of the unit root hypothesis at 5% and 1% significance level, respectively, where under the null hypothesis of non stationarity, the test is distributed as N (0,1), so large negative values indicate in favour of stationarity.

Based on Table 1, the IPS test results on the level form of the above variables indicate a failure to reject the null of non-stationarity, with the exception of the *U* in both full and the richest samples and $tariff_{EU}$ in the richest sample at 5%; however they do reject the null as first differenced become stationary at the 1% significance level. Having established that the four variables are integrated of the first order, the second step is to test for cointegration to determine if there is a long run relationship between these four variables.

5.2 Cointegration Test Results

As all the variables indicated the integration of order one, i.e. *I* (1), became stationary, they are candidates for inclusion in a long-run relationship. Then, we test for cointegration based on residual for the null of no cointegration in the spirit of Pedroni's (1997) procedure to detect long-run relationship among the set of integrated variables: *U*, $tariff_{EU}$, $tariff_{TP}$, *TF*. If the residuals seem stationary, this suggests that the variables are cointegrated. Allowing for the highest degree of heterogeneity across countries, our cointegration tests are carried out based on examining the stationarity of the error term (ADF for residuals) estimated from the following equation:

$$U_{it} = \alpha + \beta_i tariff_{EU\,it} + \gamma_i tariff_{TPit} + \psi_i TF_{it} + \varepsilon_{it}$$

Where, $t = 1,\dots\dots,T$, $i = 1,\dots\dots,N$ indexes the time series and cross-sectional dimensions, respectively. The idea is that the error term ε_{it} is stationary when cointegration exists among the variables under consideration and it has a unit root in case of the absence of cointegration. Thus, testing the null hypothesis of no cointegration for cross-sectional data is equivalent to testing whether ε_{it} possesses a unit root by using the following autoregression (for more details see Negem, 2008):

$$\varepsilon_{it} = \rho_i \varepsilon_{it} + \upsilon_{it}$$

As we are interested in testing if the no cointegration null holds for the panel as a whole, i.e. we want to test the null that $\rho_i = 1$ for all i, two ways to estimate ρ_i are applied: the panel approach (Panel-ADF statistics) and the group approach (Group-ADF statistics). The results of the cointegration test are shown in table 2.

Table 2: Cointegration test results

	Panel-ADF statistics				Group-ADF statistics			
	Lag order				Lag order			
	P_i= 1	P_i= 2	P_i= 3	P_i= 4	P_i= 1	P_i= 2	P_i= 3	P_i= 4
Full sample	-1.82	-0.25	-1.73	-3.52	-2.84	-3.74*	-3.85*	-5.14*
The richest	-0.99	-2.29	-2.73	-3.15	-2.92	-5.28*	-11.03*	-12.84*
The rest	-1.45	-3.24	-7.95*	-9.23*	-3.18	-4.12*	-6.29*	-7.38*

Notes:

- Signifies the rejection of the unit root hypothesis of the residuals at 1% or (no cointegration hypothesis).

Allowing for up to four years lag length, our estimated panel *t* and group *t* statistics, especially for the rest group, are much higher than the critical value at the 1% level, indicating stationary residuals in the regression or cointegration among all variables. Hence, we can conclude that there is a cointegrating relationship among the variables. It is notable that evidence of cointegration increases with the order of the lag.

The existence of a long-run relationship (stationarity of the residuals) is indicated from the reported ADF statistics in table 2. The results indicate that the variables of interest are cointegrated, especially; the results of the group-ADF statistics that show a higher level of significance starting from lag 2 than those for the panel-ADF. It is notable that unlike the panel-ADF, the group-ADF allows us to reject the null hypothesis of no cointegration for all the estimated groups. The panel-ADF results for both full sample and the richest group raise a question as to the power of the test to enable inferences to be drawn. We therefore continue by employing causality tests based on the Vector Error Correction Model (VECM).

5.3 Vector Error Correction Model (VECM) Results

Since a long-run relationship among the variables in all sample groups is detected verifying the existence of causality in at least one direction, so it becomes important to determine the direction of the causality by examining, in particular, whether tariffs Granger cause unemployment or whether the variables cause each other in the long-run. While the cointegration test gives us an indication about the long-run relationship among the variables, we can use VECM to examine the short-run dynamics. The following table presents the short-run coefficients obtained using the VECM which was said to incorporate the short-run interactions and the speed of adjustment towards long-run equilibrium. As the coefficient of *ECT* for every variable under consideration increases, the response of its variable to the previous period's deviation increases. The variable becomes unresponsive to deviation in the equilibrium if its coefficient is insignificant.

Table 3: Granger Causality based on VECM

Dependent variables	ΔU	$\Delta tariff_{EU}$	$\Delta tariff_{TP}$	ΔTF	*ECT*	
		Wald test-statistics	(P-value)		coefficient	t-ratio
Full sample						
ΔU	-	-8.972 (0.000)*	2.632 (0.732)	-6.973 (0.003)*	-0.234	6.351
$\Delta tariff_{EU}$	3.954 (0.398)	-	0.126 (0.001)*	0.534 (0.000)*	-0.024	-4.235
$\Delta tariff_{TP}$	8.327 (0.278)	4.7546 (0.004)*	-	0.347 (0.568)	-0.003	1.334
ΔTF	2.018 (0.631)	1.363 (0.000)*	6.356 (0.000)*	-	-0.045	5.623
The richest						
ΔU	-	-2.367 (0.011)*	3.272 (0.231)	-7.53 (0.000)*	-0.043	-3.762
$\Delta tariff_{EU}$	5.473 (0.006)*	-	1.746 (0.000)*	4.298 (0.228)	-0.004	2.246
$\Delta tariff_{TP}$	0.893 (0.754)	6.856 (0.000)*	-	1.523 (0.233)	-0.006	6.564
ΔTF	-1.387 (0.831)	3.645 (0.003)*	-2.377 (0.000)*	-	-0.016	5.364
The rest						
ΔU	-	-9.653 (0.000)*	5.372 (0.653)	-3.874 (0.002)*	-0.033	9.272
$\Delta tariff_{EU}$	1.837 (0.000)*	-	7.467 (0.000)*	-5.782 (0.001)*	-0.011	2.156
$\Delta tariff_{TP}$	0.263 (0.356)	4.382 (0.000)*	-	2.389 (0.425)	-0.067	-5.762
ΔTF	3.726 (0.674)	-2.883 (0.000)*	-6.352 (0.000)*	-	-0.027	-0.674

Notes:

(1) Δ is the first operator

(2) * denotes statistically at 1% level

(3) The significance of the error correction term (*ECT*) is evaluated with t-statistics

(4) Wald test tests the jointly significance of the lagged values of independent Variables. H_0: a_2 = ………=a_4 = 0 which is verified at 1% and 5% significance levels.

(5) Numbers in parentheses are the P-values.

The results of the Granger causality test, within the VECM framework, are presented in table 3. Panel data are used for the richest group of the EU, the rest group and full sample of the EU countries. The whole sample panel shows, in the short-run, the existence of unidirectional causality between *U* and $tariff_{EU}$, implying that the single external tariff of the EU affects inversely, the coefficient has negative, on unemployment in the agricultural sector. Unidirectional causality also exists between unemployment, *U*, and trade flow, *TF*, inversely running from trade flow to unemployment. It is one-way causality. No causality is detected from unemployment to the third variable, $tariff_{TP}$. For the whole sample panel, we find that the *ECT* coefficients, except for the $tariff_{TP}$ equation, are significant and have negative signs, implying that the series cannot drift too far apart and convergence is achieved in the long-run. The negative sign means that the variables react negatively to any deviations in the long-run equilibrium, implying positive deviations from this equilibrium. The *ECT* for unemployment is greater, implying faster response to deviations, than for other variables. Each *ECT* coefficient indicates that a deviation from long-run equilibrium value in one period is corrected in the next period by the size of that coefficient. The coefficient for *U*, which measures the speed of temporal adjustment to long run equilibrium, indicates that 23 percent of adjustment occurs in a year, and it takes about 4 years to adjust to the long run equilibrium. The t-statistic for $tariff_{TP}$ is low, suggesting that exports are less responsive to deviations. From the analysis of the coefficients of *ECT*, we can conclude that the adjustments take place within different periods, implying that the system settles down, but not quickly.

Regarding the richest group panel, Table 3 shows that there is bidirectional causality between unemployment and the external tariff applied by the EU, with negative sign in the direction from $tariff_{EU}$ to unemployment, *U*, and positive sign in the other direction, however, a unidirectional causality running from trade flow, *TF*, towards unemployment, *U*, is detected. There is no causal relationship between the tariffs applied by the EU trading partners within this group. When examining *ECT* for the richest group, we find that all the variables react negatively to deviations in the long run equilibrium. The $tariff_{TP}$ appears to be more responsive to deviations since t-statistics are higher than those of the other variables.

The rest group panel shows that there is bidirectional relationship between the external tariff applied by the EU, $tariff_{EU}$ and unemployment, *U*. A unidirectional exists between trade flow, *TF*, and unemployment, *U*. They are the same results detected in the richest group. Also, there is no causal relationship detected between the tariffs applied by the EU trading partners, $tariff_{TP}$ and the unemployment, *U*. By examining *ECT*, for the rest group, *U*, as in the whole sample, reacts negatively to the shocks in the system with the highest adjustment speed at 3 percent and it is obvious that the coefficient of *ECT* for the *U* equation is significant. On the other hand, *TF* and $tariff_{EU}$ have insignificant estimated coefficients of *ECT*, which means it appears unresponsive to deviations in the long run

The following tables, 4, 5, and 6 summarises the Wald test results for the whole sample, the richest and the rest groups. It is carried out using the estimated coefficient. The Wald test concerns of the null of no causality by calculating F-statistic based on the null hypothesis that a set of coefficients on the lagged values (changes) of the independent variables (the other three variables and the error correction adjustment term) are jointly equal to zero. Accepting the null hypothesis means that the independent variables do not cause the dependent one.The Wald test null hypothesis, based on the statistics obtained from estimating the VECM, can be summarised as follows:

Table 4: Wald Test for Full Sample

	Coefficient sign
For *U* equation:	
H_0: $tariff_{EU}$ does not Granger cause *U*……………………………………rejected	(-)
H_0: $tariff_{TP}$ does not Granger cause *U* ………………….......failed to be rejected	(+)
H_0: *TF* does not Granger cause *U*………………………….................... rejected	(-)
For $tariff_{EU}$ equation:	
H_0: *U* does not Granger cause $tariff_{EU}$ …………………failed to be rejected	(+)
H_0: $tariff_{TP}$ does not Granger cause $tariff_{EU}$ …..................................rejected	(+)
H_0: *TF* does not Granger cause $tariff_{EU}$ …………….............................rejected	(+)
For $tariff_{TP}$ equation:	
H_0 : *U* does not Granger cause $tariff_{TP}$……………………failed to be rejected	(+)
H_0 : $tariff_{EU}$ does not Granger cause $tariff_{TP}$………………………..rejected	(+)
H_0 : *TF* does not Granger cause $tariff_{TP}$…………………..failed to be rejected	(+)
For *TF* equation:	
H_0: *U* does not Granger cause *TF*…………………….........failed to be rejected	(+)
H_0: $tariff_{EU}$ does not Granger cause *TF*………………………………..rejected	(+)
H_0: $tariff_{TP}$ does not Granger cause *TF*…………………....................rejected	(+)

Note: the rejection of null is based on the statistics in Table 3 obtained from the estimation of VECM

Table 5: Wald test for the richest group

For U equation:	Coefficient sign
H_0: $tariff_{EU}$ does not Granger cause U……………………………rejected	(-)
H_0: $tariff_{TP}$ does not Granger cause U……………….......failed to be rejected	(+)
H_0: TF does not Granger cause U……………………………………..rejected	(-)
For $tariff_{EU}$ equation:	
H_0: U does not Granger cause $tariff_{EU}$ ……………………………...rejected	(+)
H_0: $tariff_{TP}$ does not Granger cause $tariff_{EU}$ …..................................rejected	(+)
H_0: TF does not Granger cause $tariff_{EU}$ …………..........failed to be rejected	(+)
For $tariff_{TP}$ equation:	
H_0 : U does not Granger cause $tariff_{TP}$……………………failed to be rejected	(+)
H_0 : $tariff_{EU}$ does not Granger cause $tariff_{TP}$………………………...rejected	(+)
H_0 : TF does not Granger cause $tariff_{TP}$…………………..failed to be rejected	(+)
For TF equation:	
H_0: U does not Granger cause TF………………….........failed to be rejected	(-)
H_0: $tariff_{EU}$ does not Granger cause TF………………………………..rejected	(+)
H_0: $tariff_{TP}$ does not Granger cause TF………………………………..rejected	(-)

Note: the rejection of null is based on the statistics in Table 3 obtained from the estimation of VECM

Table 6: Wald test for the rest group

For U equation:	Coefficient sign
H_0: $tariff_{EU}$ does not Granger cause U……………………………rejected	(-)
H_0: $tariff_{TP}$ does not Granger cause U…………………......failed to be rejected	(+)
H_0: TF does not Granger cause U……………………………………..rejected	(-)
For $tariff_{EU}$ equation:	
H_0: U does not Granger cause $tariff_{EU}$ ……………………………...rejected	(+)
H_0: $tariff_{TP}$ does not Granger cause $tariff_{EU}$ ………………………...rejected	(+)
H_0: TF does not Granger cause $tariff_{EU}$ …………..........................rejected	(-)
For $tariff_{TP}$ equation:	
H_0 : U does not Granger cause $tariff_{TP}$……………………failed to be rejected	(+)
H_0 : $tariff_{EU}$ does not Granger cause $tariff_{TP}$………………………..rejected	(+)
H_0 : TF does not Granger cause $tariff_{TP}$……………….. failed to be rejected	(+)
For TF equation:	
H_0: U does not Granger cause TF………………….........failed to be rejected	(+)
H_0: $tariff_{EU}$ does not Granger cause TF………………………………..rejected	(-)
H_0: $tariff_{TP}$ does not Granger cause TF………………………………..rejected	(-)

Note: the rejection of null is based on the statistics in Table 3 obtained from the estimation of VECM

6. Concluding Remarks

This paper addresses whether there are any causal impacts between tariffs and unemployment. To increase the number of observations and, consequently, the power of the test, a panel data approach has applied to investigate the causality between the mentioned variables. Our contribution to the literature is to investigate the causal relationship between tariffs and unemployment of the EU by conducting the causality test within the Vector Error Correction Model (VECM) framework. It is notable that, from reviewing the literature, almost all the studies, theoretically or empirically, on the relationship between trade liberalisation and unemployment, interested in the existence of this relationship. And if it exists, is it positive or negative? No attention is paid to the causal relationship between both, i.e. the relationship direction. Moreover, to the best of my knowledge, the absence of the European Union application in the empirical studies on the relationship between trade liberalisation and unemployment is obvious, despite, from my point of view based on some facts; it represents, empirically, the best case in this regard.

A causality test was carried out based on the vector error correction model (VECM), as mentioned. The results obtained from using panel data for the richest countries of the European Union and its rest countries documented that the tariff applied to the EU imports in the agricultural sector, $tariff_{EU}$, affects unemployment of this sector, *U*, and vice versa. They gave evidence for the bi-directional relationship between both. However, in the case of full sample, unexpectedly, the relationship is unidirectional, running from the tariff applied to the EU imports, $tariff_{EU}$ to unemployment, *U*.

For the whole sample, another bi directional causality between trade flow, *TF*, and $tariff_{EU}$ exists. This is confirmed by the results of both the “richest” and the “rest” groups. There is a disappearance of a causal relationship, running from unemployment, *U*, to both *TF* and $tariff_{TP}$ for all samples, however this is not true when the relationship runs in the opposite direction, as indicated in tables 3, 4, 5, and 6. Also, it is noted the existence of causal relationships between the explanatory variables themselves. These relationships are mostly unidirectional. The error correction term (*ECT*) carries a negative, but not always statistically significant, coefficient, confirming that the variables in the model are indeed cointegrated when their coefficients are statistically significant.

Appendix 1

EU countries and their Trading Partners

Ser.	Country	Exports-partners	Imports-partners
	Austria*	Germany, US, and Switzerland	Germany, Switzerland, and Italy
	Belgium*	Germany, US, and France	Netherlands, US, and France
	Bulgaria	Germany, Italy, and Turkey	Russia, Turkey, and Germany
	Croatia	Italy, Bosnia and Herzegovina, and Serbia	Italy, Russia, and China
	Cyprus	Greece, UK, and Germany	Greece, Israel, and China
	Czech Republic	Germany, Slovakia, and Poland	Germany, China, and Russia
	Denmark	Germany, US, and Norway	Germany, Norway, and China
	Estonia	Sweden, Finland, and Russia	Finland, Russia, and China
	Finland	US, Russia, and China	Russia, Sweden, and Germany
	France	Germany, Belgium, and US	Germany, Belgium, and China
	Germany*	France, US, and China	China, Russia, and Netherlands
	Greece	Turkey, Italy, and Germany	Russia, Germany, and China
	Hungary	Germany, Romania, and France	Germany, Russia, and China
	Ireland*	US, UK, and Belgium	UK, US, and China
	Italy	Germany, US, and France	China, France, and Germany
	Latvia	Russia, Lithuania, and Estonia	Russia, Lithuania, and Germany
	Lithuania	Russia, Belarus, and Estonia	Russia, Germany, and Poland
	Luxembourg*	Germany, France, and Belgium	US, China, and Belgium
	Malta	Singapore, Hong Kong, US, and Japan	Italy, Germany, and UK
	Netherlands*	Germany, Belgium, and France	China, Russia, and US
	Poland	Russia, Germany, and UK	Russia, China, and Germany
	Portugal	Spain, Angola, and US	Spain, Angola, and Germany
	Romania	Turkey, Germany, and Italy	Germany, Russia, and Italy
	Slovakia	Germany, Poland, and Hungary	Russia, South Korea, and China
	Slovenia	Austria, Russia, and Croatia	China, Germany, and Italy
	Spain	France, Germany, and Italy	Germany, France, and China
	Sweden*	Norway, US, and Germany	China, Russia, and Germany
	United Kingdom	Switzerland, Germany, and US	Germany, China, and US

Source: the World Factbook-CIA
* is for the richest group based on the country's per capita income (PPP)

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