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The effect of trade openness on unemployment: Long-run versus short-run

BACHELOR THESIS GENERAL ECONOMICS

STUDENT NAME: EDAN MARTES

STUDENT NUMBER: 425649

SUPERVISOR: DR. A.A.F. GERRITSEN

SECOND READER: DR. A. ERBAHAR

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ABSTRACT

This paper examines the effect of trade openness on the unemployment rate in 28 OECD countries. Existing literature shows different results when studying this relationship. In this research, data of these OECD countries over the period 2000-2016 have been used. Using panel regression analyses, the findings imply that trade openness and unemployment are negatively related. This negative relationship can be found in both the short-run and the long-run.

1 Introduction

In 2017 the values of total imports and exports in the Netherlands were €411445 million and €468517 million respectively, an increase of more than 10% compared to 2016 (CBS, 2018). Total imports and exports in 2016 formed approximately 153% of Dutch gross domestic product. Evidently, trade is and has been an important source of income for the Dutch economy. However, the Trump administration is imposing higher import tariffs to stimulate US businesses and consumers (NY Times, 2018a). Import tariffs make goods produced abroad more expensive for the local consumers. Thus, adding a tariff increases the price of foreign goods and services and decreases the demand thereof which in turn leads to less traded goods and services. These constraints could be detrimental for several economies as it reduces world trade.

Trade has not only increased in the Netherlands but over the entire world. World trade as a percentage of world gross domestic product has increased exponentially since the 1960s. This share was roughly 24% in 1964 and 35% in 1974 (WDI, 2018a). This trend continued and has risen to almost 60% in 2014. For a long time, trade was seen as a good thing that led to economic growth.

According to Matusz (1996), international trade increases employment in both the importing and the exporting country. Thus, a reduction in world trade could lead to an increase in the unemployment rate. On the other hand, recently, there have been substantial debates on the potential downsides of trade openness. According to Autor, Dorn, Hanson and Song (2014), increased trade openness has a negative impact on wages and employment especially for low-skilled workers. Autor et al. (2014) have used ordinary leased squared (OLS) and two-stage ordinary leased squared (2SLS) regressions to analyse the impact of the Chinese trade shock on US workers by using annual US employer data over the period 1992-2007.

Some economists argue that local companies move abroad to less developed countries due to lower wages (NY Times, 2018b). Local factories close and people lose their jobs. In this way, trade openness leads to more unemployment in the domestic country. Moreover, some developing countries are in favour of tariffs to secure local jobs, but at the same time also support an increase in trade (The Economist, 2017). Since trade is an important factor for many countries, the following research question could be asked:

"*What is the effect of trade openness on the unemployment rate in 28 OECD countries?"*

When countries trade, demand for goods and therefore total output can increase. This increase can be associated with an increase in jobs. If more jobs are created, the demand for labour can increase while labour supply stays constant. Starting from a position with unemployment, a country moves to a more favourable position with a lower unemployment rate. Trade openness is measured as total imports plus total exports divided by gross domestic product. Trade openness is used instead of trade itself as trade openness is in relative terms, which makes cross-country comparison more adequate. The unemployment rate refers to the percentage of people actively looking for a job but do not have one at the moment that this rate was determined.

The relationship between trade openness and unemployment has previously been examined. The theoretical paper of Helpman, Itskhoki and Redding (2010) demonstrates that opening an economy to trade leads to ambiguous effects with respect to unemployment. In their paper they construct a model where unemployment is caused by the tightness of the labour market and the hiring rate. The tightness of the labour market refers to the fraction of workers looking for work that are matched with a firm and the hiring rate refers to the fraction of the matched workers that are hired. This model illustrates that opening up to trade keeps the tightness of the labour market constant or decreases it, which leads to a similar or lower rate of unemployment. Oppositely, opening up to trade decreases the hiring rate, which increases the unemployment rate.

Felbermayr, Prat and Schmerer (2011) have studied the impact of trade openness on unemployment. They have done this by using cross-sectional and panel data from 20 OECD countries with five-year averages variables over the period 1983-2003, and found remarkably small but significant, negative effects. Felbermayr et al. (2011) used two-staged least squared (2SLS) regressions for the cross-country analysis and general methods of moments (GMM) approach for the panel analysis.

Hasan, Mitra, Ranjan & Ahsan (2012) studied the relationship between unemployment and trade liberalisation in India. In this study they focused on industry-level and state-level analyses by using labour force survey data and have found a significant, negative relationship. Data from 15 states for 1987-1988, 1993-1994, 1999-2000 and 2004-2005 have been used to run ordinary OLS and 2SLS regressions.

The purpose of this research is to demonstrate the impact of trade openness on unemployment focused on 28 OECD countries by using panel data over the period 2000-2016. This paper examines the relationship by making a distinction between the short-run and the long-run. The first finding is that the unemployment rate in the short-run decreases when trade openness increases. The second finding is that the unemployment rate in the long-run also decreases when trade openness increases. Based on this, a suggestion could be made to policy advisors of countries with the potential to increase their trade openness. Increasing trade openness can be beneficial, but policy makers could improve unemployment benefits and other labour market institutions to minimize the disruptive effects of trade.

In section 2 of this paper the relevant theory and literature concerning the relationship between trade openness and unemployment will be discussed. This section will be augmented with the introduction and motivation of two hypotheses. After this, the data used in this research will be described and justified, followed by a description of the methodology used. Subsequently, the results on the relationship between trade openness and unemployment will be interpreted and the hypotheses will be answered. Hereafter, section 5.2 continues with a robustness analysis. Finally, the most important findings will be summarised and the research question will be answered, followed by a discussion of possible limitations, policy implications and recommendations for future research.

2 Theoretical Framework

2.1 Theory

2.1.1 Trade theory

One of the first models created to explain international trade is called the Ricardian Model and has been named after David Ricardo. According to this model, trade arises due to differences in relative labour productivities between countries (Krugman, Obstfeld & Melitz, 2015). Here, countries will specialise in and export the good in which they have a relative cost advantage, in other words, a comparative advantage and import the good that they produce relatively inefficiently.

Since trade is driven by comparative advantages rather than absolute advantages, all countries can benefit from trade. Each country will export the good in which they have a comparative advantage. Opening up to trade in the Ricardian model leads to an increase in production of the exporting sector and thus an increase in jobs in this sector and a decrease in jobs in the importing sector. However, considering the assumption of complete labour mobility across sectors, workers of the importing sector will move to the exporting sector.

Another theoretical trade model is the Heckscher-Ohlin model. In this model, trade is driven by differences in resource endowments between countries (Ohlin, 1933). Countries have different factors of production, such as labour, land and capital, to produce goods and services. Here, countries export goods that use its abundant factor intensively and import goods that are intensive in its scarce factors of production. Furthermore, the model assumes that all factors can be used for the production of each good and all factors can move freely in the long-run. If trade destroys jobs in one sector, workers can retrain and work in another sector.

The last trade model discussed in this paper illustrates that trade can arise due to increasing returns to scale (Krugman, 1979). This model is known as the New Trade Theory. Increasing returns to scale occur when the percentage change in output is bigger than the percentage change in inputs. Increasing returns to scale may take place due to economies of scale, which entails that the average costs decrease while the production increases. The marginal costs of the last unit produced are than lower than the average costs per unit.

When opening up to trade, the demand for goods increases and the production can also increase. Firms that increase their production to satisfy the demand, benefit from the economies of scale and are able to sell more products at a lower price. Moreover, this model

assumes monopolistic competition. This means that different firms produce similar goods that differ in certain aspects. Because of this, countries can specialize in different goods and benefit from economies of scale when trading.

One assumption all these models have in common is full employment. These models attempt to explain why countries trade and assume that all workers have a job. However, in reality, full employment does not exist and relaxing this assumption could potentially lead to different results. Therefore, it is important to analyse the theory of unemployment.

2.1.2 Unemployment theory

To understand the effect of trade on unemployment it is essential to understand why unemployment exists at all. Firstly, the labour market is examined. The labour market is displayed in Figure 1 as the supply and demand curve of labour. The supply of labour represents the workers' willingness to work at a certain wage rate, and the demand for labour represents the number of workers employers want at a certain wage rate. Where supply and demand intersect, there is an equilibrium wage (w_e) and equilibrium employment (L_e). At that point, all workers willing to work for the equilibrium wage are employed and there exists a situation without unemployment.

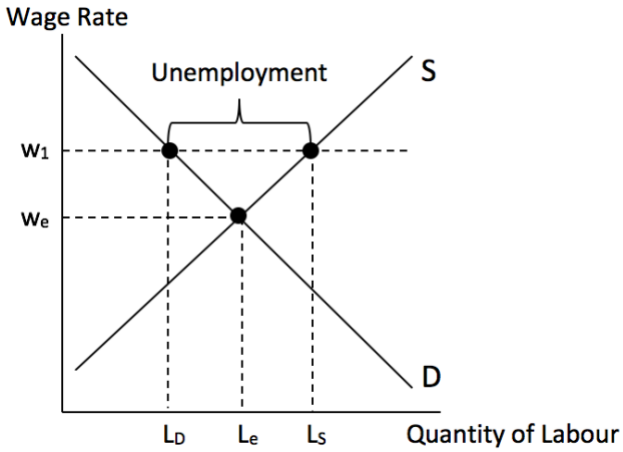

Figure 1: The labour market

If wages are flexible, wages adjust when the supply and demand curve shift (Sørensen & Whitta-Jacobsen, 2010). The adjustment of the wage rate ensures that supply and demand intersect and that there is no unemployment. However, if wages are not flexible, but rigid,

wages cannot adjust freely and the market cannot clear out. When wages are set too high, for example at w_1, because of minimum wage rates, union power or other institutions, there exists a situation with unemployment. The number of workers willing to work at wage rate w_1 is larger than the number of workers employed at wage rate w_1. The number of unemployed workers can be seen in Figure 1 as the difference between L_D and L_S.

Increasing trade openness can increase the demand for goods and therefore total output increases. To increase output, firms need to hire more workers if labour has constant returns to scale. If firms want to hire more workers, the labour demand curve shifts outwards. Figure 2 shows that an increase of labour demand and a constant labour supply curve leads to a decrease of total unemployment. Because of this, trade openness in negatively correlated with unemployment.

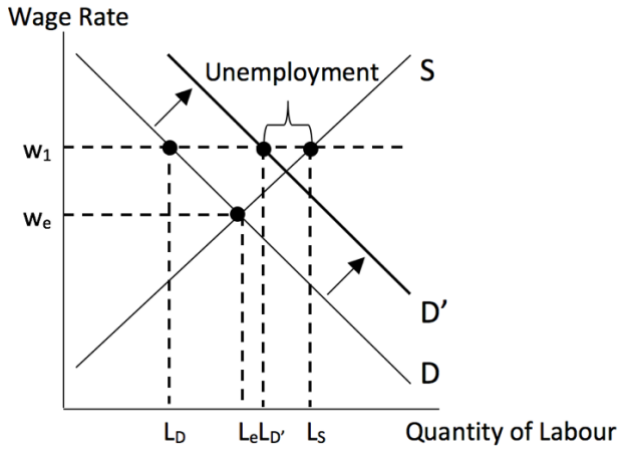

Figure 2: The labour market with increased trade openness

Next to unemployment caused by too high wages, unemployment can also exist due to frictional unemployment. Frictional unemployment is when individuals are unemployed and not looking for a job since they have already found a job but have not started working yet (Burda & Wyplosz, 2013). Since the transition from one job to another takes time, frictional unemployment will always exist.

Lastly, individuals can also be unemployed because they are looking for a new job. This type of unemployment is called search unemployment. Individuals are searching for a job and reject job offers because they choose to.

2.2 Empirical literature and hypotheses

The World Trade Organization has stated that world merchandise trade volume grew by 4.7% in 2017 and will continue to grow at a steady pace in 2018 and 2019 (WTO, 2018). However, these growth rates are only expected, provided that correct policy measures will be taken to counteract weak business confidence and promote trade. Here, the WTO claims that trade growth supports the creation of jobs. Contrarily, Görg and Görlich (2011) analysed the German labour market and have found a significantly positive relationship between trade and the probability of losing a job. In their study, fixed effect logit techniques have been used on employment data from 1999 until 2009.

Autor et al. (2014) used OLS regressions and 2SLS regressions to analyse the effect of the Chinese trade shock on the US labour market over the period 1992-2007. They have come to the conclusion that increasing trade openness has a positive effect on the US unemployment rate. The study of Autor et al. also shows that unemployment did not cause an increase in trade openness, thus reverse causality is not a big concern in this framework.

More recently, Dauth, Findeisen and Suedekum (2017) used OLS regressions and 2SLS regressions to analyse the impact of trade on manufacturing jobs in Germany. For the 2SLS regressions, trade shocks from China and Eastern Europe are analysed. Trade between China and other high-income countries and trade between Eastern Europe and other high-income countries has been used as an instrumental variable (IV) to purify the shocks specifically to Germany. They used data over the period 1993-2014 and came to the conclusion that trade has a negative effect on employment in manufacturing jobs and a positive effect on employment in service industries.

Dutt, Mitra and Ranjan (2009) used panel data to study the effect of trade openness on unemployment. They used data of 90 countries over the period 1985-2004 and have found significant, positive effects in the short-run. When a country increases its trade openness in period t, the unemployment rate increases in the same period. Moreover, they used pooled OLS regressions, OLS regressions with country fixed effect and a GMM approach.

Trefler (2004) examined the effect of free trade agreements of the US and Canada on unemployment by using OLS regressions. To address endogeneity issues of tariff concessions, an IV has been used, but interestingly, the results reject endogeneity. Trefler comes to the conclusion that more trade increases unemployment in the short-run. Based on these positive

effects of trade on the unemployment rate, a positive relationship in the short-run will also be expected in this paper. The first hypothesis is:

Hypothesis 1: Trade openness has no effect on unemployment in the short-run.

Trade openness is measured as total imports plus total exports divided by gross domestic product. This is the most common way trade openness has been measured in the past literature such as Alesina, Spolaore and Wacziarg (2000), Yanikkaya (2003) and Neumayer and De Soysa (2005). The short-run is represented as the direct effect in the same time period.

Next to analysing the effects in the short-run, Dutt et al. (2009) used the same panel data to examine the relationship between trade openness and unemployment in the long-run and found significant, negative effects. After an immediate increase in unemployment, the unemployment rate will decrease to a more favourable steady state in the long-run. Furthermore, Dutt et al. (2009) also used cross-sectional data to study the effect of trade openness on unemployment. Here, data of 90 countries and average values of the variables in question over the decade of the 1990s were used and significant, negative effects have been found. Moreover, they used OLS regressions and IV estimates. To correct for endogeneity issues, the number of years a country remained outside of the General Agreement on Tariffs and Trade (GATT) has been used as an instrumental variable.

In another empirical study, Gozgor (2014) analysed the impact of trade openness on unemployment in the G7 countries while using four different ways of measuring trade openness. In this research, panel data over the period 1993-2008 was used and a significant, negative relationship between trade openness and unemployment has been found. Moreover, Gozgor (2014) has come to the conclusion that trade openness decreases the equilibrium unemployment rate in the long-run. These results have been found by using the bias-corrected least squares dummy variable (LSDVC) approach. This method allows for unbalanced panel data and prevents a bias caused by a small number of countries. Finally, Gozgor corrected for endogeneity concerns by instrumenting lagged values appropriate to the matter at hand.

Based on these findings a negative relationship between trade openness and unemployment will also be expected in the long-run for the 28 OECD countries in this paper. The second hypothesis is:

Hypothesis 2: Trade openness has no effect on unemployment in the long-run.

The long-run is measured as the steady state values. In this paper it is assumed that a steady state exists. In the steady state the time dimension disappears and the unemployment rate only takes one value. The long-run unemployment moves towards the steady state unemployment rate over time. The aforementioned papers also define the long-run in this way.

This paper contributes to the current literature and empirical studies as it examines a set of countries that have not been analysed together before. In addition, this paper uses recent data to investigate if the literature on trade openness and unemployment still hold. Lastly, this paper uses a unique set of control variables obtained directly from the data sources.

3 Data

To analyse the effect of trade openness on unemployment in this paper, panel data is used for 28 OECD countries[1]. Annual data for imports, exports, gross domestic product (GDP) and unemployment rates are used and are obtained from OECD.Stat (OECD, 2018a) and World Development Indicator (WDI, 2018b). OECD.Stat is the database of the Organisation for Economic Co-operation and Development and it includes economic data for numerous countries. World Development Indicator is an extensive data portal of the World Bank with statistical data of countries all over the world. To use data on a large set of countries, suitable data are only available from 2000 onwards, hence annual data from 2000 until 2016 (the most recent annual data available) are used. Annual data are used because most variables of interest are only recorded on an annual basis and not on a quarterly or monthly basis.

In order to study the relationship between trade openness and unemployment, the unemployment rate measured as the number of unemployed people as a percentage of the labour force (variable *Unemployment*) and trade openness measured as the percentage of nominal imports and exports over nominal GDP (variable *Open*) are used.

Table 1: Descriptive statistics

	1990-2016				**2000-2016**			
Variable	**Obs.**	**Mean**	**Min.**	**Max.**	**Obs.**	**Mean**	**Min.**	**Max.**
Unemployment	270	5.81	2.06	11.40	475	7.81	2.25	27.47
Trade openness	270	55.31	16.01	110.00	476	88.20	19.80	221.16
Output gap	264	-0.39	-8.65	4.61	476	-0.64	-15.09	12.16
Tax wedge					476	27.17	-1.07	44.32
Participation tax rate					423	65.20	25.70	93.50
Unemployment benefit replacement rate					395	61.27	25.00	91.70

[1] See appendix A1 for list of countries.

Table 1 shows data on 10 countries for the period 1990-2016 and data on 28 countries for the period 2000-2016. When looking at the minimum and maximum value, it can be seen that both the unemployment rate and the degree of trade openness take values that differ substantially. This discrepancy can be partly due to cross-country differences. For that reason, this study takes country fixed effects into account. All countries have cultural, historical and institutional differences which do not change over time. Taking fixed effects into account controls for these differences and makes cross-country comparisons more adequate for analysis.

In this paper it is attempted to come as close as possible to finding a causal effect of trade openness on unemployment. To achieve this, internal validity and external validity need to be ensured. To address internal validity, some control variables are added to the regression model as they decrease omitted variable bias. Omitted variable bias takes place when a variable that is correlated with trade openness and has an effect on unemployment is excluded. The control variables added are output gap (variable *Output*), tax wedge (variable *Tax*), participation tax rate (*PTR*) and unemployment benefit replacement rate (variable *RR*).[2]

The variable *Output* is measured as the actual GDP minus the trend GDP as a percentage of potential GDP and is added to control for the economy's cyclical component. *Output* is obtained from OECD.Stat (OECD, 2018b).

According to Baker, Glyn, Howell and Schmitt (2004) and Felbermayr et al. (2011) labour market institutions and product market regulations do not have a significant effect on the unemployment rate. Labour market institutions include several variables such as unemployment benefit replacement rate, labour tax wedge, union density, active labour market policies (ALMP) and employment protection legislation (EPL)[3]. However, Nickell, Nunziata and Ochel (2005) show empirically and Costain and Reiter (2008) demonstrate theoretically that some labour market institutions do have an effect on the unemployment rate.

[2] In previous studies such as Felbermayr et al. (2011) and Gozgor (2014) the population size has been added as a control variable to control for market size. Adding population size does not lead to different results. See appendix A6 for the results.

[3] See appendix B for the definitions of the labour market institutions variables.

Dolenc and Laporšek (2010) find that the labour tax wedge has a significantly positive effect on unemployment. Therefore, the tax wedge (variable *Tax*) is included in the main model of this paper, and is obtained from OECD.Stat (OECD, 2018c). The tax wedge measures the extent to which labour tax discourages employment. It is measured as the sum of personal income tax, employee and employer social security contributions plus pay roll taxes, minus benefits received by the employee, as a percentage of labour costs (OECD, 2018d). An increase in the tax wedge can lower the employee's net income which makes being employed less appealing. Total unemployment can increase due to individuals who stop working and due to individuals who prefer to stay unemployed longer.

In imperfect labour markets, unemployed people become pickier in accepting job offers when they receive unemployment benefits (Boeri & van Ours, 2013). This means that unemployment benefits increase the unemployment rate in terms of duration (OECD, 2004a). Taking this into account, the variables participation tax rate (variable *PTR*) and unemployment benefit replacement rate (variable *RR*) are added. *PTR* measures the extent to which taxes and benefits reduce the financial gains of going back to work. It is measured as 1 minus the financial gains of working as a percentage of gross earnings. A higher number indicates a lower financial gain to work. *RR* shows by how much family income drops during unemployment. It is measured as the proportion of net income maintained after losing a job and thus becoming unemployed. The values are between zero and 100% and a higher value means a smaller drop in family income after losing a job. *PTR* data range from 2001 to 2016 and *RR* data are only available from 2001 until 2015. Furthermore, these two variables are obtained from OECD.Stat (OECD, 2018e, 2018f).

4 Methodology

To examine the effects stated in the hypotheses, annual data are used to run an Ordinary Least Squared (OLS) regression. Here, a panel regression is used with lags for the dependent and the independent variable. In this model the unemployment rate is the dependent variable and trade openness is the independent variable. The number of lags for the dependent as well as the independent variable in the regression model are chosen based on the Bayes Information Criterion (BIC)[4]. When using BIC, the model with smallest BIC score should be chosen. The model is as follows:

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 Y_{i,t-2} + \beta_3 X_{i,t} + \beta_4 X_{i,t-1} + \beta_5 X_{i,t-2} + \beta_6 X_{i,t-3} + \beta_7 Output + \beta_8 Tax + \beta_9 PTR + \beta_{10} RR + F_i + F_t + \varepsilon$$

Where Y is the unemployment rate, X is trade openness, Output is the output gap, Tax is the tax wedge, PTR is the participation tax rate, RR is the unemployment benefit replacement rate, F_i is a country's fixed effect, F_t represents time fixed effects and ε is the error term. Moreover, i denotes the country and t denotes the time period.

The coefficient reviewed to test Hypothesis 1, which states that trade openness has no effect on unemployment in the short-run, is the coefficient of trade openness of the current period, β_2. β_2 indicates by what percentage point the unemployment rate increases or decreases when the degree of trade openness increases. If β_2 has a significantly positive value, Hypothesis 1 is rejected and trade openness has a positive effect on the unemployment rate in the short-run. A positive or negative coefficient is statistically significant if its value is significantly different from zero.

To test Hypothesis 2, which states that trade openness has no effect on unemployment in the long-run, the long-run steady state rate of unemployment is examined. Following the assumption that the long-run steady state exists, the variables are expected to be constant in the long-run. Hence, in the steady state, the time dimensions are omitted and the formula takes the following form (excluding control variables):

$$Y_{i,SS} = \beta_0 + \beta_1 Y_{i,SS} + \beta_2 Y_{i,SS} + \beta_3 X_{i,SS} + \beta_4 X_{i,SS} + \beta_5 X_{i,SS} + \beta_6 X_{i,SS}$$

[4] See appendix C and D for Bayes Information Criterion (BIC) results.

Here, Y_t = $Y_{,t-1}$ = Y_{t-2} = Y_{SS}, where SS stands for steady state. The same applies to X. Rewriting gives the following:

$$(1-\beta_1-\beta_2)Y_{i,SS} = \beta_0 + (\beta_3+\beta_4+\beta_5+\beta_6)X_{i,SS}$$

$$Y_{i,SS} = \frac{(\beta_0)}{(1-\beta_1-\beta_2)} + \frac{(\beta_3+\beta_4+\beta_5+\beta_6)}{(1-\beta_1-\beta_2)})X_{i,SS}$$

The long-run effect is measured as $(\beta_3+\beta_4+\beta_5+\beta_6)/(1-\beta_1-\beta_2)$. The value of this formula indicates by what percentage point the unemployment rate increases or decreases when the degree of trade openness increases. If $(\beta_3+\beta_4+\beta_5+\beta_6)/(1-\beta_1-\beta_2)$ has a significantly negative value, Hypothesis 2 is rejected and trade openness has a negative effect on the unemployment rate in the long-run.

The significance of the regression coefficients found in this model is tested based on t-tests. Here, a significance level of 5% is used.

Endogeneity

To address possible endogeneity issues, control variables are added. Adding control variables are used to correct for omitted variable bias. Control variables correct for omitted variable bias if the control variable is correlated with trade openness and determines the unemployment rate. Omitted variables can affect the results in different ways. For example, the omission of a variable that has a positive effect on unemployment and is positively correlated with trade openness causes an upward bias.

This paper also corrects for omitted variable bias by adding country fixed effects. All countries have cultural, historical and institutional differences which do not change over time. Taking fixed effects into account controls for these differences.

Finally, Autor et al. (2014) have shown that reverse causality is not an issue in this framework. They use trade from China as an exogenous trade shock which indicates that trade can determine unemployment but unemployment does not determine trade. Nevertheless, lagged variables are added in this paper to correct for possible reverse causality.

5 Results

5.1 Results Panel Regressions

Table 2 displays all the regression coefficients of the panel regressions with the unemployment rate as dependent variable and trade openness as independent variable. Column (1) represents regression results for 10 OECD countries over the period 1990-2016. This column shows that the unemployment rate is significantly autocorrelated. This means that a high rate of unemployment in the current period persists during the succeeding period. Column (2) shows results for 28 OECD countries ranging from 2000 to 2016 and includes the average tax wedge as it has an effect on unemployment according to Dolenc and Laporšek (2010). Columns (3) and (4) use data over the period 2001-2016 and 2001-2015 respectively. Adding control variables leads to less observations due to lack of data availability. As a result, Table 2 contains four separate regressions.

Firstly, Hypothesis 1, which states that trade openness has no effect on unemployment in the short-run, is tested. To test this hypothesis the coefficients of the variable *Open* in the panel regressions are analysed. In this model, the effect of trade openness in the current period represents the effect in the short-run.

The first finding is the pattern of the negative coefficient of the variable *Open* in the current period (X_t). Columns (1) and (2) show that trade openness has a negative effect on unemployment. However, these coefficients are not significant and cannot be interpreted. The more concrete models in columns (3) and (4) with additional control variables and a higher explanatory power (R^2 within) show a statistically significant and negative coefficient (-0.027). If a country increases its trade openness by 1 percentage point, the unemployment rate in the same period decreases on average by 0.03 percentage points.

The coefficient found here is smaller compared to the benchmark results of Felbermayr et al. (2011). Their results show that increasing a country's trade openness by 1 percentage point, decreases the unemployment rate in the short-run by approximately 0.08 percentage points. In addition, this coefficient is small, because the model suggests that the increase of a country's trade openness by its standard deviation of about 42 percentage points, the unemployment rate in the same period decreases on average by 1.13 percentage points. A decrease of 1.13 percentage points is small considering that the standard deviation of the unemployment rate is roughly 4.15 percentage points.

Based on the negative coefficients of the variable *Open* which are statistically significant at a 10% significance level, Hypothesis 1, which states that trade openness has no effect on unemployment in the short-run, is rejected. Moreover, the findings suggest a negative relationship between trade openness and unemployment in the short-run.

Table 2: Panel regressions

	(1)	**(2)**	**(3)**	**(4)**
Variable	$\boldsymbol{\beta}$	$\boldsymbol{\beta}$	$\boldsymbol{\beta}$	$\boldsymbol{\beta}$
Unemployment (Y_{t-1})	0.871***	1.016***	0.982***	0.973***
	(0.108)	(0.075)	(0.072)	(0.075)
Unemployment (Y_{t-2})	-0.181*	-0.405***	-0.392***	-0.394***
	(0.066)	(0.050)	(0.049)	(0.053)
Open (X_t)	0.001	-0.023	-0.027*	-0.027*
	(0.019)	(0.014)	(0.015)	(0.015)
Open (X_{t-1})	-0.005	0.027**	0.022*	0.022*
	(0.017)	(0.012)	(0.012)	(0.012)
Open (X_{t-2})		0.005	0.010	0.009
		(0.009)	(0.009)	(0.009)
Open (X_{t-3})		-0.039**	-0.040***	-0.040***
		(0.008)	(0.007)	(0.008)
Output (C1)	-0.223***	-0.287***	-0.305***	-0.312***
	(0.038)	(0.034)	(0.033)	(0.033)
Tax (C2)		0.028	0.040**	0.029
		(0.017)	(0.018)	(0.022)
PTR (C3)			-0.006	0.011
			(0.016)	(0.022)
RR (C4)				-0.017
				(0.022)
Observations	247	392	351	323
Number of countries	10	28	28	28
R^2 (within)	0.837	0.929	0.932	0.931
R^2 (between)	0.977	0.760	0.666	0.635
R^2 (overall)	0.888	0.822	0.767	0.750

Standard errors between brackets; *p < 0.1; **p < 0.05; ***p < 0.01

To test Hypothesis 2, which states that trade openness has no effect on unemployment in the long-run, the same panel regressions seen in Table 2 are used. Columns (2), (3) and (4) all show the same pattern; after an initial drop in the rate of unemployment this rate seems to increase again over the course of one to two years. Nevertheless, the coefficients in columns (2), (3) and (4) indicate that an 1 percentage point increase in trade

openness lowers the long-run unemployment rate by 0.08[5], 0.09[6] and 0.09[7] percentage points respectively. These results are small compared to the findings of Felbermayr (2011) and Gozgor (2014) which show that an increase of trade openness by 1 percentage point, decreases the unemployment rate by roughly 0.19 and 0.29 percentage points respectively.

Nevertheless, in line with Felbermayr et al. (2011), the results show that trade openness has a bigger impact on the unemployment rate in the long-run than in the short-run.

Based on these results, Hypothesis 2, which states that trade openness has no effect on unemployment in the long-run, is rejected. The findings indicate a negative relationship between trade openness and unemployment in the long-run.

Table 2 illustrates that the output gap has a significant coefficient of -0.3 on average. This implies that the output gap is a suitable way to correct for business cycles. The output gap negatively related to the unemployment rate. The tax wedge has a small positive value and is in line with the expectations. Higher labour tax wedge discourages employment. However, the coefficient is not significantly different from zero and is therefore not meaningful. The participation tax rate is expected to take a positive value but the variable *PTR* takes a negative value in column (3) and a positive value in column (4) and is statistically insignificant in both models. Finally, the coefficient of the unemployment benefit replacement rate is expected to take a positive value, but is also insignificant.

One important finding in columns (2), (3) and (4) of Table 2 is the statistically significant negative coefficient of the third lag of trade openness. If a country increases its trade openness in period t, the unemployment rate drops in period t+3. A plausible explanation is that the creation of jobs takes time. If a firm is working at full capacity in the current period after having hired new workers, it cannot hire more workers in the next period. The firm can however invest in new machinery or land to increase their production capacity. Building new machines or office spaces can take three years, after which more workers can get hired.

[5] (-0.023+0.027+0.005-0.039)/(1-1.016+0.405) = -0.077
[6] (-0.027+0.022-0.010-0.040)/(1-0.982+0.392) = -0.085
[7] (-0.027+0.022+0.009-0.040)/(1-0.973+0.394) = -0.086

5.2 Robustness Analysis

5.2.1 Control Variables

To check the robustness of this model an additional model is used with the Fraser Institutes' indicator of economic freedom focused on regulations. This index measures the degree of economic freedom with respect to regulatory restraints in credit, labour and product markets and is also used in the study of Felbermayr et al. (2011). The Fraser Institute uses a combination of 42 variables of external sources such as the International Country Risk Guide and the World Bank's Doing Business project. The index uses scores on a scale of 0 to 10. A higher index refers to a higher degree of freedom and less limitations due to legislation. This variable is denoted as Economic Freedom with respect to Regulation (variable *EFR*) and replaces the variables *Tax, PTR* and *RR* since *EFR* includes similar components. Annual *EFR* data is available from 2000 until 2015 and is obtained from the Fraser Institute (Fraser Institute, 2018), a research and educational organization that studies and measures among other things the effect of government policies on the quality of life.

According to Bassanini and Duval (2009) and Belot and van Ours (2004), labour market institutions should not be analysed separately as they interact with each other. Analysing solely one labour market institution could lead to insignificant results, while analysing multiple labour market institutions in the same model could lead to significant results. In this robustness analysis, the *EFR* variable is used as a proxy for all the institutions.

Table 3 shows the corresponding panel regression to test Hypothesis 1, which states that trade openness has no effect on unemployment in the short-run. The coefficient of interest to test this hypothesis is the coefficient of the variable *Open* in the current period (X_t). This coefficient represents the effect in the short-run and has a non-significant negative value. Due to the statistical insignificance this value is not meaningful. Based on this, Hypothesis 1 is not rejected.

Table 3: Panel regression with EFR

Variable	$\boldsymbol{\beta}$
Unemployment (Y_{t-1})	0.995***
	(0.080)
Unemployment (Y_{t-2})	-0.395***
	(0.056)
Open (X_t)	-0.019
	(0.014)
Open (X_{t-1})	0.027**
	(0.013)
Open (X_{t-2})	0.005
	(0.009)
Open (X_{t-3})	-0.037***
	(0.008)
Output (C1)	-0.294***
	(0.033)
EFR (C2)	-0.416**
	(0.153)
Observations	364
Number of countries	28
R^2 (within)	0.929
R^2 (between)	0.802
R^2 (overall)	0.843

Standard errors between brackets; *p < 0.1; **p < 0.05; ***p < 0.01

To test Hypothesis 2, which states that trade openness has no effect on unemployment in the long-run, the results shown in Table 3 are used again. This regression follows the same pattern discovered in columns (2), (3) and (4) of Table 2. Initially, trade openness has a negative impact on unemployment followed by an increase in the rate of unemployment after one to two years. Au contraire, if a country increases its trade openness by 1%, the long-run unemployment rate falls by 0.06%[8]. The result in this robustness analysis is also negative, but slightly smaller than the results of section 5.1.

Based on these findings, Hypothesis 2, which states that trade openness has no effect on unemployment in the long-run, is rejected. Moreover, the results show a negative relationship between trade openness and the rate of unemployment.

Lastly, the coefficient of the variable *EFR* is negative and significant at a 5% significance level. The degree of economic freedom is negatively related with the unemployment rate. More economic freedom and less legislation is associated with a lower rate of unemployment.

[8] (-0.019+0.027+0.005-0.037)/(1-0.995+0.395) = -0.06

5.2.2 Stationarity

When using time-series data it is important to examine if the variables used contain a unit root. If the variables have unit roots, the results can be misleading since they can show spurious regressions. A regression can show spurious results when two trends appear related when in fact they are not. To test for stationarity the Im-Pesaran-Shin unit root test is used for all the variables. The null hypothesis of the Im-Pesaran-Shin unit root test is that the variable contains a unit root. This null hypothesis needs to be rejected for a variable to be stationary. Here, a significance level of 5% is used. To make all variables stationary, first differences are taken. See appendix E for the Im-Pesaran-Shin unit root test results. Taking the first difference of all variables makes it possible to interpret the coefficients as the effect of trade openness (X) on the unemployment rate (Y). Table 4 displays the panel regression results after making all variables stationary.

Following the same structure as in section 5.1, Hypothesis 1, which states that trade openness has no effect on unemployment in the short-run, is tested first. For this test, the coefficient of the variable *Open* in the current period (X_t) is analysed. Columns (1) and (2) show positive values for this coefficient whilst columns (3) and (4) indicate a negative relationship between trade openness and unemployment. However, none of these coefficients are significant and for that reason they are not meaningful. The lack of significant coefficients could be due to the fact that there are less observations. Based on these findings, Hypothesis 1 is not rejected.

Table 4: Panel regressions with stationary variables

	(1)	(2)	(3)	(4)
Variable	$\boldsymbol{\beta}$	$\boldsymbol{\beta}$	$\boldsymbol{\beta}$	$\boldsymbol{\beta}$
Unemployment (Y_{t-1})	0.302***	0.473***	0.524***	0.522***
	(0.069)	(0.048)	(0.043)	(0.045)
Unemployment (Y_{t-2})	-0.109***	-0.162***	-0.185***	-0.216***
	(0.033)	(0.038)	(0.040)	(0.043)
Open (X_t)	0.007	0.002	-0.004	-0.009
	(0.009)	(0.009)	(0.011)	(0.011)
Open (X_{t-1})		-0.011	-0.012*	-0.013
		(0.009)	(0.008)	(0.008)
Open (X_{t-2})		-0.001	0.002	0.000
		(0.005)	(0.005)	(0.006)
Open (X_{t-3})		-0.030***	-0.032***	-0.035***
		(0.008)	(0.009)	(0.009)
Output (C1)	-0.293***	-0.352***	-0.346***	-0.332***
	(0.030)	(0.027)	(0.027)	(0.027)
Tax (C2)		0.033	0.040	0.050
		(0.020)	(0.026)	(0.038)
PTR (C3)			-0.003	-0.002
			(0.023)	(0.023)
RR (C4)				-0.008
				(0.017)
Observations	237	364	310	284
Number of countries	10	28	26	26
R^2 (within)	0.547	0.683	0.720	0.718
R^2 (between)	0.863	0.922	0.919	0.888
R^2 (overall)	0.551	0.694	0.730	0.728

Standard errors between brackets; *p < 0.1; **p < 0.05; ***p < 0.01

One finding shown in columns (2), (3) and (4) of Table 4 is the significantly negative coefficient of X_{t-3}. This implies that the unemployment rate falls after three periods if trade openness is increased in the current period. A plausible explanation for this is given in section 5.1. But, to test Hypothesis 2, which states that trade openness has no effect on unemployment in the long-run, the long-run is analysed. According to the panel regressions in columns (2), (3) and (4), if a country increases its trade openness by 1%, the unemployment rate decreases by 0.06%[9], 0.07%[10] and 0.08%[11] respectively. This long-run effect is slightly smaller than the findings in section 5.1.

[9] (0.002-0.011-0.001-0.030)/(1-0.473+0.162) = -0.057

[10] (-0.004-0.012+0.002-0.032)/(1-0.524+0.185) = -0.069

[11] (-0.009-0.013+0.000-0.035)/(1-0.522+0.216) = -0.082

Based on the negative long-run relationship found in the panel regressions with stationary variables, Hypothesis 2, which states that trade openness has no effect on unemployment in the long-run, is rejected. The results show that trade openness has a negative effect on the unemployment rate.

The coefficients of the output gap is negative and also statistically significant. The output gap is negatively associated with the unemployment rate. Thus, GDP above the trend GDP, in other words, an economic boom, is associated with a decrease in the unemployment rate. The coefficients of the variables *Tax* and *RR* have the same sign pattern as in Table 2 and are not significantly different from zero. Lastly, the coefficient of the participation tax rate is negative and insignificant in columns (3) and (4) of Table 4, therefore not meaningful.

6. Discussion, Policy Implications & Conclusion

In this paper the relationship between trade openness and the unemployment rate has been analysed by using panel data. The panel data generally contain data of 28 OECD countries over the period 2000-2016.

Based on the findings from the results, Hypothesis 1, which states that trade openness has no effect on unemployment in the short-run, is rejected. Here, the short-run is determined as the current period. Trade openness is negatively correlated with the unemployment rate in the current period. If a country increases its trade openness, the unemployment rate in the current period falls. These results are not in line with previous studies by Dutt et al. (2009) and Trefler (2004), but do correspond with the findings of Felbermayr et al. (2011). This decrease in unemployment could arise due to an increase in the demand for goods and services when increasing trade openness. Firms attempt to satisfy this demand by increasing their production. Hiring more (temporary) workers could lead to an increase in production (output) of goods and services.

Subsequently, Hypothesis 2, which states that trade openness has no effect on unemployment in the long-run, is rejected. The long-run effect of trade openness on the unemployment rate is negative. This result coincides with the findings of Dutt et al (2009) and Felbermayr et al. (2011). A possible explanation could be the same as for the explanation in the short-run. Hiring more temporary and permanent workers could lead to a decrease in unemployment in the short-run followed by an increase in the rate of unemployment after one or two years since the temporary contracts expire. Nonetheless, the long-run unemployment decreases and the economy moves to a new steady state equilibrium unemployment rate due to the addition of permanent contracts. Using these results, the following research question could be answered:

"*What is the effect of trade openness on the unemployment rate in 28 OECD countries?"*

In this paper a negative relationship has been found between trade openness and the unemployment rate. This relationship is negative in the short-run and in the long-run. If a country increases its trade openness, the unemployment rate in the current period as well as the unemployment rate in the long-run decrease. Additionally, the effect in the long-run is bigger than the effect in the short-run.

In order to interpret the findings as causal effects, internal validity has to hold. In this research, lags of the dependent and independent variable are added to correct for possible reverse causality. Furthermore, there could certainly be omitted variable bias. Relating to this, data on several variables used in previous research such as product market regulation, union density and other taxes were not available for the time period used in this paper. The absence of variables that are correlated with trade openness and influence the unemployment rate make the findings not fully internally valid.

Another limitation that should be taken into consideration next to internal validity is the way trade openness is measured. Trade openness can also be measured in real terms, correcting for cross-country differences, or by using an index for trade openness. Nevertheless, in this paper trade openness is measured in nominal terms as it is the most common method.

In light of the findings in this paper, policy recommendations could be made. Policy makers can increase trade openness to decrease the unemployment rate. However, according to some economists, trade is not as good for the economy as alleged (Rodriguez & Rodrik, 2000). Temporary workers might only benefit from trade in the short-run. According to Görg and Görlich (2011) increased trade openness is associated with a higher probability of losing a job for workers with a temporary contract. Policy makers could take this into consideration by adjusting labour market institutions in favour of temporary workers.

Moreover, the robustness analysis shows that economic freedom with respect to regulations is significant in determining the unemployment rate. As this variable resembles a mixture of numerous (labour) market institution, this finding is in line with the conclusions drawn by Bassanini and Duval (2009) that a combination of institutions is needed to reach a desired effect. Using only one labour market institution could lead to insignificant effects, while using a combination of multiple institutions can lead to significant results, because they interact with each other. When increasing trade openness, policy makers should implement a correct combination of (labour) market institutions to minimize the unemployment rate. Moreover, further research can analyse if trade is more successful in reducing the unemployment rate when market institutions are better.

Finally, the findings in this paper indicate that trade openness influences unemployment, but to what extent do tariffs and other trade policies influence unemployment. How much do import tariffs influence trade openness and therefore,

indirectly influence unemployment? The increase in tariffs imposed by the Trump administration and other countries could be detrimental for trade. Further research can investigate how these tariffs affect the unemployment rate.

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Appendix A

Table A1: List of countries used per panel regression

Country	Table 2 Column (1)	Table 2 Column (2)	Table 2 Column (3)	Table 2 Column (4)
1	Australia	Australia	Australia	Australia
2	Austria	Austria	Austria	Austria
3	Canada	Belgium	Belgium	Belgium
4	Chile	Canada	Canada	Canada
5	Germany	Chile	Chile	Chile
6	Japan	Czech Republic	Czech Republic	Czech Republic
7	Korea	Denmark	Denmark	Denmark
8	Mexico	Estonia	Estonia	Estonia
9	New Zealand	Finland	Finland	Finland
10	United States	Germany	Germany	Germany
11		Greece	Greece	Greece
12		Hungary	Hungary	Hungary
13		Ireland	Ireland	Ireland
14		Israel	Israel	Israel
15		Italy	Italy	Italy
16		Japan	Japan	Japan
17		Korea	Korea	Korea
18		Mexico	Netherlands	Netherlands
19		Netherlands	New Zealand	New Zealand
20		New Zealand	Norway	Norway
21		Norway	Poland	Poland
22		Poland	Portugal	Portugal
23		Portugal	Slovak Republic	Slovak Republic
24		Slovak Republic	Slovenia	Slovenia
25		Slovenia	Sweden	Sweden
26		Spain	Spain	Spain
27		United Kingdom	United Kingdom	United Kingdom
28		United States	United States	United States

Table A2: Descriptive statistics Table 2 Column (1)

	1990-2016				
Variable	**Obs.**	**Mean**	**St. dev.**	**Min.**	**Max.**
Unemployment	270	5.81	2.20	2.06	11.40
Trade openness	270	55.31	22.14	16.01	110.00
Output gap	264	-0.39	2.07	-8.65	4.61

Table A3: Descriptive statistics Table 2 Column (2)

	2000-2016				
Variable	**Obs.**	**Mean**	**St. dev.**	**Min.**	**Max.**
Unemployment	475	7.81	4.16	2.25	27.47
Trade openness	476	88.20	41.78	19.80	221.16
Output gap	476	-0.64	3.20	-15.09	12.16
Tax wedge	476	27.17	10.31	-1.07	44.32

Table A4: Descriptive statistics Table 2 Column (3)

	2001-2016				
Variable	**Obs.**	**Mean**	**St. dev.**	**Min.**	**Max.**
Unemployment	448	7.81	4.17	2.25	27.47
Trade openness	448	88.66	42.11	19.80	221.16
Output gap	448	-0.73	3.23	-15.09	12.16
Tax wedge	448	27.05	10.35	-1.07	44.03
Participation tax rate	423	65.20	14.17	25.70	93.50

Table A5: Descriptive statistics Table 2 Column (4)

	2001-2015				
Variable	**Obs.**	**Mean**	**St. dev.**	**Min.**	**Max.**
Unemployment	420	7.83	4.15	2.25	27.47
Trade openness	420	88.18	41.44	19.80	216.19
Output gap	420	-0.67	3.26	-15.09	12.16
Tax wedge	420	27.11	10.37	-1.07	44.03
Participation tax rate	395	65.12	14.16	25.70	93.50
Unemployment benefit replacement rate	395	61.27	12.73	25.00	91.70

Table A6: Panel regressions with and without population size

	(1)	(2)
Variable	$\boldsymbol{\beta}$	$\boldsymbol{\beta}$
Unemployment (Y_{t-1})	0.973***	0.972***
	(0.075)	(0.075)
Unemployment (Y_{t-2})	-0.394***	-0.394***
	(0.053)	(0.053)
Open (X_t)	-0.027*	0.027*
	(0.015)	(0.015)
Open (X_{t-1})	0.022*	0.022*
	(0.012)	(0.012)
Open (X_{t-2})	0.009	0.009
	(0.009)	(0.009)
Open (X_{t-3})	-0.040***	-0.040***
	(0.008)	(0.008)
Output	-0.312***	-0.313***
	(0.033)	(0.032)
Tax	0.029	0.028
	(0.022)	(0.022)
PTR	0.011	0.011
	(0.022)	(0.023)
RR	-0.017	-0.017
	(0.022)	(0.023)
Population		-0.660
		(2.647)
Observations	323	323
Number of countries	28	28
R^2 (within)	0.931	0.931
R^2 (between)	0.635	0.755
R^2 (overall)	0.750	0.818

Standard errors between brackets; *p < 0.1; **p < 0.05; ***p < 0.01

Table A7: Descriptive statistics panel regression with EFR

	2000-2015				
Variable	**Obs.**	**Mean**	**St. dev.**	**Min.**	**Max.**
Unemployment	448	7.72	4.19	2.25	27.47
Trade openness	448	86.78	41.49	19.80	216.19
Output gap	448	-0.57	3.21	-15.09	12.16
EFR	448	7.49	0.75	5.47	9.12

Appendix B

Labour Market Institutions

- *Unemployment benefit replacement rate:*

  Unemployment benefit replacement rate shows by how much family income drops during unemployment. It is measured as the proportion of net income maintained after losing a job and thus becoming unemployed (OECD, 2018f).

- *Labour tax wedge:*

  Difference between labour costs to the employer and the net value the employee receives. It is measured as the sum of personal income tax, employee and employer social security contributions plus pay roll taxes, minus benefits received by the employee, as a percentage of labour costs (OECD, 2018d).

- *Union density:*

  The share of workers that participate in a trade union (OECD, 2004b).

- *Active labour market policies (ALMP):*

  An activation scheme that helps recipients of unemployment benefits find a job faster instead of take advantage of the unemployment benefits for the entire unemployment benefit duration. It is measured as the total public expenditures on ALMPs as a percentage of GDP (OECD, 2018g).

- *Employment protection legislation (EPL):*

  A set of norms and procedures followed in case of dismissal of individuals (OECD, 2018h). This is an OECD indicator of the strictness of regulation on dismissals.

- *Participation tax rate:*

  It measures the extent to which taxes and benefits reduce the financial gains of going back to work (OECD, 2018e). It is measured as 1 minus the financial gains of working as a percentage of gross earnings.

Appendix C

The tables in Appendix C show the BIC scores of the models used for the panel regressions of section 5.1. The objective is to use the model with the smallest BIC scores. The models with the smallest/chosen scores are underlined.

Table C1: BIC scores lags y-variable

	(1)	**(2)**	**(3)**	**(4)**
Unemployment – 0 lags	734.573	1441.022	1285.872	1186.966
Unemployment – 1 lag	432.823	1011.600	904.656	837.669
Unemployment – 2 lags	429.158	922.748	822.867	772.679
Unemployment – 3 lags	430.435	928.407	828.570	778.089

Table C2: BIC scores lags x-variable

	(1)	**(2)**	**(3)**	**(4)**
Open – 0 lags	415.317	859.152	758.252	707.323
Open – 1 lag	420.393	863.130	763.037	712.088
Open – 2 lags	420.589	855.608	759.908	710.520
Open – 3 lags	425.514	825.695	731.722	685.111
Open – 4 lags	427.512	830.541	737.115	690.576

Appendix D

The tables in Appendix D show the BIC scores of the models used for the panel regressions of section 5.2. The objective is to use the model with the smallest BIC scores. The models with the smallest/chosen scores are underlined.

Table D1: BIC scores lags y-variable with EFR

	(1)
Unemployment – 0 lags	1328.854
Unemployment – 1 lag	923.571
Unemployment – 2 lags	854.471
Unemployment – 3 lags	860.161

Table D2: BIC scores lags x-variable with EFR

	(1)
Unemployment – 0 lags	789.132
Unemployment – 1 lag	792.730
Unemployment – 2 lags	789.601
Unemployment – 3 lags	766.696

Table D3: BIC scores lags y-variable with stationary variables

	(1)	**(2)**	**(3)**	**(4)**
Unemployment – 0 lags	403.034	964.312	855.160	802.333
Unemployment – 1 lag	372.545	861.796	749.001	711.305
Unemployment – 2 lags	370.152	848.214	732.488	691.589
Unemployment – 3 lags	375.322	853.778	737.383	696.791

Table D4: BIC scores lags x-variable with stationary variables

	(1)	**(2)**	**(3)**	**(4)**
Open – 0 lags	357.059	786.887	667.877	624.459
Open – 1 lag	362.447	791.864	673.253	629.892
Open – 2 lags	367.147	797.285	678.026	634.838
Open – 3 lags	372.200	781.240	661.460	616.014
Open – 4 lags	377.223	783.616	663.838	617.927

Appendix E

Table E1: Results Im-Pesaran-Shin unit root test

	(1)	(2)	(3)	(4)
Variable	**Z(t)**	**Z(t)**	**Z(t)**	**Z(t)**
Unemployment	-0.243	1.488	0.730	0.730
First difference Unemployment	-6.861*	-5.300*	-4.293*	-4.293*
Open	-1.284	1.159	-0.190	-0.190
First difference Open	-8.197*	-9.399*	-8.944*	-8.944*
Output	-3.597*	-1.737*	-1.058	-1.058
First difference Output	-8.417*	-7.843*	-7.148*	-7.148*
Tax		-0.507	0.308	0.308
First difference Tax		-8.609*	-7.648*	-7.648*
PTR			0.185	0.185
First difference PTR			-8.233*	-8.233*
RR				-0.006
First difference RR				-9.371*

*p < 0.05