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Estimating Poverty Transitions in Turkey Using Repeated Cross-Sectional Data*

Ömer LİMANLI[1]

ABSTRACT

In order to fight poverty more effectively, it is vital to determine the extent to which households are chronic or transient poor. In this context, this paper has two aims. The first is to estimate poverty transition between 2006 and 2016 in Turkey using a newly developed synthetic panel method. With this method, the transition of poverty between two-time points can be estimated without the need for real panel data. The second aim of the study is to test how well this method works. To this end, the analysis has been performed once again by using real panel data for the years 2006-2009 and 2013-2016. The findings show that the percentage of households those who chronically poor is between 3.9% and 10.7%, the percentage of those who escaped from poverty is between 12.1% and 20.8% and the percentage of those who fall into poverty is between 5.4% and 12.2%. The analysis with actual panel data has revealed that the method works quite well.

Keywords: cross-sectional data, poverty, poverty transition, synthetic panel, Turkey.

JEL Codes: C23, C31, I32

The first goal of the United Nation's (UN) Millenium Development Goals is to reduce the number of people who live in extreme poverty and to eliminate hunger. The results suggest that more than 1 billion people have been saved from extreme poverty. However, 800 million people still live in extreme poverty across the globe (UN, 2019). We do not know how many of those 800 million people fell into extreme poverty first time or how many of them were already in extreme poverty. To discover who moves in and out of the poverty (in the extreme form or not), data contain information about the same analysis units (individuals or households) for multiple time points are needed. Fortunately, panel structured datasets meet this feature. The problem at this point is that panel data is an exception rather than a rule for developing countries. The lack of necessary data has made analysing the poverty transition in those countries complicated for many years.

In his seminal paper, Deaton (1985) has developed the pseudo-panel data method, allowing the use of cross-sectional data when no actual panel data are available. In pseudo-panel data, individuals are classified as homogenous cohorts according to their specific characteristics. The most used character is the year of birth. So, individuals are grouped in specified age categories, and the cohort averages are used observations (Verbeek, 2008). Although Bane & Ellwood (1986) used the actual panel in their pioneering study examining poverty from a dynamic perspective, pseudo-panel or cross-sectional data have been used extensively in the dynamic poverty analysis due to the fact that the panel data is an exception for most developing countries. For instance, Gibson (2001), Antman & McKenzie (2007) and Cuesta, Ñopo, & Pizzolitto (2011) have utilised repeated cross-sectional data for analysis of chronic poverty, income and earning mobility, among others. Despite the emphasised advantage, the main criticism of repeated cross-sectional data is that the use of cohorts compels the researchers to make a trade-off between the number of cohorts and the number of observations per cohort. If the number of the cohort is to be higher, which means more analysis units, the number of observations in each cohort must be reduced. This will

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increase the within-cohort variance and damage the estimation efficiency. There is no certainty in the literature about the number of cohort and the number of observations for each cohort. Therefore, there has been a need to develop more effective analysis methods.

As is in many previous studies, balanced panel data have been employed to scrutinise the dynamics of poverty in Turkey. In all of these studies, Survey on Income and Living Conditions (SILC) panel data which conducted since 2006 by the Turkey Statistics Institute (TurkStat) has been used. For instance, Acar & Başlevent (2014) have estimated the determinants of entry and exit from poverty for the 2007-2010 period using the traditional probit estimation method. They concluded that the employment status and education level of the household leader was strictly related to the change in the poverty situation. Similarly, Acar (2014) examined multidimensional poverty transitions for 2007-2010. Random effects probit model results show that the increase in the level of education and the homeownership reduce the probability of being multi-dimensional poor. Şeker & Dayıoğlu (2015), unlike previous studies, have used the spell approach of Bane and Ellwood (1985) to perform a duration analysis for the period 2005-2008. They have revealed that almost a quarter of the poor are in persistent poverty. Using a similar method, Dayioğlu & Demir Şeker (2016) have examined child poverty in the period 2006-2009 and found that 30 per cent of poor children has been poor during the whole period. Lastly, Sigeze & Şengül (2018) have used the multinomial panel probit method to estimate the determinants of the poverty dynamics of households and chronic poverty for the 2009-2012 period. The results differ according to the characteristics of the household head and the household. Nevertheless, this study can not tell us what proportion of poor households is transient or chronically poor.

The characteristic feature of all these studies is that the time dimension in the panel data they use is at most four years. This is since SILC has a rotating panel structure. That is, one-quarter of the sample is dropped every year, and a new sample is added instead. Therefore, one-quarter of the sample can be followed for a maximum of four years. Considering the structure of the phenomenon of poverty, it can be said that four years is a short period. Poverty is a result of structural problems.[1] Therefore, the solution of structural problems also requires time. To be analysed for a more extended period of poverty transition is thought to reveal more consistent results on how the poverty changes in Turkey. However, it is evident that this cannot be done with the methods employed so far and using four-year panel data.

Taking into account the studies carried out on Turkey, the aim of this paper is to estimate poverty transitions in Turkey using cross-sectional data for the period 2006-2016. To this end, the newly developed method proposed by Dang, Lanjouw, Luoto, & McKenzie (2014) has been employed. This method allows the calculation of transient and chronic poverty rates between two-time points without the need for panel data. Several validation studies have shown that this method works reasonably well (Cruces et al., 2015; Herault & Jenkins, 2018; Urzainqui, 2017). The primary motivation behind this study is the fact that different policy sets are needed to reduce transient and chronic poverty. Transient poverty is a short time for individuals or households to remain poor and is caused by shocks such as diseases, natural disasters or death. Chronic poverty is the result of structural problems such as income distribution disorder, constraints on access to education, inequality of opportunity, or inter-regional differences in development. Therefore, it is believed that the present paper will help policymakers to develop more effective policies in terms of poverty alleviation. Moreover, it is also aimed to demonstrate how well the method works by using actual panel data.

This paper proceeds as follows. The method proposed by Dang et al. (2014) is explained in detail in Section 1. First, the background of the methodological approach is explained briefly, and then the calculation approach is presented step by step. Section 2 provides detailed information on the data set and variables used in the study. The empirical findings and robustness exercise are provided in Section 3. The article concludes with a brief discussion in Section 4.

1. Method

This section is mostly based on Dang et al. (2014) and Bierbaum & Gassmann (2012). The logic behind the method of Dang et al. (2014) can be explained as follows. Suppose we have cross-section data collected at two-time points. Let time points are represented by 1 and 2. Since these are cross-sectional data, the units in both dataset are different. Therefore, the income or consumption of the households observed in round 1

[1] For a discussion of poverty from political economy perspective, see Bahçe & Köse (2017). See also Buğra & Keyder (2005) for the social policy, and Wuripe (2018) for literature examination in tersm of government role in poverty eradication.

cannot be known in round 2, or vice versa. One thing to do at this point is to estimate the value of household income or consumption in the second round observed in the first round. This estimation can be carried out by applying the ordinary least squares (OLS) method to the consumption or income equation using the time-invariant household variables observed in both rounds.

To put it more formally, let y_{it} be the per capita income or consumption in the household i and at the round t, $t=1,2$. Likewise, x_{it} is the vector contains time-invariant household characteristics like sex, language, religion or birth of region and ε_{it} is the error term. So, the estimation equation that can be used for both rounds can be written as follows,

$$y_{it} = \beta_t' x_{it} + \varepsilon_{it} \quad (1)$$

However, it is not possible to estimate the change in the poverty status of households directly by using repeated cross-sectional data. In other words, we cannot predict the following joint possibilities; $\Pr(y_{i1} < z_1 \text{ and } y_{i2} > z_2)$: poor-nonpoor, $\Pr(y_{i1} < z_1 \text{ and } y_{i2} < z_2)$: poor-poor, $\Pr(y_{i1} > z_1 \text{ and } y_{i2} < z_2)$: nonpoor-poor and $\Pr(y_{i1} > z_1 \text{ and } y_{i2} > z_2)$: nonpoor-nonpoor, where z_t is the poverty line in the corresponding round. Instead, by using the coefficients obtained from the estimation of the first-period equation and the time-invariant household characteristics of the second period, the estimates for the first period of the households in the second period can be obtained. Dang et al. (2014) refer to the data obtained in this way as "synthetic panel".

Two assumptions are necessary for the method to function (Dang et al., 2014: 114). According to the first assumption, the population where the sample is collected should not change between two rounds. The reason why this assumption is required is that the household characteristics remain the same over time as a result of the sampling population does not change so that the first round can be estimated by using the data obtained from the second round. The second assumption requires that the correlation between the error terms obtained from the two rounds is not negative. Dang et al. (2014) justify this assumption as follows. Because of the fixed household characteristics in the error terms, households with high (low) income or consumption in the first round will also have high (low) income or consumption in the second round.

Furthermore, a positive autocorrelation will be observed in the error term due to the external shocks affecting household income or consumption. Also, the authors have not entirely ignored the possibility of a negative correlation. For example, households with limited access to credit will reduce their current expenditures for future payments. This will cause the error term to be negatively correlated. Lastly, a zero or one correlation means that the poverty status of all households in the first round has changed in the second round (upper bound) and that no household's poverty status has changed (lower bound), respectively. Under the assumptions mentioned above, the upper and lower bound of poverty mobility, which Dang et al. (2014) call the "nonparametric bounds" can be estimated by the following steps.

To estimate nonparametric upper bound;

Step 1: Estimate the equation 1 with OLS using data from round 1, obtain $\hat{\beta}_1'$ and $\hat{\varepsilon}_{i1}$.

Step 2: For each household in the second round, select randomly a residual with replacement from the residuals calculated in the first step. Denote these residuals with $\hat{\varepsilon}_{i1}^2$. Using data from round 2, $\hat{\beta}_1'$ and $\hat{\varepsilon}_{i1}^2$, estimate the income level of the households in the first round: $\hat{y}_{i1}^{2U} = \hat{\beta}_1' x_{i2} + \hat{\varepsilon}_{i1}^2$.

Step 3: Calculate the following probabilities using $\hat{y}_{i1}^{2U}$ and parameters estimated in the previous steps.
$P(y_{i1}^{2U} < z_1 \text{ and } y_{i2} > z_2)$, $P(y_{i1}^{2U} > z_1 \text{ and } y_{i2} < z_2)$,
$P(y_{i1}^{2U} > z_1 \text{ and } y_{i2} > z_2)$ and $P(y_{i1}^{2U} < z_1 \text{ and } y_{i2} < z_2)$.

Step 4: Repeat step 2 and step 3 R times and take the average of each calculation.

To estimate nonparametric lower bound:

Step 1: Estimate the equation 1 with OLS using data from round 1, obtain $\hat{\beta}_1'$ and the standard error of the ε_{i1} , $\hat{\sigma}_{\varepsilon_1}$ Similarly, obtain the $\hat{\beta}_2$ and $\hat{\sigma}_{\varepsilon_2}$ using round 2 data, moreover, calculate $\gamma = \frac{\hat{\sigma}_{\varepsilon_1}}{\hat{\sigma}_{\varepsilon_2}}$.

Step 2: Using data from round 2, $\hat{\beta}_1'$ and $\hat{\varepsilon}_{i2}$, estimate the income level of the households in the first round for the household in the second round: $\hat{y}_{i1}^{2L} = \hat{\beta}_1' x_{i2} + \gamma \hat{\varepsilon}_{i2}$.

Step 3: Calculate the following probabilities using $\hat{y}_{i1}^{2L}$ and parameters estimated in the previous steps.

$P(y_{i1}^{2L} < z_1 \text{ and } y_{i2} > z_2)$, $P(y_{i1}^{2L} > z_1 \text{ and } y_{i2} < z_2)$,

$P(y_{i1}^{2L} > z_1 \text{ and } y_{i2} > z_2)$, and $P(y_{i1}^{2L} < z_1 \text{ and } y_{i2} < z_2)$.

In the nonparametric estimation method, the bounds of poverty mobility are estimated using the smallest (0) and the highest (1) value of the correlation coefficient. As expected, the correlation coefficient generally takes a value between 0 and 1. A parametric approach can be used to narrow the range of values the correlation coefficient can take. This approach requires a more strict version of the second assumption expressed earlier. According to this assumption, with the non-negative correlation coefficient ρ , and standard deviations σ_{ε_1} and σ_{ε_2} , ε_1 and ε_2 follows the bivariate normal distribution. In the parametric analysis, it is assumed that the correlation coefficient has a maximum and minimum value between zero and one, $\rho \in [\rho_s, \rho_h],\ 0 < \rho_s < \rho_h < 1$, where ρ_s and ρ_h are the smallest and the highest hypothesised values of the ρ , respectively. Dang et al. (2014) have used the actual panel data of four developing countries besides Indonesia and Vietnam to calculate the correlation values between the residuals (Table 2). Based on the correlation coefficients obtained from these estimates, authors have chosen the 0.2-0.8, and 0.3-0.7 pairs in the bound estimates.

Consequently, to estimate parametric upper bound;

Step 1: Estimate the equation 1 with OLS using data from round 1 and round 2, obtain $\hat{\beta}_1'$, $\hat{\beta}_2'$, $\hat{\sigma}_{\varepsilon_1}$ and $\hat{\sigma}_{\varepsilon_2}$.

Step 2: Calculate the following quantities using ρ_s .

$$\hat{P}^{2U}(y_{i1} < z_1 \text{ and } y_{i2} > z_2) = \Phi_2\left(\frac{z_1 - \hat{\beta}_1' x_{i2}}{\hat{\sigma}_{\varepsilon_1}}, -\frac{z_2 - \hat{\beta}_2' x_{i2}}{\hat{\sigma}_{\varepsilon_2}}, -\rho_s\right),$$

$$\hat{P}^{2U}(y_{i1} > z_1 \text{ and } y_{i2} < z_2) = \Phi_2\left(-\frac{z_1 - \hat{\beta}_1' x_{i2}}{\hat{\sigma}_{\varepsilon_1}}, \frac{z_2 - \hat{\beta}_2' x_{i2}}{\hat{\sigma}_{\varepsilon_2}}, -\rho_s\right),$$

$$\hat{P}^{2U}(y_{i1} > z_1 \text{ and } y_{i2} > z_2) = \Phi_2\left(-\frac{z_1 - \hat{\beta}_1' x_{i2}}{\hat{\sigma}_{\varepsilon_1}}, -\frac{z_2 - \hat{\beta}_2' x_{i2}}{\hat{\sigma}_{\varepsilon_2}}, \rho_s\right), \text{ and}$$

$$\hat{P}^{2U}(y_{i1} < z_1 \text{ and } y_{i2} < z_2) = \Phi_2\left(\frac{z_1 - \hat{\beta}_1' x_{i2}}{\hat{\sigma}_{\varepsilon_1}}, \frac{z_2 - \hat{\beta}_2' x_{i2}}{\hat{\sigma}_{\varepsilon_2}}, \rho_s\right).$$

To estimate the parametric lower bound, replace ρ_s with ρ_h .[2]

[2] We would like to thank McKenzie (2019) for making the simulation code we used in the analysis publicly available.

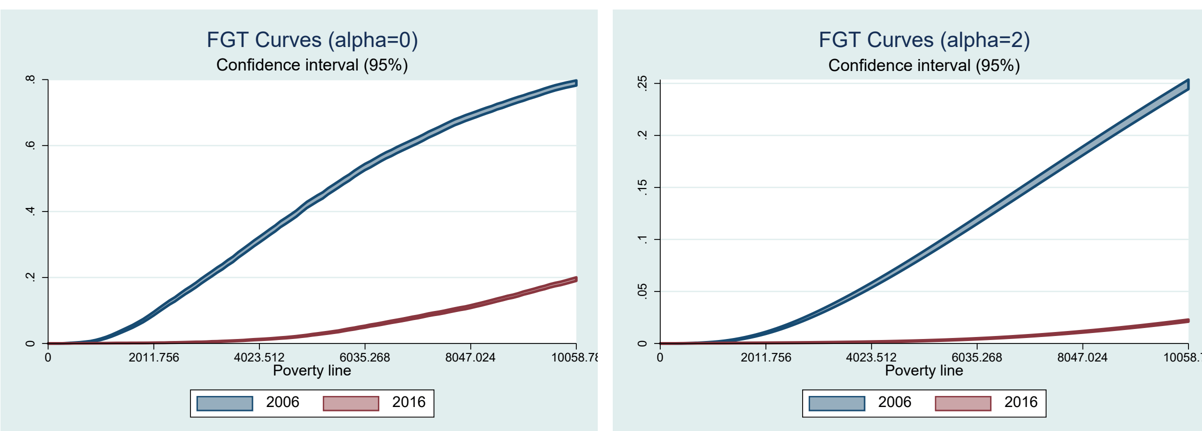
2. Data

The data used in the analysis come from Survey on Income and Living Conditions (SILC) conducted and released by the Turkish Statistical Institute (TurkStat) since 2006. SILC has rich information regarding demographic and socioeconomic characteristics of households and individuals such as sex, age, working status, health status and household conditions. The most crucial feature of SILC is its rotating panel data structure. One-quarter of the sample is replaced with a new one every year. As a result of that feature, the time dimension of the panel data is limited to four years. The data in SILC represents the information about the previous year. For example, the file for 2016 contains information for 2015. During the analysis, this fact must be kept in mind when interpreting. 2006 and 2016 are selected for analysis because the first and the last date SILC were released are 2006 and 2016. Besides, as mentioned earlier, two-panel data covering the years 2006-2009 and 2013-2016 have been utilised to test the performance of the method. The sample sizes are 10,920 and 21,870 for 2006 and 2016, respectively. Due to the difference between sample sizes, 10,920 observations have been randomly selected from 2016.

2.1. Variables

Equivalent disposable household income has been used as an indicator of household welfare and dependent variable in the estimations. This indicator is obtained by dividing disposable household income by the square root of the total household size. Let this indicator is denoted by y as is in Equation 1. In order to identify poor households, 60% of the median income is defined as the poverty line (z). Therefore, if $y < z$ the household will be considered poor. In order to give an overview of the poverty in Turkey between 2006 and 2016, results from the poverty index proposed by Foster, Greer, & Thorbecke (1984) are given in Graph 1. It is evident that the poverty rate has fallen considerably.

While Graph 1 depicts that poverty has declined, it cannot say what percentage of households have fallen into or escaped from poverty between two years. To explore poverty mobility, twelve independent variables have been used in the estimations. In the selection process of the independent variables, both strict adherence to literature and data set constraints have been taken into consideration. Independent variables can be grouped into two categories: (i) those belonging to the household leader, and (ii) those belonging to the housing conditions. In the first category, there are five variables associated with household leaders: age, sex, education, occupation and marital status. The second category consists of seven variables: the region, household size, the number of children under five, and the presence of television, refrigerator, piping system and an indoor toilet. Detailed information about the independent variables is given in Table 1.



Graph 1: Poverty Rates in Turkey, 2006-2016.

Source: Own elaboration using SILC.

Notes: (i) All sample used. (ii) The highest value on the axis of poverty line represents the poverty line for 2016. This value has also been used for 2006. The poverty line for 2006 is 3,425.05 TL. (iii) When $\alpha = 0$ FGT equals to the head-cont ratio. If $\alpha > 1$, the index assigns more weight to the poorest.

Table 1: Independent Variables Used in the Analysis

Name	Variable Type	Description
	Variables Associated with Household Head	
Age	Ordered (2006) Continuous (2016)	The age of household head is restricted to 25+.
Sex	Dummy	= 1 if the head is female.
Education	Ordered	The last completed education level of the household head. Recoded as the dummy variable. Illiterate is the base category.
Occupation	Multinomial	Occupational category according to the ISCO-88 for 2006, and ISCO-08 for 2016. Recoded as the dummy variable. Currently not working is the base category.
Marital Status	Multinomial	Recoded as the dummy variable. Grass widow is the base category.
	Variables Associated with Household Conditions	
Region	Multinomial	Where household is interviewed. Recoded as the dummy variable. Istanbul is the base category.
Household Size	Count	-
The # of children under five	Count	-
TV	Dummy	= 1 if the household does not have coloured TV for any reason.
Refrigerator	Dummy	= 1 if the household does not have a refrigerator for any reason.
Piping System	Dummy	= 1 if the household does not have a piping system.
Indoor Toilet	Dummy	= 1 if the household does not have an indoor toilet.

Source: Own elaboration.

Following Dang et al. (2014), in the nonparametric analysis, not all independent variables have been used at once. Modelling has been expanded by adding independent variables step by step to the previous model. Thus, it can be seen how the prediction intervals change as the model expands. To this end, four models have been created. Related models and the variables used in each model are given below.

Model 1c: *y = f(age, sex, education, occupation, marital status)*
Model 2c: *y = f(model1, region)*
Model 3c: *y = f(model2, household size, household size^2, the # of children under five)*
Model 4c: *y = f(model3, tv, refrigerator, piping system, indoor toilet)*

Also, as stated earlier, real panel data has been used to test how well the method works. However, of the independent variables discussed above, the panel data set do not contain information about the region. Therefore, models using panel data are constructed as follows;

Model 1p: *y = f(age, sex, education, occupation, marital status)*
Model 2p: *y = f(model1, household size, household size^2, the # of children under five)*

Model 3p: *y = f(model2, tv, refrigerator, piping system, indoor toilet)*

Lastly, to compare non-parametric and parametric estimation results, only Model 1c and Model 1p have been estimated when using cross-sectional data and panel data, respectively. In addition, the parametric method has been once again performed using different correlation coefficients, and in case the normality assumption has been violated.

3. Findings

Table 2 presents the non-parametric lower and upper bound estimates of poverty transitions. Since the real panel data covering 2006 and 2016 are not available, it is not known whether the lower and upper bounds are around the actual values. Therefore, it should be noted that the upper and lower bounds in the table are *estimations*. The first thing that stands out in the table is that the gap between upper and lower bounds narrows as the model moves simple specification (Model1c) to final specification (Model4c). We will focus on Model4c. The ratio of chronically poor households lays between 10.7% and 3.9%. The fact that the lower and upper bounds of the households that escape from poverty (P-NP) are higher than the bounds of households falling into poverty (NP-P) *might* be a sign of poverty reduction. This finding confirms Graph 1.

Table 2: Poverty Transitions Using Cross-Sectional Data Between 2006 and 2016.

	Nonparametric Lower Bounds				*Nonparametric Upper Bounds*			
Poverty Status	***Model1c***	***Model2c***	***Model3c***	***Model4c***	***Model4c***	***Model3c***	***Model2c***	***Model1c***
P-P	11.7	11.7	11.2	10.7	3.9	3.9	3.9	3.8
P-NP	10.9	11.9	12	12.1	20.8	20.8	20.7	20.9
NP-P	4.3	4.8	4.8	5.4	12.2	12.2	12.1	12.2
NP-NP	73.1	72.1	72	71.8	63.2	63.2	63.3	63.1
ρ	-.002	.006	.004	.002				

Source: Author's calculations using SILC.
Notes: (i) Dependent variable is log(y). (ii) The number of replication is 500. (iii) P-P: Poor-Poor; P-NP: Poor-Nonpoor; NP-P: Nonpoor-Poor; NP-NP: Nonpoor-Nonpoor.

As may be recalled, the values given in Table 2 are obtained as a result of highly conservative assumptions. One of these is that the correlation coefficient only takes extreme values. The nonparametric lower and upper bound estimates are given in Table 2 are calculated under this assumption; the correlation between the error terms between the two rounds is zero or one. To relax this assumption, we have reestimated the Model1c using $\rho = (.2,.8)$ and $\rho = (.3,.7)$ pairs by parametric approach. The results of the parametric approach are given in Table 3. The findings in the first and last columns in the table are equivalent to the non-parametric estimation results. Given the ρ values in Table 2, it is not surprising that the findings in these columns are close to the parametric results because the correlation is very close to zero.

3.1. Robustness Check

We now return to the findings using panel data in the analysis to test how well the method works. The panel data have been constructed as follows. The samples belong to 2006 and 2009 have been first pooled. The final sample was then randomly divided into two parts. The first and second sub-samples represent round 1 and round 2, respectively. Thus, real and synthetic panels derived from the actual panel have become comparable. We will start with the results of the poverty transition between 2006 and 2009. The relevant findings are given in Table 4. The first remarkable point in the table is that the lower and upper bounds of different models are very close to each other. This is, in a way, a result of the independent variables used to remain constant, at least to a large extent, over time. We again will focus on the most extended model; Model3p. In the column named *true*, the table shows that 8.5% of the population was chronic poor, 78.2% did not fall into poverty at all, and 13.4% was transient poor between 2006 and 2009. Note that all values fall between the upper and lower bounds. This is a sign the method works well. Parametric estimation results also confirm that inference. All simulated values lay between lower and upper bounds. As the range of the correlation coefficient narrows, the gap between the estimated upper and lower bounds closes.

Table 3: Poverty Transitions Using Cross-Sectional Data Between 2006 and 2016

	Parametric Lower Bounds			*Parametric Upper Bounds*		
Poverty Status	$\rho = 1$	$\rho = .8$	$\rho = .7$	$\rho = .3$	$\rho = .2$	$\rho = 0$
P-P	13.4	10.8	9.7	6.5	5.9	4.7
P-NP	10.4	13	14	17.2	17.8	19.1
NP-P	4.7	7.3	8.4	11.6	12.2	13.4
NP-NP	71.5	68.9	67.9	64.7	64.1	62.8

Source: Author's calculations using SILC.
Notes: (i) Dependent variable is log(y). (ii) The number of replication is 500. (iii) P-P: Poor-Poor; P-NP: Poor Nonpoor; NP-P: Nonpoor-Poor; NP-NP: Nonpoor-Nonpoor. (iv) The estimated model is Model1c in Table 2.

The findings calculated utilised panel data covering 2013 and 2016 using the nonparametric and parametric approach are presented in Table 6 and Table 7, respectively. It is worth to compare Table 4 and Table 6. First of all, chronic poverty has declined slightly. However, transient poverty changed considerably. Compared to the 2006-2009 period, the proportion of those who fell into poverty in 2013-2016 exceeded the rate of those who escaped from poverty. Also, the proportion of the household, which are persistently nonpoor, decreased as well.

Since we do not know about poverty transitions calculated using actual panel data between these two periods, we cannot say that stated changes increase or decrease poverty. Nevertheless, the poverty rates calculated by TurkStat using SILC decreased between the relevant periods. However, note that TurkStat uses equivalent individual disposable income. The present paper uses equivalent disposable household income. There are significant differences between these two income measures in terms of some income sources. For example, household cash and in-kind benefits, rent or security income are included in household income and not in individual income.

Table 4: Poverty Transitions Using Panel Data Between 2006 and 2009

	Nonparametric Lower Bounds			True	*Nonparametric Upper Bounds*		
Poverty Status	***Model1p***	***Model2p***	***Model3p***		***Model3p***	***Model2p***	***Model1p***
P-P	15.1	15	15.1	8.5	5.9	5.9	5.6
P-NP	4.9	4.8	4.6	7.7	14.8	16.4	16.7
NP-P	.6	.5	.7	5.7	9.2	9.2	9.6
NP-NP	79.4	79.7	79.7	78.2	70	68.4	68.1
ρ	.612	.601	.572				

Source: Author's calculations using SILC.
Notes: (i) Dependent variable is log(y). (ii) The number of replication is 500. (iii) P-P: Poor-Poor; P-NP: Poor Nonpoor; NP-P: Nonpoor-Poor; NP-NP: Nonpoor-Nonpoor.

Table 5: Poverty Transition Using Panel Data Between 2006 and 2009.

	Parametric Lower Bounds			True	*Parametric Upper Bounds*		
Poverty Status	$\rho=1$	$\rho=.8$	$\rho=.7$		$\rho=.3$	$\rho=.2$	$\rho=0$
P-P	16.6	12.3	11.1	8.9	7.6	6.8	5.5
P-NP	1.5	5.8	7	9.2	10.6	11.3	12.6
NP-P	1.3	5.5	6.7	8.8	10.3	11	12.3
NP-NP	84.4	80.6	76.3	75.1	73	71.5	70.8

Source: Author's calculations using SILC.
Notes: (i) Dependent variable is log(y). (ii) The number of replication is 500. (iii) P-P: Poor-Poor; P-NP: Poor Nonpoor; NP-P: Nonpoor-Poor; NP-NP: Nonpoor-Nonpoor. (iv) The estimated model is Model1p in Table 4.

Table 6: Poverty Transitions Using Panel Data Between 2013 and 2016.

	Nonparametric Lower Bounds			True	*Nonparametric Upper Bounds*		
Poverty Status	***Model1p***	***Model2p***	***Model3p***		***Model3p***	***Model2p***	***Model1p***
P-P	14.2	14.3	14	8.4	4.9	4.6	4.4
P-NP	.1	.1	.4	6.2	10.6	11.1	11.3
NP-P	4.1	4	4.3	8.6	13.8	14.1	14.3
NP-NP	81.7	81.6	81.3	76.7	70.7	70.2	70
ρ	.609	.593	.586				

Source: Author's calculations using SILC.
Notes: (i) Dependent variable is log(y). (ii) The number of replication is 500. (iii) P-P: Poor-Poor; P-NP: Poor Nonpoor; NP-P: Nonpoor-Poor; NP-NP: Nonpoor-Nonpoor.

Table 7: Poverty Transitions Using Panel Data Between 2013 and 2016.

Poverty Status	*Parametric Lower Bounds*			True	*Parametric Upper Bounds*		
	$\rho = 1$	$\rho = .8$	$\rho = .7$		$\rho = .3$	$\rho = .2$	$\rho = 0$
P-P	15.8	11.8	10.6	9.2	6.9	6.2	4.8
P-NP	0	4	5.2	6.3	8.9	9.6	11
NP-P	4.1	8.1	9.3	10.4	13	13.8	15.1
NP-NP	82.9	80.1	76.1	74.9	74.1	70.4	69.1

Source: Author's calculations using SILC.
Notes: (i) Dependent variable is log(y). (ii) The number of replication is 500. (iii) P-P: Poor-Poor; P-NP: Poor Nonpoor; NP-P: Nonpoor-Poor; NP-NP: Nonpoor-Nonpoor. . (iv) The estimated model is Model1p in Table 6.

Finally, the lower and upper bound estimates for the different correlation values using the actual panel for the 2013-2016 period are presented in Table 7. When switching from specification one, where ρ is equal to 0 and 1, to specification two, where ρ is equal to .2 and .8, the upper and lower bounds vary dramatically. The last specification has once again reached the narrowest upper and lower bounds. According to the last specification, true poverty mobility rates are much closer to the lower bound. Considering the ρ value at the bottom of the first column in Table 6, this is not a coincidence. This fact reveals once again that the model works reasonably well.

4. Conclusion and Discussion

The major problem experienced in poverty studies on underdeveloped or developing countries is that these countries do not have balanced panel data covering an extended period. This constraint causes poverty mobility to be calculated for short periods. However, due to the nature of poverty, long-term periods are needed to see the effects of policies aimed at preventing poverty. The recently developed synthetic panel method has made it possible to analyse poverty transitions without the need for long-term panels. Unlike previous studies employed traditional methods and analysed narrower period, this paper has tried to estimate the lower and upper bounds of poverty mobility in Turkey using this newly developed method. It is also tested how well the method works.

The findings from the nonparametric approach using purely cross-sectional data indicate that the proportion of chronically poor people is on somewhere between 3.9% and 10.7% for the most extended model. Compared to findings from Latin America or the African, this ratio is quite good. For example, Cruces et al. (2015, p. 170-171) have estimated that the lower and upper bounds for chronic poverty is 28.83%-18.28% in Peru for the period 2008-2009, and 37.74%-31.09% in Nicaragua for the period 2001-2005. Dang & Dabalen (2018, p. 13) suggests that 35.9% of the sample is chronically poor using 21 countries from Africa. Our estimates obtained from actual panels covering 2006-2009 and 2013-2016 periods demonstrate that chronic poverty rate almost remained the same around 8.4%. The good news is that the proportion of those who have escaped from poverty is significantly higher than that of those falling into poverty. Estimates demostrate that the proportion of those who fall into poverty is between 5.4% and 12.2%, while the proportion of those who escape from poverty is between 12.2% and 20.8%. Moreover, Turkey has also given a good test on the eradication of extreme poverty. According to the Millennium Development Goals' first article, it was aimed to eradicate extreme poverty in 2015. Turkey has not altogether eliminated extreme poverty, though, has managed to reduce significantly. The ratio of people living in extreme poverty in 2017 was 0.1% while it was 3% in 1994 (World Bank, 2021). Turkey may consider lowering or completely removing income taxes levied on the minimum wage, which is the sole income source for many poor households if it wants to reduce this ratio further. The Parametric approach also suggests suitable true values fall into between bounds.

Despite its original aspects, this study has some limitations. First of all, there is no region information on the questionnaire of the panel data. In countries where there is a significant development gap between regions, such as Turkey, to examine the poverty ignoring the region factor will undermine poverty estimates. It is believed that the estimates to be made in the presence of the region variable will be more accurate than the current estimates. Second, the analysis was not carried out at the sub-sample level. The reason for this is that the sub-samples are quite small in some of the essential variables associated with household leader or household conditions. We believe that better predictions will be made in the future with the richer data set and larger samples. Lastly, developing models to consider endogeneity will improve prediction accuracy. The complexity of the model makes it difficult for now.

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Return of Education for Women across Socio-Economic Status: Using Quantile Regression and Machado-Mata Decomposition Methods for Turkey*

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ABSTRACT

The purpose of this paper is to identify gender-based wage differentials through wage distribution. Although studies on gender-based wage differentials with the quantile regression method have been carried out before, this study contributes to the literature by way of gender-based wage differentials as determined by the Machado-Mata decomposition method. In this paper, TurkStat's 2017 Household Budget Survey data is examined. The total sample size is 10,073 respondents aged 15 years old or older. Our findings show that a significant portion of the wage differential is based on characteristic which should exist in the labor market and little is due to gender-based; but, it should not be ignored that due to gender-based wage differentials part. Nevertheless, it is found that gender-based wage differential is higher in low-income individuals than high-income individuals. This is important for women in low-income groups who are already disadvantaged. This paper reveals that the return on education and experience on wages is higher for women with low socio-economic status.

Keywords: Quantile Regression, Gender-Based Wage Differentials, Expanded Mincerian Wage Equations.

JEL Classification Codes: C21, J16, J24.

1. Introduction

The aim of this study is to determine gender-based wage differential through wage distribution and to evaluate how wage differential between men and women develops in Turkey. The model is estimated using the data set of the 2017 Household Budget Survey conducted by the Turkish Statistical Institute (TurkStat). By using the method described by Machado and Mata (2005), it is found that a large part of the wage differentials between men and women depends on covariate in the model, whereas very little depends on gender-based. As the wage distribution data is skewed in Turkey, it is appropriate to use quantile regression. Neo-classical economics defines discrimination as assessment of wages according to criteria that do not directly affect the productivity of the productive factors. Wage discriminations are the most common form among all discrimination types (McConnell, Brue and Macpherson, 2013). Discrimination in the labor market has severe implications for the economy, especially deterioration of distribution efficiency. For these reasons, it is essential to follow up and be able to measure wage differentials in the labor market, which will ensure economic efficiency.

In the case of wage differentials, based on social prejudices and that the employer's preferences are discriminatory, disadvantaged groups often receive lower wages because of their gender, sector, industry, races and religions. Women are included in the disadvantaged group. Studies by Oaxaca (1973), Dustmann and van Soest (1997), Dayoglu and Kasnakoglu (1997), Akcomak and Kasnakoglu (2003), Tansel (2003), Ozcan, Ucdogruk, and Ozcan (2003), Meurs and Ponthieux (2005), Kara (2006), Ilkkaracan and Selim (2007), Cudeville and Gurbuzer (2007), Thrane (2008), Garcia-Suaza et al., (2009), Guner (2009), Azam and Prakash (2010), Ismail (2011), Ersaslan (2012), Ismail and Jajri (2012), Celik and Selim (2014), Celik and Selim (2016), found

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that female employees earn less than men. There is also discrimination based on public-private sector or industry differential or occupational (Dustmann and van Soest (1997), Tansel (2003), Ozcan, Ucdogruk, and Ozcan (2003), Tansel (2005), Hyder and Reilly (2005), Casero and Seshan (2006), Kara (2006), Lucifora and Meurs (2006), Gurler Kiren and Ucdoğruk (2007), Thrane (2008), Azam and Prakash (2010), Celik and Selim (2014), Tansel and Bircan Bodur (2012) and Mercan and Karakas (2015)), racial discrimination (Neal and Johnson (1996), Bertrand and Mullainathan (2004), Lang and Lehmann (2012), Borowczyk-Martins, Bradley, and Tarasonis (2017)) and religious discrimination (Blackaby et al., (1998), Brown (2000), Lindley (2002), Modood (2003), Brynin and Guveli (2012), Heath and Martin (2013)) in addition to gender discrimination.

Wage differentials studies have been comprehensively carried out in many countries by different methods, especially including the ordinary least squares (Casero and Seshan (2006), Garcia-Suaza et al., (2009), Andrada and Galassi (2009), Tansel and Bircan Bodur (2012), Celik and Selim (2014)), quantile regression (Budría and Pereira (2005), Tansel and Bircan Bodur (2012), Hyder and Reilly (2005), Lemieux (2006), Celik and Selim (2014), Celik and Selim (2016)), logit model (Tansel (2003) and Tansel (2005)), Oaxaca and Ransom (1994) decomposition methods (Silber and Weber (1999), Meurs and Ponthieux (2005), Fortin, (2008), Ismail (2011), Ismail and Jajri (2012)),Oaxaca-Blinder decomposition methods (Blinder (1973), Oaxaca (1973), Dayioglu and Kasnakoglu (1997), Ozcan, Ucdogruk, and Ozcan (2003), Kara (2006), Gurler and Ucdoğruk (2007), Ilkkaracan and Selim (2007), Cudeville and Gurbuzer (2007), Guner (2009), Azam and Prakash (2010), Akhmedjonov (2012), Ersaslan (2012), Mercan and Karakas (2015), Zhou, Zhao, Chou, and Leivang (2019)). Gardeazabal and Ugidos (2005) extended the scalar measurement of the Oaxaca method for quantile regression as the variance of men is higher in wage distribution as the dependent variable in comparison to women. This is precisely why Machado and Mata (2005) proposed an alternative method of decomposition that combines the quantile regression and bootstrap approaches to enable the counterfactual analysis in the Machado-Mata decomposition method used by Albrecht, Bjorklund and Vroman (2003), Fitzenberger and Kunze (2005), Heinze (2010), Arulampalam, Booth and Bryan (2007), de la Rica, Dolado and Llorens (2008), Albrecht, van Vuuren and Vroman (2009), Christofides, Polycarpou and Vrachimis (2013) and Aktas and Uysal (2016) for different countries.

In this study, expanded Mincerian wage equations were used to explain wages with the variables of education, experience and experience squared, full-time employee, head of household, married, family size, having children . Although there are numerous theoretical and empirical studies discussing the impact of human capital variables, particularly by Mincer (1974) and Card (1999), there are no universally accepted variables that should be included in researching the determinants of wages (Heinze, 2010: 13). The theory of human capital, which is developed to explain the role of labor force from production factors, is defined as the person's knowledge, skills and abilities that are innate (Schultz, 1961). Human capital allows usage of production factors more efficiently and effectively. In the literature, the most critical component of human capital is considered to be education.

This study contributes to the literature by the way of analyzing gender-based wage differentials with the Machado-Mata decomposition method. There are some methods for using wage differentials (as mentioned above), but some of these methods -ordinary least squares, logit model, Oaxaca-Blinder decomposition method- do not provide information about discrimination through the distribution, while some of these -ordinary least squares, logit model, quantile regression- do not decompose discrimination. Machado-Mata decomposition enables identification of how much of the actual wage differentials are based on gender by decomposing wage distribution. Aktas and Uysal (2016) used this decomposition for Turkey with firm-level data for 2006, but our data covers Turkey for 2017. The analysis shows that a significant portion of the wage gap is based on gender, and wage differentials are higher in the lower tail of the distribution.

The rest of the paper is organized as theoretical background, provision of data and method, empirical results, and finally, some concluding remarks.

2. Theoretical Background

Through the Industrial Revolution, the opportunity to make a more intense and mass production has been achieved. The production process, thus, entered a period where the capital and investment of capital gains importance while the labor force becomes less significant relatively. Technological innovations and their inclusion in the production process allowed to increase production until the middle of the 1900s, without paying much attention to the productivity of the labor force. However, since the transformation in technological developments and increase in the density of physical capital investments make it impossible to use unqualified labor force of the capital factor, the productivity increase of the labor force through human capital investments became a compulsory. From the beginning of the 1950s, as a result of studies of economists like Theodore Schultz (1961), Gary Becker (1962) and Jacob Mincer (1974), the fact that human capital investments are important in the production process has entered the literature. The labor force needs to become educated to use existing technologies, and even to detect defects arisen from the production process. The fact that, at the point of technological knowledge, unskilled labor does not efficiently increase production within the production process is now a widely accepted issue in the literature. Therefore, today, human capital investments have become very significant in the production process.

Human Capital Investment

In terms of economic development process, in the human capital theory developed to explain the role of the labor force, one of the production factors, human capital is defined as the whole of person's knowledge, abilities and innate talents (Schultz, 1961; Eyiusta and Ilhan 2015: 114). Human capital allows the production factors to be used more effectively and efficiently thanks to the education, knowledge and equipment of the labor force. According to the human capital theory, which was later comprehensively developed by supply-side economics, the skills and knowledge acquired by people through their education and work experience increase their marginal productivity, which leads them to get higher wages in the labor market (Becker, 1974). Human Capital Theory, developed by Becker (1974) and regarded as one of the classic approaches explaining the role of education in the economy, has three basic components of human capital investment: innate abilities, information acquired by schooling, and learning on-the-job. Therefore, wage differentials in the market can be explained using the human capital theory in this respect.

In the economic literature, it is stated that human capital investments have four different effects on the productivity of the labor force. The first of these effects is the individual efficiency-promoting effect of the labor force, which is also called the "laborer" effect. In the "allocation" effect, which is the second effect, compared to a less-educated labor force, a higher-educated labor force increases the productivity of other production factors faster. The third effect, the "spillover" effect, emphasizes that a better-educated labor force can adapt to technological innovation more and demonstrate new production techniques more quickly. The final effect of human capital on labor productivity is the "research" effect. Accordingly, the increase in the higher-educated labor force in the production process will also encourage research and development activities (Cörvers, 1997: 976, 977). All these effects are factors that increase factor productivity.

When we look at the evolutionary development stages of human capital, on the other hand, it is seen that it has a branch that establishes a relationship between human capital and wage and works in this direction. In the approach shaped by the studies of economists such as Becker (1974), Mincer (1974), and Schultz (1961), as one's human capital investments increase, especially as the time of labor force spent in education increases, both individual productivity and productivity of other production factors increase. The fact that the labor force is equipped with a higher-education, therefore, indicates a higher-efficiency and higher real wages.

However, this direct-relation between education and wage in human capital theory is not expressed this much in all economic schools. Moreover, in some economic approaches, there is no direct relationship between human capital and education and wages. Education is the most important phenomenon that undermines the assumption that the labor force is homogeneous in fact. Different levels of education also have the feature of eliminating the effects of abilities or inabilities brought about by the labor force either innate or acquired in the first period of life. Education, therefore, has different effects on the labor market and each economic school addresses only some of these effects.

To summarize the development of the notion of human capital, each of them was derived from the search for solutions to the problems that their era tried to solve. Schultz (1961) made tangible connections between education and the concept of capital, he underlined the processes of learning on-the-job, and thus, he has changed the approaches of the Classical and Neoclassical economics related to the productivity of the labor force. Denison (1962) made the relation between human capital and education and wage differentials testable. Becker (1974) emphasized that the reasons for the income and wage differentials in the market were affiliated with the different education people have and human capital investments; Jorgenson and Griliches (1972), on the other hand, made the first study showing that there is a positive relationship between human capital and economic growth. While Mincer (1974) revealed the relationship between wage, education, and experience, while Lucas (1989) cited human capital investments as the reason for differences in economic growth rates between countries. Mankiw, Romer, and Weil (1992), on the other hand, explained the differentiation of countries' development with human capital investments and applied the notion of human capital to convergence theories. Jones (1996) and Barro (2001) emphasized that it is the human capital that provides the relationship between technology transfer and accumulation of physical capital.

One of the most important questions about education is the reason for the higher wage is due to the employee is better educated or has more skills. In addition, direct and alternative costs of education are still ignored in the literature (Blundell et.al, 1999: 3). The individual's decision to receive education depends on the efficiency of this education; in other words, its reflection on future earnings. Individuals need to earn higher salaries, including the costs of education, so that individuals can decide to receive education (Maazouz, 2013: 525).

Wage Discriminations

Neoclassical economics envisages the employment and pricing of production factors according to their marginal physical efficiency to ensure distribution efficiency in production. Therefore, neoclassical economics defines the assessment of wages according to criteria that do not directly affect the productivity of production factors as discrimination. In this context, neoclassical economics considers discriminations experienced in the labor market under four titles. Wage discrimination, the first discrimination in the labor market, is the pricing of the labor force according to features such as male-female, white-black, Muslim-Christian, Employment discrimination is the discrimination made by the employer in employment preferences according to personal characteristics. The third discrimination, job and occupational discrimination, is the situation that some occupational groups are closed to some disadvantaged population groups due to employers or customers with discriminatory preferences. The last discrimination type, human capital discrimination, is the situation where companies with discriminatory preferences use human capital investments that enable the labor to get better promotion and wages in favor of some employment groups again due to social prejudices (McConnell, Brue and Macpherson, 2013).

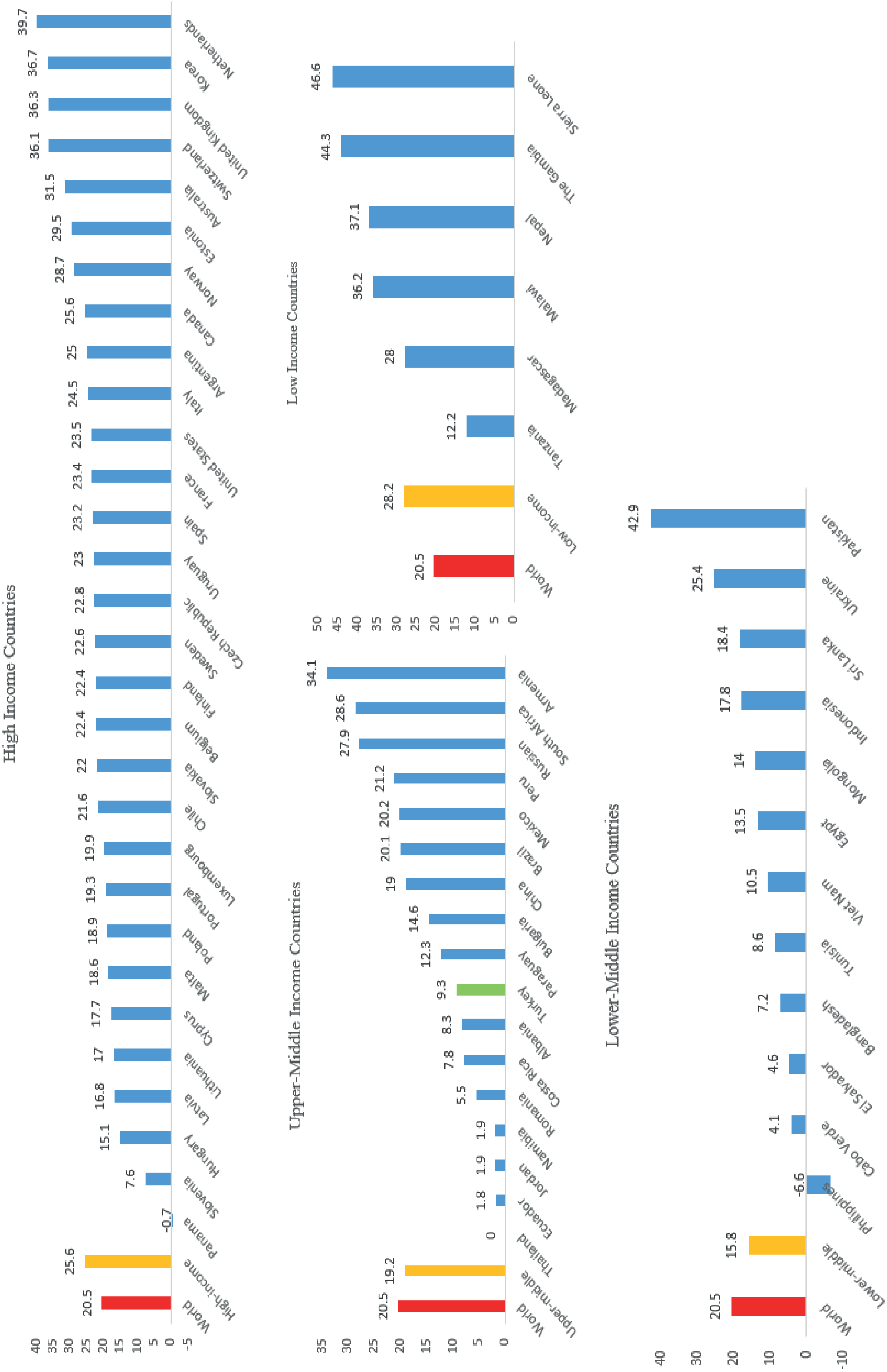
As mentioned above, the real wages in neoclassical economics is set at the point where the labor is equal to the marginal physical efficiency and firms maximize their profits. Since the firm cannot maximize its profits in all cases where this equality is not achieved, it will not be able to compete with its rivals in the long-term. In gender-based wage discrimination, since the employer, as a social prejudice, considers that the female labor as will work more inefficiently, for this reason, the employer will tend to pay lower wages to the female labor for profit maximization. However, when the female worker who works as efficiently as a male worker receives lower wages, the real wages will be lower than the marginal physical productivity and thus, distribution and production efficiency of the company will be impaired.

For all these reasons, firms with gender-based wage discrimination preferences not only lose their production efficiency, but also impair the distribution efficiency of production factors in the country. Although the firms adopting such a behavior increase their income in the short- term, they lose due to disrupting the long-term distribution efficiency (Borjas, 2010). On the other hand, due to companies with discriminatory preferences, the labor peace in the country is deteriorating, disadvantaged groups are created within the population and income distribution is disrupted (Jacobsen and Skillman, 2004).

According to the ILO (2018) report, women earn approximately 20% less than men across the World. At both national and international levels, the gender wage gap is a widely used indicator of gender inequality. The United Nations Sustainable Development Goal, target 8.5, emphasizes "equal pay for work of equal value", and "average hourly earnings of female and male employees" (UN, 2017). Equal Pay International Coalition (EPIC), is aimed at equal pay for women and men, and interprets the progress towards this target. Figure 1 shows the mean gender wage gap based on monthly earnings, for up to 65 countries; estimated by ILO (2018).

The first taking attention from figure 1 is that the gender wage gap is estimated as a positive value. Only two of 65 countries show negative gender wage gaps, it means that men earn more than women. For example, in the case of Turkey, the mean monthly gender wage gap is 9.3%, while around the world monthly gender wage gap is 20.5%. Even if the Turkey's gender wage gap is below the world average, the 9.3% provide evidence of an overall wage gap in favour of men.

Figure 1: Gender Wage Gap: High-Income, Upper-Middle Income, Lower-Middle Income, and Low-Income Countries



Source: ILO (2018).

3. Data and Method

This study presents determination of gender-based wage differentials in Turkey by estimating expanded Mincerian wage equations. Machado-Mata decomposition method that uses the quantile regression method is employed in the analysis performed by using micro data set of 2017 Household Budget Survey, published by TurkStat.

Data

The Household Budget Survey provides information on socio-economic structures, standards of living, and consumption patterns of the households and also it is used to socio-economic analyses. Indicators of consumption expenditure were obtained by 1296 sample households changing every month and 15.552 sample households for a year between 1st January and 31st December 2017. The estimation level of 2017 Household Budget Survey is whole Turkey; it is not possible to make estimations on urban, rural and regional basis because of sampling design of the survey. The first flow sampling frame for 2017 Household Budget Survey was obtained from National Address Database and the final sampling unit was household live at the address. Stratified two-stage cluster sampling method was used. For 2017 Household Budget Survey, the non-response rate was 21.8% for overall Turkey.

Table 1: Descriptive Statistics of Variables

Variable	Observation	Mean	Standart Deviation	Min	Max
Logwage	10,073	9.620487	1.012743	3.688879	12.94801
Gender	10,073	0.289983	0.4537768	0	1
Men	7152 (%71)				
Women	2921 (%29)				
Educaiton	10,073	2.572918	1.536254	0	6
Non-graduate	427 (%4.24)				
Primary school	2734 (%27.14)				
Secondary school	2062 (%20.47)				
High school	2290 (%22.73)				
2-3 years of university	791 (%7.85)				
4-6 years college	1589 (%15.77)				
Master and PhD	180 (%1.79)				
Experience	10,073	7.344088	8.461327	0	70
Employment	10,073	0.933883	0.2484994	0	1
Part-time	666 (%6.6)				
Full-time	9407 (%93.40)				
Household head	10,073	0.544326	0.498056	0	1
Yes	5483 (%54.43)				
No	4590 (%54.43)				
Marital status	10,073	0.709719	0.4539145	0	1
Married	7149 (%70.97)				
Other cases	2924 (%70.97)				
Family size	10,073	4.078924	1.855863	1	19
Household with children	10,073	0.829247	0.3763121	0	1
Yes	8353 (%82.92)				
No	1720 (%17.08)				

Descriptive statistics of variables are given in Table 1. The annual cash wage was taken as a dependent variable. The annual earnings of women were 19.600 TL, while those of men were 23.453 TL. Women earned about 16.4% less than men according to 2017 Turkey's Household Budget Survey. The education variable referred to categorical data by the twelve type of schools in the data set; we defined as seven categories (non-graduate, primary school, secondary school, high school, 2-3 years of university, 4-6 years college, master, and PhD) in the analysis. The experience variable was defined as working years at the current job; the average experience of women were 7.2 years, while those of men were 8.4 years. We also included to individuals who were working as full-time or part-time employees. The incidence of part-time work is higher among women than among men; 12.1% of women employees but only 4.3% of men employees are part-time workers. Household headship status are overwhelmingly favour of men; males are household heads in 93.6% of households. Marital status and household with children are also binary variables. The average household size is 4.08 according to 2017 Turkey's Household Budget Survey. Our sample consisted of 10073 observations. Distribution of gender, wages and experience by education level is presented in Table 2.

Table 2 reveals that there were very few people with vocational or technical secondary school and 5- and 6-year college education, and most individuals were on a primary education level. After the high school education level, both men and women's wages increased. The level of education and wages were both increasing.

Method

Mincer (1974), expanded his study in 1958, focused on human capital that expresses the investment made by the individual. The Mincer wage equation includes human capital measures to assess wage inequality. According to Mincer (1974), the most critical factor of human capital is education; thus, the Mincerian earnings equation is a single-equation model that explains wage as a function of year of schooling, experience and experience squared. The model is:

$$log(Wage_i) = \beta_0 + \beta_1 Scholling_i + \beta_2 Experience_i + \beta_3 Experience_i^2 + \varepsilon_i \quad (1)$$

Table 2: Distribution of Gender, Wages and Experience by Education Level, 2017, Turkey

Educational level	**Gender (Number)**		**Average Annual Wage (TL)**		**Average Experience (Years)**	
	Women	*Men*	*Women*	*Men*	*Women*	*Men*
Non-graduate	206	221	9151.34	13897	6.67	7.67
Primary school (5 years)	742	1,992	10543.04	17365.49	5.59	9.55
Secondary school	230	821	9757.478	17149	3.2	6.43
Vocational or technical secondary school	3	34	12383.33	18195.38	8.67	5.62
Primary school (8 years)	175	799	11068.63	15783.3	2.38	3.46
High school	289	856	16286.23	22149.4	4.81	7.74
Vocational or technical high school	265	880	16222.72	22802.44	5.08	7.04
2-3 years of university	270	521	21266.91	29608.6	6.82	9.18
4 years college, faculty	642	876	30769.21	38917.97	8.04	9.43
5, 6 years college, faculty	30	41	42144.67	49764.05	9.77	6.24
Master	55	74	40414.42	54851.58	9.58	9.68
PhD	14	37	59945.71	87527.57	16	18.59

Source: TurkStat (2017).

In estimating the wage functions, empirical models such as 'basic Mincer earnings equation' and 'expanded Mincer earnings equations' are applied to the human capital theory (Assaad (1997), Ali (2002), Dewen, Fang, and Guoqing (2010), Nour (2011), Huy (2020), Zhou, Zhao, Chou, and Leivang (2019), Busso, Muñoz, and Montaño (2020)). In this paper, we use an expanded Mincerian function to jointly observe the returns to different types of social levels and skills. Some variables are incorporated in the expanded Mincer equation in order to control socio-economic bias among individuals that may influence the earnings. The expanded earnings function converts the continuous variable of years of schooling into a categorical variables (Psacharopoulos, 1994:1325). Consider impacts of socioeconomic factors (A_i) on the earnings differences, expanded Mincer earnings equations should take the form of:

$$log(Wage_i) = \beta_0 + \beta_1 Scholling_i + \beta_2 Experience_i + \beta_3 Experience_i^2 + \beta_4 A_i + \varepsilon_i \quad (2)$$

In the equation (2), A_i denotes the explanatory variables including full-time employee, head of household, married, family size, having children. We try to keep the incorporation of explanatory variables as consistent as possible the Household Budget Survey data sets.

García, Hernández and López-Nicolás (2001) hypothesized that there was a gender-based wage differential in Spain and analyzed the wage distributions according to the characteristics with the quantile regression method. In their study, they found wage differentials at one point rather than at quantiles. Gardeazabal and Ugidos (2005), on the other hand, extended Oaxaca's scalar measure to any quantile of the distribution of wages, and using the same Spanish data set, they made analysis with quantile regression by concentrating on differences in returns of certain characteristics of individuals. The results obtained from this study are in contradiction with the study of García Hernández and López-Nicolás (2001); García, Hernández, and López-Nicolás (2001) found that the differences in returns of characteristics increases at the distribution of wages, while Gardeazabal and Ugidos (2005) found that it decreases. In these mentioned studies, the averages of the dependent variable were taken as basis and they were insufficient to explain the differences between the two distributions. Even if the characteristics of men and women would be the same for the selected sample, their variances would not be the same, and the variance of men would be higher in the distribution of the dependent variable. For this very reason, Machado and Mata (2005) proposed an alternative method of decomposition that combines the quantile regression and bootstrap approaches to enable the counterfactual density functions (Heinze, 2010: 4).

The quantile regression method produces an estimation for different quantiles. The quantile regression method may be used without making the normality assumption. The quantile regression method as introduced by Koenker and Bassett (1978) uses a linear model for conditional quantiles, while the ordinary least squares method is just for conditional means. Quantile regression estimates conditional quantile functions including the quantiles of the conditional distribution of the response variable. The quantile regression method is appropriate for skewed distribution that is often associated with wage or income inequality (Koenker and Hallock, 2001: 143). Therefore, different methods are needed to measure issues such as income inequality. This is because the Machado-Mata decomposition method is an extension of the Oaxaca (1973) and Blinder (1973) decomposition method for quantile regression. These decomposition methods analyze whether there is a difference in the wages of individuals who have the same characteristics based on the independent variables determining productivity and qualification. In decomposition methods, wage regressions are estimated for samples of men and women. These methods allow counter-factual analysis. So, the estimated wage differentials are decomposed into two components: individuals' characteristics (productivity and skill qualification) and gender-based wage differentials. Thus, one may determine whether there is a gender-based wage differential. Oaxaca and Blinder assume that the characteristic returns of individuals are mutually interchangeable; this is referred to as counter-factual analysis in the literature. These decompositions are not only gender-oriented but are also used to discriminate based on race, religion, labor market, sector, state or region, etc. Discrimination in the labor market may occur in different ways, and each of them has adverse effects on the economy, firms and individuals, especially on deterioration of income distribution. Wage discrimination, which is one of the discrimination types of the labor market, is considered as lower wages of disadvantaged groups due to social prejudices regardless of the productivity of the employees. Gender-based wage discrimination is one of the most common and often severe problems in all economies.

We can rewrite the equation (2) for the quantile regression as follows:

$$log\ Wage_{\theta i} = \beta_{\theta 0} + \beta_{\theta 1} scholling_i + \beta_{\theta 2} experience_i + \beta_{\theta 3} experience_i^2 + \beta_{\theta 4} A_i + \varepsilon_{\theta i} \tag{3}$$

$$\begin{aligned} log\ Wage_{\theta}^{m} &= X^{m}\beta_{\theta}^{m} + \varepsilon_{\theta}^{m} \\ log\ Wage_{\theta}^{w} &= X^{w}\beta_{\theta}^{w} + \varepsilon_{\theta}^{w} \end{aligned} \tag{4}$$

X, ε and θ denote independent variables, the error term, and the quantile, respectively. We can write men (m) and women's (w) wage models as follows:

Because of $E(\varepsilon_{\theta i}|X) = 0$ equation (3) can be written as follows:

$$\begin{aligned} log(\overline{Wage}_{\theta}^{m}) &= \bar{X}^{m}\hat{\beta}_{\theta}^{m} \\ log(\overline{Wage}_{\theta}^{w}) &= \bar{X}^{w}\hat{\beta}_{\theta}^{w} \end{aligned} \tag{5}$$

In the methodology of the decomposition, samples of men and women are estimated with the quantile regression and the coefficient vector, $\hat{\beta}_{\theta}^{w}$ and, $\hat{\beta}_{\theta}^{m}$ obtained for each quantile. Random samples are taken from the estimated coefficient vector of the samples of men and women, and then, coefficients are replaced with each other, so that counter-factual analysis can be conducted. $\bar{X}^{m}\hat{\beta}_{\theta}^{w}$ and $\bar{X}^{w}\hat{\beta}_{\theta}^{m}$ values are calculated for each quantile. We can write the women's counter-factual wage function as follow:

$$log(\overline{Wage}_{\theta}^{m}) - log(\overline{Wage}_{\theta}^{w}) = (\bar{X}^{m} - \bar{X}^{w})\hat{\beta}_{\theta}^{m} + \bar{X}^{w}(\hat{\beta}_{\theta}^{m} - \hat{\beta}_{\theta}^{w}) \tag{6}$$

The basis of the counter-factual analysis is as if women (men) had men's (women's) wage-generating characteristics, but her/his wage is as women (men). $(\bar{X}^{m} - \bar{X}^{w})\hat{\beta}_{\theta}^{m}$ explains part of the equation (6) and denotes the contribution of individuals' wage-generating characteristics on the wage gap. Explained wage differentials are due to the productivity of individuals in the labor market. Individuals who have higher levels of human capital should be paid more, and the expected wage differentials in the market would be estimated in this part. Therefore, this part is multiplied by the parameter for male ($\hat{\beta}_{\theta}^{m}$). Let the average characteristics of all men and women in the data set be the same, then the explained part of the equation takes the value of zero. $\bar{X}^{w}(\hat{\beta}_{\theta}^{m} - \hat{\beta}_{\theta}^{w})$ is the unexplained part of this equation and denotes gender-based wage differentials. $\bar{X}^{w}(\hat{\beta}_{\theta}^{m} - \hat{\beta}_{\theta}^{w})$ indicates the difference in the wages of the individuals who have the same ability of wage-generating characteristics but different gender. This component is taken as wage discrimination.

Following the Machado-Mata method, the literature has continued to progress with the subject. Melly (2005) extended this study by determining the asymptotic distribution of the estimators in the Machado-Mata method. Martinez-Sanchis Mora and Kandemir (2012), on the other hand, extended the methodologies developed by Machado-Mata and Melly, for the endogeneity of schooling decisions using a control function approach.

4. Empirical Findings

The model is estimated using the data set of the 2017 Household Budget Survey conducted by the TurkStat. Quantile regression, ordinary least squares (OLS) regression and Machado-Mata decomposition analysis were done in Stata version 15.0. Using the Mincerian wage equations, the quantile regression estimates are given in Table 3.

Almost all coefficients reported here are statistically significant, and the wage increases with education level and experience, which is in accordance with expectations. Table 3 suggests that the wage differentials in the lower part of the education distribution are much higher than the ones in the upper part. The increase in wages for individuals with low education will be higher than those with higher education in Turkey. The same comments may also apply to the experience, full-time employee, head of household, married, family size and children variables. The return of these variables decreases in the upper parts of the distribution. In both education level and experience variables, the coefficients towards upper distribution tend to remain fixed.

Table 3: Quantile Regression Results

Independent Variables \ Quantile	0.05	0.1	0.25	0.5	0.75	0.9	OLS
n=10073							
Education (Non-graduate=0)							
Primary school	-0.456*	-0.052	0.126**	0.162*	0.159*	0.116*	0.079***
	0.002	*0.695*	*0.048*	*0.000*	*0.000*	*0.008*	*0.057*
Secondary school	0.238	0.400*	0.293*	0.287*	0.290*	0.208*	0.280*
	0.120	*0.003*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
High school	0.621*	0.664*	0.516*	0.457*	0.421*	0.412*	0.496*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
2-3 years of university	1.011*	0.978*	0.783*	0.687*	0.665*	0.603*	0.754*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
4-6 years college	1.315*	1.235*	0.975*	0.899*	0.869*	0.882*	1.010*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Master and PhD	1.446*	1.435*	1.211*	1.217*	1.328*	1.363*	1.383*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Experience	0.166*	0.150*	0.096*	0.048*	0.038*	0.035*	0.070*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
$Experience^2$	-0.006*	-0.005*	-0.003*	-0.001*	-0.001*	-0.001*	-0.002*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Fulltime	1.532*	1.521*	1.629*	1.279*	0.816*	0.508*	1.164*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Household head	0.779*	0.581*	0.321*	0.235*	0.223*	0.269*	0.377*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Married	0.453*	0.368*	0.209*	0.134*	0.104*	0.083*	0.178*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Family size	-0.041**	-0.033**	-0.041*	-0.025*	-0.016*	-0.004	-0.019*
	0.025	*0.043*	*0.000*	*0.000*	*0.000*	*0.412*	*0.000*
Children	0.190**	0.100	0.086**	0.060*	0.041**	0.016	0.070*
	0.031	*0.197*	*0.022*	*0.002*	*0.014*	*0.525*	*0.004*
Constant	5.107*	5.715*	6.820*	7.800*	8.568*	9.111*	7.517*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
R^2	*0.269*	*0.289*	*0.274*	*0.244*	*0.280*	*0.266*	*0.394*
*, ** and *** indicate the level of significance at 1%, 5% and 10%, respectively.							
p values are italic.							

Source: Authors' estimates.[1]

The first step of the Machado-Mata decomposition is to apply quantile regression on the datasets of men and women separately. The quantile regression results are given in Table 4.

[1] To provide convenience, 0.05, 0.1, 0.25, 0.5, 0.75 and 0.9 quantiles are given in the table. The others are available upon request.

Table 4: Quantile Regression Results by Gender

Independent Variables \ Quantile	0.05	0.1	0.25	0.5	0.75	0.9	OLS
Women (n=2921)							
Education (Non-graduate=0)							
Primary school	-0.575**	-0.32***	-0.004	0.176*	0.226*	0.082	0.039
	0.033	*0.095*	*0.976*	*0.006*	*0.000*	*0.148*	*0.596*
Secondary school	0.203	0.040	0.113	0.318*	0.297*	0.136**	0.203**
	0.491	*0.848*	*0.413*	*0.000*	*0.000*	*0.028*	*0.011*
High school	0.702**	0.756*	0.581*	0.557*	0.440*	0.321*	0.571*
	0.014	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
2-3 years of university	0.974*	1.081*	0.851*	0.756*	0.674*	0.601*	0.822*
	0.003	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
4-6 years college	1.670*	1.440*	1.101*	1.023*	0.937*	0.870*	1.148*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Master and PhD	1.569*	1.553*	1.320*	1.231*	1.328*	1.308*	1.411*
	0.001	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Experience	0.232*	0.245*	0.162*	0.073*	0.044*	0.045*	0.103*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Experience^2	-0.008*	-0.009*	-0.005*	-0.002*	-0.001*	-0.001*	-0.003*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Fulltime	1.515*	1.370*	1.478*	1.254*	0.841*	0.496*	1.126*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Household head	0.309	0.206	0.159	0.167*	0.110*	0.111**	0.218*
	0.187	*0.217*	*0.147*	*0.003*	*0.003*	*0.024*	*0.001*
Married	0.607*	0.355*	0.182**	0.133*	0.089*	0.052	0.197*
	0.000	*0.001*	*0.012*	*0.000*	*0.000*	*0.110*	*0.000*
Family size	-0.064	-0.022	-0.045**	-0.027**	-0.033*	-0.01***	-0.03**
	0.179	*0.515*	*0.044*	*0.016*	*0.000*	*0.092*	*0.019*
Children	-0.039	-0.088	0.024	-0.011	0.030	0.036	-0.004
	0.839	*0.517*	*0.793*	*0.803*	*0.320*	*0.364*	*0.932*
Constant	5.051*	5.674*	6.728*	7.679*	8.519*	9.105*	7.439*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
R^2	*0.257*	*0.300*	*0.322*	*0.282*	*0.321*	*0.299*	*0.422*
Men (n=7152)							
Primary school	-0.408***	-0.005	0.097	0.085**	0.088**	0.112***	0.031
	0.090	0.970	0.195	0.042	0.027	0.056	0.550
Secondary school	0.164	0.338**	0.244*	0.185*	0.205*	0.180*	0.197*
	0.500	0.016	0.001	0.000	0.000	0.002	0.000
High school	0.504**	0.527*	0.390*	0.357*	0.359*	0.375*	0.392*

	0.038	0.000	0.000	0.000	0.000	0.000	0.000
2-3 years of university	0.900*	0.797*	0.654*	0.611*	0.601*	0.556*	0.658*
	0.001	0.000	0.000	0.000	0.000	0.000	0.000
4-6 years college	1.133*	1.051*	0.835*	0.771*	0.792*	0.873*	0.858*
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Master and PhD	1.293*	1.292*	1.096*	1.181*	1.249*	1.371*	1.316*
	0.001	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Experience	0.147*	0.120*	0.074*	0.040*	0.038*	0.032*	0.058*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Experience^2	-0.005*	-0.004*	-0.002*	-0.001*	-0.001*	-0.001*	-0.002*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Fulltime	1.512*	1.455*	1.504*	1.220*	0.756*	0.524*	1.096*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Household head	0.819*	0.597*	0.319*	0.162*	0.155*	0.149*	0.281*
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Married	0.302**	0.409*	0.226*	0.155*	0.126*	0.164*	0.221*
	0.044	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Family size	-0.034	-0.049*	-0.042*	-0.029*	-0.019*	-0.014**	-0.025*
	0.187	*0.001*	*0.000*	*0.000*	*0.000*	*0.030*	*0.000*
Children	0.327**	0.182**	0.098**	0.068*	0.025	-0.005	0.079*
	0.011	*0.015*	*0.014*	*0.002*	*0.237*	*0.878*	*0.004*
Constant	5.264*	6.037*	7.133*	8.048*	8.783*	9.248*	7.803
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
R^2	*0.247*	*0.260*	*0.240*	*0.221*	*0.261*	*0.257*	*0.358*
, ** and * indicate the level of significance at 1%, 5% and 10%, respectively.*							
p values are italic.							

Source: Authors' estimates.[2]

Table 4 reports that the return of education and experience variables on wages is higher for women. It is observed that the high return of education is a lower quantile for both men and women and tends to decrease in the upper part of the distribution. The high return of experience on wages is realized in the upper part of the distribution for men and women. These results are consistent with Table 3. While other variables were generally similar for men and women, the variable 'having children at home' was found to be insignificant for women in all quantiles and OLS.

The decomposition results are based on 1000 bootstrap repetitions[3]. Wage differentials are presented as raw, total, explained and unexplained wage differentials in Table 5. Negative coefficients show that wages are disadvantageous to women. If the coefficients are zero, this means that there are no wage differentials and differences. Total wage differentials are the sum of the difference between the explained and unexplained wage. Explained wage differentials represent the characteristics of wage differentials, namely non-gender-based difference. The unexplained part shows the gender-based part of the wage gap, a difference that is not related to the human capital of individuals. The results of the decomposition are given in Table 5.

[2]To provide convenience, 0.05, 0.1, 0.25, 0.5, 0.75 and 0.9 quantiles are given in the table. The others are available upon request.
[3]Detailed bootstrap results in detail are available upon request.

Table 5: Machado-Mata Decomposition Results

Quantile	Raw (observed) wage difference	Total wage difference $[\bar{W}_Q^m - \bar{W}_Q^w]$	Explained (characteristic) wage difference $[(\bar{X}^m - \bar{X}^w)\hat{\beta}_Q^m]$	Unexplained (gender-based) wage difference $[(\bar{X}^w\hat{\beta}_Q^m - \hat{\beta}_Q^w)]$
0.05	-1.0508	-0.9925	-0.5955	-0.3970
0.1	-1.0704	-0.8814	-0.5419	-0.3395
0.15	-0.9808	-0.7837	-0.4802	-0.3035
0.2	-0.8109	-0.6662	-0.4057	-0.2604
0.25	-0.6433	-0.5575	-0.3416	-0.2159
0.3	-0.4793	-0.4720	-0.2943	-0.1777
0.35	-0.4019	-0.4061	-0.2613	-0.1447
0.4	-0.3196	-0.3547	-0.2379	-0.1167
0.45	-0.1431	-0.3193	-0.2222	-0.0971
0.5	-0.1335	-0.2920	-0.2117	-0.0803
0.55	-0.1942	-0.2702	-0.2021	-0.0681
0.6	-0.2208	-0.2487	-0.1920	-0.0567
0.65	-0.2421	-0.2238	-0.1791	-0.0447
0.7	-0.2136	-0.1971	-0.1664	-0.0307
0.75	-0.2231	-0.1708	-0.1529	-0.0179
0.8	-0.0821	-0.1416	-0.1385	-0.0031
0.85	-0.0690	-0.1129	-0.1306	0.0177
0.9	-0.1376	-0.1028	-0.1275	0.0247
0.95	-0.1475	-0.1143	-0.1191	0.0048

Source: Authors' estimates.

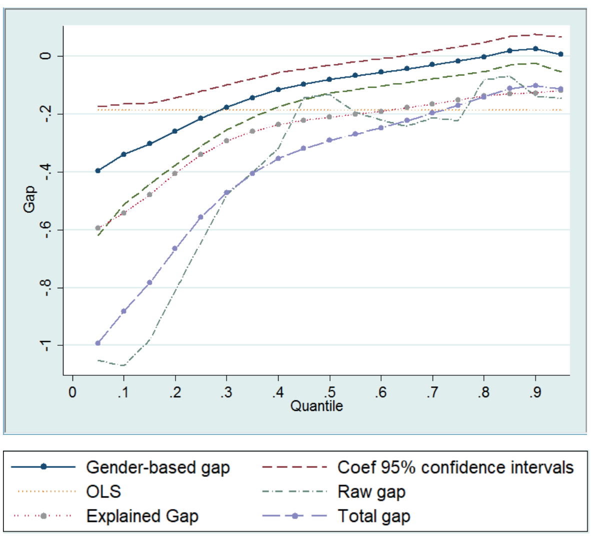


Figure 2: Wage differentials and confidence intervals

As it may be seen in Table 5, the observed wage differentials are quite high in the lower tail of the distribution, and they decrease towards the upper tail of the distribution. This decrease is more clearly observed in the total, explained and unexplained wage difference. While much of the wage difference between men and women in all quantiles are based on independent variables, in other words, characteristics, few depend on the gender-based. The coefficients of the characteristic wage difference are negative; the returns of the characteristics (depends on the independent variable) of men are higher than those of women. However, examining the wage differentials explained, a decrease at quantiles draws attention, and this means that the characteristics of women at high socio-economic levels converge to men and gender-based wage differentials are gradually decreasing. It is noteworthy that, on average, about 70% of the wage differentials are based on characteristic features and the rest on gender. But, it should not be ignored that the rest of the part, gender-based wage differentials, was also at a considerable amount.

In Turkey, the gender-based wage differentials in the lower tail of the distribution are more extensive, while in the upper tail of the distribution, they tend to be closed up. The gender-based wage differentials are quite high in the lower part of the distribution and gradually decrease up to the upper part. This is important for low-income women who are already disadvantaged.

This situation mentioned was shown in Figure 2. Again, it can be clearly seen from Figure 2 that the gender-based and characteristic wage differentials were quite high in the lower parts of the distribution and that these differentials tend to close as the distribution progresses to the upper parts. It stands out that the total wage differentials were equal to the sum of the characteristic and gender-based wage differentials and that the total and characteristic wage differential curves were relatively closer. Another striking point in Figure 2 was the OLS curve. Since it gives condition means-based point estimation, OLS fails to provide information about both the distribution and the source of the mentioned wage differentials.

The findings of this study were consistent with some studies examining gender-based wage differentials, while they were not consistent with others. Dayioglu and Kasnakoglu (1997) concluded that gender-based wage differentials are 64% against women while Ilkkaracan and Selim (2007) found this rate as 43% and Cudevill and Gurbuzer (2007) calculated it as 25% for men in countenance. The studies of Fitzenberger and Kunze (2005) for Germany, Arulampalam et al. (2007) for North European countries and Heinze (2010) for Germany concluded that, in the lower part of the distribution, gender-based wage differentials are higher, and as the quantiles increase, the wage differentials reach a decreasing trend, and the results overlap with this study's results. Albrecht et al. (2003) for Sweden, Gardeazabal and Ugidos (2005) for Spain and Christofides et al. (2013) obtained results that were contrary to those in this study. Tansel and Bircan Bodur (2012) analyzed wage differentials between sectors by gender and emphasized gender wage gap in the private sector in favor of men while no gender-based in the public administration. Aktas and Uysal (2016) did not find gender-based gap at the lower end of the wage distribution at a firm level while we found high in the lower tail of the distribution for nation-wide. ILO (2018), has shown that among high-income countries the gender wage gap tends to widen at the upper end of the distribution, so this result was contrary to those in this study.

5. Discussion

This study aimed to explore the gender-based wage differentials in Turkey by using the Machado-Mata decomposition method. It was found that a minor part of the total wage differentials were gender-based, and majority of the total wage differentials depended on the independent variables, which were education, experience and experience squared, full-time employee, head of household, married, family size, having children. But, it should not be ignored that the rest of the part, gender-based wage differentials, was also at a considerable amount.

Not only the observed wage differentials but also the gender-based wage differentials were high in the lower tail of the distribution and low in the distribution's upper tail. This situation is even more challenging for women in low-income groups who are already disadvantaged. According to the explained wage differentials results, the productivity of women in the upper parts of the distribution increased significantly, and this situation slowed down the wage differentials against women even if it did not eliminate the discrimination. The gender-based wage differentials towards the upper part of the distribution were reduced but did not become zero. In conclusion, men earned more than women at every point of distribution. However, women in the low-income group were subject to more gender-based wage differentials than those in the high-income group. Women in Turkey, as a result of increased socio-economic level, obtain two advantages: decrease in gender-based wage differentials and increase in the return of wages.

The reason why women in the low-income group enter the labor market is to contribute to the household as a second income because their husbands are already working (Ozcatal, 2011: 28). These women who do not have the concern of being retired or under insurance are employed in jobs that do not require qualifications. Women in low-wage groups in Turkey are employed in informal sectors, especially in the agricultural and textile sectors (ASPM, 2014), and the fact that women work more intensively at low wages and their wages are detached from productivity makes it easier for wage differentials to occur. Non-market discrimination, which is discrimination against women entering the labor market, causes women to work at low wages, where the productivity of women is not essential. So, this leads to a low female labor force participation rate. It would be useful to investigate the reasons that force women to leave the labor market or the sociological factors on why women prefer not to enter the labor market. Besides all these, firms with gender-based wage discrimination preferences keep a population that can work efficiently away from production and thus, also cause the production capacity in the country to decrease. Discrimination, experienced particularly in the labor market, has serious implications for the entire economy, primarily for disruption of distribution efficiency. For this reason, monitoring the emergence of wage discrimination in the labor market and being able to measure it accurately is important for policies that ensure economic efficiency.

Since the factors that gender wage gaps varies from country to country and as well as from region to region. Better data that can be regional and sectorial basis estimates and contain more socio-economic variables, is required for developing the right policies and measures. It is also important to determine that workers in the informal economy. The decomposition results show that explain part of the gender wage gap can be explained by productivity of individuals in the labor market, including level of education. It is important to note that saying that gender equality in education or in other spheres should be ensured. ILO's (2018: 97) report shows that motherhood wage gap, is the wage gap between mothers and non-mothers, ranges from 1% per cent or less in Canada, Mongolia or South Africa to as much as 30% in Turkey. It should be ensured that women have a fair deal in the workplace or flexible working-time arrangements and provide more kindergarten in the workplaces.

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Real Exchange Rates and Growth: Contractionary Depreciations or Appreciations?

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ABSTRACT

This study investigates the impact of real exchange rates (RER) on growth of a large number of advanced (AE) and developing economies (DE) estimating conventional growth models augmented with global financial conditions variables. First of all, replicating Rodrik (2008) and following studies employing panel autoregressive distributed lag (PARDL) and PARDL mean group (PARDL-MG) models, we show that the expansionary depreciation findings for DE are often based on a misinterpretation of an error correction mechanism coefficient. Then, we investigate the relationship between RER and growth explicitly taking into account balance sheet or external debt vulnerabilities which often do not considered by conventional growth literature. Fully-Modified OLS estimation results show that, the external variables demonstrating global financial and monetary conditions are strongly significant in explaining growth in DE along with the conventional domestic variables including trade openness, human capital and savings. Furthermore, our results suggest that, RER depreciations are contractionary for DE with high external debt and expansionary for AE. However, higher trade openness decreases the contractionary impact of depreciations in both AE and DE. These results are robust for different RER and real income measures.

Key words: Balance Sheets, Developing Economies, Growth, Real Exchange Rates, Panel Data

JEL Classification: F30, F41, F60, F65, O11.

1. Introduction

In the Mundell–Fleming framework, which maintains that as long as the Marshall-Lerner conditions hold, real exchange rate (RER) depreciations are expansionary as they make tradable sectors more competitive. The success of China and some other East Asian countries with high growth under undervalued RER has been taken as evidence for this postulation. According to Rodrik (2008), for instance, systematic RER undervaluations facilitate economic growth in developing economies (DE) by making tradable sectors more profitable which are affected from institutional problems and market inefficiencies to a more extent.

RER depreciations, according to Levy-Yeyati, Sturzenegger and Gluzmann (2013), are expansionary not through the "neo-mercantalist" trade competitiveness channel but, instead, through higher domestic savings. In the absence of external vulnerabilities, the higher savings impact of depreciations is consistent with Diaz-Alejandro (1965) suggesting that RER depreciations lead to income transfer from labour to capital and thus to higher savings through this regressive income distribution.

The "mercantilist" or "savings" channels, however, do not consider the impacts of RER depreciation on high foreign currency (FX) debt or the net financial positions of firms with high liability dollarization (LD). In this context, another strand of the literature, following the balance sheet (BS) channel (see, among others, Krugman 1999; Calvo, Izquerdo and Mejía 2004), often finds that RER depreciations are contractionary in DE due to mainly the presence of high LD. Under high LD and high FX debt, currency mismatches between assets

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and liabilities, lead to deterioration of the net worth of the economy in the face of real depreciations.

The BS literature provides a strong rationale for contractionary RER depreciations. However, there is only a very limited number of studies investigating the relationship between RER and growth explicitly taking into account BS or external debt vulnerabilities. Furthermore, the empirical growth literature often ignores integration and cointegration properties of variables (Eberhardt and Teal, 2011) and estimates unbalanced equations including I(1) and I(0) variables. Another important contribution of this paper is that, "undervaluation" variable coefficient in studies following Rodrik (2008), indeed, may be representing an error correction mechanism instead of supporting the expansionary devaluations postulation. Furthermore, growth of DE is often determined by not only domestic fundamentals, but also global financial conditions. The conventional growth literature, however, often does not consider such variables. This paper attempts to fill these important gaps in the literature also by employing the recent panel data estimation procedures.

The plan for the rest of the paper is as follows. Section II presents a brief literature review. Section III presents empirical results. In Section III.1, we attempt to replicate the results by Rodrik (2008) and the following studies. The main finding of this section, based on simple panel autoregressive distributed lag (PARDL) and PARDL mean group (PARDL-MG) models, is that the results supporting expansionary devaluations in DE should be interpreted with an extreme caution, as they may be, indeed, representing an adjustment to deviations from cointegration between real exchange rates and per capita real output.

Economic growth of DE is shown to be highly dependent on the global monetary and financial conditions (Kose, Otrok and Prasad 2012; Erdem and Özmen 2015). Therefore, section III.2, considers a conventional growth model augmented with variables representing external financial and monetary conditions. In the context of the BS literature, this section also investigates the impact of external debt and its interaction with RER on growth. Considering the potential endogeneity of the domestic explanatory variables for the long-run evolution of growth, we estimate the models by employing fully modified OLS (FM-OLS) procedure which considers endogeneity, serial correlationa and heterogeneity in the long-run relationships Finally, Section IV concludes and provides some policy implications.

2. A Brief Review of The Literature

Under the Mundell–Fleming framework and the Marshall-Lerner conditions, RER depreciations positively affects growth since they lead to a more competitive tradable sector. According to this "neo-mercantilist" mechanism (Levy-Yeyati, Sturzenegger and Gluzmann 2013), systematically under-valued domestic currency shifts domestic production from nontraded to traded goods which have a higher total factor productivity. According to Rodrik (2008), for instance, by increasing the profitability of the tradable sector, RER undervaluation facilitates economic growth in DE. The success of some East Asian countries with high growth under undervalued RER has been taken as evidence supporting this postulation. Recently, Guzman, Ocampo and Stiglitz (2018) suggest that stable and competitive real exchange rate policies can promote economic development if it is supported by macro stability and industrial policies.

The neo-mercantalist view, however, provides no systematic monetary policy rule or transmission mechanism to maintain a sustained undervalued RER under flexible exchange regimes and inflation targeting. Diaz-Alejandro (1965) suggests that RER depreciations cause income transfer from labour to capital and this regressive income distribution leads to higher domestic savings and lower growth. The higher savings impact of RER depreciations provides also a starting point for the recent expansionary devaluations arguments (Gluzmann, Levy-Yeyati and Sturzenegger 2012; Levy-Yeyati, Sturzenegger and Gluzmann 2013). Real devaluations relax the binding borrowing constraints of firms by means of saving channel. Eichengreen (2008), argues that both the competitiveness and savings (due to higher growth) are important determinants of expansionary RER depreciations.

The recent evidence on the impact of RER on growth is mixed. The results by Rodrik (2008), Di Nino, Eichengreen and Sbracia (2011), Gluzmann, Levy-Yeyati and Sturzenegger (2012) and Levy-Yeyati , Sturzenegger and Gluzmann. (2013) all provide empirical support for the expansionary RER depreciation postulation for DE. In all these studies, RER are "corrected" for the Balassa-Samuelson effect. Bussiere, Lopez and Tille (2015) finds that RER appreciations lead to productivity increases and have a greater impact on growth than those due to capital inflows RER appreciations, per se, are found to be contractionary. Montiel and Serven (2008), on the other hand, argues that there is only weak analytical or empirical support for the argument that systematic RER depreciations promote increased domestic saving and consequently higher domestic capital accumulation and growth. Ahmed, Kamin and Huntley (2002) finds that devaluations tend to be expansionary in AE and contractionary in DE. According to Alper and Civcir (2012), whilst large and persistent devaluations are associated with financial crises, relatively small and transitory RER appreciations promotes growth of Turkish economy. Nouira and Sekkat (2012) reports that they do not find any strong support for the expansionary undervaluation claim for a panel of 52 DE. For a panel data set of 150 countries, Habib, Mileva and Stracca (2017) reports a robust and significant effect of real appreciation on real GDP per capita growth once they control simultaneity problem with instrumentation approach. Their results show that the effect is stronger for developing countries and countries with pegging currency. Focusing on euro area economies, Lane and Stracca (2018) points out that a real appreciation creates a trade-off between expenditure switching (expansionary) and terms of trade (contractionary) effects while the latter dominates in most of the countries. Their findings reveal that the effects of appreciations are different especially for 'core' and 'peripheral' countries at which appreciations lead to more growth but also more current account imbalances.

An important consequence of the expansionary RER depreciations is the "fear of appreciation" in DE (Levy-Yeyati, Sturzenegger and Gluzmann, 2013). This clearly contradicts with the "fear of floating" argument by Calvo and Reinhart (2002). The presence of pervasive liability dollarisation (LD) is the basic reason of "fear of floating" in DE. High level of LD and FX debt, indeed provides the basic starting point of contractionary RER depreciations argument in the context of the balance sheet (BS) literature (Krugman 1999; Calvo, Izquierdo and Mejía 2004; Frankel 2005). The contractionary RER depreciations due to high FX debt, which is closely related with LD, was indeed clearly identified much earlier by Diaz-Alejandro (1965)[1].

According to the BS literature, real decisions of economic agents, basically firms, depend crucially on their financial positions. Financial positions of economic agents, may considerably vary due to the currency denomination of their balance sheets and, in turn, the elasticity of their net income to RER. RER depreciations affect BSs significantly due to currency and time mismatches in the presence of high LD and FX debt. Consequently, borrowing capacity of firms deteriorates decreasing their investment and production. Total effect of RER is an empirical issue and critically depends on sector/country characteristics such as their import dependence of production, FX debt along with currency composition of BS.

Frankel (2011) suggests that weak BS due to LD leads to not only contractionary devaluation, but also currency crises. According to Cespedes, Chang and Velasco (2003), negative BS effect dominates competitiveness effect when the economy has high debt to net worth ratio, high FX debt and underdeveloped financial markets. Céspedes (2005) finds that output is significantly affected from the presence of large external debt and real devaluations. Ahmed, Kamin and Huntley (2002) finds that contractionary devaluations are often the case for DE. Galindo, Panizza and Schiantarelli (2003) suggest that traditional competitiveness impact of depreciations on investment reverses in the case of high LD. Kesriyeli, Özmen and Yiğit (2011) reports that RER depreciations are contractionary for non-financial sectors of Turkey. Bebczuk, Galindo and Panizza (2006) finds that when external dollarization or debt exceeds a certain level, contractionary effect of devaluation dominates the trade competitiveness effect.

3. Data, Model and Empirical Results

3.1. Expansionary Depreciations or an Error Correction Mechanism?

To investigate the relationship between real exchange rates and growth, we first consider the baseline model[2] of Rodrik (2008):

$$\Delta y_{it} = a_0 + a_1 UNDERVAL_{it} + u_{it} \tag{1}$$

where UNDERVAL are the residuals from the estimation of:

$$rer_{it} = b_0 + b_1 y_{it} + v_{it} \tag{2}$$

In Eq. (1), y = ln(RGDP), RGDP = per capita real GDP at constant 2010 USD, reer=ln(RER), RER = real effective US$ exchange rate. We first use the real exchange rate index of the International Monetary Fund (IMF), RER^{IMF}. For robustness check we consider also the "price level of GDP" data by Penn World Tables (PWT) version 9.0 and define RER^{PWT}_{it} as PPP_{it}/XR_{it} where XR is the nominal exchange rate and PPP is the purchasing power parity conversion factor. Consequently, an increase in RER^{PWT} means real appreciation. Rodrik (2008), and Gluzmann, Levy-Yeyati and Sturzenegger (2012) define RER^{PWT}_{it} as XR_{it}/PPP_{it} and thus an increase in RER^{PWT} means real depreciation. Our unbalanced panel data contain 25 AE and 66 DE for the annual period of 1980-2014. The choice of countries is determined by data availability. Tables A1 and A2 of the Appendix present the data sources and the full list of countries, respectively.

According to Rodrik (2008), UNDERVAL is the RER "corrected" for the Balassa-Samuelson postulation suggesting that higher productivity causes appreciation[3]. A similar procedure is employed also by some other studies supporting expansionary depreciations, including Di Nino, Eichengreen and Sbracia (2011), Levy-Yeyati, Sturzenegger and Gluzmann (2013) and Gluzmann, Levy-Yeyati and Sturzenegger (2012). Following Rodrik (2008), we estimate (1) and (2) by employing panel fixed effects procedure.

Consistent with the findings of Rodrik (2008), the estimation of (2) yielded the slope coefficient estimates as 0.38 for rer^{PWT} and 0.22 for rer^{IMF} with highly significant t-statistics. Rodrik (2008) interprets such result as supporting the Balassa-Samuelson postulation. The results of the Levin, Lin and Chu (2002) panel unit root tests (the lag lengths chosen as 3 by Akaike Information criterion, AIC) yielded -6.26 for rer^{PWT} and -6.48 for rer^{IMF}, strongly suggesting the stationarity of the equation residuals. Considering the finding that the variables are integrated of order one (I(1), see Table 3, below), this result, suggests the presence of a long-run equilibrium relationship (cointegration) between real exchange rates and per capita real GDP[4].

Table 1 shows estimation results of equation (1) for the whole sample. The results appear to support the Rodrik (2008) finding that real depreciations are expansionary for both measures of real exchange rates. Table 1 contains also the estimation of equation (1) using $UNDERVAL_{it-1}$ instead of[5] $UNDERVAL_{it}$. The results remain essentially the same both for rer^{IMF} and rer^{PWT}.

Given that rer_{it} and y_{it} are cointegrated, the $UNDERVAL_{it}$ variable (residuals from the regression of rer_{it} on y_{it}) may, indeed, be representing deviations from long-run equilibrium. As already noted, UNDERVAL is a stationary combination of two I(1) variables, rer_{it} and y_{it}. Consequently, the $UNDERVAL_{it-1}$ coefficient (c_1) in:

$$\Delta y_{it} = c_0 + c_1 UNDERVAL_{it-1} + e_{it} \qquad (3)$$

may, indeed, be representing the adjustment coefficient in an error correction mechanism (EC) set up, rather than a real exchange rate impact. Therefore, the negative $UNDERVAL_{it-1}$ coefficients in equations (1.3) and (1.4) may better be interpreted as suggesting real income adjusting to deviations from long-run equilibrium rather than supporting the expansionary real depreciation postulation.

We consider also the following reparametrized simple panel autoregressive distributed lag (PARDL) model:

$$\Delta y_{it} = d_0 + d_1 EC_{it-1} + d_2 \Delta y_{it-1} + d_3 \Delta rer_{it-1} + v_{it} \qquad (4)$$

In (4) EC_{it-1} is indeed $UNDERVAL_{it-1}$ and consequently the coefficient of this gives the adjustment coefficient. A negative and significant d_1 estimate simply suggest that real income adjusts to deviations from the long-run equilibrium. Equations (1.5) and (1.6) in Table 1 presents the results. The estimated EC coefficients are essentially the same with the coefficients $UNDERVAL_{it}$ in Eqs. (1.1) and (1.2). Consequently, the interpretation of $UNDERVAL_{it}$ coefficients as the impact of real exchange rate may be seriously misleading and thus should be taken with an extreme caution.

We now proceed with the estimation of the following PARDL mean group (PARDL-MG) model:

$$\Delta y_{it} = e_0 + e_1 EC_{it-1} + e_{21}\Delta y_{it-1} + \ldots + e_{2p}\Delta y_{it-p} + e_{30}\Delta rer_{it} + \ldots + e_{3p}\Delta rer_{it-p} + v_{it} \qquad (5)$$

The PARDL approach can be employed even if the variables are integrated of order zero or one and are not weakly-exogenous. (Pesaran, Shin and Smith 1999; Chudik and Pesaran 2015). The PARDL-MG procedure assumes the long run coefficients are the same but allow the short-run and EC coefficients to be different across countries. The EC and short-run PARDL-MG coefficients can be found by taking the simple averages of individual country coefficients. Table 2 reports the PARDL-MG results[6]. Accordingly, RER appreciations are contractionary for AE (eq. 2.2) and expansionary for DE (eq. 2.3). The significant EC_{t-1} coefficients support the hypothesis that real income adjusts to deviations from the long-run equilibrium.

Table 1: "Undervaluation", Growth and Error Correction Mechanism

	Real Exchange Rate Measure					
	rer^{PWT}	rer^{IMF}	rer^{PWT}	rer^{IMF}	rer^{PWT}	rer^{IMF}
Equation	1.1	1.2	1.3	1.4	1.5	1.6
intercept	0.018** (0.001)	0.018** (0.001)	0.018** (0.001)	-0.018** (0.001)	0.016** (0.001)	0.014** (0.001)
$UNDERVAL_{it}$	-0.013** (0.005)	-0.016** (0.004)				
$UNDERVAL_{it-1}$			-0.017** (0.003)	-0.019** (0.004)	-0.017** (0.003)	-0.016** (0.003)
Δrer_{it-1}					-0.007 (0.006)	-0.002 (0.006)
Δy_{it-1}					0.256 (0.018)**	0.223 (0.019)**
Diagnostics	N=91, NT=2847 $R^2 = 0.25$ F = 7.19	N=91, NT=2724 $R^2 = 0.25$ F = 7.11	N=91, NT=2836 R^2=0.26, F=7.47	N=91, NT=2700 R^2=0.26 F=7.44	N=91, NT=2756 R^2=0.32 F=9.94	N=91, NT=2619 R^2=0.32 F=9.30

Notes. Standard errors are given in parentheses. ** denotes the significance at the 5 % level, N and NT represents the the effective numbers of countries and observations, respectively.

Table 2: Real Exchange Rates and Growth: PARDL-MG Results

Country Grouping	ALL	AE	DE
Equation	2.1	2.2	2.3
		Long-Run	
rer^{IMF}_{it}	0.900** (0.043)	-1.612** (0.191)	0.947** (0.053)
		Short-Run	
EC_{t-1}	-0.027** (0.007)	-0.031** (0.006)	-0.033* (0.019)
Δrer^{IMF}_{it}	-0.031 (0.032)	-0.022 (0.039)	-0.002 (0.041)
Δrer^{IMF}_{it-1}	-0.082** (0.016)		
Δy_{it-1}	0.232** (0.027)	0.297** (0.038)	
intercept	0.169** (0.037)	0.620** (0.108)	0.196** (0.088)
Sample	N=91, NT=2610	N=25, NT=823	N=66, NT=1834

Notes. Standard errors are given in parentheses. ** denotes the significance at the 5 % level, N and NT represents the the effective numbers of countries and observations, respectively.

The empirical growth literature often ignores integration and cointegration properties of the data and estimates unbalanced equations including I(1) and I(0) variables[7]. The results of this paper, so far, highlight the importance of this and related issues. RER changes, *per se*, may also be reflecting omitted domestic macroeconomic fundamentals and global financial conditions beyond the variables already contained in equations 1.1-1.6. The following section proceeds with the estimation of a growth model.

3.2. Real Exchange Rates and Growth: Evidence from a Growth Model

To estimate the relationship between real exchange rates and growth, we now consider the following equation:

$$y_{it} = \gamma_0 + \gamma_1 rer_{it} + D'_{it}\gamma_2 + E'_t \gamma_3 + u_{it} \quad (6)$$

where, rer_{it} is rer^{IMF}_{it}, D'_t and E'_t are the transposes of the vectors of, respectively, domestic and external variables, γ_2 and γ_3 are the corresponding vector of coefficients and u_{it} is the error term[8]. D´ contains the main variables postulated by the growth literature[9]. These include human capital, based on years of schooling and returns to education (HC, Feenstra, Inklaar and Timmer, 2015), trade openness (OPEN, expressed as the sum of exports and imports over GDP) and domestic savings (SAV, as a share of GDP).

Business cycles and economic growth of DE are supposed to be highly affected from global financial conditions (Kose, Otrok and Prasad 2012; Erdem and

Özmen 2015; Almansour, et al. 2015). Many DE yields respond to "world interest rates" (Bahadir and Lastrapes, 2015). Borrowing costs of DE in international markets are often determined by global financial conditions (Gonzalez-Rozada and Levy-Yeyati 2008; Özatay, Özmen and Şahinbeyoğlu 2009; Özmen and Yaşar 2016).

The external variables in (6) contain fed rate and vix where fed rate is ln(1+R^{FED}/100) with R^{FED} being the FED Funds target rate[10] and vix is the log of volatility implicit in U.S. stock options (VIX). The FED target rate is postulated to proxy monetary policy conditions in the USA. VIX represents liquidity conditions and risk appetite globally (Gonzalez-Rozada and Levy-Yeyati 2008). According to Rey (2015), VIX goes in line with global financial conditions which lead to booms and busts in DE. The equations which include VIX are estimated for 1990-2014 period since VIX data can be found after 1990.

Considering the potential endogeneity of the domestic explanatory variables for the long-run evolution of growth, we estimate (6) by employing fully modified OLS (FM-OLS) procedure[11] (Pedroni, 2000). The FM-OLS procedure considers endogeneity, autocorrelation and potential heterogeneity in the long-run relationships. As already noted, the conventional growth literature often ignores integration and cointegration properties of the data and estimates unbalanced equations including I(1) and I(0) variables. FM-OLS takes this issue into account in the sense that endogeneity of the variables does not affect the estimation results since FM-OLS estimates are superconsistent when variables are cointegrated.

Table 3 reports the results of Levin, Lin and Chu (2002) panel unit root tests (LLC) for the panel variables and augmented Dickey-Fuller tests for vix and fed rate. The results of the tests suggest that all the variables in (5) are I(1)[12]. Table 4 reports the FM-OLS results for country groupings. The results of the LLC tests suggest that the equation residuals are stationary. Consequently, the equations in Table 4 may be interpreted as representing a long-run equilibrium relationships (cointegration)[13].

According to equations 4.1-4.4, human capital (HC), domestic savings (SAV) and trade openness (OPEN) all have positive and significant coefficients for the whole, AE and DE samples. The impact of HC (and thus education) appears to be the same for AE and DE. OPEN and SAV tend to enhance growth much more (about twice) in AE than in DE. RER appreciations, *per se*, are expansionary as suggested by the positive rer_{it} coefficients. However, consistent with the competitiveness channel, this impact decreases with higher trade openness. For AE, the net impact of rer_{it} becomes almost insignificant (decreases to 0.11) when evaluated at the mean trade openness (=0.37-0.90*0.29, where 0.9 is mean openness, 0.37 and 0.29 are the estimated coefficients of OPEN and OPEN*reer, respectively). Consequently, RER appreciations may be interpreted as contractionary or, at best, insignificant in highly open AE. The impact of RER through trade openness channel appears to be much more small in DE. The net impact at the mean trade openness (0.78) is around 0.21 which is, indeed, very close to the rer_{it} coefficient (0.23) in eq. 4.3 of Table 4. This lends a support to the contractionary RER depreciation hypothesis for DE.

Table 3: Unit Root Tests

Variables	*LLC*	
	Levels	*First Differences*
rer^{IMF}_{it}	-0.61[3]	-43.0[1]**
rer^{PWT}_{it}	-0.57[3]	-32.8[3]**
y_{it}	-0.69[3]	-31.7[3]**
y^{PWT}_{it}	-1.37[3]	-41.0[3]**
HC_{it}	8.06[2]	-2.26[1]**
SAV_{it}	-0.72[2]	-32.3[2]**
$OPEN_{it}$	-1.44[2]	-48.7[2]**
$E.Debt_{it}$	-1.25[3]	-28.6[2]**
Variables	*ADF*	
vix_t	-0.48[0]	-4.30[0]**
fed $rate_t$	-1.55[1]	-5.39[1]**

*LLC and ADF are the Levin, Lin and Chu (2002) panel unit root and augmented Dickey-Fuller tests, respectively. ** denotes the rejection of the unit root null at the 5% level. The values in brackets [.] are the lag lengths determined by AIC.*

Better global liquidity conditions (a decrease in VIX) and lower FED target rates both have a positive impact on growth in DE. The impact of the FED rate for both AE and DE is consistent with a view that "there is a powerful transmission channel of US monetary policy across borders via credit flows, leverage of banks, risk premia and the term spread" (Miranda-Agrippino and Rey, 2015). The results by Kose, Otrok and Prasad (2012) and Erdem and Özmen (2015) suggest that global financial conditions including VIX shocks are amongst the main determinants of business cycles in DE. The significant and negative vix_t coefficient is consistent with these studies. Contrasting to the DE evidence, a decrease in the global risk appetite (an increase in VIX) enhances growth in AE. An increase in VIX leads to a risk-aversion shock and consequently generates flight-to-quality due to preference to safer assets. The resulting capital flights from DE to AE (or sudden stops of capital inflows to DE) often leads to severe output contractions (or financial crises) in DE. The return to safety appears to enhance growth in AE, through potentially mainly capital-flow reversals and the resulting domestic credit expansion.

As already discussed, the presence of high external debt and LD are the main mechanisms of the contractionary devaluation postulation of the BS literature. The direct measures of LD are, unfortunately, available only for a very limited number of DE. Alternatively, we follow Bebczuk, Galindo and Panizza (2006) and define external dollarization as External Debt/GDP (E.Debt)[14]. Such a definition is consistent also with the pioneering contribution by Diaz-Alejandro (1965). World Bank's Global Development Finance data base does not report external debt data for AE. Therefore, equations (4.4) and (4.6) of Table 4 are estimated by using only the DE data.

Higher external debt in DE leads to higher risk premiums, lower credit ratings and thus higher spreads and borrowing costs. The presence of original sin and the consequent BS mismatch potentially alleviate this negative impact. Furthermore, higher external net liabilities and debt increase the risk of financial crises (Bordo, Meisner and Stuckler 2010; Catão and Milesi-Ferretti 2014). Dell'Erba, Hausmann and Panizza (2013) finds that there is a significantly positive correlation between FX debt levels and sovereign spreads (and thus borrowing costs) in DE. Consequently, growth in DE may be expected to decline with higher external debt. The negative and significant E.Debt coefficient estimate in Eq. (4.4) strongly supports this postulation. RER appreciations, on the other hand, have a positive impact on growth as they lead to a decline both external debt and debt service in terms of domestic real income. This is indeed the main channel of the expansionary RER appreciations of the BS literature.

Table 4: RER and Growth: FM-OLS Results

Country Grouping	*All*	*AE*	*DE*	*DE*	*AE*	*DE*
Equation	***(4.1)***	***(4.2)***	***(4.3)***	***(4.4)***	***(4.5)***	***(4.6)***
Dependent variable			y_{it}			y^{PWT}_{it}
$reer_{it}$	0.258** (0.008)	0.366** (0.023)	0.227** (0.009)	0.223** (0.006)	0.767** (0.024)	0.304** (0.011)
HC_{it}	0.692** (0.007)	0.665** (0.016)	0.728** (0.009)	0.733** (0.005)	1.129** (0.016)	0.895** (0.013)
SAV_{it}	0.527** (0.019)	0.991** (0.041)	0.419** (0.022)	0.516** (0.013)	1.336** (0.036)	0.831** (0.023)
$OPEN_{it}$	0.540** (0.055)	1.510** (0.122)	0.248** (0.065)	0.435** (0.040)	3.011** (0.153)	0.645** (0.054)
$OPEN_{it}$ * $reer_{it}$	-0.082** (0.012)	-0.286** (0.028)	-0.024* (0.013)	-0.077** (0.009)	-0.607** (0.034)	-0.122** (0.012)
vix_t	-0.008** (0.002)	0.025** (0.004)	-0.025** (0.003)	-0.026** (0.002)	0.034** (0.004)	-0.047** (0.004)
fed $rate_t$	-1.018** (0.044)	-0.915** (0.070)	-1.067** (0.057)	-1.165** (0.034)	-1.149** (0.036)	-1.770** (0.067)
$E.Debt_{it}$				-0.114** (0.034)		-0.856** (0.074)
$E.Debt_{it}$*$reer_{it}$				0.037** (0.008)		0.198** (0.016)
Diagnostics	N=84, NT=2099 R^2 = 0.99 LRV= 0.002 LLC = -10.5 [0.00]	N=24, NT=667 R^2 = 0.96 LRV= 0.002 LLC) = -6.83 [0.00]	N=60, NT=1431 R^2 = 0.99 LRV= 0.002 LLC = -8.56 [0.24]	N=50, NT=1211 R^2 = 0.98 LRV= 0.001 LLC = -8.08 [0.00]	N=24 NT=667 R^2 = 0.93 LRV= 0.002 LLC = -7.32 [0.00]	N=50 NT=1217 R^2 = 0.97 LRV= 0.003 LLC = -7.44 [0.00]

Notes: LRV is the long-run variance. Standard errors are given in parentheses. ** denotes the significance at the 5 % level. N and NT represents the effective numbers of countries and observations for the sample, respectively. LLC shows the Levin, Li and Chu (2002) panel unit root test statistic for the equation residuals. The optimum lag lengths for the tests are chosen by the AIC. The values in brackets [.] are the p-values for the no cointegration null hypothesis.

For a robustness check, we consider also $y^{PWT} = \ln(RGDP^{PWT})$, $RGDP^{PWT}$ = per capita real GDP at purchasing power parities[15] (Feenstra, Inklaar and Timmer 2015). Equations (4.5) and (4.6) in Table 4 reports the results. For the AE sample, we obtain essentially the same results (Eq. 4.5), albeit the coefficient estimates are substantially higher (in absolute values) especially for $reer_{it}$, HC_{it}, $OPEN_{it}$, and $OPEN*reer_{it}$. The $reer_{it}$ cooefficient is still positive (0.79) but, again, tends to vanish when considered along with the competitiveness impact (-0.61). For the DE sample, on the other hand, the earlier findings for y_{it} remains almost unchanged for y_{it}^{PWT}.

4. Concluding Remarks and Policy Implications

RER depreciations increase the value of FX debt and debt service in terms of domestic currency and deteriorate financial positions of the debtor sectors of an economy. Consequently, RER depreciations may be contractionary for DE with higher FX debt as argued by Diaz-Alejandro (1965) much earlier. We find that balance sheet effects, captured by the interaction between RER and FX debt have a significant and negative impact on output in DE. This result provides a strong support for the Diaz-Alejandro (1965) proposition and some related studies including Ahmed, Kamin and Huntley (2002), Galindo, Panizza and Schiantarelli (2003), Cespedes, Chang and Velasco (2003), Céspedes (2005), Bebczuk, Galindo and Panizza (2006) and Frankel (2005, 2011). Our data, on the other hand, support that RER depreciations are expansionary (or at least not contractionary) for AE.

Another important finding of our paper is that, the studies interpreting "undervaluation" variable coefficient as a support for expansionary depreciations postulation may be misleading and thus should be interpreted with an extreme caution. This is because, these coefficients may, indeed, be representing error/equilibrium correction mechanism to deviations from cointegration between RER and per capita real income.

Higher trade openness decreases the contractionary impact of RER depreciations in both AE and DE. This international competitiveness affect is much higher in AE than DE. Consequently, the net impact of RER appreciations becomes contractionary or, at best, insignificant in highly open AE.

We also find that external variables representing global financial (VIX) and monetary (FED funds target rate) conditions are strongly significant in explaining growth in DE along with the conventional domestic variables including trade openness, human capital, domestic savings. An increase in the FED rate leads to an output decline in both AE and DE. Contrasting to the DE evidence, a decrease in the global risk appetite (an increase in VIX) enhances growth in AE. This is consistent with the sudden stops or capital-flow reversals from DE to AE due to the flight-to quality mechanism during turbulent times. The impact of HC (and thus education) appears to be the same for AE and DE. Trade openness and domestic savings tend to enhance growth much more (about twice) in AE than in DE.

The main tenet of the "mercantilist view" is export-led growth through systematic RER depreciation. According to Ahmed, Kamin and Huntley (2002), on the other hand, RER elasticity of exports has substantially declined during the recent decades due to higher degree of globalization of production and trade. In this process, which is called global value chains (Johnson, 2014) or global supply chains (Baldwin and Lopez-Gonzalez, 2015), production of final product is sliced up into different stages and tasks are distributed among different countries. As countries has become more dependent on imports for production and exports, complementarity of exports and imports has increased (Johnson 2014; Baldwin and Lopez-Gonzalez 2015). A RER depreciation, improves the competitiveness of domestic value added in exports and increases the cost of imported inputs leading to a decrease in the RER elasticity of trade. Together with the BS effect of RER depreciation in countries with higher FX debt, the decline in the RER elasticity of exports with higher integration to global value/supply chains, provides another plausible explanation and a promising research agenda for the expansionary RER appreciation postulation.

According to Guzman, Ocampo and Stiglitz (2018) a competitive RER is crucial for the generation of backward and forward linkages of existing economic activities and should be complemented with industrial policies. In the international trade context, an industrial policy aiming to increase forward participation (the use of domestic intermediates in third country exports) and decrease backward participation (the use of foreign inputs in exports) appears to be strategically important for a higher sustainable growth in DE.

Better education (higher human capital), higher savings and trade openness are amongst the complementary tools of higher sustainable growth. Lower levels of LD and FX debt are necessary for a successful export-led growth strategy. However, all these require macroeconomic stability. The literature, unfortunately, is yet to provide a convincing answer how a systematic undervalued currency can be achieved under a flexible exchange rate regime and inflation targeting (Woodford, 2008).

The importance of exogenous global factors for growth of DE does not necessarily relegate the importance of domestic fundamentals and macroprudential regulations. The domestic fundamentals, including FX debt and LD, are indeed, amongst the main mechanisms through which the impacts of exogenous shocks are transmitted. Given the results that global financial and monetary conditions are crucially important for DE growth, the success of a sustained undervalued RER may become more ambiguous. The recent studies on the "impossible trinity", including Rey (2015, 2016), Aizenman, Chinn and Ito (2015) and Obstfeld (2015), indeed, provide important insights and a promising research agenda also for investigating RER and growth relationships.

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5. Appendix

Table A1. Data Sources

GDP, per capita real GDP at constant 2010 USD.	*World Bank, World Development Indicators (WDI)*
GDP, per capita real GDP at chained PPPs.	*PENN World Table, Version 9.0, Feenstra, et. al., (2015)*
RER^{IMF}, real effective exchange rates	*IMF-IFS, Bank for International Settlements[a] and Inter-American Development Bank[b]*
$REER^{PWT}$, real effective exchange rates	*PENN World Table, Version 9.0 Feenstra, et. al., (2015)*
HC, human capital per worker	*PENN World Table, Version 9.0 Feenstra, et. al., (2015)*
Population	*PENN World Table, Version 9.0 Feenstra, et. al., (2015)*
OPENNESS, trade openness (expressed as the sum of exports and imports over GDP)	*World Bank, WDI*
SAV, domestic savings (as a share of GDP).	*World Bank, WDI*
E.Debt, External Debt/GDP	*World Bank, WDI and Global Development Finance database[c].*
VIX, Volatility implicit in U.S. stock options	*Bloomberg*
R^{FED}, Effective FED Funds target rate	*Federal Reserve Board*

***Notes:* a.** *RER^{IMF}* data for Iceland, India, Indonesia, Korea R., Lithuania, Slovenia, Thailand, Turkey and Estonia are from Bank for International Settlements (BIS) database.
b. *RER^{IMF}* data for Argentina, Guatemala, Haiti, Honduras, Jamaica and Peru are from Inter-American Development Bank (IADB).
c. External Debt/GDP data for Argentina, Bahamas, Chile and Uruguay are from IADB.

Table A2. Country List

Advanced (AE)		*Developing or Emerging (DE)*		
Australia Austria Belgium Canada Denmark Finland France Germany Greece Iceland Israel Italy, Japan, Luxembourg Malta Netherlands N. Zealand Norway Portugal Singapore	Spain Sweden Switzerland U. Kingdom U. States	Algeria Argentina Armenia Bahamas Belize Bolivia Brazil Bulgaria Burundi Cameroon C.African R. Chile China Colombia Costa Rica Cote D'Ivore Croatia Cyprus Czech R. Dominica Dominican R. Ecuador	Estonia Fiji Gabon Gambia Ghana Guatemala Guyana Haiti Honduras Hungary India Indonesia Iran Jamaica Korea R. Latvia Lesotho Lithuania Malawi Malaysia Mexico Morocco	Nigeria Pakistan Paraguay Peru Philippines Poland Romania Russian F. Sierra Leone Slovakia Slovenia S. Africa Thailand Togo Tunisia Turkey Uganda Ukraine Uruguay Venezuela Zambia

Endnotes

1 Obstfeld (2004, p. 42) cites Diaz-Alejandro (1965, p. 31) "Devaluation may produce another type of wealth effect when some groups of the country have debts to foreigners expressed in terms of foreign currencies. A devaluation will then increase the value of the debt expressed in domestic currencies and will exert a depressing influence on the expenditures of these groups, especially when the domestic prices they receive for the sale of their products or services do not increase proportionally with the devaluation. When a country has a net foreign debt, this effect will make more likely an improvement in the trade balance and a drop in output following devaluation, especially when the debt is held by the private sector and is concentrated in short-term maturities".

2 Rodrik (2008) uses 5-year averages and includes also an initial income variable. Following Pedroni (2007), we do not include an initial income variable in cointegrating equations. However, our results from these equations are consistent with the findings of Rodrik (2008).

3 This procedure, however, may be subject to serious empirical modelling issues as convincingly argued by Woodford (2008).

4 The Pedroni (2004) residual-based panel cointegration test (panel Phillips-Perron statistics estimated with lag length 3) yielded -18.0 for y_{it} and rer_{it}^{PWT}, -29.2 for y_{it} and rer_{it}^{IMF}. This provides a further support for the presence of cointegration between the variables.

5 Gluzmann, Levy-Yeyati and Sturzenegger (2012) also uses the lagged values of the UNDERVAL variable to estimate (2).

6 We started with a maximum lag of PARDL-MG (4,4) and the optimum lag lengths of the equations are chosen by the likelihood ratio tests of sequential lag length reduction.

7 As noted by Pedroni (2007), the use of panel cointegration techniques allows to relax to continuous steady-state position of the conventional growth literature. The stationarity of residuals of the real income equation (thus the presence of a cointegration) is a necessary condition for income convergence. Consequently, Pedroni (2007) argues that there is no need to specify a lagged dependent variable (initial income) term as in the conventional convergence equations. Furthermore, the estimation of a cointegrating equation with an initial income variable is often not feasible. Therefore, we do not include this variable. Also note that, in the presence of an initial income variable which is often constant for individual countries, the estimation of the conventional models with an intercept term by employing a cross-section fixed effects procedure is not feasible due to perfect multicollinearity. Because of this, the empirical models containing a constant initial income variable do not include an intercept term. However, this may result in an identification problem as the initial income coefficient may indeed be representing the intercept term rather than convergence.

8 We considered also rer^{PWT}_{it} and obtained essentially similar results with rer^{IMF}_{it}.

9 See, Eberhardt and Teal (2011), Calderon and Fuentes (2012), Barro (2015) and Rockey and Temple (2016) for the recent surveys.

10 IMF (2004, p.68) notes that, "measures of short-term rates, such as the Fed Funds target rate or three-month treasury bill rates, are very closely correlated with the three-month LIBOR rate".

11 Econometric theory is yet to provide a support to the use of PARDL-MG procedure in the presence of large number of regressors relative to the time span of the panel along with the inclusion of interaction variables. Therefore, Eq, 6 is not estimated by PARDL-MG.

12 The results are found to be robust to different country groupings and to the use of other commonly used unit root tests. These results are not reported to save the space but available on request.

13 Note that, these residuals based cointegration tests maintains that there can be only one within group cointegration in the panel.

14 Bebczuk, Galindo and Panizza (2006) multiplies E.Debt with the original sin (OSIN) measure built by Eichengreen et al. (2003). As the OSIN has very limited time variability, we maintain that it is unity for DE.

15 According to Cline (2015, p.5) "testing cross-country growth patterns without permitting a comparable cross-country level of real per capita income is a classic instance of staging Hamlet without the Prince of Denmark.

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Sticky Cost Behavior: Evidence from BRICS+T Countries

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ABSTRACT

The aim of this study is to determine the sticky cost behavior of publicly-traded companies in Brazil, Russia, India, China, South Africa and Turkey (BRICS+T) that are classified as developing economies during the period 2010-2019. In addition to the purpose, the firm characteristics that play a role in the sticky cost behavior of firms and the effect of the Gross Domestic Product (GDP), which is a macroeconomic indicator, has been investigated. The study revealed that the firms in BRICS+T exhibit a sticky cost behavior. Furthermore, it also suggested that inventory intensity, which is one of the firm characteristics, does not affect cost stickiness and that asset, employee and property, plant and equipment intensity raise the level of cost stickiness while debt intensity declines the level of cost stickiness. Last but not least, it was found out that GDP, which is a macroeconomic indicator, raises the sticky cost level when it tends to rise.

Keywords: Cost stickiness, Asymmetric cost behavior, Sticky cost behavior, Firm characteristics, BRICS+T firms

JEL classification: M41

1. Introduction

Cost, which is crucial for firms, is the monetary sum of sacrifices made for goods or services required to run operations. An accurate cost estimation and analysis is of importance for firms as it sheds light on managerial actions. Understanding cost behaviors is a significant factor for cost management. Costs are considered to be either fixed or variable according to the traditional cost behavior. In addition, variable costs in any traditional cost model are managed by the volume of activity. However, some costs rise as a result of increasing volume of activity while they decrease less in line with equal declines in volume of activity (Anderson et al. 2003: 47-48; Bugeja et al. 2015: 248). In other words, the reaction of costs to the ever-changing volume of activity may vary by times when the activity volume increases and decreases (Cooper and Kaplan, 1998a: 147). In this case, an increase in cost stands for a function of the volume of activity while a decrease in cost stands for a function of managerial actions. In this sense, cost behaviors at times of decreased volume of activity can display a "sticky" correlation with past volume of activity depending on managerial actions (Öztürk and Zeren, 2016: 32). In literature, this is known as cost stickiness, and it was put forward by Anderson et al. (2003).

If the size of an increase in costs associated with an increase in volume of activity is larger than the size of an equivalent decrease, this leads to cost stickiness namely asymmetric cost behavior (Anderson et al. 2003: 47-48; Bugeja et al. 2015: 248). The cost estimation methods based on linear cost hypothesis could not be adopted for cost analysis, planning, control and pricing while they do not yield accurate results from many traditional techniques such as cost volume profit analysis, moving budget and cost-plus pricing. Therefore, managers have to take sticky (asymmetrical) behavior into account when they classify costs to make the right decisions and maintain their firm's competitive edge in the market (Ibrahim and Ezat, 2017: 17).

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The purpose of this study is to determine the cost stickiness (asymmetric cost behavior) in publicly-traded companies in BRICS+T that are classified as developing economies. In line with this purposes, the presence of cost stickiness was tested in various aspects based on various models on reaction to firm characteristics and the aspect of time and a macroeconomic indicator that all play a role in cost stickiness. The study is expected to offer a multilateral input to the literature about cost stickiness in the aforementioned aspects.

2. Literature Review and Hypotheses Development

Understanding the correlation between sales and costs is of capital importance for firms, and it is, therefore, imperative to ascertain the cost behavior in essence. Cost behavior is one of the main themes of cost and management accounting. Dividing costs into fixed and variable ones based on sales volume, the traditional view of cost behavior presumes that variable costs are consistent with changes in volume of activity (Noreen, 1991: 163). Variable costs can also have to do with the trend of changes in costs as well as the size of a change in activity (Anderson et al., 2003: 48). However, it is argued that some costs tend to increase much more when the activity volume increases compared to a decrease in them (Cooper and Kaplan, 1998a: 247; Anderson et al., 2003: 48). Cost behavior signifies the relationship between costs and activities. Cost stickiness is the asymmetrical relationship between sales and costs borne by businesses (Balakrishnan et al., 2004: 283). As noted before, the concept of cost stickiness was put forward by Anderson et al. (2003). The related concept is based on the assumption that costs are not symmetrically correlated with sales volume (Anderson et al., 2003: 47). Therefore, Anderson et al. (2003) describes the asymmetric cost behavior as "sticky" (Karadeniz et al., 2019: 172).

In literature, studies over cost stickiness are divided into three main groups. The first group covers studies (Anderson et al., 2003; Subramaniam and Weidenmier, 2003; Porporato and Werbin; 2012; Abu-Serdaneh, 2014; Banker and Byzalov, 2014; Dalla Via and Perego, 2014; Ibrahim, 2015) over evidence of asymmetric cost behavior, determination of the time dimension and analysis of firm characteristics that affect cost stickiness with the second group covering studies (Dierynck et al., 2012; Kama and Weiss, 2013; Koo et al., 2015) over correlations among managerial incentives, earnings management and asymmetrical costs and the third group covering studies (Calleja et al., 2006; Chen et al. 2012; Pichetkun, 2012; Banker et al., 2013; Xue and Hong, 2016) over correlations between corporate governance and asymmetrical cost behavior (Ibrahim, 2018: 304-306). Apart from the three aforementioned groups, the literature review offers studies that investigate the correlation with the performance of mergers and acquisitions while testing cost stickiness (Alexandridis et al. 2012; Betzer et al., 2015; Jang et al., 2017; Uğurlu et al., 2019). Gathered under three main groups by themes, the literature on cost stickiness is briefly presented as follows:

The first study out of the first group was conducted by Anderson et al. (2003) (henceforth, ABJ) to provide an evidence for asymmetric cost behavior. The study investigated the cost stickiness for the US firms based on Selling, General, and Administrative (SG&A). The analytical results revealed that 1% increase in sales raises SG&A by 0.55% while 1% decrease in sales reduces SG&A by 0.35%. Based on the results, the cost tends to be sticky when an increase coupled with an increase in volume is larger than a decrease in costs coupled with a decrease in volume. This behavior is called cost stickiness.

Calleja et al. (2006) tried to identify cost stickiness based on the operating cost in firms based in US, UK, Germany and France. It was reported that 1% increase in sales raises the operating cost by 0.97% while 1% decrease in sales reduces the operating cost by 0.91%. Therefore, the firms analyzed exhibited a sticky cost behavior. The study also reported that the level of cost stickiness in French and German firms is higher than the level of cost stickiness in UK and US firms, and that this is likely to stem from corporate governance systems and managerial mentality.

Cook et al. (2019) noted their study on the study of Anderson et al. (2003) and used current operating lease expenses to measure the cost stickiness, and of Novy-Marx's (2011) study for fixedness (operating leverage measure), and of Gu et al.'s (2017) study for inflexibility and investigated its correlation with stock return. In addition, this study directly addressed cost stickiness in the context of operating lease to determine the correlation with stock return. They took the asset volatility into account as a determinant of operating lease expenses. As a result, they reported that R&D, staff, and advertising expenses are not sticky as they are flexible expenses whereas pension and rental expenses are highly similar to SG&A costs, and they are sticky costs or non-flexible expenses.

While there is no consensus in literature over the classification of costs as a part of cost stickiness, and empirical tests performed, the main study over cost stickiness is the one by Anderson, Banker and Janakiraman (2003), and it is known as ABJ method as noted earlier (Dalla Via and Perego, 2014; 758). To explain cost behavior, Cooper and Kaplan (1998a,b) made estimations based on many managerial perspectives and focused on a variety of costs from a managerial standpoint. Anderson et al. (2003) focused on agency cost in consideration of SG&A cost (Cook et al., 2019: 3). The sticky cost behavior tested for H_1 hypothesis was also based on ABJ method, and many studies in literature adopt the method (Banker and Chen, 2006; Calleja et al., 2006; Anderson and Lanen, 2009; Banker et al., 2011). The following hypotheses are proposed to determine the sticky behavior of costs within the scope of the studies in the literature:

H_1: Cost is sticky for BRICS+T.

This hypothesis is divided into four sub-hypotheses:

H_{1a}: *SG&A costs are sticky for BRICS+T.*

H_{1b}: *COGS is sticky for BRICS+T.*

H_{1c}: *OC is sticky for BRICS+T.*

H_{1d}: *LC is sticky for BRICS+T.*

As H_1 hypothesis developed to identify cost stickiness is tested, the aspect of "time" is taken into account in literature. Therefore, H_{2-1} and H_{2-2} hypotheses were developed to test the cost stickiness's aspect of time. The hypotheses are as follows:

H_{2-1}: Cost stickiness reverses in subsequent periods.

This hypothesis is divided into four sub-hypotheses:

H_{2-1a}: *SG&A stickiness reverses in subsequent periods.*

H_{2-1b}: *COGS stickiness reverses in subsequent periods.*

H_{2-1c}: *OC stickiness reverses in subsequent periods.*

H_{2-1d}: *LC stickiness reverses in subsequent periods.*

H_{2-2}: Cost stickiness declines with the aggregation of periods.

This hypothesis is divided into four sub-hypotheses:

H_{2-2a}: *Cost stickiness of SG&A declines with the aggregation of periods.*

H_{2-2b}: *Stickiness of COGS costs declines with the aggregation of periods.*

H_{2-2c}: *OC stickiness declines with the aggregation of periods.*

H_{2-2d}: *LC stickiness declines with the aggregation of periods.*

It is of importance to identify firm characteristics that affect the level of cost stickiness, which is the final part of the first-group studies. These factors are Asset Intensity (Anderson et al., 2003; Calleja et al., 2006; Chen et al., 2012; Abu- Serdaneh, 2014; Banker and Byzalov, 2014; Bradbury and Scott, 2014), Property, Plant and Equipment Intensity (Bugeja et al., 2015; Magheed, 2016; Subramaniam and Watson, 2016), Debt Intensity (Calleja et al., 2006; Abu-Serdaneh, 2014; Banker and Byzalov, 2014; Bradbury and Scott, 2014; Magheed, 2016; Subramaniam and Watson, 2016), Employee Intensity / Labor Wage Intensity (Anderson et al. 2003; Dalla Via and Perego, 2014; Submariniam and Weidenmier, 2003) and Inventory Intensity (Submariniam and Weidenmier, 2003). The aforementioned factors except for debt intensity are expected to raise the level of cost stickiness. The hypotheses on cost stickiness and firm characteristics are as follows:

H_3: *The more asset intensity is, the higher the level of cost stickiness is.*

H_4: *The more property, plant and equipment intensity is, the higher the level of cost stickiness is.*

H_5: *The more inventory intensity is, the higher the level of cost stickiness is.*

H_6: *The more employee intensity is, the higher the level of cost stickiness is.*

H_7: *The more debt intensity is, the lower the level of cost stickiness is.*

In addition to the correlation between firm characteristics and sticky cost behavior, there are studies in literature conducted to test the relationship between economic growth, which is one of the macroeconomic indicators, and sticky cost behavior (Anderson et al., 2003; Abu-Serdaneh, 2014; Banker and Byzalov, 2014; Kim and Wang, 2014; Bu et al., 2015; Lee and Chiang, 2018; Yang, 2019). Cost stickiness is expected to rise at times of economic growth (Anderson et al., 2003; Banker and Byzalov, 2014; Kim and Wang, 2014; Bu et al., 2015: 10). The aforementioned studies took GDP into account as an indicator of economic growth, and H_8 hypothesis are proposed to test the relationship between economic growth and cost stickiness as it is expected to rise at times of GDP growth.

H_8: *The more the GDP is, the higher the level of cost stickiness is.*

The second group of studies focused on the causes of asymmetric cost behavior. As for the causes of asymmetric cost behavior, managers make a choice between two behaviors as a measure against uncertainty in sales. Stickiness of costs occurs if managers decide to retain unutilized resources rather than incur adjustment costs when volume of activity declines. In addition, the fact that managers think the decline in sales is temporary leads to an asymmetric cost behavior (Anderson et al., 2003). Chen et al. (2012) associate the cause of asymmetric cost behavior with the response of managers. They argue that incentives push managers go for growth beyond optimal levels. As sales increase, managers rapidly increase SG&A cost, and decrease it extremely slowly when sales are in decline. This leads to an asymmetric cost behavior. The managerial incentives of asymmetric cost behavior could not be investigated as a part of this study as there was no access to sufficient amount of data about firms in BRICS+T.

The third group covers studies over the relationship between corporate governance and asymmetric cost behavior (Calleja et al., 2006; Chen et al. 2012; Pichetkun, 2012; Banker et al., 2013; Xue and Hong, 2016). An effective corporate governance system would make a positive impact on managerial decisions and a robust corporate governance system would approximate the levels of cost stickiness to the optimum level of cost (Chen et. al., 2012). Ibrahim (2018) investigated the potential effect of corporate governance actions on asymmetric cost behavior (cost stickiness) in 80 Egyptian firms from 2008 to 2013. Their study reported that the cost of sales exhibits an asymmetrical behavior and that 1% increase in sales raises the cost of sales by 1.05% while 1% decrease in sales reduces the cost of sales by 0.87%. In the context of corporate governance, larger boards, role duality and more independent board members raise the level of sticky cost behavior while higher corporate ownership and economic growth reduce the level of sticky cost behavior. Cost stickiness could not be analyzed in this study, as there was no access to sufficient amount of data about corporate governance of firms in BRICS + T.

This study took into account not only the change of SG&A Cost but also the Cost of Goods Sales (COGS), Total Operating Cost (TOC) and Labor Cost (LC) to test cost stickiness as a part of the analyses. As a part of the study, developing economies (BRICS+T) were selected as a sample based on the aforementioned arguments. In addition to the studies carried out with focus on the subject of this study such as studies by Erdoğan et al. (2019) on the case of Turkey, Hacıhasanoğlu and Dalkılıç (2018) the case of Turkey, Ibrahim (2018) the case of Egypt, Zonatto et al. (2018) the case of India and a limited number of samples with 260 firms based in BRICS, Öztürk and Zeren (2016) on the case of Turkey, Çelik and Kök (2013) on the case of Turkey, Yükçü and Özkaya (2011) on the case of Turkey, the sticky cost behavior was tested by a large number of observations for multiple countries. In addition, the study addressed cost stickiness as a whole unlike the literature, and investigated whether multiple costs exhibit an asymmetrical behavior or not, and what firm characteristics affect cost stickiness. The study is expected to offer an input for the literature from the aforementioned perspectives.

3. Methodology, Sample and Data

This study investigated the sticky cost behavior of firms in BRICS+T from 2010 to 2019 based on various models. All the data obtained from Refinitiv's Thomson Reuters Datastream (in May 2020). The reason why the panel data set starts from 2010 is the intention to select a period of time following the global financial crisis that lasted from 2007 to 2009 and eliminate the potential effects of the financial crisis for analytical purposes. In addition, the financial data of all countries were based on dollar, the currency of the United States of America. Table 1 shows the number of total observations by countries. However, the observations with missing data and observations that failed to meet the requirements of the relevant model excluded from the analysis. Therefore, the number of observations varies by analysis, and thus it is presented for each model under the regression tables to have a better idea about the case.

Table 1: Countries and Total Number of Observations

Country	Freq.	Percent
Brazil	2,610	3.59
China	29,170	40.17
India	32,810	45.19
Russia	3,880	5.34
South Africa	1,680	2.31
Turkey	2,460	3.39
Total	72,610	100.00

Table 2 reports the industries of firms included in the study and total number of observations in industries. The study includes thirty-three industries. The industrial classification was made based on the first two digits of the four-digit industrial code that represent the main industry for each firm.

Table 2: Sectors

Sector	Freq.	Percent
Aerospace and Defense	510	0.70
Alternative Energy	550	0.76
Automobiles and Parts	3,640	5.01
Beverages	990	1.36
Chemicals	6,290	8.66
Construction and Materials	4,170	5.74
Electricity	2,120	2.92
Electronic and Electrical Equipment	2,020	2.78
Fixed Line Telecommunications	490	0.67
Food Producers	4,720	6.50
Food and Drug Retailers	500	0.69
Forestry and Paper	1,200	1.65
Gas, Water and Multiutilities	700	0.96
General Industrials	1,730	2.38
General Retailers	2,710	3.73
Health Care Equipment and Services	1,080	1.49
Household Goods and Home Construction	1,750	2.41
Industrial Engineering	4,350	5.99
Industrial Metals and Mining	4,380	6.03
Industrial Transportation	1,950	2.69
Leisure Goods	790	1.09
Media	1,230	1.69
Mining	1,470	2.02
Oil Equipment and Services	490	0.67
Oil and Gas Producers	710	0.98
Personal Goods	5,400	7.44
Pharmaceuticals and Biotechnology	4,700	6.47
Software and Computer Services	4,720	6.50
Support Services	1,510	2.08
Technology Hardware and Equipment	2,960	4.08
Tobacco	70	0.10
Travel and Leisure	1,940	2.67
Unclassified	770	1.06
Total	72,610	100.00

3.1. Empirical Models

The study included publicly-traded companies of BRICS+T considered to be developing economies at the time from 2010 to 2019 in an effort to determine their sticky cost behavior, identify firm characteristics and investigate the effect of GDP. Table 3 presents variables of the study and details on their measurements.

Table 3: Descriptions of Variables

Variable	**Variable Name**
COST	COST[a]
ΔSG&A Cost	Change of Selling ,General, and Administrative Costs[b]
ΔCOGS	Change of Cost of Goods Sales[b]
ΔOC	Change of Total Operating Cost[b]
ΔLC	Change of Total Labour Cost[b]
$\Delta REV1_{i,t}$	Change of Revenue (for two years)[b]
$\Delta REV2_{i,t}$	Change of Revenue (for three years)[c]
$D_{i,t}$	Dummy Variable (Decrease $Dummy_{i,t}$)[d]
$D_{i,t-1}$	Dummy Variable (Decrease $Dummy_{i,t-1}$)[e]
$D_{i,t}$ x Log ($\Delta REV1_{i,t}$)	Interaction-term
$SD_{i,t}$	Dummy Variable (Successive Decrease)[f]
$EG_{i,t}$	Economic Growth (GDP) (Macroeconomic Indicator- according to per capita national income)
Asset $Intensity_{i,t}$ (AI)	Total Asset/ Revenue
Employee $Intensity_{i,t}$ (EI)	Total Employee / Revenue
Debt $Intensity_{i,t}$ (DI)	Total Debts / Revenue
Property, Plant and Equipment $Intensity_{i,t}$ (PPEI)	Property, Plant and Equipment / Revenue
Inventory $Intensity_{i,t}$ (II)	Inventory / Revenue

[a]Cost statement separately represents change of Selling, General and Administrative Costs (SG&A Cost), Cost of Goods Sales (COGS), Operating Cost (OC) and Labor Cost (LC) in models.
[b] It is measured as the value of relevant variable of year t divided by that of year t-1 for the firm i
[c] It is measured as the value of relevant variable of year t-1 divided by the revenue of year t-2 for the firm i
[d] $D_{i,t}$ equals 1 if the current year's (t) revenue are less than the previous year's (t-1) revenue and 0 otherwise
[e] $D_{i,t-1}$ equals 1 if the previous year's (t-1) revenue are less than the two previous year's (t-2) revenue and 0 otherwise
[f] $SD_{i,t}$ takes the value 1 if the revenue of the year t-1 are lower than the revenue of the year t-2, and 0 otherwise

The following regression models were developed as a part of the study to test the hypotheses. The models were developed to determine sticky cost behavior, cost stickiness and reaction to the time dimension, as well as firm characteristics that affect the level of cost stickiness.

Costs sticky behavior (Model 1)

$$\log\left[\frac{COST_{i,t}}{COST_{i,t-1}}\right] = \beta_0 + \beta_1 \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \beta_2 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \varepsilon_{it} \quad (1)$$

The first equation tests the H1 hypothesis.

Costs, sticky behavior and time (Model 2)

$$\log\left[\frac{\mathrm{COST}_{\mathrm{i,t}}}{\mathrm{COST}_{\mathrm{i,t-1}}}\right] = \beta_0 + \beta_1 \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \beta_2 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right]$$
$$+\beta_3 \cdot \log\left[\frac{REV_{i,t-1}}{REV_{i,t-2}}\right] + \beta_4 \cdot D_{i,t-1} \cdot \log\left[\frac{REV_{i,t-1}}{REV_{i,t-2}}\right] + \varepsilon_{it} \quad (2)$$

The second equation tests $H_{2\text{-}1}$ and $H_{2\text{-}2}$ hypotheses.

Costs, sticky behavior and firm characteristics (Model 3)

$$\log\left[\frac{\mathrm{COST}_{\mathrm{i,t}}}{\mathrm{COST}_{\mathrm{i,t-1}}}\right] = \beta_0 + \beta_1 \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \beta_2 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right]$$
$$+ \beta_3 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot log\left[\frac{ASSETS_{i,t}}{REV_{i,t}}\right] + \beta_4 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot log\left[\frac{EMP_{i,t}}{REV_{i,t}}\right]$$
$$+ \beta_5 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot log\left[\frac{PPE_{i,t}}{REV_{i,t}}\right] + \beta_6 \cdot D_{i,t} \cdot log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot log\left[\frac{INVENTORY_{i,t}}{REV_{i,t}}\right] \quad (3)$$
$$+ \beta_7 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot log\left[\frac{TOT\_DEBTS_{i,t}}{REV_{i,t}}\right] + \beta_8 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot SD_{i,t} + \varepsilon_{it}$$

The third equation tests H_3-H_7 hypotheses.

Costs, sticky behavior, firm characteristics, and economic growth (Model 4)

$$\log\left[\frac{\mathrm{COST}_{\mathrm{i,t}}}{\mathrm{COST}_{\mathrm{i,t-1}}}\right] = \beta_0 + \beta_1 \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \beta_2 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right]$$
$$+ \beta_3 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot log\left[\frac{ASSETS_{i,t}}{REV_{i,t}}\right] + \beta_4 \cdot D_{i,t} \cdot log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot log\left[\frac{EMP_{i,t}}{REV_{i,t}}\right]$$
$$+ \beta_5 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot log\left[\frac{PPE_{i,t}}{REV_{i,t}}\right] + \beta_6 \cdot D_{i,t} \cdot log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot log\left[\frac{INVENTORY_{i,t}}{REV_{i,t}}\right] \quad (4)$$
$$+ \beta_7 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot log\left[\frac{TOT\_DEBTS_{i,t}}{REV_{i,t}}\right] + \beta_8 \cdot D_{i,t} \cdot log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot EG_{i,t}$$
$$+ \beta_9 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot SD_{i,t} + \varepsilon_{it}$$

The fourth equation tests H_8 hypothesis.

In addition to all, some additional analyses were performed by the addition of year, industry and country dummy variable to the end of all the equations.

4. Estimation Results

The sticky cost behaviors of the publicly-traded companies of BRICS+T were tested in various aspects to determine their level of cost stickiness. The statistical analysis consists of pooled regressions, based on ordinary least squares (OLS) (Dalla Via and Perego 2014; Anderson et al. 2003). Each model each sample by considering costs. The estimates are run through panel OLS estimator with robust standard errors, consistent with autocorrelation and heteroskedasticity (Siniţîn and Socol, 2020: 1040). Robust standard errors are often reported when the sample size is large. These standard errors are asymptotically valid in the presence of any kind of heteroskedasticity, including homoscedasticity (Wooldridge, 2002:57). When there is correlation between the independent variables, the results may be deviated. This problem, which is described as multicollinearity, can be measured with the variance inflation factors (VIF). When the VIF criteria is below 10, there seems to be no problem of multicollinearity among the variables (Orhunbilge, 2002: 242). It is checked the presence of multicollinearity and found that VIF criteria was below 10 for all models. This indicates that there is no collinearity problem between the independent variables.

Table 4 reveals no difference between taking the variables of year, industry and country dummy variables into account and not considering them in general. In consideration of the dummy variables, it was initially estimated the Model (1) with changes in SG&A costs, Cost of Goods Sales, Total Operating Cost, Labor Cost and Revenue defined for one-year periods. The estimated value of β_1 reveals that SG&A costs increase, on average, by 0.485 per cent for 1 per cent increase in sales revenue, the cost of goods sold increases by 1.023 per cent, which is more than the increase in revenues, the operating costs by 0.673 per cent and the labor cost by 0.479 per cent. The estimated value of β_2 is all negative. The combined value of $\beta_1 + \beta_2 = 0.3135$ indicates that SG&A costs decreased only 0.31% per 1% decrease in revenue. On the other hand, the combined value of $\beta_1 + \beta_2$ revels that the cost of goods sales decrease, on average, by 0.952 per cent for 1 per cent decrease in revenue, the operating costs by 0.544 per cent and the labor cost by 0.3027 per cent. This results provides strong support for the sticky costs hypothesis. This result reveals that H_1 hypothesis is accepted in accordance with the literature. Whether the dummy variable is taken into account or not, it would be pertinent to argue that sticky cost behavior is exhibited for all types of cost.

The aforementioned results of SG&A Cost are consistent with the results of the study, one of the leading ones over cost stickiness in literature, by Anderson et al. (2003) known as ABJ method. 1% increase in sales corresponded to 1.02% increase in cost of goods sales. This is consistent with the results of the studies in literature (Subramaniam and Weidenmier, 2003; Dalla Via and Perego, 2014). On the other hand, 1% decrease in sales resulted in 0.95% decline in COGS, and this is consistent with the results of the studies in literature (Subramaniam and Weidenmier, 2003). The results of operating cost show consistency with the results of the studies in literature (Calleja et al., 2006; Bugeja et al., 2015; Hartlieb and Loy, 2017; Bradbury and Scott, 2018). Finally, the same applies to labor cost, too (Dalla Via and Perego, 2014).

Table 4: Estimated Results of Regression Model on the Determination of Costs Sticky Behavior

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SG&A_Cost	COGS	OC	LC	SG&A_Cost	COGS	OC	LC
β_1	0.5074***	1.02601***	0.68259***	0.50552***	0.48525***	1.02261***	0.67264***	0.47934***
	(0.00753)	(0.00429)	(0.00355)	(0.00654)	(0.00757)	(0.00434)	(0.00355)	(0.0065)
β_2	-0.1645***	-0.07155***	-0.12524***	-0.17959***	-0.17174***	-0.07057***	-0.12827***	-0.17665***
	(0.01314)	(0.0067)	(0.00547)	(0.01024)	(0.01317)	(0.00674)	(0.00547)	(0.01014)
cons	0.05511***	-0.01014***	0.01112***	0.06613***	0.04483	0.01257	0.03007**	0.08935***
	(0.00292)	(0.00155)	(0.00128)	(0.00237)	(0.0283)	(0.01682)	(0.01457)	(0.03033)
Observations	32835	45178	40757	38799	32835	45178	40757	38799
R-squared	0.17014	0.72932	0.63701	0.1982	0.18571	0.73046	0.64376	0.22788
Year Dummy	NO	NO	NO	NO	YES	YES	YES	YES
Industry Dummy	NO	NO	NO	NO	YES	YES	YES	YES
Country Dummy	NO	NO	NO	NO	YES	YES	YES	YES

Notes:Standard errors are in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

The results of the regression models developed to test H_{2-1} and H_{2-2} hypotheses on cost stickiness and time are presented in Table 5.

In Table 5, to test the hypotheses that stickiness reversed in subsequent periods, we expanded the Model 1by including the terms of one-period lag changes in sales revenue. As can be seen from Table 5 there is not any difference between taking the variables of year, industry and country dummy variables into account and not taking them into account in general. SG&A Cost reveals that the significant and positive coefficient β_1 of 0.4939 is similar to its counterpart in the Model (1) estimation (Table 4), as is the significant and negative coefficient β_2 of –0.1920, supporting the sticky costs hypothesis. The significant and positive coefficient β_3 of 0.0745 indicates a lagged adjustment to SG&A for changes in revenue. Lastly, the estimated coefficient β_4 of 0.0455 is also significant and positive, indicating a partial reversal of stickiness in the period after a revenue decline ($\beta_4 <|\beta_2|$). When the coefficients for LC are checked in table 5, it is seen that similar results are obtained with SG&A cost. In this case, the comments for SG&A cost are the same for LC in all situation and for OC only without dummy variables. However, it is not possible to comment on the results obtained for COGS in all situation and OC with dummy variables. Since the general rule (as β_1 is >0 as a rule of thumb and β_2 is <0 and β_4 is $<|\beta_2|$) is not verified, the H_{2-1} and H_{2-2} hypotheses are not supported for COGS in all situation and OC with dummy variables. As late as these results support the hypothesis (H_{2-1}) that managers delay decisions to make reductions to committed resources. H_{2-1} and H_{2-2} hypotheses are confirmed by the empirical findings for SG&A Cost and LC. It would be pertinent to note that the results are consistent with the results of the studies by Anderson et al. (2003).

The results of the regression models built to test H_3-H_7 hypotheses developed to identify the relationship between cost stickiness and firm characteristics are presented in Table 6.

Table 5: Estimated Results of Regression Model on the Costs, Sticky Behavior and Time

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SG&A_Cost	COGS	OC	LC	SG&A_Cost	COGS	OC	LC
β_1	0.51436***	1.03565***	0.7176***	0.51213***	0.49387***	1.03176***	0.70653***	0.48078***
	(0.00863)	(0.00491)	(0.00393)	(0.00736)	(0.00867)	(0.00496)	(0.00395)	(0.0073)
β_2	-0.18881***	-0.08293***	-0.1732***	-0.20174***	-0.19197***	-0.08028***	-0.17246***	-0.18949***
	(0.01438)	(0.00732)	(0.00584)	(0.01105)	(0.01441)	(0.00736)	(0.00584)	(0.01091)
β_3	0.08573***	0.00601	0.04817***	0.07662***	0.0745***	0.00222	0.04429***	0.06836***
	(0.0077)	(0.00422)	(0.00337)	(0.00625)	(0.00774)	(0.00426)	(0.00338)	(0.00619)
β_4	0.04887***	0.04606***	0.01023*	0.05974***	0.04551***	0.04701***	0.00695	0.05509***
	(0.01387)	(0.00702)	(0.00541)	(0.01033)	(0.01386)	(0.00703)	(0.00539)	(0.01017)
cons	0.03886***	-0.01057***	0.00107	0.05512***	-0.05981*	0.02073	-0.03687**	-0.08172**
	(0.00341)	(0.00178)	(0.00141)	(0.00265)	(0.03068)	(0.01804)	(0.01491)	(0.03176)
Observations	28296	39064	36546	34461	28296	39064	36546	34461
R-squared	0.16899	0.72515	0.64487	0.20065	0.18242	0.72637	0.65061	0.23237
Year Dummy	NO	NO	NO	NO	YES	YES	YES	YES
Industry Dummy	NO	NO	NO	NO	YES	YES	YES	YES
Country Dummy	NO	NO	NO	NO	YES	YES	YES	YES

Notes: Standard errors are in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Table 6: Estimated Results of Regression Model on Correlation Between Costs, Sticky Behavior and Firm Characteristics

	(1) SG&A_Cost	(2) COGS	(3) OC	(4) LC	(5) SG&A_Cost	(6) COGS	(7) OC	(8) LC
β_1	0.56278***	1.0109***	0.84549***	0.60238***	0.54405***	1.00954***	0.83655***	0.55659***
	(0.0113)	(0.00497)	(0.00435)	(0.0101)	(0.01131)	(0.00503)	(0.0044)	(0.00988)
β_2	-0.4764***	-0.09251***	-0.08246***	-0.2444***	-0.52556***	-0.09516***	-0.09144***	-0.26703***
	(0.03804)	(0.01622)	(0.0135)	(0.03219)	(0.03812)	(0.01635)	(0.01355)	(0.03129)
β_3	0.05278***	0.00086	-0.01707***	0.016***	0.05243***	0.00071	-0.01677***	0.01619***
	(0.00387)	(0.00168)	(0.00137)	(0.00365)	(0.00384)	(0.00168)	(0.00137)	(0.00352)
β_4	0.00735	0.02215***	0.0083***	-0.02345***	0.01172**	0.02286***	0.00918***	-0.01879***
	(0.00546)	(0.00265)	(0.00196)	(0.00463)	(0.00543)	(0.00265)	(0.00195)	(0.00447)
β_5	-0.01103***	0.00104	0.03043***	0.00488	-0.01174***	0.00093	0.03024***	0.00365
	(0.00391)	(0.00175)	(0.00142)	(0.00341)	(0.00387)	(0.00175)	(0.00141)	(0.00329)
β_6	0.02133***	0.00625***	0.02179***	0.01403***	0.02134***	0.0063***	0.02181***	0.01388***
	(0.00391)	(0.00179)	(0.00142)	(0.00339)	(0.00388)	(0.00179)	(0.00141)	(0.00326)
β_7	0.01135***	-0.00023	0.00493***	0.0093***	0.01141***	-0.00032	0.00494***	0.00939***
	(0.00345)	(0.00153)	(0.00124)	(0.0029)	(0.00342)	(0.00153)	(0.00123)	(0.0028)
β_8	-0.27946***	-0.00117	0.12075***	-0.09402***	-0.28801***	-0.00003	0.11552***	-0.10688***
	(0.02807)	(0.01244)	(0.01006)	(0.02499)	(0.02792)	(0.01247)	(0.01004)	(0.02415)
cons	0.05236***	0.00014	0.01249***	0.07751***	-0.10749***	0.02129	-0.00702	-0.06794*
	(0.00408)	(0.0017)	(0.00144)	(0.00339)	(0.04165)	(0.01816)	(0.01561)	(0.03665)
Observations	15032	17885	16475	16399	15032	17885	16475	16399
R-squared	0.18769	0.8068	0.7904	0.22759	0.20704	0.80826	0.794	0.28747
Year Dummy	NO	NO	NO	NO	YES	YES	YES	YES
Industry Dummy	NO	NO	NO	NO	YES	YES	YES	YES
Country Dummy	NO	NO	NO	NO	YES	YES	YES	YES

Notes: Standard errors are in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Table 6 indicates that there is not any difference between taking the variables of year, industry and country dummy variables into account and not taking them into account in general. In consideration of the dummy variables, when there is cost stickiness for SG&A cost, the firm characteristics raise the level of PPEI (β_5) cost stickiness and reduces the level of cost stickiness of AI (β_3), EI (β_4), and, II (β_6) on the contrary. DI (β_7) decline the level of cost stickiness for SG&A cost. The results on COGS suggest that only EI (β_4) and II (β_6) variables raise the level of cost stickiness while other variables of firm characteristics cannot be commented as their coefficient are insignificant. From the perspective of OC, it can argue that AI (β_3) variable raises the level of cost stickiness on its own while other firm characteristics reduce the level of cost stickiness. While PPEI (β_5) variable's coefficient is insignificant and thus cannot commented from the perspective of LC variable, it can argue that EI (β_4) variable raises the level of sticky cost behavior, and other firm characteristics reduce the level of sticky cost behavior. When the results that exclude the dummy variables are compared to the results that include the dummy variables, only EI (β_4) variable's coefficient turned out to be insignificant from the perspective of SG&A Cost while comments about other factors were similar. From the perspective of COGS, OC and LC, the results and interpretations are consistent with the results that include the dummy variables. Based on the results that include the dummy variables for the four dependent variables of $H_{3\text{-}7}$ hypotheses,

- SG&A Cost in support of hypotheses H_4 and H_7,
- No hypothesis supported for COGS,
- OC in support of hypotheses H_4 and H_7,
- LC in support of hypotheses H_6 and H_7.

The results of the regression models built to test H_8 hypothesis developed upon the addition of the economic growth factor to variables of sticky cost behavior and firm characteristics are presented in Table 7.

Table 7 shows that the results of Model 4. Model 4 is created by adding the economic growth factor as a macroeconomic indicator to Model 3. Therefore, it would be pertinent to test H_{3-7} hypotheses again while testing H_8 hypothesis. Based on the inclusion of year, industry and country dummy variables, there is a sticky cost behavior for SG&A Cost. PPEI (β_5) variable's coefficient is insignificant as it was minus whereas other firm characteristics (AI [β_3], EI [β_4], II [β_6], DI [β_7]) reduced the level of cost stickiness, and the economic growth

Table 7: Estimated Results of Regression on Economic Growth in Addition to Sticky Cost Behavior and Firm Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SG&A_Cost	COGS	OC	LC	SG&A_Cost	COGS	OC	LC
β_1	0.56019***	1.01356***	0.84477***	0.59497***	0.5438***	1.01007***	0.8364***	0.55221***
	(0.01152)	(0.00496)	(0.00446)	(0.01041)	(0.01153)	(0.00502)	(0.00451)	(0.01018)
β_2	-0.54949***	-0.11217***	-0.07138***	-0.25909***	-0.59842***	-0.11336***	-0.08253***	-0.29609***
	(0.0404)	(0.01709)	(0.0144)	(0.03461)	(0.04053)	(0.01723)	(0.01446)	(0.03364)
β_3	0.05036***	-0.00333**	-0.0176***	0.01699***	0.04964***	-0.00345**	-0.0174***	0.01681***
	(0.00395)	(0.0017)	(0.00141)	(0.00376)	(0.00392)	(0.0017)	(0.00141)	(0.00363)
β_4	0.01864***	0.03327***	0.00751***	-0.02054***	0.02437***	0.03393***	0.00892***	-0.01227**
	(0.00605)	(0.00301)	(0.00217)	(0.00517)	(0.00603)	(0.00302)	(0.00216)	(0.005)
β_5	-0.00344	-0.00923***	0.0364***	0.00936**	-0.00429	-0.00946***	0.03638***	0.00865**
	(0.00531)	(0.00225)	(0.00188)	(0.00451)	(0.00527)	(0.00226)	(0.00187)	(0.00435)
β_6	0.02462***	0.01191***	0.02118***	0.01462***	0.02502***	0.0119***	0.02139***	0.01534***
	(0.00404)	(0.00186)	(0.00147)	(0.00353)	(0.00401)	(0.00186)	(0.00146)	(0.0034)
β_7	0.01484***	-0.00497***	0.00685***	0.01049***	0.01467***	-0.00504***	0.00685***	0.01065***
	(0.0036)	(0.00157)	(0.00129)	(0.00306)	(0.00357)	(0.00157)	(0.00129)	(0.00295)
β_8	-0.08141***	-0.06727***	-0.00029	-0.00802	-0.09475***	-0.06572***	-0.00482	-0.0397**
	(0.02441)	(0.00989)	(0.00813)	(0.01922)	(0.02429)	(0.00991)	(0.0081)	(0.01856)
β_9	-0.2107***	0.08847***	0.12456***	-0.09711***	-0.2038***	0.08795***	0.12375***	-0.08064***
	(0.03613)	(0.01591)	(0.01289)	(0.03099)	(0.03598)	(0.01594)	(0.01286)	(0.02993)
cons	0.05466***	-0.00149	0.01487***	0.08718***	-0.09956**	0.02813	-0.00561	-0.05096
	(0.00427)	(0.00175)	(0.00153)	(0.00361)	(0.04462)	(0.01897)	(0.01673)	(0.03951)
Observations	13761	16184	14768	14728	13761	16184	14768	14728
R-squared	0.19014	0.81986	0.79576	0.22924	0.20785	0.82119	0.79929	0.28979
Year Dummy	NO	NO	NO	NO	YES	YES	YES	YES
Industry Dummy	NO	NO	NO	NO	YES	YES	YES	YES
Country Dummy	NO	NO	NO	NO	YES	YES	YES	YES

Notes: Standard errors are in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

(β_8) raised its level. Based on the results from the perspective of COGS, the economic growth (β_8) and AI (β_3), PPEI (β_5), and, DI (β_7), which are firm characteristics, raised the level of cost stickiness while EI (β_4) reduced its level. From the perspective of OC, the economic growth's (β_8) coefficient could not be interpreted as it was insignificant while being a minus, and the AI (β_3) variable, one of the firm characteristics, was the only factor to raise the level of sticky cost behavior while other firm characteristics reduced the level of sticky cost behavior. This result on OC is also consistent with the results in Table 6. As for LC variable, the economic growth (β_4) and EI (β_4) variable raised the level of sticky cost behavior while other firm characteristics (AI [β_3], PPEI [β_5], II [β_6], and DI [β_7]) reduced it. When the results that exclude the dummy variables are compared to the results that include the dummy variables, the PPEI variable's coefficient turned out to be insignificant from the perspective of SG&A Cost while comments about other variables and economic growth (β_8) were similar. From the perspective of COGS, OC and LC, the results and comments are consistent with the results that include the dummy variables. The economic growth's (β_8) coefficient was insignificant and could not be interpreted for OC variable while comments on firm characteristics were similar. The economic growth's (β_8) coefficient was insignificant and could not be commented for LC variable while comments on firm characteristics were similar. Based on the results that include the dummy variables for the four dependent variables of H_{3-8} hypotheses,

- SG&A Cost in support of hypotheses H_7 and H_8,
- COGS in support of hypotheses H_3, H_4 and H_8,
- OC in support of hypotheses H_3 and H_7,
- LC in support of hypotheses H_6, H_7 and H_8.

With the addition of the economic growth variable, there is some change in the results of the H_3-H_7 hypotheses according to Table 6. As a result, it can argue that the addition of the economic growth variable to the regression model raises the possibility to test and interpret the firm characteristics.

5. Conclusion

This study aims to determine the sticky cost behavior of firms based in BRICS+T. In accordance with this purpose, investigated the reaction of sticky cost behavior to time, determined the firm characteristics that affect the level of cost stickiness, and analyzed the effect of economic growth on the level of sticky cost behavior in many aspects.

The results of the study suggest that the publicly-traded companies in BRICS+T exhibit a sticky cost behavior from the perspective of SG&A Cost, COGS, OC and LC. The results are consistent with Anderson et al. (2003), Subramaniam and Weidenmier (2003), Calleja et al. (2006), Dalla Via and Perego (2014), Bugeja et al. (2015), Hartlieb and Loy (2017), Bradbury and Scott (2018). Considering the time dimension after determining the existence of cost stickiness behavior, it is determined that the level of cost stickiness decline in the following periods. The firm characteristics that raised the level of cost stickiness were asset, property, plant and equipment, and employee intensity while debt intensity declined its level. This is consistent with the results of the studies over the determination of cost stickiness as well as studies by Abu-Serdaneh (2014) and Bradbury and Scott (2014). Last but not least, in this study, which examines the economic growth of countries, that is, the effect of GDP on cost stickiness, it has been determined that the level of cost stickiness also raised as expected in the periods when GDP raised. The results are consistent with Anderson et al. (2003), Banker and Byzalov (2014), Kim and Wang (2014), Bu et al., (2015).

Briefly, unlike the few other studies in the literature, the sticky cost behavior of the firms based in BRICS+T considered to be developing economies was tested by a large number of observations, and it was concluded that they exhibit a sticky cost behavior. Moreover, this study addressed the sticky cost behavior as a whole in a broader perspective. It study also adds to market forecasts by providing evidence that it is necessary to look at measurable macroeconomic factors such as GDP regarding cost behavior. When viewed from a macroeconomic perspective, the findings have important implications for the inflation dynamics. Accordingly, in case of aggregate demand expansion caused by a monetary shock, price increases may be faster than expected due to cost stickiness. On the other hand, as the aggregate demand returns to its normal level, asymmetric cost behavior indicates that the disinflation process will be slower. Together with these situations, some guiding results are offered for firms of developing economies, too. Finally, further studies can be conducted to compare sticky cost behaviors of firms in developing and developed economies, and determine the level of cost stickiness of firms in the aforementioned economies based on certain firm characteristics.

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Stock Market Inclusion and Its Connection with Economic Activity in Turkey

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ABSTRACT

This study explores the relationship between stock market inclusion and economic activity (liveliness) in Turkey by taking advantage of the recent contributions in causality theory. Stock market inclusion is represented by the seasonally adjusted real stock market trade volume per capita (TV) and economic activity by the seasonally adjusted real gross domestic product per capita (GDP). We use quarterly series covering the period 2003:1-2020:2 and employ asymmetric bootstrap and asymmetric Fourier bootstrap causality testing procedures to obtain robust parameter estimates. Both procedures adopt a nonlinear methodology but the latter is distinguished from the first in the sense that it follows a Fourier series approximation which allows for structural breaks of unknown number, form, and point. Empirical findings suggest that the Fourier-type asymmetric bootstrap causality procedure, thanks to its trigonometric components, captures two unidirectional (one-way) causalities; one running from the positive components of TV to those of GDP and the other running from the negative components of TV to those of GDP, but not vice versa. These findings verified a strong influence on GDP of the alterations i.e. positive and negative shocks in stock market conditions.

Key words: Stock market inclusion, economic activity, asymmetric bootstrap causality, Fourier series approximation

JEL classification: C22, E44, E61, G10

1. Introduction

The linkage between the financial markets and economic activity has been established by the famous work of Schumpeter long ago in 1911 (Schumpeter, 1911). Schumpeter claims that the development of the financial markets and banks combined with well-organized regulatory and supervisory financial institutions would facilitate the distribution of productive capital among the most efficient users, which in turn enhance economic growth and thus real income. This argument is later acknowledged by other studies such as Gurley and Shaw (1955), Goldsmith (1969), McKinnon (1973), and Shaw (1973), which are regarded as milestones in the literature. The positive influence of financial development on overall economic activity or real income, or on its distribution is still finding a widespread support even today [see, Azman-Saini et al. (2010), Bumann et al. (2013), Samargandi et al. (2015), Shahbaz et al. (2015), Caporale et al. (2015), Kandil et al. (2017), and most recently Asteriou and Spanos (2019), among others].

Stock markets have promising shares in the financial markets of the developing nations. Besides, stock market development is considered as one of the major indicators affecting economic growth [see, Demirgüç-Kunt and Levine (2001)]. As a developing nation, Turkey is not an exception when it comes to the figures depicting the improving share of Turkey's stock markets in its entire financial system. The course of improvement with respect to the Turkish stock market is illustrated by Table 1. Depending on the annual reports of Borsa İstanbul (BIST) published in 2018 and 2019, i.e. BIST (2018 and 2019), total value of stocks traded in BIST increases from 1993 billion TL in 2018 to 2130 billion TL in 2019. When we consider that the total trade value for BIST more than doubled from 7800 billion TL in 2018 to 19800 billion TL in 2019, we may conclude that there still is a room for improvement for the stock market's share in

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total value traded of BIST. The daily average stock value traded likewise rises from 7.9 billion TL to 8.5 billion TL between 2018 and 2019. The total market value of Turkish stock market is showing progress too: It jumped from 795 billion TL in 2018 to 1100 billion TL in 2019, which correspond to 21.3% and 25.9%, respectively as the shares in Turkish gross domestic product. These figures place the stock market of Turkey to the 21st rank among the entire global stock markets in both 2018 and 2019, verifying a stable global course.

This study investigates the relationship between stock market inclusion and economic activity, i.e. real per capita GDP in Turkey to put an emphasis on the linkage between the financial and real sectors of the Turkish economy. As stated above, the vast amount of studies in the related literature deal generally with the link between several financial development indicators and real economic activity, i.e. real income and/or its distribution. These studies mostly utilized "financial depth" measures such as the share of total credits to private sector, or that of total deposits in private and state-owned banks, or alternatively that of short-term financial liabilities in real GDP to mimic financial development. However, De la Torre et al. (2017), and TCMB (2011) stressed that the concept of financial development has multifaceted qualitative dimensions beyond financial depth, which can better be understood by financial inclusion. This study takes financial inclusion as access to stock markets depending on the importance of stock markets in Turkish financial system, illustrated above.

Our study is distinguished from the vast number of earlier empirical works for the reason that it adopts asymmetric bootstrap and asymmetric Fourier bootstrap causality testing procedures to obtain robust parameter estimates, and thus a reliable outcome. Both causality procedures follow a nonlinear methodology, but the one with a Fourier series approximation is distinguished from the other on the grounds that it allows for structural breaks of unknown number, form, and point thanks to its trigonometric components. Perron (1989) is the pioneering study which initially proved that structural breaks are very important components of a time series as they change the pattern (the mean and/or the time trend), namely the behavior of a series. The omission of breaks would lead to biased parameter estimates. For this reason, we followed two different causality procedures that allow for nonlinearities and structural breaks, which generally represent the true behavior of real life data series. As far as the authors of the present paper are concerned there is no previous study in the related literature that follows the comparative nonlinear causality framework adopted here. The rest of the paper is organized as follows. Second section provides a review of the recent literature. Third section depicts the data and source of the data. Fourth section explains the econometric methodologies. Fifth section illustrates the estimation results and makes an inference. And finally the sixth section concludes.

2. Literature review

The empirical literature on the nexus between financial inclusion and economic growth is exceedingly large. Besides, a wide range of dimensions have been added recently by the incorporation of new research questions such as those regarding poverty reduction, financial stability, firm size, natural resource-based economies, various development indices, and gender equality into the issue. It is worthwhile to note that the literature depicted here primarily focuses on the empirical papers that investigate the association between financial inclusion and economic growth or real income.

Table 1: Outlook of Turkey's Stock Market in Retrospect

Indicators (in billion TL)	2013	2014	2015	2016	2017	2018	2019
Total value traded	815	873	1026	1014	1468	1993	2130
Average daily value traded	3.3	3.5	4.1	4	5.9	7.9	8.5
Total value traded in BIST	7900	9000	11894	13018	6967	7800	19800
Total market value	503.7	627	555	614	880	795	1100
Total market value/ GDP (%)	27.6	31	21.5	26	28.3	21.5	25.9
Number of firms listed	421	422	429	405	411	416	402
Share of international investors (%)	62.5	64	62.4	64*	66	65	61

Note: The values are gathered by the authors from the annual reports of BIST published between 2013 and 2019, which are available on BIST's website "borsaistanbul.com". Symbol * implies that the value is calculated by the authors.

The literature on the positive effects on economic activity of different forms of financial inclusion is quite thick. Burgess and Pande (2005) documented that an increased financial inclusion would lead to a corresponding rise in real incomes and thus help reduce poverty in India. More specifically, they discovered by using data for the period 1977-1990 that rural poverty is alleviated as the public banks keep extending loans to rural regions of India. Andrianaivo and Kpodar (2011) investigated whether financial inclusion promotes economic performance in a sample of 44 African nations. They found a positive relationship between the two variables by adopting a GMM estimator. Inoue and Hamori (2016) conducted an investigation for 37 Sub-Saharan African countries by using data for 2004-2012. Their findings revealed that an improvement in the number of commercial bank branches fosters economic growth. Likewise, Kim et al. (2018) examines the connection between financial inclusion and economic growth for a sample of 55 OIC countries. They also conclude by using their findings from dynamic panel models, panel VAR estimations, and panel Granger causality tests that the first has a positive impact on the latter. Park and Mercado (2018) made a global analysis by using a data set for 176 countries to evaluate the inclusion-poverty and income inequality linkage. They report a strong correlation between a heightened financial inclusion and a lessened poverty and income inequality worldwide. Dawood et al. (2019) reports similar findings for the Indonesian economy. According to their findings, lifting the obstructions in front of free access to financial means would help lower poverty. Inoue (2019) employed a GMM approach and a data set covering the period between 1973 and 2004 to assess the relationship between poverty level and financial access in India. Their results unveiled that together with financial depth, inclusion has a positive impact on poverty reduction. Most recently, Huang et al. (2021) investigated by using a panel model and a data set for 1995-2015, the effect of access, depth, efficiency, and the overall development of financial institutions on economic growth in a sample of 27 EU nations, which comprises the low- and high-income countries as well as new and old member states as sub-samples. Their findings showed that the impact is positive for all country groups analyzed.

The flip side of the literature is represented by the studies evidencing that financial inclusion is either detrimental to or at best ineffective on economic performance. As a leading empirical study, Arestis et al. (2001) found evidence via a time series analysis in favor of the view that the previous cross-country studies may have exaggerated the positive impact of stock market access and development on economic growth rates. They report that the positive link is insignificant even in the advanced economies such as the US and the UK. In addition, they put that risks (or volatility) associated with the stock markets lead to negative growth dynamics in the UK, France, and Japan. Naceur and Ghazouani (2007) explored the correlations between bank and stock market development and economic growth by using a data set for 11 MENA region countries and employing a GMM estimator. They find that there is no significant relationship between bank or stock market development and economic activity. Moreover, they proved that the impact of bank development on economic growth is even negative having controlled for the stock market development. Barajas et al. (2013) investigated whether the favorable impact of financial deepening and access on economic growth varies across regions, income levels, and types of the economies by using a data set for 150 countries which covers the period 1975-2005. They found that the impact is heterogeneous at the international level. More specifically, their findings uncovered that oil-exporting and low-income nations make do with a smaller improvement in economic performance associated with an increased banking depth and stock market activity. They put that this unpleasant outcome appears due to lack of competition, efficiency, progress, and quality in the financial intermediation. Bhattarai (2015) is another pessimist study as it stresses that too much financial deepening and inclusion, which is defined by over-financing by using several financial deepening ratios, may lead to inefficiencies combined with fluctuations in the growth rates of the economies which in turn bring instability to both financial and real sectors. They put the argument by shedding light on the distinction between over-financed yet shrinking developed economies such as Germany, France, UK, USA, and Japan following the 2008 global financial crises and two largest emerging economies, namely China and India, who grew much faster during the post-crisis period despite the fact that they displayed a more discreet stance in financial deepening.

3. Data

Stock market inclusion is measured as the seasonally adjusted real stock market trade volume per capita (TV) and economic activity as the seasonally adjusted real gross domestic product per capita (GDP). We use quarterly series covering the period 2003:1-2020:2. The series, descriptive statistics and correlation coefficients of which are shown in Table 2 and Table 3 respectively, are gathered from TCMB's online database. The individual series TV and GDP are visually observable in Figure 1 and Figure 2, respectively.

Table 2: Descriptive Statistics for TV and GDP Series

	TV	GDP
Mean	2.746259	7.832110
Median	2.756540	7.841055
Maximum	4.525811	8.108382
Minimum	1.054181	7.455156
Std. Dev.	0.534348	0.168382
Skewness	-0.359500	-0.208370
Kurtosis	5.518304	2.109598
Observations	70	70

It is apparent from Table 2 that both TV and GDP series have positive mean and median values. The range for the values of the TV series is larger than that of the GDP. This finding is verified by the fact that the volatility value for the first is almost 3.2 times larger than that for the latter, i.e. 0.53 and 0.17, respectively. The skewness and kurtosis values for a normally distributed data series are equal to 0 and 3, or near values respectively. Negative values for skewness imply a left-skewed distribution (with a longer left tail), which is the case for both TV and GDP series. As for kurtosis, since the values for TV and GDP are far from being around 3, one can conclude that these series do not exhibit a standard normal distribution.

Table 3: Correlation between TV and GDP Series

	TV	GDP
TV	1	0.5335
GDP	0.5335	1

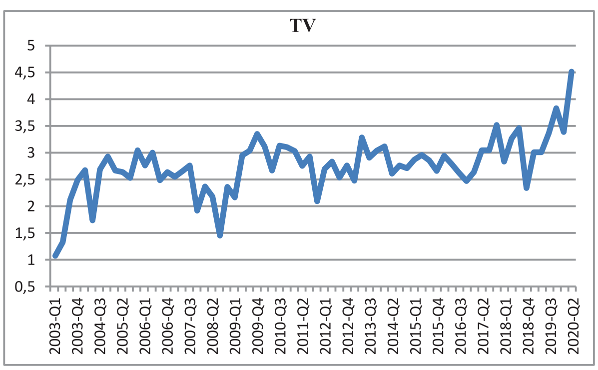

Figure 1: TV series: 2003:1-2020:2

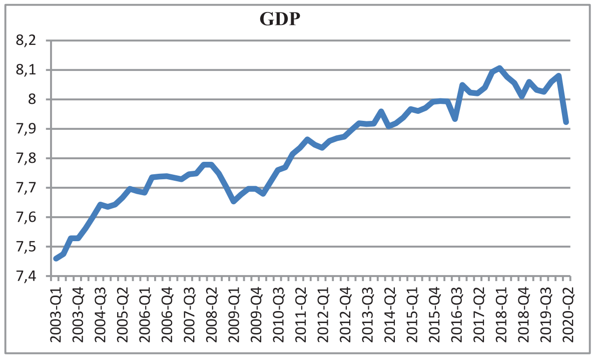

Figure 2: GDP series: 2003:1-2020:2

Figure 1 evidences that TV series represents a volatile behavior against time. In Figure 2, we see that there are two major structural shifts in GDP following 2008 and 2020, which correspond to the global financial crisis and the Covid-19 pandemic, respectively.

4. Econometric methodology: Causality tests

4.1. Asymmetric bootstrap causality test

Causality tests in econometrics date back to 1969 when C. W. J. Granger proposed an estimation methodology, where a time series is regressed on its own as well as on a second variable's lagged values. Sims (1972), Hsiao (1981), Toda and Yamamoto (1995), and Hacker and Hatemi-J (2006) are among the leading papers contributed to the causality literature. However, they share the same shortcoming that effects of both favorable and unfavorable developments on the variables are treated evenly i.e. symmetrically in those procedures. In real life, positive and negative shocks or events lead to asymmetric effects instead on both financial and real sectors of a national economy.

Granger and Yoon (2002) is the first study which put forward that the association between two time series could be quite different from those between the cumulative positive and/or negative components of those series. To put it clearly, two time series may not prove to be cointegrated, but they may respond to negative and/or positive events simultaneously. To clarify this property, they separated the series into positive and negative components and acknowledged that there may well be a "hidden" long-run relationship, i.e. a hidden cointegration, between the negative and/or the positive components of those series. Hatemi-J (2012) applied this asymmetric cointegration logic of Granger and Yoon (2002) into the causality framework. Likewise, they search for a similar hidden association between the negative and positive components of two time series, even when there is no causality at all between the level of these series themselves.

Let variables y_{1t} and y_{2t} be two integrated series, between which we are searching for a causality relationship. Hatemi-J (2012) defines them as random walk processes shown by Eq. (1) and Eq. (2).

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{10} + \sum_{i=1}^{t} \varepsilon_{1i} \quad (1)$$

$$y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{20} + \sum_{i=1}^{t} \varepsilon_{2i} \quad (2)$$

where $t = 1,2, \ldots T$; the constants y_{10} and y_{20} represent the initial values; and ε_{1i} and ε_{2i} symbolize white-noise disturbances. Positive and negative components of the variables are read as follows:

$$\begin{aligned} &\varepsilon_{1i}^{+} = \max(\varepsilon_{1i}, 0)\, , \varepsilon_{2i}^{+} = \max(\varepsilon_{2i}, 0) \;\; \text{(for positive shocks)} \\ &\varepsilon_{1i}^{-} = \min(\varepsilon_{1i}, 0)\, , \varepsilon_{2i}^{-} = \min(\varepsilon_{2i}, 0) \;\; \text{(for negative shocks)} \end{aligned} \quad (3)$$

So, we can rewrite the series as the combinations of the positive and negative components as follows [i.e. Eq. (4) and (5)]:

$$\varepsilon_{1i} = \varepsilon_{1i}^{+} + \varepsilon_{1i}^{-} \quad (4)$$

$$\varepsilon_{2i} = \varepsilon_{2i}^{+} + \varepsilon_{2i}^{-} \quad (5)$$

Substituting Eq. (4) and (5) into Eq. (1) and (2), respectively yields Eq. (6) and (7) below.

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{10} + \sum_{i=1}^{t} \varepsilon_{1i}^{+} + \sum_{i=1}^{t} \varepsilon_{1i}^{-} \quad (6)$$

$$y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{20} + \sum_{i=1}^{t} \varepsilon_{2i}^{+} + \sum_{i=1}^{t} \varepsilon_{2i}^{-} \quad (7)$$

Consequently, the positive and negative shocks can be written in a cumulative form as follows: $y_{1t}^{+} = \sum_{i=1}^{t} \varepsilon_{1i}^{+}$, $y_{1t}^{-} = \sum_{i=1}^{t} \varepsilon_{1i}^{-}$, $y_{2t}^{+} = \sum_{i=1}^{t} \varepsilon_{2i}^{+}$, and $y_{2t}^{-} = \sum_{i=1}^{t} \varepsilon_{2i}^{-}$.

Hatemi-J (2012) stressed that, by definition, positive and negative shocks would have permanent effects on the variables in question. Having constructed the above framework, he then estimates the causal association between the cumulative positive components as well as the cumulative negative components of the variables. Hatemi-J (2012) notes also that other potential causalities between the components can be tested in the further studies. Having presumed that $y_{t}^{+} = (y_{1t}^{+}, y_{2t}^{+})$, and $y_{t}^{-} = (y_{1t}^{-}, y_{2t}^{-})$ a vector autoregressive model of order p, i.e. $VAR(p)$. can be employed to determine the causal relationships. It is displayed in Eq. (8) and (9) below.

$$y_{t}^{+} = a + A_1 y_{t-1}^{+} + \cdots + A_p y_{t-p}^{+} + u_{t}^{+} \quad (8)$$

$$y_{t}^{-} = \beta + \gamma_1 y_{t-1}^{-} + \cdots + \gamma_p y_{t-p}^{-} + \omega_{t}^{-} \quad (9)$$

where y_{t}^{+} and y_{t}^{-} stand for the 2×1 vectors of the variables, a and β are the 2×1 vectors of intercepts, and u_{t}^{+} and ω_{t}^{-} represent 2×1 vectors of error terms that match the positive and negative cumulative components of the variables, respectively. The matrices A_r and γ_r are 2×1 matrices of coefficients for lag order r $(r = 1, \ldots, p)$. Hatemi-J (2012) introduces the following information criterion to choose the optimal lag length (p):

$$HJC = \ln\left(\left|\widehat{\Omega}_j\right|\right) + j\left(\frac{n^2 lnT + 2n^2 \ln(\ln T)}{2T}\right), \quad j = 0, \ldots, p. \quad (10)$$

In eq. (10), T stands for the sample size, and n represents the number of equations in the VAR system. $\left|\widehat{\Omega}_j\right|$ is the determinant of the estimated variance-covariance matrix of the error terms in the VAR system depending on the lag length j. Having picked the optimal lag length, the following two null hypotheses are tested: "k^{th} element of y_{t}^{+} does not Granger cause the m^{th} element of y_{t}^{+}", and "l^{th} element of y_{t}^{-} does not Granger cause the f^{th} element of y_{t}^{-}". A Wald-type test is performed, which is defined as follows:

$Y := (y_1^{+}, \ldots, y_T^{+})$ $\quad(n \times T)$ matrix,

$D := (a, A_1, \ldots, A_p)$ $\quad(n \times (1 + np))$ matrix,

$$Z := \begin{bmatrix} 1 \\ y_t^{+} \\ y_{t-1}^{+} \\ \vdots \\ y_{t-p+1}^{+} \end{bmatrix} \quad ((1 + np) \times 1) \text{ matrix, for } t = 1, \ldots, T;$$

$Z := (Z_0, \ldots, Z_{T-1})$ $\quad((1 + np) \times T)$ matrix, and

$\delta := (u_1^{+}, \ldots, u_T^{+})$ $\quad(n \times T)$ matrix.

In the final step, the $VAR(p)$ system is written in a compact form as in Eq. (11).

$$Y = DZ + \delta \quad (11)$$

Wald's test methodology is employed to test the null of non-Granger causality, i.e. $H_0 : C\emptyset = 0$.

$$\text{Wald} = (C\emptyset)'[C((Z'Z)^{-1} \otimes S_U)C']^{-1}(C\emptyset), \quad (12)$$

In Eq. (12), $\emptyset = vec(D)$, and vec implies the column-stacking operator; $\otimes$ stands for the Kronecker product, and C is a matrix of $p \times n(1 + np)$, the elements of which are one for restricted parameters and zero for the remaining parameters. S_U shows the variance-covariance matrix of the unrestricted VAR system, which is estimated as follows: $S_U = \frac{\widehat{\delta}'_U \widehat{\delta}_U}{T-q}$, where q is the number of parameters in each equation in the VAR system. The Wald statistic depicted above will have an asymptotic chi-square distribution with degrees of freedom equal to the number of restrictions to be tested, i.e. p, as long as the normal distribution is satisfied. Hatemi-J (2012) emphasized that real-life financial data generally follow a non-normal distribution. To resolve this problem, he obtains the critical values by utilizing bootstrap simulations.

4.2. Fourier-type asymmetric bootstrap causality test

Enders and Jones (2016) note that it is useful to use time dummies in order to estimate the precise point and magnitude of the structural break, when that break is sharp. If the structural break is smooth, an alternative approach is needed. Enders and Jones (2016) developed, by following Gallant (1981), a flexible Fourier series approximation shown in Eq. (13). They substitute the trigonometric components into the conventional Granger (1969) causality equations, which are illustrated in Eq. (14). n in Eq. (13), stands for the highest number of breaks that can be found in a data series such as y_t. However, identifying a large value for n generally corresponds to a case where the stochastic parameters change, which brings about a fall in the degrees of freedom and an over-parameterized (over-fitted) model. For this reason, as suggested by Becker, Enders, and Lee (2006), a single-frequency Fourier series component, displayed by Eq. (14), can be preferred which has a stronger potential to capture the breaks of indefinite number, form, and point in the deterministic trend of the series.

$$d(t) = a_0 + \sum_{k=1}^{n} a_{1k} \sin\left(\frac{2\pi kt}{T}\right) + \sum_{k=1}^{n} b_{1k} cos(\frac{2\pi kt}{T}) \quad (13)$$

$$d(t) = a_0 + a_1 \sin\left(\frac{2\pi kt}{T}\right) + b_1 cos(\frac{2\pi kt}{T}) \quad (14)$$

where k represents the number of frequencies in the Fourier function that minimizes the sum of squared residuals. t shows the trend component; T symbolizes the number of observations; and π is identical to 3.1416.

In addition, Nazlıoğlu et al. (2016) suggested superimposing the same Fourier series approximation into Toda and Yamamoto's (1995) causality testing procedure, which is represented by Eq. (15). Note that Eq. (15) redefines y_t in such a way as to make it reflect the gradual structural changes of unknown number, form, and point thanks to $d(t)$, the time-dependent constant parameter. Note also that these structural changes in y_t are disregarded, namely the constant parameter is presumed as fixed (time-independent), in a conventional VAR system.

Yılancı et al. (2019) developed the asymmetric Fourier causality test, which is a hybrid of the methodologies put forward by Hatemi-J (2012) and Nazlıoğlu et al. (2016). This study follows Yılancı et al. (2019) and estimates Eq. (16) and (17) and reports the estimation results in the next section. In Eq. (15), (16), and (17); p shows the optimal number of lags in the VAR system, and $dmax$, the maximal integration order of the variables.

5. Empirical findings and inference

Depending on the suggestion of Dolado and Lütkepohl (1996) we did not determine the integration orders, i.e. time series properties, of the variables by unit root testing procedures prior to the formal causality tests applied in this study. The same approach is followed more recently by an applied study by Yılancı and Bozoklu (2014). Findings from the asymmetric bootstrap causality test, which are reported in Table 4, suggest that there is causal linkage neither among the positive nor the negative components of TV and those of GDP series running in any direction. In other words, the asymmetric causality test failed to confirm any causality relationship between either the negative or the positive shocks in reference to the variables under investigation.

However, when the findings from the asymmetric bootstrap causality test with a Fourier series approximation are concerned there exist two causal connections: The first, running from the positive shocks of TV to those of GDP and the latter, from the negative shocks of TV to those of GDP, but not vice versa. This result acknowledges that the Fourier-type asymmetric bootstrap test captures a hidden causality basically running from TV to GDP, but not vice versa, when structural breaks of unknown number (k), form, and date are allowed for.

$$y_t = a_0 + a_1 \sin\left(\frac{2\pi kt}{T}\right) + b_1 cos\left(\frac{2\pi kt}{T}\right) + \beta_1 y_{t-1} + \cdots + \beta_{p+d} y_{t-(p+d)} + \varepsilon_t \quad (15)$$

$$Y_t = \beta_0 + \beta_1 \sin\left(\frac{2\pi kt}{T}\right) + \beta_2 \cos\left(\frac{2\pi kt}{T}\right) + \sum_{i=1}^{p+d_{max}} \theta_i Y_{t-i} + \sum_{i=1}^{p+d_{max}} \delta_i X_{t-i} + \varepsilon_t \quad (16)$$

$$X_t = \gamma_0 + \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) + \sum_{i=1}^{p+d_{max}} \tau_i Y_{t-i} + \sum_{i=1}^{p+d_{max}} \varphi_i X_{t-i} + u_t \quad (17)$$

Table 4: Asymmetric Bootstrap Causality Test Results

Procedure		Null	Test statistic	Critical Value			
				p	1%	5%	%10
Asymmetric causality test (Hatemi-J, 2012)	$TV \neq> GDP$	$TV^+ \neq> GDP^+$	2.161	1	8.105	4.198	2.893
		$TV^- \neq> GDP^-$	1.298	1	8.297	4.181	2.717
	$GDP \neq> TV$	$GDP^+ \neq> TV^+$	0.292	1	8.207	4.073	2.779
		$GDP^- \neq> TV^-$	0.005	1	9.082	4.156	2.678

Note: p, determined by the Hatemi-J Criterion (HJC), shows the optimal lag length of the VAR model. Symbols *, **, and *** stand for statistical significance at 10%, 5%, and 1%, respectively. $X \neq> Y$ implies the null of "X does not Granger cause Y".

Table 5: Asymmetric Fourier Bootstrap Causality Test Results

Procedure		Null	Wald statistic	Bootstrap Probability	Optimal lag length	Optimal frequency number (k)	dmax
(Yilanci et al. 2019)	Asymmetric Fourier causality test	$TV^+ \neq> GDP^+$	48.630	0.000***	9	3	1
		$TV^- \neq> GDP^-$	27.510	0.010**	9	3	1
		$GDP^+ \neq> TV^+$	12.533	0.240	9	3	1
		$GDP^- \neq> TV^-$	13.374	0.198	9	3	1

Note: One additional lag is imposed into the VAR system as dmax. Symbols *, **, and *** stand for statistical significance at 10%, 5%, and 1%, respectively. $X \neq> Y$ implies the null of "X does not Granger cause Y".

6. Conclusion and economic policy suggestions

In this paper we examine the causal relationship between stock market inclusion and economic activity in Turkey. We hypothesize that any positive and/or negative development in Turkish stock market inclusion may lead to respectively a positive and/or a negative development in the real economy. In other words, we postulate that there are causal linkages between the financial and real sectors in Turkey.

Stock market inclusion is measured as the seasonally adjusted real stock market trade volume per capita (TV) and economic activity as the seasonally adjusted real gross domestic product per capita (GDP). Quarterly series covering the period 2003:1-2020:2 are used and asymmetric bootstrap and asymmetric Fourier bootstrap causality testing procedures are employed to obtain robust parameter estimates. Both procedures follow a nonlinear form but the latter is distinguished from the first in the sense that it utilizes a Fourier series approximation which allows for structural breaks of unknown number, form, and point.

The findings from our empirical analyses are quite interesting. The asymmetric bootstrap causality test without the Fourier series approximation failed to capture any causality in any direction among the positive and negative components of TV and those of GDP. However, thanks to its trigonometric components which allow for structural breaks of indefinite point, number and form, the Fourier-type asymmetric causality test verified that there exist two unidirectional causal linkages between TV and GDP: The first linkage running from the positive components of TV to those of GDP and the second linkage running from the negative components of TV to those of GDP, but not vice versa.

These results unveiled that a strong hidden causality exists between the positive and negative developments regarding the TV and those concerning the GDP, respectively. To put it more specifically, positive and negative shocks in TV represent causal associations that justify respectively the positive and negative developments in GDP. Our findings are consistent with the argument that stock market (or financial) inclusion induces economic activity. More specifically, the findings from the asymmetric Fourier bootstrap causality procedure are supported by Burgess and Pande (2005), Dawood et al. (2019) and Inoue (2019) who also found a positive connection between stock market and financial development or inclusion and economic performance in different individual emerging market economies like Turkey. Our findings are consistent also with the following studies which adopted panel data settings with samples of developing or developed nations:

Andrianaivo and Kpodar (2011), Inoue and Hamori (2016), Kim et al. (2018), Park and Mercado (2018), and Huang et al. (2021).

The major policy suggestion that follows from the findings is that the policy makers in Turkey should consider the fact that the policies that stimulate stock market inclusion would also trigger improvements, namely positive growth dynamics, in real GDP of Turkey. Besides, they also have to take into consideration that a negative policy shock affecting the stock market inclusion would also set off a corresponding negative effect on the real economic activity.

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The Nexus Between Tourism, Environmental Degradation and Economic Growth

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ABSTRACT

This study analyzes the impact of tourism on environmental degradation for 32 OECD countries employing panel estimation techniques taking into consideration cross-sectional dependence. The test results demonstrate that tourism and economic growth enhance CO2 emissions in these countries. The Emirmahmutoglu-Kose panel Granger causality test show that unidirectional association running from tourism to CO2 emissions exists in OECD countries. For individual countries, bidirectional association between tourism and CO2 emissions for Canada, a unidirectional association from tourism to CO2 emissions for Chile, Germany, Ireland, Latvia, and United States exists. Bidirectional relationship is also confirmed between tourist arrivals and GDP for Austria, Germany, and Slovak Republic. Moreover, unidirectional causality is found from tourist arrivals to GDP for Colombia, Latvia, Netherlands, Poland, and Spain.

Keywords: Tourism, CO2 emissions, OECD countries, Cross-sectional dependence, Emirmahmutoglu-Kose panel Granger causality test

JEL codes: C23, O13, O44, Z32

INTRODUCTION

The nexus between tourism and CO2 emissions has drawn much research interest recently due to an increasing trend in CO2 emissions which have been witnessed in the world. Lenzen et al. (2018) estimated the contribution of international tourism account for 8% of global greenhouse gas emissions. Besides, international tourism may contribute to CO2 emissions by variety of factors such as tourist activities (Becken and Simmons, 2002; Becken and Patterson, 2006) air travel (Gössling, 2000; Olsthoorn, 2001; Gössling, 2002; Gössling et al. 2002; Gössling et al., 2005; Kuo and Chen, 2009), infrastructure facilities, such as hotels, roads, airports and other tourist establishments (Katircioglu 2014a; Katircioglu et al., 2018). Pang et al. (2013) argue that while tourism may be affected due to the climate changes, at the same time, tourism sector contributes to CO2 emissions. Scott (2011) emphasizes that it is crucial for the sustainability of tourism, the response of tourism to climate change. Besides, Fang et al. (2018) conclude that the examination of the nexus between climate change and tourism has been rapidly increased between 1990 and 2015 analyzing 976 academic papers indicating the importance of tourism on environmental degradation.

International tourism affect economy through different channels, such as creating job opportunities, increasing income levels, and foreign exchange reserves (Balaguer and Cantavella-Jorda, 2002; Dritsakis, 2004; Zhang and Gao, 2016; Alam and Paramati, 2016; Paramati et al., 2017a; Shahzad et al. 2017). According to the report of Travel Tourism Economic Impact (2019) published by World Travel and Tourism Council in 2019, the tourism sector's direct and total contributions to World's GDP in 2018 were 3.2% and 10% of total GDP in the world, respectively. The report also indicated that sector generated about 122.8 million jobs (3.8% of total employment) directly and 318.8 million jobs (10% of total employment) indirectly.

As aforementioned above, it is important to examine the dynamic relationship between tourism, CO2 emissions, and economic growth in a combined approach to implement policies aiming at higher economic

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growth and number of tourist arrivals without harming environment. The primary purpose of this paper is to examine the relationships among tourism, CO2 emissions, and economic growth utilizing Common Correlated Effects Mean Group (CCE-MG) developed by Pesaran (2006) and Augmented Mean Group (AMG) estimator proposed by Eberhardt and Teal (2010). This study further employs Emirmahmutoglu-Kose (2011) panel Granger causality test to find the direction of causality between tourism, CO2 emissions, and economic growth for OECD countries.

LITERATURE REVIEW

Numerous studies have examined the effect of tourism activities on CO2 emissions with different contexts. Becken (2013) provides compressive reviews on the relationship between tourism and climate change. The literature review section discusses the nexus between tourism, CO2 emissions and economic growth.

Tourism and economic growth

There is mounting mass of literature estimating the nexus between tourism and economic growth in a multivariate framework focusing on a single country or group of countries utilizing various econometric analysis. However, the results of the studies are ambiguous due to the sample of countries, time period, used methodology, selected variables and the data. Besides, comprehensive surveys provide valuable insights on this issue utilizing meta-analysis (Nunkoo et al., 2020; Fonseca and Sánchez Rivero, 2019; Qin et al., 2018; Seetanah et al, 2017; Castro-Nuño et al., 2013). For instance, Fonseca and Sánchez Rivero (2019) employ a meta-analysis on a dataset of 55 studies employing Granger causality test concluding that the tourism-led growth hypothesis is inclined to be confirmed more populated countries and countries which is more specialized in tourism activities. Seetanah et al. (2017) and Nunkoo et al. (2020) emphasize that data, econometric methodology used in the paper affects the results of the studies. Castro-Nuño et al. (2013) conclude that tourism activities contribute to economic growth. Lee and Brahmasrene (2016) conclude that economic growth is positively affected by tourism in Sub-Saharan African countries. For four Pacific Island countries, Narayan et al. (2010) found that a rise in tourism contributes to a rise in economic growth.

The causal relationship between tourism and economic growth has been synthesized into four hypotheses. First hypothesis called tourism-led growth hypothesis asserts that tourism contributes to economic growth positively. A unidirectional causal relationship running from tourism to economic growth was found by many studies of Gunduz and Hatemi-J (2005) for Turkey; Tang et al. (2016) for India; and Tang and Abosedra (2016) for Lebanon; Tang and Tan (2015) for Malaysia; Wu and Wu (2019) for Cambodia, China, and Malaysia. Qureshi et al. (2017) confirm the TLG hypothesis for 37 tourism- induced countries. Isik et al. (2017) confirmed TLG hypothesis for China, and Turkey. Again, similar result obtained for China, Turkey, and for the top seven most visited destinations by Isik et al. (2018). Tang and Abosedra (2014) support the TLG hypothesis in the MENA region. Shahzad et al. (2017) confirm TLG hypothesis for top ten tourism countries. Balli et al. (2019) for Egypt, Italy, and Spain.

Second, economic-driven tourism hypothesis indicates that economic growth leads to an increase in tourism. The second hypothesis confirmed by Isik et al. (2018) for Spain; Oh (2005) for South Korea.

Third hypothesis considers that bidirectional causality exists between tourism and economic growth. Such bidirectional causal relationship confirmed in many countries. For instance, Demiroz and Ongan (2005) and Balli et al. (2019) for Turkey; Cortes-Jimenez and Pulina (2010) and Perles-Ribes et al. (2017) for Spain; Lean and Tang (2010) for Malaysia; Isik et al. (2018) for Germany; Ben Jebli Hadhri (2018) for a sample of top ten tourism countries; Aslan (2014) for Portugal; Dogru and Bulut (2018) for seven Mediterranean countries; Mitra (2019) for 158 countries, dividing into three sub-groups according to the ratio of international tourism receipts to GDP. Akadiri and Akadiri (2019) for 16 selected tourism island countries, Akadiri et al. (2020a) for Germany.

Fourth hypothesis indicates that no causal relationship between tourism and economic growth exists. The fourth hypothesis confirmed by Katircioglu (2009) for Turkey; Isik et al. (2018) for France, Italy, and the US; Aslan (2014) for Malta and Egypt; Wu and Wu (2019) for Japan and Thailand.

Tourism and CO2 Emissions

Most studies found a positive impact of tourism on climate change. Dogru et al. (2019) provide evidence of the presence of the vulnerability of tourism sector to climate changes. León et al. (2014) reveal that tourism leads to an increase in CO2 emissions in the different stage of developed countries. Zaman et al. (2016) point out that tourism expansion contributes the environmental deterioration for 34 countries. Dogan (2017) found positive correlation between tourism and CO2 emissions for top ten most visited destinations.

Paramati et al. (2017a) argue that the tourism affects CO2 emissions positively, but magnitude differs across developing and developed countries. Paramati et al. (2017b) demonstrated that tourism activities surge CO_2 emissions in Eastern EU, while decrease in Western EU. Gulistan et al. (2020) find that tourism negatively affects environment via increasing CO2 emissions for 112 countries.

In contrast, Lee and Brahmasrene (2013) found that tourism negatively correlated with CO2 emissions in the EU countries. Brahmasrene and Lee (2017) find that tourism activities reduce CO2 emissions in the ten Southeast Asian countries. Azam et al. (2018) found that while there is negative association between tourism and environmental pollution for Singapore and Thailand, a positive association found for Malaysia.

Regarding Turkey, Katircioglu (2014a) and Eyuboglu and Uzar (2019) found positive correlation between tourism and CO2 emissions. Similar finding is obtained for Cyprus by Katircioglu et al. (2014).

Saint Akadiri et al. (2019) point out that tourism gives rise to CO2 emissions in Turkey. Unidirectional causal association found from tourism to CO2 emissions by many scholars both for a group of counties or in a country level. Dogan and Aslan, 2017; Dogan et al., 2017 for OECD countries; Sharif et al., 2017 for Pakistan; Solarin, 2014 for Malaysia; Yorucu, 2016 for Turkey; Raza et al., 2017 for the United States. Alola et al. (2019) confirm bidirectional association between tourist arrivals and CO2 emissions for nine Coastline Mediterranean Countries. Katircioglu et al. (2019) found that tourism growth was positively associated with energy consumption in major tourism countries, suggesting that countries need to invest more renewable energy usage sources for no harm to the environment. Shi et al. (2019) found that net international arrivals positively affect CO2 emissions. Kadir et al. (2019) argued that tourism was positively correlated with CO2 emissions for 30 selected countries. Akadiri et al. (2020b) found that unidirectional causal association between tourism and CO2 emissions exists for 16 island developing economies. Eluwole et al. (2020) conclude that tourism contributes to environmental deterioration for 37 developed countries. Katircioglu et al. (2020) pointed out that tourism results in CO2 emissions in Cyprus.

Apart from that, some other studies also examined whether the tourism-induced EKC hypothesis is valid for countries. Katircioglu (2014b) posits that tourism contributes to environmental degradation in establishing the tourism-induced EKC in Singapore. For Turkey, De Vita et al. (2015) provide evidence for the presence the tourism-induced EKC. For Asia-Pacific countries, Shakouri (2017) provide evidence of the validity of tourism-induced EKC hypothesis. On the other hand, Zhang and Gao (2016) provide no evidence to presence of tourism induced EKC for China.

DATA, METHODOLOGY and MODEL

The objective of this paper is to examine the relationship between tourism, CO2 emissions, and economic growth for selected OECD countries, namely Australia, Austria, Belgium, Canada, Chile, Colombia, Czech Republic, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Korea, Rep., Latvia, Lithuania, Luxembourg, Mexico, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Turkey, United Kingdom, and United States. The dataset for the countries covers the period from 1995 to 2014 and extracted from World Bank. The final period as 2014 was determined by the availability of the data for CO2 emissions variable. We used CO2 emissions as the measurement for environmental degradation.

Several study such as Gunduz and Hatemi-J, 2005; Katircioglu et al., 2014; Dogan and Aslan, 2017 used tourist arrivals to measure tourism activities. In the present study, CO2 emissions is used as an environmental degradation variable. Following Tang et al. (2014), and Lee and Brahmasrene (2013) the model is expressed as follows:

$$CO_{2t} = f(TOU_{it}, GDP_{it})$$

where TOU_{it} is number of tourist arrivals, CO_{2it} denotes CO2 emissions, and GDP_{it} denotes GDP per capita at 2010 prices.

Cross-sectional dependence and homogeneity tests determine the appropriate econometric methodology in the analysis. Hence, this paper utilized cross-sectional independence test proposed by Pesaran (2004), and homogeneity test developed by Pesaran-Yamagata (2008). After cross-sectional independence and homogeneity test, we investigate the time series properties of the variables utilizing CIPS unit roots developed by Pesaran (2007) that takes into account cross-sectional dependence. Then, according to the data characteristics of the used variables in the study, we employ common correlated effect (CCE) estimator taking into account the cross-sectional dependence developed by Pesaran (2006) and Augmented Mean Group (AMG) estimator proposed by Eberhardt and Teal (2010). Finally, in order to determine the direction of causal relationship between tourism, CO2 emissions and economic growth, we used Emirmahmutoglu-Kose (2011) Granger panel causality test.

EMPIRICAL RESULTS

Before investigating the linkages among tourism, CO2 emissions and economic growth, first, we analyze cross-sectional dependence test proposed by Pesaran (2004) between variables and homogeneity test developed by Pesaran-Yamagata (2008) across OECD countries, and the results are illustrated in Table 1 and Table 2.

Table 1: Cross-sectional dependence test results

lnCO2	20.86*
lnTOU	65.32*
lnGDP	85.74*

* refers to a significance level of 1%.

According to the results there exists cross-sectional dependence, implying that a shock occurred in one OECD countries may spill over to other countries.

Table 2: Delta Homogeneity Test Results

$\tilde{\Delta}$	2.729*
$\tilde{\Delta}adj$	3.212*

* refers to a significance level of 1%.

Table 2 reports Delta homogeneity test results. According to the results, we reject the null hypothesis of slope homogeneity, confirming cross-country heterogeneity for OECD countries.

Table 3: The Results of CIPS Unit Root Test

lnCO2	-1.746
lnTOU	-2.196
lnGDP	-1.296
ΔlnCO2	-4.142 *
ΔlnTOU	-3.819 *
ΔlnGDP	-2.802 *

* refers to a significance level of 1%.

Table 3 presents CIPS unit root test results developed by Pesaran (2007). The results reveal that we fail to reject the null hypothesis of unit root at level, however, we reject the null at first difference.

Table 4: Panel Cointegration Test Results

Durbin-H Group	18.049 *

* refers to a significance level of 1%.

According to the Westerlund–Durbin–Hausman (2008) panel cointegration test results tourist arrivals, CO2 emissions and economic growth are cointegrated.

Table 5: Individual CCE-MG Test Results

Country	Dependent variable: CO2 emissions	
	lnTOU	**lnGDP**
Australia	-0.31	0.35
Austria	0.49***	-1.11
Belgium	0.29	1.77
Canada	0.34**	0.35
Chile	0.21	0.56
Colombia	-0.04	1.40*
Czech Republic	0.18**	-0.22
Finland	0.20	-2.69**
France	-0.01	0.98
Germany	-0.12	0.77*
Greece	0.08	0.41**
Iceland	0.42**	0.75
Ireland	0.32	0.65*
Israel	-0.04	2.28*
Italy	-0.27*	1.54*
Japan	-0.05	2.49*
Korea, Rep.	0.23	1.13*
Latvia	0.52*	-0.51
Lithuania	-0.10	1.06*
Luxembourg	-0.01	-0.64
Mexico	-0.20**	0.22
Netherlands	-0.02	-0.58***
Norway	0.31	1.51
Poland	-0.18	0.85*
Portugal	0.24	2.12***
Slovak Republic	0.14**	0.25**
Slovenia	0.12	1.36*
Spain	0.33	2.37*
Sweden	0.04	2.22**
Turkey	-0.01	1.18*
United Kingdom	-0.13	0.72**
United States	0.05	1.38*
Panel	0.08**	0.78*

The results of CCE-MG estimation are presented in Table 5. CCE-MG test results show that an increase in tourist arrivals lead to an increase in CO2 emissions in Austria, Canada, Czech Republic, Iceland, Latvia, Mexico, and Slovak Republic. Besides, an increase in GDP results in an increase in CO2 emissions most OECD countries.

Table 6: Individual AMG Test Results

Country	Dependent variable: CO2 emissions	
	lnTOU	lnGDP
Australia	-0.33**	1.26*
Austria	0.48	1.43*
Belgium	0.30	0.11
Canada	0.37*	0.65*
Chile	0.21	0.56
Colombia	-0.10**	1.99*
Czech Republic	-0.13	0.46*
Finland	0.07	0.86*
France	-0.01	1.02*
Germany	-0.01	0.38
Greece	0.11	0.67*
Iceland	0.39**	0.27**
Ireland	-0.13	0.77*
Israel	-0.07***	2.02*
Italy	-0.28*	1.75*
Japan	-0.05	1.27*
Korea, Rep.	0.49*	0.54
Latvia	0.62*	-0.70*
Lithuania	-0.15	0.36***
Luxembourg	-0.39	1.16*
Mexico	-0.26	0.82*
Netherlands	-0.09***	0.13
Norway	0.10	1.23
Poland	0.26**	0.53**
Portugal	0.20	1.68*
Slovak Republic	0.09**	0.17**
Slovenia	0.04	0.66*
Spain	0.49**	1.12*
Sweden	0.11	0.10
Turkey	0.04	0.64*
United Kingdom	-0.01	0.67*
United States	0.01	0.74*
Panel	0.07***	0.79*

AMG test results are illustrated in Table 6. The results reveal that a rise in tourism increases environmental deterioration in Australia, Canada, Colombia, Iceland, Israel, Italy, Latvia, Netherlands, Poland, Slovakia, and Spain. Similar to the panel CCE-MG test results, panel AMG results show that GDP was positively correlated with CO2 emissions in most OECD countries. The surge in GDP results in increase in CO2 emissions in most OECD countries.

In addition, panel CCE-MG and panel AMG estimators reveal that the CO2 are positively affected by tourism and economic growth. The panel CCE-MG estimation results exhibit that an 1% increase in tourism contributes to CO emissions by 0.08%. Moreover, a 1% increase in GDP leads to a rise in CO2 emissions by 0.78% in a panel of OECD countries.

Finally, causality between TOU and CO2; TOU and GDP, GDP and CO2 was tested by Emirmahmutoglu-Kose (2011) panel Granger causality test.

Table 7 shows Emirmahmutoglu-Kose panel Granger causality test results between TOU and CO2 emissions for 32 OECD countries. The results show that unidirectional association from TOU to CO2 emissions in OECD countries exists. For individual countries, bidirectional association between TOU and CO2 emissions for Canada is found. The results also show that a unidirectional association from TOU to CO2 emissions for Chile, Germany, Ireland, Latvia, and United States exists.

Table 7: Emirmahmutoglu-Kose Granger panel causality test results

Country		TOU => CO2			CO2 => TOU	
	Lag	Wald Statistic	p-value	Lag	Wald Statistic	p-value
Australia	1	1.255	0.263	1	1.875	0.171
Austria	1	0.129	0.719	1	3.033	0.082***
Belgium	2	0.952	0.621	2	17.479	0.000*
Canada	1	5.711	0.017**	1	6.054	0.014**
Chile	2	10.945	0.004*	2	10.676	0.005*
Colombia	2	2.215	0.330	2	3.155	0.207
Czech Republic	1	0.744	0.388	1	2.380	0.123
Finland	1	0.125	0.724	1	3.389	0.066***
France	4	0.967	0.617	2	0.594	0.743
Germany	1	3.876	0.049**	1	0.390	0.532
Greece	2	0.568	0.753	3	6.589	0.086***
Iceland	3	1.274	0.735	1	0.035	0.851
Ireland	3	8.088	0.044**	1	0.024	0.876
Israel	1	1.604	0.205	1	1.766	0.184
Italy	1	0.768	0.381	2	12.373	0.002*
Japan	3	1.561	0.668	1	0.000	0.998
Korea, Rep.	1	0.214	0.644	1	0.266	0.606
Latvia	2	6.654	0.036**	1	0.082	0.775
Lithuania	1	0.633	0.426	1	0.723	0.395
Luxembourg	2	0.135	0.935	2	2.080	0.353
Mexico	1	0.470	0.493	1	0.191	0.662
Netherlands	3	4.075	0.253	2	9.843	0.007*
Norway	1	1.467	0.226	1	0.164	0.685
Poland	3	2.087	0.554	1	0.012	0.912
Portugal	2	1.014	0.602	1	0.188	0.664
Slovak Republic	1	0.343	0.558	1	0.733	0.392
Slovenia	1	1.007	0.316	2	0.886	0.347
Spain	1	0.000	0.993	1	0.868	0.648
Sweden	1	0.754	0.385	1	2.206	0.137
Turkey	2	1.351	0.509	1	0.470	0.493
United Kingdom	3	0.179	0.981	2	0.152	0.927
United States	1	8.192	0.004*	1	0.139	0.709
Panel Fisher		84.897			110.119 **	

Table 8 exhibits Emirmahmutoglu-Kose panel Granger causality test results between TOU and GDP for 32 OECD countries. The results show that bidirectional relationship between tourist arrivals and GDP for Austria, Germany, and Slovak Republic exists, confirming the feedback hypothesis. Unidirectional causality is confirmed from tourist arrivals to GDP for Colombia, Latvia, Netherlands, Poland, and Spain.

Table 8: Emirmahmutoglu-Kose panel Granger causality test results

Country	Lag	TOU=> GDP		Lag	GDP => TOU	
		Wald Statistic	p-value		Wald Statistic	p-value
Australia	2	1.792	0.408	2	1.759	0.415
Austria	1	5.426	0.020**	1	4.139	0.042**
Belgium	1	0.325	0.569	1	0.421	0.516
Canada	1	0.213	0.644	1	0.103	0.748
Chile	1	3.457	0.063***	1	0.437	0.509
Colombia	1	6.869	0.009*	1	0.023	0.879
Czech Republic	1	0.052	0.820	1	0.004	0.951
Finland	1	0.378	0.539	1	0.002	0.962
France	1	0.055	0.814	1	0.700	0.403
Germany	1	3.240	0.072***	1	5.837	0.016**
Greece	2	3.810	0.149	1	3.428	0.180
Iceland	1	0.063	0.802	2	1.072	0.300
Ireland	1	0.302	0.582	1	0.373	0.541
Israel	1	0.923	0.337	1	4.241	0.039**
Italy	1	0.173	0.678	1	0.046	0.830
Japan	1	0.419	0.517	1	0.235	0.628
Korea, Rep.	1	1.266	0.261	1	0.000	0.992
Latvia	3	7.838	0.049**	3	0.365	0.947
Lithuania	1	1.819	0.177	1	0.131	0.718
Luxembourg	1	0.053	0.818	1	1.148	0.284
Mexico	1	0.309	0.578	1	0.075	0.785
Netherlands	2	5.022	0.081***	2	2.121	0.346
Norway	1	0.216	0.642	1	0.307	0.579
Poland	2	4.883	0.087***	2	0.056	0.972
Portugal	1	2.522	0.112	1	0.104	0.748
Slovak Republic	3	8.535	0.036**	3	6.254	0.100***
Slovenia	1	0.195	0.658	1	1.197	0.274
Spain	3	8.891	0.031**	3	0.694	0.874
Sweden	1	0.432	0.511	1	0.706	0.401
Turkey	1	0.010	0.922	1	1.476	0.224
United Kingdom	1	0.084	0.772	1	1.205	0.272
United States	2	0.747	0.688	2	1.109	0.574
Panel Fisher		89.587			60.387	

Table 9 reports Emirmahmutoglu-Kose panel Granger causality test results between GDP and CO2 for OECD countries. The test results provide evidence of bidirectional causal association between GDP and CO2 emissions Slovenia, and unidirectional causal association from GDP to CO2 emissions for Israel, South Korea, Netherlands, Poland and United States. Moreover, unidirectional causal association is confirmed running from CO2 emission to GDP for Austria, Belgium, Canada, Finland, and Luxembourg.

Table 9: Emirmahmutoglu-Kose panel Granger causality test results

Country	Lag	GDP=> CO2		Lag	CO2 => GDP	
		Wald Statistic	p-value		Wald Statistic	p-value
Australia	1	0.331	0.565	1	1.875	0.171
Austria	1	0.013	0.911	1	3.033	0.082***
Belgium	2	0.104	0.747	2	17.479	0.000*
Canada	1	0.025	0.873	1	6.054	0.014**
Chile	1	0.065	0.798	2	10.676	0.005*
Colombia	1	1.386	0.798	2	3.155	0.207
Czech Republic	1	0.351	0.553	1	2.380	0.123
Finland	1	2.258	0.133	1	3.389	0.066***
France	3	1.141	0.767	2	0.594	0.743
Germany	3	6.156	0.104	1	0.056	0.812
Greece	3	2.982	0.394	2	1.888	0.389
Iceland	3	5.076	0.166	3	4.951	0.175
Ireland	1	0.039	0.844	1	0.011	0.917
Israel	1	7.481	0.006*	1	1.557	0.212
Italy	1	0.119	0.731	1	0.350	0.554
Japan	1	0.317	0.573	1	0.102	0.750
Korea, Rep.	1	3.492	0.062***	1	2.563	0.109
Latvia	2	1.520	0.468	2	1.415	0.493
Lithuania	1	0.315	0.575	1	0.014	0.905
Luxembourg	2	0.301	0.860	2	11.059	0.004*
Mexico	1	0.366	0.545	1	0.965	0.326
Netherlands	3	10.291	0.016**	1	0.178	0.674
Norway	1	0.955	0.328	1	0.474	0.491
Poland	1	3.044	0.081***	3	4.620	0.202
Portugal	1	0.148	0.700	1	0.046	0.831
Slovak Republic	1	0.084	0.773	1	0.000	0.984
Slovenia	1	3.881	0.049**	3	8.834	0.032**
Spain	1	0.311	0.577	2	2.329	0.312
Sweden	1	1.006	0.316	1	0.028	0.866
Turkey	1	1.049	0.306	1	0.517	0.472
United Kingdom	3	2.470	0.481	1	0.762	0.383
United States	3	12.027	0.007*	3	0.674	0.879
Panel Fisher		83.005			107.827 ***	

CONCLUSION

This paper investigates the link between tourism, CO2 emissions, and economic growth utilizing CCE approach developed by Pesaran (2006) and AMG approach proposed by Eberhardt and Teal (2010) for selected OECD countries for the period of 1995-2014. This study lastly utilizes the Emirmahmutoglu-Kose panel Granger causality test so as to demonstrate the direction of causality among tourism, CO2 emissions, and economic growth for the countries under investigation.

Given the span of data set and the CCE and AMG results, the results show that tourism enhances CO2 emissions in OECD countries, suggesting that an increase in tourist arrivals leads to an increase in CO_2 emissions. Also, our results reveal that economic growth contributes to environmental degradation in these countries. Moreover, Emirmahmutoglu-Kose panel Granger causality test provide evidence of uni-directional association running from tourism to CO_2 emissions in OECD countries.

Given these results, we strongly suggest more attention on implementation of policies for the sustainability of tourism. The findings show that while tourism contributes to economic growth in OECD countries, it also increases CO_2 emissions. This imply that policy makers should follow the policies, aiming at not only to expand the tourism but also reduce CO_2 emissions. Therefore, stakeholders should take into account investing in more clean energy sources and especially clean transportation applications and decreasing the share of fossil fuel energy in tourism activities to lower the harm to the environment while promoting economic growth at the same time.

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