

# Exchange Rate, Terms of Trade and Employment Nexus: Evidence From Turkey

Muhammad Salah Uddin (✉ [salahuddindu2004@gmail.com](mailto:salahuddindu2004@gmail.com))

Sakarya University: Sakarya Universitesi <https://orcid.org/0000-0001-8386-7096>

Mahadi Hasan

Bangladesh University of Business and Technology

Zobayer Ahmed

International Islamic University Chittagong

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## Research

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Exchange Rate, Terms of Trade

**Exchange Rate, Terms of Trade and Employment Nexus: Evidence from Turkey**

Muhammad Salah Uddin\*<sup>1</sup>, Dr. Mahadi Hasan<sup>2</sup> & Zobayer Ahmed<sup>3</sup>

Sakarya University, Turkey<sup>1</sup> & Corresponding Author\*,  
Bangladesh University of Business and Technology (BUBT), Bangladesh<sup>2</sup>,  
Selcuk University, Turkey<sup>3</sup>

**Exchange Rate, Terms of Trade and Employment Nexus: Evidence from Turkey**

## ABSTRACT

The objective of this study is to analyze the impact of the real exchange rate (RER) on employment, and real wage using quarterly disaggregated data (ISIC Rev 4 classification) composed of 19 industries in Turkey from 2010 to 2017. In our study, we employed the Fixed Effect Model, where industry-specific effects are used to control heterogeneity within the sectors. Moreover, robustness is applied to get rid of the heteroscedasticity in the error terms. Our results find that the currency appreciation has a negative, however insignificant effect on employment; whereas it has a significant positive impact on real wage. Generally, the terms of trade has no remarkable impact on employment and real wages; however, the larger industries have a substantial adverse impact on employment. Nevertheless, the interaction between currency appreciation and the top 25 per cent larger industries indicates a moderate increase in employment. The findings reflect that the appreciation of the domestic currency decreases employment at the industry level. The originality of this paper includes the effects of the terms of trade and interaction with currency appreciation in larger industries using Fixed Effect Model approach.

**Keywords:** Employment, Exchange Rate, Real Wage, Terms of Trade, Turkey

## 1. Introduction

As an emerging open economy, Turkey heavily depends on foreign trade, particularly on imported raw materials. Simultaneously, in the last decade, it experiences a depreciation of the currency, leading to a robust impact not only on foreign trade but also on the entire economy. In order to understand the dynamics of the Turkish economy, it is important to examine how the labor market as part of the economy (especially the employment in manufacturing industries) is affected by the fluctuations of the exchange rate.

In this laissez-faire economy, generally, the exchange rate plays a crucial role. It determines the path of exports and imports as well as the output of the economy. The depreciation of a currency makes the domestic goods more affordable for foreigners accelerating the volume of exports. Imports, on the other hand, tend to fall upon such depreciation. Whereas the depreciation inflates the prices in the local market as imports, for example, energy raw materials (e.g. oil and gas), become pricier which adversely affect imports, however, and improve exports. Therefore, the exchange rate has a robust net impact, at first hand, on foreign trade, on the entire economy thereafter.

As we observe, Turkey has experienced a severe depreciation since last decade. The exchange rate fell down from 1 USD = 1.74 Turkish Lira (TL) in January 2008, to 5.76 TL in April-2019. It has experienced a substantial amount of depreciation, i.e. approximately 380% (*TCMB - Gösterge Niteliğindeki Merkez Bankası Kurları*, 2019). Such volatility of exchange rate severely affects the economy of Turkey. Consequently, labour market plays a significant role in Turkish economy. In recent times, Turkey's labour market has faced a negative shock. Turkish Statistical Institute published the latest news in January-2019 that shows the employment rate has decreased by 1.9% compared to the previous year. Sector-wise employment rates are 17%, 19.90%, 5.40% and 57.7% in agriculture, industry, construction and service sectors respectively. Employment in agriculture and the construction sector has decreased by 0.7% and 1.6% respectively, while the industry sector employment rate remained constant. However, the service sector gained more employment rather than the previous year (*Turkey Statistical Institute, Labor Force Statistics, February 2020*). Although the overall employment in the industry sector is constant; our study shows that individual industry-level

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data reflects a downward trend with the overall Turkish economy. Hence, the major challenge is to figure out the effects of the exchange rate and its economic consequences especially on the employment and wage. Besides, the terms of trade, i.e. the ratio of export and import, has significant impacts on output and subsequently on employment and wage. And thus, the exchange rate and terms of trades are two major economic indicators in the context of an open economy, which requires scientific investigation to analyze their effects on employment and wage.

Moreover, in the literature, it is found that the impact of exchange rate on Turkish foreign trade does not follow any linear path, which is observed by focusing on two different economic regimes: one pre-1980 duration defined as an import substitution industrial policy and another post-1980 period export-oriented policy. While an increase in export has a significant impact on employment in pre-1980, the exports in post-1980 had no substantial influence on employment. Despite no effect of export on employment, a rise in export mediates the drastic reduction of employment as a buffer (Erlat, 2000).

Such diversified channels lead further to examine the relationship between exchange rate and employment. In this empiric research, using quarterly data from 2010 to 2017, we would address four questions. Firstly, how the fluctuations in the exchange rates impact on employment and wages in the Turkish manufacturing industry? Secondly, how would it measure the effect of international trade on employment and real wages? Thirdly, how the effect of top 25% larger industries on employment and wages, considering the terms of trade, will be analyzed?. And finally, how will the interaction between the exchange rate and top 25% larger industries affect employment and wages?

## **2. Literature Review**

It is well known that the fluctuation in exchange rate results in national income and thus the variation of employment. The influence of exchange rate on the employment could be analyzed in a simple way that the appreciation of currency leads to the rise of the price of domestic products, which, in turn, becomes more expensive relative to foreign products because of the

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absence of compensation for the currency appreciation to local producers. This reduces the demand for local products; subsequently, domestic producers will be less competitive in the market. As a result, it contracts employment in the domestic market. (Branson and Love, 1988; Goldberg et al., 1999; Demir, 2010; Gourinchas, 1998; Alexandre et al., 2011; Burgess & Knetter, 1998; Nucci & Pozzolo, 2009; Filiztekin, 2004).

Although there were many empirical studies, Branson and Love (1988), for the first time, reported a negative relationship between the employment and exchange rate fluctuation. Using the US data from 1970 to 1986, they regressed the log employment on the exchange rate, controlling the other variables for every manufacturing sector separately. Their findings demonstrated that appreciation of the US dollar between 1980 to 1985 reduced employment around 5% in the US market. Moreover, Goldberg et al. (1999) determined the impact of the exchange rate varied to the nature of markets and industry patterns. The effect of the exchange rate was more pronounced in the manufacturing sectors than non-durable and non-manufacturing sectors outside of the service sector.

Furthermore, it was found that the exchange rate altered the employment of job-changing and job-switching. A worker's job-switching possibility, within the same type of industries, was more than the probability of job changing from different industries. On the other hand, applying the fixed effects Model, Dynamic GMM method, and using the firm-level 691-panel data from 1983-2005, Demir, (2010) found the exchange rate movement has a significant effect on the level of employment. Nonetheless, it depended on two other factors: firm's share in output and level of indebtedness. When the firm had a larger export share in output, and a higher level of indebtedness, the effect of the exchange rate was significantly higher on the employment.

This response of employment to the exchange rate is not limited in the manufacturing sector. The 1% appreciation of the exchange rate in the tradable sector also reduced employment in the US economy by 10%. The sensitivity of the exchange rate was appeared more in the import-competing industries rather than export-competing industries (Gourinchas 1998). In addition, the effects of the exchange rate were measured using the four components of the labor market; which includes wages, overtime wages, employment, and overtime employment. This analysis revealed the major impacts of the exchange rate on overtime activity. In contrast, the labor

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market's adjustment and response to the exchange rate for other components such as wages, overtime wages and employment were less significant (Campa & Goldberg, 2001).

The employment and wages in the lower mark-up industries are more sensitive to the exchange rate movement. In line with this study, using the Fixed-effect model and data of G-7 countries, it was found that the France and Germany were less sensitive to exchange rate movement and much slower to adjust to long-run steady states due to mark-up adjustment. However, other G-7 countries, i.e. USA, Japan, Canada, UK and Italy, swiftly responded to the exchange rate fluctuation. Similarly, in order to detect the long-run relationship between employment and exchange rate, Burgess & Knetter, 1998 applied the panel cointegration analysis and annual data (1975-1999) from France and reported that the appreciation of national currency reduced the employment in the manufacturing sector. They also confirmed that the long-run elasticity has the expected relationship between exchange rate and employment. Furthermore, openness and productivity with the exchange rate play a significant role to determine the level of employment, hours and job flows. A study (Alexandre et al., 2011) employing the Portuguese data 1988-2006 from OECD-STAN bilateral trade database for 20 manufacturing sectors concluded that the more low-technology sectors exposed to international trade, more they suffered for the exchange rate fluctuation. Subsequently, they adjusted this impact of exchange rate through employment destruction. On the other hand, high-technology industries appeared not to be that sensitive to exchange rate shock.

The market power of firms, along with exchange rate variation magnifies the response of employment and hours. Nucci & Pozzolo, 2009 reported that the firms with low-level monopoly power faced the high-level import penetration to the domestic market. In addition, its response was more robust to the exchange rate fluctuation. (). For this study, the firm-level data during 1984-1998 were collected from the sources of the Company Accounts Data Service Reports and the Survey of Investment in Italian Manufacturing (SIM).

On the other hand, export, as one of the determinants of gross domestic product, plays a crucial role in accelerating economic development and has a significant impact on the level of employment. In general, the rise in export increases the gross output, and in order to maintain this level of production, more labor is needed. Subsequently, it generates more employment. Most of the literature finds that growth in export leads to an increase in the level of employment. (Akkuş, 2014; Aydiner, 2016; Dizaji & Badri, 2014; Erlat, 2000; Greenaway et

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al., 1999; Gul & Kamacı, 2012; Hao, 2011; Polat & Uslu, 2011; Tandoğan, 2019). Hao, (2011), in his empirical studies, using the data from 1980 to 2007 in Chinese textile industries, investigated the short and long-run response of employment to rise in export, and found the positive impact of export on employment not only in the short run but also in the long run. The short-run impact, however, was more pronounced than long-run impact. Similarly, applying the Fully Modified Ordinary Least Squares (FMOLS) and Vector Error Correction (VEC) model with the monthly data from January-2005 and September-2015, Aydiner, Altay and Yilmaz, (2016) explored the positive impact of export on employment in both short and long-run. Moreover, regional-level export-led to increase regional employment. The empirical study has covered the export and employment of two sub-regions in Turkey from 2005 to 2016, where a rise of export resulted in increasing employment at the regional level. (Tandoğan, 2019). The firm-level study also corroborated this positive link of export on employment in Turkey, including top 1000 Turkish-export firms, the estimation demonstrated the increase in export, by 1%, resulting in rising the employment by 0.20%. Nevertheless, the labour-intensive firms responded more vigorously than capital intensive firms.

Gul and Kamacı, (2012), using evidence from developed and developing countries data during the periods of 1980-2010 and 1993-2010, investigated the causality between international trade and employment, and found the bi-directional relationship. However, an increase in trade volume, comprising the export and import volumes of the 167 manufacturing industries in the United Kingdom during 1979-1991, reduced the labor demand since openness tended to increase the efficiency and productivity within the firms. (Greenaway et al., 1999).

*Table 1: Tabular form of the Literature Review*

Author(s) and year	Context	Nature of the study	Relationship
Hao, (2011) (Barro 1996)	Empirical studies were analyzing the short and long-run effect of the textile industry's export on employment in China from 1980 to 2007.	Empirical study	+ve
Tandoğan, (2019)	The empirical study covers the export and employment of two	Empirical study	+ve

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	sub-regions in Turkey during 2005 to 2016.		
(Akkuş, 2014)	The research-based upon data from 2003 to 2010 from the Turkish manufacturing sector and incorporating the variables of international trade and productivity assesses the change in employment.	Empirical study	+ve
Aydiner, Altay and Yilmaz, (2016)	Applying the Fully Modified Ordinary Least Squares (FMOLS) and Vector Error Correction (VEC) model with the monthly data from January-2005 and September-2015, it estimates short and long-run relationship	Empirical study	+ve
(Aydiner, 2016)	Including top 1000 Turkish-export firms, it estimates the effect of export and non-export sales on employment	Empirical study	+ve
(Erlat, 2000)	Dividing the import substitution and export orientation regimes into four sub-periods from 1969 to 1996, it analyzes the net-export effects on employment	Theoretical with empirical justification	Pre-1980:+ve, Post-1980: no effect
Greenaway et al., (1999)	This empirical assessment using the 167 United Kingdom manufacturing industries from 1979-1991 estimate the impacts of terms of trade on employment.	The Dynamic Panel Framework	-ve
Gul and Kamacı, (2012)	Using the developed and developing countries data from the periods of 1980-2010 and 1993-2010 correspondingly, it examines the relationship between international trade and employment.	Empirical Study	Causality
(Polat & Uslu, 2011)	The impacts of international trade being investigated using the data from 1992 to 2001 for 95 manufacturing industries.	Theoretical with empirical justification	+ve
Polat & Uslu, (2011)	The study estimates the impact of foreign trade on employment including 22 Turkish	The Panel Data Analysis	No effect

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	manufacturing industries during 2003-2008		
Dizaji & Badri, (2014)	This analysis using the data of 1976-2005 found the relationship between export and employment	Autoregressive -Distributed Lag Model	+ve
(Pashtoon, 2018)	This empirical study applying ARDL model focuses on Afghanistan during 2004 to 2016	Empirical Study	No effect

Despite the fact that numerous studies reported the foreign trade has either positive or adverse effect on employment, a number of studies focusing on Turkish manufacturing industries concluded that the terms of trade, particularly export, has no substantial effect on employment (Erlat, 2000; Ozgur , Enes , & Cahit , 2011; Polat & Uslu, 2011). Another empirical analysis of 22 Turkish manufacturing industries (2-digit NACE Rev classification) also explored the foreign trade has no significant role in employment, while production positively influences employment, and wages adversely effected on employment (Ozgur , Enes et al. 2011).

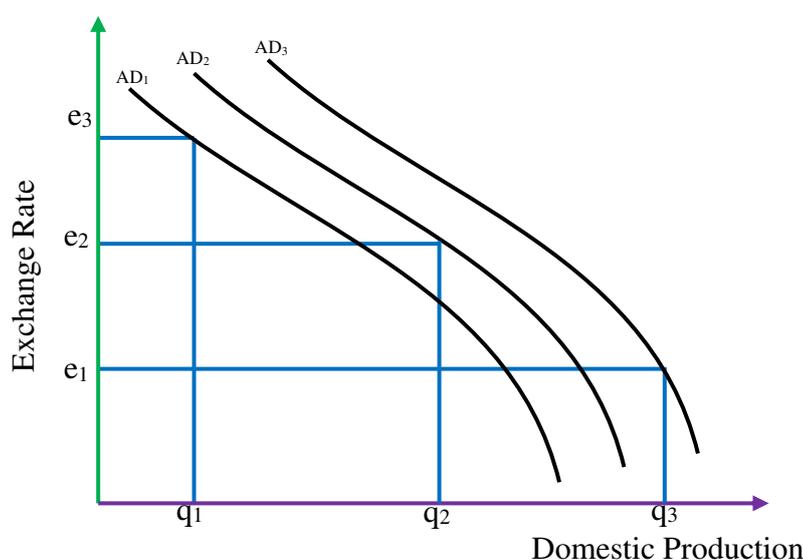
On the other hand, the industry level analysis covering 95 Turkish manufacturing industries with theoretical justification concluded that export in the current cycle had no substantial impact on employment; however, the lagged value of export represented the statistically significant positive relationship with employment (Polat & Uslu, 2011). Likewise, concentrating on two different economic regimes (one pre-1980 period defined as an import substitution industrial policy and another post-1980 period export-oriented policy), an increase in export had a significant impact on employment in pre-1980. However, the export in post-1980 had no substantial effect on employment. Even though there was no effect on employment from exports, a rise in exports mediates a drastic reduction in employment as a buffer (Erlat, 2000).

In a nutshell, all the previous studies exhibit various aspects of the exchange rate, terms of trade and employment nexus in different contexts. However, the perspective of Turkey using latest data can make a significant contribution to the existing body of knowledge. Moreover, the foreign trade variables, productivity, efficiency and the labour market nexus in Turkish economy through this study will guide future research at the firm level.

### 3. Theoretical Foundation

In principle, the shock of the exchange rate across channels of demand and supply affects on real production. In demand networks, currency appreciation makes domestic manufactured products expensive. As a result, exports will face competition in the international market at a higher price, reducing the demand for domestic goods. It would eventually drag down domestic production and costs. In this context, we are using a simpler version of Dincer & Kandil, (2011) who proposed the demand and supply model.

An assumed economy where the initial exchange rate and domestic demand prevail respectively at points  $e_2$  and  $q_2$  on the  $AD_1$  (aggregate demand) curve provides a scenario in Figure 2: Demand curve **Error! Reference source not found.**. After a shock of the exchange rate which refers to currency appreciation, it shifts from  $e_2$  to  $e_3$ ; the domestic production would become costly on the foreign market, thereby facing competition, and reducing the demand for such goods. As a result, higher prices are constraining domestic production. Thus, the change in exchange rates from  $e_2$  to  $e_3$ , eventually shifts downward the aggregate demand curve from  $AD_2$  from  $AD_1$ , and decreases domestic demand from  $q_2$  to  $q_1$ . So, more currency appreciation would bring down further domestic demand. Conversely, in the case of currency depreciation which changes the exchange rate from  $e_2$  to  $e_1$ , it will shift the aggregate demand curve from  $AD_2$  to  $AD_3$ . This change makes the domestic products cheaper and competitive in the international market, thus, tends to increase the domestic production from  $q_2$  to  $q_3$ .



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On the supply side, the shock of the exchange rate, which means the appreciation of the currency makes the imported products in the local market cheaper. The cost of production would be reduced; therefore, the domestic output would be increased.

In an emerging open economy, the initial exchange rate at  $e_2$  imports raw materials  $m_2$  amount. The appreciation of currency cause to move the exchange rate from  $e_2$  to  $e_3$ , which makes cheaper the imported raw materials in the domestic market. Therefore, the use of imported raw materials in local production would continue to increase. Finally, this change in the exchange rate will increase the availability of imported raw materials, that is to say from  $m_2$  to  $m_3$ . It would reduce the cost of production, which could trigger the level of employment; however, the change depends on the mix of production materials. The heavy dependence on the imported raw materials could reduce the cost of production, which increase the overall production in the currency appreciation. Nevertheless, the dominance of domestic raw materials in the production might raise the prices, as a result, reduce the demand of goods for higher prices, thus lowering the domestic production. On the other hand, change in the exchange rate from  $e_2$  to  $e_1$  depreciating the local currency makes the imported goods expensive in the domestic market, therefore, shifts the aggregate supply leftward from  $AS_2$  to  $AS_1$ , and results to reduce the supply of imported goods to  $m_1$ .

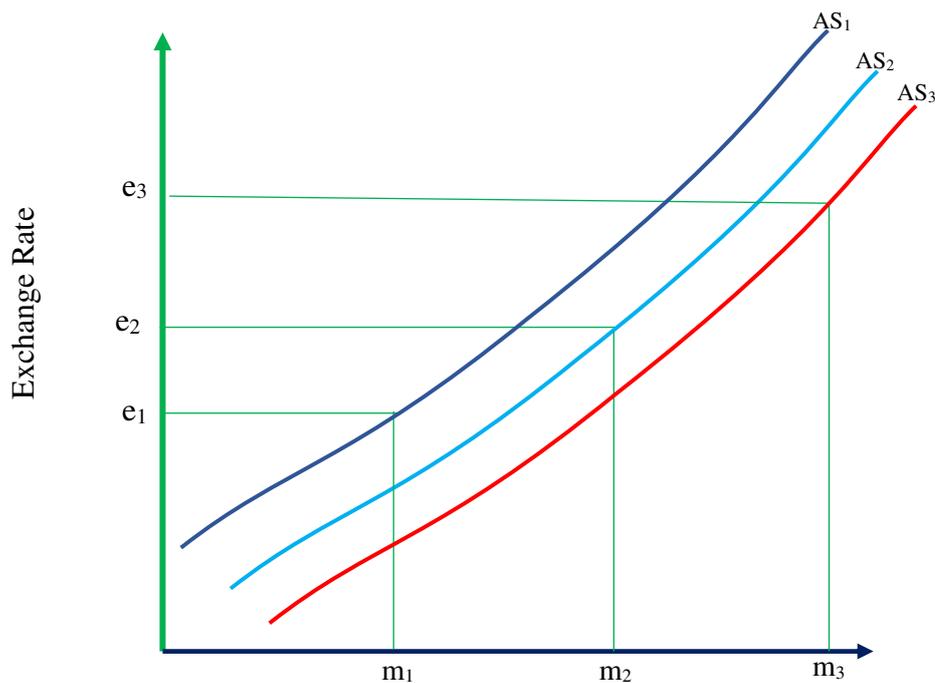


Figure 2: Supply Curve

Imported raw materials

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Both the demand and supply curve will interact to decide the level of production. Achieving an equilibrium point will depend on the speed of adjustment, which is determined by the elasticity of demand to exchange rate and price elasticity of supply. Here, in Figure 3: Supply Curve, the exchange rate  $e_1$  determines the production level  $d_1$  at an initial equilibrium point. In the case of Turkish manufacturing industry, the appreciation of currency reduces the export; as a result, shifts the aggregate demand curve downward to  $AD_2$ .

In the supply side, the appreciation of the currency, in theory, increase the supply of imported raw materials, nevertheless, in our study, it reduces imported raw materials, which shift the Aggregate supply curve in leftward from  $AS_1$  to  $AS_2$ , not rightward. The reduction in demand for export also decreases the supply of raw materials because the elasticity of demand to exchange rate fluctuation is higher than the price elasticity of supply.

In addition, export and import are heavily dependent on each other. So, reduction in export decreases the amount imported raw materials as well, which is generally used in the production of exported goods. Moreover, the change in currency appreciation reduces the level of employment, but is not significant. Likewise, the ratio of export to import that is terms of trade, even though it reduces the level of employment in Turkish manufacturing industries, does not transmit any substantial impact on the level of employment. This conceptual framework is supported by the empirical studies of Dincer & Kandil, (2011); Erlat, (2000); Filiztekin, (2004).

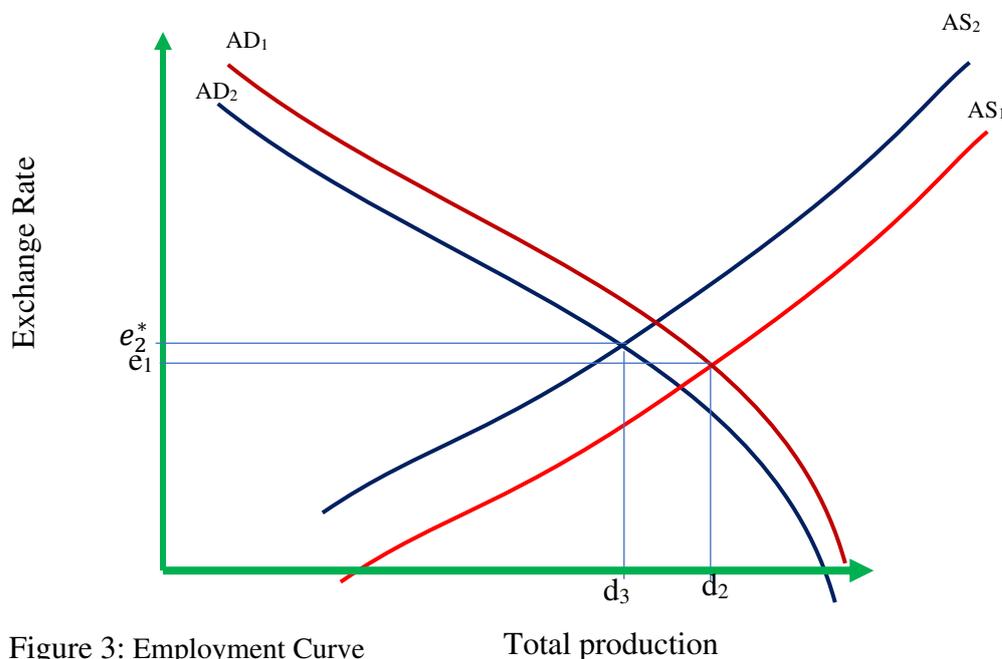


Figure 3: Employment Curve

Total production

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In a nutshell, currency appreciation reduces domestic production from  $q_2$  to  $q_3$ , which subsequently decreases the demand for labor. Finally, it shrinks the employment from  $emp_3$  to  $emp_2$ . Despite the fact that currency appreciation reduces the employment, it is not a substantial amount and is not statistically significant.

### 4. Data Collection:

The data that is used for this study is manufacturing industries data, which have been collected from two sources: the Turkish Statistical Institute and Central Bank of the Republic of Turkey (CBRT). Employment, gross wage, and salary, export and import index, inflation are industry-specific index data, which are obtained from the Turkish Statistical Institute, and exchange rate index from CBRT. It comprises the quarterly index data from 2010 to 2017 with the base year 2010. There are 19 two-digit manufacturing industries (ISIC Rev 4 classification) compiled in our data set.

#### 4.1. Econometric Methodology

This study applies the conventional econometric model to account the exchange rate effect on employment and real wage.

$$Y_{it} = \beta_0 + \beta_1 Ex\_rate_{i,t-1} + \beta_2 Terms\_trade_{i,t-1} + \beta_3 Top_i + \beta_4 Ex\_rate_{i,t-1} \times Top_i + \beta_5 X_{it} + a_i + u_{it} \quad (i)$$

$Y_{it}$  is denoted as employment and  $Ex\_rate$  is the real effective exchange rate. The  $Terms\_trade$  refers to the ratio of export to import, while the  $Top_i$  represents the 25% larger industries in respect of  $Terms\_trade$  as a dummy variable equal to one. We also employ the interaction terms between the exchange rate and top 25% larger industries because the larger exporters simultaneously become the larger importers. (Amiti et al., 2012). So, we want to investigate how the larger industries affect differently from, the smaller industries on employment.  $X$  is the control variables. Furthermore,  $a_i$  is the unobserved industry-specific effect and  $u_{it}$  is the error term.

$$Z_{it} = \beta_0 + \beta_1 Ex\_rate_{i,t-1} + \beta_2 Terms\_trade_{i,t-1} + \beta_3 Top_i + \beta_5 X_{it} + a_i + u_{it} \quad (ii)$$

In the second model,  $Z$  as a dependent variable represents the real wage.

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Before running the panel regression, there are some econometric requirements to be addressed. First, the properties of the cross-section and the time series are to be considered. Employing the Breusch and Pagan (1980), and Pesaran (2004) tests, we investigate the cross-section dependence test. The tests reject the null hypothesis of no cross-section, which confirms there is cross-section dependence in this data. (See Table 3 Cross Sections Dependence Tests). In addition, the first-generation unit root tests, Hadri LM and IPS, are used to evaluate the properties of the time series (Hadri, 2000, Im et al., 2003). While Hadri LM test has the null hypothesis of no unit root to account the heterogeneity and individual deterministic trend, IPS unit root test shows all panels have unit-roots. (Hadri, 2000, Im et al., 2003). Both of these tests show the panels have the unit-roots. So, the pooled OLS is not allowed because of time trend, which would provide the spurious regression. In addition, Pesaran, (2007) suggested a simple unit root test in light of the potential cross-sectional dependency and serially correlated errors. This method is for the individual series, using ADF regression, where it takes the mean of both current and lagged cross-section. Hence, CIPS (Pesaron, 2007) and  $Z_A^{SPC}$  and  $Z_A^{LA}$  tests (Hadri and Kurozumi, 2012) are also investigated for second-generation unit root test. The advantage of second generation test over the first-generation test is that it considers the cross-section correlation.(Guloglu et al., 2012). In this study, we apply the unit root tests to variables and also to individual industries, as well as overall industries. CIPS and  $Z_A^{SPC}$  and  $Z_A^{LA}$  deliver the conflicting results of unit root testing, which refers to the different order of integration. Thus, for the cointegration test, Westerlund, (2008) offered an approach in which the null hypothesis is no cointegration against the alternative hypothesis of cointegration. It results in there is cointegration.

In this empirical study, the cross-section dependence, unit root and cointegration that are verified by the tests as mentioned earlier, (see table: Table 3 Cross Sections Dependence Tests,

Table 4 CADF statistics for each country, Table 5 CIPS statistics for all industries, Table 6 Hadri LM & IPS Unit Root Test Table 7 Second Generation Unit Root Test, Table 8 Cointegration Test). The data provides that it has cross-section dependence with unit root and cointegration. In this context, Fixed and Random Effect Models are suitable for this empirical study; however, the Fixed Effect Model is applied due to the smaller cross-section than time

series, whereas the random effect model is preferable for the entire population. (Wooldridge, 2012). In addition, we use the one-way fixed-effect test to check the individual or industry effect in this model, as suggested by Baltagi, (2005). Assuming the time effect in this model, for the existence of the individual effect, we will do the test of the null hypothesis that unobserved individual effect equal to zero.

$H_0: \mu_1 = \dots = \mu_{n-1} = 0$ , here  $N= 19$  industries allowing  $\lambda t = 0$  for  $t = 1, \dots, 32 - 1$

In this case, the null hypothesis is rejected that indicates there is the individual effect verified by one-way fixed-effect test (see table Appendix).

## 5. Result Estimation and discussion:

In this empirical study, two models are employed to find the effect of the exchange rate on the employment and wage. The first model is applied to explore the response of employment to the change in the exchange rate and its interaction with the top 25% larger industries with respect to terms of trade. Similarly, the response of wage to exchange rate is accounted for using the Fixed Effect Model. In order to capture the effect of the exchange rate (currency appreciation) and the terms of trade, the industry fixed effect models are applied to decide the real wage response.

Table 10: Employment Model with lag summarizes the impact of the exchange rate on employment. Column one to six demonstrates the regression model using the variables in multiple ways and analyzes how the changes in the explanatory variables affect the level of employment. The values within the brackets represent the robust standard deviation. The star at the top of the coefficients estimates the significance level. In column 1, the response of employment to changes in the exchange rate is significantly negative, the rise of the exchange rate at present substantially reduces the level of employment until quarter one, i.e. three months. As Alexandre et al., (2011) find, the lag of the exchange rate has an impact on employment at the current period; their empirical research similarly uses one lag that justifies our findings.

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Similarly, the effects of the terms of trade on employment reflect the significant impact up-to lag one, which is corroborated by the study of Polat & Uslu, (2011). In their empirical research, using the yearly data, they demonstrate the lag of export has a substantial impact on today's employment. In comparison, log GDP and inflation as control variables are seen separately to have a major impact on employment in columns 3 and 4. To justify our variables in the models, we use the Fixed Effect models in column 5 and Random Effect model in column 6. Both models show a similar pattern of relationship and value of coefficients that verify our findings.

The terms of trade are defined as the export volume to import volume ratio. In this regard, a one-unit increase in terms of trade denotes either rise of export or reduction of import. The source of impact on employment derives from export shock, not from import in this study. The terms of trade lead to a substantial increase in the level of employment. GDP and inflation, on the other hand, are used as control variables. Both inflation and GDP have a strong association with employment. (Akcoraoglu, 2010; Ali, 2007; Karahan et al., 2012). The one percent growth of GDP increases the level of employment by about 20 percent. Moreover, an increase in inflation by one percent raises employment by 0.15 percent. The GDP shows a more pronounced effect on employment than inflation.

The full model is presented in column 5, in which the appreciation of Turkish *Lira* is seen to have a negative association with employment but is insignificant in our study. This finding is supported by the studies of Branson and Love, (1988); Goldberg et al., (1999); Demir, (2010). Furthermore, the terms of trade positively affect employment. This influence derives from the export volume, not from import volume. A rise in export contributes to a substantial increase in employment. However, terms of trade in the column-five model do not show any significant relationship, with a robust standard deviation. This finding is corroborated by the studies of Erlat, (2000); Ozgur , Enes , & Cahit , (2011); Polat & Uslu, 2011).

However, in contrast to smaller industries, larger industries in respect of terms of trade have a more rigorous negative effect on employment. Top 25 percent of larger industries decrease the level of employment by more than 27.32 percent compared to smaller 75 percent industries. The reason behind this pronounced effect is that, as Amiti et al.,(2013) argued, the bigger

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exporters are at the same time the bigger importers. While larger industries produce the exported goods using the imported input, the benefit of high-level of export on employment is outweighed by the heavy imported inputs. In addition, Turkish manufacturing industries are heavily dependent on imported inputs. (Filiztekin, 2004) Thus, these arguments justify the fact that larger industries reduce employment more than smaller ones.

On the other hand, the interaction between exchange rate and larger industries increase employment levels. Since the currency appreciation makes the imported inputs cheaper, the bigger industries would get benefit from using this cheaper imported input into production. As a result, this interaction term increases the level of employment.

Table 12: Real Wage model with lag outlines briefly how the exchange rate influences the real wage. Here, the models in column up to 3 explain the individual variable impact on real wage. The full model is explained in column 4 and 5, in which the Fixed Effect and Random Effect model are used respectively. The currency appreciation has a significant positive effect on real wage. One percent increase in the exchange rate raises the real wage by 0.63% at the current period. It is supported by the study of Filiztekin, (2004). At one lag which is after one quarter, there is no significant exchange rate relationship on real wage. While the response of real wage to exchange rate movement is positive, the terms of trade does not reflect any significant influence on real wage. The log GDP is used as a control variable in column 3. The link between GDP and real wages is significantly positive. The better economic conditions tend to increase the real wage. The higher output, therefore, raises the demand for labor and eventually raises the real wage for labor.

## 6. Conclusion

This study focuses on the impact of exchange rate on employment and real wage in Turkish manufacturing industries using the quarterly data during the period of 2010-2017. It entails nineteen manufacturing industries where the exchange rate contains the value of the real effective exchange rate, and the export volume-to-import ratio is the terms of trade. The study

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shows that the exchange rate fluctuations referring to Turkish Lira appreciation have a negative; however, negligible effect on employment, whereas it has a significant positive impact on real wage. By contrast, the variation in the exchange rate has a more pronounced effect on real wage than on employment. On the other hand, the terms of trade have no substantial influence on employment and the real wage. Nonetheless, with respect to terms of trade, the top 25% of the larger industries have a significant negative impact on employment due to the heavy reliance of the larger exporting industries on imported inputs. The interaction between currency appreciation and the top 25 per cent larger industries, however, increases employment moderately. Despite the fact of the findings described above, the scope of the study is limited in nineteen Turkish manufacturing industries without distinguishing the characteristic of rural and urban manufacturing industries. The heterogeneity within the industries is also not considered. Using the firm-level data could reflect a more accurate relationship between the variables; however, in this research, we employed sectorial level data. In this study, we identified the impact of the exchange rate and the terms of trade on employment and the real wage. We also figured out how the interaction term between the top 25% larger industries and currency appreciation influence employment. In the future research micro-level data, market exposure and factor intensities could be considered to explore the effects of the openness and export-intensity on employment level.

## **Declarations:**

- **Availability of data and material**

The authors confirm that the data used for this findings is available at Turkish Statistical Institute (<https://www.tuik.gov.tr/en/>) and the Central Bank of the Republic of Turkey (<https://www.tcmb.gov.tr/wps/wcm/connect/en/tcmb+en>).

- **Competing interests**

On behalf of all authors, I, Muhammad Salah Uddin as a corresponding author state that there is no conflict of interest.

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- **Authors' information**

**Muhammad Salah Uddin** (Corresponding author)

Muhammad Salah Uddin is pursuing his PhD in Economics at Sakarya University, Sakarya, Turkey. He has completed his second M.A (Master of Arts) in Economics at Ibn Haldun University, Istanbul, Turkey, and his first MSS (Master of Social Science) and BSS (Bachelor of Social Science) in Economics from University of Dhaka, Bangladesh. Mr. Uddin has been working in the banking industry for more than five years as a credit analyst. He privileged to work for the policy development of Small & Medium and Women enterprises' areas in the banking sector. He has research experience of publishing scientific papers on a regular basis, and also presented the conference paper at home and abroad and travelled various countries, e.g. Turkey and the Kingdom of Saudi Arabia.

**Dr. Mahadi Hasan**

Dr. Hasan is currently working as Assistant Professor and Chairman of the Department of Textile Engineering, Bangladesh University of Business and Technology (BUBT), Dhaka Bangladesh. He obtained his PhD from University of Wollongong (UOW), Australia, master from Asian Institute of Technology (AIT), Thailand and bachelor from Rajshahi University of Engineering and Technology (RUET), Bangladesh. He has practical industrial working experience of about 5 years in multinational companies which is assessed and recognized by Engineers Australia. Along with his brilliant academic performance, he achieved a number of highly prestigious scholarships and grants in Bangladesh, Thailand, China and Australia. He published over 20 articles in various well indexed international journals and conferences. He has research collaboration with several universities globally as proven by joint publications.

**Zobayer Ahmed**

Mr. Zobayer Ahmed is currently pursuing his PhD in Economics at Selcuk University, Turkey. He is a faculty member (Assistant Professor) at the Department of Economics & Banking in the International Islamic University Chittagong. Earlier, he completed BSS (Hon's) and MSS in Economics from Shahjalal University of Science & Technology with excellent academic records. Later, he achieved Master of Development Studies (MDS) degree from the University of Dhaka. He started his career as a professional researcher in Unnayan Shamannay, a civil society think-tank founded by Prof. Dr. Atiur Rahman, former governor of the central bank of Bangladesh. So far, he has 13 publications with 24 citations. Mr. Ahmed attended various conferences both at home and abroad. He has visited India, Nepal, Turkey, and Malaysia so far.

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## Appendix A

Table 2: Data Definition

Variable	Abbreviation	Frequency	Source
Employment consists of all employees working either in enterprise or establishment	Employment	Quarterly	TurkStat
Real Effective Exchange Rate index at lag three	ex_rate	Quarterly	CBRT
Ratio of export volume index to import volume index at lag three	terms_trade	Quarterly	TurkStat
Top 25 percent industries in terms of trade	Top_25_pct_ind	Dummy=1	-
Interaction between top 25 pct industries in terms of trade and Real Effective Exchange Rate at lag three	Int_Top_25_pct_ind_L3.ex_rate	Dummy and interaction term	-
Log of Gross Domestic Product	Lngdpreal	Quarterly	TurkStat
Domestic Producer Price Index	Dppi	Quarterly	TurkStat
Real wage measures the ratio of gross wage and salary to the domestic producer price index	real_wage	Quarterly	TurkStat

Note: Some of the variables are converted into log form:  $\log(\text{Variable}) = \ln \text{Variable}$ .

Table 3 Cross Sections Dependence Tests

CD tests (employment)	CD statistics	P-value
cd Lm1 (Breusch,Pagan 1980)(T>N)	430.273	0.000
cd LM2 (Pesaran 2004 CDlm)(T>N)	14.020	0.000
Bias-adjusted CD test	196.804	0.000
CD tests (real wage)	CD statistics	P-value
cd Lm1 (Breusch,Pagan 1980)(T>N)	651.506	0.000
cd LM2 (Pesaran 2004 CDlm)(T>N>)	25.983	0.000
Bias-adjusted CD test	167.236	0.000

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Table 4 CADF statistics for each country

Ho; unit root or non-stationary, H<sub>1</sub>: No unit root or stationary

CADF (employment)	Statistics	Critical value	CADF (Wage)	Statistics
-2.568		-3.34	-3.384 **	
-2.718		-3.34	-1.954	
-3.953 **		-3.34	-4.066**	
-0.9402		-3.34	-3.772**	
-2.020		-3.34	-2.039	
-1.129		-3.34	-3.785 **	
-1.228		-3.34	-4.042**	
-2.240		-3.34	-2.306	
-2.049		-3.34	-1.960	
-0.7851		-3.34	-2.681	
-2.880		-3.34	-4.340**	
-4.273 **		-4.11	-2.881	
-4.998**		-4.11	-1.699	
-3.686		-4.11	-3.156	
-1.832		-3.34	-4.755 **	
-2.803		-3.34	-4.437**	
-3.205		-3.34	-4.179**	
-1.171		-3.34	-1.899	

Table 5 CIPS statistics for all industries

CIPS - H<sub>0</sub>: Unit Root, H<sub>1</sub> : No Unit Root

Hadri-Kurozumi H<sub>0</sub> : No Unit Root, H<sub>1</sub> : Unit Root

Unit Root Test	Employment Model	Real Model	Wage	Critical Value
CIPS statistics	-2.460	-3.167**		-2.72
Hadri- Kurozumi test				
ZA_SPC	-0.988	-1.978		1.645
ZA_la	-1.734	-2.046		1.645

Table 6 Hadri LM & IPS Unit Root Test

Ho: All panels are stationary, Ha: Some panels contain unit roots

IPS Unit Root Test: Ho: All panels contain unit roots, Ha: Some panels are stationary

Variables	LM_AD (no time trend)	LM_AD (time trend)	IPS (no time trend)	IPS (no time trend)
Employment	69.8120***	33.2972***	-1.7460**	-8.5830***

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ex_rate	59.2304***	3.0184**	1.9942	-5.4403***
Dppi	71.1036***	29.8650***	14.7134	14.7134
terms_trade	21.1062***	3.4333***	-10.2457***	-12.7111***
lngdpreal	79.8152***	-1.3552	2.1105	-13.5461***
real_wage	69.7503***	7.9515***	-2.0290**	-11.2288***

Table 7 Second Generation Unit Root Test

Variables	CADF (no time trend)	CADF (time trend)
Employment	-4.318***	-4.877***
ex_rate	2.610	1.700
Dppi	-1.790	-2.065
terms_trade	-2.221	-2.406
Lngdpreal	2.610	1.700
real_wage	-4.871***	-4.914***

Table 8 Cointegration Test

H<sub>0</sub>: No Cointegration, H<sub>1</sub> : There is cointegration

Cointegration Test (employment)	Statistics	P-value
Bias Adjusted CD test for cointegration equation	60.957***	0.000
Cointegration Test (real wage)		
Bias Adjusted CD test for cointegration equation	112.056***	0.000

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Table 9 :Employment Model without lag

	(1)	(2)	(3)	(4)	(5)*	(6)*
	Employment	Employment	Employment	Employment	Employment	Employment
ex_rate	-1.313*** (.181)				-.179** (.063)	-.179** (.063)
terms_trade		14.318* (6.949)			-2.346 (5.22)	-2.346 (5.3)
lngdpreal			32.654*** (4.785)		19.672*** (4.851)	19.672*** (4.926)
Dppi				.436*** (.061)	.183*** (.059)	.183*** (.06)
top 25% larger industries in term of trade					-29.417* (14.501)	-29.417** (14.724)
Interaction between top 25% larger ind. and ex_rate					.352* (.174)	.352** (.177)
_cons	234.607*** (15.585)	106.082*** (7.37)	-756.706*** (128.658)	63.836*** (7.995)	-413.876*** (128.067)	-419.255*** (129.01)
Observations	608	608	608	608	608	608

Standard errors are in parentheses

\*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$

(5)\*- Panel fixed effect Model

(6)\*- Panel random effect Model

(7) The brackets represent robust standard deviation

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Table 10: Employment Model with lag

	(1) Employment	(2) employment	(3) employment	(4) employment	(5) employment	(6) employment
ex_rate <sub>i,t</sub>	-.617*** (.094)				-.10 (.059)	-.022 (.064)
ex_rate <sub>i,t-1</sub>	-.784*** (.132)				-.088 (.101)	-.171 (.112)
terms_trade <sub>i,t</sub>		9.61* (4.707)			-1.76 (4.21)	-1.738 (4.268)
terms_trade <sub>i,t-1</sub>		12.12** (4.589)			-.896 (3.361)	-.847 (3.391)
lngdpreal <sub>i,t</sub>			9.493*** (2.848)		2.702 (3.612)	2.566 (3.661)
lngdpreal <sub>i,t-1</sub>			24.86*** (3.847)		20.228*** (3.119)	20.227*** (3.164)
dppi <sub>i,t</sub>				.161** (.072)	.001 (.071)	-.003 (.071)
.dppi <sub>i,t-1</sub>				.288*** (.07)	.154** (.068)	.156** (.068)
top 25% larger industries in term of trade					-27.322** (12.343)	-24.981* (14.52)
Interaction between top 25% larger ind. and ex_rate					.33** (.15)	.299* (.172)
_cons	242.882*** (15.042)	98.814*** (9.789)	-801.488*** (120.121)	63.059*** (7.652)	-495.401*** (131.471)	-495.802*** (131.316)
Observations	589	589	589	589	589	589

Standard errors are in parentheses

\*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$

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(5)\*- Panel fixed effect Model

(6)\*- Panel random effect Model

(7) The brackets represent robust standard deviation

*Table 11: Real Wage model without lag*

	(1)	(2)	(3)	(4)	(5)
	real_wage	real_wage	real_wage	real_wage	real_wage
ex_rate	-2.609*** (.257)			.343** (.157)	.343** (.16)
terms_trade		29.345** (10.613)		-5.473 (6.502)	-5.473 (6.602)
Lngdpreal			70.264*** (7.013)	79.534*** (7.357)	79.534*** (7.47)
1.top_25_pct_te~e				-1.386 (2.517)	-1.386 (2.555)
_cons	360.898*** (22.213)	104.613*** (11.255)	-1753.46*** (188.553)	-2026.198*** (209.191)	-2034.482*** (211.927)
Observations	608	608	608	608	608
r2_p	.z	.z	.z	.z	.z

*Standard errors are in parentheses*

\*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$

Exchange Rate, Terms of Trade

(4)\*- Panel fixed effect Model

(5)\*- Panel random effect Model

(6) The brackets represent robust standard deviation

Table 12: Real Wage model with lag

	(1) real_wage	(2) real_wage	(3) real_wage	(4) real_wage	(5) real_wage
ex_rate <sub>i,t</sub>	-1.315*** (.159)			.63*** (.16)	.63*** (.162)
ex_rate <sub>i,t-1</sub>	-1.503*** (.216)			.288 (.173)	.288 (.175)
terms_trade <sub>i,t</sub>		19.568** (7.608)		-3.715 (6.495)	-3.715 (6.598)
terms_trade <sub>i,t-1</sub>		27.657*** (7.634)		-.772 (4.175)	-.772 (4.241)
lngdpreal <sub>i,t</sub>			16.021** (6.628)	27.175*** (6.97)	27.175*** (7.081)
lngdpreal <sub>i,t-1</sub>			60.267*** (7.889)	69.954*** (6.867)	69.954*** (6.976)
top 25% larger industries in term of trade				-1.75 (2.172)	-1.75 (2.206)
_cons	380.118*** (21.977)	86.66*** (15.439)	-1913.531*** (181.311)	-2547.832*** (224.118)	-2557.292*** (227.055)
Observations	589	589	589	589	589
r2_p	.z	.z	.z	.z	.z

Standard errors are in parentheses

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\*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$

(4)\*- Panel fixed effect Model

(5)\*- Panel random effect Model

(6) The brackets represent robust standard deviation

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# Figures

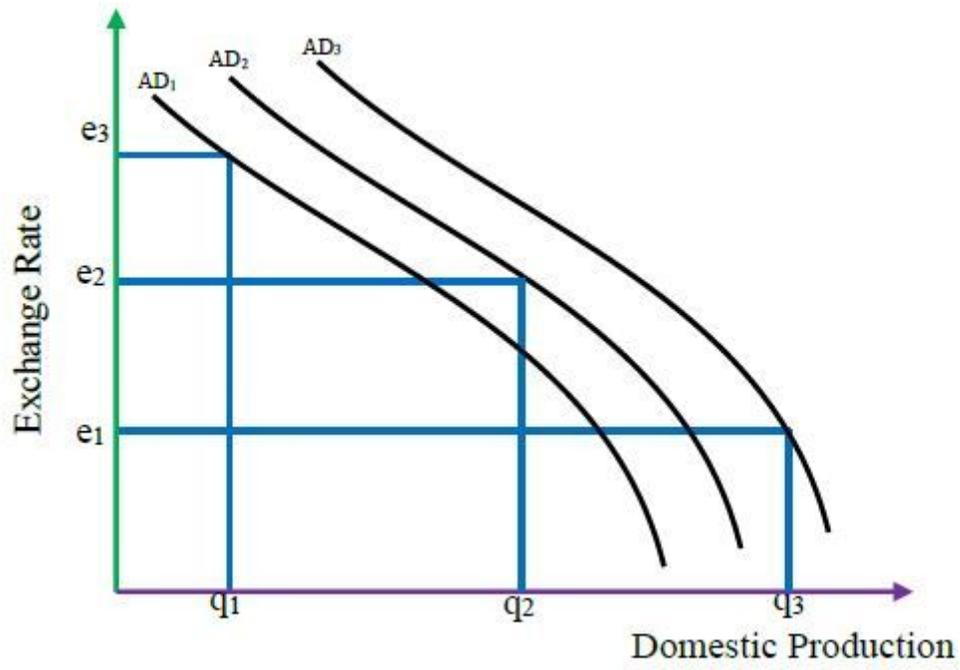


Figure 1

Demand curve

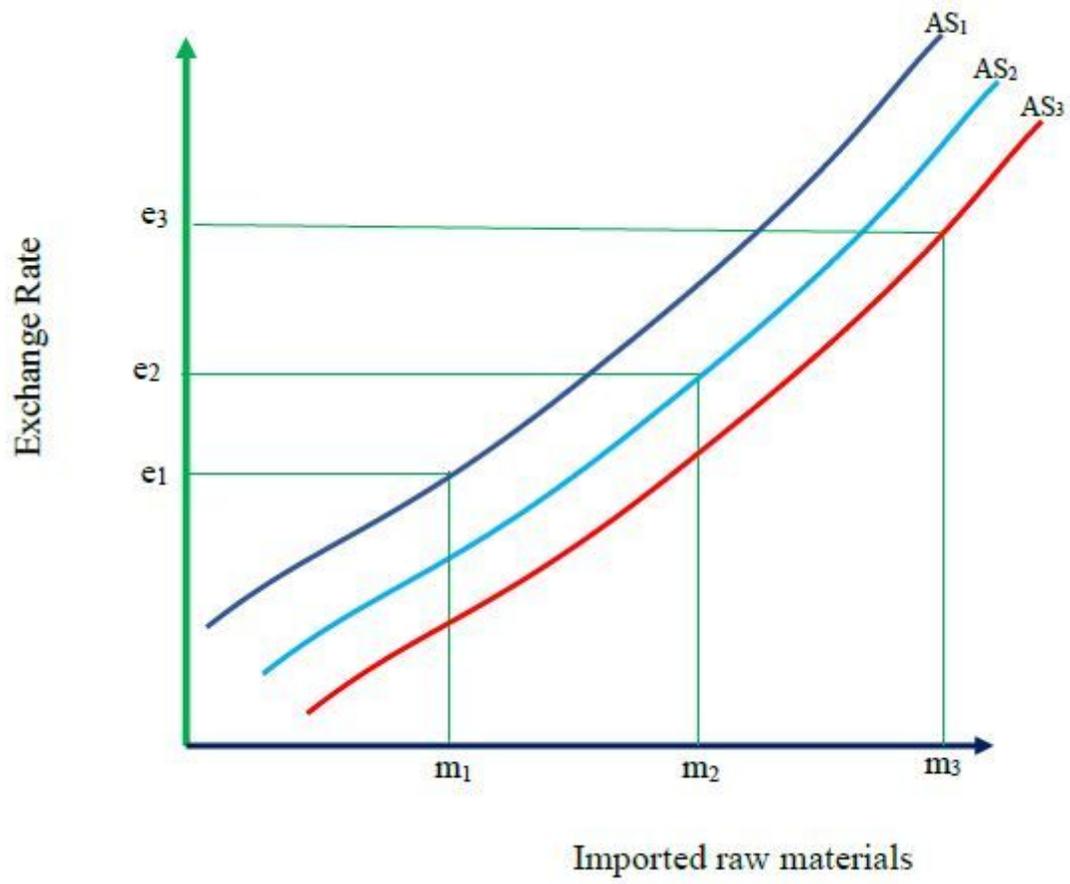


Figure 2

Supply Curve

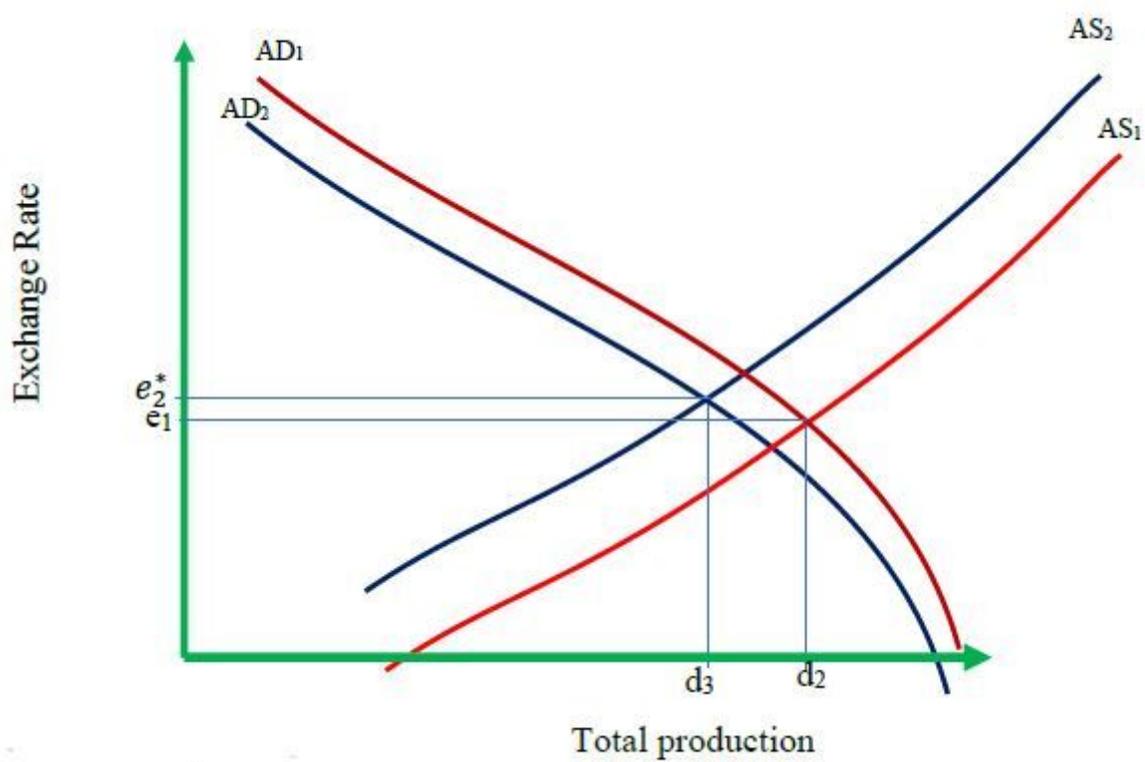


Figure 3

Total production