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Abstract

Despite the distributive effects of government policies are linked to many macroeconomic variables, the effects on real exchange rate (RER) were relatively neglected. Additionally, estimating the differences between the two tails changes of income inequality in affecting RER has relatively little attention. Theoretically, two main intermediaries for income inequality to affect RER are addressed: economic growth and relative prices of non-traded goods (hereafter denoted by non-tradables) to traded goods (hereafter denoted by tradables). Empirically, the relationship can be positive or negative. In this paper, a dynamic panel model is estimated using macroeconomic data for MENA and North Mediterranean region. The paper proved that inequality is of main determinants of RER. Moreover, both of changes in the right-tail inequality and the left-tail inequality are effectively affecting RER in opposite directions. Also, having different initial income levels between economies lead to differentials in the effects of inequality on RER. All of these require greater cautiousness when dealing with income inequality especially if it is used as a tool to encourage growth and encouraging the competitiveness of domestic products.

Keywords: Consumption inequality, Income inequality, Real exchange rate, MENA countries, North Mediterranean countries, Tails inequality.
JEL Classifications: E25, F21, F31, F41, F66.

1. Introduction

Reducing income inequality is one of the main concerns globally. It is considered of the most challenging macroeconomic problems in MENA and North Mediterranean countries. In most of these countries the gap between the richest and the poorest has no significant improvement over the last two decades. The share of income held by highest 10 percent of population in these countries has a maximum of 33 percent while its minimum is more than a fifth of income in these countries according to World Development Indicators data (WDI, 2019). On the other hand, the share of income held by lowest 10 percent of population in these countries has a maximum of 4 percent while its minimum is 1.8 percent of income in these countries according to World Development Indicators data (WDI, 2019). The failure in reducing income inequality can be a threat in these countries on economic, social, and political stability.

Several studies have analyzed the effects of income inequality on macroeconomic performance including economic growth, investment and savings, aggregate consumption, poverty, and inflation (Andrei and Cracium, 2015; Berg and Ostry, 2011; Dabla-Norris, Kochhar, Ricka, Suphaphiphat, and Tsounta, 2015; Keeley, 2015; Kocherlakota and Pistaferri, 2008; Min, Shin and McDonald, 2015).

Stable and competitive policies of real exchange rate (RER) play a vital role in promoting economic development. Stable and competitive RER has a direct effect on facilitating the diversification of the economy through affecting the relative prices of exports. This indirectly supports aggregate demand and employment as well as strengthens economic stability through help in managing both of the cyclical swings in foreign sources of finance and the fluctuations of terms of trade (ToT). Moreover, stable and competitive RER coupled with effective tax systems can help improving welfare through reallocating the economy's factors of production towards tradable sectors with large spillovers and externalities.

To the best of our knowledge, in spite of the multiplicity of studies on the macroeconomic effects of income inequality, the effects on RER were relatively neglected (Min *et al.*, 2015). Additionally, very few of these studies estimated the differences between the richest portion (hereafter denoted by right-tail) and the poorest portion (hereafter denoted by left-tail) changes of income inequality in affecting RER (Kocherlakota and Pistaferri, 2008; Min *et al.*, 2015).

There are two main goals of this paper; those are considered the contributions of it to the literature. The first is the study of the effects of the income inequality on RER in a set of MENA and North Mediterranean countries in the presence of a number of other control variables. The second is to analyze the different effects between right-tail and left-tail inequality changes on RER changes. The specific objectives are to identify the main

channels those can lead income inequality to affect RER, differentiate between the impacts of the two tails of inequality in affecting RER, quantify the impact of income inequality and the differences in the effects between the changes in the two tails of inequality on RER using macroeconomic data set for countries in MENA and North Mediterranean region, and draw policy conclusions.

In order to achieve the objectives of the paper, the literature on the effects of income inequality on RER is reviewed to identify the most important channels from which income inequality moves to affect the RER; followed by an estimation of a dynamic panel model to test the effect of income inequality on RER in addition to the different effects between right-tail and left-tail inequality changes on RER changes in 24 countries in MENA and North Mediterranean region, the list of countries are mentioned in appendix 1, during the period 2000-2017.

The structure of the paper includes five sections. Section 1 includes an introduction. Section 2 reviews the literature that supports and opposes the effects of income inequality on RER and differences between tails of inequality on changes in RER. Section 3 analyzes the status of income inequality in MENA and North Mediterranean region over time. Section 4 provides empirical evidence of the relationship between income inequality and its channels that affect RER and its different effects between the tails of inequality on RER. Section 5 discusses the estimation techniques, specification of the models, data sources, empirical results and discussion of the results. Section 6 involves conclusions and policy implications.

2. Review of Literature

Reducing income inequality has widespread considerable attention as inequality has increased worldwide. Also, it is a prerequisite for the Arab Spring revolutions. Despite the importance of equitable distribution of income politically and socially, the distributive effects of government policies are linked to many macroeconomic variables. Thus, several studies have analyzed the effects of income inequality on macroeconomic performance, as mentioned before.

The real exchange rate (RER) is a fundamental variable in the formulation of a country's trade policy. RER has an impact on the competitiveness of the country's products and consequently its trade balance. Especially, as many countries adopt export-led growth strategies. However, the macroeconomic effects of income inequality on RER and the differences between right-tail and left-tail changes of income inequality in affecting RER growth were relatively neglected.

The relationship between income inequality and RER is neither direct nor unambiguous as it depends on the intermediaries used between them in addition to satisfying several

conditions, as will be mentioned in item 2-2 of the research (Aiyar and Ebeke, 2018; Berg and Ostry, 2011; Dabla-Norris *et al.*, 2015; Garcia, 1999; Min, 2002; Min *et al.*, 2015).

In order to study the impact of income inequality on RER, identifying and characterizing both of income inequality and RER is taken place. Then a review of the theoretical background of the impact of income inequality on RER and the differences between the impacts of right-tail and left-tail income inequality on RER is done. This is followed by investigating practical researches those studied both effects.

2.1. Conceptual framework

In general, inequality refers to differences in the well-being among the whole population or groups of people. This broad definition of inequality reflects the fact that it is a multidimensional phenomenon. The disparity in obtaining certain material choices ranges from income inequality to inequality in opportunities and outcomes. It can be extended to economic inequality. Moreover, it may increase to include social and political aspects and in this case it is called human capital inequality (Andrei and Craciun, 2015; Garcia, 1999). Sometimes the environmental dimension can be added to capture an overall measurement of inequality. Dabla-Norris *et al.* (2015) stated that income inequality is considered the most widely used measurement of outcomes inequality. Moreover, it is the main source of inequality in its various forms. However, the rest of the dimensions of equality[2]can help in reducing income inequality through increasing income share of the poor regardless of the country's economic development levels (Garcia, 1999). Chatterjee, Sinha and Chakrabarti (2007) stated that despite the differences in economic indicators and policies adopted, income inequality follows historically a particular universal pattern irrespective of the stages of economic development.

The most common measurement of income inequality is Gini Coefficient. Gini Coefficient is a mathematical indicator based on the visual indicator called Lorenz curve[3] (Lahouij, 2017). This Coefficient is usually measured using the market values called “gross Gini” or after deducting the net tax called “net Gini” (Dabla-Norris *et al.*, 2015). In both cases, it takes values between zero, in case of perfect equity, and one, if there is perfect inequality where all the income is hold by one individual. The Gini Coefficient is used to measure inequality in the whole society rather than simply comparing different income groups. This leads a number of researchers to use the changes in income shares of groups of population as supplements to Gini Coefficient in order to capture the changes in income inequality (Min *et al.*, 2015).

[2] These dimensions can include improving access to education, health care, opportunities, and redistributive social policies.

[3]The Lorenz Curve developed by Max Lorenz is a graphical representation of the distribution of wealth. It shows the proportion of income earned by any given percentage of the population.

In measuring changes in income shares of groups of the population, tracing highest or lowest decile or quintile of income shares are used. Highest decile (quintile) is measured as the percentage share of income or consumption accrues by the highest 10% (20%) of population. Changes in highest decile or quintile of income distribution can be used to measure the changes in the right-tail of income distribution. Lowest decile (quintile) is measured as the percentage share of income or consumption accrues by the lowest 10% (20%) of the population. Changes in lowest decile or quintile of income distribution can be used to measure the changes in the left-tail of income distribution.

The real exchange rate can be defined as the nominal exchange rate adjusted for prices differentials between the country and the rest of the world. Although most of the literature defined real exchange rate (RER) as relative prices, there was no agreement on the form of these prices. It was initially defined as the equivalent of the nominal exchange rate (NER) multiplied by world price level (P*) and divided by the domestic price level (P). RER calculated in this way is the RER measured on the basis of purchasing power parity (PPP) (Betts and Kehoe, 2008; Bhalla, 2008; Min, 2002; Rodrik, 2008). RER is calculated in this way according to equation (1).

$$RER_{PPP} = NER \times \frac{P^*}{P} \quad \text{.... (1)}$$

The real exchange rate was then defined as the relative prices of tradables (P_T) to non-tradables (P_{NT}) (Bhalla, 2008; Burstein, Eichenbaum, and Rebelo, 2006;Edwards, 1989) assuming that PPP holds only for traded-goods and there are no taxes or any other types of costs involved in international trade (such as transport, shipping, etc.).Thus, RER can be expressed as in equation (2).

$$RER = \frac{P_T}{P_{NT}} \quad \text{.... (2)}$$

2.2. The effects of income inequality on RER theoretically

Whereas the literature argued that theoretical arguments stated that the distribution of wealth is more relevant than the distribution of income in affecting economic performance, it has been rarely used because its data are not exist for a sufficient number of countries (Bagchi and Svejnar, 2015). Accordingly, proxies are used referring to the distribution of wealth because of the lack of data. The most commonly used proxy for the distribution of wealth is the distribution of income after making some transformations on it like using an average of the distribution of income for a number of years or having the lagged value for the distribution of income as an independent variable referring to the accumulation of wealth.

A review of related literature states two main channels can be used as intermediaries to study the effects of income inequality on RER. These channels are economic growth and relative prices of non-tradables to tradables.

A. Economic growth channel

Economic theory gives many links between wealth and income inequality and economic growth on the one hand, and economic growth and RER changes on the other. This has led many empirical research papers to use economic growth as an intermediary in determining the relationship of the inequality to RER. This is despite the relatively few studies that examined the relationship between economic growth and RER changes.

The Classical and neo-classical approach has shown that wealth and income inequality are necessary for accelerating economic growth (Lahouij, 2017). Moreover, they considered inequality as a prerequisite for economic growth and that any efforts to redistribute incomes would be at the expense of accelerating economic growth (Mosqueira and Fahimi, 2014). Many arguments are introduced to explain this positive relationship (Delbianco, Dabús, and Caraballo, 2014; Galor, 2009; Keeley, 2015). First, the increased wealth and income inequality leads to a concentration of wealth and income among the rich. While the marginal propensity to save (MPS) is higher for the rich, increased inequality increases national savings, investment and consequential accelerates economic growth. Second, inequality is a motivation for the entrepreneurs to get a higher risk return and it raises the incentives to innovate. Third, enhancing economic efficiency, where supporters of inequality argue that the poor are not receiving all the money taken from the poor as taxes. Thus, the loss generated from the tax reduces the economic efficiency (Alesina and Rodrik, 1994; Bagchi and Svejnar, 2015).

Empirical evidence puts pressure on the classical and neo-classical thoughts as real cases have proved that income inequality impedes economic growth[4]. Even if it leads to short-term economic growth, it impedes its medium- and long-term sustainability (Dabla-Norris *et al.*, 2015; Mosqueira and Fahimi, 2014).The modern perspective has emerged to justify the inverse relationship between increased inequalities in income distribution and economic growth (Galor, 2009).

The literature has shown many factors that make more wealth and income inequality restricts the sustainability of economic growth (Bagchi and Svejnar, 2015; Brueckner and Lederman, 2018; Chletsos and Nikolaos, 2016; Dabla-Norris *et al.*, 2015; Delbianco *et al.*, 2014; Keeley, 2015; Lahouij, 2017; Litschig and Lombardi, 2019; Majeed, 2010; Mosqueira and Fahimi, 2014). First, the lack of the ability of low-income non-wealthy people to stay healthy and to spend more on children's education lead to the disruption of

[4]Empirically, income inequality has been the most commonly used proxy for wealth inequality because of the lack of having sufficient data for the latter.

individual productivity over the medium term[5]. Second, the reduction of aggregate demand as the wealthy spend a relatively lower proportion of their income on consumption compared to low and middle income groups. Third, discouraging productive investment restricts the sustainability of growth, especially in times of crisis[6]. Fourth, the more income inequality may put further pressure on economic policies against growth-enhancing economic reform and liberalization. For example, pressure to fight the use of effective laws to compete and prevent monopoly. Fifth, the political economy approach states that the increase in wealth and income inequality is a threat to the sustainability of political and social stability, which directly affects economic stability as a challenge to improve the macroeconomic variables including growth.

Delbianco *et al.* (2014) mentioned a unified explanation that can combine the two contradictory relations between income inequality and economic growth. In their paper, they explained the contradictory relations by different stages of development. At earlier stages of production, the positive relationship between income inequality and economic growth holds as physical capital accumulation plays a critical role in accelerating growth. Accordingly, the concentration of income with the rich, whose higher marginal propensity to save, accelerates growth. In the later stages of development, human capital becomes the engine of growth. Hence, the negative relationship between income inequality and economic growth holds.

Delbianco *et al.* (2014) and Min *et al.* (2015) concluded that the income level matters for the effects of inequality on economic growth. They explained that the greater the income inequality in favor of the segment of the highest income population, the more the savings and therefore investment. Accordingly, the relationship between income inequality and growth follows the classical thought. On the other hand, they stated that the greater the income inequality in favor of the segment of the lowest income population, the less the ability to satisfy necessities which could lead to political and social unrest. Accordingly, the relationship between income inequality and growth follows the political economy approach.

Therefore, it can be concluded that the relationship between income inequality and growth is complex. Although inequality is an important factor in increasing the incentive for investment and increasing productivity, inequality puts pressure on the economic growth due to the previous causes (Berg and Ostry, 2011). Keeley (2015) argued that this relationship is indirect and depends on the degree of inequality. Keeley explained that inequality is useful to speed up growth to a certain extent. But excessive inequality restricts

[5]According to the credit market imperfection approach, income inequality could result in an over-investment in physical capital at the expense of investing in human capital (Berg and Ostry, 2011; Galor, 2009; Majeed, 2010).

[6]Practical experience has proved that long periods of income inequality in developed countries before the financial crisis have been associated with excessive credit, loosening the standards used to evaluate mortgages and increasing pressure from lobbyists to push for financial deregulation.

growth. This relationship is referred to as the Kuznets inverted U hypothesis (Andrei and Craciun, 2015; Bagchi and Svejnar, 2015; Gallo, 2002; Lahouij, 2017; Meneejuk and Yamada, 2016; Wroblowsky and Yin 2016). This is what prompted Keeley (2015) to mention the optimal rate of inequality.

Economic growth can be linked to a change in RER through several theories to explain exchange rate changes, including structural, absorption, monetary, and asset market approaches to explain exchange rate changes. Despite both of the structural and absorption approaches explain the changes in exchange rate in real terms, monetary and asset market approaches focus on the changes in demand and supply of money in changing exchange rates (Bird, 1998).

The structural approach focuses on the changes in demand and supply of goods and how can it affect exchange rate. According to the income effect, the economic growth results in generating incomes which will increase the demand for imports leading to a depreciation of the domestic currency. This channel between economic growth and RER depends on foreign trade elasticities. By contrast, the economic growth can lead to current account disequilibria. This disequilibrium has its impact on the capital account through resulting in a positive net foreign investment. The latter increases demand for domestic currency and results in an appreciation of the domestic currency. This trend increases with the fact that investments are directed to countries with relatively higher growth rates. Additionally, one of the most popular hypotheses in studying the relationship between economic growth and RER is the Balassa-Samuelson effect (Kilicarslan, 2018). This hypotheses state that, the productivity increases in the tradables sector tend to be higher than those of non-tradables sector, resulting in a fall in RER (Rodrik, 2008).

The absorption approach rely changes in the exchange rate to the relationship between changes in domestic absorption relative to changes to domestic output (Bird, 1998). If domestic absorption exceeds domestic output, this means that imports outweigh exports. This is therefore an indicator of the depreciation of the local currency.

According to the monetary approach of determining the exchange rate, the exchange rate moves as a result of changes in the relative prices of currencies, which depend on the interaction of supply and demand forces of money in both countries. In determining interest rates, GDP growth rate should be put into consideration. Sometimes, GDP growth rates are used as an indication for inflation. Here, central banks can use interest rates to manage inflation. Hence, economic growth enhances central banks to raise the interest which raises the demand for money in the country. Accordingly, domestic currency is appreciated.

The asset market approach is an extension on the monetary approach. The asset market approach looks at money as an asset. Therefore, it focuses on how can the changes in

demand and supply of money as an asset affects the exchange rate (Bird, 1998). According to this approach, the effects of economic growth on exchange rates can be identified by two basic channels. The first is the interest rates which central banks increase during economic growth in most cases leading to an appreciation of the currency. The second is the expectations of the exchange rate in the future as currency is expected to appreciate with economic growth. Accordingly, traders will speculate increasing demand for the domestic currency, which puts pressure on its value to increase.

Thus, we can conclude that the relationship between growth and RER changes is no less complicated than the relationship between inequality and growth. The study of the theory illustrated that this relationship is governed by a number of real and monetary variables. The long-term determinants of real variables such as the long-term exchange rate and productivity are also different from the short-term determinants of monetary variables such as inflation rates and the expectations of traders towards future exchange rate as a result of economic growth.

B. Prices of non-tradables channel

The second channel uses prices of non-tradables to link income inequality to RER (Min, 2002; Min *et al.*, 2015). Min *et al.* (2015) set three assumptions: the first being the heterogeneity of preferences among different income groups, which concluded that the richest segments had a more elasticity of demand for non-tradables. The second is that purchasing power parity theory holds only for traded-goods. Thus, while traded-goods are affected by world prices, the prices of non-tradables are affected by the distribution of income within the country. The third suggests that prices both internally and externally are weighted averages of the prices of tradable and non-tradable goods. Accordingly, they expressed RER as a function of P_T and P_{NT}, where P_T is exogenous as it is related to world prices according to the second assumption and P_{NT} is a function of the degree of income inequality (G), as follows:

$$RER = f(\overline{P_T}, P_{NT}(G)) \qquad \text{.... (3)}$$

Subject to these assumptions and after differentiating RER with respect to prices of non-tradables, they concluded that the less (more) income inequality; ceteris paribus; will result in a real depreciation (appreciation) of the value of the RER.

Dogan and Bettendorf (2018) confirmed the same idea stating that the traded sector shock is cointegrated globally. Accordingly, traded sectors have the same trend all over the world in the long run and it cannot explain the changes in RER. They claimed that the volatility of RER can be strongly explained by the variations in the relative prices of non-tradables across countries. They stated two main channels for the variations in prices of non-tradables. The first is the differences in non-tradables sectors productivity chocks between

nations those can lead to changing the relative prices of tradables to non-tradables which leads to variations in RER. The second uses Balassa-Samuelson effect, illustrated before, to explain that as labor is mobile across sectors, a productivity improvement in one sector, even if it is a tradable sector, affects wages in all sectors. This puts pressure on prices of non-tradables to increase. The latter can lead to variations in RER. For both channels, the strength of the relationship between changes in prices of non-tradables and RER depends on the value of the elasticity of substitution between non-tradables and foreign produced goods. The higher the non-tradables bias in preferences, the stronger the relationship between prices of non-tradables and RER.

Few papers used consumption inequality instead of income inequality to connect inequality to RER through relative prices of non-tradables to tradables (Backus and Smith, 1993; Kocherlakota and Pistaferri, 2008). However consumption inequality is more relevant to disparities in economic well-being, it is relatively neglected in measuring inequality. Because of the lack of data on consumption inequality compared to income inequality, a number of researchers use income inequality to express disparities in economic well-being. Income can be used as a mirror of consumption if consumers lack the ability to borrow or save, or if they cannot receive transfers whether from other family members or the government in response to income shocks.

Kocherlakota and Pistaferri (2008) argued that the correlation between income inequality and consumption inequality breaks down if residents are insured against idiosyncratic shocks such as unemployment, disability, or wage fluctuations. Instead, the economic theory confirms this correlation if residents are partially insured. Thus, they concluded that the lower the degree of insurance against the risk of income fluctuations, the greater the effect of the consumption inequality on RER.

In order to explain the effect of the consumption inequality on RER, Kocherlakota and Pistaferri (2008) assumed having two different models of partial insurance. In the first model, which they call “incomplete markets model of partial insurance”, households can use assets as a payment tool in case of aggregate but not idiosyncratic shocks. In the second model, which they call “a private information Pareto optimal model of partial insurance”, households can sign contracts to insure their lifetime. These contracts are optimal subject to a moral hazard problem, the insurers then trade assets on behalf of households. In both models of partial insurance, consumption inequality affects RER through affecting relative prices of non-tradables to tradables. In the first model, as insurance are limited and does not cover idiosyncratic shocks, there will be precautionary demand for assets. This type of demand for assets is maximized in case of shocks faced by those existing in the left-tail inequality. During these shocks, the poor demands more non-tradable relative to tradables. In the second model, because of having the incentive to insure their lifetime and the diminishing marginal utility of consumption, the demand for non-tradables decreases more

than the demand for tradables. Accordingly, in both cases RER will be affected by changes in consumption inequality.

2.3. Differences between the two tails of inequality in affecting RER

Although being relatively neglected, some papers studied the differences between the impacts of right-tail and left-tail changes of income inequality on RER changes. These studies concerned how can the channels, those can relate income inequality to RER, be affected in different ways by differences in the two tails of inequality (Kocherlakota and Pistaferri, 2008; Min *et al.*, 2015). As mentioned before, Kocherlakota and Pistaferri (2008) and Min *et al.* (2015) used the incomplete markets and private information Pareto optimal models of partial insurance to explain the relationship between the changes in inequality tails and RER through affecting prices of non-tradables. They stated that changes in right-tail and left-tail inequality affect RER in opposite directions. Following the incomplete markets model, the increase in left-tail inequality puts pressure on prices of non-tradables to increase relative to tradables which results in an RER appreciation. On the other hand, the increase in right-tail inequality follows private information Pareto optimal model leading to a reduction in the prices of non-tradables more than tradables. This results in RER depreciation.

Litschig and Lombardi (2019) claimed, in studying the differences between the effects of changes in the two tails of inequality on economic growth, that both physical and human capital accumulation far superior in places with high degree of inequality in the left-tail while inequality in the right-tail is uncorrelated with physical or human capital growth. This leads to differentials between tails of inequality in affecting RER through the growth channel.

Delbianco *et al.* (2014) gave another explanation for the differences between tails of inequality on affecting growth. They claimed that while the increase in income inequality towards the right-tail of income encourages growth as the relation follows the Classical and neo-classical approach, the increase in income inequality towards the left-tail of income discourages growth as it follows the political economy approach.

2.4. The effects of income inequality on RER empirically

Through reviewing the literature, we divided the related empirical literature into nine categories of studies: studies that examine the relationship from income inequality to economic growth, studies that examine the relationship from economic growth to RER, studies that inspect the relationship from income inequality to price of non-tradables, studies that test the relationship from price of non-tradables to RER, studies that explore the relationship from income inequality to RER, studies that check the relationship from consumption inequality to RER, studies that investigate the difference between changes in the two tails of inequality in affecting growth, studies that test the difference between

changes in the two tails of inequality in affecting price of non-tradables, and studies that examine the difference between changes in the two tails of inequality in affecting RER.

Regarding the first group that examines the relationship from income inequality to economic growth, reviewing the literature illustrated that studies gave four main possibilities for the relationship between income inequality and economic growth: studies found a negative relationship, studies found a positive relationship, studies found a nonlinear relationship with changing sign, studies found no relationship. Some of these studies are reported in table no. 1.

Concerning the second group that examines the relationship between economic growth and RER, reviewing the literature shows that several studies have analyzed the impact of exchange rate changes and exchange rate regimes on economic growth, but there has been little study of the impact of economic growth on RER. These few studies do not agree about the direction of the effect. While some confirmed this relationship for low levels of income, the relationship is not confirmed for higher levels of income. Some of these studies are reported in table no. 2.

With reference to the third group that inspects the relationship between income inequality and price of non-tradables, relatively few papers estimated this relationship. These papers agreed that the more the income inequality, the more the price of non-tradables. Some of these studies are reported in table no. 3.

Concerning the fourth group that tests the relationship between price of non-tradables and RER, empirical papers confirmed this relationship as they found that prices of non-tradables negatively related to RER. Burstein *et al.* (2006) stated that changes in relative prices of non-tradables to tradables explain more than half of the fluctuations in RER. Some of these studies are reported in table no. 4.

Regarding the fifth group that explores the relationship between income inequality and RER, relatively few papers estimated this relationship. They found a conflicting relationship as more income inequality can lead to depreciate RER because of the effect of inequality on productivity of tradables or it can lead to appreciate RER if the income elasticity of demand exceeds one and with an absence of factor price equalization. Some of these studies are reported in table no. 5.

With reference to the sixth group that studies the difference in the effect between the two tails of inequality on RER, to the best of our knowledge, only two papers are found. Both do not agree about the significance of the relationship between relative growth of consumption inequality and RER growth. Some of these studies are reported in table no. 6.

Table 1. Examples of studies those examine the relationships from income inequality to economic growth

No.	Authors	Data included	Technique used
1. Studies examine the effects of income inequality on economic growth			
A) Studies found a negative relationship			
1	Dabla-Norris *et al.* (2015)	5-year panels over the period 1980–2012 of a sample of 159 countries from developed, developing, and emerging economies	A system dynamic GMM model
2	Delbianco *et al.* (2014)	20 Latin American and Caribbean countries during the period 1980-2010	A dynamic panel model using GMM models
3	Panizza (2002)	State-level panel data for 48 states in the US during the period 1940-1980	Both of fixed effects and GMM models
4	Alesina and Rodrik (1994)	35 countries (including 17 developed countries) during the period 1960-1985	Both of OLS and TSLS models
5	Lahouij (2017)	12 of oil-importing MENA countries from 1980 to 2007 using a panel data	Fixed-effect model
6	Litschig and Lombardi (2019)	Sub-national data for Brazil from 1970 to 2000	OLS regression model
B) Studies found a positive relationship			
1	Forbes (2000)	45 countries from 1966 to 1995	Random effects, fixed effects, and Arellano - Bond's GMM technique
2	Chletsos and Nik olaos (2016)	Panel data set of 126 countries during the period 1968-2007.	GMM, fixed effects, and Two stages least squares models
3	Meneejuk and Yamada (2016)	quarterly data set[7] for Thailand from 1993:Q1 to 2015:Q4	Simultaneous smooth transition kink equation (SKE) model
C) Studies found a nonlinear relationship with changing sign			
1	Brueckner and Lederman (2018)	Data period 1970-2010 for a large set of countries. Only countries which inequality data are available for at least two or more consecutive 5-year intervals are included	Instrumental variables regression and Difference-GMM estimation
D) Studies found no relationship			
1	Wroblowsky and Yin (2016)	Data from 2000 to 2014 for China	Comparative study with some other countries
2	Bagchi and Svejnar (2015)	Data for 1987-2007 for 26 countries	Fixed effects model

Source: Prepared by the researcher depending on reviewing the literature.

Regarding the seventh group that tests the relationship from the difference in the effect between the two tails of inequality on growth, papers do not agree whether the effects of changes in right-tail or left-tail inequality on economic growth. Both directions of effect are explained by the theory as mentioned before. Some of these studies are reported in table no. 7.

[7]Gini coefficient index was disaggregated to generate the quarterly series from the annual one.

With reference to the eighth group that investigates the difference in the effect between the two tails of inequality on price of non-tradables, while papers agreed about the effects of the increase in left-tail inequality on prices of non-tradables as it increases the demand for non-tradables and accordingly increases its prices, they did not agree about the effect of the increase in the right-tail inequality on prices of non-tradables. Some of these studies are reported in table no. 8.

Concerning the ninth group that tests the difference in the effect between the two tails of inequality on RER, papers gave different results about the effects of changes in both tails of inequality on RER. Some of these studies are reported in table no. 9.

Table 2. Examples of studies those examine the relationships from economic growth to RER

No.	Authors	Data included	Technique used	Further results
2. Studies examine the effects of economic growth on RER				
1	Bhalla (2007)	Annual data for 2117 from 1996 to 2007	Non-log non-linear S-shaped relationship	The more the per capita income, the higher the RER. Once per capita income reaches a certain level, RER is marginally affected by income changes
2	Rodrik (2008)	Seven developing countries (China, India, South Korea, Taiwan, Uganda, Tanzania, and Mexico) during 1950-2004	Fixed effects model	An increase in incomes by 10 percent leads to RER falls by around 2.4 percent. This confirms Balassa-Samuelson effect
3	Kilicarslan (2018)	Annual data for Turkey during 1974-2016	FMOLS method	Output growth is significant and negatively affect RER
4	Adusei and Gyapong (2017)	Annual data for Ghana during 1975-2014	Partial Least Squares Structural Equation Modeling approach	GDP growth rate contribute in explaining the depreciation of the cedi-dollar exchange rate in Ghana by 15.1 percent
5	Mirchandani (2013)	Annual data for India from 1991 to 2010	Pearson's correlation analysis	Exchange rates is correlated with growth rate in either direct or indirect manner

Source: Prepared by the researcher depending on reviewing the literature.

Table 3. Examples of studies those examine the relationships from income inequality to price of non-tradables

No.	Authors	Data included	Technique used	Further results
3. Studies examine the effects of income inequality on price of non-tradables				
1	Min *et al.* (2015)	Data for 69 countries over the period 1980-2007	The correlation analysis	The more the income inequality, the more the price of non-tradables
2	Min (2002)	Data are averaged over 1980-89 for 73 countries	OLS and WLS	Reducing inequality leads to a decrease in price of non-tradables

Source: Prepared by the researcher depending on reviewing the literature.

Table 4. Examples of studies those examine the relationships from price of non-tradables to RER

No	Authors	Data included	Technique used	Further results
4. Studies examine the effects of price of non-tradables on RER				
1	Min *et al.* (2015)	Data for 69 countries over 1980-2007	The correlation analysis	Changes in prices of non-tradables negatively related to RER
2	Min (2002)	Data for all variables are averaged over 1980-89 for 73 countries	OLS and WLS	The decrease in relative prices of non-tradables, will depreciate RER.
3	Burstein *et al.* (2006)	Quarterly data for 11 countries from Q1: 1971 to Q3: 2002	The correlation analysis	Changes in relative prices of non-tradables explain more than half of the fluctuations in RER.
4	Dogan and Bettendorf (2018)	Data from1982 to 2007 between UK and EU	Vector error correction model	The relative changes in prices of non-tradables are necessary in explaining the volatility of RER
5	Mendoza (2006)	Mexico-U.S. data from January, 1969 to February, 2000	Variance analysis	Changes in relative prices of non-tradables explains from 50 to 70 percent of the fluctuations of the Mexico-US RER during adopting managed exchange rate in Mexico

Source: Prepared by the researcher depending on reviewing the literature.

Table 5. Examples of studies those examine the relationships from income inequality to RER

No.	Authors	Data included	Technique used	Further results
5. Studies examine the effects of income inequality on RER				
1	Min *et al.* (2015)	Data for 69 countries over the period 1980-2007	Fixed effects and system-GMM models	Less income inequality leads to a real depreciation
2	Min (2002)	Data for all variables are averaged over 1980-89 for 73 countries	OLS and WLS	Less income inequality tends to depreciate RER
3	Garcia (1999)	5-year bilateral averages of the period 1960-1990 for 76 countries	Fixed effects model	More income inequality is associated with RER depreciation

Source: Prepared by the researcher depending on reviewing the literature.

Table 6. Examples of studies those examine the relationships from consumption inequality to RER

No.	Authors	Data included	Technique used	Further results
6. Studies examine the effects of consumption inequality on RER				
1	Kocherlakota and Pistaferri (2008)	A wide range of countries including European, Latin American and the Caribbean, African, and former USSR countries from 1970 to 2005	Panel OLS regression model and sensitivity analysis	Relative growth of consumption inequality is economically and statistically significant in determining RER growth
2	Backus and Smith (1993)	Quarterly data for eight OECD countries for the period 1971-1990	The correlation analysis	Consumption inequality is not related to real exchange rates

Source: Prepared by the researcher depending on reviewing the literature.

Table 7. Examples of studies those estimate the differences between the effects of inequality tails on economic growth

No.	Authors	Data included	Technique used	Further results
7. Studies examine the difference in the effect between the two tails of inequality on economic growth				
1	Delbianco *et al.* (2014)	20 Latin American and Caribbean countries during the period 1980-2010	A dynamic panel model using GMM models	Higher inequality, measured by right-tail encourages growth, however higher inequality, measured by left-tail discourages growth.
2	Litschig and Lombardi (2019)	Sub-national data for Brazil from 1970 to 2000	OLS regression model	The more the inequality measured by left-tail, the more rapid the economic growth, while the increase in inequality measured by right-tail does not support growth.

Source: Prepared by the researcher depending on reviewing the literature.

In conclusion, regardless of the channel used, neither theoretical nor empirical studies confirmed the direction or the significance of the effects of income inequality on RER. The results of the difference in the effect between the two tails of inequality on RER illustrated the same disagreement. All studies confirmed that the relationship depends on several factors including the initial income level, the period of time included in the study, whether it is a single country or a comparative study, the model used, and the technique used in estimation. This makes studying this relationship is a matter of application which leads us to estimate our model.

Table 8. Examples of studies those estimate the differences between the effects of inequality tails on price of non-tradables

No.	Authors	Data included	Technique used	Further results
8. Studies examine the difference in the effect between the two tails of inequality on price of non-tradables				
1	Min (2002)	Data for all variables are averaged over 1980-89 for 73 countries	OLS and WLS	An increase in income share of the lowest quintile reduces the price of non-tradables because of the decrease in the demand for non-tradables
				An increase in income share of the highest quintile was insignificant in affecting price of non-tradables
2	Min *et al.* (2015)	Data for 69 countries over the period 1980-2007	Random effects model	An increase in income share of the lowest quintile decreases the demand for non-tradables and thus reduce their prices
				An increase in income share of the highest quintile increases the demand for non-tradables and increases their prices

Source: Prepared by the researcher depending on reviewing the literature.

Table 9. Examples of studies those estimate the differences between the effects of inequality tails on RER

No.	Authors	Data included	Technique used	Further results
9. Studies examine the difference in the effect between the two tails of inequality on RER				
1	Min *et al.* (2015)	Data for 69 countries over the period 1980-2007	Random effects model	An increase in income share of the lowest quintile leads to a real depreciation of RER
				An increase in income share of the highest quintile leads to a real appreciation of RER
2	Min (2002)	Data for all variables are averaged over 1980-89 for 73 countries	OLS and WLS	An increase in income share of the lowest quintile leads to real depreciation of RER
				An increase in income share of the highest quintile was insignificant in affecting RER
3	Kocherlakota and Pistaferri (2008)	A wide range of countries including European, Latin American and the Caribbean, African, and former USSR countries from 1970 to 2005	Panel OLS regression model and sensitivity analysis	While differences between countries in the growth rates of right-tail are statistically significant in affecting RER growth, left-tail inequality growth is not.

Source: Prepared by the researcher depending on reviewing the literature.

3. Specification of the Model, data sources, and estimation technique,

In this section, the specification of the model, sources of data and its description, as well as the estimation strategy used to estimate the impact of income inequality and the

difference in effects between the changes in the two tails of inequality on RER are performed.

3.1. Specification of the Model

The objective of estimating the model is to measure two main effects. The first is the effect of income inequality on RER. The second is the effect of variations between the two tails of inequality on RER. Both effects are required to be estimated in levels and changes in the presence of other control variables. Three models are therefore estimated using RER as a dependent variable. The first model uses Gini coefficient as a measurement of income inequality. The second uses the highest quintile of income "highqu" as an indication for right-tail inequality. The third uses the lowest quintile of income "lowqu" as an indication for left-tail inequality. The proposed empirical specification of the model will be as follow:

$$RER_{it} = \propto + \rho RER_{i(t-1)} + \beta inequality_{it} + \sum_k \delta_k X_{ikt} + \lambda_i + \varepsilon_{it} \quad \text{.... (4)}$$

Where i and t denote country and time period, respectively. The lag of "RER" is used to express the high degree of persistence in real exchange rates and to test what Chatterjee *et al.* (2007) stated that inequality follows historically a particular pattern, as mentioned before. The independent variable *inequality* refers to "Gini" coefficient in the first model, "highqu" in the second model, and "lowqu" in the third model. "X_{ikt}" refers to a set of control variables; "λ_i" is a set of individual and time-invariant country's fixed effect and ε_{it} stands for the error term.

In choosing the macroeconomic control variables "X_{ikt}", only those which have been identified as having a stable long-run relationship in the literature are used. These control variables are real GDP per capita "**RGDPpc**", liquid liability to GDP "**liquid**" to capture the effects of liability and as a proxy for inflationary pressures in countries, terms of trade "**ToT**" measured as dividing export price by import price, trade openness "**open**" measured as the summation of exports and imports as a percentage of GDP, value added in industry to GDP "**VAind**" as a proxy for manufacturing sector productivity and business cycles because many developing countries lack having a measurement for manufacturing sector productivity, and country's stock of human capital "**humcap**" measured by Human Development Index.

Using the control variables in equation (4), the specification of the model can be shown after having natural logarithm (L) as follow:

$$\begin{aligned} LRER_{it} = \propto + \rho LRER_{i(t-1)} + \beta Linequality_{i,t} + \delta_1 \mathrm{LRGDPpc}_{it} + \delta_2 Lliquid_{it} \\ + \delta_3 L\mathrm{ToT}_{it} \\ + \delta_4 Lopen_{it} + \delta_5 LVAind_{it} + \delta_6 Lhumcap_{it} + \lambda_i + \varepsilon_{it} \end{aligned} \quad \text{.... (5)}$$

The inequality measures are considered the main independent variables in this model. As mentioned above, both of theoretical and empirical evidences are mixed. The effect of "**RGDPpc**" on "RER" is also mixed. Some papers (Adusei and Gyapong, 2017; Bhalla, 2007) found a positive relationship between the increase in per capita income and the higher RER (meaning real depreciation), others (Kilicarslan, 2018; Rodrik, 2008) confirmed the negative relationship between them (meaning real appreciation as per capita income decreases), ceteris paribus. Both effects are reasonable through the relative prices of tradables to non-tradables depending on the income levels of studied countries as Bhalla (2007) mentioned.

The impact of "**liquid**" used as a proxy for inflationary pressures is likely to have a positive effect on RER as increasing liquidity, ceteris paribus, is expected to raise the relative demand for tradables, leading to a real depreciation.

"**ToT**" is expected to influence "RER" through income and substitution effects depending on the sources of variations in TOT. Usually the deterioration in ToT, ceteris paribus, results in a real depreciation.

"**Open**" variable as a measurement of trade openness can used as an indication for the competitiveness of the country. Accordingly, the likely effect of Openness on RER is negative as the increased amounts of both of exports and imports, ceteris paribus, results in a reduction in the prices of tradables, and accordingly a reduction in RER.

"**VAind**", which is used as a proxy for manufacturing sector productivity and business cycles as many developing countries lack measuring manufacturing sector productivity, is likely to have an inverse effect on RER only if Balassa-Samuelson effect holds[8]. The improvements in productivity during expansion lead to a relative reduction in prices of exports, the later results in a real appreciation.

"**Humcap**" is expected to have a negative effect on RER in the short-term as both of financial and human capital go in opposite directions. Then with time, after having returns from the human capital investment, it will have a positive effect on RER as improvements in human capital results in a relative increase in demand for tradables and so lower prices of non-tradables (Kilicarslan, 2018; Rodrik, 2008).

A dummy variable is used to estimate the regional level effect "**DMENA**". Two dummies are added to estimate the income level of economies are used in order to test the hypothesis

[8]There exist several factors that may prevent the Balassa-Samuelson effect. First, this effect assumes that both of capital and labor are homogeneous and perfectly mobile between tradables and non-tradables sector, this is not realistic. Second, the implications of the rising relative prices of services affects prices of non-tradables, putting into consideration the overlap between service intensive goods and non-tradables. Third, Balassa-Samuelson effect focuses on the effects of differentials in productivity on domestic relative price of non-tradables ignoring its effect on inflation despite both affect RER.

that different income levels of countries have different effects of income inequality on RER. These dummies are "**Dhigh**" for high-income countries and "**Dlowmid**" for lower middle-income countries. The dummy variables of upper middle-income countries and low-income are omitted to avoid the dummy trap problem.

3.2. Data sources and description

In order to test the implications of the model, data is collected from several sources depending on the availability of the data of the selected countries. Data sources include IFS to measure RER. The measure income inequality, terms of trade, real per capita GDP, trade openness, and value added in industry to GDP are collected from World Development Indicators of the World Bank national accounts data. The liquid liability to GDP is collected from Global Financial Development of the World Bank and IFS data. The Human Development Index is collected from Human Development Data- Human Development Reports of the United Nations Development Programme (UNDP).

Some features of data in the selected countries are notable in appendix 2. First, the average of the natural logarithm of Gini Coefficient is 3.517. This means that the index itself has an average of 33.7 during the period in the country studied. Second, the average of the natural logarithm of the other two indicators used to measure inequality: HIGHQU and LOWQU are 3.72% and 1.98% meaning that the averages of the two percentages are41.5% and 7.25% respectively. Both the first and second notes illustrate that the inequality is essential in the countries included in the study. Third, the standard deviations of the natural logarithm of the three indicators used to measure inequality shows that there is relative considerable variation in Gini Coefficient then HIGHQU while LOWQU has the lowest variation among the countries included in the study.

3.3. Estimation Technique

This section empirically investigates the effects of income inequality and the differences in the effects between the changes in the two tails of inequality on RER using macroeconomic data set for countries in MENA and North Mediterranean region for the period 1990-2017[9], depending on the availability of inequality data in the selected countries and taking into account that inequality data is scattered in some of them.

Before running the models included in equation (5), the time series properties of the variables should be checked to avoid the problem of spurious regression. First, the panel unit roots of variables are performed. Tests of Levin, Lin and Chu (LLC), Im, Peseran and Shin (IPS), Fisher-type-ADF (FADF),and Fisher-type-PP (FPP) are used. They all test the null of having unit roots in all panels against the alternative of the stationarity of them.

[9]The panel data-set covers 23 countries. Out of the 23 countries 13 belong to the MENA countries with an exception of Bahrain, Kuwait, Libya, Qatar, Saudi Arabia, State of Palestine, and United Arab Emirates because of the lack of data. The remaining 10 countries are Mediterranean non-MENA countries. These countries are listed in appendix '1'.

Then the correlation analysis is used to test the validity of hypothesis especially the relationship between RER and the measures of inequality.

Putting into consideration the possibility of having the endogeneity problem, the Ordinary Least Squares (OLS) is not appropriate as it has a problem of omitted variable bias[10]. Despite that the fixed effects technique could avoid this problem; it results in biased parameter estimates in case of using lag dependent or independent variables (Majeed, 2010). Accordingly, the panel fixed effect methods is employed, without adding the lag dependent as an independent variable, to confirm the existence of the fixed effects which will be tested using redundant fixed effects – likelihood ratio. Then the models are specified using a non-balanced yearly dynamic panel data technique based upon modification of Arellano and Bond (1991) [11] on the generalized method of moments (GMM) to estimate a system GMM model in order to capture the potential cyclical interdependencies between RER and its causes, mainly ToT[12], and to avoid the biasness of results and the doubts on reliability (Agboghoroma *et al*., 2009; Arellano and Bond, 1991; Min *et al.*, 2015). Accordingly, following Arellano and Bond (1991), the model in equation 5 is estimated as a system of two models. The first uses lagged differences as instruments in the level of variables equation. The second employs lagged levels of variables to be included as instruments for the difference equation. The use of the modification of Arellano and Bond gave the ability to capture the effects of levels and changes in the same model.

4. Empirical Results and Discussions

Before running the models, unit root tests are performed using LLC, IPS, FADF, and FPP tests as the rest of tests require strongly balanced data than what is available.

As shown in table 3 of the appendix, variables of *LRER*, *LVAind*, and *Lhumcap* were found to be stationary in their levels while variables of *LGini*, *Lhighqu*, *Llowqu*, *LRGDPpc*, *Lliquid*, *LToT*, and *Lopen* were found to be integrated in their levels and stationary with their first difference. Hence, the variables included in the models can be cointegrated.

The correlation analysis which is illustrated in table 4 of the appendix proved the correlations between RER and the measures of inequality. The correlation coefficients

[10] The method of measuring both ToT and RER may lead to treat all the variables within the model as endogenous, where the ToT is defined as the relative prices of exports while the RER is defined as the relative prices of tradables (Min et al., 2015).

[11] Arellano and Bond (1991) used the first-differenced variables instead of their levels to exclude the individual effects during the estimation of the dynamic GMM model. They simultaneously used the lagged levels of predetermined explanatory variables and the differenced endogenous as instruments. These results take all the potential orthogonality conditions into account. Agboghoroma et al. (2009) studies the weaknesses of using the first differences instead of levels in estimating GMM model. They concluded that lagged levels can be poor instruments for first-differenced variables, especially if the variables are persistent. In a modification of the estimator, system GMM estimator for dynamic panel data model is used. In this paper, the model combines lagged levels to be included as instruments for the difference equation and lagged differences as instruments in the level equation.

[12] As mentioned before, measuring ToT as the relative prices of exports while measuring RER as the relative prices of tradables leads to treat ToT in the model as endogenous.

between *LRGDPpc* and all of inequality measures have the expected significant sign with an exception of the relationship with *Llowqu* which was insignificant. Both of the correlation coefficients with *LGini* and *Lhighqu* is negative while the correlation coefficient with *Llowqu* is positive. On the other hand, the correlation coefficient between *LRER* and *LRGDPpc* is negative and significant. This is reflected on the correlation coefficient between *LRER* and all of inequality measures have the expected significant sign with an exception of the relationship with *LGini* which was insignificant. Both of the correlation coefficients with *LGini* and *Lhighqu* are positive while the correlation coefficient with *Llowqu* is negative. This supports our theoretical findings that economic growth and the increase in per capita income are considered of the main intermediaries between income inequality and RER.

Pairwise Granger Causality Test is performed to check for the the endogeneity problem. The test proved that RER causes all of inequality measures in addition to *Lliquid*, *Lopen*, and *LToT*. Accordingly, equation (5) is estimated using a system GMM estimator for non-balanced dynamic panel data model. Both levels and differences in RER across countries and time are explained by "$RER_{(t-1)}$" referring to the available previous year for RER, one of the variables used to express income inequality including *LGini*, *Lhighqu*, and *Llowqu* in addition to the macroeconomic control variables *LRGDPpc*, *Lliquid*, *LToT*, *Lopen*, *LVAind*, *Lhumcap*, *DMENA*, *Dhigh*, and *Dlowmid*.

Panel fixed vs. random effects are employed using Hausman test. Then the existence of the fixed effects is tested using redundant fixed effects – likelihood ratio. The results strongly reject that both of cross-section and period effects are redundant. The results of fixed effects model proved that all of the inequality measures are statistically significant as shown in table 5 of the appendix. Both of *LGini* and *Lhighqu* coefficients are negative and statistically significant at 10% and 5% critical levels respectively. This means that the improvement in income distribution (a decrease in the value of Gini coefficient or the highest quintile) is associated with an increase in RER (a devaluation of the domestic currency meaning an increase in RER). The *Llowqu* coefficient is statistically significant and positive resulting in two implications. The First is that the effects of left-tail inequality growth of income distribution differ than that of the right-tail inequality growth. The second is that the improvement in income distribution towards the lowest quintile (an increase in their share of income) leads to real depreciation of RER. The rest of the variables included in the model are statistically significant and have the expected sign with an exception of *LToT* and *LVAind* who are insignificant and *Lliquid* who has an unexpected sign referring to the absence of the link between increasing liquidity and RER, ceteris paribus, through affecting relative prices of non-tradables.

In a trial to eliminate the fixed effects, Arellano-Bond method of adding first difference to the system of regression equation is taken. The values of the Sargan test of over-identifying

restrictions rejected the null of over-identifying restrictions for all models used to estimate equation 5. The values of Wald test Chi-squared of System Residual imply that problems of second order autocorrelation in differences can be rejected. The results of estimating the Dynamic panel GMM models are reported in table no. 10.

In table 10, columns 1, 2, and 3 refer to the estimation results of regressing RER on its determinants including *LGini*, *Lhighqu*, *Llowqu* referring to inequality respectively. The results confirmed both of the theoretical basis and the fixed effects model that income inequality measures are statistically significant in affecting RER. More specifically, the estimated coefficients of both of *LGini* and *Lhighqu* are negative and statistically significant in the RER model. This means that the increase in inequality towards the highest quintile of population leads to a real appreciation of exchange rates as a result of the increase in demand for non-tradables which puts pressure on its relative prices. The results also confirmed that the effects of income inequality on RER differ depending on which tail of income inequality changes. While the estimated coefficients of *LGini* and *Lhighqu* are negative and statistically significant, the estimated coefficient of *Llowqu* is positive and statistically significant in the RER model. The positive sigh of *Llowqu* means that the decrease in inequality towards lowest-income-quartile decreases the demand for non-tradables resulting in a decrease in their prices and accordingly, a real depreciation of the exchange rates.

The rest of the significant variables included in the models have the expected potential sign except for *LVAind* that has a positive sign in the model despite the theoretical negative sign. This implies that Balassa-Samuelson effect does not hold because of the factors, mentioned before, that may prevent the Balassa-Samuelson effect.

Another important hypothesis that needs to be tested is whether the relationship between income inequality and RER depends on both the region and countries initial income level. In order to test this hypothesis three dummy variables are used, as mentioned before, (DMENA, Dhigh, and Dlowmid) to adjust the inequality measure. Accordingly, a variable that express the product of the inequality measure multiplied by one of the three dummy variables is used, in equation 5, instead of using the natural logarithm of inequality measure in its level.

Columns 4, 5, and 6 of table 10 estimates the regional effects implications in regressing RER on its determinants through estimating the effects of *LGini*, *Lhighqu*, *Llowqu* referring to inequality only in MENA region respectively. The results imply that the regional effects do not exist as its variable is insignificant in all models. The rest of variables included in the model have the same significant effect as the models used for all countries included in estimation.

Columns 7, 8, and 9 of table 10 tests to which extent the relationship between RER and income inequality depends on differentials in initial level of income between economies. Here two dummies (*Dhigh* and *Dlowmid*) are used coupled with *LGini*, *Lhighqu*, *Llowqu*. In the three models, while the estimated coefficients of *LGini* and *Lhighqu* are negative and statistically significant for high income countries, the estimated coefficient of *Llowqu* is positive and statistically significant in the RER model. This confirms all of the theoretical basis, the fixed effects model, and the panel GMM models shown in columns 1, 2, and 3 of table 10 as them all state that income inequality measures are statistically significant in affecting RER. However, the relationship between income inequality and RER is not proved for all measures of inequality for lower middle-income countries.

Table 10. Determinants of LRER using Dynamic panel GMM models

Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LRER(-1)	0.319106*** (3.38)	0.300879*** (3.22)	0.345717*** (3.49)	0.2379** (2.421821)	0.2229** (2.347)	0.3251*** (3.2836)	0.3113*** (3.012)	0.3032*** (2.905)	0.36566*** (3.8125)
LGINI	-0.405558* (-1.89)								
LHIGHQU		-0.613726* (-1.78)							
LLOWQU			0.227407* (1.77)						
LGINI_dMENA				0.3551 (0.837116)					
LHIGHQU_dMENA					0.8607 (1.334)				
LLOWQU_dMENA						0.2935 (1.260)			
LGINI_DHIGH							-0.995** (-2.376)		
LGINI_DLOWMID							0.0466 (0.0911)		
LHIGHQU_DHIGH								-1.3454* (-1.884)	
LHIGHQU_DLOWMID								-0.0994 (-0.1293)	
LLOWQU_DHIGH									0.5267* (1.783)
LLOWQU_DLOWMID									0.2797 (0.9533)
LRGDPPC	-0.662872** (2.14)	-0.645448*** (-4.48)	-0.668834*** (-4.72)	-0.67738*** (-4.847)	-0.7034*** (-5.016)	-0.6252*** (-4.364)	-0.7819*** (-4.7097)	-0.7345*** (-4.3993)	-0.7267*** (-4.2336)
LLIQUID	0.213214** (2.14)	0.206972** (2.05)	0.216734** (2.20)	0.2460** (2.568)	0.2569*** (2.7)	0.2071** (2.0623)	0.28515** (2.5565)	0.278** (2.4383)	0.2365** (2.1979)
LTOT	0.032415 (0.38)	0.027923 (0.32)	0.023440 (0.27)	0.016899 (0.20334)	0.01576 (0.1933)	0.0286 (0.3366)	0.0221 (0.2491)	0.02826 (0.3142)	0.0113 (0.1342)
LOPEN	-0.348985*** (-4.39)	-0.359920*** (-4.44)	-0.337428*** (-4.30)	-0.3088*** (-3.7954)	-0.2909*** (-3.5737)	-0.3702*** (-4.427)	-0.2768*** (-3.0745)	-0.2998*** (-3.3403)	-0.3027*** (-3.2598)
LVAIND	0.215642** (2.22)	0.220958** (2.26)	0.225101** (2.36)	0.3214*** (3.5155)	0.3488*** (3.723)	0.2645*** (2.926)	0.2034** (2.0501)	0.2225** (2.2138)	0.1887** (2.022)
LHUMCAP	1.413428*** (3.33)	1.409312*** (3.29)	1.319644*** (3.16)	1.3550*** (3.334)	1.401*** (3.468)	1.2727*** (3.035)	1.4714*** (3.2706)	1.3561*** (2.9951)	1.3883*** (3.1021)
Observations	98	98	98	98	98	98	98	98	98
J-statistic	72.50517	71.77561	74.42655	82.44540	83.36843	75.86663	64.21612	64.79725	69.23355
Sargan Test (p-value)[1]	1.59E-09	2.1523E-09	7.18590E-10	2.4876E-11	1.682E-11	3.94E-10	4.68619E-08	3.7081389E-08	6.1149465E-09
Walt Chi-square of Autocorr.[2] [probability]	1.24 [0.265]	1.21 [0.272]	1.24 [0.265]	2.94 [0.089]	3.48 [0.062]	1.41 [0.24]	3.26 [0.07]	3.19 [0.07]	1.36 [0.24]

Note: Significance at the 10, 5, and 1 percent level is denoted by *, **, and ***, respectively.
t-statistics are reported in parentheses.
1Sargan test of over-identifying restrictions
2 Wald Test of second-order autocorrelation in residuals; first-order autocorrelation is not reported.

5. Conclusions and policy implications

This paper investigates both of the theoretical and empirical relationships between income inequality and RER. Additionally, three supplementary effects are tested. The first is whether the differences between the two tails changes of income inequality have the same effect on RER. The second is whether there exists a regional effect in studying the relationship between income inequality and RER. The third is whether differentials in initial incomes level between countries affect the relationship between income inequality and RER. The paper demonstrated that theoretically, the relationship from income inequality to RER goes through two main intermediaries (economic growth and relative prices of non-tradables).

The estimated models give several implications regarding the empirical relationship between income inequality and RER. First, all of the correlation coefficients, the fixed effects model, and the panel GMM models proved that income inequality is one of the main determinants of RER in the selected countries. Second, both of the right-tail inequality and the left-tail inequality significantly affect RER but in opposite directions in the selected countries. Third, Balassa-Samuelson effect does not hold meaning that differential productivity growth does not seem to be one of the main determinants of differences in RER because of the changes in prices of non-tradables. Fourth, the estimated model failed to prove the regional effects in determining the relationship between income inequality and RER. Fifth, having different initial income levels between economies lead to differentials in the effects of inequality on RER. While the relationship between income inequality measures and RER is proved to be statistically significant for high income countries, this relationship is not proven for low income countries. Sixth, income inequality follows historically a particular pattern irrespective of the stages of economic development which confirms the findings of Chatterjee *et al.* (2007).

From the findings of this paper, it must be borne in mind that the relationship between income inequality and RER is a complicated one. Moreover, it differs depending on several factors including the initial income levels of the economy and whether the inequality changes result from changes in right or left-tail inequality. Governments are advised to adopt supportive efforts to achieve an increased level of twinning between efforts to reduce income inequality and use RER to increase the competitiveness of country's products. These efforts can include governments' sustainable redistributive policies associated with real depreciation like:

1) Targeting more effective equality putting into account the tradeoff between equality and incentives to accelerate growth mentioned in the Classical and neo-classical approach of studying the relationship between inequality and growth.
2) Giving a top priority to the decrease in inequality through increasing the income share of the lowest portion of population leading to a reduction in demand and accordingly prices of non-tradables. Effective policy options can include improving the quality and

accessibility of public services, establishing comprehensive social protection systems universally, and enforcing the guarantee of labor rights including minimum wages and equal pay.

3) Reducing income inequality by decreasing the share of the richest is no less important than increasing the share of the poor in income. Here, implementing an effective tax system which adopts replacing the undifferentiated value-added tax, which set the burden on the poor, by a type of taxation that is based on the ability to pay, can be required. This point out the importance of studying the effective use of progressive taxes. Additionally, reinforcing initiatives against illicit financial flows and tax abuse, and strengthening anti-trust policies and competition can be Effective policies.
4) Establishing special mechanisms between income inequality and RER in low-income countries as the prices of non-tradables link do not work because of the increasing reliance on non-tradables that prevents its prices from reduction as a result of the increase in the income share of the lowest portion of population.

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Appendix 1

List of MENA and North Mediterranean non-MENA countries included in estimating the models

No.	Country	High income	Upper middle income	Lower middle income	Low income
	MENA countries				
1	Algeria		*		
2	Djibouti			*	
3	Egypt, Arab Rep.			*	
4	Iran, Islamic Rep.		*		
5	Iraq		*		
6	Jordan		*		
7	Lebanon		*		
8	Malta	*			
9	Morocco			*	
10	Oman	*			
11	Syrian Arab Republic				*
12	Tunisia			*	
13	Yemen, Rep.				*
	North Mediterranean non-MENA countries				
1	Albania		*		
2	Croatia	*			
3	Cyprus	*			
4	France	*			
5	Greece	*			
6	Italy	*			
7	Montenegro		*		
8	Slovenia	*			
9	Spain	*			
10	Turkey			*	

Source: Prepared by the researcher depending on countries classification of the World Bank.

Appendix 2

Descriptive Statistics

	L_GINI	L_HIGHQU	L_HUMCAP	L_LIQUID	L_LOWQU	L_OPEN	L_RER	L_RGDPPC	L_TOT	L_VAIND
Mean	3.517	3.726	-0.366	4.180	1.981	4.255	4.6193	8.878	4.695	3.303
Median	3.515	3.714	-0.313	4.175	1.974	4.281	4.6067	8.661	4.607	3.266
Maximum	3.809	3.924	-0.104	5.504	2.322	5.786	6.3542	10.684	5.673	4.440
Minimum	3.165	3.526	-1.041	2.407	1.459	-3.863	3.4686	6.504	3.930	2.237
Std. Dev.	0.143	0.091	0.201	0.558	0.186	0.737	0.2564	1.093	0.256	0.415
Skewness	-0.130	0.177	-1.120	0.099	-0.193	-5.563	0.8834	-0.017	1.276	0.337
Kurtosis	2.782	2.697	3.911	3.009	2.117	57.541	10.441	1.794	5.481	2.711
Jarque-Bera	0.828	1.564	146.156	0.966	6.695	83400.9	1503.63	39.425	243.83	13.927
Probability	0.661	0.457	0.000	0.617	0.035	0.000	0.000	0.000	0.000	0.001
Sum	608.456	644.632	-219.844	2482.891	342.693	2748.77	2850.12	5770.761	2169.07	2054.377
Sum Sq. Dev.	3.502	1.424	24.209	184.629	5.968	350.557	40.512	775.974	30.106	107.172
Observations	173	173	600	594	173	646	617	650	462	622

Source: Prepared by the researcher depending on estimation results.

Appendix 3

Summary of Panel Unit Roots of Variables

No.	Variable	Calculated $p-value$ (Probability)			
		LLC	IPS	FADF	FPP
1	LRER	- 8.937(0.0000)	-4.363(0.0000)	102.319(0.0000)	82.528 (0.0008)
2	LGini	-0.398 (0.345)	0.896 (0.815)	15.400 (0.909)	46.875 (0.0035)
3	Lhighqu	-0.88161 (0.1890)	0.00306 (0.5012)	21.5902 (0.6037)	57.0319 (0.0002)
4	Llowqu	-0.96626 (0.1670)	0.90555 (0.8174)	18.0090 (0.8026)	27.6006 (0.2772)
5	LRGDPpc	-2.02492 (0.0214)	0.81339 (0.7920)	41.0084 (0.6809)	46.2636 (0.4614)
6	Lliquid	-3.92462 (0.0000)	-0.09139(0.4636)	48.3951(0.3765)	77.1619(0.0027)
7	LToT	-2.96592 (0.0015)	-0.29966 (0.3822)	42.9001 (0.5187)	42.3882 (0.5409)
8	Lopen	-3.24146 (0.0006)	-1.25705 (0.1044)	50.1729 (0.3115)	54.1683 (0.1909)
9	LVAind	-3.35183 (0.0004)	-1.34089 (0.0900)	60.0808 (0.0795)	76.3042 (0.0033)
10	Lhumcap	-6.53088 (0.0000)	-1.69291 (0.0452)	70.7488 (0.0110)	112.587 (0.0000)
11	D(LGini)	-3.549 (0.0002)	-2.41015 (0.0080)	41.1358 (0.0079)	110.403 (0.0000)
12	D(Lhighqu)	-3.47338 (0.0003)	-2.49971 (0.0062)	42.0756 (0.0061)	116.380 (0.0000)
13	D(Llowqu)	-2.66985 (0.0038)	-2.33944 (0.0097)	40.6542 (0.0091)	89.4951 (0.0000)
14	D(LRGDPpc)	-4.96071 (0.0000)	-5.96102 (0.0000)	129.891 (0.0000)	257.734 (0.0000)
15	D(Lliquid)	-10.7803 (0.0000)	-11.9278 (0.0000)	223.595 (0.0000)	438.647 (0.0000)
16	D(LToT)	-7.81535 (0.0000)	-5.77265 (0.0000)	125.282 (0.0000)	251.643 (0.0000)
17	D(Lopen)	-14.5070 (0.0000)	-12.0579 (0.0000)	235.689 (0.0000)	320.725 (0.0000)

Source: Prepared by the researcher depending on estimation results.

Appendix 4

Correlation Matrix

	L_RER	L_GINI	L_HIGHQU	L_LOWQU	L_HUMCAP	L_TOT	L_LIQUID	L_OPEN	L_RGDPPC	L_VAIND
L_RER	1									
L_GINI	0.1108 (0.1456)	1								
L_HIGHQU	0.1629 (0.0317)	-0.4625 (0.000)	1							
L_LOWQU	-0.1418 (0.062)	-0.9076 (0.000)	-0.8149 (0.000)	1						
L_HUMCAP	-0.2246 (0.000)	-0.4625 (0.000)	-0.5569 (0.000)	0.2813 (0.0002)	1					
L_TOT	-0.2501 (0.000)	-0.0997 (0.203)	-0.0829 (2897)	0.1815 (0.0196)	-0.0810 (0.1115)	1				
L_LIQUID	-0.0340 (0.4416)	-0.1592 (0.035)	-0.1750 (0.0202)	0.1808 (0.0163)	0.3268 (0.000)	-0.2884 (0.000)	1			
L_OPEN	0.0020 (0.9624)	-0.5369 (0.000)	-0.5109 (0.000)	0.5176 (0.000)	0.1579 (0.0003)	0.0102 (0.838)	0.3359 (0.000)	1		
L_RGDPPC	-0.0992 (0.0196)	-0.3275 (0.000)	-0.4281 (0.000)	0.1188 (0.1162)	0.8717 (0.000)	-0.1807 (0.000)	0.2020 (0.000)	0.1056 (0.0113)	1	
L_VAIND	0.0370 (0.3964)	0.1118 (0.141)	0.1837 (0.0149)	-0.0610 (0.4228)	-0.2327 (0.000)	0.4752 (0.000)	-0.5692 (0.000)	-0.2126 (0.000)	-0.2428 (0.000)	1

Source: Prepared by the researcher depending on estimation results.

Appendix 5

Panel Fixed Effects Models using L_RER as a dependant variable

Variable	Using L_GINI referring to inequality		Using L_HIGHQU referring to inequality		Using L_lowQU referring to inequality	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
C	13.41230***	7.262551	14.37195***	7.294646	12.23746***	7.867718
L_GINI	-0.326567*	-1.903894				
L_HIGHQU			-0.573055**	-2.330038		
L_LOWQU					0.239617*	1.884202
L_HUMCAP	1.510541***	2.990102	1.550687***	3.089928	1.580667***	3.092230
L_LIQUID	-0.218568**	-2.468531	-0.229343**	-2.609896	-0.214485**	-2.436005
L_OPEN	-0.650251***	-8.526700	-0.648102***	-8.567544	-0.643977***	-8.424259
L_RGDPPC	-0.376548***	-3.131253	-0.364738***	-3.101219	-0.432964***	-3.328276
L_TOT	0.023544	0.357764	0.020749	0.323660	0.024740	0.376629
L_VAIND	0.000909	0.012626	-0.006865	-0.095840	0.018521	0.260679
Adj. R-sq.	0.867274		0.869463		0.867182	
	Chi-Sq. Stat.	Prob.	Chi-Sq. Stat.	Prob.	Chi-Sq. Stat.	Prob.
Hausman Test (p-value)	35.437057	0.0000	34.758881	0.0000	35.616388	0.0000

Source: Prepared by the researcher depending on estimation results.