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Measuring the effect of energy consumption on the epidemic of overweight in Latin America and Caribbean countries

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Abstract

The impact of overweight on the consumption of energy and the impact of energy consumption on overweight was analysed for Latin America and Caribbean Countries for the period from 1975 to 2016. The Quantile via Moments econometric technique was used to assesses the role of energy consumption on the mean body mass index of man and woman controlling for the effects of global, economic and social globalisation, as well as Gross Domestic Product (GDP), urbanisation and carbon dioxide (CO2) emissions. Results point out by one hand, that as we go up in the quantiles the contribution to excess weight decreases for the variables economic globalisation, urbanisation, and energy consumption, and increases for social globalisation and CO2 emissions. On the other hand, the rise of GDP contributes to the downward overweight of women, but as we go up in the quantiles, the contribution fades away. The effect of GDP is statistically insignificant as a driver of man overweight. An additional model estimation to apprise if overweight impacts energy consumption, confirms that as overweight raises the energy consumption rises too.

Keywords: Overweight; Body mass index; Energy consumption; Latin American and the Caribbean countries; Quantile regression for panel data.

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1. Introduction

A significant fight for humankind through the millennia is to have enough food to survive. Epidemic overweight is a new stage that only is possible with fast economic growth. The link between economic and social factors with overweight is a problem deserving research. One missing connection in the literature is the relationship between energy consumption and human behaviour that can contribute to an epidemic of overweight. The phenomenon is directly observable and seems to be different in its magnitude depending on the genre, i.e. if we look to men or women.

The general economic conditions of countries probably have a substantial effect on the quality of life of people. Consequently, it is expected to have a measurable effect on their behaviour that can lead to overweight. On the one hand, if people are wealthy, this affords them to buy food of high quality contributing to fitness. On the other hand, the wealthy lets people be physically less active, and consequently demanding more energy to moving around. Other factors, such as the level of urbanisation or the depth of globalisation embodies profound transformations in the everyday behaviours that require study.

The phenomenon under analysis is by its nature a dynamic one. The wealth of countries evolves in time, as well as the level of globalisation, consumption of energy or carbon dioxide (CO2) emissions. The research should consider not only the effect of the mean of variables but too if different levels of independent variables have the same explanatory power on dependent variables. To handle those complexities, a quantile regression estimator emerges as an essential econometric tool. Indeed, it is robust against shocks (outliers) and uses different measures of central tendency that allows one more complete study of the relationship between variables (KOENKER, 2005).

A good starting point to analyse the phenomenon is to choose a group of countries that have experienced fast transformations but were similar enough to be handled as a panel. Latin America and the Caribbean (LAC) region positioned well to that task. This group of countries shares features like fast economic growth, intense process of urbanisation and consumption of energy, as well as a growing of emissions of CO2. LAC countries have had a fast increase in overweight and have data that let us research the phenomenon over a long-time span (1975-2016). Adds that the LAC countries have experienced several shocks that if not controlled, can blur the analysis.

In this research, we will focus on the relationship between overweight and energy consumption. We formulate the following research questions. Can the overweight have explanatory power on the consumption of energy? Can economic variables explain overweight? The following hypothesis was advanced to research these two queries. **H.1**, overweight causes energy consumption with a positive sign. Indeed, as people becoming weight, they use more transportations in daily walking activities. **H.2**, globalisation and the level of urbanisation cause positive sign of overweight. Globalisation produces intense changes in human behaviour, some in a healthy way and others in the opposite one. Among the unhealthy ones are the access to fast-food chains and the increase in stress, both contributing to arise weight. **H.3**, Gross Domestic Product should cause, with of a negative sign, the overweight. Indeed, wealthy societies can pay for healthy food.

The research is organised as follows. **Section 2** debates the relationship between economics and overweight. **Section 3** presents the methodology and data. **Section 4** presents the empirical results. **Section 5** discusses the results. **Section 6** presents conclusions and policy implications.

2. Debate on the economics of overweight

2.1. On the link between economics and health

Economic growth and development of economies and societies have been related to non-communicable disease levels increases across the world. ASISEH and YAO (2016) relate the overweight effect to public health policies, microeconomically impacting food system changes and food security on dietary changes and physical activity.

The socio-economic status has ambiguous effects on obesity levels, depending on country development and social factors. If we adopt a microeconomic approach, it must be noted that average per capita income depends, among other things, on the development status of the economy, the size of the economy and income distribution of the country (GERBENS-LEENES et al., 2010). Economic growth has effects on dietary changes. Nutrition transition theory suggests that initially, lower socio-economic status groups shift towards the energy-dense animal source and fatty foods adding to the energy consumed and thus contributing to overweight and obesity levels, except for countries where home production of food is prevalent (GERBENS-LEENES et al., 2010; ROSKAM et al., 2010; DRENOWSKI and SPECTER, 2004). In developed and upper-middle-income economies, overweight presents itself as a problem in lower socio-economic classes, but in developed economies overweight and obesity levels are lower due to preference shift towards more healthy food (BUTZLAFF, 2016; MONTEIRO et al., 2005). Thus, according to nutrition transition theory, the initial income increases allows for higher energy food intake, contributing to obesity. The empirical findings are not consistent. The lower economic inequality, commonly associated with higher economic development, also affects higher obesity rates (COSTA-FONT and MAS, 2016).

In countries with low income but high economic growth, food insecurity underscores the risk of obesity via future food consumption at the higher income stage. The developmental origins of the mismatch theory state that undernourished populations follow a pattern. The early nutritional deficits are followed by excess (SULLIVAN et al., 2008). Moderate food insecurity is associated with higher obesity prevalence, but not in its severe form of hunger (SWINBURN et al., 2019). Therefore, economic growth is associated with overweight, both with its contemporaneous and future effects on food consumption.

The other dimension of the economic link to health is its healthcare policy and education-cost view. More economically developed societies can afford more efficient policies targeting the overweight problem. In developed countries, state governance and economic policies are more sophisticated. The costs of obesity range from 2-8% of the world's GDP. Indeed, the direct healthcare costs and the loss of productivity make that loss a strong incentive for governments to intervene (SWINBURN et al., 2019; GERBENS-LEENES et al., 2010).

The use of price instruments, as taxing highly processed and unhealthy foods, and the changing of the subsidy distribution of the agricultural sector, have shown to be only slightly effective in reducing overweight. Overall, the most substantial effect materialises on low socioeconomic status groups, especially when taxing fattening foods and subsidising healthy food groups like fruits and vegetables (THOW et al., 2010; POWELL and CHALAPOUPKA, 2009). Furthermore, socially inefficient agricultural subsidies could be reversed to aid to lessen the obesity problem (FRANK, 2007). Therefore, price-related policies (both subsidies and taxation) while with positive results, are only marginally effective to be used by high-income countries to manage the overweight problem. These policies currently favour the processed food system in high-income countries (THOW et al., 2010).

Regarding structural policies, the preference for soft, rather than hard policies are the norm. These policies rely on the goodwill and voluntary action. Indeed, policies aimed at education and culture on food consumption have dominated. While policy responses are generally weak, the obesity rates, although growing, are being slowed down in the presence of the food industry tackling regulation (LANG and RAYNER, 2007).

2.2. The effects of globalisation

The process of globalisation has been a source of transformations that have generated profound changes in almost all aspects of humankind's comportment ranging from cultural to social and economic issues. Globalisation has several dimensions that have evolved at different speeds. For example, the KOF GLOBALIZATION INDEX (2020) divide globalisation into three components, stressing the economic, social and political aspects of that process. The economic and the social of globalisation have

substantial impacts that could contribute to the progressive path for overweight, which empirically has been identified in several countries.

One of the main features of economic globalisation is the change in food systems. The food value chain extension has made scale-economy produced processed food, and a diet richer in energy-dense foods, and high in sugar and salt, less expensive and thus more accessible to lower-income classes, offering a ready supply of processed foods by multinational food corporations, fast-food chains and multinational supermarket chains (FOX et al., 2019; POPKIN, 1998). On the demand side of food systems, the socio-economic dimension of globalisation has increased time constraints resulting in less home-made food, contributing to overweight.

Regarding economic globalisation related to energy expenditure, it also allows the penetration of new technologies that less physical activity of people via labour-saving innovations in industrial sectors, more accessible home appliances and motorised transportation (BELL et al., 2002; SOBAL, 2001). The social aspect primarily promotes the use of relatively inexpensive transportation, communication, and other activity-sparing systems (SOBAL, 2001).

There are changes in a social environment where food is distributed, marketed and consumed, and more extensive exposure to global eating practices or Westernization of food consumption; McDonaldisation or Cocalisation processes lead to higher-energy food consumption that consequently contributes to increasing peoples' weight (FOX et al., 2019; GERBENS-LEENES et al., 2010). Therefore, the "globesity" phenomenon is stimulated by both economic and social globalisation via economic growth that in turn facilitates the nutrition transition, but primarily drives overweight levels due to its social dimension with effects of changes in 'information flows' and 'social proximity' on obesity (FOX et al., 2019; COSTA-FONT and MAS, 2016).

Empirical evidence supports that globalisation induces overweight and obesity in developing countries (GORYAKIN et al., 2015). These authors found that: (i) a broad measure of globalisation can be linked with an increasing tendency for women being overweight; and (ii) the political and social globalisation surpass economic globalisation in explaining overweight and obesity.

2.3. The effects of urbanisation

The worlds' urbanisation has been a tendency of the last century. More often than not, urbanisation had moved side by side with economic development, affecting the environment where food is accessed, consumed, and energy expended.

Depending on the development of the urban area, urbanisation allows for better food accessibility via supermarkets; facilitates the increasing presence of fast-food chains and multinational supermarkets offering a ready supply of processed foods reducing farm stands and open markets with more healthy foods (REARDON et al., 2003). Studies of developing regions have shown that overweight is more pronounced in urban areas for both genders. Urban sprawl contributes to overweight levels (CHRISTENSEN et al., 2008; LOPEZ, 2004).

Food desert areas in urban territories and food marketing can aid overweight. Supermarkets lead to more inequality in food accessibility, aiding overweight (TOIBA et al., 2015; HAWKES, 2008). Food marketing activities in urban areas leads to the exposure of people to mass media marketing of food and beverages that can influence the change in traditional diets (HAWKES, 2006). Thus, the distribution and marketing of food in urban areas may lead to overweight.

Urban areas also require less food energy expenditure related to commuting and leisure activities. More car travelling and less walking or biking for transportation or leisure contribute to overweight and obesity (KJELLSTROM et al., 2007; LINDSTROM, 2008). Densely populated neighbourhoods, with less recreational space for outdoor activities, and more leisure time spent sitting and in screen-viewing leisure activities, also positively affect overweight (PIRGON and ASLAN, 2015; BRUG et al., 2011).

Urbanisation also relates to a higher proportion of manufacturing and service sector jobs, which translates into less energy expended in daily work activities for individuals, and consequently reduce the creation of fewer active jobs, such as farming (FOX et al., 2019; KJELLSTROM et al., 2007; BELL et al., 2002).

Urbanisation reveals a natural prone to increase the consumption of caloric food as well as to cut down physical effort and consequently to increase the weight of people (e.g., FOX et al., 2019; CHRISTENSEN et al., 2008; POPKIN, 1999). Indeed, urbanisation can be seen as a critical driver of overweight trends.

The research of WILHELMSEN et al. (2017) found that green areas and adolescents' body mass index are related. The authors support their founds on the perception that a natural environment is beneficial to health as it provides attractive conditions to play physical activity.

2.4. The consumption of energy

The link between energy consumption and overweight is a less well-discussed topic in literature. Nevertheless, the availability of energy leads to intensive use of modern household appliances, as well as the use of motor vehicles for transportation, thus contributing to the diminishing of physical effort and consequently to increase the weight of people (e.g., FOX et al., 2019).

Overweight people are predominantly found in wealthy countries, which have higher burdens of obesity (SWINBURN et al., 2019). In wealthy, high-income countries, households, industry, and transportation consume the most energy (EEA, 2020).

In households, energy is mostly consumed by heating homes and water, followed by lighting, and least saved in low socio-economic status groups. Using conjoint analysis, POORTINGA et al. (2003) found that low-income households have a lower preference for energy saving for home use. The behavioural pattern of people with lower education suggests that lower socioeconomic status, in high-income countries, lead to higher household energy consumption (SANTIN, 2011; RAAIJ and VERHALLEN, 1983). The social globalisation and the promotion of motorised vehicles have leading people to preferences for lower physical energy use that may also have contributed to higher household energy consumption. In individual-use transportation, the preference to save energy is even lower than that of the energy consumption at home (SANTIN, 2011). Indeed, lower-income individuals are prone to spend proportionally more energy than the rich. As lower-income households are more likely to be

overweight in high- and middle-income countries, overweight may cause higher energy consumption. These undesired results could have been magnified by individual preferences impacted by economic growth and social globalisation.

Energy consumption may be related to globalisation in trade. Increased incomes mean more trade, and more cars, among other transport modes needed to sustain the industrial trade relations (KJELLSTROM et al., 2007). The food industry is one of the most energy-intensive sectors in developed countries, where overweight is prevalent; thus, energy use and overweight and obesity might be interlinked.

Overall, less energy saved in developed countries, low socio-economic groups with higher total overweight, as well as social urbanisation, may lead to higher energy consumption in the household sector. At the same time, economic globalisation, trade, and the growth of energy-intensive industries may also have added to increase energy expenditures.

2.5. The CO_2 emissions

The increase in CO2 emissions can be seen as a proxy of the intensive use of modern household appliances and the use of motor vehicles for transportation. If so, it has explanatory power and let us have an order of magnitude of the influence of reduced physical effort and increased weight of people (e.g., FOX et al., 2019). CO2 emissions are linked to overweight through motorised vehicle use caused by urbanisation, strong preferences to use modern household appliances, the shift in diets towards more animal-produced foods, and sectorial economic shifts. Therefore, individual microeconomic preferences and sectorial economy characteristics are the most important reasons for CO2 emission rise alongside overweight.

The country's transition shift towards motorised urban transportation modes has led them to experience higher greenhouse emissions (SWINBURN et al., 2019). Moreover, globalisation favour longer and more dispersed supply chains that increase the use of transportation in the transmission of the production's factors.

Not only shifts in transportation use, but also the increase in consumption of food from the animal have raised greenhouse emissions. In high-income countries, the consumption of dairy products mostly prices inelastic. Given that, dairy and meat food sectors have high CO2 emissions, the high-income country consumption of animal produced foods affects energy consumption and global warming due to livestock's released gases (CHOUINARD et al., 2007).

2.6. The Case of Latin American and Caribbean Region Countries

Latin American and Caribbean region countries size, development and economic potential are highly heterogeneous, with the highest socioeconomic disparities in Americas: average per capita GDP in 2007–2016 ranges from 4130 dollars to 18 722 dollars, poverty rate, between 0% and 40.6% (OECD, 2019). Globalisation, urbanisation, the rise of obesity, and physical inactivity account for almost 30% of regional mortality (PAHO, 2017). The social progress in the last decade was tremendous. Between 2003 and 2012, the proportion of people living in extreme poverty was halved. Moderate poverty fell from 41.1% to 25.3%, and the middle class have expanded (BAEZ et al., 2017).

Food insecurity contributes to overweight. Low levels of education limited social capital and living in a country with low GDP contribute to the likelihood of the experience of food insecurity in LAC countries, despite the heterogeneity of the region (OECD-FAO, 2019; SMITH et al., 2017). The affordability of food and undernourishment has increased in recent years. In LAC, food-insecure people faced 20% to 40% higher obesity than people who were not food insecure (BUTZLAFF, 2016). Adds that 10% of households have both stunted and wasted children who are at a higher risk of developing abdominal obesity (POPKIN and REARDON, 2018).

Regarding the nutrition transition, in LAC, it has been manifested with different stages and speeds. Nutrition transition within the 1960s was the most characteristic of Brazil and at lower rates in Central America and Caribbean countries. In the 1980s, when the general transition in the LAC region occurred, the low socioeconomic status groups maintained traditional diet and high rates of undernutrition, with the transition in rural areas occurring later, and ruling out home production factors that were associated with lower obesity in transition countries (BERMUDEZ and TUCKER, 2003; AGUIRRE-ARTENAS,

1998). Upper-middle income Southern Cone countries, with the highest GDP per capita during the 1960s–1990s had the highest animal food, fat intakes, but animal product food trends were growing across the region since 1961–2013, only stagnating in the Caribbean during the 1990s (POPKIN and REARDON, 2018; BERMUDEZ and TUCKER, 2003). The current nutrition transition phase of ultra-processed food consumption is expected to change with income rises and industrialisation of healthy food alternatives, currently constituting a small niche segment (POPKIN and REARDON, 2018).

Industry and agriculture grew on average 2% over the past two decades, and the region has positioned itself as a leading exporter of agricultural products, with pork, poultry and animal feed among the leading ones. Economic policies in the agroindustry sector in LAC prior 1980s were mostly agricultural price interventions broadly harming farmers and aiming at fiscal revenues and consumer price lowering. The following trade liberalisation-privatisation policies since the 1980s and early 1990s were trade-restrictive measures as farm support and taxation, keeping food prices artificially low, only in recent years becoming higher than the world average (ANDERSON and VALDES, 2007). The farming industry growth relative to subsidy incentives is relatively small and decreases farm sector performance. Subsidising the farming sector in LAC is not efficient, but targeted conditional transfer programs have proved to be successful in lowering rural poverty (ANRÍQUEZ et al., 2018).

The policy liberalisation, and agri-food parastatal privatisation, during the 1980s and 1990s in LAC, led to a diversification of products and the entry of large foreign firms. Indeed, immediately after liberalisation the processors, supermarkets and fast-food chains, in many sectors, have acquired SMEs. Government controls were loosened, and food system regulation largely dismantled, which lead to a lack of policies related to curbing bad food consumption habits (POPKIN and REARDON, 2018).

Public health policies in the LAC region have included dietary guidelines consistent with high-income country guidelines, except for Southern Cone in the 1990s. However, as noted before, LAC public health policies have not seen much attention in public debate. With the liberalisation and the ingress of extra-LAC multinational firms, which initiated super marketisation, the liberalised and

market-governed food sector has moved the government controls away. It complicates the recent debate on public health and obesity-targeting price and subsidy instruments (POPKIN and REARDON, 2018).

The downstream and upstream food system has changed, facilitating the economic globalisation and reflecting into the social aspect of food consumption in LAC. Indeed, the effect exerted by globalisation can be divided into infrastructure improvement, urbanisation and the rise of rural non-farm employment. Although private and public infrastructure investment rates were in decline during the 1980s to 1990s, their resurgence in the first the half of 2010s improved transportation networks leading to reduced transaction costs in LAC food systems and promoted their spatial expansion.

Urbanisation in LAC happened early compared to other developing regions, from 55% urban share in 1970 to 75% by 2010. Retail transformation coincided with urbanisation from the 1950s to the 1980s, and during the 1990s the cities across the LAC region have experienced a supermarket revolution (from supermarkets' average share of food retail of 10-20% in 1990 to 50-60% by early 2000s). This phenomenon began in larger South American countries as Argentina and Brazil and have had a second wave in the mid-90s (Mexico, Ecuador, Guatemala and the Dominican Republic), and later one in the 1990s and 2000s in Bolivia, Nicaragua, and Peru. This phenomenon was characterised by the diffusion from upper-income consumer segments to urban poor in later periods. Processed food share of supermarket retail is usually two thirds and semi-processed food ranging from 20–25%. Hence, with the urbanisation, the emergence of scale economies and the supermarket retail chain revolution in LAC, the urban population had broad access to predominantly processed and semi-processed food, with fresh food share increasing as supermarkets become more available (POPKIN and REARDON, 2018).

With more urbanisation and social globalisation, the demand for convenience and processed food also increased due to more time spent working and commuting outside of the home. The women's participation in the labour force (from 44% in 1990 to 54% in 2014) is now comparable with developed countries' women participation. Another aspect of the rise in processed food comes from the demand-side by the generalisation of food system product marketing. Indeed, daily children's exposure to mass media's unhealthy food marketing has focused on where they live, learn and play. Worst, promoting

foods and drinks have been locally and demographic-based. The new role of multinational firms has acted in changing traditional food preferences towards European and US products and becomes to be followed by domestic firms (POPKIN and REARDON, 2018).

Urbanisation also contributed to fewer opportunities for people to practice exercise. Cities in Latin America exhibit extreme social and economic differences. Low-income neighbourhoods are either interspersed or completely lacking green spaces. In contrast, high-income neighbourhoods have a higher concentration of green areas. This disparity could lead to more overweight in urban poor (PAUCHARD and BARBOSA, 2013). Moreover, urbanisation and social globalisation impact motorised Car travel. Car-travel in LAC has rapidly increased. The number of vehicles per 1,000 people rose from 113 to 177 in 2002-2012 (ENERGY, 2020), which may also have contributed to higher energy consumption and greenhouse gases.

In the LAC region, energy consumption and in particular electricity consumption (both per capita) are strongly correlated with per cap Electricity electricity consumption can be linked to economic and social developments. Indeed, households' cases have to lead to a high share (21%) of electricity consumption on final energy consumption. The rapid rise in electricity consumption is mainly due to increased household appliance ownership as the income increased, as well as to demographic and social trends. Indeed, most of the energy used by households is for appliances. At the same level of income, however, the consumption per household for electricity is dispersed, explained by income inequality, climate and prices and policies (ECLAC, 2016).

LAC region's carbon-intensive energy mix is comparable to highly developed OECD countries. However, its agriculture contribution to carbon emissions (23% compared to 7% in OECD, and 11% in the world) is much higher, reflecting the large animal farming industry. There are differences in energy intensity across sectors, with the transportation sector and the industry the most energy-intensive.

3. Methodology and data

This Section is divided into two parts. The first one (3.1.) presents the adopted methodological strategy that will be applied, and the Second (3.2.) describes the data and variables that will be used in this investigation.

3.1 Methodology

As mentioned before, this section will show the methodological strategy that this investigation will use. Therefore, in order to help to answer the central question, as well as answer the specific questions of this investigation, the Quantile via Moments approach. This method was introduced by MACHADO and SILVA (2019) as an alternative for Quantile regression. According to MACHADO and SILVA (2019) that developed this methodology points out that this approach allows the use of methods that are valid in the estimations of conditional means, such as differencing out individual effect in panel data models. Moreover, this method can provide information on how the regressors affect the entire conditional distribution.

Therefore, these informational gains by Quartile via Moments is the most attractive feature of quantile regression (e.g., BASSETT and KOENKER, 2017; CADE and NOON, 2003; KOENKER and HALLOCK, 2001; CHAMBERLAIN, 1994; BUCHINSKY, 1994). Indeed, these gains can reduce the difficulty in the estimation of complex models as mentioned by MACHADO and SILVA (2019). As well as, leads to estimates of the regression quantiles that do not cross, a crucial requisite often ignored in empirical applications (e.g., MACHADO and SILVA, 2019; FERNNDEZ-VAL and WEIDNER, 2016). These capacities are due to the Quantile via Moments model is based on conditional means (MACHADO and SILVA, 2019). That is, it does not share some of the robustness properties of the seminal quantile regression estimator of KOENKER and BASSETT (1978), which is based on the check function. Therefore, this method develops by MACHADO and SILVA (2019) needs stronger assumptions on the existence of moments than those needed for the validity of KOENKER and BASSETTÍS (1978) estimator. Moreover, this method under appropriate conditions can identify the

same conditional quantiles, where the optimal predictors under the usual asymmetric loss function are inherently robust (MACHADO and SILVA,2019).

Additionally, the Quantile via Moments can also be adapted to estimate in the presence of cross-sectional models with endogenous variables (MACHADO and SILVA, 2019). That is, this method is not based on the estimation of conditional means, but on moment conditions that under exogeneity identify conditional means. This characteristic is closely related to that of CHERNOZHUKOV and HANSEN (2008) model. That is, under suitable conditions, Quantile via Moments is able to identify the same structural quantile function. It makes this method being used to non-linear models and being much simpler, especially in models with multiple variables that are endogenous (MACHADO and SILVA, 2019). Therefore, it was by these advantages that this investigation opted to use Quantile via Moments as the main methodology. The Quantile via Moments models is constructed around the following **Equation (1):**

$$Y_{it} = a_i + X'_{it}\beta + \left(\delta_i + Z'_{it}\gamma\right)U_{it} \qquad (1)$$

Where the $\{(Y_{it}, X'_{it})'\}$ from a panel of n individuals $i = 1, \ldots, n$ over T time periods with, $P\{\delta_i + Z1_{it}\gamma > 0\} = 1$. Moreover, the parameters $(\alpha_1, \delta_i), i = 1, \ldots, n$, capture the individual i fixed effects and Z is a k-vector of known differentiable (with probability 1) transformations of the components of X with element l given by $|_l = |_l(X), l = 1, \ldots, k$. The sequence $\{X_{it}\}$ is i.i.d. for any fixed i and independent across t. U_{it} are i.i.d. (across i and t), statistically independent of X_{it}, and normalised to satisfy the moment condition $E(U) = 0 \wedge E(|U|) = 1$ (MACHADO and SILVA, 2019).

Indeed, the **Quantile via Moments** model will be used, and the results will be compared with those from a **Pooled OLS** and **Robust**. The Pooled regression model will be used as a benchmark. These two regressions were estimated to evaluate the effect of consumption of energy on male and female overweight and on their total of overweight that is a form of checking the robustness of results that will be found in the models (male and female overweight), as well as evaluate the effect of total overweight (sum of Mean body mass index (BMI) equal to or greater than 25 in adult Man and Woman) on the

consumption of energy that is a form of verifying the existence of bi-directionality between overweight and consumption of energy. That is, this investigation will estimate four models to answer the central question that arose. Therefore, before the realisation of the **Quantile via Moments** model and **Pooled OLS** estimations, it is necessary to verify the proprieties of variables that will be used in this investigation, which includes, check the normality, the presence of multicollinearity, and fixed or random effects.

Consequently, the first tests that need to be applied before the **Quantile via Moments** model estimation are:

I. Shapiro-Wilk and Shapiro-Francia test for normality (ROYSTON, 1983). This test verifies the normality of the model. The null hypothesis of this test is the presence of normality;
II. Skewness and Kurtosis test for normality (D'AGOSTINO et al., 1990). This test checks the normality based on skewness and another based on kurtosis and then combines the two tests into an overall test statistic. The null hypothesis of this test is that the data is normally distributed;
III. Variance Inflation Factor (VIF) test, to verify if variables are multicollinear (BELSLEY et al., 1980);
IV. Hausman test to identify heterogeneity, i.e., whether the panel has random effects (RE) or fixed effects (FE).

Indeed, after the Quantile via Moments model and Pooled OLS estimations, it is necessary to apply some post-estimation tests, such as:

I. Breusch-Pagan / Cook-Weisberg test for heteroskedasticity (BREUSCH-PAGAN, 1979; COOK and WEISBERG, 1983). The null hypothesis of this test is the presence of homoscedasticity;
II. Wald test (AGRESTI, 1990) to test the global significance of the estimated models. The null hypothesis of the Wald test is that all the coefficients are equal to zero.

These two post-estimation tests need to be applied to verify the presence of heteroscedasticity in the models. Moreover, the estimation and testing procedures are accomplished using Stata 16.0.

3.2 Data

This investigation used annual data that was collected from 1975 to 2016 of eighteen countries from the LAC region, i.e. Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, and Venezuela (RB). The use of time-series between 1975 to 2016 is due to the availability of data until 2016 for the variables carbon dioxide emissions in kilotons (Kt) per capita, consumption of energy in (kWh) per capita, and urban population rate at WORLD BANK DATA OPEN (2019) for in all countries selected.

Therefore, this group of countries was selected due to several reasons: (i) they have experimented a rapid process of economic growth; (ii) they have experimented a rapid process of urbanisation and consumption of energy, and consequently the emissions of CO2; (iii) they have registered a rapid expansion of overweight; and (iv) the existence of a complete database was the main criteria for choosing these countries from the LAC region. The variables which were chosen to perform this investigation are:

- Mean body mass index (BMI) equal to or greater than 25 in adult Man and Woman (aged 18 years and older) (BMI_MAN and BMI_WOMAN) retrieved from OUR WORLD IN DATA (2020). The Body mass index (BMI) is measured as a person's weight in kilograms (kg) divided by his height (in meters), squared. The WHO define a BMI <=18.5 as 'underweight'; 18.5 to <25 as 'normal/healthy'; 25.0 to <30 as 'overweight'; and >30.0 as 'obese'. This variable was used because between 1975 to 2016 the LAC region saw the overweight jump from 33.4% to almost 60% while the obesity affected 8.6% of the region's citizens (NAÇÕES UNIDAS BRASIL, 2019);
- Total of mean body mass index (BMI) (BMI_TOTAL) that is the sum of Mean body mass index (BMI) equal to or greater than 25 in adult Man and Woman (aged 18 years and older). This variable was created and used to verify the robustness of results found in the models (male and female overweight);

- Economic Globalisation index (ECO_GLOBA) in the de facto, retrieved from the KOF Globalisation Index (KOF GLOBALISATION INDEX, 2020). This variable measure trade and financial globalisation. Trade globalisation is determined based on trade in goods and services, and financial globalisation includes foreign investment in various categories. This variable was used because the process of economic globalisation allows the entrance of multinational food corporations, fast-food chains, and multinational supermarket chains that offering a ready supply of processed foods (FOX et al., 2019). Moreover, this process also allows access to new technologies that minimise physical activity levels (SOBAL, 2001);
- Social globalisation index (SO_GLBA), in the de facto, retrieved from the KOF Globalisation Index (KOF GLOBALISATION INDEX, 2020). This variable measure interpersonal contact flows of information and cultural proximity. Interpersonal contact is measured within the de facto segment concerning international telephone connections, tourist numbers, and migration. Flows of information are determined within the de facto segment concerning international patent applications, international students and trade in high-technology goods. Cultural proximity is measured in the de facto segment via trade in cultural goods, international trademark registrations and the number of McDonald's restaurants and IKEA stores. This variable was used because the process of social globalisation can influence the adoption of a stronger fast-food/processed foods culture through McDonaldisation or Cocalisation processes leading to more consumption of caloric (energy) and consequently the increase of weight gains (FOX et al., 2019). Moreover, this Westernisation caused by social globalisation also can influence the use of relatively inexpensive transportation, communication, and other activity-sparing systems through automobiles and household appliances that minimise physical activity levels (SOBAL, 2001);
- Gross Domestic Production (GDP_PC) in constant local currency unity (LCU) and expressed per capita, retrieved from WORLD BANK OPEN DATA (2020). This variable was used because the process of economic growth caused by economic and social globalisation facilitates the nutrition transition from staple whole grains to a diet richer in energy-dense foods (e.g., FOX et al., 2019; POPKIN, 1998);
- Urban population rate (URBA), which refers to people living in urban areas as defined by national statistical offices, retrieved from WORLD BANK OPEN DATA (2020). This variable was used because the rapid process of urbanisation over the last several decades caused by economic development has increase the presence of more fast-food chains and multinational supermarket that offering a ready supply of processed foods, as well as this process, reduce the presence of farms stands and open markets with more healthy foods (REARDON et al., 2003).

Moreover, more, cars, roads, and car travel, and less walking or biking for transportation or leisure (KJELLSTROM et al., 2007). This process also encourages the existence of a more densely populated neighbourhood that difficult outdoor activities due to the less recreational space (PIRGON and ASLAN, 2015). As well as exposure to mass media marketing of food and beverages, which can influence the change in traditional diets (HAWKES, 2006). Finally, the process of urbanisation influence the creation of more sedentary jobs, such as desk and manufacturing jobs, and consequently reduce the creation of fewer active jobs, such as farming (FOX et al., 2019; KJELLSTROM et al., 2007). All this influences an increase in the consumption of caloric (energy) as well as the reduction of physical effort and less caloric (energy) expenditure and consequently, the increase of weight gain. For this reason, the urbanisation process is viewed as a key underlying driver of overweight trends. Some authors previously discussed this relationship (e.g., FOX et al., 2019; CHRISTENSEN et al., 2008; POPKIN, 1999);

- Consumption of energy (ENE), from fossil and renewable energy sources in(kWh per capita), retrieved from WORLD BANK OPEN DATA (2020). This variable was used because the increase in consumption of energy by intensive use of modern household appliances, as well as the use reliance on motor vehicles as a mode of transportation, contributes to reducing of physical effort and less caloric (energy) expenditure and consequently the increase of weight gain (e.g., FOX et al., 2019);
- Carbon dioxide emissions (CO2) in kilotons (Kt) per capita from the burning of fossil fuels and the manufacture of cement. These include carbon dioxide produced during the consumption of solid, liquid and gas fuels and gas flaring retrieved from WORLD BANK OPEN DATA (2020). This variable was used because the increase of CO2 emissions caused by consumption of energy from the intensive use of modern household appliances and the use of motor vehicles as a mode of transportation contributes to reducing of physical effort and less caloric (energy) expenditure and consequently the increase of weight gain (e.g., FOX et al., 2019).

The variables CO2, GDP_PC, and ENE were transformed into per capita values with the total population of each cross. The per capita value allows disparities to be controlled for population growth over time and within countries (e.g., KOENGKAN et al., 2019). Table 1 shows the summary statistics of variables.

Table 1. Descriptive statistics.

Variables	Descriptive Statistics				
	Obs.	Mean	Std.-Dev.	Min.	Max.
LnBMI_MAN	798	3.2056	0.0576	3.0672	3.3328
LnBMI_WOMAN	798	3.2365	0.0665	3.0113	3.3967
LnBMI_Total	798	3.9343	0.0586	3.7679	4.0489
LnECO_GLOBA	798	3.8043	0.2684	2.9700	4.3639
LnSO_GLOBA	798	3.8871	0.2643	3.2271	4.3518
LnGDP_PC	798	11.0167	2.8799	7.2408	17.1658
LnURBA	798	4.1383	0.2472	3.4691	4.5553
LnENE	798	6.8415	0.7941	4.7573	8.8668
CO2	798	3.0918	4.8998	0.3008	36.0916

Notes: 'Ln' denotes variables in the natural logarithms; Obs. denotes the number of observations in the model; Std.-Dev. denotes the Standard Deviation; Min. and Max. denote Minimum and Maximum, respectively; The command sum of Stata was used.

Moreover, we should stress that they are already in their natural logarithms (see prefix 'Ln'). The next section will evidence the empirical results of this investigation.

4. Empirical results

As previously explained in the introduction, this section will present the empirical results of preliminary and post-estimation tests as well as the outcomes of the Quantile via Moments model and Pooled estimations. Therefore, to verify the normality for each model, the Shapiro-Wilk W-test for normally distributed data was used to test the residuals of models from Pooled regression (e.g., Resid_BMI_MAN; Resid_BMI_WOMAN; Resid_BMI_TOTAL; and Resid_ENE). In Table 2 below, we can see the results of the Shapiro-Wilk W-test for normally distributed data for four models that will be estimated.

Table 2. Shapiro-Wilk W-test for normally distributed data.

Models	Obs.	W	V	Z	Prob>z
Resid_BMI_MAN	798	0.9793	10.620	5.797	0.0000
Resid_BMI_WOMAN	798	0.9778	11.367	5.963	0.0000
Resid_BMI_TOTAL	798	0.9768	11.874	6.070	0.0000
Resid_ENE	798	0.9835	8.463	5.240	0.0000

Notes: The command sktest of Stata was used.

Regarding the Shapiro-Wilk W-test for normally distributed data, we see that the null hypothesis of normality is rejected in all models that will be used. Indeed, after the Shapiro-Wilk W-test, it is necessary to apply the Skewness and Kurtosis test to verify the normality in the residuals of models from Pooled regression (e.g., Resid_BMI_MAN; Resid_BMI_WOMAN; Resid_BMI_TOTAL; and Resid_ENE). The null hypothesis that indicates that the data is normally distributed is also rejected for all models (see Table 3, below).

Table 3. Skewness/Kurtosis tests for normality.

Models	Obs.	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>Chi^2
Resid_BMI_MAN	798	0.0000	0.0332	24.18	0.0000
Resid_BMI_WOMAN	798	0.0000	0.0010	24.80	0.0000
Resid_BMI_TOTAL	798	0.0000	0.0089	24.65	0.0000
Resid_ENE	798	0.0001	0.0024	21.90	0.0000

Notes: The command sktest of Stata was used.

The results of both tests reject the null hypothesis at a significance level of 1%. Moreover, the results of these tests evidence constitute additional support for the adequacy of using the quantile regression (AFONSO et al., 2019). After the tests of normality, the VIF test that informs on the presence of multicollinearity needs to be computed. The results of VIF-test indicate that the presence of multicollinearity is not a concern in the estimation of each model, given the low VIF and mean VIF

values registered, which are lower than the usually accepted benchmark of 10, in the case of the VIF values, and 6 in the case of the mean VIF values (see Table 4 below).

Table 4. VIF-test.

Variables	VIF	1/VIF	Mean VIF
LnBMI_MAN; LnBMI_WOMAN; and LnBMI_TOTAL			
LnECO_GLOBA	2.06	0.4852	2.78
LnSO_GLOBA	3.40	0.2942	
LnGDP_PC	1.06	0.9472	
LnURBA	2.49	0.4014	
LnENE	5.54	0.1803	
CO2	2.15	0.4642	
LnENE			
LnECO_GLOBA	2.28	0.4387	2.53
LnSO_GLOBA	3.53	0.2829	
LnGDP_PC	1.08	0.9274	
LnURBA	1.67	0.5997	
LnBMI_TOTAL	4.10	0.2438	

Notes: (Ln) denotes variables in the natural logarithms.

Indeed, the VIF-test helps us to understand the degree of multicollinearity which may be present in our models and which can lead to problems in estimation. After the realisation of the VIF-test, the next step is to assess the presence of individual effects in each model (e.g., BMI_MAN; BMI_WOMAN; BMI_TOTAL; and ENE). To this end, the Hausman test, comparing random (RE) and fixed effects (FE), was used. The null hypothesis of this test is that the difference in coefficients is not systematic, (i.e., random effects are the most suitable estimator). In Table 5 below, we can see the results of the Hausman test for four models that will be estimated.

Table 5. Hausman test.

BMI_MAN	BMI_WOMAN	BMI_TOTAL	ENE
chi2(6) = 14.21**	chi2(6) = 137.85***	chi2(6) = 77.22 ***	chi2(5) = 90.78 ***

Notes: ** and *** denote statistically significant at the 1% and 5% level; Hausman results for H0: difference in coefficients not systematic; the Stata command hausman (with the options sigmamore) was used.

The Hausman test indicates that the null hypothesis should be rejected in all models and that a fixed-effects model is the most appropriate for this analysis. After the realisation of preliminary tests, the Quantile via Moments model and Pooled OLS estimations can be made. Remembering, the Quantile via Moments model that is the principal methodology of this investigation will be used, and the results will be compared with those from a Pooled OLS and Robust.

Therefore, the Pooled OLS and Pooled Robust were used as a benchmark. Indeed, the Pooled Robust was added in this estimation due to the possible presence of heteroscedasticity in the models based on visual analysis of descriptive statistics of variables. Moreover, the Pooled Robust provides corrected standard errors, and consequently, the correct coefficient significant level (AFONSO et al., 2019). Regarding the Quantile via Moments model, the 25th, 50th, and 75th quantiles were respectively calculated to assess the impact of energy consumption on, male and female overweight and their total, as well as identify the possible impact of total overweight on energy consumption. The method used does not allow us to perform causalities. It only allows observing the effect at the quantiles. Table 6, shows the results of Pooled OLS and Robust, and Quantiles of BMI_MAN model, as well as the results of post-estimation tests (e.g., Breusch-Pagan / Cook-Weisberg test for heteroskedasticity and Wald test), to confirm the presence of heteroskedasticity in the models.

Table 6. Estimations for BMI_MAN.

Independent variables	Dependent variable (LnBMI_MAN)				
	Pooled		Quantiles		
	OLS	Robust	25^{th}	50^{th}	75^{th}
LnECO_GLOBA	0.031***	***	0.0127***	0.0114***	0.0101*
LnSO_GLOBA	0.0923***	***	0.0694***	0.0837***	0.0978***
LnGDP_PC	-0.0017***	***	-0.0075	-0.0035	0.0003
LnURBA	0.0831***	***	0.1284***	0.1270***	0.1257***
LnENE	0.0055*	*	0.0354***	0.0262***	0.0173***
CO2	-0.0000		0.0009***	0.0010***	0.0012***
Constant	2.4022***	***	n.a.	n.a.	n.a.
Obs	798	798	798	798	798
F / Wald test	F(6,791) = 279.22***	F(5,791) = 301.99***	Chi2(6) = 5411.88***	Chi2(6) = 7009.89***	Chi2(6) = 3368.97***
Breusch-Pagan/Cook-Weisberg test	Chi2(1) = 40.60***	n.a.	n.a.	n.a.	n.a.

Notes: The Stata command reg and xtqreg were used; *** and * denote statistically significant at 1%, and 10% level respectively; 'Ln' denotes variables in natural logarithms. The option robust was used in OLS estimation; n.a., denotes not available.

The Pooled OLS and Robust estimators indicate that the economic and social globalisation, urbanisation, and consumption of energy increase the Man overweight, while the economic growth decreases the overweight. However, the CO2 emissions point to be statistically insignificant and do not cause any impact on Man overweight. Regarding the Quantile via Moments model, the 25th, 50th, and 75th quantiles indicate that the economic and social globalisation, urbanisation, consumption of energy, and CO2 emissions increase the Man overweight. Economic growth does not cause any impact on the dependent variable because it is statistically insignificant. Moreover, the post-estimation tests (e.g., Breusch-Pagan / Cook-Weisberg test for heteroskedasticity and Wald test) indicating the presence of

heteroscedasticity in the model. The result from the post-estimation test is an indicator that the estimations that this investigation use is adequate.

Indeed, after identifying the positive impact of consumption of energy on Man overweight, it is necessary to identify this same effect on women overweight. Table 7, shows the results of Pooled OLS and Robust, and Quantiles of BMI_WOMAN model, as well as the results of post-estimation tests (e.g., Breusch-Pagan / Cook-Weisberg test for heteroskedasticity and Wald test), to confirm the presence of heteroskedasticity in the models.

Table 7. Estimations for BMI_WOMAN.

Independent variables	**Dependent Variable (LnBMI_WOMAN)**				
	Pooled		**Quantiles**		
	OLS	**Robust**	25^{th}	50^{th}	75^{th}
LnECO_GLOBA	0.0750***	***	0.0398***	0.0362***	0.0329***
LnSO_GLOBA	0.1300***	***	0.0627***	0.0901***	0.1146***
LnGDP_PC	-0.0017***	***	-0.0519***	-0.0460***	-0.0407***
LnURBA	0.0651***	**	0.2350***	0.2108***	0.1891***
LnENE	-0.0007		0.0572***	0.0438***	0.0318***
CO2	0.0003		0.0025***	0.0029***	0.0032***
Constant	2.1995***	***	n.a.	n.a.	n.a.
Obs	798	798	798	798	798
F/Wald test	F(6,791) = 376.06***	F(6,791) = 356.52***	Chi2(6) = 2885.10***	Chi2(6) = 4635.42***	Chi2(6) = 2483.43***
Breusch-Pagan/Cook-Weisberg test	Chi2(1) = 35.74***	n.a.	n.a.	n.a.	n.a.

Notes: The Stata command reg and xtqreg were used; *** denotes statistically significant at 1% levels; 'Ln' denotes variables in natural logarithms. The option robust was used in OLS estimation; n.a., denotes not available.

The results from Pooled OLS and Robust point out that the economic and social globalisation, and urbanisation, increase the Woman overweight, while the economic growth decreases the overweight. However, the consumption of energy and CO2 emissions point to be statistically insignificant and does not cause any impact on Woman overweight. Regarding the Quantile via Moments model, the 25th, 50th, and 75th quantiles indicate that the economic and social globalisation, urbanisation, consumption of energy, and CO2 emissions increase the Woman overweight, while economic growth decreases the overweight. Moreover, the post-estimation tests (e.g., Breusch-Pagan / Cook-Weisberg test for heteroskedasticity and Wald test) indicating the presence of heteroscedasticity in the model. The result from the post-estimation test is an indicator that the estimations that this investigation use is adequate.

Table 8. Estimations for BMI_TOTAL.

Independent Variables	**Dependent variable (LnBMI_TOTAL)**				
	Pooled		**Quantiles**		
	OLS	**Robust**	25^{th}	50^{th}	75^{th}
LnECO_GLOBA	0.0534***	***	0.0256***	0.0235***	0.0218***
LnSO_GLOBA	0.1112***	***	0.0649***	0.0879***	0.1054***
LnGDP_PC	-0.0017***	***	-0.0287***	-0.0241***	-0.0207***
LnURBA	0.0739***	***	0.1814***	0.1685***	0.1586***
LnENE	0.0024		0.0464***	0.0342***	0.0249***
CO2	0.0001		0.0017***	0.0020***	0.0022***
Constant	2.9950***	***	n.a.	n.a.	n.a.
Obs	798	798	798	798	798
F/Wald test	F(6,791) = 410.77***	F(6,791) = 368.10***	Chi2(6) = 3970.79***	Chi2(6) = 6128.82***	Chi2(6) = 3371.21***
Breusch-Pagan/Cook-Weisberg test	Chi2(1) = 49.31***	n.a.	n.a.	n.a.	n.a.

Notes: The Stata command reg and xtqreg were used; *** denotes statistically significant at 1% levels; 'Ln' denotes variables in natural logarithms. The option robust was used in OLS estimation; n.a., denotes not available.

The results from Pooled OLS and Robust point out that the economic and social globalisation, and urbanisation, increase the total overweight, while the economic growth decreases the total overweight. However, the consumption of energy and CO2 emissions point to be statistically insignificant and does not cause any impact on total overweight. Regarding the Quantile via Moments model, the 25th, 50th, and 75th quantiles indicate that the economic and social globalisation, urbanisation, consumption of energy, and CO2 emissions increase the total overweight, while economic growth decreases the overweight. Moreover, the post-estimation tests (e.g., Breusch-Pagan / Cook-Weisberg test for heteroskedasticity and Wald test) indicating the presence of heteroscedasticity in the model. The result from the post-estimation test is an indicator that the estimations that this investigation use is adequate. That this, the results that were found in Table 8, indicate that this investigation is robust.

Indeed, beyond the consumption of energy increase the overweight as can been seen in Tables 6, 7, and 8. The increase of overweight also can increase the consumption of energy by intensive use of modern household appliances, as well as the use reliance on motor vehicles as a mode of transportation, contributing to the reduction of physical effort and less caloric (energy) expenditure and consequently the increase of weight gain, as mentioned by Fox et al. (2019) in Section 3.2. Therefore, to confirm this affirmation, the impact of total overweight on the consumption of energy was checked. Table 9, shows the results of Pooled OLS and Robust, and Quantiles of ENE model, as well as the results of post-estimation tests (e.g., Breusch-Pagan / Cook-Weisberg test for heteroskedasticity and Wald test), to confirm the presence of heteroskedasticity in the models.

Table 9. Estimations for energy consumption.

Independent Variables	Dependent variable (LnENE)				
	Pooled		Quantiles		
	OLS	Robust	25th	50th	75th
LnECO_GLOBA	-0.0050		0.1606**	0.1009**	0.0523
LnSO_GLOBA	1.5967***	***	0.1936***	0.2444***	0.2858***
LnGDP_PC	0.0007		0.4988***	0.5182***	0.5340***
LnURBA	1.2164***	***	0.6284**	0.4089***	0.2303
LnBMI_TOTAL	0.8957	*	3.8083*	3.9349***	4.0378***
Constant	-7.9127***	***	n.a.	n.a.	n.a.
Obs	798	798	798	798	798
F/Wald test	F(5,792) = 325.99***	F(5,792) = 769.98***	Chi2(5) = 1863.32***	Chi2(5) = 4050.56***	Chi2(5) = 2968.94***
Breusch-Pagan/Cook-Weisberg test	Chi2(1) = 8.19**	n.a.	n.a.	n.a.	n.a.

Notes: The Stata command reg and xtqreg were used; ***, **, and * denote statistically significant at 1%, 5%, and 10% levels respectively; 'Ln' denotes variables in natural logarithms. The option robust was used in OLS estimation; n.a., denotes not available.

The results from Pooled OLS indicate that social globalisation and urbanisation increase the consumption of energy. However, the economic globalisation, economic growth, and total overweight point to be statistically insignificant and does not cause any impact on energy consumption. Moreover, the Pooled Robust points out that social globalisation, urbanisation and total overweight encourages energy consumption. However, economic globalisation and economic growth point to be statistically insignificant and does not cause any impact on the consumption of energy. Regarding the Quantile via Moments model, the 25th and 50th quantiles indicate that the economic and social globalisation, economic growth, urbanisation, and total overweight increase the consumption of energy. However, the 75th quantile points out that only social globalisation, economic growth, and total overweight

encourages energy consumption. That is, the economic globalisation and urbanisation point to be statistically insignificant and does not cause any impact on energy consumption.

Additionally, the post-estimation tests (e.g., Breusch-Pagan / Cook-Weisberg test for heteroskedasticity and Wald test) indicating the presence of heteroscedasticity in the model. The result from the post-estimation test is an indicator that the estimations that this investigation use is adequate. The next section will show the discussion of the empirical results.

5. Discussions

By large, the research questions were confirmed, and in line with sound economic fundamentals along with contributing to support quantitatively, some hypothesis advanced in the literature. Indeed, the prospect of economic variables explain overweight as well as overweight has explanatory power on the consumption of energy was supported by data. The LAC region revealed to be non-linearities that can be captured by quantile regression for panel data.

5.1. Model of drivers of body mass index

Three estimations were performed to infer the impacts of overweight's drivers. To better understand the phenomenon were examined the effect of the drivers on the total, man and woman overweight. Results were all in the same way but whit differences in intensity. Results point out that as we go up in the quantiles, the contribution to excess weight decreases for the variables economic globalisation, urbanisation, and energy consumption, and increases for social globalisation and CO2 emissions. The rise of GDP contributes to the downward overweight of women, but as we go up in the quantiles, the contribution fades away.

Globalisation manifests itself in the form of economic globalisation and social globalisation, as suggested by literature that portrays LAC countries' overweight epidemic. Indeed, the deepening of globalisation produces intense changes in human behaviour, some in a healthy way and others in the opposite one. Among the unhealthy ones are the access to fast-food chains and the increase in stress,

both contributing to arise weight. Globalisation also contributes to diversifying the diet available to people and consequently have a healthy effect that could help to lower overweight. The net result of globalisation proved to be in contributing to overweight.

As more urbanised, a LAC country is, more it contributes to being an overweight one, but with loosening intensity, as can be verified by the decline of parameters as quantiles go up. This is in line with urbanisation worsen overweight and the improving quality of cities improving the health of people.

The GDP is likely to impact, with a negative sign, the overweight, because wealthy societies can pay for healthy food. This effect is expected to be detected among women that traditionally are associated with health food concerns. Indeed, this effect was statistically significant for the woman, but the effect of GDP revealed to be statistically insignificant as a driver of man overweight. As the quantiles go up the effect vanishes in line with predict by economic theory reflecting a smaller weight of food in the family's income.

Energy consumption impacts the overweight, suggesting that energy could be used to limit people's physical activity. Nevertheless, this is more pronounced in lower quantiles. As CO2 emissions rise, overweight rises too. This result is compatible with people consuming more animal food that is intensive in producing CO2 emissions.

5.2. Model of drivers of energy consumption

In the context of the same variables, now used as drivers of energy consumption, we conclude for the idleness of CO2 emissions that was, in accordance, excluded from model estimation. An additional model estimation to apprise if overweight impacts the energy consumption confirms that as overweight rises, the energy consumption rises too, and as we go up in the quantiles, it increases the intensity of the impact.

Economic globalisation promotes the increase of transportation as more and more products become available. As an economy specialises, transportation needs tend to increase more than proportionally. Social globalisation reflects profound changes in the standards of life and the way people work, as well as broad changes in the culture and more generally as on the organisation of societies. As countries have access to more sophisticated standards, their citizens lean towards to imitate the behaviour of rich countries and their high consumption of energy. This behaviour can be shown in the increasing of the parameter's value for high quantiles.

The impact of economic growth in energy consumption is well known, and there is a vast bulk of literature in the field, the so-called energy-growth nexus. The linking of urbanisation with energy consumption can be the result of more intensive mobility and the trend for people to move for cities outskirts increasing the distance between home and work. Traffic congestion also plays a role in increasing energy consumption. A rise in overweight rises energy consumption; indeed, as people become more massive than they use more transportations in daily activities, reducing walking and activities intensives in physical exercise.

6. Conclusions and policy implications

The impact of overweight on the consumption of energy and the impact of energy consumption on overweight was analysed for Latin America and Caribbean Countries for the period from 1975 to 2016. The regression of Quantile via Moments model for panel data econometric technique was used to assesses the role of energy consumption on mean body mass index of man and woman controlling for the effects of global, economic and social globalisation, as well as GDP, urbanisation and CO2 emissions. The pre-testing, as well as the port-estimation, have confirmed that Quantile via Moment's regression for panel data econometric technique, was able to handle the analysis properly.

Results point out by one hand, that as we go up in the quantiles the contribution to excess weight decreases for the variables economic globalisation, urbanisation, and energy consumption, and increases for social globalisation and CO2 emissions. On the other hand, the rise of GDP contributes to the downward overweight of women, but as we go up in the quantiles, the contribution fades away. The effect of GDP is statistically insignificant as a driver of man overweight. An additional model estimation to apprise if overweight impacts the energy consumption confirms that as overweight raises the energy consumption rises too, and as we go up in the quantiles, it increases the intensity of the impact.

Economic policymakers should limit the adverse effects of globalisation counteracting unhealthy food consumption habits imported from abroad. Particular attention should be put in given people access to green areas in poor urban areas. Curbing energy consumption and CO2 emissions contribute to decreasing the epidemic of overweight. Fortunately, economic growth helps to solve the problem of overweight.

References

AFONSO T. L., MARQUES A. C., FUINHAS J. A. Energy–growth nexus and economic development: a quantile regression for panel data. **The Extended Energy-Growth Nexus**, p. 1–25, 2019. doi: 10.1016/b978-0-12-815719-0.00001-2.

AGRESTI A. **Categorical Data Analysis**. John Wiley and Sons, New York, 1990. ISBN 0-471-36093-7.

AGUIRRE-ARENAS J., ESCOBAR-PÉREZ M., CHÁVEZ-VILLASANA A. Evaluación de los patrones alimentários y la nutrición en cuatro comunidades rurales. **Salud Pública de México**, 40(5):398-407, 1998.

ANDERSON K., VALDES A. **Distortions to Agricultural Incentives in Latin America**. The World Bank, p. 1-56, 2007. URL: http://siteresources.worldbank.org/INTTRADERESEARCH/Resources/544824-1146153362267/LAC_overview_0708.pdf.

ANRÍQUEZ G., FOSTER W., ORTEGA J. Rural and agricultural subsidies in Latin America: Development costs of misallocated public resources. **Development policy review**, 38:140–158, 2018.

doi: https ://doi.org/10.1111/dpr.12389.

ASISEH F., YAO J. Family income and body mass index – what have we learned from China. **Health Economics Review**, 6:52:1-10, 2016. doi: https://doi.org/10.1186/s13561-016-0129-z.

BAEZ J., FUCHS A., RODRÍGUEZ-CASTELÁN C. **Shaking Up Economic Progress: Aggregate Shocks in Latin America and the Caribbean**. Washington, D.C.: World Bank Group, p. 1-96, 2017. URL: http://documents.worldbank.org/curated/en/771491511793184415/Shaking-up-economic-progress-aggregate-shocks-in-Latin-America-and-the-Caribbean.

BASSETT JR., G.S., KOENKER R. A Quantile Regression Memoir in Koenker, R., Chernozhukov, V., He, X., and Peng, L. (eds.), **Handbook of Quantile Regressio**n, Ch. 1, 3-5, Boca Raton (FL): Chapman-Hall/CRC, 2017. doi: 10.1201/9781315120256.

BELL A. C., GE K., POPKIN B. M. The Road to Obesity or the Path to Prevention: Motorized Transportation and Obesity in China. **Obesity Research**, 10:277-283, 2002. doi: https://doi.org/10.1038/oby.2002.38.

BELSLEY D.A., KUH E., WELSCH R.E. **Regression Diagnostics: Identifying Influential Data and Sources of Collinearity**. New York: Wiley, 1980. doi: 10.1002/0471725153.

BERMUDEZ O. I., TUCKER K. L. Trends in dietary patterns of Latin American populations. **Cadernos de Saude Publica**, 19 (1): 87-99, 2003. doi: https://doi.org/10.1590/S0102-311X2003000700010.

BREUSCH T. S., PAGAN A.R.A simple test for heteroscedasticity and random coefficient variation. **Econometrica**, 47:1287-1294, 1979. URL: https://www.jstor.org/stable/1911963.

BRUG J., VAN STRALEN, M.M., TE-VELDE, S.J., CHINAPAW M.J.M., DE BOURDEAUDHUIJ I., LIEN N., BERE E., MASKINI V., SINGH A. S., MAES L., MORENO L., JAN N., KOVACS E., LOBSTEIN T., MANIOS Y. Differences in Weight Status and Energy-Balance Related Behaviors among Schoolchildren across Europe: The ENERGY-Project. **PLoS ONE** 7(4), 2012. doi: 10.1371/journal.pone.0034742.

BUCHINSKY M. Changes in the U.S. Wage Structure 1963-1987: Application of Quantile Regression. **Econometrica**, 62:405-458., 1994 doi: 10.2307/2951618.

BUTZLAFF I. BMI growth rates and the nutrition transition: The role of income, inequality and income growth in Russia. **GlobalFood Discussion Papers**, 81:1-42, 2016. URL: http://hdl.handle.net/10419/129507.

CADE B.S., NOON B.R. A Gentle Introduction to Quantile Regression for Ecologists. **Frontiers in Ecology and the Environment**, 1:412-420, 2003. doi: 10.1890/1540-9295(2003)001[0412:AGITQR]2.0.CO;2.

CANAY I.A. A Simple Approach to Quantile Regression for Panel Data. **The Econometrics Journal**, 14:368-386, 2011. doi: 10.1111/j.1368-423X.2011.00349.x.

CHAMBERLAIN G. Quantile Regression, Censoring and the Structure of Wages. **Harvard Institute of Economic Research Working Papers**, p.171-209, 1994. doi: 10.1017/CCOL0521444594.005.

CHERNOZHUKOV V., HANSEN C. Instrumental Variable Quantile Regression: A Robust Inference Approach. **Journal of Econometrics**, 142:379-398, 2008. doi: 10.1016/j.jeconom.2007.06.005.

CHOUINARD H., DAVIS D., LAFRANCE J., PERLOFF J. Fat Taxes: Big Money for Small Change. **Forum for Health Economics & Policy**, 10(2):1-30, 2007. doi: https://doi.org/10.2202/1558-9544.1071.

CHRISTENSEN D.L., EIS J., HANSEN A.W., LARSSON M.W., MWANIKI D.L., KILONZO B. Obesity and regional fat distribution in Kenyan populations: impact of ethnicity and urbanization. **Annals of Human Biology**, 35(2):232–249, 2008. doi: 10.1080/03014460801949870.

COOK R.D., WEISBERG S. Diagnostics for heteroscedasticity in regression. **Biometrika** 70: 1-10, 1983. URL: https://www.jstor.org/stable/2335938.

COSTA-FONT J., MAS N. 'Globesity'? The effects of globalization on obesity and caloric intake. **Food Policy**, 64:121–132, 2016.doi: https://doi.org/10.1016/j.foodpol.2016.10.001.

D'AGOSTINO R.B., BELANGER A.J., D'AGOSTINO JR. R.B. A suggestion for using powerful and informative tests of normality. **The American Statistician** , 44:316-321, 1990. doi: 10.2307/2684359.

DRENOWSKI A., SPECTER S.E. Poverty and obesity: the role of energy density and energy costs. **The American Journal of Clinical Nutrition**, 79(1):6-16, 2004. doi: https://doi.org/10.1093/ajcn/79.1.6.

ECONOMIC COMMISSION FOR LATIN AMERICA AND THE CARIBBEAN (ECLAC), 2016. Monitoring energy efficiency in Latin America. United Nations, Santiago. URL: https://eclac.org/en/publications/40809-monitoring-energy-efficiency-latin-america.

ENERGY, 2020. Open Energy Data. URL: https://www.energy.gov/data/open-energy-data.

EUROPEAN ENVIRONMENT AGENCY (EEA), 2020. Final energy consumption by sector and fuel in Europe. URL: https://www.eea.europa.eu/data-and-maps/indicators/final-energy-consumption-by-sector-10/assessment.

FERNNDEZ-VAL I., WEIDNER M. Individual and Time Effects in Nonlinear Panel Models with Large N, T. **Journal of Econometrics**, 192:291-312, 2016. doi: 10.1016/j.jeconom.2015.12.014.

FOX A., FENG W., ASAL V. What is driving global obesity trends? Globalization or "modernization"? . **Globalization and Health**, 15(32):1-16, 2019. doi: https://doi.org/10.1186/s12992-019-0457-y.

FRANK J. Meat as a bad habit: A case for positive feedback in consumption preferences leading to lock-in. **Review of Social Economy**, 65(3):319-348, 2007. doi: 10.1080/00346760701635833.

GERBENS-LEENES P.W., NONHEBEL S., KROL M.S. Food consumption patterns and economic growth. Increasing affluence and the use of natural resources. **Appetite**, 55(3):597-608, 2010. doi: 10.1016/j.appet.2010.09.013.

GORYAKIN Y., LOBSTEIN T., JAMES W.P.T., SUHRCKE M. The impact of economic, political and social globalization on overweight and obesity in the 56 low and middle-income countries. **Social Science & Medicine**, 133:67-76, 2015. doi: https://doi.org/10.1016/j.socscimed.2015.03.030.

HAWKES C. Uneven dietary development: linking the policies and processes of globalization with the nutrition transition, obesity and diet-related chronic diseases. **Globalization and Health**, 2:4: 1-18,2006. doi: https://doi.org/10.1186/1744-8603-2-4.

HAWKES C. Dietary Implications of Supermarket Development: A Global perspective. **Development Policy Review**, 26(6):657-692, 2008.doi: 10.1111/j.1467-7679.2008.00428.x.

KJELLSTROM T., HAKANSTA C., HOGSTEDT C. Globalisation and public health-overview and a Swedish perspective. **Scandinavian journal of public health**, 70:2-68, 2007. doi: https://doi.org/10.1080/14034950701628494.

KOENGKAN M., SANTIAGO R., FUINHAS J.A. The impact of public capital stock on energy consumption: Empirical evidence from Latin America and the Caribbean region. **International Economics**, 160:43-55, 2019. doi: https://doi.org/10.1016/j.inteco.2019.09.001.

KOENKER R. Quantile Regression for Longitudinal Data. **Journal of Multivariate Analysis**, 91:74 -89, 2004. doi: 10.1016/j.jmva.2004.05.006.

KOENKER R. Quantile Regression. **Cambridge University Press**, Cambridge, UK, 2005.doi: https://doi.org/10.1017/CBO9780511754098.

KOENKER R., BASSETT JR. G.S. **Regression Quantiles. Econometrica**, 46:33-50, 1978. doi: 10.2307/1913643.

KOENKER R., HALLOCK K.F. Quantile regression. **Journal of Economic Perspectives**, 15(4):143-156, 2001. doi: 10.1257/jep.15.4.143.

KOF GLOBALIZATION INDEX, 2020. URL: https://www.kof.ethz.ch/en/forecastsand-indicators/indicators/kof-globalisation-index.html.

LANG T., RAYNER G. Overcoming policy cacophony on obesity: an ecological public health framework for policymakers. **Obesity Reviews**, 8:165-181, 2007. doi: https://doi.org/10.1111/j.1467-789X.2007.00338.x.

LINDSTROM M. Means of transportation to work and overweight and obesity: A population-based study in southern Sweden. **Preventive Medicine**, 46:22-28, 2008. doi: https://doi.org/10.1016/j.ypmed.2007.07.012.

LOPEZ R. Urban Sprawl and Risk for Being Overweight or Obese. **American Journal of Public Health**, 94 (6): 1574 – 1579, 2004. doi: 10.2105/AJPH.94.9.1574.

MACHADO J.A.F., SILVA J.M.C.S. Quantiles via Moments. **Journal of Econometrics**, forthcoming, 2019. doi: 10.1016/j.jeconom.2019.04.009Get.

MONTEIRO C., CONDE W., MOURA E., POPKIN B. M. Socioeconomic status and obesity in adult populations of developing countries: a review. **Bulletin of the World Health Organization**, 82: 940-946, 2005. doi: 10.1590/S0042-96862004001200011.

NAÇÕES UNIDAS BRASIL, 2019. ONU vê ‘epidemia de obesidade’ na América Latina e Caribe. URL: https://nacoesunidas.org/onu-ve-epidemia-de-obesidade-na-america-latina-e-caribe/.

OECD-FAO.OECD-FAO Agricultural Outlook 2019-2028, 2019. doi: 10.1787/agr_outlook-2019-en

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD). Latin American Economic Outlook 2019: Development in Transition, OECD Publishing, Paris, 2019 https://doi.org/10.1787/g2g9ff18-en.

OUR WORLD IN DATA. Obesitym, 2020. URL: https://ourworldindata.org/obesity.

PAN AMERICAN HEALTH ORGANIZATION (PAHO). Mortality in Americas, 2017. URL: https://www.paho.org/salud-en-las-americas-2017/?p=1457.

PAUCHARD A., BARBOSA O. Regional Assessment of Latin America: Rapid Urban Development and Social Economic Inequity Threaten Biodiversity Hotspots. **Urbaization, Biodiversity and Ecosystem Services: Challenges and Opportunities: A Global Assessment**, 589-608,2013. doi: 10.1007/978-94-007-7088-1_28.

PIRGON Ö., ASLAN N.., The Role of Urbanization in Childhood Obesity. **Journal of Clinical Research İn Pediatric Endocrinology**, 7(3): 163–167, 2015. doi: 10.4274/jcrpe.1984.

POORTINGA W., STEG L., VLEK C., WIERSMA G. Household preferences for energy-saving measures: A conjoint analysis. **Journal of Economic Psychology**, 25(1):49-64, 2003. doi: https://doi.org/10.1016/S0167-4870(02)00154-X.

POPKIN B.M. The nutrition transition and its health implications in low-income countries. **Public Health Nutrition**, 1(1):5–21, 1998. doi: https://doi.org/10.1079/PHN19980004.

POPKIN B.M. Urbanization, lifestyle changes and the nutrition transition. **World Development**, 27(11):1905-1916, 1999. doi: https://doi.org/10.1016/S0305-750X(99)00094-7.

POPKIN B.M., REARDON T. Obesity and the food system transformation in Latin America. **Obesity Reviews**, 19(8): 1028-1064, 2018. doi: 10.1111/obr.12694.

POWELL L. M., CHALOUPKA F. J. Food Prices and Obesity: Evidence and Policy Implications for Taxes and Subsidies. **The Milbank Quarterly**, 87: 229-257, 2009.doi: https://doi.org/10.1111/j.1468-0009.2009.00554.x.

RAAIJ W.F.V., VERHALLEN T.M.M. A behavioral model of residential energy use. **Journal of Economic Psychology**, 3(1):39-63, 1983. URL: https://pure.uvt.nl/ws/portalfiles/portal/595939/28_3_2.pdf.

REARDON T., TIMMER C.P., BARRETT C.B., BERDEGU J. The rise of supermarkets in Africa, Asia, and Latin America. **American Journal of Agricultural Economics**, 85(5):1140-1146, 2003. URL: https://www.jstor.org/stable/1244885.

ROSKAM A.J., KUNST A.E., VAN OYEN H., DEMAREST S., KLUMBIENE J., REGIDOR E., HELMERT U., JUSOT F., DZUROVA D., MACKENBACH J.P. Comparative appraisal of educational

inequalities in overweight and obesity among adults in 19 European countries. **International Journal of Epidemiology**, 39(2):392-404, 2010. doi: https://doi.org/10.1093/ije/dyp329.

ROYSTON P. A simple method for evaluating the Shapiro-Francia W' test for non-normality. **Statistician**, 32: 297-300, 1983. doi: 10.2307/2987935.

SANTIN O.G. Behavioural Patterns and User Profiles related to energy consumption for heating. **Energy and Buildings**, 43(10): 2 2662-2672, 2011. doi: 10.1016/j.enbuild.2011.06.024.

SMITH M.D., KASSA W., WINTERS P. Assessing food insecurity in Latin America and the Caribbean using FAO's Food Insecurity Experience Scale. **Food Policy**, 71: 48-61, 2017. doi: https://doi.org/10.1016/j.foodpol.2017.07.005.

SOBAL J. Commentary: Globalization and the epidemiology of obesity. **International Journal of Epidemiology**, 30:1136–1137, 2001. doi: https://doi.org/10.1093/ije/30.5.1136.

SULLIVAN M.C., HAWES K., WINCHESTER S.B., MILLER R. Developmental Origins Theory from Prematurity to Adult Disease. **J Obstet Gynecol Neonatal Nurs**, 37 (2): 158–164, 2008. doi: 10.1111/j.1552-6909.2008.00216.x.

SWINBURN M.D.B.A, KRAAK V.I., ALLENDER S., ATKINS V.J., BAKER P.I., BOGARD J.R. The Global Syndemic of Obesity, Undernutrition, and Climate Change: The Lancet Commission report, 393(10173):791-846, 2019. doi: https://doi.org/10.1016/S0140-6736(18)32822-8.

THOW A.M., JAN S., LEEDER S., SWINBURN B. The effect of fiscal policy on diet, obesity and chronic disease: a systematic review. **Bull World Health Organ**, 88(8):609-614, 2010. doi: 10.2471/BLT.09.070987.

TOIBA H, UMBERGER W.J., MINOT N.W. Diet Transition and Supermarket Shopping Behaviour: Is there a link?. **Bulletin of Indonesian Economic Studies**, 51, 2015. doi: 10.1080/00074918.2015.1111997.

WILHELMSEN C.K., SKALLEBERG K., RAANAAS R.K., TVEITE H., AAMODT G. Associations between green area in school neighbourhoods and overweight and obesity among Norwegian adolescents. **Preventive Medicine Reports**, 7:99–105, 2017. doi: https://doi.org/10.1016/j.pmedr.2017.05.020.

WORLD BANK OPEN DATA 2019. URL: http://www.worldbank.org/.