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URBAN POPULATION IMPACT ON CO² EMISSION: 1961-2014 PANEL DATA ANALYSIS

Impacto da população urbana nas emissões de CO²: análise de dados em painel de 1961 a 2014

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RESUMO

Neste artigo, apresentamos evidências empíricas do impacto do desenvolvimento na poluição, em uma perspectiva de longo prazo, de 1961 a 2014, utilizando dados médios quinquenais de países do Banco Mundial sobre as emissões de CO2 (uma proxy para a poluição), crescimento populacional e população urbana (proxy para a pressão sobre os recursos naturais humanos) e expectativa de vida ao nascer (proxy para o desenvolvimento). Também consideramos os efeitos regionais, níveis de renda e efeitos temporais. Descobrimos que apenas a população urbana possui um efeito positivo e robusto sobre a poluição. Isso faz sentido, uma vez que a população mundial e a concentração urbana aumentaram significativamente no século XX. Essa concentração humana espetacular em uma sociedade baseada em carbono teve um forte impacto no meio ambiente.

PALAVRAS-CHAVE: Poluição. Meio ambiente. População urbana. Dados em painel.

ABSTRACT

In this paper we get empirical evidence to development impact on pollution in a long run perspective, 1961-2014, using five years average World Bank countries annual information for CO2 emissions (a proxy for pollution), population growth and urban population (proxy for human natural resources pressure) and life expectancy at birth (proxy for development). We also considerer regional, income levels and time effects. We found that only urban population has robust positive effect on pollution. It makes sense once the world population and urban concentration increased a lot in 20th century. This spectacular human concentration in a consider carbon-based society had strong environment impact.

KEYWORDS: Pollution. Environment. Urban population. Panel data.

Classificação JEL: Q52; Q53; Q56; F64

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1 INTRODUCTION

Pollution and development are part of economic literature at least since Marshall's 1890 principles and Pigou's 1920 contribution to welfare debate. But recently this subject became particularly important because of worldwide high pollution levels, especially in "big cities." In fact, world population and urban concentration increased a lot in 20th century. In 1900's the world had close to two billion people and just a few cities had more than one million people. In 2000's the world had about seven billion people, lot of cities with more than one million people and many cities with more than ten million people, especially in Americas and Asia. Cities with population bigger than many countries. This spectacular human concentration had environment impact as increase water demand and decline air quality. The steam age used coal as the main fuel, and petrol is the most important source of energy since the eletric-metal-mechanic paradigm. But it is more intense and complex if we keep in mind we live in a carbon and steal based society, and his institutions, as the European Coal and Steel Community, under the Treaty of Paris between 1951 and 2002, and the former International Iron and Steel Institute (1967-2008), now World Steel Association.

In the last one hundred years we learn a lot about externalities, tragedy of commons, agglomeration (des)economies, in theory and practice. About 50 years ago Nordhaus and Tobin (1972) pointed out that many of the negative externalities of economic growth are connected with urbanization and congestion and increase in migration from rural agriculture to urban industry comes together. Without this occupational and residential revolution, we could not have enjoyed the benefits of technological progress. But some portion of the higher earnings of urban residents may simply be compensation for the disamenities of urban life and work. Higher wages and higher population densities are proxies to costs of urban life as they are valued by people making residential and occupational decisions. In sum, life quality decline to incredibly low levels in many cities and countries, and local and national governments must made changes.

In this paper we get empirical evident to development impact on pollution in a long run perspective, 1961-2014, using five years average World Bank countries annual information for CO2 emissions (a proxy for pollution), population growth and urban population (proxy for human natural resources pressure) and life expectancy at birth (proxy for development). We also use time effects, regional (East Asia and Pacific, Europe and

Central Asia, North America, Latin America and Caribbean, Middle East and North Africa, South Asia, and Sub-Saharan Africa) and income (High, Lower Middle, Upper Middle, Low) groups according to World Bank classification. While many studies focus on cities in the developed world, we consider both developed and developing nation. We find that urban population is the main cause of CO2 increase. The other variables are eventually statistically significant probably because of regression specifically randomness, but there is not robustness. Next literature review, data base and variables, results discussion, and conclusion.

2 LITERATURE REVIEW

Let's begin with the rise and fall of environment Kuznets curve (EKC) debate. The EKC proposes that indicators of environmental degradation first rise, and then fall with increasing income per capita. Some 1990's study gives empirical evidence about it, but later they were considered not robust enough.

The 1990's literature hypothesize a Kuznets type inverted U-shape relationship between the rate of environmental degradation and the level of economic development. At low levels of development both the quantity and intensity of environmental degradation is limited to the impacts of subsistence economic activity on the resource base and to limited quantities of biodegradable wastes. As economic development accelerates with the intensification of agriculture and other resource extraction and the takeoff of industrialization, the rates of resource depletion begin to exceed the rates of resource regeneration, and waste generation increases in quantity and toxicity. At higher levels of development, structural change towards information-intensive industries and services coupled with increased environmental awareness, enforcement of environmental regulations, better technology and higher environmental expenditures, result in levelling off and gradual decline of environmental degradation (Panayotou, 1993).

Evidence using precarious cross-section data from a sample of developed and developing countries with the 1980's data available indicated that the turning point for deforestation occurs between $800 - $1,200 per capita and the turning point for emissions between $3,800 - $5,500. Environmental degradation overall (combined resource depletion and pollution) is worse at levels of income per capita under $1,000. Between $1,000 and $3,000, both the economy and environmental degradation undergo dramatic structural change from rural to urban, from agricultural to industrial. A second structural transformation begins to take place as countries surpass a per capita income of $10,000 and begin to shift from energy intensive heavy industry into services and information/technology-intensive industry (Panayotou, 1993).

There are many theoretical and empirical critics to EKC as Stern (2004) summed up. The key criticism is EKC`s assumptions: i) the economy is sustainable, i.e., there is no feedback from environmental damage to economic production, ii) income is assumed to be an exogenous variable, iii) environmental damage does not reduce economic activity sufficiently to stop the growth process and that any irreversibility is not so severe that it reduces the level of income in the future. But, if higher levels of economic activity are not sustainable, attempting to grow fast in the early stages of development when environmental degradation is rising may prove counterproductive.

On one hand, it is clear that emissions of many pollutants per unit of output have declined over time in developed countries because of increasingly stringent environmental regulations and technical innovations. On the other hand, the mix of residuals has shifted from sulfur and nitrogen oxides to carbon dioxide and solid waste so that aggregate waste is still high and per capita waste may not have declined. In fact, economic activity is inevitably environmentally disruptive in some way. Satisfying the material needs of people requires the use and disturbance of energy flows and materials stocks. An effort to reduce some environmental impacts may just increase other problems. Part of the reduction in environmental degradation levels in the developed countries and increases in environmental degradation in middle income countries may reflect production specialization. Environmental regulation in developed countries might further encourage polluting activities move to developing countries. Capital-intensive activities that are concentrated in the developed countries are more polluting and hence developed countries have a natural comparative advantage in polluting goods in the absence of regulatory differences (Stern, 2004).

Although EKC is an essentially empirical phenomenon, most of the EKC literature is econometrically weak. In particular, little or no attention has been paid to the statistical properties of the data used, such as serial dependence or stochastic trends in time-series. Also, little consideration has been paid to issues of model adequacy such as the possibility of omitted variables bias. In very brief, EKC empirical evidence fall into four main categories: heteroskedasticity, simultaneity, omitted variables bias, and cointegration issues. Despite recent estimates that indicate higher or nonexistent turning points, the impression produced by the early studies in the policy, academic, and business communities seems weak (Stern, 2004).

An EKC alternative literature analyze pollution and development under urban agglomeration and economic geography perspective. For example, Carrothers (1956) focus on the gravity of human interaction, based on the law of gravity. It means that the relative volume of migration to a given destination from each of several source areas varies directly with the “force of attraction” of the destination and inversely with the square of the distance between the source and the destination. An alternative point of view suggests a relationship between distance and mobility: the number of persons going a given distance is directly proportional to the number of opportunities fit that distance and inversely proportional to the number of intervening opportunities.

From a simple general equilibrium model of an economy, where production and consumption occur in cities, Henderson (1972) try explaining the different sizes and types generated by market forces and whether these market forces generate optimum size cities. He address four fundamental questions: i) Why does an economy have cities, in particular larger cities, instead of spread out economic activities across the countryside? ii) What limit cities? iii) Why do cities vary? iv) Are the size of different cities attain in a market economy is optimal?

Henderson’s answer to the first question is technology economies of scale in production and/or consumption and because these activities are not space or land intensive relative to agriculture, for example. Scale economies may occur at the final output level, at the marketing level, or at the intermediate input level such as transport, natural resources extraction, capital and labor markets. To the second question he points out that agglomeration occurs due to scale economies in production of a city’s traded goods but transport cost from house to work, time inclusive, give a limit to special expansion. To the third interrogation, the difference in efficiency in cities organization, public good provision and differing access to export and import markets is the suggested answer. In theory, different types of cities exist specializing in the production of different traded goods. At least, under Henderson (1972) perspective, city size may be non-optimal because of i) inefficient pricing of congestion in commuting or ii) the output of goods that are produced with economies of scale external to the firm or iii) other externalities such as pollution.

Krugman (1991) develops a model that show how a country can endogenously became industrialized or agricultural, or center or periphery in a global economy. According to him, once a country realize scale economies and minimize transport costs, manufacturing firms tend to locate in that region. It also increase demand once the location of manufacturing supply influence demand's location. But it also influence pollution concentration if the manufacturing firms and the respective industrial and urban area has a not clean technology. It suggests that, theoretically, the location of factors production in space has impact on pollution location.

According to Ottaviano and Thisse (2004), at the time of the Industrial Revolution, the modern sector was manufacturing. The geographical concentration of industry generated an additional demand for manufactured goods, as shown by the history of the Manufacturing Belt in the United States or the development of the Ruhr in Germany. Today, the modern sector is the service industry in which firms do not only supply consumers and manufacturing firms, but also serve each other. The tendency toward agglomeration is thus strengthened by the fact that business services tend to work more and more for headquarters and research labs of manufacturing firms, which remain mostly located in large urban agglomerations.

We find further details about urbanization effects on pollution under an spatial analysis perspective in Combes and Gobillon (2015). Ongoing urbanization is sometimes interpreted as evidence of gains from agglomeration that dominate its costs, otherwise firms and workers would remain sparsely distributed. One can imagine, however, that the magnitude of agglomeration economies depends on the type of workers and industries, as well as on the period and country. Moreover, firms' and workers' objectives, profit and utility, are usually not in line with collective welfare or the objective that some policy makers may have in particular for productivity or employment. Even if objectives were identical, individual decisions may not lead to the collective optimum as firms and workers may not correctly estimate social gains from spatial concentration when they choose their location. A large literature details the overall impact on local outcomes of spatial concentration, and of a number of other characteristics of the local economy, such as its industrial structure, its labor force composition, or its proximity to large locations. Local productivity and wages have been the main focus of attention, but we also present the literature that studies how employment and firm location decisions are influenced by local characteristics. Most positive agglomeration effects can also turn negative above some city size threshold, or can induce some companion negative effects, and one cannot say whether some positive effects are partly offset by negative ones, as only the total net impact is evaluated. Moreover, while some mechanisms imply immediate static gains from agglomeration, other effects are dynamic and influence local growth.

About cities and the environment, a city's greenness is a function of its natural beauty and is an emergent property of the types of households and firms that locate within its borders and the types of local and national regulations enacted by voters, says Kanh and Walsh (2015). The concentration of economic activity along the coasts and major rivers is a function of both the historical persistence of early settlement patterns and the key role that transportation access played in determining the locations of early waves of industrial activity. The persistence of these coastal patterns today is in no small part supported by the environmental amenities conveyed by proximity to rivers and coasts and the climate amenities enjoyed by those living on or near the coast. In coastal cities such as Los Angeles, richer people consistently live close to the beach, and thus, there has been less suburbanization of income than in noncoastal metropolitan areas. In fact, nonmarket amenities such as clean air, green spaces, temperate climate, and safe streets help fuel the modern consumer city. Environmental amenities also shape cross city competition for workers and firms (Kanh and Walsh, 2015).

A colateral phenomenon is the rise of superstar green cities. In 2012, residential and commercial buildings were responsible for 74% of total electricity consumption in the United States. Given that electricity continues to be generated using fossil fuels (coal is the fuel source for 70% of India’s power and more than 70% in China), urban real estate is a major producer of global greenhouse gas emissions. Such cheap fossil fuels exacerbate the climate change externality. Coal-fired power plants are major producers of a large vector of local pollutants that can cause significant harm to health and aesthetics. Studies based on data from the United States and from China have estimated large Pigouvian social costs associated with the use of fossil fuel-fired power plants. The composition shift from coal to natural gas power plants should reduce both the local and the global greenhouse gas externalities associated with electricity consumption (Kanh and Walsh, 2015).

Effectively, air quality, water quality, and energy efficiency have become an emergent property of the industry, buildings, regulations, voters, and households who locate within a city’s borders. Progress along these dimensions has been seen in cities such as Chicago, London, and New York City. Researchers see the start of similar trends in China once China’s emerging system of cities care about environment. Some of China’s cities are choosing to specialize in heavy industry and this is raising pollution challenges (Kanh and Walsh, 2015). At the same time, rich eastern Chinese cities are desindustrializing and pollution is declining, but industry are moving to another countries as Phillipines, Malysia and Vietnam.

3 DATA BASE AND VARIABLES

We get a set of variables available for 1961-2014 in the World Bank online data base. There are other variables related to this subject, but not for long time and to a reasonable number of countries. They are i) CO2 emissions (metric tons per capita). It is carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring; ii) Population growth (annual %). Annual population growth rate for year t is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage. Population is based on the *de facto* definition of population, i.e., counts all residents regardless of legal status or citizenship; iii) Urban population (% of total population). It refers to people living in urban areas as defined by national statistical offices. The data are collected and smoothed by United Nations Population Division; iv) Male years life expectancy at birth. It indicates the number of years a new-born infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life. It is a good development long run proxy once life expectancy is affected by health, sanitary, income, among others socio-economic indicators.

Once those variables change need some time to have effective effect, we use five years average: 1961-65 (we found data available for 156 countries), 1966-70 (157), 1971-75 (159), 1976-80 (162), 1981-85 (162), 1986-90 (168), 1991-95 (191), 1996-2000 (192), 2001-05 (193), 2006-10 (192), 2011-14 (196). We also use regional (East Asia and Pacific, Europe and Central Asia, North America, Latin America and Caribbean, Middle East and North Africa, South Asia, and Sub-Saharan Africa) and income (High, Lower Middle, Upper Middle, Low) groups according to World Bank classification.

It is important remember that after the fall of the Berlin Wall international borders change substantially. Many countries split after 1989 and since does not exist, and there are many new countries after 1989. Former Czechoslovakia and former URSS are two well know examples that helps understand why close to 150 countries in our sample in 1960's and close to 200 in 1990's and after. It is also important to remember that some countries did not join to international data base immediately and that spend some time the new countries be on international data base.

Descriptive statistics give us a good picture for our 1928 countries unbalanced panel. As TABLE 1 shows, CO_2 average levels is 4,96 metric tons per capita, with a substantial dispersion as variation coefficient sum up. Checking dispersion in details, there are remarkable difference between the low 5% and the 50% (median) and the 50% and top 5% (95%). Minimum and maximum indicates outliers in the distribution's top and bottom. Population Growth (CRESCPOP) is 1.86% a year on average, negative below median and 95% are below 4%. Urban population (POPURB) central tendency is about 50%, but extremely low minimum (2.19%), 5% below 12% and only 5% above 90%. At least, male life expectancy (EXPECMASC) around 60 - 65 years, minimum close to 20 years, maximum near 80 years, 5% below 41 years and 5% above 76 years.

TABLE 1: DESCRIPTIVE STATISTICS

	MEAN	SD	CV	MINIMUM	5%	MEDIAN	95%	MAXIMUM
CO2	4,96	12,87	2,59	0,01	0,06	1,58	16,61	227,96
CRESCPOP	1,86	1,56	0,84	(-) 4,44	(-) 0,25	1,87	3,81	16,98
POPURB	49,00	24,82	0,51	2,19	12,04	47,80	89,72	100,00
EXPECMASC	61,64	10,93	0,17	19,29	41,44	64,06	76,38	81,02
EXPECFEM	66,08	12,00	0,18	25,15	44,25	69,35	81,53	86,67

Source: Author`s elaboration from World Bank open data base. Female descriptive statistics is similar to male, but about 5 years more in dispersion and central tendency.

4 REGRESSIONS RESULTS

We run eight panel data regressions with robust errors and random effects (it gets some no observable country characteristics as the efficiency of environmental policies) via Generalized Least Squares (GLS) (Greene, 2018). The results for our unbalanced panel are summed up in TABLES 2A and 2B below.

The basic regression (REG1) has CO_2 emissions as dependent variable and population growth, urban population, male life expectancy at birth as independent. The other eight has REG1 variables plus regional dummies (REG2), income level dummies (REG3), time dummies (REG4), regional and income levels dummies (REG5), regional and time dummies (REG6), income levels and time dummies (REG7) and regional, income levels and time dummies (REG8).

REG 1 informs us that only urban population (POPURB) is statistically significant and has positive impact on CO2, i.e., as urban population increase pollution increase. Population growth (CRESPOP) and male life expectancy at birth (EXPECMASC) are not statistically significant. But maybe it is variable omission. The other regression adds some important aspect. According to REG 2 urban population and South Asia (DRSA) and Sub-Saharan Africa (DRSSA) have positive impact on CO2. REG 3 suggests that urban population and high income and upper middle income have positive impact on CO2. The fourth regression is the basic plus time dummies and only population growth and male life expectancy at birth are statistically significant and have positive impact on CO2. But considering regional and income level effects together (REG5), only urban population and high income are statistically significant and have positive impact on CO2. Regional and time effects (REG6) and income level and time effects (REG7) does not change the basic result and regional, income and time effects (REG8) keep REG1 result: only urban population (POPURB) is statistically significant and has positive impact on CO2.

In sum, in all regression urban population is statistically significant and has positive effect on CO2, i.e., a robust result. About the other variables, some of them are eventually statistically significant probably because of regression specifically randomness, but there is not robustness.

TABLE 2A: REGRESSIONS RESULTS

CO2	REG1	REG2	REG3	REG4
CONST	0.86 (0.82)	7.89 (0.12)	(-) 0.01 (0.99)	(-) 9.13 (0.00) ***
CRESCPOP	0.27 (0.55)	0.29 (0.51)	0.32 (0.46)	0.06 (0.90)
POPURB	**0.14 (0.00)*** **	**0.12 (0.00)*** **	**0.09 (0.00)*** **	**0.16 (0.00)*** **
EXPECMASC	(-) 0.05 (0.40)	(-) 0.06 (0.35)	(-) 0.05 (0.39)	**0.13 (0.03)** **
DR-EAP		**(-) 6.26 (0.09)***		
DR-ECA		(-) 4.2 (0.25)		
DR-LAC		(-) 4.59 (0.36)		
DR-MENA		(-)3.66 (0.40)		
DR-SA		**(-) 6.94 (0.07)***		
DR-SSA		**(-) 8.34 (0.02)** **		
D-HI			**8.33 (0.00)*** **	
D-LMI			0.11 (0.76)	
D-UMI			**1.41 (0.01)** **	

1966-70				0.42 (0.17)
1971-75				0.91 (0.21)
1976-80				(-) 0.00 (0.99)
1981-85				(-) 1.55 (0.21)
1986-90				(-) 3.11 (0.22)
1991-95				(-) 3.33 (0.23)
1996-2000				(-) 3.62 (0.21)
2001-05				(-) 3.74 (0.21)
2006-10				(-) 4.14 (0.19)
2011-14				(-) 4.67 (0.17)
OBS	1928	1928	1928	1928
AKAIKE	15137	15116	14997	15108
SWARTZ	15159	15171	15036	15186
LOG-LIKE	(-) 7564	(-) 7548	(-) 7491	(-) 7540

Source: Author`s elaboration from World Bank open data base. P-value in brackets. Maximum significance level considerer:10%. Akaike, Schwartz and log-likelihood are information criteria. Regressions with female life expectance instead of male had any significative difference.

TABLE 2B: REGRESSIONS RESULTS

CO2	REG5	REG6	REG7	REG8
CONST	2.15 (0.60)	(-) 8.14 (0.44)	(-) 6.84 (0.02)**	(-) 7.91 (0.39)
CRESCPOP	0.26 (0.57)	0.024 (0.97)	0.12 (0.84)	0.053(0.93)
POPURB	**0.09 (0.00)*** **	**0.16 (0.00) *** **	**0.13 (0.02)** **	**0.13(0.04)** **
EXPECMASC	(-) 0.05 (0.42)	0.15 (0.16)	0.11 (0.30)	0.11(0.87)
DR-EAP	(-) 2.36 (0.56)	(-) 2.83 (0.59)		(-) 0.84 (0.87)
DR-ECA	(-) 2.32 (0.51)	(-) 2.23 (0.60)		(-) 1.19 (0.77)
DR-LAC	(-) 0.30 (0.96)	(-) 1.95 (0.77)		0.76 (0.91)
DR-MENA	0.70 (0.88)	(-) 0.71 (0.89)		1.50 (0.76)
DR-SA	(-) 0.96 (0.83)	(-) 1.09 (0.87)		1.48 (0.81)
DR-SSA	(-) 2.35 (0.57)	(-) 1.08 (0.88)		0.89 (0.89)
D-HI	**8.06 (0.00)*** **		2.98 (0.45)	4.04 (0.14)
D-LMI	(-) 0.22 (0.61)		(-) 1.43 (0.31)	(-) 1.14 (0.26)
D-UMI	0.73 (0.45)		(-) 2.15 (0.54)	(-) 1.59 (0.61)
1966-70		0.39 (0.34)	0.55 (0.17)	0.54 (0.23)
1971-75		0.85 (0.36)	1.18 (0.20)	1.15 (0.25)
1976-80		(-) 0.10 (0.94)	0.38 (0.76)	0.33 (0.81)
1981-85		(-) 1.68 (0.34)	(-) 1.05 (0.53)	(-) 1.12 (0.55)
1986-90		(-) 3.27 (0.31)	(-) 2.50 (0.42)	(-) 2.57 (0.44)
1991-95		(-) 3.50 (0.31)	(-) 2.62 (0.44)	(-) 2.69 (0.46)
1996-2000		(-) 3.81 (0.30)	(-) 2.83 (0.43)	(-) 2.91 (0.46)
2001-05		(-) 3.96 (0.30)	(-) 2.88 (0.45)	(-) 2.97 (0.47)
2006-10		(-) 4.38 (0.28)	(-) 3.19 (0.43)	(-) 3.28 (0.45)
2011-14		(-) 4.94 (0.27)	(-) 3.62 (0.41)	(-) 3.75 (0.44)
OBS	1928	1928	1928	1928
AKAIKE	14990	15114	15042	15039
SWARTZ	15062	15225	15136	15167
LOG-LIKE	(-) 7482	(-) 7537	(-) 7504	(-) 7496

Source: Author`s elaboration from World Bank open data base. P-value in brackets. Maximum significance level considerer:10%. Akaike, Schwartz and log-likelihood are information criteria. Regressions with female life expectance instead of male had any significative difference.

5 RESULTS DISCUSSION

Here we highlight three points. First, time effects probably had financial impact but not pollution effect. Second, urbanization sounds the key point in this paper subject. Third, nonsignificant results are informative.

In fact, as Bloom (2009) points out, at least since 1970's there were many uncertainty shocks with strong impact on expectations and reflections on monetary and financial markets. The 1971-1980 period had the first and second oil shock effect, the inflation in developed countries and the balance of payments and external debit crises, especially in Latin America. In the 1981-1990, the monetary cycle turning point (from October 1982 to August 1982), the black Monday (October 1987), the Golf War I (1990), that affect global oil market – none of them favourable to global exchange. The 1991-2000 period had the Asian Crises (1997) and Russian and LTCM default (1998). The 2001-2010 period had the 9/11 terrorist attack (2001), the Enron case (2002) and the Golf War II (2003), that again affect global oil market. The first two events were restricted to USA and the third hit oil and gas price but not the global economy as in 1980´s, probably because of more energy efficiency and new suppliers out of Middle East, as Brazil, Mexico, Venezuela, and Russia.

Some events are out of Bloom (2009) analysis. The 2001–2010-decade finish under 2008 financial crises consequences. Bordo and Landon-Lane (2010) analysed the 2008 global financial crises and based on real GDP relative to the USA they identify the main global financial crises since 1880: 1890-91, 1907-08, 1913-14, 1931-32, 2007-2008. The 2008 crise is fourth in their ranking and comparable to 1907-08. Cecchetti, Kohler, Upper (2009) studied the relationship between financial crises and economic activity using the output costs of forty systemic banking crises since 1980 as proxy. They conclude that the 2008 monetary crisis is unlike any others in terms of a wide range of economic factors. Although this event take place in the end of 2001-2010 decade, it had more monetary and financial negative repercussion in the next decade, also with asymmetric time and regional effects.

Second, the literature review is clear about negative urbanization effects on environment, and about pollution as a global phenomenon. About globalization and environment, Frenkel (2003) asks: Does globalization help or hurt in achieving the best tradeoff between environmental and economic goals? Do international trade and investment allow countries to achieve more economic growth for any given level of environmental quality? Or do they undermine environmental quality for any given rate of economic growth?

Globalization is a complex trend, encompassing many forces and many effects. It would be surprising if all of them were always unfavorable to the environment, or all of them favorable. The highest priority should be to determine ways in which globalization can be successfully harnessed to promote protection of the environment, along with other shared objectives, as opposed to degradation of the environment. One point to be emphasized here is that it is an illusion to think that environmental issues could be effectively addressed if each country were insulated against incursions into its national sovereignty at the hands of international trade or the WTO. Increasingly, people living in one country want to protect the air, water, forests, and animals not just in their own countries, but also in other countries as well. International cooperation is required to change this game. National sovereignty is an obstacle to such efforts, not an ally. Multilateral institutions are a potential ally, not obstacle (Frenkel, 2003).

At least, “Nonsignificant empirical results (usually in the form of t -statistics smaller than 1.96) relative to some null hypotheses of interest (usually zero coefficients) are notoriously hard to publish in professional / scientific journals. This state of affairs is in part maintained by the widespread notion that nonsignificant results are non-informative.,” says Abadie (2020). Also, according to him this view of statistical inference is misguided, once nonsignificant results are not only informative but also more informative than remarkable results in scenarios common in empirical practice in economics. Part of this set of results have these characteristics, they are not statically significant, but they are informative and useful to set up a low pollution development agenda once urban population is the robust variable that increase CO2 levels.

6 CONCLUSION

The related literature is clear about negative urbanization effects on environment, and about pollution as a global phenomenon. We found that urban population has robust positive effect on pollution. Other issues as population growth, life expectancy at birth, regional, income levels and time effects are not important. It makes sense once the world population and urban concentration increased a lot in 20th century. In 1900’s the world had close to two billion people and just a few cities had more than one million people. In 2000’s the world had about seven billion people, lot of cities with more than one million people and many cities with more than ten million people, especially in Americas and Asia. This spectacular human concentration had environment impact as increase water demand and decline air quality. But it is more intense if we consider a carbon-based society. The steam age used coal as the main fuel, and petrol was the most important source of energy in the eletric-metal-mechanic paradigm, and it is until today. As Frenkel (2003) points out, international cooperation is required to change this game. National sovereignty is an obstacle to such efforts, not an ally. Multilateral institutions are a potential ally, not obstacle.

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