

How does urbanization affect the capital forms of sustainable development?

Master's Thesis

Radboud University Nijmegen

Abstract: A high global urbanization rate appears to coexist with increasing unsustainability. This paper investigates the effects of global urbanization on sustainable development. The study finds no direct effect of urbanization on any of the capital forms (natural, produced, and human), yet finds indirect effects of urbanization on produced and natural capital through an increase in school enrolment and decreased natural resource use. Literature suggests a trade-off between the positive effects of urbanization on produced and human capital, but a negative effect on natural capital. This is caused by an increase in consumption, which puts a strain on natural resources. An increase in population size could further worsen this problem. A Generalized Structural Equation model finds urbanization increases school enrolment, which increases natural and produced capital. However, it also decreases population size slightly, which has negative effects on productivity through a decrease of workforce. We conclude that urbanization has no direct effects on any of the capital forms yet does influence some of the components through individual effects. Governments should view education as an important driver of sustainability and minimize the use of natural resources. Health care, institutional quality, and trade provide overall improvements for sustainable development.

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Introduction

Sustainability gains more and more attention from society, governments, and firms that seek to prolong their production without harming the environment or running out of resources. Sustainability is defined as “A condition of ecological and economic stability that is sustainable far into the future, and capable of satisfying the basic material needs of all people” (Club of Rome, 1972). The progress towards reaching sustainability can be described as sustainable development, which is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland’s World commission on Environment and Development, 1987). It is therefore important to understand the mechanisms through which sustainability may be affected, and what we understand under sustainability. There are several ways to measure the sustainability of nations. For this paper, I will focus on the capital forms that consist of (i) natural-, (ii) human- and (iii) produced capital as they provide the productive base of social intertemporal wellbeing (UNU-IHDP, UNEP, 2014). Non-sustainability is usually caused by the neglect of some of these capital forms. There have been many studies on the causes of the decrease in sustainability.

As the earth becomes more and more urbanized, one of the main influences on sustainable development is the rate of urbanization that has made large increases in the past decades. Increases in urbanization create for more demanding production and a strain on natural resources (Langeweg et al., 2000). On the other hand, urbanization aids investments and education (Andersson 2009). With ever-increasing sustainability issues, the question arises whether the increasing urbanization rate should be held back or actually encouraged. The effects of urbanization on sustainable development have been studied, yet not to a satisfactory extent. Many studies focus on specific areas, however the effects on global levels have not clearly been isolated. Moreover, there is still no consensus on what the exact effects of urbanization are on sustainable development. Literature is divided between the negative effects associated with the depletion of natural resources and the positive effects associated with human and productive capital. This paper will contribute to this debate by isolating the effect of urbanization on the different capital forms to better understand how much urbanization affects sustainability and through which channels this would occur. Having a better understanding of what capital forms are influenced directly would create a more evidence-based argument for policymakers. With this knowledge they can pursue a policy that is in line with sustainable behaviour and to allow governments and citizens to better understand the effects that urbanization may have. This research could benefit society as governments can focus on these aspects of urbanization that improve sustainability. The research question that will be answered in this paper is “*What are the effects of the urbanization rate on sustainable development?*”

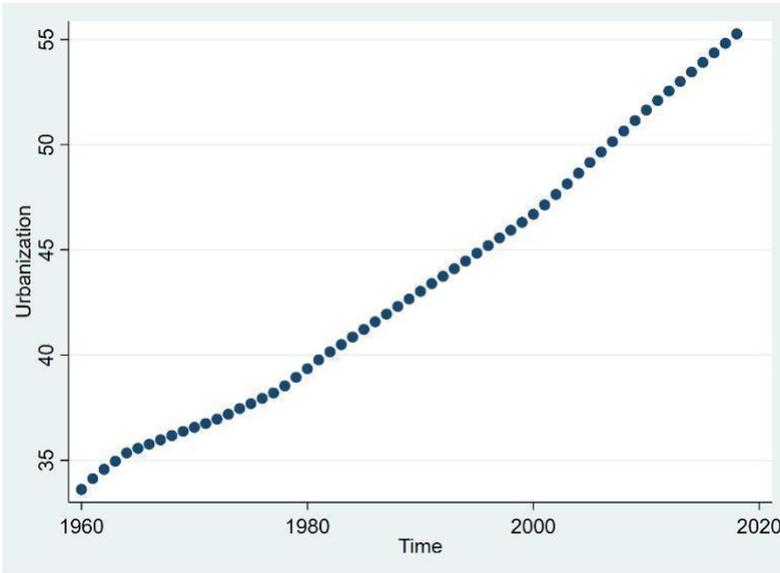
I will connect strands of literature that research the effect of urbanization on sustainable development and empirically test whether there is a significant effect. The way urbanization impacts sustainable development will be tested through a variety of mechanisms. I will use a mediator variable for institutional quality, educational quality, and population size to see how the urbanization rate could have an effect on sustainable development through an indirect effect.

Section 1 will give a literature review which isolates the effects of urbanization on natural capital, produced and human capital to show how the different forms of sustainability are affected by urbanization. The literature review also looks at how population size and institutional quality affects urbanization and sustainable development, and makes hypotheses. Section 2 will outline the research methodology for the paper which will offer results provided in section 3. Section 4 will conclude these results and form a discussion, which will point out some improvements to be made for future research.

1. Theoretical Background

The literature on urbanization and sustainable development is quite extensive. Over the past 60 years, the world urbanization rate has grown from 34 to 55 percent, see figure 1 (World Bank). It is expected that this number will increase even further to at least 60 percent in 2030 according to the United Nations (2018). A third of the world population will live in cities with more than half a million people. The growing urbanization rate is expected to have many influences on the economy, sustainability, agriculture, transport, infrastructure, education, and population size. According to the World Bank, cities generate jobs and income and deliver education, health care, and other services. Cities would also present opportunities for social mobilization and women's empowerment. In figure 1 we see the world urbanization rate, which shows that for the last 60 years, the urbanization rate has grown from 34 to 55 percent. The growth doesn't seem to flatten over time.

Figure 1 – world urbanization rate – Data from World bank



The urbanization rate could have large effects on sustainability. Sustainable development usually encompasses three spheres, economic, social, and environmental sustainability. To have a better understanding of sustainable development as a whole, the Inclusive Wealth index (UNU-IHDP, UNEP, 2014) takes the three spheres into account by measuring them as produced, human, and natural capital. These capital assets are primarily measured as a shadow, or social price, which values capital assets to

their estimated marginal contribution to the intertemporal welfare of a countries citizens (Roman & Thiry 2016).

Produced capital entails all the productive assets that countries possess. These are an accumulation of assets such as machinery, infrastructure, buildings, and equipment from which their contribution to intertemporal welfare is measured. Human capital is subdivided into health and education. Natural capital is measured with the use of shadow prices of forests, fossil fuels, agricultural land, and minerals.

The term sustainability can be applied to a lot of things. However, the political aspect of it primarily focuses on the three spheres (environmental, economic, and social). The Inclusive Wealth index provides the measures of what in theory should be sustained (Roman & Thiry 2016). which is the productive base supporting intergenerational well-being, which is here consisting of natural, productive, and human capital. Sustainable development may be differentiated between weak and strong sustainability (Neumayer 1999, Ayres et al., 2001). Weak sustainability considers that the different capital forms are substitutable for each other. The depletion of natural capital may be compensated by investments in produced and human capital as these aid sustainability as well. Strong sustainability theory assumes the capital forms, in particular natural capital, consists of such essential characteristics for human life that they are indispensable by the other capital assets. For this paper, however, we will assume weak sustainability, in which capital forms may be substituted for other capital forms. The goal of this paper is to promote green growth, which according to the OECD means “fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this, it must catalyse investment and innovation which will underpin sustained growth and give rise to new economic opportunities” (OECD, 2011 p4).

There are several studies done that recognize the influence of urbanization on sustainable development or hint towards there being an interaction between the two. These will be extensively analyzed in the first sub-section. At first, the effect of urbanization on natural resources will be given, which suggests that there is a negative effect of urbanization on the natural capital element. Then we will focus on the effect of urbanization on the innovative productive and human capital formations that are expected to benefit from urbanization. This appears to introduce a trade-off between the social and economic sustainability spheres and the environmental/natural one. To foster developments in both areas, the effect of institutions will be examined and assessed to explain developments in sustainability. As population size also seems to be influencing the relationship, the linkage between population size and urbanization will be further investigated.

1.1 Depletion of natural resources

Langeweg, Hilderink, & Maas (2000) claim that industrialization and urbanization will create policy challenges for sustainable development as the use of land, materials, and energy will increasingly meet natural limits. According to Bloom et al., (2008) urban development has led to an increase in concentrations of land, water, and air pollution that would put a strain on natural resources. These developments that happened in cities in Western countries are also appearing in China where the consequences are even more serious. The increasing urbanization rate has several direct effects. For example, Jie (2000) finds the private use of automobiles grew from roughly 25 percent to 40 percent in just one year (1996-1997). The structure of automobile consumption increased greatly, and the effects on sustainability are evident. Automobile consumption can be linked with urbanization as the amount of secondary and tertiary jobs are more present in cities than in rural areas. Within rural areas, people predominantly work where they live whereas people in cities usually have to travel more towards their job. However, people that live in cities may also commute with public transport more often, leading to a decrease in automobiles. The study of Jie (2000) however finds that overall, the amount of automobiles increases, which is negative for environmental sustainability due to the use of fossil fuels and CO₂ emissions.

Urbanization has large effects on the environment, and it is something which literature often neglects; Clement (2010) finds that the effect that urbanization has on the natural environment has been underrepresented in environmental sociological studies. The author addresses the gap and provides literature that illustrates the effects of urbanization on the environment. He finds that most environmental sociologists argued that urbanization and urban growth have led to environmental degradation compared to the group of researchers that found urbanization is good for the environment. However, there is still no agreement about the mechanisms at play that cause the presumed environmental degradation. Anderson (1976) and Molotch(1976) explain the environmental degradation as the cause of profit-seeking. The growth machine model (Molotch 1976) claims the desire to expand profit lead to a growth society with accompanying environmental problems. Anderson (1976) empowers the growth machine model of Molotch(1976) claiming that urban society attempted to eliminate the natural environment. Growth of urban environments, according to Molotch(1976) would automatically decrease the natural environment.

What we can take from this is that there is a certain point of urbanization in which the harms of environmental impact are larger than the benefits of urbanization. De Soysa & Neumayer (2005) argue that urbanization has important implications for levels of pollution and investment in manufactured capital because it is argued that consumption rises with rising urbanization. Urbanization leads to a different consumption pattern than for people living in rural areas. Urban people consume more food, energy water, and land (Parikh et al., 1991). Apart from that, urban areas pollute more and affect the health and quality of life of the urban population. Urban populations eat more than twice as much pigs as their rural counterparts. What, why, and how much people consume directly impacts the environment

(Trudel, 2019). An increase in consumption would be negative for sustainable development as this puts a strain on the economy. If consumption grows more than nature or production can provide, a country will become unsustainable. The negative effects of urbanization on natural capital may also have a negative effect on the human capital component as Hartig et al., (2014) claim that due to urbanization and resource exploitation, the lifestyle changes have diminished the possibilities for human contact with nature. The health benefits of contact with nature are discussed as improved air quality, physical activity, social cohesion, and stress reduction aid towards improved health and may benefit human capital.

As most literature has reached a consensus over the negative effects urbanization has on the environment, Hypothesis 1 reads: ***H1: Urbanization has a negative effect on natural resource stock, and therefore decreases sustainable development by deteriorating the natural capital component.***

1.2 Education, productivity and the environmental Kuznets curve

As production may put a strain on natural resources, it does not have to mean that the resources are wasted. Gylfason (2001) suggests that if natural resource rents are managed well, it can educate, heal, and provide jobs for the people. Urbanization could thus increase sustainable well-being provided that the natural resources are used efficiently and are put to good use. While some countries such as Norway manage to improve sustainable development with the use of their natural resources, other countries such as Nigeria appear to burn through their natural resources without investing much in sustainable capital. This subsection isolates studies that suggest positive effects of urbanization on sustainable development through education, productivity and the environmental Kuznets curve.

1.2.1 Education and knowledge transfusion and it's production increase

Andersson et al., (2009) underline the importance of investment in education. Especially higher education will result in increased productivity and innovation that will increase the productive and human capital aspects of sustainable development. Urbanization benefits the spill over effect of knowledge as people are more narrowly concentrated. This enhances the spread of knowledge. It is explained further that “the effect of urbanized economies on worker productivity may be only about half as large at distances over 8 km as it is at closer distances” (Andersson et al., 2009, p13). One example given is Sweden, which undertook a special decentralization of its system of higher education. This policy had increased the productivity of output per worker. Another example that underlines the importance of close proximity has been a large role of university research in Stanford and Berkeley on the success of Silicon Valley in California. The spread of knowledge remained close to its' origins, which benefited the local area in northern California. Urbanization thus allows networks to interact more frequently, creates a larger diffusion of knowledge thanks to the closer proximity of educated workers. Urbanization should in theory thus increase sustainable development through the improvement of education and knowledge transfusion that appear in close networks. There is one thing to say about this however, as Qiao, Ding & Liu (2019) found that knowledge spillovers, especially in those dense, urbanized environments, lead to a negative effect on R&D investments. This can be explained as there

is a higher chance the knowledge will spill over from other firms. Firms that would normally decide to invest in R&D now expect their neighbors to invest for them. This could lead to lower incentives for firms to invest in R&D, however the knowledge that is achieved with R&D is transfused faster in urban environments.

Bloom et al., (2008) state that a country's urbanization rate is highly correlated with the level of income. Urbanization would lead to economies of scale and richer market structures which boost productivity per worker. This point of view is shared by Rauch (1993), which explains the productivity gains from the geographical concentration of human capital. Cities with higher average levels of human capital should have higher wages but also increased land rents. One of the counter-arguments for resource use is that the rents can be used to "educate, heal and provide jobs for the people" (Gylfason, 2001). This assumes a substitution of capital forms that allow a country to become more sustainable through the reinforcement of other capital forms. As for all public investments, education requires money to achieve quality. Without the rents achieved using natural resources, it proves hard for some countries to develop education on a level that it becomes sustainable.

1.2.2 Environmental Kuznets curve

From this point it appears that urbanization has positive effects on social sustainability through education, knowledge transfusion and productivity increases. Urbanization in the past subsection however yet negative effects on environmental sustainability. However, according to the (urban) sustainability Kuznets curve of Dongfeng, Chengzhi & Ying (2013), urbanization starts with an increase of unsustainability as countries start to develop, but would eventually lead to a decrease of unsustainability as better techniques are available and circumstances allow for a focus on sustainability. The environmental Kuznets curve has gained a lot of attention over the years. Similarly to the original Kuznets curve, the environmental Kuznets curve started by looking at the effect of income. Where the original Kuznets curve looks at the effect on inequality instead of sustainability, the Kuznets curve predicts an increase of inequality, in the beginning, followed by a decrease later on as countries earn more. The environmental Kuznets curve of Shafik (1994) looks at the effect of income on sustainability. Results show some environmental indicators improve with rising incomes while others first degrade and then improve later on, while other indicators worsen steadily. The evidence of the paper suggests that it is possible to grow out of some environmental problems, however, that it requires policies and investments to be put into place. Those often coevolve with increased income, however, do not come automatic according to Shafik (1994). More recent studies (Winslow 2005) revisit the environmental Kuznets curve and find that the relationship is weak at best and that it is difficult to say anything definitive about the relationship. Stern (2017) re-examines the validity of the environmental Kuznets curve and finds that only for very high incomes the pollution reduces. Increases in income overall increase in carbon dioxide, sulfur dioxide, and industrial greenhouse gas emissions.

The environmental Kuznets curve often focusses on CO₂ emissions, which primarily targets environmental sustainability. From this, we can see that the strain on natural resources and increases in CO₂ emissions will increase in the developing period, but will eventually decrease. The recommendation that we can make from this is to allow countries to develop and accept a decrease in environmental sustainability in the short run. We hereby allow investments to be made in human and produced capital, which will increase sustainability overall. According to the environmental Kuznets curve, we expect the negative effects on environmental sustainability will decrease over time as countries develop and put more focus on environmental sustainability. According to the environmental Kuznets curve of Shafik (1994), sustainable development is aided by increases in income levels.

From the literature provided above, we can argue that urbanization would increase sustainable development by improving knowledge transfusion which improve the beneficial effects of education. This increases productivity of workers as is shown in areas such as silicon valley. According to the environmental Kuznets curve, the negative effects on the environment would decrease as countries develop and urbanize more. The second hypothesis therefore reads: ***H2: Urbanization has a positive effect on productivity and quality of education and therefore increases social and economic sustainable development.***

1.3 Importance of institutions on sustainability

The literature seems to point towards a trade-off between on one hand the negative effects of urbanization on natural capital and the positive effects on produced and human/social capital on the other hand. To achieve these positive effects, while also limiting negative natural resource depletion, the requirements are that the adequate institutions need to be in place. Hereby good institutions are deciding whether natural resource rents are put to good use (Mehlum et al., 2006, Brunnschweiler and Bulte 2008, Wai-chung Lai, 2006). Hereby the effectiveness of environmental sustainability (natural resources) on productivity and economy, is defined by the social component (the quality of institutions). Apart from the fact that sustainability can be looked at from an economic, social, and environmental perspective, the capital forms itself have an influence on each other as well. The way institutions (social capital) influences the effect of natural on economic capital forms will be explained with the use of certain institutions types.

Wai-chung Lai(2006) finds that property management as a part of resource management is crucial for sustainable development, and the protection of property rights is thereby essential. Institutional quality here provides the prerequisite for a successful (sustainable) development of a nation. Without the proper institutions, citizens lack the incentive to act sustainably. The key mechanism at play here is reciprocity. When a government shows (or appears) to provide the best policy for its citizens, the citizens are more likely to aid such policy. However, when feeling that the governing system is fraudulent, individuals will display more egocentric behavior. Institutions could lay the foundations for the cognitive functions and behavior of its citizens. Trudel (2019) considers the cognitive functions that explain sustainable behavior. System 1 and system 2 illustrate the consideration between unsustainable

and sustainable behavior. For one to act sustainable, system 1 that acts emotionally, needs to be overridden by system two, which acts in the interest of society in favor of sustainability. In order to override system 1 and act in a sustainable system 2, the environmentally friendly option needs to become more attractive. Proper institutions allow for rewarding the sustainable option (cheap public transport, subsidies for the acquisition of solar panels, affordable vegetarian food) by overriding the more effortless and short term oriented system 1. Institutions not only affect environmental sustainability but have an effect on all sustainability spheres. Proper institutions overall decrease inequality Lechthaler & Snower (2012) and improve the productivity of workers (Scarpetta et al., 2002).

The quality of government services can be objectively assessed. Overall, the less dependent a government is from political pressures, the better it performs. Government effectiveness (World bank) measures the quality of policy implementation and the credibility of the government to commit to such policies. The quality of policy implementations, especially those aiming towards benefitting sustainable development, aid a lot towards sustainable development. For instance, Nigeria, Venezuela, and Mexico have poor institutions that invite ‘grabber friendly’ behavior instead of ‘producer friendly’ behavior (Mehlum et al., 2006). In order to achieve sustainability, the proper institutions need to be realized that advocates such behavior.

Institutional quality may affect the urbanization rate of countries as well. Countries overall urbanize as they develop. Henderson & Wang (2007) find that institutions affect the size distribution of cities. The degree of democracy leads to an increase in city formation, while also leading to less growth of the bigger cities compared to national population growth. Democratization thus primarily benefits and increases the amount of smaller cities. Henderson & Wang (2007) explain democratization limits the power of the elites, allowing more possibilities for smaller cities to grow. Elections often also vote in favor of local areas, promoting the growth of smaller cities. These urbanization processes could aid economic and social sustainability. According to Henderson & Wang (2007), Democratization may involve the development of better and more transparent institutions. It would also lead to a decrease of spatial inequality, which could benefit social sustainability as well.

The third hypothesis reads ***H3: institutional quality positively moderates the relationship between resource rents and sustainable development(social, economic, and environmental). Poor institutional quality leads to non-sustainability, while good institutions improve urbanization and sustainable development.***

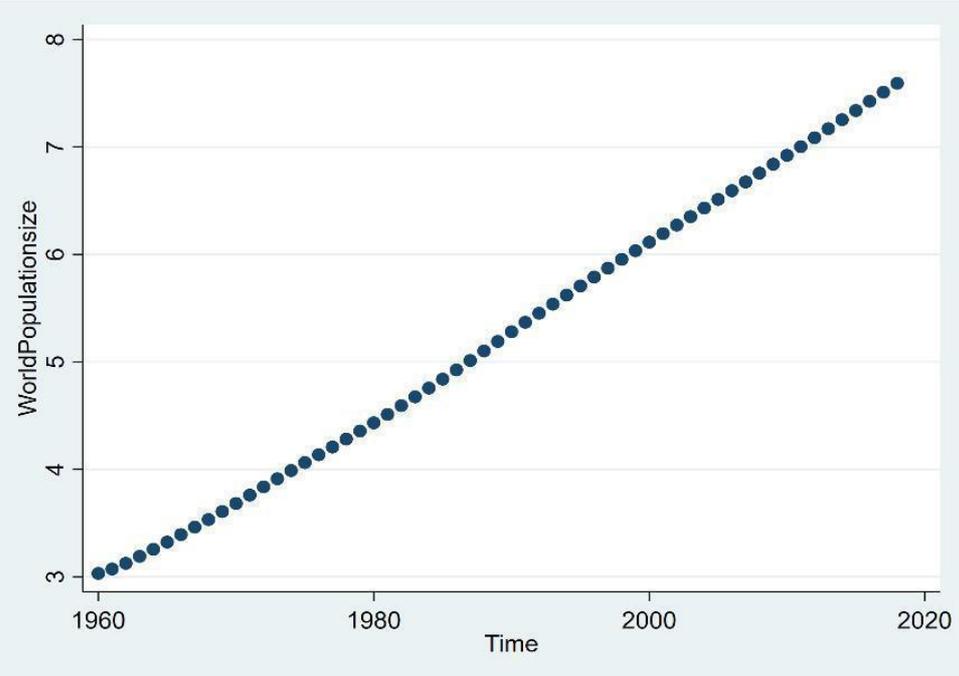
1.4 Urbanization and population growth

The link between urbanization and sustainability also appears to be influenced by the size of a nation’s population. Urbanization allows for better living conditions that allow for an increase in population size of some countries(Abate 1980). In figure 2 we see the world population size from 1960 to 2018. We see that the world population size, in 60 years’ time has grown with 150 percent from 3 billion to 7.5 billion people. The growth of the population size does not appear to flatten over the next

years. Next to the world population size, we see similar growth in the urbanization rate, which had grown from 34 to 55 percent. If this trend continues, the world population in 2080 will be approximately 18.75 Billion. With today’s consumption pattern, this would lead to ever-increasing unsustainability and degradation of natural capital.

The increase of population size however heavily influences sustainable development by the increase of consumption of the population. On average, American adults eat 1996 pounds of food per year. With a current population size of the United States at 331 million people, this accounts for an astronomical 660 billion pounds of food consumption just for the US. However, the consumption levels, nor the population size show a decrease any time soon.

Figure 2 – world population size – Data from the World Bank

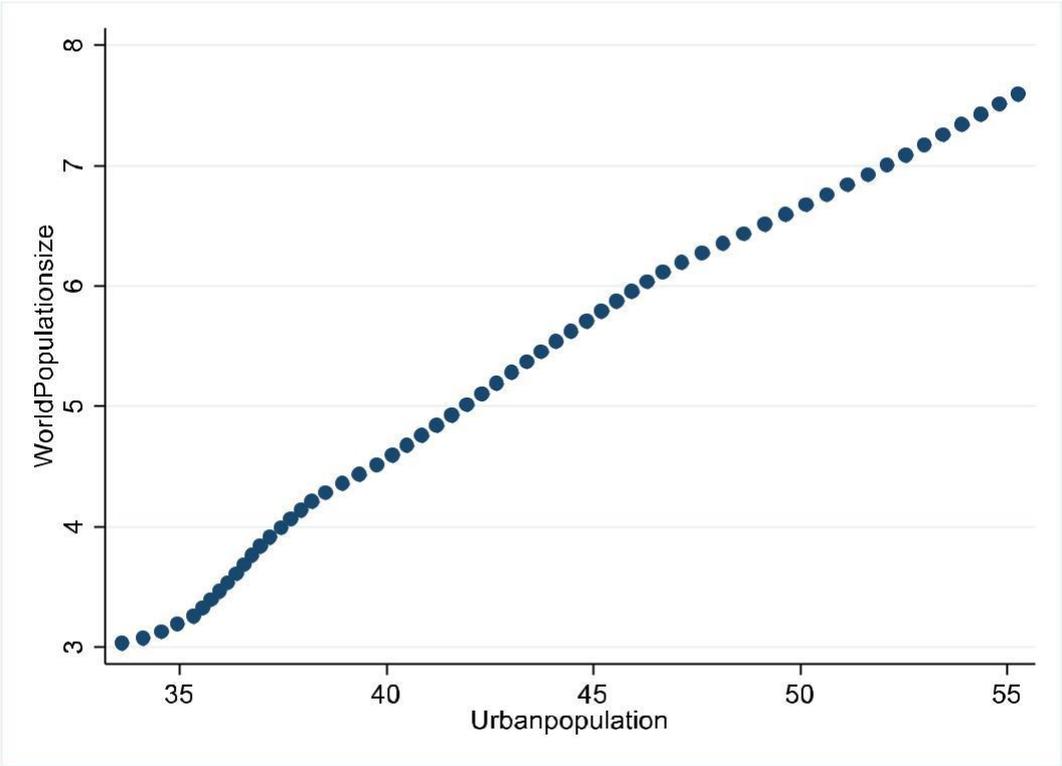


The link between urbanization and population size has been studied by Lovett (2008). The paper finds that disaster theories about population growth have been around for a long time. It was raised in the late 18th and early 19th century with Thomas Malthus. Malthus expected agricultural production could not keep up with the exponential growth of population. However, this theory has been largely debunked as a large growth of population size has been accompanied by increases in agricultural production. Lovett(2008) however argues that urbanization and globalization are the main causes of concern. Especially the rapid growth of African cities has led to problems such as the spread of disease, massive unemployment, corruption, pollution, poverty, lack of education, and high child mortality (Boadi et al., 2005).

On the other hand, the increase of urbanization could also decrease the population size as urban areas often possess lower fertility rates (Martine et al., 2013). The previously mentioned problems such as increased unemployment and high child mortality may dampen population growth. On the one hand,

the literature suggests an increase in population growth in urban areas, but those are primarily African countries. On the other, we have a decrease in fertility in western countries that could lead to lower population growth. This is often also paired with lower mortality rates. Overall we still expect an increase in population size due to large increases in population in African urban areas. In the scatterplot (figure 3) we see the correlation between the world population size and the world urbanization rate.

Figure 3 – Scatter world population size and the world urbanization rate



The problems caused by urbanization in African cities are further described by Abate (1980), who investigates the link between population size and urbanization in Africa. The author states urbanization is the other dimension of the population issue in Africa. “Large cities will continue to grow at a rapid pace because they offer a greater share of public services, employment opportunities, and better medical and educational facilities” (Abate 1980, p104). These facilities, which are due to urbanization, could also aid in sustainable development.

Apart from increased consumption, the large increases in population size may also have a negative effect on social sustainability. Alongside the increased population size, the number of jobs has to be increased as well. As with more consumption, firms can produce more, however, firms will also become more efficient and can produce on large scale without needing as many employees (Lee, 2001). This will lead to more inequality between heads of firms and the employee, which can now be replaced by more people increases of social inequality could lead to increases in homicide as well, according to Lee (2001). On the other hand, increased population size could lead to an increase in labour capital, which increases economic sustainability.

The fourth hypothesis, therefore, reads ***H4: Urbanization has a positive effect on population size, which in turn leads to a decrease in environmental and social sustainable development, but an increase of economic sustainable development***

2. Research design

The Empirical section will include panel data regressions for the three components of Inclusive Wealth, which will be tested with the independent variable Urbanization, a mediator variable for population size, education, and resource dependence, a moderating variable for the interaction of resource rents and institutional quality and some control variables. Panel data will be used as this allows taking changes over time into account over multiple countries. A generalized structured estimation model (GSEM) will be used to control for all influences that do not change over time such as country size and geographical positioning. It also allows adding mediator and moderator variables that have an influence on the dependent variables. Control variables will be added to control for influences that do change over time. To make regressions with panel data, fixed and random effects may be used. However, in order to take indirect effects through mediating variables into account, we make use of the GSEM. Structural equation modelling is a powerful multivariate technique (Gunzler et al., 2013). It allows a model to contain independent variables, that are also an independent variable in other components of the SEM system. This allows us to have a better understanding of the indirect effects that urbanization may have on the Inclusive Wealth measure. As our model may include endogenous variables, such as population size, educational quality, and resource dependence. These variables can still be included in the model by taking into account the variables that have an influence on them. For our model, we use Generalized Structural equation modelling, rather than the Structural equation model. The reason for this is that GSEM allows for multilevel models, which allows researching the interaction between different level variables.

As suggested by Arrow et al., (2012), to measure sustainable development, the Inclusive Wealth index of the United Nations will be used. This index can be found in The Inclusive Wealth Report of 2014 (UNU-IHDP, UNEP 2014). The index measures sustainable development with the use of several capital stocks. In order to take into account different amounts of starting capital, we will look at the per capita growth measures of (i) produced, (ii) human, and (iii) natural capital. These capital forms are theorized to affect the sustainability of a country through several mechanisms (UNU-IHDP, UNEP 2014). data consists of 140 countries for the years 1990, 1995, 2000, 2005, and 2010. The independent variables that are used will be used in all models, except for health, which will only be used as a control variable for produced and human capital per capita growth.

Urbanization is measured as the percentage of the population that lives in urban areas as opposed to rural areas. It is measured for 140 countries. Data will be retrieved from the World Bank.

To measure population size, the total population size of 140 countries will be used, which will also be retrieved from the World Bank. The data will be logged in order to minimize the effect of extreme values. As education is a large determinant of sustainable development, it will be added as a variable by measuring the net primary school enrolment (World Bank). The net enrolment rate is the ratio of children of official school age who are enrolled in school to the population of the corresponding official school age. Urbanization however also has an effect on the quality of education, which is why the education variable will be added as a mediator variable to better understand the effect that urbanization has on educational quality and what this means for sustainable development.

As resource dependence is theorized to have a negative influence on sustainable development, the percentage of rents as a portion of GDP will be added. However as institutional quality has proven an important moderator for resource rent effectiveness (Mehlum et al., 2006, Brunnschweiler and Bulte 2008), it is important to take into account the moderating effect of institutional quality on resource rents. So this will be added by measuring government effectiveness (World Bank). As Mehlum et al., (2006) suggest that with good institutions the resource curse does not exist, yet it does with poor institutions, this variable will be added as a moderating variable with resource rents. Resource dependence, however, is influenced by more variables, which is why it will also be added as a mediator effect, which is affected by industrial activity, government effectiveness, and GDP. As GDP has, similar to population size, extreme values, the data will also be logged. Data is also collected by the world bank as GDP (constant 2010 US dollars). Government effectiveness will also be used to measure the effect of institutional quality on the urbanization rate, and school enrolment.

Another control variable used is trade, which is also an important determinant of sustainability, especially with respect to biofuels (Trindade 2009). Not every country in the world should be producing biofuels because of the negative effects on eco-systems such as rainforests. This particularly affects environmental sustainability. However, economic sustainability may also increase due to benefits associated with comparative advantages. Trade makes it possible for a few countries to produce biofuels, from which all countries can benefit, without having as much as an ecological impact. To incorporate trade as a control variable, the amount of GDP devoted to trading will be included as a trade variable. Data is available from the World bank for at least the 140 countries that are being analyzed in this paper.

Langeweg, Hilderink, & Maas (2000) claim that industrialization will create policy challenges for sustainable development as it puts a strain on natural resources. However, it may also improve produced capital, which is why this will be added as a control variable. Industrialization is measured by calculating the Industrial activities' value-added as a percentage of GDP (World Bank). Health is also a determinant of sustainable development (van Loghum 2014) as the sector is narrowly related to sustainable development through the human capital and produced capital forms. Health could affect the productivity of workers and improve social relations which is why it will be added as a control variable. Health is measured with the average life expectancy (World Bank).

As explained there are many more determinants of sustainability, among which the cognitive and social influences on individual behavior. However, due to the difficulty to measure these influences, these control variables are omitted in our model.

Table 1 provides the summary statistics of the variables used for this research.

Table 1 - Summary Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
InclusiveWealth pc growth	557	106.774	715.384	-99.221	8633.807
Produced capital pc growth	557	152.483	1086.774	-99.609	16080.15
Human Capital pc growth	557	665.343	11419.15	-99.8	267000
Natural capital pc growth	557	810.2	7065.155	-99.96	112000
Urbanization	700	54.969	23.121	5.416	100
Trading activity	650	79.889	50.049	.021	420.431
Industry activity	637	28.198	10.872	4.247	84.796
	543	-2.069	9.845	-76.535	42.621
Goveffectiveness * resource rents					
Logged GDP	677	24.502	2.091	20.073	30.339
Government effectiveness	560	.047	.998	-2.232	2.241
Resource rents	681	7.542	11.065	0	63.935
Health	697	67.378	10.172	31.037	82.843
Education expenditure	695	4.138	3.045	.3	61.095

The regression equations look as follows:

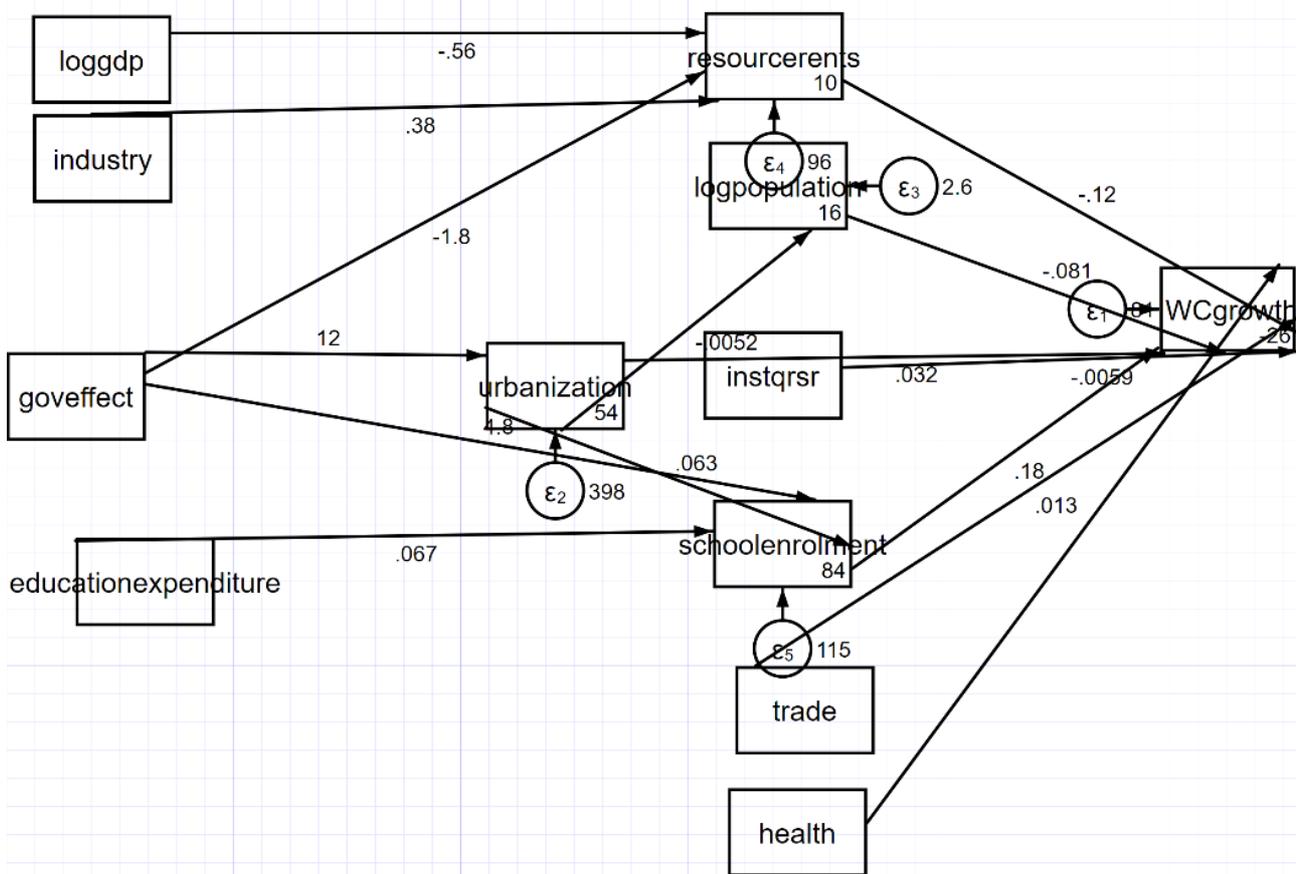
1. $Natural\ capital\ per\ capita\ rate_{i,t} = \alpha + \beta_1 Urbanization_{i,t} + \beta_2 Population\ size_{i,t} + \beta_3 Resourcerents_{i,t} + \beta_4 Education_{i,t} + \beta_5 Trade_{i,t} + \beta_6 Resourcerents * Goveffectiveness + \epsilon_{i,t}$
2. $Produced\ capital\ per\ capita\ rate_{i,t} = \alpha + \beta_1 Urbanization_{i,t} + \beta_2 Population\ size_{i,t} + \beta_3 Education_{i,t} + \beta_4 Resourcerents_{i,t} + \beta_5 Trade_{i,t} + \beta_6 Resourcerents * Goveffectiveness + \beta_7 GDP_{i,t} + \beta_8 Health_{i,t} + \epsilon_{i,t}$
3. $Human\ capital\ per\ capita\ rate_{i,t} = \alpha + \beta_1 Urbanization_{i,t} + \beta_2 Population\ size_{i,t} + \beta_3 Education_{i,t} + \beta_4 Resourcerents_{i,t} + \beta_5 Trade_{i,t} + \beta_6 Resourcerents * Goveffectiveness + \beta_7 GDP_{i,t} + \beta_8 Health_{i,t} + \epsilon_{i,t}$
4. $Inclusive\ Wealth\ per\ capita\ rate_{i,t} = \alpha + \beta_1 Urbanization_{i,t} + \beta_2 Population\ size_{i,t} + \beta_3 Education_{i,t} + \beta_4 Resourcerents_{i,t} + \beta_5 Trade_{i,t} + \beta_6 Resourcerents * Goveffectiveness + \beta_7 GDP_{i,t} + \beta_8 Health_{i,t} + \epsilon_{i,t}$
5. $Population\ size_{i,t} = \alpha + \beta_1 Urbanization_{i,t} + \epsilon_{i,t}$
6. $Resourcerents_{i,t} = \alpha + \beta_1 Urbanization_{i,t} + \beta_2 Industrial\ activity_{i,t} + \beta_3 GDP_{i,t} + \beta_4 Goveffectiveness_{i,t} + \epsilon_{i,t}$

$$7. Education_{i,t} = \alpha + \beta_1 Urbanization_{i,t} + \beta_2 Goveffectiveness_{i,t} + \beta_3 Educationexpenditure_{i,t} + \epsilon_{i,t}$$

$$8. Urbanization_{i,t} = \alpha + \beta_1 Goveffectiveness_{i,t} + \epsilon_{i,t}$$

Where the dependent variable for country i at time t is determined by the constant α plus the independent variable, mediating variables, control variables, and the standard error term ϵ . β Resourcerents*Goveffectiveness_{i,t} captures the moderating effect of natural resource rents and institutional quality. Figure 4 below shows the GSEM model illustrated on the Inclusive wealth per capita growth. The model is the same for the Produced capital per capita and the human capital per capita model except for the natural capital per capita model does not have an effect of health integrated. We see the independent variable urbanization with a direct estimate on Inclusive wealth per capita growth (IWCgrowth). The control variables resource rents(Resourcerents), logged population size(logpopulation, interaction term government effectiveness * Resourcerents (instqrsr), school enrolment, trade and health are shown beside it. Furthermore we have the logged gdp, industry, government effectiveness and education expenditure included as indirect effects mediators on resource rents, population size, schoolenrolment and urbanization.

Figure 4 – GSEM model illustration



3. Results

We will first test the data for Multicollinearity. In order to have a full understanding of which capital components are affected exactly, the three different capital forms that make up the Inclusive Wealth rate are shown in tables 3,4, and 5. The overall effects on the sustainable development measure Inclusive Wealth per capita growth will be shown in table 6. We will test for multicollinearity of the independent variables with the Pearson's correlations.

Table 2 - Pearson's correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) logged GDP	1.000										
(2) logged population	0.667	1.000									
(3) health	0.490	0.004	1.000								
(4) urbanization	0.585	-0.032	0.571	1.000							
(5) School enrolment	0.326	0.021	0.710	0.331	1.000						
(6) industry	0.145	0.225	0.038	0.024	0.151	1.000					
(7) resourcerents	-0.158	0.083	-0.243	-0.191	-0.115	0.443	1.000				
(8) goveffect*resourcerents	0.204	0.072	0.401	0.300	0.295	-0.196	-0.312	1.000			
(9) goveffectiveness	0.481	-0.074	0.667	0.522	0.458	-0.130	-0.327	0.548	1.000		
(10) educationexpe~e	0.018	-0.218	0.123	0.205	0.114	-0.071	-0.053	0.056	0.214	1.000	
(11) trade	-0.235	-0.369	0.169	-0.004	0.171	0.044	-0.063	0.125	0.253	0.095	1.000

In the Pearson correlation matrix, we see population size shows high correlations with our logged GDP measure. However, correlations are still below 0.7, which means that they do not correlate too much. Urbanization shows high correlation with GDP and life expectancy (health) as well. Table 4 shows the GSEM model on Natural capital per capita growth.

Table 4 – GSEM model on Natural capital per capita growth

<i>DV</i>	<i>IV</i>	<i>Coefficient</i>
Natural Capital per capita growth	Logged population size	0.254 (0.70)
	School enrolment	0.187** (0.05)
	Resource rents	-0.133* (0.06)
	Urbanization	0.051 (0.04)
	Trade	0.013 (0.01)
	Government effectiveness*Resource rents	-0.004 (0.07)
	Logged GDP	-0.366 (0.64)
	_cons	-23.795** (8.27)
Logged population size	Urbanization	-0.005** (0.00)
	_cons	16.393** (0.18)
School enrolment	Urbanization	0.063* (0.03)
	Government effectiveness	4.823** (0.68)
	Education expenditure	0.067 (2.23)
	_cons	84.309** (1.91)
Resource rents	Industry	0.385** (0.433)
	Logged GDP	-0.556* (0.23)
	Government effectiveness	-1.811** (0.49)
	_cons	10.413 (5.63)
Urbanization	Government effectiveness	11.592** (0.84)
	_cons	54.368** (0.84)
<i>R</i> ²		0.1070
<i>N</i>		559

Standard error in parenthesis

* $p < 0.05$; ** $p < 0.01$

In this table, we see the effects of the independent variables on the natural capital per capita growth-dependent variable, as well as the mediator effects of the logged population size, school enrolment, and resource rents. The main independent urbanization variable does not appear to have a direct significant effect on the natural capital per capita growth variable. This contradicts the first hypothesis

that predicts that urbanization will have a direct negative effect on the natural capital component. The reason for an insignificant effect could be that not all urbanized countries deplete as much of their natural resources as others, and countries such as Norway (Gylfason, 2001) can sustainably use their resources without depleting them, while countries such as Nigeria deplete a lot of them.

The logged population size does not appear to have a significant effect as well. This means that there is no direct effect of population on Natural capital per capita growth. Increases of the population thus do not lead to a strain on natural capital directly. School enrolment does appear to increase the natural capital measure. With a coefficient of 0.187, this means that one percent extra of children going to primary school results in an increase of natural capital per capita growth of 0.187 percent. A reason for this could be that countries that put more focus on education have more knowledge about the dangers of the depletion of natural resources and will be more prudent in their use of their natural capital, hence allowing for more natural capital in their country. Resource rents have a significant negative effect on the natural capital per capita growth with a coefficient of 0.133. This means that an increase of a percentage of GDP devoted to natural resources decreases the natural capital growth with 0.133 percent. Trade does not have a significant effect on the natural capital per capita growth measure. This can be explained as trade does not make a distinction between natural or produced tradables and trade does not significantly affect how much resources are depleted.

The interaction term Government effectiveness * resource rents do not have a significant effect as well, which means that countries that have low-quality institutions and are more resource-dependent do not deplete more of their natural resources than others. The mediation effect of urbanization on logged population size is significant, however, it is not as hypothesized. Urbanization decreases the logged version of the population with 0.005 per percentage point. This effect could be expected from the literature review as well, as Martine et al., (2013) hypothesized that urbanization leads to a decrease in the fertility rate, which in turn would lead to a decreased population size. However, as the logged population variable does not appear to have an influence on the sustainability of natural capital per capita rate, this means that it does not matter in for sustainable development outcomes.

The mediator variable resource rents, however, did appear to have a significant negative effect on the natural capital dependent variable. Urbanization does not significantly affect this mediator meaning there is still no effect of urbanization on natural capital per capita growth. Industrial activity, however, affects the resource rents with a positive coefficient of 0.385. This means that an increase of one percent of GDP earned by industrial activity affects the number of resource rents made with 0.385 percent. This makes sense as an increase in industrial activity makes it possible to earn more with the natural resources used. From this, we can conclude an increase in industrial activity has a negative effect on the natural capital per capita growth rate through an increase in resource rents per GDP. The logged version of GDP has a significant negative effect on resource rents with a coefficient of -0.556 which means that GDP earned with natural resources decreases with 0.556 percent per dollar gross domestic product. This can be explained as nations earn more, they will specialize more and become less

dependent on natural resources in general. This has a positive indirect effect on the natural capital per capita growth through a negative effect on resource rents, which improves sustainability from an environmental sustainability perspective. Government effectiveness has a significant negative effect on resource rents with a coefficient of -1.811. An increase of government effectiveness with one point (ranging from -2.5 to 2.5) decreases the amount of GDP devoted to natural resources with 1.811 percent. This again improves environmental sustainability through an indirect negative effect on GDP devoted to natural resource rents.

The mediator variable school enrolment has a significant positive effect on environmental sustainability. This mediator is significantly positively affected by urbanization with a coefficient of 0.063. This means that an increase in the urbanization rate with one percent increases the amount of primary school enrolment with 0.063 percent. According to this, urbanization thus has an indirect positive effect on environmental sustainability through primary school enrolment. This can be explained as was hypothesized that urbanization leads to an increase in knowledge transfusion attained with education. Enrolment increases as urbanized areas often consist of closed schools and children are not needed to extract natural resources as is the case in rural areas. government effectiveness also has a positive effect on school enrolment with a coefficient of 4.823. This means that an extra point on the government effectiveness scale increases primary school enrolment with 4.823 percent. This can be explained as with an increase in the quality of public services, the quality of the civil service and the degree of its independence from political pressures, there is more incentive to get a good educational diploma in order to gain better jobs. With political corruption, educational knowledge may be less valuable. We see that our institutional quality measure, government effectiveness, has a significant positive effect on the mediator urbanization with a coefficient of 11.592. This means that for one extra point of government effectiveness (ranging from -2.5 to 2.5), the urbanization rate increases with 11.6 percent. This is according to what we hypothesized. From these results, we can conclude there is no direct effect of urbanization on environmental sustainability. However, it is indirectly influenced through education as urbanization increases primary school enrolment, which then increases the natural capital per capita growth sustaining environmental sustainability. To look at economic sustainability, Table 5 shows the results for Produced capital per capita growth.

Table 5 – GSEM Produced capital per capita growth

<i>DV</i>	<i>IV</i>	<i>Coefficient</i>
Produced Capital per Capita growth	Logged population size	2.572* (1.15)
	School enrolment	0.231* (0.11)
	Resource rents	0.148 (0.10)
	Urbanization	-0.056 (0.06)
	Trade	0.021 (0.02)
	Government effectiveness*Resource rents	0.367** (0.12)
	LogGDP	-2.036 (1.08)
	Health	0.177 (0.17)
	_cons	-10.345 (13.34)
logpopulation	Urbanization	-0.005 (0.00)
	_cons	16.393** (0.17)
schoolenrolment	Urbanization	0.063* (0.03)
	Government effectiveness	4.823** (0.68)
	Education expenditure	0.067 (0.23)
	_cons	84.309** (1.92)
resource rents	Industry	0.385** (0.04)
	Logged GDP	-0.556* (0.23)
	Government effectiveness	-1.811** (0.49)
	_cons	10.413 (5.63)
urbanization	goveffect	11.592** (0.85)
	_cons	54.368** (0.85)
<i>R2</i>		0.1047
<i>N</i>		559

Standard error in parenthesis

* $p < 0.05$; ** $p < 0.01$

From these results, we also see that urbanization does not have a direct significant effect on produced capital. The logged population size however significantly increases the produced capital with 2.572 percent per logged population unit. This is according to the hypothesis which explains that an increase in population size increases productivity by allowing for an increase in the labor force. School enrolment has a positive effect on produced capital per capita growth with a coefficient of 0.231. This means that an increase of one percent of children going to primary school increases the growth of produced capital per capita with 0.231 percent. This can be explained as education increases knowledge that can be used to increase the productivity of the labor force. The GDP devoted to natural resource rents does not significantly affect the produced capital growth, perhaps as produced capital can be made from either natural resources or second-hand resources. Trade does not significantly affect produced capital either.

The interaction term institutional quality*resourcerents has a significant effect on produced capital. This means that resource-rich countries have more produced capital, but only when they have high institutional quality. We see this for countries such as Norway that have a high amount of natural resources but manage them well through good institutional quality such as high levels of government effectiveness. Health, measured with life expectancy, does not appear to have a significant increase in produced capital. This may be due to the fact that people usually become older than the average retirement age, which means that productivity is not affected by people becoming older as people do not work after the retirement age either way.

The mediator effects are similar to table 2, which means that urbanization now has a negative effect on economic sustainability through a slight decrease in population size. On the other hand, urbanization does have a positive effect on economic sustainability through an increase in school enrolment. As urbanization both increases and decreases produced capital, this explains the insignificant direct effect of urbanization on produced capital. The mediator school enrolment is also significantly positively affected by government effectiveness which also indirectly increases produced capital growth. Education expenditure does not significantly increase primary school enrolment, perhaps because most money goes to higher or university education. The resource rents mediator does not have a significant effect as resource rents appeared to not significantly affect produced capital per capita growth.

From these results, we thus have conflicting influences of urbanization. Urbanization does not appear to have a direct influence but is indirectly enhanced through school enrolment and hampered through population size. Overall, urbanization does not have an unequivocal effect on produced capital (economic sustainability). To understand the effects on Human capital (social capital), we will have a look at table 6 which provides the effects on human capital per capita growth.

Table 6 – GSEM model on Human capital per capita growth

<i>DV</i>	<i>IV</i>	<i>Coefficient</i>
Human Capital per capita growth	Logged population	0.435 (0.405)
	School enrolment	-0.035 (0.037)
	Resource rents	-0.008 (0.036)
	Urbanization	0.036 (0.024)
	Trade	0.008 (0.008)
	Government effectiveness*Resource rents	-0.032 (0.041)
	Logged GDP	-0.555 (0.381)
	Health	0.045 (0.060)
	_cons	9.373* (4.705)
Logged population size	Urbanization	-0.005 (0.003)
	_cons	16.393** (0.176)
School enrolment	Urbanization	0.063* (0.031)
	Government effectiveness	4.823** (0.685)
	Education expenditure	0.067 (0.230)
	_cons	84.309** (1.924)
Resource rents	Industry	0.385** (0.043)
	Logged GDP	-0.556* (0.235)
	Government effectiveness	-1.811** (0.496)
	_cons	10.413 (5.625)
Urbanization	Government effectiveness	11.592** (0.845)
	_cons	54.368** (0.845)
<i>R</i> ²		0.0234
<i>N</i>		559

Standard error in parenthesis

* $p < 0.05$; ** $p < 0.01$

From these results, we also see that urbanization does not have a direct significant effect on human capital as well. This can be explained as the rise of urbanization does lead to an increase of more dense

areas, the networks are often less dense and more individually centered. Cities are characterized by lower levels of voluntary engagement and “community size and population density are negatively associated with network and mobilization opportunities” (Hooghe & Botterman, 2012 p1) People do not know their neighbors while in rural areas people more people are aware of the people in their environment. Urbanization was further hypothesized to increase human capital due to better knowledge transfusion. However, the other determinant of human capital, health may be decreased due to a lack of natural elements in the environment (Hartig et al., 2014).

Contrary to the previous capital forms however, we also do not see an indirect effect of urbanization on human capital through the mediator variables. Population size does not affect human capital significantly, it was hypothesized that an increase in population size would lead to inequalities and outrage among society. However, overall, this effect is not significant in our results which may mean that population size has grown as much to create such effects. School enrolment was hypothesized to increase human capital. However, educational attainment is already accounted for to measure the human capital formation, which means this effect is already taken into account. Resource rents do not affect human capital. Literature suggests that if resource rents are used well, it can educate the people (Gylfason, 2001). However, how much of a nation’s earnings are devoted to natural resources does not matter for how much is invested in human capital. The amount of trade is insignificant as well, as trade benefits the relations among countries, it appears to not have a large effect on within-country relations nor on education skills. The interaction term institutional quality*resourcerents does not have a significant effect on human capital as well. GDP does not affect human capital, richer countries may invest more in education, however mostly appear to become more unequal as well. Life expectancy (health) was also hypothesized to increase human capital, however, is likely already captured within the human capital measure. The mediator variables do not have a significant effect on human capital per capita growth.

In order to have an understanding of the net effects on the overarching capitals, we will also include a GSEM model of the effects on the Inclusive Wealth per capita growth, as can be seen in Table 7

Table 7 – GSEM model on the Inclusive Wealth per capita growth

<i>DV</i>	<i>IV</i>	<i>Coefficient</i>
Inclusive Wealth per capita growth	Logged population	0.186 (0.346)
	School enrolment	0.014 (0.032)
	Resource rents	-0.038 (0.031)
	Urbanization	-0.024 (0.020)
	Trade	0.016* (0.007)
	Government effectiveness*resource rents	0.148** (0.035)
	Logged GDP	-0.027 (0.326)
	Health	0.337** (0.051)
	_cons	-25.277** (4.018)
Logged population size	Urbanization	-0.005 (0.003)
	_cons	16.393** (0.176)
School enrolment	Urbanization	0.063* (0.031)
	Government effectiveness	4.823** (0.685)
	Education expenditure	0.067 (0.230)
	_cons	84.309** (1.924)
Resource rents	Industry	0.385** (0.043)
	Logged GDP	-0.556* (0.235)
	Government effectiveness	-1.811** (0.496)
	_cons	10.413 (5.625)
Urbanization	Government effectiveness	11.592** (0.845)
	_cons	54.368** (0.845)
<i>R</i> ²		0.3172
<i>N</i>		559

Standard error in parenthesis

* $p < 0.05$; ** $p < 0.01$

Here we see that urbanization does not have a significant effect on the Inclusive Wealth per capita growth rate. This can be explained according to the hypothesis, as urbanization has positive effects on human and produced capital, yet negative effects on natural capital, these effects cancel each other out. Although population size was primarily hypothesized to have a negative effect on human and natural capital, it was theorized to may increase produced capital. The logged population variable appears to not be significant as well, suggesting a probable trade-off. Primary school enrolment does not appear to have a significant effect on the Inclusive Wealth rate. As school enrolment improved natural and produced capital, this was expected to increase overall Inclusive Wealth growth as well. However, the effects appear too small to have an effect on overall sustainable development. The percentage of GDP acquired with resource rents appear to be insignificant as well. This can be explained as it only decreases the natural capital component slightly. Trade does have a significant positive effect on the accumulation of sustainable development with a coefficient of 0.016, which increases inclusive wealth with 0.016 for each percentage of GDP devoted to trade. This was hypothesized as the comparative advantages gained and the specialization in biofuels (Trindade, 2009) would allow for more sustainable behavior. The interaction term Government effectiveness * resource rents has a positive effect on the Inclusive Wealth rate as well with a coefficient of 0.148, as countries that are endowed with natural resources and have good institutions appear to prosper from it while having bad institutions appears to lead to resource dependence (Mehlum et al., 2006). GDP does not appear to have a significant effect, it has a negative effect on natural capital due to the increased consumption of natural resources, but it has an indirect positive effect through a decrease in resource dependence. Life expectancy has a positive effect on sustainable development with a coefficient of 0.337. This means that as people become on average one year older, they will increase Inclusive Wealth with 0.337 percent. Healthier people overall become more sustainable as they have a longer life span and will choose more sustainable options.

4. Conclusion

This paper contributes to research that investigates the link between urbanization and sustainable development by scrutinizing the effects of urbanization on the capital forms of which it is made of. It contributes to the work of DongFeng et al., (2013), Clement (2010), Rana (2011), and Zeng et al., (2016) by looking at the different components and indirect effects that determine sustainable development. Policymakers may benefit from the research as it provides detailed results on which components of sustainability are affected by urbanization. Having more knowledge about which aspects of sustainability are affected allows policymakers to make policy that is more targeted towards the situation of a country. The research question that was tried to answer is: “*What are the effects of urbanization and population growth on sustainable development?*” Literature suggests a trade-off between on the one hand an improvement of produced and human capital (Andersson et al., 2009, Bloom et al., 2008, Rauch, 1993) while on the other hand depletion of natural resources to account for the ever-increasing consumption and investments (de Soysa & Neumayer 2005, Bloom et al., 2008, Jie 2000, Langeweg, Hilderink, & Maas 2000). However, the environmental Kuznets curve (Dongfeng et al., 2013, Shafik 1994; Winslow, 2005; Stern, 2017) suggests the degradation of natural capital will decrease as countries further develop and urbanize. Population size may

increase consumption further, while also leading to an increase in inequality. However, it could increase production as well due to an increase in the labour force.

5. Discussion

From our results we can interpret that urbanization does not have a direct significant effect on sustainable development, however that it significantly influences some portions of the capital forms out of which sustainable development consist. Sustainability is influenced by a great number of factors, out of which urbanization may not be too large of a determinant. The lack of direct effects of urbanization could be due to large differences among countries. Some countries appear to be more focussed on sustainable development than others, even while being equally urbanized. To solve this, future research should research the determinants that provide the moderating effects through which urbanization has an effect on sustainable development. The measurements for urbanization and sustainable development are based on estimated values and/or are based on different standards, which may explain some results were different than expected. The effects of urbanization are widespread. Some benefit from urbanization while others do not. From this research, we cannot conclude the direct effect of urbanization on sustainable development.

However, we did find urbanization to have several indirect influences. Among some of the most important determinants of sustainable development is school enrolment, which positively influences produced as well as natural capital. Population size does not appear to influence social and environmental sustainability, although it does improve economic sustainability. Urbanization has a positive effect on school enrolment, which thus indirectly improves sustainable development. Urbanization has a negative effect on population size, which is contrary to the hypothesis made. This could be caused by a decrease in the fertility rate in urban areas. As urbanization has a positive indirect effect on natural capital growth through school enrolment and resource rents, there may be some omitted variables that show a negative effect on natural capital, which explains the insignificant direct effects of urbanization on natural capital.

5.1 Shortcomings

There are some shortcomings of this paper that could be improved in future research. At first, the urbanization rate as provided by the World Bank is estimated differently for some countries compared to others. According to the World Bank, there is no consistent and universally accepted standard for distinguishing urban from rural areas. This has to do with different situations and circumstances within cities across countries. Some cities in a country may be less developed, containing worse infrastructure than other cities of another country. Some cities in some countries may have a lower population than villages in other countries. Whether an area is considered urban is thus partially dependent on whether the country considers it to be urban or rural. This creates a fallacy in the consistency of urban areas. Although most countries use an urban classification related to the size or characteristics of settlements, others define an area based on administrative arrangements. Because cities entail many different characteristics, there is not a single definition of a city that would be applicable to

all countries, according to the World Bank. The lack of direct effects of urbanization on sustainable development could be due to the different ways countries are urbanized. Henderson & Wang (2007) explain the difference that democratization makes in the composition of cities. While non-democratic cities usually favor large cities, while more democratic cities benefit the formation of new cities and are in favor of smaller cities. Future research could be improved by scrutinizing the effect of different ways countries are urbanized, for example by including the distinction between small and larger cities. Including city size could determine why some countries may benefit from urbanization while other countries do not.

On the other hand, it is also hard to get an adequate measure of the sustainable development of countries. The Inclusive Wealth measure takes shadow prices of its' capital forms. These values represented may not be the most realistic as they are estimated values of the marginal contribution to intertemporal welfare. Sometimes, however market prices are used as a proxy for unavailable shadow prices (UNU-IHDP, UNEP 2014). According to Roman & Thiry (2016) This could provide a problem as the market price of assets does not provide the exact social value of said capital. "market prices do not properly reflect the marginal social contribution of capital assets to well-being" (Roman & Thiry 2016, p188). On top of that, market prices are affected by market failures. Unexpected changes in supply or demand could change market prices which would also show a different 'social' value for the capital assets. As the social value of capital assets cannot be affected, the market prices for capital assets should not be included in the Inclusive Wealth index. Reality may thus be different than what is suggested.

On top of that, the Inclusive Wealth values are calculated for the years 1990, 1995, 2000, 2005, and 2010, which means that there are large gaps between the data set which provides a lower amount of observations than what could be achieved. Also, the measure of Inclusive Wealth considers weak as opposed to strong sustainability. Weak sustainability theory considers that different capital assets such as produced capital and human capital may substitute for other capital formations such as natural capital (Neumayer 1999, Ayres et al., 2001). This goes against the strong sustainability criteria which assumes that the different capital forms are not substitutable. This can be explained as, for instance, natural capital, consist of such essential characteristics that it may not be substitutable for produced and human capital. For this study, the inclusive wealth measure may be questionable as it promotes weak sustainable growth instead of strong sustainability. In reality, capital forms may not be as substitutable, and the degradation of natural capital may not be excused with an improvement of produced or human capital.

5.2 Future research and policy recommendations

Future research should benefit from having an increase in data on Inclusive Wealth and, or other measurements of sustainable development that may provide for more realistic and larger data sets. The estimations of capital assets should unequivocally consist of social value, as market values may provide unrealistic values that may be affected by market failure. The urbanization rate should be more

universal, the definition of a city should be applicable to all countries and should have certain characteristics such as size and population that is comparable with cities in other countries. This way urbanization rates among different countries can better be compared and the effects of these urbanization rates can be better interpreted.

Apart from the measurements of urbanization and sustainable development, there are enormous amounts of direct and indirect actors that affect sustainable development. Many of these are hard to measure as these are influenced by behavior and cognitive human functions (Trudel 2019). As the influences on sustainability are hard to grasp, the explanatory power of our model lacks enough control variables to make proper regressions. Future research should include influences on sustainability that include cognitive functions and human behavior to increase the explanatory power of the model. Of course, urbanization has an effect on most of these behavioral functions as well. Also, the development of a country has an effect on the behavioral functions of its citizens that affect their sustainable behaviors. To pursue strong sustainability, opposed to only weak sustainability, sustainable development should be measured with the help of a more realistic measure of sustainability. In this measure the depreciation of one of the capital forms should lead to the depreciation of the accumulated sustainability measurement.

As many indirect effects on both urbanization and sustainable development are not accounted for, one may question the endogeneity of the research. For example, urbanization is said to increase the quality of higher education. However, as more students move towards a city with a university, this also increases the urbanization rate. To solve for the endogeneity problem, future research could include multilevel data regressions to exclude the possibility for reverse causality and endogeneity problems or make use of lagged variables when the data allows for a larger variety of time units. Further research could deeper scrutinize the different characteristics of urban areas to have a better understanding of which characteristics cause the urbanization rate to have the found effects.

The policy that is recommended for governments is to become aware of the determinants of sustainable development. The role urbanization plays is essential for the sustainable developments of nations as urbanization has proven to have several indirect effects. Urbanization can be advocated as it shows positive effects on school enrolment, which positively affects the natural and produced capital formations. Governments should take into account the decrease of population growth that is caused by urbanization and the effects that this has on produced capital. As results underline the importance of education, governments should take into account the importance of city characteristics that provide the best conditions for sustainable development to thrive. Health care, institutional quality, and trade have shown to directly influence sustainable developments, which means these areas should achieve more attention in order to improve further.

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