The effect of family planning on human development

A regression analysis of the effect of family planning on the three dimensions of Human Development Index in low-income countries.

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11 January 2021

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Bachelor Thesis

Department of Economics

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Abstract

This thesis analyses the effect of the prevalence of family planning on the three dimensions of the Human Development Index (HDI) in low income countries. The sample consists of 75 countries with annual data from 1990-2018. Empirics indicate that falling fertility rates, due to increased availability and use of family planning, should increase GNI per capita, education and health. The outputs from the panel regression models provided a significant effect on GNI per capita but unmeaningful results for the effect on education and health.

Keywords: Family planning, Total fertility rate, Human Development Index, Low- income countries

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Notes

1. Family planning is defined as the information about fertility and different contraception methods as well as the access to said contraception and other related health-care services (UNFPA, 2020c).
2. When referring to the experiences of women in this paper it is done so with an understanding of intersectional feminism, meaning that other factors such as economic-status, religion, rural or urban location, ethnicity, marital-status, disabilities and age in addition to the factors discussed in the paper such as country of residence will be determinants of what women's individual lives look like and what struggles they may face.
3. Following Leach (2016), the authors understand that women have faced a disproportionate amount of focus in regards to population topics and fertility and the purpose is not to advocate for gender-skewed solutions.
4. On the topic of fertility and childbearing the authors refer to women as the main agents in accordance with available data and empirics. The authors do however agree with gender identity as a spectrum and that all childbearers don't identify as women.
5. In this essay, gender equality is defined as the equal capabilities and rights of women to men, covering a range of areas such as; access to power and resources, political and economic participation, not facing discrimination and not being restricted by gendered norms.

1. Introduction

In the light of gender-mainstreaming and the international development agenda, this paper aims to analyze the effect of family planning on three important dimensions of development. As access to family planning is determined to be a key tool for female empowerment (United Nations Population Fund [UNFPA], 2020c) the effects of such an intervention are of interest from both a gender-equality and development perspective. Taking into account criticism of development-work with a mere economic focus being too narrow and excluding important aspects of human life (Sen, 1999; Stiglitz, 2001) the aim is to contribute to the current literature by analyzing the effect of the prevalence of family planning on the three dimensions of the Human Development Index (HDI). A significant effect could further substantiate the importance of access to family planning as an intervention, not only from a gender perspective. The paper aims to answer the following question:

Does the prevalence of family planning have an effect on the three dimensions of the HDI in low-income countries?

The three sets of panel regressions run with GNI per capita, education and health as dependent variables respectively and total fertility rate (TFR), representing the prevalence of family planning, as the explanatory variable indicates a significant effect on GNI per capita but show inconclusive results for education and health. Although the whole effect of TFR can't be accounted for by the prevalence of family planning, the literature on the topic suggests that a high rate of the variance in TFR can be derived from the prevalence of family planning. It is therefore noteworthy that this study cannot conclude the exact effect of the prevalence of family planning but rather that there may be an indication of such an effect. The findings of the regression with GNI per capita and TFRs, estimating an average effect of 0.069 percent increase in GNI per capita for every 1 percent decrease in TFRs are consistent with existing literature and studies (United Nations Department of Economic and Social Affairs, Population Division [UN DESA], 2020). The findings for the regressions estimating the effect on education and health are ambiguous and no conclusion could be drawn from the results, instead of the positive expected relationship between TFRs and both education and health (UNFPA, 2020c). Although the estimated effect of TFR on GNI per capita is small, there is support for family planning interventions due to the few alternative methods

available, the cost reduction for governments as well as the strong moral justification (Ritchie, n.d; UNFPA, 2017; UNFPA, 2020c).

1.1 Background

1.1.1 Gender equality

Gender equality has over the recent decades been at the center of the international work towards sustainable development, embodied by the sustainable development goals of the United Nations (United Nations [UN], n.d b). Proven to have a key role in most development issues by both literature and empirics, gender equality has cemented its place on the international political agenda (United Nations Women, 2014).

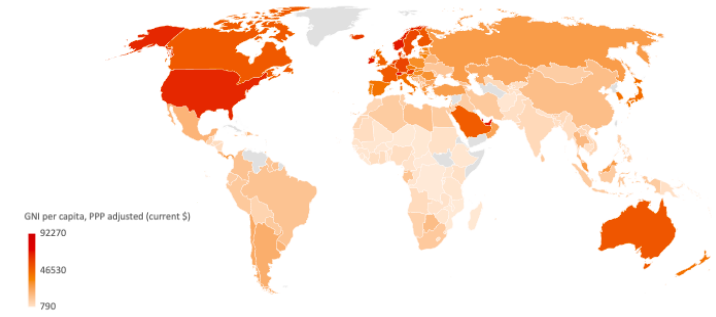
Since the fourth World Conference on Women held in Beijing in 1995, the role of women on the international development agenda has had a noteworthy transformation. Previous to the conference, ideas of women in the developing world as victims to their surroundings and as passive actors in society dominated the discourse in both developed and developing countries. The viewpoint was not only an incorrect and unjust representation of the women but also focused the international development-work towards male-based solutions. Moving forward from the conference the focus shifted to female empowerment and intersectionality, with efforts to portray women as the diverse group they are in reality and enabling them to be agents of their own lives. Another noticeable change post-conference was the term gender-mainstreaming, i.e. implementing gender perspectives in policy- making both locally and globally. The importance of incorporating a gender perspective in all areas of development from start to finish was highlighted, which meant that gender equality no longer could be seen as a goal concerning only women that could be separated from the broader development agenda (Sida, 2005).

1.1.2 Family planning

In 1968 at the United Nations Conference on Human Rights in Tehran, access to voluntary family planning for parents was declared a human right (Kamen, 2018). The time leading up to the decision had been characterized by resource and environmental issues gaining more attention and rising efforts to decrease the population growth rate in poor countries. Rapid population growth had been framed as the cause of the problem and the solutions were focused on reducing fertility rates. Family planning at that point was used as a tool for

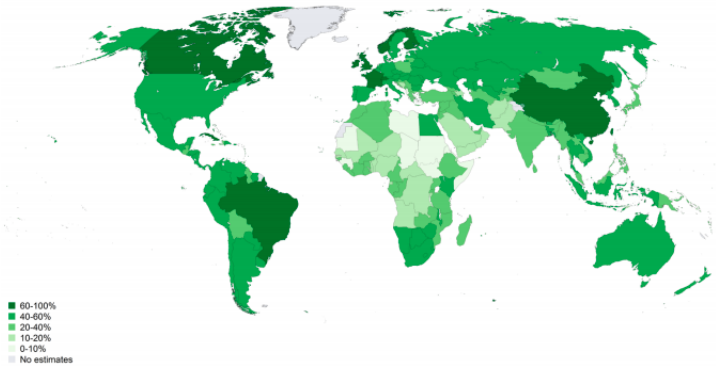
population control in the form of forced sterilization, high-risk contraception and policies such as China's one-child policy. In hindsight such measures have been proven to be ineffective and hard, if not impossible, to morally justify (UN Women, 2014). Family planning today is meant as a tool to empower couples and especially women, to make informed choices about when or if to have children. This means that family planning services should be accessible to everyone but completely voluntary. The focus is on the impact unintended pregnancies can have on women's lives and what effects an unmet need for contraception has on women and their families as well as the economy as a whole (UNFPA, 2020c).

As illustrated in the following two diagrams there is a trend between income and contraception use. The poorest countries, shown as the lightest shaded areas in figure 1, also tend to have the lowest prevalence of contraception, shown as the lightest shaded areas in figure 2. The figures indicate some degree of correlation implying potential for improvements in regards to both indicators.



Source: Diagram by authors, data retrieved from World Bank Databank.

Figure 1. GNI per capita by country, 2019.



Source: United Nations Department of Economic and Social Affairs, Population Division (2020).

Figure 2. Prevalence of modern contraceptive use among women aged 15-49, by country or area, 2019.

1.1.3 Development

Access to family planning services are essential parts for achieving the 2030 Agenda for Sustainable Development. Women's empowerment, gender equality and health are all parts of many of the Sustainable Development Goals. Family planning is a vital part of Goal 3, good health and well-being for all, and Goal 5, promoting gender equality and empowering women and girls. It is also assumed to be connected indirectly to other goals such as the goal to end poverty or provide economic growth (UN, 2019). From the 2012 London Summit on family planning, the FP2020 was created, where more than 20 governments agreed to invest in family planning. The FP2020 strives towards empowering women by providing access to contraceptives and ensuring sexual and reproductive health services. Their main agenda was to ensure that 120 million women had access to family planning information and services by the year of 2020. FP2020 has had a great impact on increasing and spreading family planning globally, with the help of national governments, donors and civil societies (Family Planning 2020). Investments in family planning are also expected to save governments up to $6 for every $1 dollar invested (UNFPA, 2017).

Development is a process that creates growth and includes both social, economic, environmental and demographic components. According to the United Nations Development Programme (UNDP, n.d), human development is about the wellbeing and freedom of people's life. Rather than assuming that economic growth automatically results in a better life, it focuses on the choices and the opportunities to live a life a person values. Human development is a broad term and the Human Development Index can be seen as a measure of average achievement in human development (United Nations Development Programme [UNDP], 2019).

2. Theoretical framework

This section aims to describe the theoretical framework of the study. Relevant economic theory and literature will be explained in regards to the three indicators of the HDI as well as family planning.

2.1 GNI per capita

2.1.1 Historical overview

To explain the use of the endogenous growth model in this paper, a short historical overview of the field will give a valuable insight into the complexity of the matter and show that there is no solution that fits all. At the beginning of the 1950s, at the rise of development economics, western economists had considerable influence over the field of economic growth in the developing world and interventions and policies alike were based on neoclassical growth models, where focus lay on capital accumulation as the source of growth (Banerjee & Duflo, 2004). Developing countries were assumed to have dysfunctional market pricing systems and widespread market-failures, that at this point in time were believed to only have one solution, government interventions at macro level. As time went by, high levels of unemployment still prevailed and the poor were increasing in numbers, leading to a new generation of development economics taking over. Unsuccessful government intervention and bad policies were blamed for the failure of development efforts and focus shifted from capital accumulation to the productivity of factors of production. Building on the neoclassical growth theory, the importance of human capital caved the way for the endogenous growth theory (Barro, 2001). Even though it has faced criticism for its lack of empirical application, it still remains one of the dominating theories in the field. The application of the endogenous growth model on the issue of economic growth in developing countries also marked a change from the previous macro- and one solution fits all- perspective on interventions and theories to a micro perspective that focused on particular issues of underdevelopment within specific levels of society (Meier & Stiglitz, 2000).

2.1.2 The endogenous growth theory

In contrast to the exogenous neoclassical growth models, the endogenous growth theory long-run growth is presumed to be possible and is determined by increased total factor productivity as a result of investments in human capital (Romer, 1989). The AK-model is a part of the endogenous growth theories- family and the level of income in a country can be represented in its simplest form as:

$$Y_t = AK_t \quad (1)$$

and

$$\dot{K}_t = sY_t + \delta K_t \quad (2)$$

In equation 1, Y is the national income which is determined by A, an exogenous and constant productivity parameter, and K, which in Lucas (1998 as cited in Jones, 2019) represents human capital. $\dot{K}$ denotes the derivative of $K$with respect to time, representing the fractional change of K where s is an exogenous constant investment rate in human capital. Due to the non-rival nature of investments in human capital, as the knowledge gained by one person does not exclude another person from gaining that same knowledge, the endogenous growth theory is assumed to have increasing returns to scale (Jones, 2019; Meier & Stiglitz, 2000).

2.1.3 The demographic dividend

The basic models that include human capital as the source of long-run economic growth usually disregard the effects of fertility and mortality rates on economic growth (Romer, 1989). The demographic dividend refers to the positive effects of falling fertility and mortality rates on economic growth (UNFPA, 2016). In this paper there will be no attempt to combine these theories but instead apply them in a parallel manner to the analysis.

In many developing countries the ratio of the young population to the working-age population is high, meaning that there are many dependents, defined as young people relying on someone else to sustain them, compared to the portion of the population with an income. As fertility and mortality rates decline a country can experience a spur in economic growth as the ratio of dependents to working-age population decreases (UNFPA, 2016). This is due to more people contributing to the economy leading to a rise in free capital to be invested, raising the per capita income (Barro, 2001). According to the United Nations Population Fund (2019), a similar effect to the demographic dividend can be attained through gender focused policies that increase female participation in the workforce, leading to more productive agents contributing to the economy. There are however other factors that the demographic dividend has to coincide with to fully reap the benefits expected by a shift in the demographic of the country. If for instance, few labor opportunities, unstable governance, conflict and/or low investment in education and health prevail the growth possibility will not be realized (UNFPA, 2016).

2.2 Education

Having access to quality education is a powerful factor for achieving sustainable development. Education has multiple effects on both individuals and the society (World Health Organization [WHO], 2017). The literature and economic theories have different perspectives on education as a goal for development. This section will explain the main theories and literature of the factors behind education, connecting this with family planning.

Amartya Sen is critical about measuring development by only looking at Gross Domestic Production (GDP), and argues for the importance of including other factors such as human freedom. According to Sen, development is a result of peoples' functionings and capabilities, what people value being or doing. He highlights the importance of freedom to choose between different functionings. Human freedom, does not only depend on an increase in individual income, but on economic facilities, social opportunities, political arrangements etc. These are all important determinants for an increased capability. The freedom of social opportunity includes facilities for education, which has a positive impact on the individual's chance to choose her future. These freedoms and opportunities do not only affect the individuals, but creates a higher attendance in different activities, both political and economic. Expanding peoples' capabilities will increase their well-being and freedom of choices (Sen, 1999). Looking at Sen's approach from a gender perspective, women suffer from varieties of unfreedom, including not having the right to decide the size of their family and whether or not to get educated. Not having access to education, means not being able to decide for your own future. Family planning services emphasize both women's rights and empowerment and makes it easier to decide if or when to have children, and increases the chances to get an education (WHO, 2017).

Like Sen, Stiglitz highlights the importance of including other factors when studying development, than GDP alone. According to Stiglitz, economic growth does not necessarily mean an improvement in education. Instead of solely maximizing income, policy-makers should also focus on improving education. He argues that policy-makers and the government in a country are important factors of development. Without investing efficiently in education, sustained development might be difficult to achieve in a country. As the population grows, it is even more important that the government ensures a good quality and promotes social services such as education (Meier & Stiglitz, 2000).

To summarize, family planning programs emphasize both women's rights and empowerment and makes it easier to decide if or when to have children, which is a basic human right. Women get the right to life and liberty as well as freedom of opinion, including the right to education. Governments and policy-makers have an important role investing in social services and improving access to quality education. There is empirical evidence showing the multiple benefits of family planning on education, which will be discussed later in the paper.

2.3 Health

The topic of health is a very broad one, interconnected with multiple of the sustainable development goals in addition to the specific goal for improved health. One could argue that this represents a global consensus on the importance of health and that it on its own is a goal worth working towards (UN, n.d a). Yet in economic theory there seems to be little focus on health, even as a means towards economic growth. This section will bring to light some of the main points made by existing literature on health as a measure of development and its connection to family planning.

In modern theories of development, emphasis is placed on the more normative goals, concerning the non-economic aspects of human lives. In Sen's perspective on development, the capabilities to function plays a central role in determining the level of development (Sen, 1999). The essence of his theory in respect to health is that a medium- income country whose population struggles with health related issues or obstacles, could be considered less developed in comparison to a low-income country with better health standards and a healthier population. It may seem bizarre to argue that development is determined to such an extent by health but an example may aid in clarifying the reasoning behind the statement. Based on Sen's approach, the idea is that a sick person, without access to proper health-care, might have a smaller possibility of living their life in a way that they find meaningful with respect to, for instance, employment or utilising their income. Hence, removing any potential benefit they could have gained if they were healthy. From a more wide-reaching perspective this means that the availability of for example health services, clean water or food have a central role in determining the general health of the population and development potential of a country (Sen, 1999).

Although Stiglitz theories of development differ from Sen's approach, he has a similar focus and, to some extent, conclusion. He points out that economic growth does not intrinsically improve health (Squire 1993 as cited in Meier & Stiglitz, 2000), an idea common to older theories of development, and that policies and interventions for development should have a broader perspective (Meier & Stiglitz, 2000). The solution, according to Stiglitz, is to incorporate normative perspectives in policy-making and that well functioning and transparent governments can be important actors for development. In the long-run, if such policies are evaluated from different perspectives and implemented in an effective manner, can be successful in increasing health (Meier & Stiglitz, 2000).

3. Empirics

In developing countries, about 232 million women are not using any contraceptives even though they want to avoid pregnancy. Not having access to contraceptives or modern family planning methods affects women's chance for a better future for themselves and their families (UNFPA, 2020c). The consequences of early and unintended pregnancies can be economic, education- or health-related. This part of the essay aims to describe the empirics of the effects that family planning has on development based on these three perspectives.

3.1 Family planning and GNI per capita

This section will first present the empirics of the effect of human-capital investments on economic growth. As the effect of family planning on human-capital is strongly related to the next sections the reader is directed to section 3.2 and 3.3 for the presentation of the empirics in regard to this. Secondly the empirics of the demographic dividend and its connection to family planning will be presented.

Investments in human-capital are expected to have a positive effect on the income level of a country in a couple of ways (Steinback, 2019). In low-income countries there has, according to Steinback (2019), been an increase in the investment levels in human-capital since 2001 which has led to increased growth. He states that a quarter of the 5 percentage point increase in government spending has been directed to public investment. The increased investment along with other favorable conditions such as, receding conflicts and commodity price booms, has had an influential role in increasing the growth rate from 1.6 percent to 5.2

percent a year over the last two decades. He states that the increased government spending on education has led to a near doubling of the net secondary school enrolments on average for low-income countries. Further, health interventions to prevent and treat HIV and malaria have led an increasingly healthy population. Combining the two, low-income countries have created advantageous conditions for a productive population and future sustained growth (Steinback, 2019).

Banerjee and Duflo (2004), have a different focus when looking at investments in human-capital and state that family- or parental-wealth is the key determinant of the level of investment. Building on this, a study conducted in the sub-district of Matlab in Bangladesh, some families were provided with extensive family planning services while a control group in the same area was left without access to the service. The study concluded that the household earnings of families who were given extensive family planning services increased while the families who did not receive any services saw no change, indicating a positive effect of family planning on the income and investment potential on a family level (Gribble & Voss, 2009).

Regardless of the source of the investment empirics seem to indicate a positive correlation between human-capital investment and the income level, even though the magnitude of the effect is somewhat unclear. Bloom, Canning and Sevilla (2001) argue that the effect will depend on a considerable number of other factors and that the final effect is, in some cases, much smaller than expected. The idea that investment in human-capital on its own cannot bring about growth is supported by most literature and the authors advocate for a broad understanding of people's lives and society as a whole (Leach, 2016; Steinbach, 2019; Stiglitz, 2001).

There is also a large amount of literature supporting the demographic dividend. The East Asian Miracle refers to the rapid economic growth seen in Japan, South Korea, Taiwan, Hong Kong, Singapore, Thailand, Malaysia, and Indonesia from the 1960s. One of the reasons for this spur in growth was the increased access to voluntary family planning which paved the way for a shift in the demographic composition in those countries. Declining fertility rates and increasing economic growth also brought on multiple other benefits such as, improvements in standards of living, the creation of an educated workforce, higher female labor participation, higher wages and household earnings (Petruney, Wilson, Stanback &

Cates, 2014). In the long-run perspective some expect the economic effect of a shift from medium to low fertility rates, as defined by the United Nations, could lead to a per capita income increase of 5.6 percent after 20 years and 11.2 percent after 50 years (Mbizvo, Bellows, Rosen, Mupeta, Mwiche & Bellows, 2020).

In respect to female participation in the workforce and the potential of a demographic dividend-like effect, there are however contradicting ideas in the literature. Although most argue that increased labor possibilities for women should lead to economic growth due to the increase in productive agents in the economy (Mbizvo et al., 2020), there are some that do not agree. The main point for this perspective is that women in the poorest countries in the world typically already have full-time employment and that interventions for increased female participation in the workforce may not have a noticeable effect (Canning & Shultz, 2016).

There are both demographic and investment related causes to economic growth. Although the magnitude of the effect of investment and source of investment vary in the litterature, one can conclude that there is a positive relationship between economic growth and both the decrease in fertility rates and the increase in investment in human capital respectively. The effect of increased opportunities for women to participate in the workforce is ambiguous and depends on the individual case.

3.2 Family planning and education

The lack of access to family planning may result in unintended pregnancies. Early and unintended pregnancy is a challenge partly due to women's and children's limited access to education (UNFPA, 2013). One of the key benefits of family planning is improving education and the knowledge among children and women. The size of the family plays a major role in school attendance and the years of staying in school. Having smaller families, means that parents can invest more in human capital for each child. Children's and women's education is an important driver of fertility decline and improves human- and economic development (WHO, 2017). This section aims to describe the empirics behind family planning and its effects on education.

A common consequence of unintended pregnancies among adolescent girls is that they drop out of school at an early age. Even though there is an uncertainty regarding the correlation between early pregnancy and to dropout of school, since it can be both a consequence and the cause of dropping out. According to an UNFPA study, in developing countries, 20 000 girls under the age of 18 give birth every day. Rural and poorly educated girls are more likely to become pregnant compared to more educated, wealthier, urban girls (UNFPA, 2013). It is also shown that a higher level of literacy rate among women between ages 15 and 19 has a connection with lower birth rates. Access to a good quality of education is an effective way of empowering adolescents. It also increases the knowledge about basic comprehensive sexual education and understanding that there is a choice for women to decide if or when to have children (Loaiza & Liang, 2013). In most Sub Saharan African countries, pregnancies among adolescent girls tend to lead to an unfinished education. Early and unplanned pregnancy decreases the chances for girls to get educated (Birungi, Undie, MacKenzie, Katahoire, Obare & Machawira, 2015). A study in Chile measured the effect of motherhood among adolescent girls and their school attendance. These young mothers were between 24 and 37 percent less likely to complete or even attend high school. It also showed that having access to a high school education reduces the risk of becoming pregnant at an early age (Kruger, Berthelon & Navia, 2009).

The study of the Matlab sub-district of Bangladesh, mentioned in section 3.1, confirms that long-term investment in family planning has positive effects both for families, households and communities in respect to education. The families that were included in the Matlab experiment got a higher educational achievement compared to those who were not. Even though education was not a goal of the family planning program, the children from the women who participated had better access to education than the children from the women who did not. When having fewer children and smaller families, the quality of the children's life tends to increase. The women who had an education, got better off financially, and as the level of education increased, so did the income (Gribble & Voss, 2009). As women get more income, they tend to allocate more resources on their children such as nutrition, health and schooling (WHO, 2017).

The empirics show that family planning has several positive effects on education. Not having access to family planning has a negative effect on women and their quality of life. Early and unintended pregnancies among adolescent girls determines their level of education and their

future. Education is an important factor to empower women, which later improves the families and the childrens life.

3.3. Family planning and health

As described in the theoretical framework the inclusion of a health dimension is key in development work as health represents an important dimension of human life. This section aims to describe what determines the health of a population and the effect of family planning on life expectancy and human capital investments.

Infant and child mortality is a strong determinant of the life expectancy of a population (Ritchie, Ortiz-Ospina & Roser, 2019). According to the UNFPA (2020b) newborn deaths could be reduced by 76 percent if all demand for family planning was met. The study conducted in Bangladesh, referred to in previous sections, further supports the claim that family planning reduces child mortality. The children in families who were given access to family planning services had a longer life expectancy and were healthier in general as those families saw an increase in free resources due to the possibility of planning pregnancies (Phillips, Wayne, Shushum, Makhlisur, Chakraborty, 1982; Mbizvo et al., 2020).

Besides infant and child mortality, death at an older age due to for instance accidents, illness or disease are other factors that determine life expectancy (Ritchie, Ortiz-Ospina & Roser, 2019). Every day approximately 810 women die from preventable pregnancy and childbirth complications (Leach, 2016). Even though not all deaths can be prevented with increased availability of family planning, an estimated 76 000 maternal deaths could be avoided in developing countries if the total demand for contraception was satisfied (UNFPA, 2020a). Of all maternal deaths 13 percent are due to unsafe abortions. Unwanted pregnancies could drastically decrease with increased access to contraception as a mean of prevention. The right to terminate a pregnancy is however a very political question and family planning services seldom include such procedures (Global Health Watch, 2011 cited in Leach, 2016). Within the group, adolescent mothers are especially vulnerable, with complications during pregnancy and childbirth being the main cause of death (UNFPA, 2020c). The poor health and low access to health services of adolecent mothers also increases the risk for miscarriage and stillbirths (UNFPA, 2013).

Ritchie, Ortiz-Ospina & Roser (2019), also point out that the level of health expenditures and availability of health- services will determine the health and life expectancy of the population. Investments in women's health has a strong correlation with improved reproductive health and infant and child health (UNFPA, 2020a). Following section 3.1 and 3.2 of this paper, as women's incomes increase, as a result of either access to family planning or other factors, they tend to invest more in the health of their children (WHO, 2017). Making family planning services more widely available is key in empowering women and their children to their human right to life and liberty (UN, n.d c) as well as promoting a productive and healthy population (Mbizvo et al., 2020; UNFPA, 2020a).

By reducing maternal, infant and child mortality, family planning is predicted to improve the health and life expectancy of the population (UNFPA, 2020a). Other benefits to increased access to family planning include a more productive population, further investments in children's health and strengthened capabilities and human rights (Mbizvo et al., 2020; UN, c; UNFPA, 2020a; WHO, 2017).

3.4 Family planning and total fertility rate

There is strong evidence for the inverse relationship and high correlation between fertility rates and the prevalence of family planning, especially contraception (Jain, 1989; Robey, Rutstein & Morris, 1993; UN DESA, 2020). According to regression analyses including a range of countries and spanning over periods reaching back to 1960, fertility rates fall when family planning becomes more available (UN DESA, 2020). Jain (1989), links falling fertility rates to the use of contraception but argues that in the long-run, the quality of the family planning service and not only the availability will have the determining role of the use of contraception. Robey, Rutstein & Morris (1993) concludes that up to 90 percent of the variance in TFR can be derived from the availability and use of family planning services. By increasing the availability of family planning there is a strong basis for the conclusion that it will to some degree decrease the fertility rate taking into consideration other societal factors such as marital status, religion and location that can affect both the fertility rate and use of contraception (Jain, 1989 and Robey, Rutstein & Morris, 1993).

4. Data and variables

This section aims to give a description of the data, variables and model used to conduct the analysis.

4.1 Data description

The data was collected from the World Bank Database and UNDP, both well-established organizations and reliable data-sources. In addition to the data, detailed information on data collection methods as well as the sources the data was collected from in the case that it had been retrieved from another source. Data availability from low-income countries is usually low and the data selected for this analysis was no exception. Due to the limited data for the variables *rule of law* and *voice and accountability*, estimates were used instead. As the variables with estimated data were few and used as control variables, the positive effects of including the estimated, such as the larger number of control variables in the model, were assumed to outweigh the possible negative effects. The sample contains all counties that have been classified as low-income countries by the World Bank at some point between 1990 and 2019 (World Bank, 2020). The reasoning behind this selection was to gain a wider sample compared to, for instance, just including the current low-income countries. A majority of the countries in the sample are located in regions with especially high fertility rates (UN DESA, 2020), which further strengthens the sample choice.

Somalia and Democratic People's Republic of Korea were excluded from the sample due to completely missing data for at least one of the dependent variables or the explanatory variable. For a complete list of the countries included in the sample see Appendix 1. The final dataset includes a selection of 75 countries over a time-period of 29 years, from 1990-2018, with a total of 2175 observations. Due to missing values in the dataset the panel is considered to be unbalanced. Even though a balanced panel would be preferable, due to the less complicated statistical operations, excluding all missing values leads to 14 observations remaining meaning that leaving the panel unbalanced is presumed to be more beneficial for the analysis.

4.2 Variables

To measure the effect of family planning on human development, the regression is run with three different dependent variables. Each of the dependent variables represent one indicator used in the HDI, but for simplicity reasons will be in absolute values instead of indexes. Family planning, represented by TFR, is the common explanatory variable for all three regressions. Table 1. presents an overview of the variables included in the analysis with a short definition and data source which is followed by three sections elaborating on the groups of variables. The "in logs" denotation refers to the natural logarithmic form.

Table 1- List of all variables with a brief description of their meaning and data source.

Variable	**Description**	**Source**
Dependent variables		
GNI per capita	GNI per capita PPP adjusted to 2020 international dollar (in logs).	World Bank
Education	Expected years of schooling, sum of age-specific UNDP enrollment rates between the ages 4 and 17 (in logs).	
Health	Life expectancy at birth (in logs).	World Bank
Explanatory variable		
Family planning	Total fertility rate; total births per woman if she lives to the end of her childbearing years and bears children according to country- and age-specific fertility-rates (in logs).	World Bank
Control variables		
Population	Total population (in logs).	World Bank
Government expenditure on education	Government expenditure on education as a % of GDP (in logs).	World Bank
Government expenditure on health	Government expenditure on health as a % of GDP (in logs).	World Bank
Savings rate	Investment rate, gross capital formation as a % of GDP.	World Bank
Terms of trade	Net barter terms of trade index, percentage ratio of the export unit value indexes to the import unit value indexes (base year 2000).	World Bank
Inflation	Inflation, annual percentage change in consumer prices (in logs).	World Bank

Rule of law	The extent to which citizens have trust for and follow the rules in a country, especially the quality of contract enforcement and property rights (estimate).	World Bank
Voice and accountability	The extent to which citizens can participate in choosing their government and also the right to expression, free media and the freedom of association (estimate).	World Bank

4.2.1 GNI per capita, Education and Health

To incorporate a wider perspective on development, following Sen and Stiglitz (Sen, 1999; Stiglitz, 2001), the model includes the three dimensions of the HDI as the dependent variables resulting in three sets of regressions. Following McNown, Nülle & Paliova (2019) all three dependent variables will be in logarithmic form (natural logarithm) to better fit the linear model.

The use of GNI per capita PPP adjusted to 2020 international dollar is based on the use of the indicator in the HDI. Since the aim of the analysis is to see the effect of TFR on GNI per capita, the tendency of GNI to underestimate the value of low-income countries is assumed not to have a meaningful effect on the results as all countries in the sample are expected to be affected in the same way. The PPP adjustment to international 2020 dollar and the use of per capita increase the comparability of the countries in the sample and are expected to simplify the interpretation of the results (World Bank, n.d c). The educational dimension of the HDI consists of both expected years of schooling and mean years of schooling. Since the TFR is expected to have a delayed effect on education, only the effect on expected years of schooling is of interest in this analysis (McNown, Nülle & Paliova, 2019). This analysis will, like the HDI, use life expectancy as the indicator for health.

4.2.2 Total fertility rate

Based on the relationship between TFR and family planning discussed in the empiricist section, specifically section 3.4, TFR is assumed to be an adequate variable to represent family planning. In addition to this, the correlation between TFR and prevalence of family planning is approximately -0.85, indicating a high correlation. One noteworthy point is that while increased availability and use of family planning is expected to have a positive relationship with all indicators of development, TFR is expected to have a negative

relationship. This means that a decrease in the TFR is expected to cause an increase in GNI per capita, education and health (Canning & Schultz, 2012). TFR is expressed in natural logarithm following (Jain, 1989) due to the expected exponential growth-rate of the variable.

4.2.3 Control variables

The inclusion of control variables in the model assists in controlling for potential endogeneity that could arise from omitted variable bias created by the exclusion of relevant variables from the model, leading to spurious results. The variables were chosen based on previous studies and theory.

The control variables for the regression with GNI per capita as the dependent variable are; inflation, savings rate, openness, population, health, education, voice and accountability and rule of law. The effects of inflation on economic growth varies in the literature, indicating both positive and negative relationships, but is expected to be negative in this regression following Barro (2001). To account for the growth created by the savings rate, there is a consensus in existing literature that investment rate can be used as a variable to represent that effect. Savings rate is expected to have a positive relationship with GNI per capita according to both economic growth theory (Meier & Stiglitz, 2000) and empirical studies such as Barro (2001). The terms of trade variable is included to account for effects such as the increase in developing countries' terms of trade at the beginning of the 21st century as a result of the commodity price boom (Kopp, 2020; McNown, Nülle & Paliova, 2019). An increasing population means more people to divide the total income by, resulting in a negative effect on GNI per capita according to theory (UNFPA, 2016). Health and education are also expected to have a positive effect on GNI per capita (World Bank,c). As highlighted by Stiglitz, rule of law and voice and accountability are important in creating a fruitful environment for businesses and people. Multiple studies support that these variables have important roles in determining how likely people are to invest in for instance business or education and have an expected positive relationship with GNI per capita (Barro, 2001; Stiglitz, 2001)

In the regression with expected years of schooling as a dependent variable, total population, government expenditure on education, rule of law and voice and accountability are used as control variables. Government expenditure on education is expected to have a positive correlation with the dependent variable, since investing more in public spending, together with lower poverty levels, is correlated with more educated people (Leitner & Stehrer, 2016).

In accordance with Stiglitz, rule of law and voice and accountability are used as important indicators of development, and are expected to have a positive relationship with education. Total population is included as a control variable due to previous studies (McNown, Nülle & Paliova, 2019).

In the regression with life expectancy as the dependent variable, government expenditure on health, population, GNI per capita and expected years of schooling are used as control variables. According to Ritchie, Ortiz-Ospina & Roser (2019) the availability of health services, represented by government expenditure on health is expected to have a positive effect on life expectancy. The population variable is included following McNown, Nülle & Paliova (2019) and is expected to have a positive relationship with life expectancy. A higher level of GNI per capita is generally associated with higher life expectancy and is therefore included in the model (Ritchie, Ortiz-Ospina & Roser, 2019). Literacy rate is used to account for the effect of the educational level and quality in other studies (McNown, Nülle & Paliova, 2019) but due to the limited data available for the variable, expected years of schooling is used instead in this study and is expected to have a positive relationship with health.

4.3 Descriptive statistics

This section presents the descriptive statistics to provide an overview of the data used in the analysis.

Table 2 - Descriptive statistics

Variable	Mean	Median	Max	Min	Std Dev	Observations
GNI per capita, PPP adjusted current $	3248	2110	28460	270	3251	2006
Education, years	9,07	9,40	15,80	2,10	2,67	2096
Health, years	60,4	60,6	78,6	26,2	8,8	2174
Total fertility rate, number of children per woman	4,4	4,7	8,6	1,1	1,7	2175
Population, number of people (thousands)	54903	9538	1392730	119	195910	2168
Government expenditure on health, % of GDP	5,477	5,033	20,41	1,025	2,376	1293

Government expenditure on education, % of GDP	4,069	3,385	44,33	0,622	3,138	1005
Inflation, % change	38,871	6,7447	23773	-60,496	598,66	1767
Openness, % ratio	116,22	104,65	321,69	21,397	38,740	1853
Savings rate, % of GDP	23,45	22,22	69,53	-2,424	10,01	1853
Voice and accountability, range from -2.5 to 2.5	-0,71	-0,68	0,81	-2,26	0,68	1488
Rule of law, range from -2.5 to 2.5	-0,80	-0,79	0,74	-2,13	0,51	1488

4.3.1 Outliers

To detect possible outliers, the data for each variable was plotted in a box plot. Some variables, most importantly the GNI per capita and health variable, indicated the presence of outliers. Due to the possibility of these data points containing valuable information and the vast investigation needed in order to remove outliers, no outliers were excluded from the sample. In addition to this, identical regressions with and without outliers for the dependent variables were run, to compare the results. When the outliers were excluded the sample size decreased from around 1200 to 400 observations with outputs indicating similar results to the original regressions with outliers included in the sample (NIST/SEMATECH, 2012).

5. Multiple regression analysis

To test the effect of family planning on the dimensions of the HDI a multiple regression analysis is used. The purpose with this type of analysis is to model a linear relationship between the dependent and the independent variables.

5.1 Regression model

The general model is based on the methodology first introduced by Acemoglu et al. (2008) and later applied by McNown, Nülle & Paliova (2019) and uses a panel regression with lagged dependent and independent variables:

$$y_{it} = c + \alpha y_{it-1} + \beta x_{it-1} + \delta_i + \gamma_t + \varepsilon_{it} \quad (1)$$

where, $i = n$ observations (countries) and t = time periods (yearly data). c is the constant, α is the time effects of the lagged dependent variable y_{it-1},βdenotes the effect of the lagged explanatory variable x_{it-1}, δdenotes the country specific effects and γdenotes the time specific effects $\varepsilon it$is the observation specific error (Cottrell & Lucchetti, 2020).

The lagging of both sides of the equation can be used as a tool to control for problems such as reverse causality and omitted variable bias. The basic idea of the model is that the explanatory variable, TFR, has an effect on each of the dependent variables; education, health and GNI per capita, respectively. If instead, the dependent variable affects the explanatory variable, the problem of reverse causality occurs. By lagging all variables, the model cannot pick up on the effect of reversed causality as causality is presumed to only move forward in time. For example, GNI per capita in 2000, at time t, can't have an effect on the TFR in 1991, at time t-1. This method is also supported on theoretical grounds as the TFR and the control variables used in the model are all expected to have a delayed effect on the three dependent variables. The omitted variable bias occurs when there is one or more variables, unknown to the model, that affects both the dependent variables and the explanatory variable. In this model the bias could be the result of country- or time-specific factors that affect variables on both sides of the equation. To solve this, the fixed-effects model with time-dummies is applied, in accordance with Acemoglu et al. (2008, as cited in McNown, Nülle & Paliova, 2019).

To test whether to use the fixed- or random effects model, the Hausman test is applied (Cottrell & Lucchetti, 2020). The null hypothesis indicates that the individual specific effects are random and is rejected if the difference between the fixed effect estimator and the random effect estimator is significantly different from zero. Applying the Hausman test in all regressions, the fixed effects model is most appropriate.

Using the lagged dependent variable as an explanatory variable can cause autocorrelation. Despite the fixed-effects model removing some of the possible autocorrelation, the problem still exists. As shown in equation 1, y_{it} depends on the observation specific error term ε_{it} (Cottrell & Lucchetti, 2020). The proposed solution to this is using a differencing method but

due to the limited and varying data availability the method was deemed too complicated for the scope of this paper. Instead the Durbin- Watson statistic for the OLS regression was used to determine the level of autocorrelation in the model following McNown, Nülle & Paliova (2019). If the statistic takes the value 2 there is no autocorrelation but as a rule-of-thumb any values between 1.5 and 2.5 have been accepted as not being acutely problematic for the regression (Kenton, 2019).

When using panel data the risk for heteroscedasticity is high and is therefore assumed to be present in the model. To minimize the effect on the regression output, robust standard errors have been incorporated in the model. Robust standard errors will ensure that the results are valid despite the presence of heteroscedasticity. Multicollinearity can occur in a multiple regression when the independent variables are highly correlated. It can also occur if two dependent variables provide similar results. This can affect the data results and the interpretation since the data becomes less reliable. To help detect multicollinearity, the Variance Inflation Factor (VIF) is used (Hayes, 2020). Multicollinearity is indicated not to be an issue in the regression models.

6. Results

This section presents the econometric estimates of the effect of TFR on each of the indicators of the HDI respectively. Each specification builds on the equation introduced in section 5.1, lagging all variables in the equation to control for reverse causality and endogeneity. The first specification in all three sets of regressions shows the basic results, including only TFR and the lagged dependent variable as explanatory variables. To check the robustness of the estimates, meaning how the estimates vary depending on the variables included in the model, and reduce the endogeneity problem, specifications 2-4 include different sets of control variables, depending on the dependent variable. The final specification includes all control variables to further test the robustness of the estimates. The data program Gretl is used to perform all regressions.

6.1 GNI per capita and total fertility rate

The basic results in specification 1 show that a 1 percent change in total fertility creates a 0.16 percent change in GNI per capita, indicating a negative relationship as expected (Barro, 2001). This is an overestimation since the TFR variable is likely to pick up on an effect that would otherwise be accounted for by control variables in a correctly specified model. Introducing a set of control variables, commonly used in similar regression, the aim is to account for factors that affect the level of GNI per capita. As presented in specification 2 the TFR estimate decreases but remains statistically significant with the introduction of the first set of control variables, indicating that the first estimate indeed was an overestimation and that the fit of the model has improved. Specification 2 indicates that a 1 percent change in the TFR creates a 0.061 percent change in the GNI per capita, with a standard error of 0.028 and significance level of 5 percent. In specification 3 the control variables rule of law and health are included resulting in a similar effect on GNI per capita of 0.064 percent, increasing the standard error to 0.034 and in turn decreasing the significance level to 1 percent. With the inclusion of voice and accountability and education istead, a 1 percent change in TFR is expected to account for a 0.077 percent change in GNI per capita with a standard error of 0.033 at a 5 percent significance level. The final regression includes all control variables with an estimated effect of 0.072 with a standard error of 0.033 at a 5 percent significance level.

Table 3- Basic results and robustness of the regression with total fertility rate and GNI per capita.

	Dependent variable, GNI per capita, PPP (current $) (in logs)				
Explanatory variables	Fixed effect OLS	Fixed effect OLS	Fixed effect OLS	Fixed effect OLS	Fixed effect OLS
Specification	(1)	(2)	(3)	(4)	(5)
Constant	0.668*** (0.105)	2.506** (1.047)	3.668*** (1.318)	3.74*** (1.297)	3.78*** (1.37)
Total fertility rate (in logs and lagged)	-0.160*** (0.027)	−0.061** (0.028)	−0.064* (0.034)	−0.077** (0.033)	−0.072** (0.033)
GNI per capita (in logs and lagged)	0.948*** (0.010)	0.9099*** (0.017)	0.875*** (0.025)	0.886*** (0.020)	0.878*** (0.024)
Inflation (log and lagged)		−0.006** (0.002)	−0.006** (0.003)	-0.007** (0.003)	−0.006** (0.003)
Openness (lagged)		0.0001 (0.0001)	0.00008 (0.0001)	0.0001 (0.0001)	0.0001 (0.0001)
Savings rate (lagged)		0.0002	0.0005	0.0004	0.0004

		(0.0004)	(0.0004)	(0.0004)	(0.0004)
Population (in logs and lagged)		−0.099* (0.056)	−0.155* (0.089)	-0.165** (0.075)	-0.161*** (0.094)
Rule of law (lagged)			0.041** (0.019)		0.023 (0.018)
Voice and accountability (lagged)				0.041*** (0.013)	0.033*** (0.011)
Education (in logs and lagged)				0.036 (0.036)	0.036 (0.035)
Health (in logs and lagged)			0.018 (0.102)		−0.007 (0.094)
Observations	1931	1252	984	1904	984
Cross-sections	74	65	65	74	65
Time- period	28	28	19	28	19
R2	0.991	0.996	0.996	0.993	0.996
P-value	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05
Time dummies	no	yes	yes	yes	yes

Robust standard errors in parentheses and ***p<0.01, **p<0.05, * p<0.1

6.2 Expected years of schooling and family planning

Specification 1 shows the basic results of the dependent variable and two independent variables, the lagged explanatory variable and the lagged dependent variable. This specification shows that a 1 percent increase in TFR, results in a 0.019 percent decrease in expected years of schooling, with a standard error of 0.01. Both the second and the third specification shows that expected years of schooling decreases with 0.027 percent when the TFR increases by 1 percent, with a standard error of 0.013 and 0.014 at a 10 percent significance level. In specification 4, the explanatory variable is not significant but positive, showing a 0.013 percent increase when TFR increases by 1 percent, with a standard error of 0.015. In the last specification, where all control variables are included, the explanatory variable is negative showing a decrease by 0.021 percent when TFR increases by 1 percent, with a standard error of 0.014. However, not significant.

Table 4- Basic results and robustness of the regression with total fertility rate and expected years of schooling.

	Dependent variable, Expected years of schooling (in logs)				
Explanatory variables	Fixed effect OLS	Fixed effect OLS	Fixed effect OLS	Fixed effect OLS	Fixed effect OLS
Specification	(1)	(2)	(3)	(4)	(5)
Constant	0.136*** (0.028)	0.322*** (0.077)	0.321*** (0.076)	0.028 (0.267)	-0.309 (0.345)
Fertility rate (in logs and lagged)	-0.019* (0.0104)	-0.027* (0.013)	-0.027* (0.014)	0.013 (0.015)	-0.021 (0.014)
Expected years of schooling (in logs and lagged)	0.957*** (0.008)	0.879617*** (0.027)	0.878*** (0.278)	0.890*** (0.017)	0.867*** (0.029)
Total population (in logs, lagged)				0.013 (0.016)	0.040* (0.022)
Gov.exp on education (in logs and lagged)		0.007 (0.005)	0.007 (0.004)		0.006 (0.005)
Voice and accountability (lagged)			0.013* (0.007)		0.0103 (0.007)
Rule of law (lagged)		0.0159*** (0.005)		0.0108* (0.0107)	0.014** (0.006)
Observations	2021	782	782	1397	782
Cross-sections	75	71	71	75	71
Time periods	28	19	19	19	19
R2	0.990	0.989	0.989	0.988	0.989
P-value	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05
Time dummies	No	Yes	Yes	Yes	Yes

Robust standard errors in parentheses and ***p<0.01, **p<0.05, * p<0.1

6.3 Life expectancy and family planning

Specification 1 shows the basic results of life expectancy as dependent variable and the lagged TFR and the lagged dependent variable as independent. This specification shows that when the TFR increases by 1 percent, life expectancy decreases by 0.004 percent, with a

standard error of 0.004, and is not significant. The second and third specification where more control variables are added, are both significant and show that a 1 percent increase in TFR results in a 0.017 percent and 0.0073 percent increase in life expectancy, with a standard error of 0.004 and 0.002. Both at a 5 percent significance level. Specification 4 indicates a 0.007 percent increase in life expectancy, when TFR increases by 1 percent, with a standard error of 0.002. In the last specification, where all control variables are added, it shows that a 1 percent increase in TFR results in about a 0.006 percent increase in life expectancy, with a standard error of 0.003, at a 10 percent significance level.

Table 5- Basic results and robustness of the regression with total fertility rate and life expectancy

	Dependent variable, Life expectancy (in logs)				
Explanatory variables	Fixed effect OLS	Fixed effect OLS	Fixed effect OLS	Fixed effect OLS	Fixed effect OLS
Specification	(1)	(2)	(3)	(4)	(5)
Constant	0.0377 (0.041)	0.153*** (0.043)	0.194*** (0.051)	0.135*** (0.048)	0.316* (0.186)
Total fertility rate (in logs and lagged)	-0.004 (0.004)	0.017*** (0.004)	0.007*** (0.002)	0.007** (0.002)	0.006* (0.003)
Life expectancy (in logs and lagged)	0.993*** (0.009)	0.975*** (0.007)	0.959*** (0.0108)	0.966*** (0.111)	0.967*** (0.011)
Exp.years of schooling (in logs and lagged)				-0.003 (0.004)	-0.003 (0.003)
Gov.exp on health (in logs and lagged)			0.002 (0.001)	0.003** (0.001)	0.0018 (0.001)
Population (log and lagged)					-0.008 (0.011)
GNI per capita (in logs and lagged)		-0.008*** (0.002)	-0.003*** (0.001)		-0.005** (0.002)
Observations	2099	1934	1248	1293	1248
Cross-sections	75	74	72	74	72
Time periods	28	28	18	18	18

R2	0.996	0.997	0.999	0.999	0.999
P-value	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05
Time dummies	No	Yes	Yes	Yes	Yes

Robust standard errors in parentheses and ***p<0.01, **p<0.05, * p<0.1

7. Analysis and discussion

The purpose of this paper is to analyse the effect of family planning, represented by TFR, on the three dimensions of the HDI. In contrast to the current literature, this analysis provides a broader perspective on development by simultaneously analyzing the effect of family planning on three indicators of development, instead of just the economic dimension. In addition to this, the analysis provides an overview of the effects of a gender-related intervention in a more general setting as opposed to analyzing the effects on, for instance, just maternal mortality. This section will present the analysis of the results, a discussion on the model and suggestions for future studies.

The estimated effect of TFR on GNI per capita indicates a small, robust and significant negative coefficient. In line with previous research and theory (UN DESA, 2020), falling fertility rates are interpreted to cause an increase in the GNI per capita level given that the estimates are correct. Table 3 indicates insignificant effects of both the health and education variables on GNI per capita as well as an incorrect sign for health in regression 5. This indicates that no conclusions can be drawn on the effect of human capital on GNI per capita, which according to theory and existing literature should have a positive effect on the level of income in a country. The incorrect sign of the health variable estimate as well as the statistical insignificant estimates of both the health and education variables may be the result of the moderate correlation between the variables.

The estimates presented in table 3 may not reflect the expected spur in economic growth associated with the demographic dividend as all the countries included in the sample are pre- or early-demographic dividend (World Bank, n.d a, b). The estimates may also be smaller than expected due to fertility rates still being high and prevalence of family planning being low in the selected countries (UN DESA, 2020). If the identical analysis was applied to countries further in the transition of the demographic with falling fertility rates and rising prevalence of family planning the estimates could be expected to be larger following the

theory on the topic (UNFPA, 2016). This does not mean the estimates are inaccurate, but rather that they are true for the sample of countries that have not yet reaped the potential benefit of the demographic dividend and family planning. It is also worth noting that economic growth generated by the transformation of the demographic of a population isn't an inevitable event that all countries will eventually go through, but rather something that has to coincide with many other factors that have to be intentionally brought on by actors in a country (Stiglitz, 2001; UNFPA, 2016). For the countries included in this sample, this means that that effect may never be realised and that the estimated effect of TFR may never come to include that effect.

Another factor that may have influenced the estimated coefficients is the fact that they are estimated keeping all other variables constant. This may have had implications for the estimates presented in table 3 for TFR, education and health. As discussed by Barro (2001), the estimate of a variable such as TFR may become larger if other variables in the model, such as education, that are expected to have a positive effect on the variable are not held constant. The coefficient of education and health may have become larger if the TFR variable wasn't held constant, following the same argument. Including variables with a gender-dimension may also have improved the results of the analysis. As the TFR is expected to have a bigger effect on women than men the productivity gains as well as the health and education dimensions may have shown different results if the effects on women and men were presented separately.

The results in table 4, indicates a small, negative effect of TFR on the dependent variable, expected years of schooling. This is in accordance with both the empirics and economic theory. Increasing the access of family planning, reducing the fertility rate, has several positive effects on education. These effects are expected to be positive both on human capital and education. However, not all 5 regressions are significant, and the significance level is at a 10 percent level. No conclusion can be drawn that the TFR has a negative impact on expected years of schooling. The reason for this result could be a possible error in the regression analysis. Education is probably dependent on other factors as well, and not only the ones that were included. To incorporate and highlight the effect on females, variables with a gender-dimension could have been included in the model. As TFRs are expected to affect female participation in education and the workforce disproportionately, this effect would have

been interesting to include in the model. It may have also resulted in larger estimates of the regression with education as the dependent variables.
The findings in table 5 indicate a small positive effect of TFRs on life expectancy. According to theory and empirics, falling fertility rates should increase life expectancy (UNFPA, 2013) which was not indicated in the results. Due to this, the results have no economic significance regardless of the statistical significance level. As a result, the effect of family planning on the health dimension of human capital cannot be concluded from this study. The incorrect sign of the estimated coefficient for the TFR variable and other control variables, such as GNI per capita, indicate specification errors in the model. This may be the result of important control variables being excluded from the model. Due to the limited amount of existing studies analyzing the effect of a variable on all dimensions of the HDI separately the model in this analysis was primarily based on a previous study by McNown, Nülle & Paliova (2019). This resulted in other variables, such as access to sanitation, prevalence of HIV and nutritional status of the population, that were used in other studies (Horrace, Shaw & Vogel, 2005), being excluded from the model. Given that the samples differ and that some of the variables used in the study by McNown, Nülle & Paliova (2019), such as the gini coefficient, had to be excluded from this analysis due to the limited data availability, the model used for the health dimension may not be the most suitable one, resulting in unmeaningful results.

As mentioned previously in the text, using a differencing method to control for autocorrelation was an option for this analysis. Due to the large variation in data availability and the choice of running three sets of regressions with different dependent variables, the method was deemed too complicated for this analysis. Following McNown, Nülle & Paliova (2019), the two-step system generalized methods of moments estimations would have also been an alternative method to the one used in this analysis. The GMM method may have provided insight into the estimated effect of TFRs on the three dependent variables and controlled for endogeneity (McNown, Nülle & Paliova, 2019). The method was however deemed too complicated for the scope of this analysis, but the authors encourage further studies on the topic to include such estimates.

The main tradeoff in this analysis is between analyzing a broader perspective on development and the depth of the analysis. Recommendations for future studies on the topic will mainly focus on the depth aspect of the analysis as a broader perspective may struggle with meaningful results without in-depth analysis as a complement. The HDI does not include

important factors such as inequality, poverty and gender disparity, which would have provided important insight in the analysis (UNDP, n.d). As most inequality, poverty and gender inequality indicators are fairly new or have low data availability for the sample chosen for this analysis, they were not fit for this analysis but are encouraged to be considered in future studies.

Stiglitz mentions the importance of looking at the differences between rural and urban populations (Meier & Stiglitz, 2000). The unmet need for family planning is often higher in rural areas among poorer, less educated women. Making family planning services more available in rural areas is a major problem among developing countries (Senanayake, 1977), and analyzing the effect separately may further aid in focusing interventions on the areas most in need.

Family planning and access to properly trained health professionals are the most efficient methods to decrease maternal mortality (Ritchie, n.d). Family planning is also the only current method for women to control their own fertility, enabling them to plan their lives and pregnancies as they please (UNFPA, 2020c). As mentioned in section 1.1.3, family planning is also expected to save governments six times the initial investment, meaning that it is a financially feasible intervention (UNFPA, 2017). Even though the regression output indicated a small effect of TFR on GNI per capita, the estimates were similar to those of other studies on the topic (Barro, 2001). This, in addition to the strong moral justification, the few, if any, alternative methods of achieving the same goal and the money governments can save as a result of family planning investments, may indicate that family planning is a worthwhile priority, at least in regards to the empowerment of women and the income level of a country.

6. Conclusion

The focus of this paper has been to investigate if family planning has an effect on the three dimensions of the HDI in low income countries, through a panel data regression analysis. The theoretical and empirical literature supports that family planning has an impact on GNI per capita, education and life expectancy. Although the effect of TFRs on health and education are inconclusive, most likely due to misspecifications in the models, the results show a significant effect on GNI per capita. Due to the current literature on the effects of

development interventions on all three dimensions of the HDI being quite scarce, the authors encourage further studies on the topic. The authors do however note that such analyses may lack the depth needed to provide meaningful results and argue for the inclusion of additional indicators of inequality, poverty and gender inequality. In regards to female empowerment and GNI per capita, the results in addition to family planning being an efficient intervention indicate support for further use of family planning interventions.

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Appendix 1

List of countries included in the sample for analysis.

Afghanistan
Albania
Angola
Armenia
Azerbaijan
Bangladesh
Benin
Bhutan
Bosnia and Herzegovina
Burkina Faso
Burundi
Cambodia
Cameroon
Central African Republic
Chad
China
Comoros
Congo, Democratic Republic
Congo
Côte d'Ivoire
Egypt
Equatorial Guinea
Eritrea Ethiopia
Gambia
Georgia
Ghana
Guinea
Guinea-Bissau
Guyana
Haiti
Honduras
India
Indonesia
Kenya
Kyrgyzstan
Lao People's Democratic Republic
Lesotho
Liberia
Madagascar
Malawi
Maldives
Mali
Mauritania
Moldova
Mongolia
Mozambique
Myanmar
Nepal
Nicaragua
Niger
Nigeria
Pakistan
Papua New Guinea
Rwanda
Sao tome and Principe
Senegal
Sierra Leone
Solomon Islands
South Sudan
Sri Lanka
Sudan
Syrian Arab Republic
Tajikistan
Tanzania, United Republic
Timor-Leste
Togo
Turkmenistan
Uganda
Ukraine
Uzbekistan
Vietnam
Yemen
Zambia
Zimbabwe