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FOREIGN AID, INEQUALITY AND GROWTH: A COMPUTABLE MODEL FOR POLICY ANALYSIS

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I. ABSTRACT

This paper designs an overlapping generations (OLG) model for foreign aid and growth policy analysis. The model endogenises household saving and spending on consumption, education and health. The specification of this model allows analysis of the effect of foreign aid on human and physical capital and establishes a connection between foreign aid, inequality and economic development. The calibration uses both macroeconomic and microeconomic data for a typical developing country in receipt of foreign aid in sub-Saharan Africa. Sources include household surveys, existing literature and the World Development Indicators. Simulations in this paper are performed and investigate steady state dynamics, foreign aid allocation between adults and 'elders', reflective of the level of gerontocracy in the economy, and intrahousehold bargaining power between men and women, denoting the level of gender inequality in the economy. In this way, there are two facets to the efficiency of aid allocations: age and gender. This paper demonstrates how, by decreasing savings and spending on the human capital of children, the speed of convergence to the steady state is lower with a larger allocation of aid to those in retirement and how, by increasing household power to women, physical capital per capita and human capital accumulation is higher in the steady state. Gender equality in the household has the potential to increase steady state output per capita, health status and education status by 3.9%, 4.7% and 4.6% respectively. This thesis therefore provides a framework to quantify the effects foreign aid and inequality in an economy on convergence and the resulting steady state.

II. ACKNOWLEDGEMENTS

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III. THESIS DECLARATION

This thesis is the result of my own work. Material from the published or unpublished work of others, which is referred to in the thesis, is credited to the author in the text and bibliography. The MATLAB code and model file for the simulation of the steady states is available upon request to the author. The final page count for the main body of this thesis is approximately 33.

The Université Paris 1 Panthéon-Sorbonne neither approves nor disapproves of the opinions expressed in this thesis: they should be considered as the author's own.

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1. INTRODUCTION

1.1 OVERVIEW

Foreign aid is defined as a transfer of resources for developmental purposes to populations outside the donor country (Koichi, 2007). In 2022, USD 204bn of Official Development Assistance (ODA) was given to developing countries (OECD, 2022). Foreign aid has been an instrument of development banks and western governments largely since Marshall Plan in 1947 (Bräutigam & Knack, 2004), but the progress of developing countries since draws the effectiveness of aid into question, and the role of foreign aid in development is a controversial issue and lacks consensus.

Foreign aid structures began in the 19th century with countries like France and Britain providing regular transfers to their colonies to build infrastructure, ports and roads. The past century has seen foreign aid provision become increasingly tied to economic and political interests with a growing humanitarian movement and intent to reduce poverty and hunger, and promote economic development (Phillips, 2013).

The poorest countries have made progress since the 1940s. Global growth has exceeded two percent a year, nutrition has improved, diseases have been prevented, and absolute poverty and infant mortality has declined dramatically (Cooper, 2004). Poverty has halved since 1940, and since 1990 more than one billion people have been lifted out of extreme poverty (United Nations, 2015). However, global poverty is still one of the world's most pressing issues. Developing countries continue to suffer from undernourishment, a lack of education and poor access to infrastructure including roads, electricity and water (Hasell et al., 2022).

Foreign aid has taken developing countries some way towards convergence to wealthier countries. Development assistance builds up favourable conditions and allows economies to bridge their savings gap, contributing to physical capital accumulation and sustainable growth (Pham & Pham, 2017). Not only this, however, foreign aid can also be instrumental in establishing a favourable environment for human capital accumulation. The majority of aid is allocated to support social infrastructure in developing countries (53%), followed by economic infrastructure (19%) and the productive sectors (10%); social infrastructure investment involves allocations to government budgets, education, health and sanitation (UNESC, 2008).

Hence, aid is more often than not allocated to productive sectors and is used for more than just increasing the consumption of the poor in the recipient country.

These investments by donor countries into human and physical capital accumulation are important for developing countries. The debate on convergence is largely owed to the 'new' growth theories of Romer (1986) and Lucas (1988), challenging the neoclassical growth theory of Solow (1956), stressing the importance of human capital accumulation into growth and the endogeneity of technical progress (Sarkar, 1997). Romer (1990) interpreted human capital as the source of innovation that generates new technology and ideas, meaning countries with greater initial endowments grow at a rate that exceeds that of countries with less favourable initial conditions (Sarkar, 1997). Galor's (2011) unified growth theory places an equally substantial emphasis on the importance of human capital in economic take-off. As countries develop, the returns to human capital exceed that of physical capital and human capital accumulation becomes the prime engine of growth. Foreign aid can be complimentary to the development of low-growth economies by assisting in the creation of infrastructure, schools and healthcare facilities, raising the rate of savings and accelerating the accumulation of human capital, lessening the impact of unfavourable initial endowments.

However, it is important to understand the context of the country in which foreign aid is received. Aid capture is an important concept to the effectiveness of aid, with aid being allocated away from productive sectors of the economy or appropriated by the recipient governments, select demographics or socioeconomic groups. If aid is inefficiently managed, the onset of growth will be delayed or insufficient in reducing poverty and accelerating convergence.

One of the main themes of aid capture illustrated in this paper is that of gerontocracy. Many African presidents are old, and the five longest presidencies stretch between 29 and 36 years (Kiwuwa, 2015). In African societies, the association of power with age is widely accepted and can help explain many societal and economic issues (Chabal & Daloz, 1999). Even with the rapid modernisation of African developing countries, African customs and cultural respect for elders persists. In rural communities, elders are responsible for the management of the community and distribute goods (Raffinot & Venet, 2011; Meillassoux, 1981). This is not just limited to Africa. Age is associated with experience and wisdom in many developing countries,

particularly those in Latin America and Asia, and the will of the older generations can have a significant effect on how resources are allocated (Kaiser, 1993).

Aid capture is equally applicable to gender but on a more microeconomic level. It is true that policy makers in developing countries are increasingly committed to achieving gender equality and protection for the rights of women. The UN Sustainable Development Goals (SDGs) saw 193 member states recognise the importance of gender equality and commit to achieving gender equality by the target year of 2030 (UN, 2022). Governments of developing countries are recognising the importance of gender equality and empowerment of women, both in the household and in institutions, to promote the accumulation of human capital, escape poverty traps and spur convergence to a favourable steady state (World Bank, 2011).

Macroeconomic development is often linked to intrahousehold dynamics (Angel-Urdinola & Wodon, 2010). Manser & Brown (1980) argue that the bargaining power within a household is linked to the contribution made to the household's collective resources. Developing countries are still male dominated, with male household leads undertaking the majority of income generating activity and women spending the majority of their time in unpaid household work (Angel-Urdinola & Wodon, 2010). A higher involvement of women in the household's decision-making progress tends to favour children more in terms of human capital investment both through consumption and investments in health and education (Hoddinott & Haddad, 1995). The Sustainable and Millennium Development Goals (UN, 2018) have gone some way towards promoting an environment that enriches gender equality and encourages generational growth in human capital, but for foreign aid donors to foster the partnership required, the characteristics of the recipient country need to be better understood and modelled. The effects of aid and gender inequality together have not been documented in the literature, and this paper establishes a chain of causality between gerontocracy and gender inequality in a typical African economy and convergence to the achievable steady state.

1.2 AIMS OF THE THESIS

Foreign aid in and of itself is not sufficient to promote growth and the literature is unclear in the necessary preconditions to ensure economic take-off. The causality chain linking aid to growth is largely ambiguous and fragile, and cross-country regressions do not succeed in identifying what a marginal dollar of aid is able to purchase (Bourguignon & Sundberg, 2007).

It has been documented that effectiveness of aid is susceptible to conflict, institutions and instability. However, there is little literature analysing the impact of inequality on the efficiency of aid.

This paper introduces a new perspective to the debate, providing a computable framework for growth policy analysis and aid effectiveness. Two facets of inequality are examined, age and gender. Age reflects the amount of aid captured by the elders and gender reflects the intrahousehold bargaining power of men relative to women and the spending decisions that are made in the household. This paper calibrates a model that illustrates the mechanisms through which aid can help or hinder convergence to the steady state and establishes a more transparent theoretical framework within which policy experimentation and impact estimation can take place. Countries in receipt of aid are too often assumed to be homogenous, and this paper seeks to reduce the elusiveness of the causality chain and forge a more infallible connection between aid, growth and the necessary preconditions for economic take-off.

1.3 THESIS OUTLINE

This paper is structured as follows. Section 2 provides a review of the existing literature and studies analysing the impact of aid and inequality on growth. It is in this section that I explain how the findings of previous studies are embedded and incorporated into the model of this paper and I analyse some of the main drawbacks to previous research, particularly that of the assumption of homogeneity with respect to the recipient country. Section 3 outlines the overlapping generations model used in this framework, providing the aid provision specification, the optimisation problems for the household and firm, and the derivation of the dynamic system. It is in this section that the dynamic system is presented, and the steady state equations are derived. The fourth section will calibrate the model using household level and macroeconomic data for a typical African developing country that is in a low stage of economic development and in receipt of foreign aid. Section 5 will provide a discussion of the steady state of the calibrated model and illustrate the effects of aid and inequality on convergence, spending, and physical and human capital accumulation. Phase diagrams are presented to complement the discussion with the steady state and convergence changes of different levels of aid capture reflected. Finally, Section 6 will conclude the paper, discussing the implications of the findings of the paper along with a policy recommendation for foreign aid donor countries and institutions. I will also discuss some of the limitations of the research presented in this

thesis and provide recommendations for future research regarding the aid specification and the more comprehensive endogenising of microeconomic parameters.

2. LITERATURE REVIEW

The literature on the effectiveness of foreign aid is vast but lacks consensus. In 2000, Burnside and Dollar published their seminal paper 'Aid, Policies and Growth'. This paper was one of the first in a myriad of literature on the causality of aid on economic development and criticises the lack of categorisation of recipient countries. The findings of the paper were multidimensional and incorporate a plethora of causal relationships. Most significant was their finding that policy environments determine whether aid contributes to growth or not. This finding is consistent with a wealth of more contemporary literature (Acemoglu, Johnson & Robinson, 2005; Hall & Jones 1999; Rodrik, Subramanian & Trebbi, 2004) and the authors argue that good policies are, by themselves, important for growth. They propounded a new hypothesis about aid in that it does affect growth, but the impact is conditional on the same policies that affect growth. Aid only accelerates development in poor economies with already good policies, and much of the ineffectiveness of aid can be attributed to the failure of donors to select countries with good policies and an environment that makes aid productive.

'Aid, Policies and Growth' had enormous policy ramifications and provided a strategy of aid allocation that realised the importance of selective distribution (Easterly et al., 2004). It also provides an interpretation of aid that begs a more holistic assessment of the characteristics of the recipient country, providing the basis for the research of this thesis. The robustness of Burnside and Dollar's (2000) research, however, has been called into question by Easterly, Levine and Roodman in 2004 who found a lesser effect of sound policies on aid effectiveness.

Nevertheless, like Burnside and Dollar (2000), Svensson (2000) and Boone (1996) examine aid effectiveness by taking the case of a country where the government cares partly for the general welfare and partly for the welfare of a restricted ruling elite (Azam & Laffont, 2003). Azam and Laffont (2003) explain that this gives rise to a principal-agent problem and asymmetric preferences between the donor and the recipient. The recipient wishes to further the interests of the elite or a select group while the donor uses conditionality to barter for aid reforms. Svennsson (2000) and Boone (1996) provide a serious starting point for the analytics of aid capture and recognise that societies of many developing countries are highly unequal, autocratic and governed by an elite. It is only through consideration of these factors that may be difficult to isolate that foreign aid capture and effectiveness can be identified. Data was limited mainly to national accounts in the years that foreign aid began. But the increase in

household surveys and microeconomic data collection has enriched the ability of research to incorporate more intimately the elusive microeconomic mechanisms of aid capture and asymmetric preferences that may have been overlooked in earlier literature.

Easterly (2003) has remained critical of foreign aid and sides with the Burnside and Dollar (2000) argument that aid exclusively cannot 'buy growth'. Easterly argues that foreign aid is given with little regard for the performance of previous loans. The fundamental problem of the donor-recipient relationship is that both the success and failure of recipient countries to follow conditions are given as justifications for future aid.

Pham and Pham (2017) introduce a theoretical framework for evaluation of the effectiveness of aid used to finance public investment. The authors build on the Big Push theory of developmental assistance, proposing large one-time aid transfers to pull economies out of poverty traps and on a path of convergence to a higher steady state. Pham and Pham's (2017) results indicate that an economy with sufficient initial conditions, in other words an economy that is not in a poverty trap, does not require foreign aid to develop. However, the result that inspires some of the research in this thesis is the argument that importance must be placed on the recipient country's characteristics: the effects of aid in the long run are non-linear and complex and there is no 'one size fits all'. Their contributions approve the validity of a lot of the papers that employ models that differentiate recipient countries in terms of institutional, geographic and cultural initial conditions.

Dalgaard, Hansen and Tarp (2004) use an OLG model to discuss the impact of foreign aid on long-run productivity with a focus on climate-related characteristics. Again, the authors express the importance of country characteristics in the returns to aid and use this to explain the differing success levels of aid across the globe. Their analysis helps to explain why aid is sufficient for take-off and convergence inducement in some countries but is not a panacea for the reduction of poverty. In their view, it can stimulate the process but not ensure convergence.

Bourguignon and Sundberg (2007) present an important analysis to the research conducted in this thesis. The diversity in opinion to the effectiveness of foreign aid is explained by the 'black box' which is the causal mechanism of aid. Cross-country analysis ordinarily finds an ambiguous relationship between aid and development, and the key to understanding why aid is successful in some places and not in others is to open this black box. Much of the evidence

is circumstantial, but to improve the effectiveness of aid requires clarification of three relationships: donors and policymakers, policymakers and policies, and policies and outcomes. Bourguignon and Sundberg (2007) argue that improving the knowledge about these links contributes to designing effective aid models and strengthening development outcomes.

Perhaps the most relevant paper to the research presented in this thesis is that of Raffinot and Venet (2011), whose aid specification is adopted in the model of this thesis. The authors use a basic OLG model with accumulation of exclusively physical capital to demonstrate the effect of aid on development. They show that if aid is used as an instrument to induce convergence to the steady state, rather than modifying it, it may lead to a rise or fall in savings depending on the share of aid allocated to elders. Raffinot and Venet (2011) provide a valuable starting point to aid analysis in an economy with a form of inequality and demonstrate how aid expropriation by an unproductive generation can discourage convergence to the steady state level of physical capital.

The literature reviewed above has been key to understanding the 'black box' of foreign aid and the importance of accounting for the heterogeneity of recipient countries. Foreign aid is not a solution in and of itself and requires a partnership between the recipient country and the donor to understand the mechanisms and bottlenecks that explain the differing levels of success of foreign aid across the globe. Research like that of Bourguignon and Sundberg (2007), Dalgaard, Hansen and Tarp (2004), and Pham and Pham (2017) all suggest research should contextualise the recipient's unique characteristics, inspiring this thesis to move beyond accounting for factors like climate and institutions and consider aid capture in the form of gender inequality and gerontocracy.

Gender inequality is being far more widely researched in development literature and is arguably key to understanding the foreign aid successes and failures. Addressing gender inequality can have significant effects on growth and therefore the effect of foreign aid. Lagerlöf (2003) argues that the European economic take-off was caused by the education of women during the spread of Christianity, improving their human capital and going some way to equalise resource control in the household. Lagerlöf argues that equalising gender roles can lower the destructive effects poor initial conditions. Christiansen et al. (2016) goes further than Lagerlöf and estimates that the closure of the employment gender gap has the potential to raise GDP by twelve percent, not just through the macroeconomic effects of increased labour market

participation, but also through microeconomic level effects that contribute to the accumulation of human capital within the household.

On the household level, empowering women leads to far more favourable allocations of resources to health and nutritional consumption. Hoddinott and Haddad (1995) found that doubling the share of cash held by women increases the share allocated to food by two percent, a finding that is reflected in the calibration section of this thesis. The same is true for education; Lloyd and Blanc (1996) observed enrolment rates in female-headed households in Africa exceeding those of the male-headed households reflecting the higher preference of females for education.

There is a consensus that women favour human capital accumulation more than men when making household decisions, but quantifying the effects of household bargaining power on the macroeconomic level is far more challenging and requires more than just cross-sectional data (Morrison, et al., 2007). Gender inequality is an intragenerational issue and a commonly used method to assess its affects is to employ an overlapping generations model. Agénor's (2017) computable OLG model was able to assess the effects of exogenous variations in household bargaining power with outcomes on human capital accumulation, fertility, time allocation and output. This thesis will employ a household problem similar to that used in Agénor (2017) and compliments the existing research well in this respect.

African societies, like many developing countries, remain male dominated (Angel-Urdinola & Wodon, 2010). However, despite the vast literature on both effectiveness of foreign aid and gender inequality on growth, the two are analysed almost entirely exclusively. There are little to no studies that investigate the impact of inequality on the effectiveness of foreign aid, whether this be the speed of convergence or the steady state the economy converges to. The vast majority of the literature above stresses the importance of the unique characteristics of the recipient country, and the gap in the literature is at the intersect of the heterogeneity of recipient countries and the level of inequality. This paper aims to fill this gap and provide a starting framework for aid policy analysis that does not fall into the trap of assuming uniformity of recipient countries. The trap is avoided by designing an environment using an overlapping generations model to explain how growth of human and physical capital can be promoted by the receipt of aid. The concerns of Bourguignon and Sundberg (2007) are respected, and the results of this paper go some way towards opening the black box of foreign aid and generating

far more concrete relationships between the way foreign aid is provided and the outcomes it produces.

3. MODEL

The structure of the model used in this paper is based on the Diamond (1965) overlapping generations (OLG) model. Time is discrete and individuals live for three periods. In the first stage of life, childhood, agents consume healthcare and education funded by their parents. In the second stage of life, adulthood, individuals work, earn a wage and receive a proportion of aid which they use to consume, save and invest in their children's human capital, namely education and health. These investments decide the productivity of their children when they reach adulthood in the following time period. Each agent is endowed with one unit of labour which is productivity augmented and supplied inelastically to firms which employ capital and labour to produce one good which can be consumed, invested in offspring, or saved in the form of physical capital. In the final stage of life, individuals consume their savings and foreign aid income and eventually die. Population grows at the constant and exogenous rate n so the number of individuals in period $t+1, N_{t+1} = N_t(1+n)$, with N_t being the number of adults in period t.

3.1 AID

The provision of aid is assumed to speed the convergence of the economy to the steady state equilibrium instead of modifying it as in Raffinot and Venet (2011). Seminal papers such as that of Burnside and Dollar (2000), Easterly (2003) and Easterly et al. (2004) suggest that aid cannot 'buy growth', in that it cannot modify a steady state but can assist in the transition. The specification in this model reflects the literature in this way, with aid terminating when the economy reaches the steady state. Other specifications can be adopted, like assuming the role of the donor as a 'benevolent social planner', providing aid compatible with the golden rule level of consumption. In this way, poverty alleviation can be interpreted as maximising consumption at the steady state. Raffinot and Venet (2011) demonstrated that this can be achieved by providing a fixed level of aid that is insensitive to the distance to the steady state.

Nevertheless, in this model, foreign aid in period t is provided according to the distance between output per effective capita, $y_t = \frac{Y_t}{A_t N_t}$, and steady state output per effective capital, y^*. The parameter $\emptyset \geq 0$ reflects the donor country's aversion to poverty in the recipient country and the sensitivity of the size of their aid transfer to the steady state differential.

Foreign aid, therefore, is provided according to equation (1).

$$aid_t = \emptyset(y^* - y_t) \quad (1)$$

For simplicity it is assumed that the donor and the households enjoy perfect foresight. The provision of aid is internalised by the households and requires that aid is zero when $y^* = y_t$ and the economy has converged on its steady state. Some of the gender related experiments conducted in Section 5 that change the value of the steady state necessarily changes the distance to the steady state and the provision of aid.

According to exogenous specifications, aid is divided between the young and old according to parameter $\theta \in (0,1)$:

$$aid_t = \theta aid_t + (1 - \theta) aid_t \quad (2)$$

A higher θ implies a larger proportion of aid is distributed to elders or an old elite which reflects greater gerontocracy in the society. θ could also be interpreted as the donor's aversion to poverty given that most of those in poverty are young (ILO, 2016). Given also that population grows at rate n, the number of adults is larger than the number of elders in retirement, so the amount of aid received by elders in period t is $\theta aid_t(1 + n)$ (Raffinot and Venet, 2011).

3.2 HOUSEHOLDS

In this model, there are two sexes: male and female. The collective household utility function is the composite of the male and female utility functions scaled with parameter $x \in (0,1)$, which denotes the bargaining power of the adult male. A value of x closer to 1 yields a composite utility function closer to the individual male's utility function and reflects a higher intrahousehold power. The purpose of the value of x is to incorporate gender inequality into the model and integrate recipient countries' heterogeneity into the assessment of aid. Incorporating gender inequality allows the modelling of how foreign aid projects with attached conditionality can affect household resource allocations and the achievable steady state of the economy. In other words, it is assumed that aid as a direct income transfer cannot modify the steady state by itself, but through conditionality the value of x can be changed exogenously, affecting the composite utility function.

The individual utility functions are therefore:

$$U_t^g = \eta_c^g \ln c_t + \eta_h^g \ln H_{t+1} + \eta_e^g \ln E_{t+1} + \delta^g \ln d_{t+1} \quad (3)$$

Where $g = m, f$ for male and female, η_c^g, η_h^g and η_e^g are the preference parameters for current consumption, health status of children, and education status of children respectively. δ^g is the discount factor, equal to $\delta^g = \frac{1}{1+\rho^g}$, ρ^g being the discount rate, and d_{t+1} is the consumption of period t's adults in period $t+1$ (retirement).

Equation (3) implies that the health and education of children which determines their productivity is attached to the utility of the household which they maximise subject to the constraints provided below.

The preference parameters are scaled by the household bargaining parameter, with the composite being equal to:

$$\eta_c = x\eta_c^m + (1-x)\eta_c^f \quad (4)$$
$$\eta_h = x\eta_h^m + (1-x)\eta_h^f \quad (5)$$
$$\eta_e = x\eta_e^m + (1-x)\eta_e^f \quad (6)$$
$$\delta = x\delta^m + (1-x)\delta^f \quad (7)$$

The household's collective utility function is therefore:

$$U_t = \eta_c \ln c_t + \eta_h \ln H_{t+1} + \eta_e \ln E_{t+1} + \delta \ln d_{t+1} \quad (8)$$

The household is bound by the budget constraints given by equation (9) and (10):

$$c_t + e_t^h + e_t^e + s_t = A_t w_t + (1-\theta) aid_t \quad (9)$$
$$d_{t+1} = (1 + r_{t+1}) s_t + \theta aid_{t+1}(1+n) \quad (10)$$

Where e_t^h is expenditure on children's health, e_t^e on children's education, A_t is the productivity of adults in period t and w_t is the wage per unit effective labour. aid_t is the exogenous foreign

aid received by the economy in period t which is distributed between elders and adults with the parameter $\theta \in (0,1)$.

The household therefore maximises (8) subject to (9) and (10), which yields the following first order conditions:

$$\frac{\partial U_t}{\partial s_t} = \frac{-\eta_c}{A_t w_t + (1-\theta) aid_t - e_t^h - e_t^e - s_t} + \frac{\delta(1+r_{t+1})}{(1+r_{t+1}) + \theta aid_{t+1}(1+n)} = 0 \quad (11)$$

$$\frac{\partial U_t}{\partial e_t^h} = \frac{-\eta_c}{A_t w_t + (1-\theta) aid_t - e_t^h - e_t^e - s_t} + \frac{\eta_h}{e_t^h} = 0 \quad (12)$$

$$\frac{\partial U_t}{\partial e_t^e} = \frac{-\eta_c}{A_t w_t + (1-\theta) aid_t - e_t^h - e_t^e - s_t} + \frac{\eta_e}{e_t^e} = 0 \quad (13)$$

Solving for savings, spending on health, spending on education and consumption in period t and $t+1$ yields the following equations and a familiar-looking Euler equation.

$$s_t = \frac{\delta(1+r_{t+1})(A_t w_t + (1-\theta) aid_t) - \theta aid_{t+1}(1+n)(\eta_c + \eta_h + \eta_e)}{(1+r_{t+1})(\delta + \eta_c + \eta_e + \eta_h)} \quad (14)$$

$$e_t^h = \frac{\eta_h[(1+r_{t+1})(A_t w_t + (1-\theta) aid_t) + \theta aid_{t+1}(1+n)]}{(1+r_{t+1})(\delta + \eta_c + \eta_e + \eta_h)} \quad (15)$$

$$e_t^e = \frac{\eta_e[(1+r_{t+1})(A_t w_t + (1-\theta) aid_t) + \theta aid_{t+1}(1+n)]}{(1+r_{t+1})(\delta + \eta_c + \eta_e + \eta_h)} \quad (16)$$

$$c_t = \frac{\eta_c[(1+r_{t+1})(A_t w_t + (1-\theta) aid_t) + \theta aid_{t+1}(1+n)]}{(1+r_{t+1})(\delta + \eta_c + \eta_e + \eta_h)} \quad (17)$$

$$d_{t+1} = \frac{\delta[(1+r_{t+1})(A_t w_t + (1-\theta) aid_t) + \theta aid_{t+1}(1+n)]}{\delta + \eta_c + \eta_e + \eta_h} \quad (18)$$

$$\frac{c_t}{d_{t+1}} = \frac{\eta_c}{\delta(1+r_{t+1})} \quad (19)$$

From these equations, the marginal propensities to save, spend on health and education and to consume with respect to total income are given by (20). These are calibrated in the following section.

$$\sigma_s = \frac{\delta}{\delta + \eta_c + \eta_e + \eta_h}; \sigma_h = \frac{\eta_h}{\delta + \eta_c + \eta_e + \eta_h}; \sigma_e = \frac{\eta_e}{\delta + \eta_c + \eta_e + \eta_h}; \sigma_c = \frac{\eta_c}{\delta + \eta_c + \eta_e + \eta_h} \quad (20)$$

3.3 FIRM

In this economy there is one firm in the market that employs both productivity augmented labour and capital to produce a single non-storable commodity that can be used for

consumption, investment in human capital or saving. The firm's production function is a labour augmented Cobb-Douglas production function and is given by equation (21) with α being the elasticity of output with respect to capital.

$$Y_t = K_t^{\alpha} L_t^{1-\alpha} \quad (21)$$

The firm pays a wage of w_t per unit of effective labour and rents capital from the households at the rate $R_{t+1} = (1 + r_{t+1})$ which is also the return on savings for households.

The firm maximises profit with respect to capital and labour employment.

$$\max_{K_t, L_t} \Pi_t = K_t^{\alpha} L_t^{1-\alpha} - R_t K_t - w_t L_t \quad (22)$$

Using the identity $k_t = \frac{K_t}{A_t N_t}$ to represent capital per unit effective capita and with the labour market clearing condition equating the employment of labour with the productive capabilities of a single adult agent at time t, $A_t N_t = L_t$, the first order conditions for the wage per unit productive agent and the rental rate of capital are given by (23) and (24) respectively.

$$w_t = (1 - \alpha) k_t^{\alpha} \quad (23)$$

$$R_{t+1} = \alpha k_t^{\alpha - 1} \quad (24)$$

Substituting the firm's solutions into the household's solutions gives

$$s_t = \frac{\alpha\delta k_t^{\alpha}[(1-\alpha)A_t k_t^{\alpha} + (1-\theta)aid_t] - k_t \theta aid_{t+1}(1+n)(\eta_c + \eta_e + \eta_h)}{\alpha k_t^{\alpha}(\delta + \eta_c + \eta_e + \eta_h)} \quad (25)$$

$$e_t^h = \frac{\eta_h\left[\alpha k_t^{\alpha}\left((1-\alpha)A_t k_t^{\alpha} + (1-\theta)aid_t\right) - k_t \theta aid_{t+1}(1+n)\right]}{\alpha k_t^{\alpha}(\delta + \eta_c + \eta_e + \eta_h)} \quad (26)$$

$$e_t^e = \frac{\eta_e\left[\alpha k_t^{\alpha}\left((1-\alpha)A_t k_t^{\alpha} + (1-\theta)aid_t\right) - k_t \theta aid_{t+1}(1+n)\right]}{\alpha k_t^{\alpha}(\delta + \eta_c + \eta_e + \eta_h)} \quad (27)$$

$$c_t = \frac{\eta_c\left[\alpha k_t^{\alpha}\left((1-\alpha)A_t k_t^{\alpha} + (1-\theta)aid_t\right) - k_t \theta aid_{t+1}(1+n)\right]}{\alpha k_t^{\alpha}(\delta + \eta_c + \eta_e + \eta_h)} \quad (28)$$

$$d_{t+1} = \frac{\delta\left[\alpha k_t^{\alpha}\left((1-\alpha)A_t k_t^{\alpha} + (1-\theta)aid_t\right) - k_t \theta aid_{t+1}(1+n)\right]}{k_t(\delta + \eta_c + \eta_e + \eta_h)} \quad (29)$$

3.4 HUMAN CAPITAL ACCUMULATION

Productivity in period $t+1$ is given by equation (15) and is a function of health in period $t+1$ and education in period $t+1$. The health and education of agents in a given period is determined by the investments their parents made in health and education when they were children. Hence, the functions for period $t+1$'s health, education and productivity are as follows:

$$A_{t+1} = H_{t+1}E_{t+1} \quad (30)$$

with

$$H_{t+1} = B_h e_t^h \text{ and } E_{t+1} = B_e e_t^e \quad (31)$$

where H_{t+1} represents the health of adults in period $t+1$ and E_{t+1} represents the education of adults in period $t+1$, both are determined by the investments made in health and education in period t, given by e_t^h and e_t^e respectively, scaled by sensitivity parameters. $B_h \in (0,1)$ and $B_e \in (0,1)$ are exogenously calibrated and reflect the efficiency of the translation of spending in health and education to yielded health and education respectively.

3.5 EQUILIBRIUM

This model yields a competitive equilibrium with a sequence of prices $\{w_{t+1}, r_{t+1}\}_{t=0}^{\infty}$, allocations $\{c_{t+1}, d_{t+1}, s_{t+1}, e_{t+1}^h, e_{t+1}^e\}_{t=0}^{\infty}$, physical capital stock $\{K_t\}_{t=0}^{\infty}$, human capital stocks $\{H_{t+1}, E_{t+1}\}_{t=0}^{\infty}$ and spending shares such that given initial values of $K_t > 0$, $E_t > 0$ and $H_t > 0$, households maximise their collective utility function, the firm maximises its profit and markets clear. A balanced growth equilibrium is a competitive equilibrium where all values grow at a constant and endogenous rate.

The labour market clearing condition is $A_t N_t = L_t$. Assuming full depreciation for simplicity, the capital market clearing condition requires that capital stock in period $t+1$ is equal to the total savings in period t. Thus,

$$K_{t+1} = s_t N_t \quad (32)$$

Meaning capital per effective capita in period $t+1$ is given by

$$k_{t+1} = \frac{s_t}{A_{t+1}(1+n)} \quad (33)$$

3.6 THE DYNAMIC SYSTEM

Substituting the wage rate and rental rate of capital into the household's solutions, replacing A_t with the identities given by (30) and (31) yields three dynamic equations for capital, health and education.

$$k_{t+1} = \frac{\alpha\delta k_t^{\alpha}[(1-\alpha)k_t^{\alpha}H_tE_t+(1-\theta)aid_t]-k_t\theta aid_{t+1}(1+n)(\eta_c+\eta_e+\eta_h)}{H_{t+1}E_{t+1}(1+n)\alpha k_t^{\alpha}(\delta+\eta_c+\eta_e+\eta_h)} \quad (34)$$

$$H_{t+1} = \frac{B_h\eta_h[\alpha k_t^{\alpha}\left((1-\alpha)k_t^{\alpha}H_tE_t+(1-\theta)aid_t\right)+k_t\theta aid_{t+1}(1+n)]}{\alpha k_t^{\alpha}(\delta+\eta_c+\eta_e+\eta_h)} \quad (35)$$

$$E_{t+1} = \frac{B_e\eta_e[\alpha k_t^{\alpha}\left((1-\alpha)k_t^{\alpha}H_tE_t+(1-\theta)aid_t\right)+k_t\theta aid_{t+1}(1+n)]}{\alpha k_t^{\alpha}(\delta+\eta_c+\eta_e+\eta_h)} \quad (36)$$

3.7 THE STEADY STATE

In this model with aid, there is no analytical solution that yields a steady state, instead the model must be simulated with numerical values that are calibrated in the following section. The allocation of aid, however, is a function of the steady state of the economy *without* aid. Hence, the model can be solved without aid to determine the steady state value at which the donor stops transferring to the recipient country. In other words, aid stops when the economy reaches its steady state, so the model can be solved with $\emptyset = 0$ to calculate the value at which aid transfers cease. Solving the model without aid yields the following system of dynamic equations:

$$k_{t+1} = \frac{\delta(1-\alpha)k_t^{1-\alpha}H_tE_t}{H_{t+1}E_{t+1}(1+n)(\delta+\eta_c+\eta_e+\eta_h)} \quad (37)$$

$$H_{t+1} = \frac{B_h\eta_h(1-\alpha)k_t^{\alpha}H_tE_t}{\delta+\eta_c+\eta_e+\eta_h} \quad (38)$$

$$E_{t+1} = \frac{B_e\eta_e(1-\alpha)k_t^{\alpha}H_tE_t}{\delta+\eta_c+\eta_e+\eta_h} \quad (39)$$

Setting $k_t = k_{t+1} = k^*$, $H_t = H_{t+1} = H^*$ and $E_t = E_{t+1} = E^*$ gives the steady state solutions without aid.

$$k^* = \left[\frac{\delta(1-\alpha)}{(1+n)(\delta+\eta_c+\eta_e+\eta_h)}\right]^{\frac{1}{1-\alpha}} \quad (40)$$

$$H^* = \frac{\delta+\eta_c+\eta_e+\eta_h}{B_e\eta_e(1-\alpha)k^{*\alpha}} \quad (41)$$

$$E^* = \frac{\delta+\eta_c+\eta_e+\eta_h}{B_h\eta_h(1-\alpha)k^{*\alpha}} \quad (42)$$

With output per effective capita, $y_t = \frac{Y_t}{A_t N_t}$, in the steady state being equal to

$$y^* = k^{*\alpha} \quad (43)$$

4. CALIBRATION

The model is calibrated using values that are representative of a developing country in sub-Saharan Africa. Most of the exogenous values are sourced from household surveys or the World Bank and International Monetary Fund's databases, yielding parameter values that reflect a low growth country that is in receipt of foreign aid.

4.1 HOUSEHOLD PARAMETERS

The household bargaining parameter can be set first. x reflects the weight given to the male adult when the household is maximising its utility function and the initial value is set to reflect the human capital of the male relative to the woman in an economy, a method employed by Agénor (2017). This ratio is proxied with the relative literacy rates and provides $x = 0.5751$ (World Bank, 2022). Given that $x > 0.5$, this implies gender inequality in the society and the composite utility function resembles more closely that of the male than the female.

The parameters σ_s, σ_c and σ_e are calibrated. σ_s is the marginal propensity to save and is set equal to 0.173 which is the value reported by the IMF for private savings as a proportion of income in sub-Saharan Africa. σ_c is the marginal propensity to consume and is set equal to 0.467, a value given by the World Economic Forum for Kenya (Gray, 2016). σ_e is the marginal propensity to spend on education and is set to 0.2 as in Huebler and McGee (2019). From these values the collective household parameters of $\delta = 0.173, \eta_c = 0.467$ and $\eta_e = 0.2$ can be set. The preference parameter for children's heath, $\eta_h = 0.16$, is one minus the sum of these values.

Women have a greater relative preference for consumption and the human capital accumulation of children than males so $\eta_h^f > \eta_h^m$, $\eta_e^f > \eta_e^m$ and $\eta_c^f > \eta_c^m$ (Brown, 2006**;** Lloyd & Blanc, 1996; Doss, 1996; Hoddinott & Haddad, 1995; Bourguignon & Chiappori, 1992; Bussolo, et al., 2009). These inequalities imply that men have a greater preference for consumption in retirement and are less altruistic with regards to the consumption of children. This is reflected in depth in the literature covered in Section 2, with female-headed households reporting higher levels of nutrition, health and education and higher levels of consumption (see Hoddinott & Haddad, 1995). Given the preference parameters sum to 1, the discount factors are governed by the inequality $\delta^f < \delta^m$, an inequality supported in Grossbard and Pereira (2010). From these inequalities and the lack of good estimates in the literature, the value δ^f is set to 0.05, η_e^f is set to 0.21, η_h^f is 0.17 and η_c^f is set to 0.57. These values and the value of $x = 0.5751$ allows

the preference parameters for the male agent can be calibrated. Solving separately using the identities (4), (5), (6) and (7) yield $\delta^m = 0.264, \eta_c^m = 0.39, \eta_e^m = 0.193$ and $\eta_h^m = 0.153$.

The sensitivities of health and education to investments in health and education respectively are taken from Agénor's (2017) calibration for the African country of Benin and are set as $B_h = B_e = 0.4$. This implies that the translation of expenditure on human capital to the following period's productivity is imperfect.

4.2 MACROECONOMIC PARAMETERS

Macroeconomic parameters can now be set. The fertility rate is taken from the World Bank's World Development Indicators for sub-Saharan Africa in 2021 and is set to 4.6. The parameter α, the elasticity of output to capital, is given the conventional value of 0.35 as in Litsios et al. (2021). Most literature calibrates α to be between 0.3 and 0.4, implying a greater elasticity of output to productive labour than to capital.

The exogenous calibrated parameters allow calculation for the steady state values of k^*, H^*, E^* and y^* using equations (40), (41), (42). These values are the same with and without aid because aid transfers cease at convergence to this steady state as specified by equation (1).

Despite the efficiency of the translation of spending on health to status of health being the same as that for education, the lower value of η_h is reflected in the steady state value of health being lower than education.

4.3 THE PROVISION OF AID

These values give the initial provision of aid as

$$aid_t = \emptyset(0.121956 - k_t^{\alpha}) \quad (44)$$

5. RESULTS

5.1 THE DISTRIBUTION OF FOREIGN AID, SAVINGS AND INVESTMENT

Saving, consumption and investment in health and education respond to the aid allocation parameter θ in the following way.

$$\frac{\partial s_t}{\partial \theta} = \frac{-[\delta(1+r_{t+1})aid_t+(\eta_c+\eta_e+\eta_h)aid_{t+1}(1+n)]}{(1+r_{t+1})(\delta+\eta_c+\eta_e+\eta_h)} < 0 \quad (45)$$

$$\frac{\partial e_t^h}{\partial \theta} = \frac{\eta_h[aid_{t+1}(1+n)-(1+r_{t+1})aid_t]}{(1+r_{t+1})(\delta+\eta_c+\eta_e+\eta_h)} < 0 \quad (46)$$

$$\frac{\partial e_t^e}{\partial \theta} = \frac{\eta_e[aid_{t+1}(1+n)-(1+r_{t+1})aid_t]}{(1+r_{t+1})(\delta+\eta_c+\eta_e+\eta_h)} < 0 \quad (47)$$

Savings per capita fall with an increased share of foreign aid allocated to elders. Agents have perfect foresight and internalise the allocation of foreign aid in their retirement. They then save less because they know they will have an income in the third period of life in addition to the savings they accrue in their adulthood. Not only this, but agents have less income to save. The income is adulthood is smaller than it could be if $\theta = 0$ and all aid is allocated to adults. Aid is allocated from a source exogenous to the economy and an allocation away from adults depletes the potential income they could have to save or spend on consumption, education or health.

The relationship is less clear cut for health and education. More aid to elders, reflected by a larger θ increases expenditure on health and education only when $aid_{t+1}(1+n) > (1+r_{t+1})aid_t$. This means that the value of aid received by each elder must exceed the future value of aid received today for education and health to be increasing functions of θ. If the rental rate of capital is sufficiently low, expenditure on the health and education of children will increase with the proportion of aid allocated to elders. Households realise that they will receive an additional income in their retirement, and the utility they will gain from investing their adulthood wages into their children's health will be greater than saving their aid allocation for their consumption in retirement.

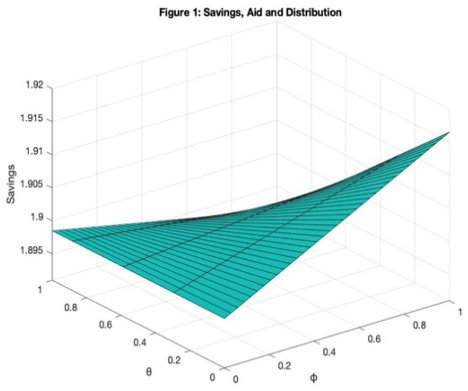
In other words, adult agents save less because they know that they have an income in their retirement, and if the return is sufficiently low, they will be altruistic and invest in the human capital of their children. However, the argument of income applies to education and health expenditure in the same was as it does for saving. A larger value of θ means more aid is

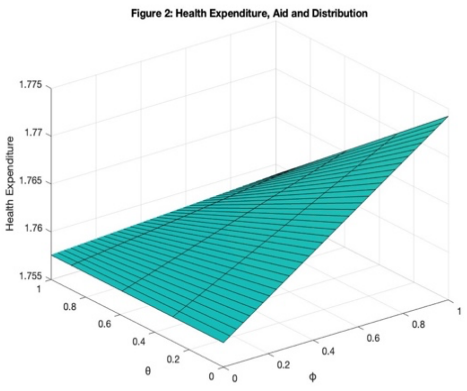
allocated to elders, so households may consume more and invest more in their children's education and health because they realise the income in their retirement. However, while an influx of aid will increase saving and spending if θ is sufficiently low, the derivatives remain negative because increasing θ lowers income relative to what it could be, so saving, and health and education expenditure are decreasing functions of θ.

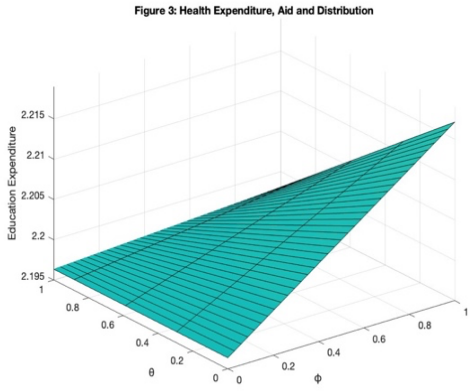
Furthermore, $(1+n)$ reflects only the fact that the population of elders is less than the population of adults. Hence, any positive rental rate of capital will ensure equations (46) and (47) are less than zero. Spending on education and health are decreasing functions of θ.

Overall, the value of θ reflects not only the deterrent to saving, but also the opportunity cost of the aid 'wasted' on allocation to those in retirement where their spending is not contributory to the productive factors of the economy, namely saving, health expenditure and education expenditure. A high allocation to elders serves not only to suppress human and physical capital accumulation but also carries a higher opportunity cost because it is allocated away from what would be productive investments.

Figures 1, 2 and 3 show how variations in aid, $\emptyset$, and distribution, θ, change the amount of savings, health expenditure and education expenditure respectively. For the simulation, the initial values of $k_0 = 0.000244994$, $H_0 = 15.751$ and $E_0 = 19.6832$ were chosen to be 10% of their steady state values provided in Table 1. As can be seen, all variables react in a similar way to variations in $\emptyset$ and θ.



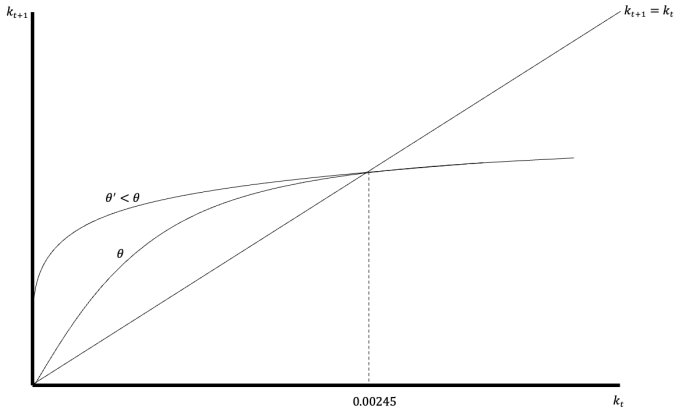




The effects on growth are twofold: savings (physical capital growth) decrease because there is income in retirement. Expenditures on health and education behave the same way. As more aid is allocated to those in retirement, income in adulthood decreases in absolute terms and stifles investment in education and health. There are two effects at play as shown by equations (46) and (47). Increased income in retirement is the effect that decreases savings in adulthood and also incites spending in education and health because the non-saved income is spent elsewhere. However, this effect is outweighed because absolute income in adulthood falls and households have a lower income to facilitate investments in the health and education of children. In other words, it is required that $aid_{t+1}(1+n) > (1+r_{t+1})aid_t$ for spending in education and health to be an increasing function of θ. This can never be achieved with a positive rental rate of capital because the population of adults is $1+n$ times larger than the population of elders. Therefore, assuming convergence to the steady state means aid decreases with time and $aid_{t+1} < aid_t$. Figures 1, 2 and 3 shows equations (25), (26) and (27), reflecting saving and spending in health and education as decreasing functions of θ. Overall, the effects of allocating aid to those in retirement is negative for physical and human capital accumulation.

The implication of this for the transition of the economy to the steady state level of capital per effective capita, k^*, is displayed more clearly in Figure 4. Figure 4 shows the transition dynamics of the economy with different levels of θ but a fixed value of $\emptyset$. The specification of aid as an income transfer in this model does not alter the steady state, merely altering the transition to the steady state. A value of θ that is high implies there is a high degree of aid capture by the elders in the economy and aid is channelled to those in retirement. Therefore, the effects described above take place. Savings decrease because adult agents have the perfect foresight and realise the aid income that is received in addition to their savings in their retirement. This does not affect the steady state level of capital but does affect the transition journey. When there is less savings the rapidity of the growth of k_t is smaller. Foreign aid continues to be received by the economy until it reaches the steady state, as required by equation (1), but will harm the economy in the transition. This is shown by the lower curve in Figure 4. Foreign aid transfers are larger for longer but do harm in the sense that they actively discourage saving.

Figure 4: Capital convergence and aid capture



Consider now a lower proportion of aid allocated to elders and a greater endowment to adults, $\theta' < \theta$. This is the higher curve on Figure 4 reflecting a more rapid and comfortable transition to the economy's steady state value of $k^* = 0.00245$. Reducing aid capture by elders diminishes the discouragement of savings because the budget constraint in retirement is tighter. Adult agents recognise the size of aid transfers and save accordingly, so less aid to those in retirement is endogenous to the household problem and income allocated to savings increases relative to the original high value of θ. While the retirement budget constraint is tightened, the constraint in adulthood is relaxed. This means that, in addition to savings, consumption can increase, health investment can increase, and educational expenditure can increase. The effects are positive for both human and physical capital accumulation throughout the convergence process.

Immediately, the productivity of aid flows is increased. The initial transition to the steady state is much more rapid and is characterised by a higher level of capital for more of the transition. While the steady state remains the same in this specification, aid flows can be deemed to be largely successful because they have induced an immediately recognisable progression to the steady state from the initial lower value of capital, health and education.

The specification of aid modelled here is compatible with a wealth of literature on aid including that of Burnside and Dollar (2000) and Easterly (2003) and could easily be extended to incorporate the golden rule level of physical capital to reflect the donor as a benevolent social planner as in Raffinot and Venet (2011). Nevertheless, foreign aid can be either harmful or beneficial. A high degree of aid capture reflected by θ in Figure 4 has net negative effects of

disincentivising saving and being allocatively inefficient. If aid capture is low, θ', then the negative effects of aid capture are outweighed by the swift and real improvement in accumulation of physical and human capital, and there should be a measurable level of growth reflective of the rapid convergence to the steady state.

This thesis has therefore been successful in its attempt to explain the differing success of foreign aid by incorporating the heterogeneity of recipient countries, as inspired by Azam and Laffont (2003). The following section will analyse how different levels of inequality can bring about differences not in the convergence to the steady state, but in the attainable steady state, explaining how the conditionalities attached to aid can be used to influence the level of gender inequality in an economy and exogenously alter the value of x.

5.2 GENDER INEQUALITY AND CONVERGENCE IN THE PRESENCE OF FOREIGN AID

Table 1: Steady State Values **Base**

	$x = 0.5751$	$x = 0.65$	$x = 0.53$	$x = 0.5$
Capital per effective capita, $\boldsymbol{k^*}$	0.00244994	0.002809	0.00224293	0.00210881
Output per effective capita, $\boldsymbol{y^*}$	0.121956	0.127936	0.118246	0.115721
Output per capita, $\boldsymbol{Y^*/N}$	3781.02	3657.06	3866.29	3928.19
Education level, $\boldsymbol{E^*}$	196.832	189.135	202.042	205.798
Health level, $\boldsymbol{H^*}$	157.51	151.109	161.833	164.945
Productivity, $\boldsymbol{A^*}$	31003.1	28580	32697.1	33945.2
Rental rate of capital, $\boldsymbol{R^*}$	17.4228	15.9408	18.4517	19.2063
Wage rate, $\boldsymbol{w^*}$	0.0792716	0.0831585	0.0768598	0.0752189
Spending on consumption, $\boldsymbol{c^*}$	1146.46	1076.63	1192.71	1225.59
Saving, $\boldsymbol{s^*}$	425.351	449.429	410.689	400.872
Spending on education, $\boldsymbol{e^{e^*}}$	492.081	472.839	505.105	514.494
Spending on health, $\boldsymbol{e^{h^*}}$	393.775	377.772	404.582	412.362

In this section, I simulate the steady state of the typical African economy for which the model is calibrated with different levels of household bargaining power. The base bargaining power that is estimated using the relative level of male to female literacy rates in Section 4 gives $x =$

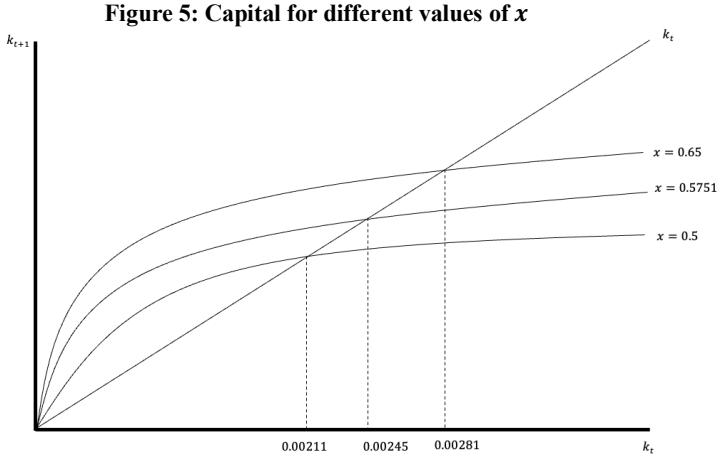
0.5751. With this level of gender inequality, the achievable steady state is displayed in Table 1 Column 1.

There are two main channels through which changing levels of bargaining power affect development. Column 2 displays the effect of an autonomous increase in male bargaining power from $x = 0.5751$ to $x = 0.65$. In other words, a heightened state of gender inequality.

One channel through which this has an effect on output is through the accumulation of physical capital. As men have a lower discount factor, their preference for consumption in retirement, δ^m is higher than that of women, δ^f. This implies men have a greater tendency to save for consumption in their retirement. Savings increase from 425 to 449 and this contributes to physical capital accumulation. Physical capital per effective capita, k, in the steady state rises from 0.0024 to 0.0028. Output per effective capita increases also from 0.122 to 0.128.

However, the outcomes regarding human capital accumulation are negative. Consumption does decrease, but so does spending on education, which falls from 492.1 to 482.8, and spending on health which falls from 393.8 to 388.8. This is the effect of the collective household utility function incorporating an overall decrease in η_e and η_h. The fall in spending on education and health naturally translates to poorer outcomes for health and education. The level of education falls from 196.8 to 189.1 and the level of health falls from 157.51 to 151.1. Overall productivity falls from 31003 to 28580 meaning a deterioration in human capital.

Figure 5: Capital for different values of x



The effect on output is two-fold. Output per effective capita, k, increases because the savings increase and productivity decreases. However, output per capita decreases because of this fall

in human capital and productivity. This magnitude and direction of this effect, however, depends on the value of α which is the elasticity of output to capital and the difference between the male and female preference parameters. A higher value of α would yield an increased output per capita despite the fall in productivity and greater symmetry of the male and female preference parameters will reduce the effect of gender inequality.

The effects are opposite for a decrease in gender inequality and a fall in the value of x to 0.53 (Column 3) and eventually 0.5 (Column 4) which reflects perfect gender equality in the economy. Savings decrease because $\delta^f < \delta^m$ and women discount the future more heavily by virtue of their higher preferences for consumption and expenditure in adulthood. However, women favour human capital investments more than men so an increase in female bargaining power leads to an increase in η_h and η_e. Expenditure on health and education increase from 393.8 to 412.4 and 492.1 to 514.5 respectively. This has a beneficial effect on the productivity of the children when they become adults which sees A^* increase from 31003.1 to 33945.2. Total output increases because the fall in savings and physical capital accumulation is more than cancelled out by the productivity growth. Output per capita increases from 3781 to 3928.2 in the steady state, but output per *effective* capita, $y_t = \left(\frac{K_t}{A_t N_t}\right)^{\alpha}$, decreases because physical capital accumulation declines and productivity increases. Both these effects act in the same direction and decrease y^* from 0.122 to 0.116. Consumption is a decreasing function of x so increased female bargaining power increases consumption in adulthood.

The effect of changes in male bargaining power can be summarised by Figures 5, 6 and 7 which show how different values of x yield larger or lower steady states depending on the variable in question. Figure 5 shows how capital per effective capita increases with male bargaining power because savings increase which determines capital in the following period. However, the education and health outcomes, shown by Figures 6 and 7, respectively worsen.

Figure 6: Education for different values of x

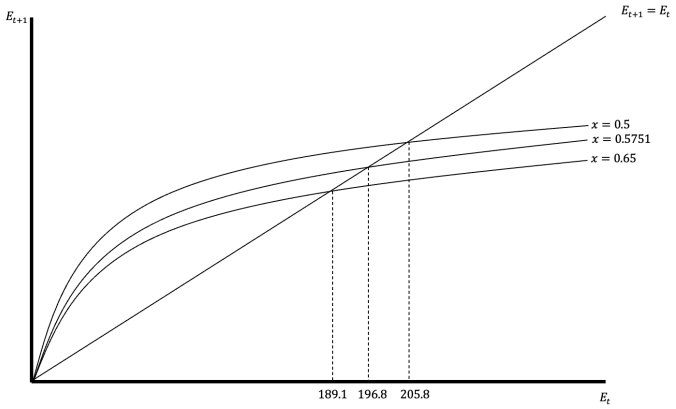
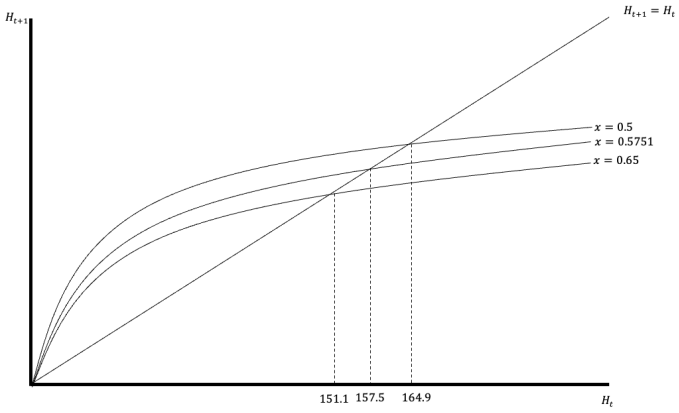


Figure 7: Health for different values of x



The figures above show how the changing values of x yields different trajectories of health and education. The economy's equilibrium is higher for education and health if the male bargaining power given by x is lower.

This section has successfully shown how foreign aid capture will not affect the steady state, as argued by Burnside and Dollar (2000) and Easterly (2003), but how country characteristics, like that of climate in Dalgaard, Hansen and Tarp (2004) or the existence of an elite in Svensson (2000) or Boone (1996), must be accounted for to increase the steady state that foreign aid encourages convergence to. It brings in the question of conditionality that is commonly associated with official development assistance and how the transfers can be manipulated to exogenously change the value of x. For example, Zhang and Huang (2023) identified World Bank foreign aid projects with integrated gender mainstreaming strategies that have been successful in diffusing gender norms to the local population. The World Bank (2016) claim that their gender mainstreaming strategy is effective in promoting gender equality and this demonstrates how foreign aid can manipulate microeconomic parameters to induce convergence to a favourable steady state, shown by the experiment below. Foreign aid strategies like this tie together the concepts of aid and inequality and show how, even with a fairly one-dimensional interpretation of aid as a direct income transfer like in this model, conditionality can be reflected in the model by exogenously changing the parameter values.

Interpretation in this way is increasingly relevant given the growth of social protection systems for women and gender focused foreign aid. 42% of bilateral aid focuses on gender empowerment issues and 4% of bilateral aid's primary objective is gender empowerment

(OECD, 2020). This means that the foreign aid in this model can be interpreted both as the direct income transfer described by Equation 1, but also as a decrease in x because the foreign aid itself is attached to gender-related empowerment conditions. For example, there is an increasing focus on women's education, health and direct transfers to women that could all serve to exogenously decrease male household bargaining power (OECD, 2020).

Figures 8 and 9 show, albeit theoretically, how inequality focused foreign aid would work in practice to promote both convergence to, and increases of, health (as an example). A foreign aid approach like that described above has two effects. The first is to empower women and health accumulation, leading to a larger steady state value of health shown by the Figure 9. The second is reflected by the lower value of $\theta_2 < \theta_1$ which induces a more favourable convergence to the steady state, characterised by higher productivity.

Figure 8: Health convergence with $x = 0.65$

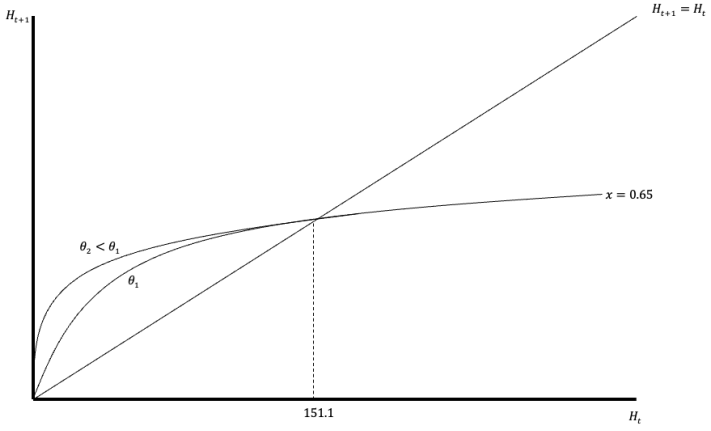
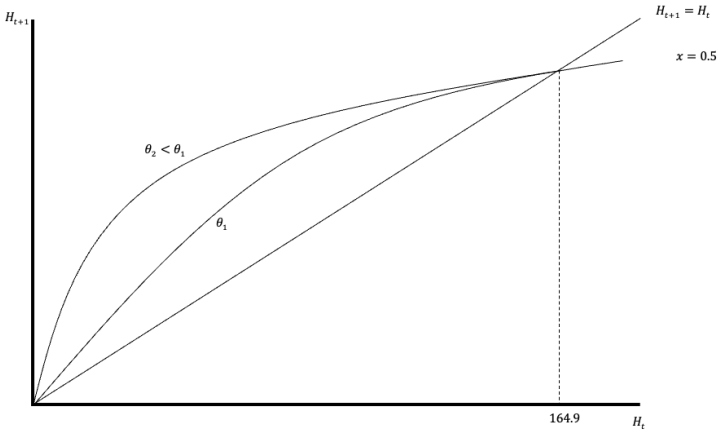


Figure 9: Health convergence with gender equality



A foreign aid project like the World Bank's gender mainstreaming strategy could not only increase the steady state from that of a highly unequal society (Figure 8), but if implemented effectively with little aid capture by the elders in the society the convergence to the higher steady state would be the wider θ_2 curve, representing higher levels of health throughout the convergence process. There are plenty of examples of projects that involve these mechanics. In Cameroon, the World Bank's conditional cash transfers were paid to female representatives to empower women and increase investments in children's human capital; in Niger, transfers were paid to women to increase the quality of food consumption (Bardasi & Garcia, 2014).

6. CONCLUSION

6.1 SUMMARY

This paper's main objective was to provide a relationship between the effectiveness of foreign aid and convergence. It has been successful in showing how foreign aid can both alter the speed of convergence to the steady state and, through conditionality and gender mainstreaming strategies like those of the World Bank, the achievable steady state. The methodology of this paper departs from the traditional literature that uses econometric analysis and captures the household level dynamics and intragenerational mechanisms determining physical and human capital accumulation in developing countries. The model presented in this paper successfully incorporated the two facets of gender and age inequality to assess the effect of foreign aid.

It has been shown through the employed OLG model how exogenous changes in the intrahousehold bargaining power affect household spending, saving and the endowments of future generations. Perfect gender equality in the household has the potential to increase steady state output per capita, health status and education status by 3.9%, 4.7% and 4.6% respectively. Development projects, especially those involving conditional cash transfers, can induce these changes, but aid capture must be limited to maximise effectiveness and the speed of the convergence. A high level of gerontocratic aid capture involving transfers to those in retirement disincentivises savings and limits the funds available for productive investments like expenditure on the health and education of children. Poorly allocated aid slows the process and instigates lower levels of physical and human capital throughout the convergence.

It has been shown how the difference in preferences for consumption, children's human capital and savings between genders can harm the convergence process and the achievable steady state when gender inequality is high. Implications for policy result from this. This thesis highlights the importance of gender focused foreign aid projects to move beyond aid as a mechanism to promote convergence to the steady state but instead to increase the steady state equilibrium. Investments by households and women lay the groundwork for human capital accumulation, an engine of growth, so empowering women is not only beneficial ethically but also critical for poverty reduction and human improvement. Policy makers can take away from this research not only a computable model for impact analysis, but also an insight into the 'black box' of foreign aid and the causal relationships between aid and development.

The analysis in Section 5.2 brings together gender inequality, capture by elders and foreign aid to illustrate incidences of successful aid flows. Previous literature has pushed for more holistic evaluations of aid tailored to the recipient country's unique characteristics and the model presented in this paper does that. The model is computable and does not inappropriately embed the assumption of homogeneity of the recipient country that results in poorly designed aid programs, allowing more individualised policy evaluation.

The analysis presented here does not fall into that category and highlights the importance of cultural factors in the development process, successfully designing a framework for a holistic approach to foreign aid that has largely been missing in the previous literature. This paper is the first to incorporate both age and gender inequality in a framework for aid policy analysis and, with development projects incorporating microeconomic inequalities more and more in recent years (Bardasi & Garcia, 2014), it fills an increasingly important gap in the literature.

6.2 RECOMMENDATIONS FOR FUTURE RESEARCH

There are some limits to the research presented here, however. Foreign aid is considered in a purely one-dimensional plane as a direct income transfer. This limits the interpretation of the conclusions of this paper because aid is often used in a much more diverse way and can be characterised by which generations or institutions hold its ownership, deciding its effectiveness (Koichi, 2007). The model designed in this paper, while simple and easily computable, assumes away a government and interprets aid as income transfers, either in adulthood or retirement, used to speed convergence to the steady state. Future research could benefit from interpreting aid in a more diverse manner, perhaps as exogenous government budget support transfers or even as a means to manipulate the economy into the golden rule steady state as in Raffinot and Venet (2011). Foreign aid donor institutions arguably act as 'benevolent social planners', minimising poverty by maximising consumption at the steady state. The model presented in this paper could serve as the foundation for analysis in this way which may enrich but not invalidate the results.

Concerning the intrahousehold dynamics, future research could benefit from endogenizing the fertility rate and the household bargaining parameter x. In Agénor's (2017) computable OLG model, the accumulation of human capital and wage rate was separated by gender, and the household bargaining parameter was the ratio of male to female human capital. Male agents

were paid their marginal product while female agents were paid a proportion of their marginal product to reflect discrimination in the wage market. Male and female agents also have, albeit different, preferences for fertility. Agénor's (2017) model provides a more comprehensive analysis regarding gender inequality and policy experimentation, but also requires far more assumptions and does not incorporate foreign aid.

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