Working Paper Series

Care Work and the Economy

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1. INTRODUCTION

Population growth is a prominent feature of long-run economic growth models but is seldom integrated in a convincing way. Changes in the size of the labor force are typically treated as exogenous or, as a result of an assumption of constant returns, inconsequential. In this paper, we outline an endogenous growth model in which demographics matter. Because this model allows for endogenous fertility and variations in returns to scale, it can link macroeconomic dynamics with changes in the level and the distribution of the costs of reproduction (defined broadly as the cost of producing and maintaining human capabilities) (Folbre and Heintz 2017; Walters, 1995). It sets the stage for an approach to reproductive decision-making that goes beyond individual utility maximization and builds on early overlapping generations models (Samuelson, 1958; Cigno, 1995) by emphasizing the effect of non-market institutions shaped by the relative bargaining power of groups based on gender, age, citizenship, and other dimensions of collective identity.

Economies feature distinct demographic patterns. At the global level, we see some economies struggling with the potential problem of a "surplus" population, while others fear the possibility of their populations shrinking. In North America, Western Europe, and some parts of Asia, many higher-income countries are faced with the prospect of below-replacement fertility and aging populations. This raises concerns about the future of their cultures and the trajectories of their economies. In contrast, other countries, particularly lower-income countries in sub-Saharan Africa and South Asia, have high fertility rates and large youth populations, with fewer working-age adults per child to generate income and perform unpaid care work. This limits the resources available to invest in the next generation.

The model presented here allows for both demographic regimes. Unlike most growth models with endogenous fertility, negative population growth is a possible long-run outcome. Economies may gravitate towards a situation of below-replacement fertility and stagnant growth of per capita income. But other dynamics are possible. Economies with different productive characteristics, as reflected in variations in returns to scale, may have high, positive fertility rates, but potentially unstable population dynamics that have negative consequences for per capita market incomes.

This paper begins with a description of those long-run macroeconomic growth models we like the best—those that allow for endogenous growth or fertility—but that we nonetheless consider unpersuasive. It then turns to an exposition of an alternative model that combines features of endogenous growth models with endogenous population dynamics in a way that allows for more realistic microeconomic foundations. The final discussion of policy implications returns to the emphasis on the role of social institutions acknowledged in early overlapping generations models.

2. ENDOGENOUS GROWTH AND POPULATION DYNAMICS

Most models in the original Solow (1956) tradition assume constant returns to scale and exogenous population growth rates. Within these models, constant returns to scale preclude population dynamics from affecting per capita market output, even when population growth changes. Shifts in population dynamics, which correspond in these models to changes in the employed paid labor force, affect aggregate output but not per capita income. By contrast, endogenous growth theory allows for a different relationship between an economy's population dynamics and per capita market income, adopting an assumption of increasing returns to scale that alters the relationship between demographics and macroeconomic outcomes.

For instance, in Romer's (1990) theory of endogenous technological change, the non-rival nature of knowledge and ideas introduces economies of scale, yielding a result in which growth rate of market output per worker varies with the population (Jones, 1999). An increase in the absolute size of the population raises the per capita growth rate. This connection between the size of the population and the growth rate of per capita income raises questions. Why would countries with large populations necessarily grow more rapidly? Other endogenous growth models yield different relationships between population dynamics and per capita outcomes. Jones (1995) proposes a model in which changes in the size of the population affect the level of market income per capita, but not its growth rate. Logically, this implies that the growth of per capita income is positively correlated with the population growth rate.

Endogenous growth models create scope for demographics to affect per capita macroeconomic outcomes. However, many of these models still treat fertility and population dynamics as exogenous. Demographic changes occur outside of and are independent of the machinations of the growth process.

Some growth models do endogenize population dynamics. Barro and Becker (1989) represent an early, and influential, effort to include fertility decisions in a neoclassical growth model across an infinite time horizon. Galor and Weil (1996) offer an alternative growth model with endogenous fertility, one based on over-lapping generations instead of dynastic utility maximization. In both models, fertility choices are the result of maximizing a unitary utility function. Other growth models incorporate bargaining dynamics into their models (see e.g. Agénor, 2017; Doepke and Tertilt, 2016). In these approaches, women's bargaining power is either exogenously given or related to the returns to their productive attributes in the paid labor market. Instead of a unitary utility function, women and men have different exogenous preferences and the models assume that women innately care more for their children than do men.[1]

[1] In the model presented in Agénor (2017), women care more about investments in their children's health outcomes relative to current consumption compared to men. Similarly, in their discussion of growth and household bargaining, Doepke and Tertilt (2016) assume that women care more about child welfare than men.

Yet these models also fall short for a number of reasons. They foreclose the possibility of below-replacement fertility and negative population growth. They assume that households are identical and representative and that all women participate in childbearing and have the same fertility rate. The models also assume that, if households have children, the minimum number of children is equal to the number of adults. For instance, in models with two-adult households, this implies that if households have children, they have at least two (in some models, individuals replicate themselves so that each individual has at least one child). This, combined with the assumption that households are identical, sets a lower bound of zero on population growth.

Furthermore, in their emphasis on individual utility optimization, many of these models ignore the possibility that individuals may engage in collective action with others to establish social institutions and public policies that affect intergenerational and inter-gender transfers of time and money. Paul Samuelson explicitly emphasized the importance of what he variously termed social collusion, social coercion, and social contracts in 1958. Allesandro Cigno has observed that intra-family contracts for intergenerational transfers are easily disrupted by the development of markets for capital and labor (1995).

This paper presents a model that combines elements of endogenous growth theory with endogenous fertility choice and population dynamics. Variations in the structure of the market economy are represented as differences in returns to scale: decreasing, constant, or increasing. Depending on these structural characteristics, the model generates distinct outcomes. It allows for below-replacement fertility and negative population growth as a possible equilibrium. It also can produce outcomes with high fertility in an unstable equilibrium, allowing for a high fertility "trap" with low, and declining, per capita incomes. While the micro-foundations are not developed here, these outcomes strengthen the argument that individual optimization of fertility decisions is unlikely to invariably generate a stable long-run equilibrium growth path with constantly rising per capita market incomes.

3. THE MODEL

This growth model loosely adapts an approach sketched out by Jones (1998) that focuses on population dynamics within an endogenous growth framework. We introduce endogenous fertility into this framework. Therefore, in the model presented here, there are two endogenously produced factors of production: human beings (labor) and knowledge that reflects technical know-how.

Assume that the production of market goods and services is described by the following relationship:

$$Y = (\lambda AhL)^{\sigma} \tag{1}$$

Y is aggregate output, L represents the potential labor force (working-age population), λ is the fraction of the potential labor force engaged in paid employment, h is the average cumulative investment in human capacities per working age adult, and A reflects the current state of knowledge that can enhance the productivity of labor. No restrictions are placed on the variable σ except that it must be greater than zero. This allows the model to explore different returns to scale: increasing, decreasing, or constant. Equation 1 is restricted to only reflect aggregate market income. For the purposes of this model, all non-market production is assumed to be dedicated to care work that produces new human beings. Adding non-market production that supplements market income and household consumption is certainly possible, but it would not change the core dynamics of the model.

We define human capacities along the same lines as Braunstein, van Staveren, and Tavani (2011). These refer to individual attributes that improve that person's productive contributions. Human capacities are not innate, but must be built in the course of a person's life. They include formal education and training, i.e. the traditional categories of human capital, but also emotional maturity, leadership, the ability to work collaboratively, cultivated creativity, good health, and other similar attributes.

In standard growth models, A typically represents the current state of technology – i.e. the output of concerted efforts at research and development. Here the variable is interpreted more broadly as the stock of knowledge that can be used to boost productivity. This includes new inventions and product innovations. But it could also include better ways of organizing production, improved management techniques, and knowledge generated by a process of learning-by-doing.

The generation of new productive know-how depends on the average cumulative investments made in human capacities and is given by the following differential equation:

$$\dot{A} = \delta h A^{\phi} \tag{2}$$

In Equation 2, δ is assumed to be greater than zero and $0 < \phi < 1$. **Because of the restrictions placed on ϕ, knowledge is accumulated over time, but at a decreasing rate (i.e. as the stock of knowledge expands, it becomes increasingly difficult to come up with something innovative). This assumption follows Jones (1998).**[2]

One feature of Equations 1 and 2 is that the generation of productivity-enhancing know-how has broad-based impacts. As discussed by Romer (1990), knowledge is a non-rival good, and excludability, i.e. designing an enforceable set of property rights, can be difficult and costly. In these respects, knowledge shares many of the characteristics of a public

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[2] Variations on the specification of the technology/know-how production function are evident in the literature on growth models with endogenous technological change. The specification used in this model assumes that technological progress slows with higher values of A (i.e. there is decreasing marginal productivity). Other approaches assume that past discoveries contribute to accelerating technological change, i.e. $\phi > 1$ **or that marginal productivity increases along with A.**

good. In this model, the benefits of knowledge production spill over across individual firms and producers. They have macroeconomic impacts and, because of the existence of non-rivalness and positive externalities, an argument can be made for public investment in human capacities that fuel on-going innovations in the way we do things.

The population growth rate is also assumed to be endogenous and represented by the following differential equation.

$$\dot{N} = \mu \left(s \frac{Y}{L} \right)^{-\tau} N - mN \tag{3}$$

Equation 3 has two components – a birth rate term reflecting gross additions to the population due to fertility decisions (the first term on the righthand side) and losses to the population due to mortality. Total deaths (mN) are assumed to be a constant share (m) of the population. Equation 3 assumes that population growth responds inversely to the expected net cost of children to women. Women are assumed to make fertility decisions based on preferences, norms, and the expected net costs of raising children. The expected costs of children are influenced by bargaining dynamics within the household, the number of working-age adults present (e.g. two-parent v. single parent households), economies of scale associated with household formation and women's degree of specialization in unpaid care. Children also may provide benefits to women and the households in which they live (e.g. adult children may transfer income to support aging parents). Therefore, we assume that fertility rates respond to the net costs of children, taking into account these benefits. Other institutional factors, such as the enjoyment of reproductive rights and the availability of contraception, influence women's ability to exercise agency with regard to fertility decisions.

One component of the cost of children is the opportunity cost of investing in children – i.e. the foregone market expenditures that could have been enjoyed if time and money were not spent on raising children. Therefore, the cost of children is assumed to rise with market income per working adult (Y/L). The variable s in Equation 3 is a scale parameter that captures the size of these opportunity costs for women. For example, a gender wage gap would reduce women's earnings relative to men's and lower their opportunity cost of women specializing (at least in part) in non-market care work. This would be captured in a lower value for s. If labor market segregation declined and new opportunities for paid employment opened up to women, the value of s would rise. Changing norms in which men shouldered a larger share of the responsibility for raising children could be reflected in a lower value for s.

Different societies exhibit distinct norms that influence gender roles and the expression of preferences. For instance, pro-natalist norms, which place greater value on childbearing and women's role as mothers, may be associated with higher fertility rates even when the expected net cost of children to women does not vary. The parameter μ in Equation 3 captures the effects of these norms on fertility rates and population growth.

To focus on the dynamics of the simple model, Equation 3 assumes a closed economy with no net migration. We discuss the issue of migration later in the paper. Mortality rates also change in the course of economic development, leading to an increase in life expectancy that affects the size of the total population. However, variations in the long-run growth rate of the working-age population are assumed to be primarily driven by fertility decisions and any impacts of changing life expectancy are therefore not explicitly modeled.[3]

Transfers of both time and money can affect the costs of children. If relatives take care of children after school, this represents a transfer of time that has real value and can reduce the individual cost of children. Similarly public services (such as childcare services) or family support grants also represent transfers that affect the private, individual cost of children. In some cases, the existence of such transfers could be modeled as a reduction in the size of s. But the impact of transfers could be more far-reaching with respect to the simple formulation presented here. A system of transfers of time, money, and services may alter the relationship presented in Equation 3. To the extent that the opportunity cost of children is delinked from personal, private income, Equation 3 would have to be modified. For example, the cost of raising children could be socialized in such a way that increases in per capita income might actually encourage higher fertility. We discuss alternative approaches later in the paper, but for the present analysis the costs of children are assumed to rise with average market income.

In order to focus on population dynamics within an endogenous growth model, we assume that h, the average cumulative investment in human capacities, is determined exogenously. To the extent that h is primarily determined by policy choices, this assumption is warranted. However, many aspects of human capacities would be determined by factors similar to those that influence fertility choices. In addition, household expenditures on education, care services, and health are important inputs into developing human capacities. Nevertheless, to keep the focus on the relationships of primary interest in this particular model, we make the simplifying assumption that h is exogenous (and can be used to illustrate policy choices around investment in human capacities). If we treat the average (i.e. per capita) investment in human capacities as exogenous, this implies that the share of market income that is dedicated to maintaining human capabilities will change with the dynamics of the model. This occurs because the growth rates of aggregate market output and population are endogenous.

4. THE DYNAMICS OF THE MODEL

From Equation 2, it is straight-forward to derive an expression for the growth rate of productivity-enhancing knowledge, g_A

[3] Falling mortality rates and increasing life expectancy would be associated with an aging population, with the share of the population in higher age cohorts growing over time. As a consequence, the working age population's share of the total population would fall over time. This model implicitly makes the simplifying assumption that the working age population's share of the total population is constant. Changes in the age composition of the population may have macroeconomic implications which are not explored in this paper.

$$g_A = \frac{\delta h}{A^{1-\phi}} \quad (4)$$

and of the steady-state, where the growth rate of knowledge production is constant and has no tendency to accelerate or decelerate:

$$g_A^* = \frac{g_h}{1-\phi} \quad (5)$$

We define g_y to be the growth rate of market income per working-age adult (Y/L). We also assume that the working-age population grows, in the long-run, at the same rate as the total population.[4] Furthermore, as a first step, we take the population growth rate, n, to be constant – but we relax this assumption shortly. Equations 1 and 5 give us an expression for g_y when knowledge production is in a steady-state:

$$g_y^* = \frac{\sigma g_h(2-\phi) + (\sigma - 1)(1-\phi)n}{(1-\phi)} \quad (6)$$

The expression in Equation 6 presents a relationship between the steady-state growth rate of income per working-age adult and the population growth rate. Here returns to scale come into play. If there are decreasing returns to scale, $0 < \sigma < 1$, then there is a negative relationship between the population growth rate and the growth rate of average market income. If there are constant returns to scale, $\sigma = 1$, the population growth rate has no impact on the growth rate of average income. Finally, if there are increasing returns to scale, $\sigma > 1$, then there is a positive relationship between the population growth rate and the growth rate in average market income.

For the purposes of this model, the existence of economies of scale happen at the aggregate level, consistent with the idea of external economies first proposed by Young (1928). As economies grow and diversify, producers become increasingly specialized in ways that generate broad productivity benefits through spill-over and clustering effects. Therefore, we would expect more developed, diverse economies to exhibit increasing returns. Note that increasing returns can exist at the aggregate level, even if individual firms experience constant returns to scale (Romer 1986). This occurs because of the existence of positive externalities that benefit industries or clusters of firms. In contrast, economies that are not diversified and depend to a large extent on fixed resources for production (e.g. land) are more likely to be characterized by decreasing returns to scale. Within this model, these two types of economies – increasing returns to scale and decreasing returns to scale – exhibit dramatically different population dynamics.

[4] As mentioned earlier, this is equivalent to assuming that the working age population's share of the total population is constant.

Equation 6 showed the relationship between the steady-state growth rate of income per working-age adult and the population growth rate when the population growth rate was taken to be exogenous. But, in this model, the population growth rate is endogenous, as presented in Equation 3. Dividing both sides of Equation 3 by the size of the population, N, give us:

$$\frac{\dot{N}}{N} = n = \left(s\frac{Y}{L}\right)^{-\tau} - m \tag{7}$$

Equation 7 tells us that the population growth rate is the difference between the birth rate minus a constant mortality rate, the rate of deaths in the population. Since the mortality rate is constant, the population growth rate will also be constant (i.e. in a steady-state) when the birth rate (i.e. the gross additions to the population relative to the size of the population) does not change.

From this relationship and Equation 1, we can derive an expression for steady-state population growth rate, this time taking g_A to be exogenous:

$$n^* = \frac{\sigma}{(1-\sigma)} g_A + \frac{\sigma}{(1-\sigma)} g_h \tag{8}$$

Equations 5 and 8 give us expressions for the steady-state growth rate of the two produced factors of production: productivity-enhancing knowledge and people. When these expressions hold simultaneously, we have a description of the growth path of this model economy. The nature of this steady-state, however, depends on **σ which determines whether the economy is exhibiting increasing, decreasing, or constant returns to scale.**

5. THE STEADY STATE

5.1. THE CASE OF INCREASING RETURNS TO SCALE

If there are increasing returns to scale, $\sigma > 1$, and the coefficient on the g_A term in Equation 7 is negative. The intercept with the horizontal axis, i.e. when $g_A = 0$, is also negative. Figure 1 shows a graph of Equations 5 and 8 when there are increasing returns to scale. The horizontal line, g^*_A, is given by Equation 5 and the downward sloping line, n^*, is given by Equation 8. The steady-state for this model is shown by the intersection of the two lines, at point S. Note that this model predicts a negative population growth rate in the steady-state – i.e. an economy that exhibits increasing returns to scale will gravitate towards a situation of below replacement fertility.

Using Equations 1, 5, and 8, with a bit of manipulation, we can show that the steady state equilibrium would be one in which average growth of market income were zero. This occurs because an exogenous increase in market income would raise the cost of children, all other things being equal, and slow the population growth rate. In an increasing returns to scale economy, a lower population growth rate reduces the growth rate of average market incomes.

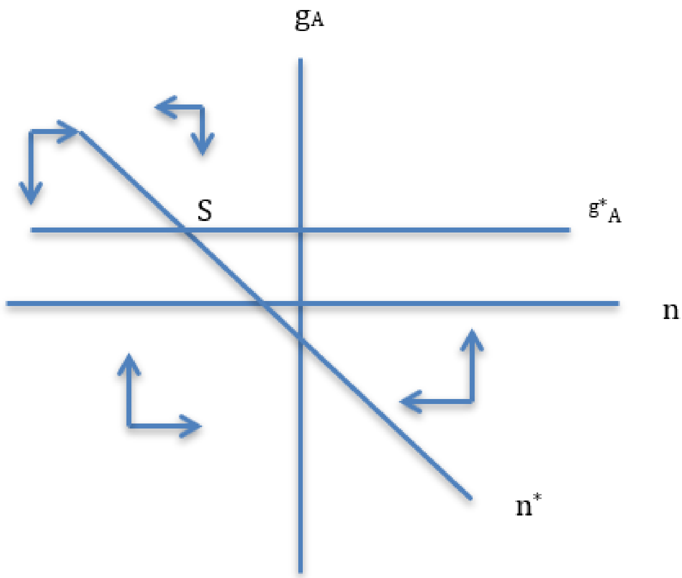

Figure 1: Phase diagram under increasing returns to scale

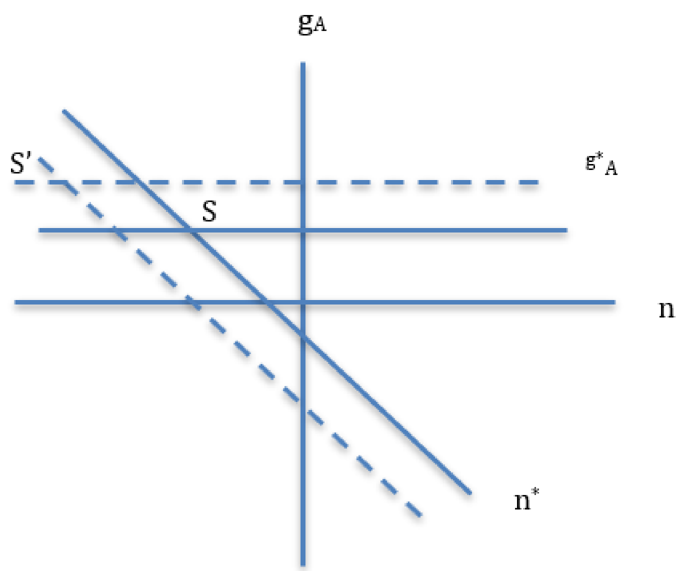

Figure 2: Steady state fertility and income growth with an increase in investment in human capacity

An examination of the dynamics of g_A and n when they take on values other than their steady-state values shows that the steady state with below-replacement fertility is a stable equilibrium (see phase diagram in Figure 1). What this suggests is that in increasing returns-to-scale economies, positive population growth rates will initially be associated with positive growth rates in market income per working age adult. This follows from Equation 6. However, as average market incomes increase, so do the cost of children, putting downward pressure on the population growth rate until it eventually turns negative. This movement towards the steady-state may be extremely slow – it could take generations – so Figure 1 may be better interpreted as illustrating a tendency towards a steady-state, rather than a rapidly established equilibrium.

In this simple presentation, we assumed that the average cumulative investment in human capacities, h, is exogenously determined. What would happen if the growth rate of h were increased? A positive growth rate for h would mean that the human capacities of children would be greater, on average, than those of their parents. The higher the growth rate of h, the bigger this difference would be. Following an increase in g_h, we would expect an increase in per capita market incomes in the short-run as the growth rate in average market incomes initially rises. However, this has a feedback effect on fertility rates and would lower the population growth rate. Lower population growth rates subsequently slow average income growth. The steady-state population growth rate would become increasingly negative as h increases (see Figure 2 in which the dotted lines correspond to the steady state values of g_A and n when the growth rate of h increases).

5.2. THE CASE OF DECREASING RETURNS TO SCALE

The case of decreasing returns to scale, $0 < \sigma < 1$, looks quite different from the case of increasing returns to scale (Figure 3). Now the n^* line, illustrating the combinations of g_A and n for which there is no tendency for n to change, is upward sloping. The steady state occurs when the population growth rate is positive. With decreasing returns to scale, a positive population growth rate puts downward pressure on average market incomes. To some extent on-going investments in human capacities, if they are forthcoming, can counteract the effect of high population growth.

The difficulty with the model's steady state under decreasing returns to scale is that the steady state is no longer stable. If the population growth rate exceeds the steady state equilibrium, this places downward pressure on average market incomes (similar to a Malthusian argument) and encourages higher, not lower, fertility rates. There is no automatic equilibrating mechanism and decreasing returns to scale economies could face a high fertility "trap". Under these conditions, an external intervention is needed to address high and increasing fertility rates. For instance, an exogenous increase in investments in human capacities (a "big push") could shift the economy towards the steady-state path.

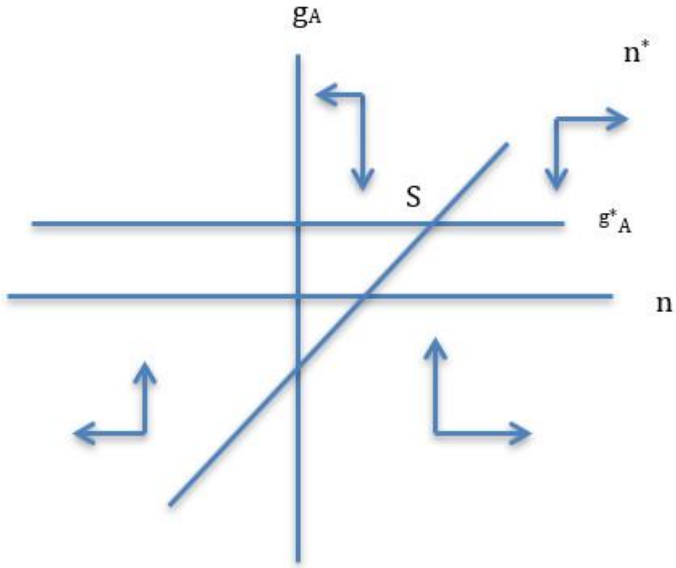

Figure 3: Phase diagram under decreasing returns to scale

5.3. STRUCTURAL CHANGE

This simple model has assumed that a country falls into one of three categories: increasing returns to scale, decreasing returns to scale, or constant returns to scale. However, the process of economic development has been described (along the lines of Kuznets and Kaldor) as one of structural change – in which economies diversify and begin to exhibit increasing returns to scale. In the simple model presented here, this would manifest itself as an increase in the value of σ and it would alter the nature of the n^* curve. When $0 < \sigma < 1$, the steady-state n^* curve would be upward sloping as in Figure 3. As σ increases, the slope of the n^* curve would flatten until it began to slope downward, as in Figure 1. As the curve flattens, we would expect that, at some point, there would be downward pressure on the population growth rate. That downward pressure would continue as the economy began to exhibit increasing returns to scale. As the process of structural change continues, the economy would eventually move towards below-replacement fertility.

5.4. BELOW REPLACEMENT FERTILITY

This model shows that, when the expected net cost of children rises with per capita income and when increasing returns to scale are present, an economy moves towards negative population growth (i.e. below replacement fertility) and low (or zero) growth in average market incomes. The distinction between levels and growth rates is important here. Although per capita incomes may stagnate (i.e. have a low growth rate), the level of per capita income in diversified economies exhibiting increasing returns to scale can still be quite high.

However, below replacement fertility generates potential problems not captured in this model. For instance, economies that currently have below replacement fertility rates also have aging populations. This can create growing demand for care services, higher health expenditures, and pressures on the social security system – all of which have macroeconomic consequences. A population that is dwindling away slowly may generate other social concerns beyond a simple consideration of the average size of market incomes.

What can be done? One possibility is to reduce the expected burden to women of raising children. This could be achieved, for instance, by reducing the size of s in Equation 3 through various policy measures (i.e. partially subsidizing the cost of childcare or better enforcement of male child support responsibilities). This would generate an increase in the population growth rate in the short-run. But as long as the cost of children is proportional to private market incomes (i.e. the opportunity costs of having children is reflected in a reduction in the discretionary use of that income for other purposes) downward pressures on population growth rates will continue in the long-run. An alternative would be to transform the relationship in Equation 3. For instance, taxes could be collected from the entire working age population (parents and non-parents) in order to finance family support policies for caregivers with children. This could significantly weaken the link between the cost of children and private market incomes in ways that would change the population dynamics of the model.

There is another way to delink population dynamics from the costs of children and market incomes. Countries with below replacement fertility could import adults from other countries. Since the costs of raising immigrants from infants to adults would have been incurred in another country, there is no direct connection between the domestic cost of raising children and increases in the population associated with immigration. Indeed, higher levels of market income per working age adult could attract immigrants to countries with below replacement fertility, depending on the costs of such immigration. Although this offers one solution to the challenge of below replacement fertility, it is important to acknowledge that the receiving country benefits from this inflow of people while parents in the sending country bear the costs. To some extent international transfers (remittances) may offset these costs. Nevertheless, allowing for the international movement of people complicates the distribution of the costs of social reproduction.

6. CONCLUSIONS AND WAY FORWARD

Long ago, Paul Samuelson expressed concern that individual optimization in the absence of social contracts could lead to unfortunate demographic and therefore, unfortunate economic outcomes (1958; 1975). Our very different model leads to similar conclusions driven partly by macroeconomic dynamics. Structural features of the market economy, captured by variations in returns to scale, can affect population dynamics and macroeconomic outcomes in a framework that includes endogenous fertility choices. Demographic trends affect macroeconomic outcomes. By making this connection between economic structure and demographics, our simple macroeconomic model shows why we observe significant differences in population dynamics, with some countries experiencing below-replacement fertility and aging populations and others experiencing high fertility and a youth bulge. Macroeconomic dynamics, as well as individual decisions and social institutions, contribute to these differences,

Because of this, a priority is the development of a more explicit micro-foundation that leaves room for individual optimization but also emphasizes the impact of social institutions and public policies on family care provision. Households are heterogenous, with some mothers raising children within partnerships, others on their own, and some women remaining childless. The distribution of the costs of caring for dependents is affected by household formation and dissolution, private and public transfers, and macroeconomic dynamics.

Our model provides a useful tool for thinking about policy responses to both population dynamics and macroeconomic outcomes. It suggests the need to move away from the current regime of social reproduction, in which women bear most of the private costs of raising the next generation and caring for the elderly, to one in which the costs of caring for dependents are more equitably shared and more generously socialized. It also highlights current demographic imbalances at the country level and points to the need to develop open-economy extensions of this model that can capture the effects of population redistribution through immigration.

Adopting a global perspective raises issues beyond a consideration of immigration and the redistribution of populations. While some national economies may exhibit increasing returns to scale, environmental constraints could limit the expansion of production at the global level. If the capacity of the global ecosystem to assimilate the by-products of market production is limited (e.g. the case of greenhouse gases), then increasing returns to scale may not ultimately hold for the world economy. This introduces another coordination problem – the population dynamics that are good for national-level macroeconomic performance may not be good for the planet as a whole.

The simple macroeconomic model presented here could be extended in a number of other ways. It would relatively easy to include physical capital accumulation in the basic model – our expectation is that it would not meaningfully change the results. At present, the treatment of investments in human capacities is rudimentary and could be conceptualized more fully. This analysis highlights the need to develop micro-economic foundations that go beyond individual optimization to consider institutional dynamics that influence the distribution of the costs of social reproduction.

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