

The Economics of Multisystemic Resilience

Gabriella Conti and Tatiana Paredes

Introduction

Children are exposed to a variety of adverse events from an early age. Most of these adversities can be traced back to poverty (understood as the lack of material resources or of other inputs in the production of child development), although in other cases they are due to human- or nature-made shocks of various kinds (Almond & Currie, 2011; Almond, Currie, & Duque, 2018; Cunha & Heckman, 2007). While eradicating poverty remains a primary policy target, one efficient way this can be achieved is by equipping children with the tools to cope with—and eventually overcome—adversity by promoting their development in a holistic manner. Preventive or remediation interventions in the early years of life, which promote children’s cognitive, socioemotional, and health development, can help build resilience in children. In economics, the more recent theory of human capital formation suggests that there are certain critical or sensitive periods when the investments made to promote children’s development are more productive. This means that once the opportunity to remedy the adverse effects of initial disadvantage is lost, it becomes harder to help children catch up (Heckman & Mosso, 2014).

At an aggregate level, education is a widely used tool to create competitive and resilient nations. A resilient society is one made up of individuals who, despite having disadvantaged origins, reach education and income levels that are similar to those of their more affluent peers. Such upward mobility translates into low levels of socioeconomic inequality. One efficient way to achieve this is through effective interventions that promote human capital accumulation beginning at an early age. Macroeconomic models envision this process of human capital accumulation—with a goal being to raise people’s productivity over time—as a continuous knowledge exchange between members of different systems (Doepke & Tertilt, 2016).

At the microlevel, the more recent applied literature reports on studies of whether subsequent investments can help children overcome the negative effects of shocks. This literature is in its infancy, the main reason being the stringent requirements for study design. As pointed out by Almond and Mazumder (2013), it is difficult to find overlapping episodes of early life trauma and an orthogonal natural experiment that assign investments in children in a quasi-random fashion (among those exposed and not exposed to the trauma) to counteract the impact of early adversity.

On the other hand, there has been important progress in the field of macroeconomics and social mobility where family decisions and government interventions designed to boost child resilience have become central to growth theory, with more recent studies emphasizing the importance of human capital accumulation. This field is very promising since it allows us to analyze the multisystemic, economy-wide effects of interventions.

In this chapter, we review the existing evidence in support of multisystemic resilience and child development in the field of economics, from both a micro- and a macroeconomic perspective. To do this, we first review the theory of human capital development and the large body of empirical literature about prevention or remediation interventions in childhood. We then summarize the recent empirical microlevel evidence that tests whether subsequent investments can help offset the effects of early-life shocks. Next, we examine the most recent literature that incorporates endogenous human capital investments into complex macroeconomic models to understand how investment decisions in human capital at the family level affect aggregate welfare via multisystemic effects.

The remainder of this chapter is structured into the following sections: an introduction to the theory of human capital development; a review of the evidence on the long-lasting effects of early life shocks and on some key interventions, with a presentation of the more recent evidence that tests whether subsequent investments can help offset the effects of early-life shocks; a presentation of a case study of multisystemic resilience; a discussion of a macroeconomic approach to multisystemic resilience; and the conclusion.

The Theory of Human Capital Development

Human capital can be defined as the set of knowledge, skills, personality, and other endowments, including health, that constitute the assets an individual possesses to generate economic value. Human capital is now considered as multidimensional, and its different components interact with each other in ways that are just starting to be elucidated. For example, it might be possible to compensate for certain deficiencies in cognitive skills with better performance in noncognitive skills, such as motivation and persistence. Although genetics plays a role in the transmission of human capital, one of the central principles of this field of study is that abilities are not only inherited, they can also be acquired. The traditional nature–nurture distinction has been overcome, and it is now recognized that genes and environments interact in complex ways in producing human capital (Heckman & Mosso, 2014). In addition, the role that parents play is an active area of investigation. Parents can offset (or reinforce) differences in human capital among their offspring by investing more in the worse (or better) endowed ones (Almond & Mazumder, 2013).

It is useful at this point to present a simple model of investment in human capital from an economics point of view, following on the simple model by Attanasio (2015). Parents in household i choose how much to spend on their own consumption and on investment in their children's human capital. Their choice is subject to two constraints: a budget constraint, which says that they can only consume up to how much they earn,¹ and a production function of human capital, which specifies the way that various inputs are converted into output. Let us define $H_{i,t}$ as the human capital of a child of age t being raised in household i and think of it as a multidimensional vector that includes different dimensions, such as cognition (c), socioemotional skills (s) and health (h). The production function of human capital $H_{i,t+1}$ is assumed to depend on the initial level of human capital $H_{i,t}$, on background variables $Z_{i,t}$ (either fixed or time varying, representing characteristics of caregivers such as mother m , father f , and other r), on investments in human capital $X_{i,t}$ (including material M like toys and time T), and on a vector of random shocks $e_{i,t}^H$. The latter can also be interpreted as reflecting inputs in the production function that are not directly observed or considered by the researcher.

The production function in a general form can then be expressed as

$$H_{i,t+1} = g_t(H_{i,t}, X_{i,t}, Z_{i,t}, e_{i,t}^H) \tag{1}$$

The variables $H_{i,t}$, $X_{i,t}$, $Z_{i,t}$ and $e_{i,t}^H$ can be multidimensional:

$$H_{i,t} = \{\theta_{i,t}^c, \theta_{i,t}^s, \theta_{i,t}^h\}$$

$$Z_{i,t} = \{\theta_{i,t}^m, \theta_{i,t}^f, \theta_{i,t}^r\}$$

$$X_{i,t} = \{\theta_{i,t}^M, \theta_{i,t}^T\}$$

As previously mentioned, parents make choices to maximize their utility subject to two constraints:

$$\max_{\{C_{i,t}, X_{i,t}\}} U(C_{i,t}, H_{i,t+1}) \tag{2}$$

$$\text{subject to : } C_{i,t} + P_t^x X_{i,t} = Y_{i,t}$$

$$\text{and } H_{i,t+1} = g_t(H_{i,t}, X_{i,t}, Z_{i,t}, e_{i,t}^H)$$

Where $C_{i,t}$ is consumption, P_t^x is the vector of prices of investments $X_{i,t}$ and $Y_{i,t}$ is income. One implication of the previous model is that, since $H_{i,t+1}$ and $H_{i,t}$ are multidimensional vectors that include, for example, cognition, socioemotional skills, and health, the various dimensions of human capital are not only self-reinforcing (an attribute defined as self-productivity: higher stocks of skills in one period create higher stocks of skills in the next period) but also cross-fertilizing (cross-productivity). Additionally, different forms of investments can be more effective at higher or lower levels of human capital at time t to produce

human capital at time $t+1$ (dynamic complementarity or substitutability).² Different from the traditional model of Becker and Tomes (1979), the more recent model of human capital development, starting with Cunha and Heckman (2007) considers multiple stages of childhood, which also allow for productivities, complementarities and substitutabilities among different inputs to vary over time. Coherent with this model, the recent empirical human capital development literature (for example, Attanasio, 2015; Cunha, Heckman, & Schennach, 2010) has estimated different functional forms of the production function in (1) to measure how substitutable investments are during different periods in producing skills. Intuitively, if the degree of intertemporal substitutability is small, low levels of early investment (X_1) are not easily remediated by later investment (X_2) in producing human capital, so investing in the early years becomes crucial.

Heckman and Mosso (2014) summarize some main findings of the empirical literature. First, only very early interventions (before age three) have been shown to improve IQ in lasting ways; this is consistent with the idea that early childhood is a critical period for cognitive development. Second, programs targeting disadvantaged adolescents are less effective than those targeting children, consistent with the concept of dynamic complementarity. Third, despite being less effective than early childhood interventions, there are some promising adolescent interventions—featuring mentoring and scaffolding—that can help boost resilience among adolescents.

Born to Fail, Nurture to Thrive? Shocks, Interventions, and Resilience

Shocks

A large body of research from numerous disciplines shows the persistence of early-life disadvantage in shaping later life outcomes. Several shocks of different nature have been studied in the economic literature, including income shocks (Baird, Friedman, & Schady, 2011; Bhalotra, 2010), air and water pollution (Chay & Greenstone, 2003; Currie & Neidell, 2005; Greenstone & Hanna, 2014), natural disasters (Cas, Frankenberg, Suriastini, & Thomas, 2014), nutrient scarcity (Almond, Hoynes, & Schanzenbach, 2011), poor sanitation (Watson, 2006), and influenza (Almond, 2006). With some variations, the general finding across these studies is that an early exposure to negative shocks has detrimental effects on a variety of outcomes across the life course, such as educational attainment (Cas et al., 2014; Almond, 2006) and socioeconomic status in adulthood (Almond, 2006), and is linked to higher rates of infant mortality (Baird, Friedman, & Schady, 2011; Bhalotra, 2010; Chay & Greenstone, 2003; Currie & Neidell, 2005; Watson, 2006) and physical disability (Almond, 2006). (For a complete review of the literature that studies the importance of prenatal and early childhood environments on adolescent and adult health and socioeconomic outcomes, the reader is directed to Cunha, Heckman, Lochner, & Masterov, 2006; Almond & Currie 2011; Almond et al., 2018; Conti, Mason, & Poupakis, 2019).

One important finding in this literature is that the negative impacts of early life shocks are often heterogeneous, reflecting differences in child endowments, budget constraints, and

production technologies. Part of this heterogeneity is also caused by the parental responses to these shocks, which can exacerbate or mitigate their effects (Almond et al., 2018; Almond & Mazumder, 2013; Attanasio, 2015). In the remainder of this section, we review recent evidence on some of the most successful early childhood interventions meant to prevent or remediate the development gaps that appear very early among underprivileged children (Conti & Heckman, 2014). We then summarize the evidence of studies where researchers have found overlapping episodes of early life trauma and an orthogonal natural experiment meant to remediate its effects.

Policies and Interventions

Promoting the development of disadvantaged children to try to reduce inequalities from an early age and, at the same time, to increase their resilience is a pressing concern for policymakers worldwide. When gaps get perpetuated, disadvantaged children keep falling behind, becoming increasingly more vulnerable to shocks of a different nature.

Cash and in-kind transfers are one way to mitigate the impact of these shocks. Cash transfers are expected to increase both childhood investments (in particular, conditional cash transfers) and household consumption. Many recent papers examine the impact of cash transfers on child and adult outcomes. Aizer, Eli, Ferrie, and Lleras-Muney (2016) evaluated the effect of the U.S. Mother's Pension program and found that children of mothers who were accepted to the program obtained one third more years of schooling and had higher income in adulthood, with the largest effects occurring for the poorest families. Another relevant U.S. program that works like a cash transfer to lower-income working families is the Earned Income Tax Credit. Hoynes, Miller, and Simon (2015) exploited variation in the generosity of the program in the mid-1990s and found that the likelihood of low birth weight decreased among mothers who benefited from the expansion of the program during pregnancy. The possible mechanisms for the changes in infant health include more prenatal care and less negative health behaviors (smoking). Dahl and Lochner (2012) also exploited the expansions of the Earned Income Tax Credit in the late 1980s and 1990s to identify the effects of family income on child achievement and found that increases in family income improve test scores, particularly among children from more disadvantaged backgrounds. Conditional cash transfers, including child-care subsidies and child allowances, have also been found effective at improving child cognitive development (Black, Devereux, Løken, & Salvanes, 2014; Milligan & Stabile, 2011). Lastly, having access to the U.S. Food Stamps program in childhood has been found to reduce the incidence of metabolic syndrome in adulthood and to increase economic self-sufficiency among women (Almond et al., 2011).

Some interventions target primarily health (among the dimensions of child development), for example, health insurance expansions and policies that promote medical care. Bharadwaj, Løken, and Neilson (2013) examined infants in Chile and Norway and used data showing that infants below the 1,500-g threshold cut-off for very low birth weight received more intensive medical services than those just above this threshold. Their data show that more intensive medical care increases adult wages by 2.7% in Chile and by 1.8% in Norway. Most studies of U.S. Medicaid rely on the fact that the expansions of this program were phased in at different rates across states. Cohodes, Grossman, Kleiner, and Lovenheim (2016)

found that expanding health insurance coverage for low-income children increases the rate of high school and college completion. Not surprisingly, access to Medicaid is also beneficial to participants' long-term health (Miller & Wherry, 2018).

One widely advocated policy deemed effective at reducing gaps in child development that are evident by the time children start school is quality child care. Some of the strongest evidence comes from the iconic Perry Preschool program in the United States, a randomized trial that targeted 123 disadvantaged, low IQ African American children aged three to four during the 1960s. Heckman, Moon, Pinto, Savelyev, and Yavitz (2010), and Conti, Heckman, and Pinto (2016) showed that the Perry program significantly enhanced adult outcomes, including better education, employment, earnings, health, and lower rates of criminal activity. Importantly, Conti et al. (2016) show that improvements in child development in the early years, rather than later socioeconomic status, are the main drivers of the treatment effects on adult outcomes. A more recent study by Heckman and Karapakula (2019) adds to this evidence by finding significant intergenerational treatment effects on education, employment, and crime, using 50-year follow-up data from the offspring of the original participants.

Another flagship preschool program in the United States is the Abecedarian. Beginning in 1972, the randomized trial included 111 low-income, mostly African American families. Treated children received a year-round, full-time center-based care for five years, starting in the child's first year of life. The program included individualized educational activities that changed as the children grew older and low child-teacher ratios of 3:1 for the youngest children and up to 6:1 for older children. The treatment group also received primary health-care and provision of nutritious meals. By the time these children were five, their IQ scores were 10 points higher than scores of comparable children who did not participate in the program (Duncan & Magnuson, 2013). Furthermore, those in the treatment group earned significantly higher scores on intellectual and academic measures as young adults (aged 21), attained significantly more years of education, were more likely to attend a four-year college (Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002), and were in significantly better health in their mid-30s (Campbell et al., 2014). Like for the Perry Preschool, Conti et al. (2016) show for the Abecedarian that improvements in child development in the early years, rather than later socioeconomic status, are the main drivers of the treatment effects on adult outcomes.

While it is difficult to replicate at scale, the intensive small-scale interventions such as the Abecedarian and the Perry Preschool, one key policy lesson that can be learned is the importance of quality. The first attempt of a large-scale, although still targeted, program has been Head Start, a public preschool program that began in the United States in 1965 as part of the "War on Poverty." Some early studies estimated the effects of Head Start by comparing program participants to their nonparticipant siblings. Results from this research design showed positive short-term effects on test scores (Currie & Thomas, 1995; Deming, 2009) and long-term effects on educational attainment and earnings (Garces, Thomas, & Currie, 2002). More recent studies use either the randomized evaluation of Head Start (the Head Start Impact Study) or quasi-experimental variation in program assignment to show Head Start had positive impacts on test scores (Kline & Walters, 2016), problem behavior (Carneiro & Ginja, 2014), and health (Carneiro & Ginja, 2014; Ludwig & Miller, 2007).

In addition to center-based childcare programs, home-visiting programs are becoming increasingly popular to reach disadvantaged populations, as they have been shown to have positive impacts on many domains, including education, income, employment, health, and behavior (Almond et al., 2018). One of the programs with the strongest evidence base is the Nurse Family Partnership (NFP), which provides nurse home visits to pregnant mothers in disadvantaged conditions with no previous live births and is now delivered at scale in the United States. In three randomized evaluations in the United States, the NFP has been shown to improve both child and maternal outcomes, with persistent effects up to adulthood (Eckenrode et al., 2010; Olds, 2006). Randomized evaluations of the NFP have been carried out also in England (Robling et al., 2016) and Germany (Sandner, Cornelissen, Jungmann, & Herrmann, 2018; Sierau et al., 2016) where the impacts are somewhat more muted than in the original U.S.-based evaluations, possibly because of the nature of the usual care delivered to the control group.

A recent strand of the literature addresses a key question: How do different interventions interact to promote human development? Rossin-Slater and Wüst (in press) conducted one of the first studies to test whether access to a home-visiting program at birth amplifies or diminishes the positive long-term effects of early childcare in Denmark. The study uses the exogenous timing of each program's rollout in the first years of the millennium and finds statistically significant negative interaction effects between home-visiting and preschool childcare exposure, suggesting that some early childhood interventions might be substitutes and not complements when the outcome of interest is years of schooling.

The evidence reviewed in this section of the chapter shows that early childhood is a critical window of opportunity for prevention and remediation interventions that promote child development and, by extension, foster resilience in contexts of early disadvantage. However, the question of whether it is possible to achieve impacts at scale in a cost-effective manner remains; a related question is whether a targeted or universal approach to scaling up is preferable. On the other hand, some adolescent interventions that seek to foster character skills—such as self-confidence, teamwork, autonomy, and discipline, which are often lacking in disadvantaged youth—have also been shown to achieve positive impacts, although of a smaller magnitude than early interventions (Heckman & Mosso, 2014). In particular, mentoring programs in schools that provide school-aged children and adolescents with information and support have been shown to be particularly effective (Bettinger, Long, Oreopoulos, & Sanbonmatsu, 2012; Cook et al., 2014; Kosse, Deckers, Pinger, Schildberg-Hörisch, & Falk, in press).

Environmental Shocks and Interventions

There are few papers that study whether subsequent investments can help children overcome the effects of a shock. This literature to date has exploited quasi-random exposures of children to shocks and interventions in the early and later stages of their childhood to provide evidence on remediation effects.³ Adhvaryu, Nyshadham, Molina, and Tamayo (2018) studied whether the conditional cash transfer program Progresá in Mexico mitigated the effects of rainfall shocks on cognitive test scores and years of education, measured at ages 12 to 21. They found that Progresá offsets 60% to 80% of the negative impact of rainfall shocks

on child development. On the other hand, Aguilar and Vicarelli (2015) found that children exposed to rainfall shocks during the early stages of life exhibit lower cognitive development, shorter height, smaller weight, and higher anxiety levels at ages two to six, with no mitigation effect by Progresá. It is unclear whether these conflicting results are caused by subtle differences in the approaches taken; it could be the case that one can find positive long-term effects even in cases where the immediate short-term effects appear to be negligible (Almond et al., 2018).

Gunnsteinsson et al. (2019) studied whether a randomized controlled trial of vitamin A supplementation in Bangladesh protected children in the study areas devastated by a tornado in 2005. Exposure to the tornado in utero and during infancy decreased birth size and physical growth, but infants who received vitamin A supplementation, which boosts immune system functioning, were protected from these effects. Triyana and Xia (2018) further exploited exogenous variation in typhoon exposure and the introduction of a disaster relief policy to analyze the effects of early-life shocks on mortality and human capital outcomes in the Philippines. Once implemented, the disaster relief policy mitigated the mortality effect of severe typhoons; however, survivors exhibited lower educational attainment and lower probability of attaining a skilled occupation. This suggests that disaster relief efforts improved the chances of survival among the treated but were not sufficient to alleviate the long-term scarring effects among those who survived. Duque, Rosales-Rueda, and Sánchez (2016) instead analyze the interaction of weather shocks and a conditional cash transfer program in Colombia and show that the timing matters, in the sense that the impacts of the program are larger for earlier rather than later childhood exposures.

A study related to this strand of literature investigates whether birth endowments affect the degree to which individuals are affected during recessions (i.e., whether children with better health at birth are more resilient in times of crises). Bharadwaj, Bietenbeck, Lundborg, and Rooth (2019) study the economic crisis during the early 1990s in Sweden and use a twin-based design to show that early-life health is an important determinant of labor market vulnerability during macroeconomic downturns. Adults who were born with higher birth weight were significantly less likely to face job loss and go on unemployment insurance during a crisis.

An important aspect about this literature that deserves further study is the optimal temporal gap between the shock and the remediation intervention. Furthermore, we still know relatively little about the optimal timing for different interventions to affect different outcomes, considering the various ways in which skills and investments can interact with each other at different stages of development. Some interventions are designed to stimulate the development of a certain type of skill (e.g., only the development of cognitive abilities), and some others have a more comprehensive approach and seek to stimulate the development of multiple skills, including health (preschool and home-visiting programs). The evidence to date seems to suggest that earlier intervention is particularly salient for health and cognition, while noncognitive skills are still malleable during adolescence. However, it is important to keep in mind that even interventions that only attempt to stimulate one type of skill can benefit the development of other skills, given the different cross-productivities embedded in the model in the first section of this paper. In fact, several studies have found

evidence of interactions, for example, between cognitive and noncognitive skills (Cunha & Heckman, 2007) and between health and cognition (Attanasio, Meghir, & Nix, 2015). All of the previous highlights the fact that we are only beginning to understand how shocks, skills, and investments interact over the life course and how interventions can help offset the negative effects of shocks by promoting resilience in children.

A Case Study of Multisystemic Resilience

Early childhood interventions have the potential to generate resilience at different levels. A policy that has proven to be effective in promoting resilience at the individual and multisystemic level through its positive impact on the community is Sure Start, a major area-based early-years initiative in England. Sure Start targets children aged zero to five. Its core offer consists of integrated early education and childcare, parental outreach, family and parenting support, child and family health services, and links with Jobcentre Plus (Conti, Mason, & Poupakis, 2019).

Scaled-up interventions like Sure Start could provide benefits through different channels, given the variety of the services offered. Conti et al. (2019) discuss some of the main direct and indirect channels through which the program might improve children's health, cognition, and behavior. First, Sure Start is expected to improve children's overall health status through an increase in health-promoting activities (e.g., because of better information), a greater willingness to use health services (e.g., due to lower stigma or increased perceived benefits), and/or better screening for conditions that might benefit from treatment. There are also a number of indirect channels through which Sure Start could affect children's health. One potentially important channel is parental employment, since Sure Start provides job-search assistance and job-related training to parents. However, the direction of this effect is not clear: a higher family income (resulting from increased employment) could allow parents to increase material investments in their children, but longer working hours might also negatively affect the time parents spend with their children. Another indirect channel through which Sure Start might promote child development is by changing the type and quality of environments that children spend time in. For example, many centers offer access to play and reading materials and so offer more stimulating environments than the ones disadvantaged children have at home. Also, through parenting classes and other forms of support, Sure Start might improve parentings skills and maternal mental health and contribute to reducing child maltreatment.

Conti et al. (2019) have found that greater access to Sure Start in the first five years of life reduces the likelihood of hospitalizations among children aged 5 to 11, with benefits growing with age. While Sure Start had few effects on hospitalizations for respiratory illness, there were big decreases in the rates of hospitalizations for infections at young ages, for injuries at every age considered (particularly fractures), and head injuries at age five, all of which are costly conditions that can cause long-term damage. Importantly, all impacts are concentrated in the poorest areas of England. The observed decline in admissions for injuries give us a hint about the possible mechanisms in place. While the available data do not make it possible to identify the mechanisms, plausible candidates are safer home environments, better parenting practices, and fewer behavioral problems in children.

Sure Start is based on the premise that children and families could be affected by the program directly via services and indirectly via community changes engendered by the program. Melhuish, Belsky, and Barnes (2010) document some improvements in community characteristics after five years of implementation (although they cannot causally link them to the program). For example, in Sure Start areas, the proportion of children under four years in workless households decreased markedly from 45% in 2000–2001 to 40% in 2005–2006. Some aspects of crime and disorder also improved, notably, burglary, school exclusions, and unauthorized school absences. Furthermore, the percentage of children identified with special educational needs or eligible for disability benefits increased, suggesting improved health screening, and there was an improvement in academic achievement among 11-year-olds (Melhuish et al., 2010).

The Macroeconomic Approach to Multisystemic Resilience

Recently, part of the macroeconomic literature has been studying micro-founded models that examine how government policies affect parental investment choices and welfare in a general equilibrium framework, as opposed to more conventional partial equilibrium treatment-effect approaches to policy evaluation. This has allowed researchers to deal with one of the limitations of small-scale empirical studies, which is that they cannot account for several indirect (multisystemic) effects of interventions. General equilibrium models are well suited to studying aggregate effects like the impact of policies on poverty reduction or aggregate welfare, but until recently they generally ignored the role of endogenous early childhood development (Daruich, 2018). A few recent studies have, however, begun to incorporate human capital investments into standard macroeconomic models (Abbott, Gallipoli, Meghir, & Violante, 2018; Daruich, 2018; Lee & Seshadri, 2019; Restuccia & Urrutia, 2004). This approach is very useful for policymakers, considering that it allows them to simulate the effect of large-scale government interventions and to estimate the indirect effects of these policies (including taxation and general equilibrium effects).

The models used in this body of literature rely on two sets of principles. The first builds on the human capital accumulation literature (Cunha et al., 2010; Heckman, 2007) where skills are determined by investments (of money and time) made during the early stages of development. The second set of principles describe a general equilibrium life-cycle framework in which these investments and intergenerational linkages are embedded (Aiyagari, Greenwood, & Seshadri, 2002; Daruich, 2018; Lee & Seshadri, 2019). The definitions and relations depicted in these models highlight the multisystemic nature of the interactions between government, firms, and households and the role that each one plays in shaping economic incentives (i.e., the returns to education) and on aggregate macroeconomic variables. For instance, if instead of being altruistic, parents were to place a higher weight on present consumption relative to the next generation's future consumption, this would dissuade savings, driving up the interest rate and modifying the investment-to-gross domestic product ratio observed in the economy (Aiyagari et al., 2002). Furthermore, general equilibrium

forces explain some indirect effects of early childhood interventions, for instance, how taxes to finance additional government expenditures reduce the welfare gains of early childhood education policies by lowering the wage of college graduates and therefore the return on those investments.

This strand of the macroeconomic literature does not address the issue of resilience explicitly, but clearly describes some of the processes by which young adults can compensate for the lack of early parental investments in adulthood. In this regard, Lee and Seshadri (2019) argue, “Young parents with high-ability children are unable to invest enough in their human capital because of life cycle borrowing constraints, but these same children can quickly accumulate human capital as an adult” (p. 889).

A resilient society is made up of individuals who, despite their background, reach similar education and income levels as those of their more affluent counterparts. This translates into low levels of socioeconomic inequality and low persistence of economic status across generations. Structural micro and macro models help explain the process by which investments made in early childhood not only create more resilient children but have redistributive and multiplicative effects that spill over to the next generation (Becker & Tomes, 1979; Goldberger, 1989; Lee & Seshadri, 2019; Restuccia & Urrutia, 2004). When governments invest in early childhood education programs, they solve the problem generated by the lack of a compensation-borrowing mechanism that compensates parents for their investments.

Lee and Seshadri (2019) compare the relative effectiveness of different government interventions on the persistence of economic status across generations. Income persistence declines when both the intergenerational and life-cycle borrowing constraints faced by parents are relaxed. A similar effect is achieved by reducing taxes on parents and by providing education subsidies. This happens because these policies allow parents to invest more in the human capital of children. However, only education subsidies targeted to children aged zero to five years seem to have a sizable impact on reducing income persistence in the long run—a fact that is consistent with complementarity of investments. Consistent with the importance of early investments, Hendren and Sprung-Keyser (2019) conducted a comparative welfare analysis of 133 historical policy changes over the past half-century in the United States and found that direct investments in low-income children’s health and education have historically had the highest marginal value of public funds (the ratio of the benefits provided to the recipient over the cost to the government). As they put it, “many such policies have paid for themselves as governments recouped the cost of their initial expenditures through additional taxes collected and reduced transfers” (p. 1).

Conclusion

The concept of resilience in the child development literature focuses on the capacity that individuals (in particular children) have to mitigate the impact of early life shocks. The question of how to protect vulnerable children or whether it is possible to engender resilience to shocks has been addressed by several branches of economics including family economics, the interventions literature, and, more recently, the macroeconomic literature in a general equilibrium framework.

From a theoretical standpoint, there are several advantages to using a micro-founded general equilibrium framework. First, compared to small-scale evaluations, studies that model human capital accumulation in a general equilibrium framework allow us to estimate the indirect effects of policies that promote human capital accumulation and to understand the mechanisms for the intergenerational transmission of skills. Furthermore, these studies can help explain the origins of inequality and inefficiency in parental investments that arise in the presence of incomplete markets where parents face intergenerational and life-cycle borrowing constraints. Understanding these mechanisms is crucial for the design of preventative and remediation interventions that foster child resilience.

From an applied standpoint, the economic literature studying how interventions can foster children's resilience by buffering them from the impacts of shocks is only in its beginnings. Further research is needed, particularly on the nature of shocks, which can be remediated; the most effective interventions at remediating those shocks; and on the optimal temporal gap between shocks and remediation interventions. More generally, there is still much to investigate about the optimal timing for different interventions to affect different outcomes, considering the various ways in which different dimensions of human capital and investments can complement each other at different stages of development. Future micro-oriented studies of multisystemic resilience in this field should explicitly account not only for the direct effects of interventions but also for their indirect effects to give a better idea of the mechanisms behind the observed improvements in resilience at the individual, community, and macrolevels.

Key Messages

1. Resilience in economics is centered around the concept of human capital.
2. Effective early interventions can promote child resilience and help children overcome the impacts of shocks.
3. The study of human capital in a general equilibrium framework allows us to account for several indirect (multisystemic) effects of interventions.

Acknowledgments

We acknowledge funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program (grant agreement No. 819752—DEVORHBIOSHIP—ERC-2018COG).

Notes

1. No borrowing or saving is allowed in this simple model.
2. Dynamic complementarity arises when the stocks of skills acquired in the past make current investments more productive (Heckman, 2007).
3. While so far we have mostly focused on the literature from developed countries, given the paucity of studies on the interactions of shocks (mostly natural disasters) and interventions, we do not make such distinction in this paragraph.

References

- Abbott, B., Gallipoli, G., Meghir, C., & Violante, G. L. (2018). Education policy and intergenerational transfers in equilibrium. Cowles Foundation Discussion Paper No. 1887R2. New Haven, CT: Cowles Foundation for Research in Economics. doi:10.2139/ssrn.3206752
- Adhvaryu, A., Nyshadham, A., Molina, T., & Tamayo, J. (2018, July). *Helping children catch up: Early life shocks and the PROGRESA experiment* (Working Paper No. 24848). Cambridge, MA: National Bureau of Economic Research. doi:10.3386/w24848
- Aguiar, A., & Vicarelli, M. (2015). *El Niño and Mexican children: Medium-term effects of early-life weather shocks on cognitive and health outcomes* (Working Paper). Retrieved from http://www.aguilaresteva.com/wp-content/uploads/2012/09/2018_07_17_Article.pdf
- Aiyagari, S. R., Greenwood, J., & Seshadri, A. (2002). Efficient investment in children. *Journal of Economic Theory*, 102(2), 290–321. doi:10.1006/jeth.2001.2852
- Aizer, A., Eli, S., Ferrie, J., & Lleras-Muney, A. (2016). The long-run impact of cash transfers to poor families. *American Economic Review*, 106(4), 935–971. doi:10.1257/aer.20140529
- Almond, D. (2006). Is the 1918 Influenza pandemic over? Long-term effects of in utero influenza exposure in the post-1940 U.S. population. *Journal of Political Economy*, 114(4), 672–712. doi:10.1086/507154
- Almond, D., & Currie, J. (2011). Human capital development before age five. In O. Ashenfelter & D. Card (Eds.), *Handbook of labor economics* (Vol. 4, Part B, pp. 1315–1486). Amsterdam, The Netherlands: North Holland. doi:10.1016/S0169-7218(11)02413-0
- Almond, D., Currie, J., & Duque, V. (2018). Childhood circumstances and adult outcomes: Act II. *Journal of Economic Literature*, 56(4), 1360–1446. doi:10.1257/jel.20171164
- Almond, D., Hoynes, H. W., & Schanzenbach, D. W. (2011). Inside the war on poverty: The impact of food stamps on birth outcomes. *The Review of Economics and Statistics*, 93(2), 387–403. doi:10.1162/rest_a_00089
- Almond, D., & Mazumder, B. (2013). Fetal origins and parental responses. *Annual Review of Economics*, 5(1), 37–56. doi:10.1146/annurev-economics-082912-110145
- Attanasio, O. P. (2015). The determinants of human capital formation during the early years of life: Theory, measurement, and policies. *Journal of the European Economic Association*, 13(6), 949–997. doi:10.1111/jeea.12159
- Attanasio, O., Meghir, C., & Nix, E. (2015, March). *Human capital development and parental investment in India* (Working Paper No. 21740). Cambridge, MA: National Bureau of Economic Research. doi:10.3386/w21740
- Baird, S., Friedman, J., & Schady, N. (2011). Aggregate income shocks and infant mortality in the developing world. *The Review of Economics and Statistics*, 93(3), 847–856. doi:10.1162/rest_a_00084
- Becker, G., & Tomes, N. (1979). An equilibrium theory of the distribution of income and intergenerational mobility. *Journal of Political Economy*, 87(6), 1153–1189.
- Bettinger, E. P., Long, B. T., Oreopoulos, P., & Sanbonmatsu, L. (2012). The role of application assistance and information in college decisions: Results from the H&R Block FAFSA experiment. *The Quarterly Journal of Economics*, 127(3), 1205–1242. doi:10.1093/qje/qjs017
- Bhalotra, S. (2010). Fatal fluctuations? Cyclicalities in infant mortality in India. *Journal of Development Economics*, 93(1), 7–19. doi:10.1016/j.jdeveco.2009.03.006
- Bharadwaj, P., Bietenbeck, J., Lundborg, P., & Rooth, D.-O. (2019). Birth weight and vulnerability to a macroeconomic crisis. *Journal of Health Economics*, 66, 136–144. doi:10.1016/j.jhealeco.2019.05.001
- Bharadwaj, P., Løken, K. V., & Neilson, C. (2013). Early life health interventions and academic achievement. *American Economic Review*, 103(5), 1862–1891. doi:10.1257/aer.103.5.1862
- Black, S. E., Devereux, P. J., Løken, K. V., & Salvanes, K. G. (2014). Care or cash? The effect of child care subsidies on student performance. *The Review of Economics and Statistics*, 96(5), 824–837. doi:10.1162/rest_a_00439
- Campbell, F. A., Ramey, C. T., Pungello, E., Sparling, J., & Miller-Johnson, S. (2002). Early childhood education: Young adult outcomes from the abecedarian project. *Applied Developmental Science*, 6(1), 42–57. doi:10.1207/S1532480XADS0601_05

- Campbell, F., Conti, G., Heckman, J. J., Moon, S. H., Pinto, R., Pungello, E., & Pan, Y. (2014). Early childhood investments substantially boost adult health. *Science*, 343(6178), 1478–1485. doi:10.1126/science.1248429.
- Carneiro, B. P., & Ginja, R. (2014). Long-term impacts of compensatory preschool on health and behavior: Evidence from Head Start. *American Economic Journal: Economic Policy*, 6(4), 135–173. doi:10.1257/pol.6.4.135
- Cas, A. G., Frankenber, E., Suriastini, W., & Thomas, D. (2014). The impact of parental death on child well-being: Evidence from the Indian Ocean tsunami. *Demography*, 51(2), 437–457. doi:10.1007/s13524-014-0279-8.
- Chay, K. Y., & Greenstone, M. (2003). The impact of air pollution on infant mortality: Evidence from geographic variation in pollution shocks induced by a recession. *The Quarterly Journal of Economics*, 118(3), 1121–1167. doi:10.1162/00335530360698513
- Cohodes, S. R., Grossman, D. S., Kleiner, S. A., & Lovenheim, M. F. (2016). The effect of child health insurance access on schooling: Evidence from public insurance expansions. *Journal of Human Resources*, 51(3), 727–759. doi:10.3368/jhr.51.3.1014-6688r1
- Conti, G., & Heckman, J. J. (2014). Economics of child well-being. In A. Ben-Arieh, F. Casas, I. Frønes, & J. E. Korbin (Eds.), *Handbook of child well-being: Theories, methods and policies in global perspective* (pp. 363–401). Dordrecht, The Netherlands: Springer.
- Conti, G., Heckman, J. J., & Pinto, R. (2016). The effects of two influential early childhood interventions on health and healthy behaviour. *Economic Journal*, 126(596), F28–F65. doi:10.1111/eoj.12420
- Conti, G., Mason, G., & Poupakis, S. (2019, June). *Developmental origins of health inequality* (Working Paper No. W19/17). London, UK: Institute for Fiscal Studies. doi:10.1920/wp.ifs.2019.1719
- Cook, P., Dodge, K., Farkas, G., Fryer, R., Guryan, J., Ludwig, J., . . . Steinberg, L. (2014, January). *The (surprising) efficacy of academic and behavioral intervention with disadvantaged youth: Results from a randomized experiment in Chicago* (Working Paper No. 19862). Cambridge, MA: National Bureau of Economic Research. doi:10.3386/w19862
- Cunha, F., & Heckman, J. (2007). The technology of skill formation. *American Economic Review*, 97(2), 31–47.
- Cunha, F., Heckman, J. J., & Schennach, S. M. (2010). Estimating the technology of cognitive and noncognitive skill formation. *Econometrica*, 78(3), 883–931. doi:10.3982/ECTA6551
- Cunha, F., Heckman, J. J., Lochner, L., & Masterov, D. V. (2006). Interpreting the evidence on life cycle skill formation. In E. A. Hanushek & F. Welch (Eds.), *Handbook of the economics of education* (Vol. 1, pp. 697–812). Amsterdam, The Netherlands: Elsevier.
- Currie, B. J., & Thomas, D. (1995). Does Head Start make a difference? *American Economic Review*, 85(3), 341–364.
- Currie, J., & Neidell, M. (2005). Air pollution and infant health: What can we learn from California's recent experience? *The Quarterly Journal of Economics*, 120(3), 1003–1030.
- Dahl, G. B., & Lochner, L. (2012). The impact of family income on child achievement: Evidence from the earned income tax credit. *American Economic Review*, 102(5), 1927–1956. doi:10.1257/aer.102.5.1927
- Daruich, D. (2018, October). *The macroeconomic consequences of early childhood development policies* (Working Paper No. 2018-029B). New York, NY: NYU Department of Economics. doi:10.20955/wp.2018.029
- Deming, D. (2009). Early childhood intervention and life-cycle skill development: Evidence from Head Start. *American Economic Journal: Applied Economics*, 1(3), 111–134. doi:10.1257/app.1.3.111
- Doepke, M., & Tertilt, M. (2016). Families in macroeconomics. In J. B. Taylor & H. Uhlig (Eds.), *Handbook of macroeconomics* (Vol. 2B, pp. 1789–1891). Amsterdam, The Netherlands: Elsevier. doi:10.1016/bs.hesmac.2016.04.006
- Duncan, G. J., & Magnuson, K. (2013). Investing in preschool. *Journal of Economic Perspectives*, 27(2), 109–132. doi:10.1257/jep.27.2.109
- Duque, V., Rosales-Rueda, M., & Sánchez, F. (2016, May). *How do early-life shocks interact with subsequent human-capital investments? Evidence from administrative data* (Working Paper). Colombia: CAF. Retrieved from http://conference.iza.org/conference_files/Gender_2019/duque_v27803.pdf

- Eckenrode, J., Campa, M., Luckey, D. W., Henderson, C. R., Cole, R., Kitzman, H., . . . Olds, D. (2010). Long-term effects of prenatal and infancy nurse home visitation on the life course of youths: 19-year follow-up of a randomized trial. *Archives of Pediatrics & Adolescent Medicine*, *164*(1), 9–16. doi:10.1001/archpediatrics.2009.240
- Garces, B. E., Thomas, D., & Currie, J. (2002). Longer-term effects of head start. *American Economic Review*, *92*(4), 999–1012.
- Goldberger, A. S. (1989). Economic and mechanical models of intergenerational transmission. *American Economic Review*, *79*(3), 504–513.
- Greenstone, B. M., & Hanna, R. (2014). Environmental regulations, air and water pollution, and infant mortality in India. *American Economic Review*, *104*(10), 3038–3072. doi:10.1257/aer.104.10.3038
- Gunnsteinsson, S., Adhvaryu, A., Christian, P., Labrique, Sugimoto, J., A., Shamin, A. A., & West, K. P., Jr. (2019, June). *Protecting infants from natural disasters: The case of vitamin A supplementation and a tornado in Bangladesh* (Working Paper No. 25969). Cambridge, MA: National Bureau of Economic Research. doi:10.3386/w25969
- Heckman, J. J. (2007). The economics, technology, and neuroscience of human capability formation. *PNAS*, *104*(33), 13250–13255. doi:10.1073/pnas.0701362104
- Heckman, J. J., & Karapakula, G. (2019, May). *Intergenerational and intragenerational externalities of the Perry preschool project* (Working Paper No. 25889). Cambridge, MA: National Bureau of Economic Research. doi:10.3386/w25889
- Heckman, J. J., Moon, S. H., Pinto, R., Savelyev, P. A., & Yavitz, A. (2010). The rate of return to the high/scope Perry preschool program. *Journal of Public Economics*, *94*(1–2), 114–128. doi:10.1016/j.jpubeco.2009.11.001
- Heckman, J. J., & Mosso, S. (2014). The economics of human development and social mobility. *Annual Review of Economics*, *6*, 689–733. doi:10.1146/annurev-economics-080213-040753
- Hendren, N., & Sprung-Keyser, B. (2019, August). *A unified welfare analysis of government policies* (Working Paper No. 26144). Cambridge, MA: National Bureau of Economic Research. doi:10.3386/w26144
- Hoynes, H., Miller, D., & Simon, D. (2015). Income, the earned income tax credit, and infant health. *American Economic Journal: Economic Policy*, *7*(1), 172–211 doi:10.1257/pol.20120179
- Kline, P., & Walters, C. R. (2016). Evaluating public programs with close: The case of Head Start. *The Quarterly Journal of Economics*, *131*(4), 1795–1848. doi:10.1093/qje/qjw027
- Kosse, F., Deckers, T., Pinger, P., Schildberg-Hörisch, H., & Falk, A. (in press). The formation of prosociality: Causal evidence on the role of social environment. *Journal of Political Economy*. doi:10.1086/704386
- Lee, S. Y., & Seshadri, A. (2019). On the intergenerational transmission of economic status. *Journal of Political Economy*, *127*(2), 855–921. doi:10.1086/700765
- Ludwig, J., & Miller, D. L. (2007). Does Head Start improve children's life chances? Evidence from a regression discontinuity design. *The Quarterly Journal of Economics*, *122*(1), 159–208. doi:10.1162/qjec.122.1.159
- Melhuish, E., Belsky, J., & Barnes, J. (2010). Evaluation and value of Sure Start. *Archives of Disease in Childhood*, *95*(3), 159–161. doi:10.1136/adc.2009.161018
- Miller, S., & Wherry, L. R. (2018). The long-term effects of early life Medicaid coverage. *Journal of Human Resources*, *54*(3), 785–824. doi:10.3368/jhr.54.3.0816.8173r1
- Milligan, K., & Stabile, M. (2011). Do child tax benefits affect the well-being of children? Evidence from Canadian child benefit expansions. *American Economic Journal: Economic Policy*, *3*(3), 175–205.
- Olds, D. L. (2006). The nurse-family partnership: An evidence-based preventive intervention. *Infant Mental Health Journal*, *27*(1), 5–25. doi:10.1002/imhj.20077.
- Restuccia, D., & Urrutia, C. (2004). Intergenerational persistence of earnings: The role of early and college education. *American Economic Review*, *94*(5), 1354–1378.
- Robling, M., Bekkers, M.-J., Bell, K., Butler, C. C., Cannings-John, R., Channon, S., . . . Torgerson, D. (2016). Effectiveness of a nurse-led intensive home-visitation programme for first-time teenage mothers (building blocks): A pragmatic randomised controlled trial. *The Lancet*, *387*(10014), 146–155. doi:10.1016/S0140-6736(15)00392-X

- Rossin-Slater, M., & Wüst, M. (2020). What Is the Added Value of Preschool for Poor Children? Long-Term and Intergenerational Impacts and Interactions with an Infant Health Intervention. *American Economic Journal: Applied Economics*, 12(3), 255–286. doi:10.1257/app.20180698
- Sandner, M., Cornelissen, T., Jungmann, T., & Herrmann, P. (2018). Evaluating the effects of a targeted home visiting program on maternal and child health outcomes. *Journal of Health Economics*, 58, 269–283. doi:10.1016/j.jhealeco.2018.02.008
- Sierau, S., Dähne, V., Brand, T., Kurtz, V., von Klitzing, K., & Jungmann, T. (2016). Effects of home visitation on maternal competencies, family environment, and child development: A randomized controlled trial. *Prevention Science*, 17(1), 40–51. doi:10.1007/s11121-015-0573-8
- Triyana, M., & Xia, X. (2018, July). *Selective mortality and the long-term effects of early-life exposure to natural disasters* (Working Paper No. 50). Stanford, CA: Stanford Asia Health Policy Program. doi:10.2139/ssrn.3166382
- Watson, T. (2006). Public health investments and the infant mortality gap: Evidence from federal sanitation interventions on U.S. Indian reservations. *Journal of Public Economics*, 90(8–9), 1537–1560. doi:10.1016/j.jpubeco.2005.10.002