The System of National Accounts and Alternative Economic Perspectives

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Abstract

Brent Moulton and Nicole Mayerhauser (2015) point out that economists have, for more than 50 years, featured the concept of human capital in their models of labor, growth, productivity, and distribution of income. We recommend the addition to the SNA of supplemental person-level accounts: i.e., a System of Person Accounts (a SPA). We see this as the best way of recognizing the processes of human capital creation as well as related issues of how income is distributed among individuals and families. We argue that this change would support three different sorts of perspectives from which economic activity can be viewed: (1) a current period outcomes perspective, (2) a risky possibilities perspective, and (3) a resources perspective. Moreover, these gains could be had without changing the SNA in any substantial respects.

1. Introduction

At the heart of recent critiques of the System of National Accounts (SNA) is anxiety that our societies have become too focused on the pursuit of Gross Domestic Product (GDP) growth, the headline SNA measure of national output growth.[2] A key complaint is that GDP and the SNA take no explicit account of much that many feel matters, especially including the rearing and teaching of children. GDP also takes no explicit account of the impacts of production activities on global warming. In response to these criticisms, former French president, Nicolas Sarkozy commissioned leading economists to look into the issues. One conclusion of the resulting Stiglitz, Sen and Fitoussi report (2009, Chapter 1, paragraph 152) is that, "sustainability requires the maintenance of a constant stock of 'extended wealth,' which … includes … human capital…." They go on to refer to "the notion of sustainability" as providing future generations "an opportunity set that is at least as large as what is currently available to living generations."

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[2] E.g., Peter van de Ven (2015). For a brief introduction to the SNA and to GDP and GDP growth, see Diane Coyle (2014), Bos (2009), Leonard Nakamura (2007), and Jorgenson, Landefeld and Nordhaus (2006) and Vanoli (2005).

We see human capital as the *most* crucial component of what is provided to the generations that follow us, and believe Brent Moulton and Nicole Mayerhauser (2015) are right that, of the types of asset that are currently excluded from the SNA, human capital is the most important. They note too that economists have, for more than 50 years, featured the concept of human capital in their models of economic growth, productivity, and the distribution of income.[3] We recommend the addition to the SNA of supplemental person-level accounts. We see this added System of Person Accounts, referred to hereafter as a SPA, as the best way of recognizing the processes of human capital creation as well as related issues of how income is distributed among individuals and families. The original Kuznetsian view of the national accounts encompassed a concern for distribution, as did related work of Tinbergen (1972), and this concern is echoed and augmented in the Stiglitz, Sen, and Fitoussi (2009) report. Fortunately, individual and family efforts over multiple years to acquire capabilities can be represented in a supplemental SPA without disrupting the SNA.

A SPA is easiest to understand when there is one account for each and every person in the nation. In that ideal situation, there are no sampling issues and hence no sampling related bias problems. Those problems have technical solutions, but here we abstract from those issues. Governments in most advanced nations already maintain some full population person-level accounts, such as for health care in a nation like Canada with a public health care system. Some private companies already maintain full-population microdata accounts for which the micro unit is the transaction, with the party that initiated each transaction being carried as a transaction attribute. However, an actual implementation of a SPA could be anywhere on the continuum from full details for each individual to a created synthetic population of micro entities, or even a heterogeneous population of maximizing agents (e.g., Nakajima and Rios-Rull, 2014).

In 1973, Alice M. Rivlin wrote:

> "It seems to me important to take a broad view of 'national accounts' and to recognize that the … problem is not so much to expose what is wrong with the GNP, but to decide what other information we need to collect on a regular and sustained basis, and how this new information can be linked to that already in the national accounts" (p. 411).

[3] See also Todd, Heckman and Lochner (2008).

This is the direction we pursue in our paper.

We argue that adding a SPA to the SNA for a nation would permit consideration in SNA-based studies of policy issues from each of the following three perspectives, instead of from just the first of these:

(1) the current period outcomes perspective,

(2) the risky possibilities perspective, and

(3) the resources perspective.

The relevance of these perspectives can most easily be conveyed in specific contexts. We use three. The unemployment and mortgage defaults that were part of the financial crisis of 2009 constitute our first context. The second is what James Heckman argues is a lack of adequate developmental support in early childhood for many children. The third is the assessment of pollution effects on people. Human capital production and protection is a theme running throughout our consideration of these issues.

In section 2, we more fully explain the three perspectives on wellbeing utilized in this paper. The vision of Guy Orcutt and of Nancy and Richard Ruggles of supplementing what we now call the SNA with micro level accounts is the subject of section 3. Section 4 considers unemployment effects of the 2009 financial crisis, and then takes up the treatment of owner occupied housing (OOH). Section 5 considers the context of the childhood development issues raised by James Heckman and his collaborators. Environmental pollutants constitute the context taken up in section 6. For each of the three contexts, we discuss how having the micro-level person accounts data in a SPA would expand the analytical and policy usefulness of the SNA. A discussion of both person and firm data needs follows in section 7. Section 8 concludes.

2. Three perspectives on wellbeing

The *current period outcomes perspective* on economic activity emphasizes the stream of consumer satisfactions that are produced via final consumption. This is the perspective now implemented in the SNA; the economy is observed via annual or quarterly aggregate snap-shots. The consequences of ex ante perceived risks are embedded in the aggregate economic outcomes

recognized in the SNA. The resources used to produce those outcomes are viewed as purely instrumental. The creation of capabilities takes place mostly as unmeasured production. In particular, there is no explicit recognition of multi-year efforts by persons to build up person-specific human capital. Only sectoral outcomes aggregated to the nation-level are observed.

To illustrate, if X is a vector of purchases and P is a vector of prices, the maximization problem of an agent is to max U(X) s.t. $XP \leq Y$ where Y is income available for consumption. The chosen ex post bundle XP is what the outcomes approach measures as the nominal transaction that is then aggregated as part of total nominal expenditures. Each individual's choice of XP provides a measure of the relative consumption of that individual. The distribution of consumption choices is the basis for measures of consumption inequality.[4] Changes over time in consumption choices form one basis for ex post measures of consumption risk.

The current period perspective allows analysis of the economy in terms of current income flows, final product demand and supply relationships, market sector intermediate product flows, and the resulting beginning and end of period recorded asset stocks. Multiple analytic needs are accommodated, and multiple checks on the data are facilitated. We agree it is vital to protect these benefits of the SNA as it is now (Davies, 2015; Lynch, 2015; Reich, 2015).

The *risky possibilities perspective* considers dynamic and distributional effects of actions and shocks. The micro entities (e.g., persons) experience a potentially wide range of outcomes even when the mean outcome can be predicted quite precisely. Risk within an economy is usually most fundamentally realized in terms of the variance of outcomes experienced by the constituent micro entities. Moreover, the planning and risk management measures of individual agents are difficult to take into account without explicit recognition of the relevant micro entities.

Crucial issues of welfare and financial stability can be most transparently examined using data at the level of the decision makers. Financial risks to individual firms and households are greatly affected by the distribution of income and assets (including debt) over micro entities. Systemic financial risk, in turn, depends on the interdependency and covariance properties of the individual risks (Leonard Nakamura, 2015).

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[4] Jasso (1997); Deaton (1997, 2003, 2005), Deaton and Tortora (2015), and Freeman and Viarengo (2014).

Also, in the risky possibilities approach, the persons or households face planning problems in which the values they place on resources may be affected by anticipated future outcomes (Tobin, 1970). Hence choices are influenced by the anticipated distribution of quantities and prices in alternative future states. For example, current and future work opportunities can affect the extent and types of education an individual chooses. One way to measure this conditional heteroscedasticity is from alternative perspectives: from the wages received for hours of work. Uncertainty and the reduction of uncertainty which may occur as knowledge and time advance are fundamental to the risky possibilities perspective.

The individual or household maximizes E U(X) subject to E XP $\leq$ E Y over some probability measure. Of course, the expected values for any given person or household will not usually equal the population-wide expected values. Perceived risks affect household allocation of financial and real assets that determine E Y. The causal properties of a model are made more transparent by representing the choices of persons and firms at the level of the micro entities that make those choices. This aids understanding of the extent to which not only market services but individual asset ownership and also the work and home production choices of other family members provide solutions to ex ante risks faced by economic actors.

The *resources perspective* on economic activity takes a further step towards the *capabilities* that Amartya Sen (1993) has emphasized. Sen views capabilities rather than outcomes as determinative of the freedoms that are the rights of individuals. One way in which micro entities cope with living in a world where many sorts of outcomes are stochastic in nature is that they accumulate stocks of various sorts of resources. While Sen's capabilities are sets of possible functionings, a step towards the quantitative estimation of these capabilities could include adding information about accumulated person-level stocks of resources, as in Rawls (1971) or Dworkin (1981). This is what we mean by the resources perspective.

With the resources perspective, assets – including individual bodily assets such as health and education, public intellectual assets such as tested scientific theories, private intellectual assets such as patents, physical capital such as homes, group assets such as organizations and laws, and environmental assets (Vanoli, 1998) including the atmosphere and life forms – are valued not just for their current functional uses but also for their impacts on our capabilities. Within this framework, distribution is a primary attribute of freedom (Sen, 1993). The

availability of resources to individuals and the holdings of resources (and wealth) by individuals are central subjects in this approach. The human capital of individuals is more than an investment, and education has a function that goes beyond consumption and investment. We are freer when we know more as individuals. Knowledge assets have intrinsic worth to people. People have always tried to know more about what it means to be human and the world we inhabit.

Sen (1997) has emphasized that when the process of choice matters to individuals, each person may maximize within incomplete orderings or with menu dependent orderings. This leads to choices from a maximal set which may not satisfy the properties of optimality. There may be no best choice. In this way, capabilities, like intangibles, challenge the framework of the SNA as well as representing a half-way house between what is sometimes called economic rationality and behaviorism.

Kuznets (1971, 1973) stressed the importance of secular knowledge and science as basic causes of Western economic ascension. He argued that humanity's fortunes changed after Gutenberg printed his first book in Mainz in 1455. Productivity in book production was revolutionized and book costs fell dramatically by the 1470s. The proportion of the population with access to books was greatly increased, and there was a much greater incentive for people to aspire to literacy.

Maddison (2004, 2005) argues that the impacts of knowledge caused the economic revolution, and that what is currently called the "industrial revolution" did not happen, or at least did not happen as it is portrayed by Arnold Toynbee (1884) who popularized the industrial revolution metaphor with its emphasis on investments in physical capital. Maddison notes that even Joel Mokyr (2002), viewed by Maddison as the most sophisticated devotee to the metaphor of the industrial revolution, acknowledges the importance of printing and also of advances in shipping based primarily on advances in navigational and other shipping related knowledge.

The resources perspective gives explicit recognition to knowledge creation over periods of years, and to how knowledge is passed forward over generations. Learning happens at the level of individual persons who spend time in study and who are aided in learning by unpaid help from parents and others as well as by paid time help from teachers. It is sometimes claimed that

the teaching professions keep doing things the same way, decade after decade. However, it is undeniably the case that the *content* of the knowledge being taught has been evolving, decade to decade and even year to year in most fields of knowledge. These learning processes happen at the level of individuals and of the knowledge stocks embedded in written materials that are then mastered by teachers who then help others learn. Sufficiently detailed time-use surveys, including sufficient family and employment details, could illuminate these essential teaching and learning processes (Houseman and Nakamura, 2002).

In their paper, "Volumes of Evidence: Examining Technical Change in the Last Century through a New Lens," Michelle Alexopoulos and Jon Cohen (2011) present a new type of indicator of technical change based on publication titles. Their indicators are based on the MARC (MAchine Readable Cataloging) records of the US Library of Congress (LOC). Alexopoulos and Cohen explain that the MARC records provide a virtually complete list of all new titles copyrighted within the US. They use the MARC record data to compile a list of new English language titles for different technology and computer topics that were published in the US each year between 1909 and 1997. They also provide quarterly indicators based on the Amazon.com database. Because Amazon is a commercial operation and cannot sell the book titles it fails to list, this company keeps their database of titles more up-to-date and the Amazon records of titles for the post-1980 years include the month as well as the year of publication. This permits Alexopoulos and Cohen to create quarterly indexes.

As Leonard Nakamura (2010) explains, measures of intangible investment expenditures by L. Nakamura (2003), Corrado et al. (2005), and Corrado and Hulten (2008) suggest that these investment expenditures rose in the US from roughly 4 percent of GDP in 1977 to 9 to 10 percent in 2006. However, the intangible investments of the learning and teaching of new knowledge by people other than the investors of that knowledge are mostly missed by more traditional measures of investments in intangible capital, and those investments might in fact be essential. The new knowledge that is not taught to others may not end up being used. Alexopoulos and Cohen (2011) may have come up with a way of getting at these teaching and learning investments in knowledge that could supplement time use studies going forward, and might give some insight into the importance of those investments in years past. Publications are

one of the main routes by which teachers (and others) teach themselves about knowledge, and that teachers then use in instructing others.

Conceptually, the transactor/transaction approach of the SNA has always encouraged explanations of the accounts in terms of the relationships of individual economic agents to each other. Persons are the group of transactors for which supplemental information is most needed right now for public policy analyses. The added system of accounts could be used separately or together with the SNA, depending on the application needs. With geographic detail, micro level accounts for persons would also take an important step towards enabling the analysis of geographic impacts such as pollution (including global warming effects). In making this proposal, we build on the SNA development visions of Guy Orcutt and of Nancy and Richard Ruggles, but without full inter-account data harmonization, as we will explain.

An existing model that shows how a SPA can usefully augment the SNA is EUROMOD,[5] a person-level tax-benefit model for a group of 28 nations that is introduced briefly here in section 3 of this paper.[6] Another existing application is the micro data augmentation to the Financial Accounts of the United States (US) being undertaken by staff at the Federal Reserve Board (Gallin and Smith, 2014) and a parallel project of the European Central Bank involving periodic surveys of household income by type, wealth, and financial flows (ECB, 2013).

3. The Orcutt and the Ruggles and Ruggles SNA-related visions

It is the development of the computer over the last several decades that has made the modern-day blossoming of microdata possible, and that has created new possibilities for using microdata.[7] Before the development of powerful computers, data-collecting agencies reduced raw data to cross-tabulated formats as the first step in data processing because of the difficulties and high costs of handling micro-level data. Aggregation was a form of data reduction intended

[5] https://www.iser.essex.ac.uk/euromod/resources-for-euromod-users/country-reports

[6] For more on other related approaches, see Dekkers, Keegan and O'Donoghue (2014).

[7] See section 1.1 titled "Historical Perspectives on computers and Econometrics" in Berndt (1991). That one chapter can be found online at http://courses.umass.edu/econ753/berndt.poe/Ch01.pdf .

to make information manageable. Subsequent data processing was confined to manipulation of the aggregated data.

However, in recent years, the trend of data processing by governments has been in the opposite direction. Maintaining the raw data in its original form makes it easier to produce the wide variety of aggregations and cross tabulations required for different purposes. Such considerations have led to a data revolution, where basic data files are computerized and maintained in their microunit form. The computer has also played a major role in permitting analysts to carry out computations at the microunit level. Even millions of observations (like we used, for example, to obtain the results presented in A. Nakamura, E. Nakamura and L. Nakamura, 2011) can now be processed quite quickly and at low cost on what have become ordinary computers.

It was while Orcutt was working in England in the late 1940s as part of a small group of scholars assembled by Richard Stone that he came up with the idea of augmenting core macro level accounts of the sort that Stone was working to create for nations with micro entity level accounts. He envisioned that over historical time periods the micro entities would be advanced one period to the next by a combination of processes that are deterministic (e.g., each surviving person's age increases by one each year), or predetermined in the sense of being rule-based (e.g., government transfer and tax payments are supposed to be made according to the program rules, and mortgage loan payments are supposed to follow the schedule agreed on when a loan was originated), or as coming from administrative data (e.g., the recorded event of death, the tax payment received by government, and even bill payments as they are actually received (or not) by companies if the official statistics agencies could be given access, by law, to consumer credit rating agency data, which it seems likely would improve the accuracy of that data with benefits for all of its users), or generated stochastically so that the distribution of outcomes within the model micro-entity population matched the realized distributions of outcomes when data are available for those distributions. The SNA, of course, contains only historical data.

Going forward into the future, Orcutt envisioned that events including births and deaths of individuals would be generated stochastically, but age would still advance deterministically and the institutional features of many other processes such as tax and transfer payments would

still largely be according to rules specified at the micro entity level.[8] Statistics of various sorts could be computed, as needed, over the evolving simulated populations (Orcutt, 1957).[9]

In a first attempt to partially realize his vision, in 1957 Orcutt set about working with three Harvard doctoral students, Greenberger, Korbel and Rivlin, to develop a monthly, dynamic microanalytic model of the US household sector (Orcutt et al., 1961). This highly simplified first microanalytic model, which nevertheless seriously strained the limits of the best available computers back then, utilized control totals of various sorts from the available macro data.[10] Inter-accounts data exchanges like this must be designed to take account of recognized data source-specific strengths and weaknesses, including incompatibilities rooted in the coverage and variable definitions of the different data resources.

The key is to pass information between accounts, data sets, and models so as to give dominance, whenever possible, to the aspects of the combined information resources that are most reliable. (This sort of exercise need not, however, involve or depend on prior or further database harmonization; what is necessary is for those carrying out the exercise to understand the definitions and strengths and weaknesses of each of the databases involved well enough to make good choices about what information to use from each one and acceptable ways of integrating information for the application at hand: a far more modest task than determining how to integrate the databases themselves, and one that does not entail overwriting the information in any one of the databases involved.)[11] It is not that harmonization does not matter; there is compelling evidence that it does (e.g., Deaton, 2005, who notes impacts of how homeowners and financial services are treated in household survey data versus the SNA). Rather we are simply arguing that it is important for national statistics agencies to facilitate the use of their household survey data

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[8] If there is empirical evidence that rules like these were not followed sometimes, that evidence could be used too.

[9] For more on this approach, see Dekkers, Keegan and O'Donohue (2014), and Harding and Gupta (2007). Also, Baroni and Richiardi (2007) provide a helpful "beginners' guide" and then an overview of the development of micro entity socio-economic models in the fifty years after Orcutt's 1957 paper was published, focusing on key methodological issues. See also

[10] Subsequent early micro model and micro data base construction efforts include James Schreyer (1968, 1975, 1995), Budd (1971), Pechman and Okner (1974), and Orcutt et al. (1971). For more on recent uses of Orcutt's later DYNASIM model, see Smith (2012) and Smith et al. (2005).

[11] For an introduction and references to some of the other relevant literature, see Nakamura and Nakamura (1978, 1983, 1985a, 1985b, 1987, 1989, 1990a, 1990b, 1993, 1994, 1996), Nakamura, Nakamura and Cullen (1979a, 1979b) and also Capozza et al. (1989) and Nakamura and Walker (1994).

together with their SNA data despite the known (and still to be discovered) problems in combining information from these sources.

The first official SNA version was published in 1953, and the first official revision of the SNA was published in 1968. This set the stage in the early 1970s for Nancy and Richard Ruggles (1973, 1974) to explicitly develop the idea for how national accounts could be built up from, and made to be fully compatible with, the accounts of micro economic decision making entities such as firms, households and non-profit organizations including governments of national and subnational jurisdictions: the same entities whose behavior had become the central focus of the microanalytic models Orcutt was working to build. That is the ideal. However, we oppose delaying the addition of supplemental systems of micro accounts until full data harmonization can be achieved (if, indeed, this will ever be possible). Fortunately, the empirical and policy analysis data user communities have become accustomed by now to the fact that different datasets can capture different aspects of reality, and suffer from different bias problems. Transparency and statistical agency neutrality with respect to competing ideologies suffer from forced database consistency, especially when general access is not provided to the databases involved prior to the forced adjustments.

EUROMOD, which is a person-level tax-benefit model for the EU28 member states, represents a modern-day example of a person-level micro model (Sutherland 2000, 2001; Immervoll et al. 2006; and Sutherland and Figari, 2013). The EUROMOD input database contains information at the individual level on household demographic, and labor market characteristics, gross market income, and all other person and household level income flows (i.e. pensions, public transfers and private incomes). This model was developed primarily with European Commission funds and has been used extensively by the European Commission and various national administrations within the EU (as well as for some external studies). It enables consistent and comparable cross-country analysis of the effects of tax-benefit policies and policy reforms on national budgets, the distribution of household incomes, and work incentives. EUROMOD enables the measurement of potential effects of changes that are made by governments including government budgets, income distribution, and work incentives in the EU.

4. Unemployment and housing impacts of the financial crisis on wellbeing

The use of tax-benefit microsimulation models to consider how public welfare systems protect people from extreme economic shocks has become known as "stress testing" a tax-benefit system (Atkinson, 2009; Sutherland and Figari, 2013). This is a case where nation-level results are needed, but where many of the economic shock effects and consequences of interest and the attempted policy responses happened at the level of persons in families.

In this section, we begin with material from the EU about the consequences for people thrown out of work during the financial crisis of 2009. We move on to alternative possibilities for accounting for owner occupied housing (OOH) in nation-level economic analyses, and consider a OOH-related proposal by Diewert, Nakamura, and Nakamura (2009) that would require detailed micro data on households and homes. Finally, we briefly consider studies of financial stability that require the kind of microdata that is currently being collected in conjunction with the US financial accounts by the Federal Reserve Board and by the European Central Bank.

As Alice, Masao and Leonard Nakamura (2013) explain, the financial crisis of 2009 greatly impeded R&D and other knowledge creation activities.[12] Unemployment also interfered with on-the-job human capital development and can be inferred to have caused depreciation of the human capital of workers subjected to long periods without work or who were forced to take new jobs of sorts that did not use the human capital they had built up on their pre-crisis jobs.[13]

4.1 Stress testing national tax-benefit systems

Using EUROMOD, Salgado et al. (2014) focus on a set of six EU countries (Belgium, Estonia, Spain, Italy, the Netherlands, and the UK) that experienced different macroeconomic changes during the first phase of the Great Recession, and that have quite different unemployment protection schemes. EUROMOD made it possible to use as the benchmark for the

[12] More background on the crisis can be found at and in the references for Ball (2014), Ollivaud and Turner (2014), Sunder (2013), A. Nakamura (2013), and Haugh, Ollivaud and Turner (2009).

[13] See. e/g/., Kambourov and Manovskii (2009a,2009b) for evidence on the importance of occupation specific human capital.

stress test for each of the six nations the real income distribution observed for the given time period. EUROMOD also made it possible to take account of the effects of incomes earned by others living with those who lost their jobs as well as interactions of family attributes with the rules of the tax and social safety net programs.[14] The attributes of each person in EUROMOD's synthetic population include family status variables, which makes it possible to take account of tax and benefit program provisions that differ depending on family attributes.

There are multiple practical reasons for organizing the data in the form of records for individuals rather than, say, records for nuclear families or households. However, the individual records should nonetheless contain the information needed to produce family or household statistical results or datasets as needed, including family or household results over time, in addition to person-level results.

4.2 Accounting for owner occupied housing (OOH)

EUROMOD analyses have helped EU policy makers seeking to better understand the performance of their social safety net programs. However, due to the limitations of the current version, the analyses neglect the potential importance of owner occupied housing (OOH) assets. If a version of EUROMOD were expanded to incorporate housing status variables, this could greatly enhance the relevant policy analyses that could be carried out.

OOH assets are a major component of personal consumption expenditure in the SNA. Moreover, housing prices and mortgages were at the center of the 2009 financial crisis in the US. Indeed, José Manuel González-Páramo (2009) asserts that the links between household wealth and consumption can only be properly understood if OOH wealth is covered. According to the estimates published by the European Central Bank, around two-thirds of euro area household wealth is held in housing. A related concern is that ignoring OOH assets can lead to wrong conclusions about the relative wellbeing of various demographic groups. For example, based on US data, Garner and Short (2009) find that current period comparisons of economic well-being

[14] See http://ec.europa.eu/eurostat/statistics-explained/index.php/EU_statistics_on_income_and_living_conditions_(EU-SILC)_methodology_-_in-work_poverty

underestimate the relative position of elderly households if the benefits of home ownership are not accounted for.

Diewert, Nakamura and Nakamura (2009) document considerable disagreement within the official statistics community over how to account for the cost of OOH. None of the conceptual approaches fully surmount the challenge of dwelling uniqueness. The exact location is only the most obvious of the many features that differentiate dwellings, and this is the case for rented as well as owned dwellings.[15] However, with a SPA, it would be possible, at least, to explicitly consider how individuals invest in homes, year after year, and when and how they rely on their home equity during periods of financial difficulty such as during spells of unemployment.

The current SNA treats the services of OOH differently from other components of consumption. Households as occupants are considered to be renting their dwellings from themselves as unincorporated enterprises. These fictitious enterprises own the dwellings and pay the costs associated with them. To offset these outlays, the unincorporated enterprises receive imputed rental fees from the household occupiers. As a consequence of this treatment, what appears in the SNA household income and outlay account on the outlay side is imputed space rental (effectively the shadow price) as a part of consumption expenditure, and on the income side is imputed rental income on OOH counted as a part of total rental income. The direct costs of owner-occupancy, including maintenance expenditures, property taxes, insurance, mortgage interest, imputed interest on owner equity, and depreciation appear in the SNA in the production account outlays of unincorporated enterprises in the real estate industry. There are good reasons for how OOH is dealt with in the SNA. However, this setup can cause a variety of problems. For instance, during inflationary periods, the imputed prices for space rental are likely to rise more than the actual homeowner expenditures.

Diewert, Nakamura and Nakamura (2009) argue that the opportunity costs of households in different situations should be assessed differently. Basically they make the case that a *user-*

[15] Since dwellings, like people, are inherently unique in ways that matter when it comes to valuation, taxation and wellbeing attributes, and since dwellings also evolve in dwelling-specific ways over time (somewhat like people), this suggests that perhaps the time has come to consider also having yet another set of micro level accounts for individual dwellings: a System of Dwelling Accounts (SDA).

cost approach is right for some, while for other households a *rental* equivalence approach is better. The suggested way of deciding which approach is right for which household is to compute the opportunity cost in both ways, and then take the maximum. Thus, *for each household* living in owner occupied housing (OOH), the *owner occupied housing opportunity cost* (OOHOC) is defined to be the maximum of what it would cost to rent an equivalent dwelling (the rental opportunity cost, ROC) and the financial opportunity cost (FOC) of the funds tied up in an owned home. Clearly this approach can only be fully implemented with data at the level of individual homeowners and their actual dwellings and financial assets.

It is well known that measures of home price inflation display positive serial correlation: a price increase (decrease) in one period is likely to be followed by a price increase (decrease) in the next. If home prices in the future are expected to increase, then home buyers have an incentive to buy now, before prices rise further, and mortgage lenders will feel more secure making the loans needed for home purchases when property values are rising. These mechanisms counterbalance the natural tendency for rising prices to curtail demand, bringing in additional demand in response to higher housing inflation rates. These procyclical mechanisms can be seen in subprime mortgages, alternative mortgage products, appraisals and certain institutional changes that occur during booms (Leonard Nakamura, 2014).

4.3 Accounting for changes in consumer finances

Recently, the US Federal Reserve Board moved to supplement the US quarterly Financial Accounts it maintains with micro data sets.[16] Gallin and Smith (2014) note that:

> "These enhancements would be supplemental in the sense that they would not necessarily be integrated into the process of equating sources and uses of funds, which would continue to be done at a quarterly, aggregate level. Nonetheless, these supplemental data series, where available, could help analysts and researchers drill down into finer levels of detail."

Thus this initiative is similar in nature to the SPA supplementation we recommend for the SNA.

[16] This initiative is based on conceptual work by Eichner et al. (2015), Gallin (2015) and L. Nakamura (2015).

The European Central Bank (ECB, 2013) has a similar initiative underway which includes the Eurosystem Household Consumption and Finance Survey. That survey collects data on individual households across the Euro area, including some 62 thousand participants, with the survey information including income by source, durable assets and demographic variables. Kavonius and Honkilla (2013) outline the efforts that have been made to bring the micro data sets into alignment with SNA aggregates. Well designed efforts of this sort can, of course, greatly improve the quality of a micro dataset, and with no harm or threat to the associated macro data (the SNA aggregates in this case). Kavonius and Honkilla (2013) explore the possibilities these data resources can open up for the study of the financial stability of nations.

As Brueckner et al. (forthcoming) show, mortgage lenders during the financial crisis created riskier alternative mortgage products that allowed buyers to stretch their current period buying power and which had low required payment schedules early in the lives of the loans. Alternative mortgage products were generally provided to home buyers (including investors) purchasing properties in relatively expensive areas; on the whole, it turns out that these were relatively sophisticated consumers whose incomes made these purchases aspirational. In retrospect, they experienced a high rate of default. However, it has now been shown that the alternative mortgage products need not be riskier than ordinary mortgage products if mortgage lending is disciplined so that products like this are only used by borrowers with reasonable expectations of higher future incomes (Cocco, 2013).

Also, once a financial crisis has erupted, it is now recognized that regulators may inadvertently worsen the situation by imposing stricter regulatory scrutiny when a downturn is already in progress. An example of this is the Home Valuation Code of Conduct, a tightening of mortgage appraisal standards in 2009 that made appraisals more stringent, and thus made home purchases more difficult during the housing downturn, as shown in Ding and Nakamura (2014). Problems attributable to regulator responses hopefully can be reduced in the future given a greater understanding of how these problems arose.

Akerlof and Shiller (2009) and others (e.g., Boeri and Guiso, 2007) have argued also that the limited ability of some people to process complicated financial information contributed to the sharp rise in mortgage defaults during the recent financial crisis. Recent research has shown that significant numbers of individuals have problems answering simple questions about basic

financial principals (e.g., Lusardi and Mitchell, 2014). This shortfall in understanding is believed to translate into higher consumption, less saving, and out-of-control credit usage (Banks and Oldfield, 2007; Lusardi and Tufano, 2008; and Mitchell and Lusardi, 2015).

For example, Gerardi, Goette and Meier (2013) test the importance of financial literacy using a microdata set of mortgage borrowers who took out loans in 2006 and 2007. These measures are matched to objective, administrative data on mortgage characteristics and payments. They find a large negative correlation between a particular aspect of financial literacy, referred to as numerical ability, and mortgage delinquency and default. Those with poor numerical ability were substantially more likely to experience foreclosure. Gerardi et al. speculate that numerical ability likely affects mortgage outcomes via an inability of individuals to perform the simple mathematical calculations necessary to determine whether monthly mortgage payments are affordable over a long horizon.[17] Perhaps a highly simplified but mandatory financial literacy test administered by a disinterested third party testing service should become part of applications for mortgages and other large loans (including credit card lines of credit), with those who fail the tests being required to have one or more co-signatories who can pass the test or approval from a special government office set up to help those lacking basic financial literacy.

To summarize, adding a SPA – a System of Person Accounts – that includes family attributes, employment and other income details (including transfer payments), housing attributes, and finances that is added as a supplement to the SNA could greatly expand current financial stability analysis, welfare, and other analysis capabilities.

5. Accounting for the human capital development of children

[17] For related results for Italy that both illustrate the importance of the person-level data and also the potentially broad implications of various sorts of person-specific accumulated knowledge assets for the functioning of a modern free market economy, see Fornero and Monticone (2011). Based on the Bank of Italy's Survey on Household Income and Wealth (SHIW), they find that many individuals lack knowledge of basic concepts such as interest rates and inflation. They find that financial literacy has a positive and significant impact on the probability of pension plan participation.

From the current outcomes perspective (e.g., the perspective of Jorgenson and Fraumeni, 1989, and Fraumeni, 2011), the real value of human capital is its contribution to expected income. In introducing the current period outcomes perspective, we stated that this is the perspective now implemented in the SNA. Where human capital is concerned, however, even this fundamental role for human capital is largely invisible in the SNA. Despite its fundamental importance and the monumental efforts of Jorgenson and Fraumeni and the many others persuaded by the research of Jorgenson and Fraumeni, the SNA treatment of human capital remains to this day profoundly underdeveloped.

Of course, the needs for knowledge and skills of different sorts shift with shifts in technology and in macroeconomic conditions. Thus governments face risks in making human capital investments. Moreover, education investments are made by individuals and their families over multiple years with the variances of predicted returns at the micro level being even greater than the risks governments face in making investments in education. Also, borrowing constraints impinge on freedom of choice at the individual level. The risky possibilities perspective focuses on human capital investment risks, and micro level data are needed for this purpose.

Moving to our third resources perspective, human capital becomes a primary desideratum, as it affects all aspects of human capability. Human capital affects the ability of individuals to make choices, both in their output and in their consumption. As we have already noted, this includes the ability to make financial decisions.

Issues concerning the development of human capital gain even greater importance when we consider the rapid pace of technological progress which continually expands the ocean of knowledge that we can learn from, if prepared to do so. The time has come surely to more explicitly represent human capital development in the accounts of nations. We see a companion SPA for the SNA for each nation as the natural vehicle for doing this, with the role of human capital finally becoming visible from all three perspectives we identify. In the rest of this section, we first touch on time use data issues and then turn our attention to the human capital development evidence and ideas and calls for measurement of James Heckman.

In his 2013 book, *Giving Kids a Fair Chance*, James Heckman argues that the accident of birth is the greatest source of inequality in America today. He shows that children born into

disadvantage are, by the time they start kindergarten, already at risk of dropping out of school, teen pregnancy, crime, and a lifetime of low-wage work. Heckman shows that acting early has much greater positive economic and social impact than later interventions. A SPA can incorporate person-level effects over time of the sort that Heckman's research has shown to be so important. And a SPA coupled with the SNA could potentially then provide the empirical basis for measures that would show the progress of nations, or lack thereof, toward re-leveling the playing field of free market economies so that there is the possibility of success for those who try hard even if they were not born to fortune.

5.1 Accounting for people's paid and unpaid time

Peter Hill (2009) notes that even in developed countries like the US, the market goods acquired by households for purposes of consumption are frequently further processed within the households before they are consumed. Indeed, many of the services consumed by households have no purchased components (e.g., teaching children words by talking to and with them, kindness and trust and cooperation toward others by interacting with them with kindness and a spirit of trust and cooperation); rather, they are entirely produced within the households.

A broader view of the human capital production processes is possible now that time use survey data have become more widely available. These surveys require respondents to keep detailed diaries of how they spend their days. Harpreet Kaur and Anupama Uppal (2015) raise multiple important practical issues that need to be attended to in the collection of time use survey data. We believe, however, that a wearable, push button electronic device will soon surely be devised that will improve the convenience of being part of a time use survey from a participant perspective, and that will also improve the quality of the resulting data collected.

5.2 Pre-school human capital development and the Heckman initiative

Child development is often discussed in cognitive and non-cognitive terms. Cognitive development refers to a child's emerging ability to think and understand and make choices, as

well as the ability to master skills such as the use of numbers.[18] Non-cognitive development refers to the development of personal abilities such as self-control, as well as to evolving abilities to communicate with, enjoy, form relationships with and cooperate with other people (Gutman and Schoon, 2013; Miyamoto et al., 2015). These two skill classes exhibit overlaps and synergies. For example, the mastery of language affects and is affected by both cognitive and non-cognitive development.

Decisions about how much, and at what life cycle points, adults in various roles should invest in the next generation are among the very most important human capital choices facing the people of any nation. In an interview published in *Macroeconomic Dynamics* (Ginther, 2010), Heckman notes that mainstream theories of economic development assign a key role to the education levels of workers, but little attention is paid to the abilities and skills underlying educational success or to the measurement and monitoring of the development of those skills in individuals from different demographic groups or to the consequences of the differences. James Heckman (2003, 2005, 2006, 2007, 2008a, 2008b, 2011, 2013) over the past decades has established three propositions that, taken together, seem likely to us to revolutionize the treatment of human capital in the accounts of nations:

1. Children at conception have potential abilities – birth endowments -- that greatly exceed the abilities most realize by adulthood.
2. Children's abilities fail to develop well without adequate stimulation in early childhood.
3. Subsequent schooling success depends critically on early childhood development.

Systematic and substantial non-cognitive ability gaps are shown to open up between more and less advantaged children in America well before those children start kindergarten,[19] leaving many children ill prepared to learn in school (Heckman, Stixrud and Urzua, 2006). Conti and Heckman (2013) explain that the most reliable evidence on the effectiveness of early interventions comes from experiments in which the early environments of children born into disadvantaged families were substantially enriched.

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[18] http://www.nichd.nih.gov/about/org/der/branches/cdbb/programs/pages/dcpbnp.aspx

[19] See Heckman, Pinto and Savelyev (2013); Cunha and Heckman (2010, 2014); Cunha, et al. (2010); Heckman, Stixrud, and Urzua (2006); and Carneiro and Heckman (2003).

Multiple Heckman group papers contend that early childhood enrichment will raise the future productivity of the US economy. The arguments are sound from the perspective of an economic fundamentals definition of national productivity. On a fundamentals level, the total factor productivity (TFP) of a nation is a measure of the efficiency with which total market output is produced from total market input. On a conceptual level, it is clearly true that a nation with more competent citizens and workers will be more efficient at transforming market inputs into market outputs: the conceptual definition of total factor productivity (Diewert 1974, 2000, 2014; Diewert and Nakamura 1999, 2003, 2006, 2007a, 2007b; and Schreyer, 2001).

However, the multifactor productivity (MFP) statistics produced by national statistics agencies are not well suited for reflecting the benefits to be expected from child development initiatives. For a start, no account is taken in the SNA and in the productivity measures for nations that are based primarily on SNA data of the parental activities within families that can produce smarter future citizens who can solve problems better at work and in their communities and at home, and will suffer fewer mortgage defaults, accidents of all sorts, and criminal failings.[20] Without either time use data on those home inputs and on program supplements for children through public or private sector programs coupled with developmental test evidence for preschool children, there will be no way of moving beyond the small group studies that Heckman and his co-researchers present to establish that there is an impact on attributes that can affect attributes of workers, as adults, that can raise the productivity of the firms and other organizations that employ them and therefore of the nation.

6. Dealing with pollutants

Public safety and control of noxious substances has long been an area of government responsibility and hence of public policy analysis and debate.

6.1 Climate change

[20] MFP is a complex statistic. For many nations, there are shortcomings for one or more components. (See Diewert and Yu, 2012 and Diewert, 2012, and also Harper, Nakamura and Zhang, 2012 regarding Canada's MFP statistics.)

Climate change is being caused by air-borne pollutants collectively referred to as greenhouse gasses. This is considered by many people to be the signature economic and political issue of our times. Yet as Albert Braakmann (2015) notes, the costs for abatement of green house gases and other pollutants that are unwanted joint products of market production are omitted from, or end up actually increasing, GDP. A solution to this problem considered in Braakmann's paper is the use of a group of indicators to measure social progress, including one or more that are designed explicitly to reflect the negative effects of pollution.[21]

We argue here that a SPA that includes person-specific pollution impacts could be helpful to a government in building confidence in the chosen indicators of the sort that Braakmann discusses. For a SPA to b useful in this regard, the attributes monitored by the indicators must also carried as attributes in the SPA database. Ideally, SPA data would allow researchers, on an ongoing basis, to related the factors being monitored in the social progress indicators to tax and benefit measures and to choices made at the level of individuals and families. This research would both build confidence in good indicators and would allow the detection of poorly performing indicators.

Both traditional pollutants and greenhouse gas emissions affect nations disparately across its geographies (Desmet, et al, 2015). Storms and extreme weather – temporally localized – can play a large role in the well-being of people living in various localities, with there being interactions with people's economic means (e.g., the differential impacts on the people of New Orleans of hurricane Katrina depending on neighborhood affluence). Climate change itself has an important element of forecast; current changes in greenhouse gases will affect the future equilibrium of climate and sea levels. The ability of climate models to foretell these movements is a risk element in the calculus of climate change policies and of expected well-being.

6.2 How micro-level accounts can help too with traditional pollutants

During the second half of the 1970s, Orcutt, Franklin, Mendelsohn, and Smith produced a 1977 *American Economic Review* paper, and Mendelsohn and Orcutt published a 1979 *Journal*

[21] This, of course, is an approach with a long history (e.g., Moser, 1973). Osberg and Sharpe (2002, 2005) provide a very helpful discussion of some of the issues involved.

of Environmental Economics and Management paper (with a follow-up in 1983), empirically exploring strategies for estimating the impacts of several air pollutants on US place-of-residence-specific mortality rates. A primary objective of this research was to remove the influence of personal-level characteristics so that the effects of local area-specific pollution factors could be detected. We believe that a similar research strategy might help identify the extent of other environmental pollutants and might help prioritize efforts for reducing these pollution problems.

Moving beyond mortality measures, if testing of children were developed to keep track of developmental progress longitudinally and if this test information were regularly updated in a SPA for the individual children whose records were included, then it might be possible also to assess the extent to which pollutants are responsible for some of the observed demographic group differences in child development and in subsequent employment and other adult outcomes.

6.3 Linking child development problems, violent crime and lead exposure

One example of a pollutant which medical research has by now shown has caused widespread harm historically, and is still causing harm, is lead. We discuss mostly US evidence here. Due to public health data collection programs in the US, especially including NHANES,[22] there is better evidence in the US to study lead effects than almost anywhere else.[23]

Lead harms human brains, particularly in the young. When taken in by a person, lead passes through the blood brain barrier (Cleveland et al. 2008). Multiple medical studies conclude that the resulting areas damaged within the brain predictably impair decision making capacity, the capacity to be patient when performing demanding tasks, and the regulation of emotional

[22] http://www.cdc.gov/nchs/nhanes.htm and especially http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6213a3.htm .

[23] The US may also have had distinctively severe effects because of the US of and ability to buy the cars the used leaded gasoline. Also, several European countries banned the use of interior lead-based paints in 1909, the US did not begin to phase out the use of interior lead paint until 1971 with the passage of the Lead-Based Paint Poisoning Prevention Act. Lead is slightly sweet to taste making chips of leaded paint attractive to eat to small children.) However, effects of lead poisoning have been documented for other nations as well (Koller et al. 2004; Nevin, 2007; Hellström et al., 2004).

responses.[24] Lead damaged children can be expected to learn both non-cognitive and cognitive skills with greater difficulty and to have less patience and persistence than normal children.

Few Americans seem aware of how dramatically US blood lead levels have changed over time, primarily due to the changing use of leaded gasoline. The average *preschool* blood lead level in America, measured in terms of micrograms per deciliter (μg/dL) of blood, rose from about 5 in 1940 to approximately 10 in 1949, to over 15 by 1953, and to almost 20 by 1957, and then to over 20 for the years of 1965-1975 before dropping back to 5 by 1985, and then to about 3 by 1986-1990.[25] [26] These average preschool blood lead levels may be compared to the current threshold of pediatric concern of 5 μg/dL.[27]

Over the period of 1966-1974 when per capita use of leaded gasoline was at its maximum in the US, the highest ambient concentrations are believed to have been in central city areas. Over those years, roughly 62 percent of black children under age six lived in central cities versus 24 percent of white children under age six (US Census, 1960-90). Nevin (2009) reports that over those years, 63 percent of black children age five and under living in central cities had blood lead levels of 20 ug/dL or higher. Nevin (2000, 2007) finds strong associations for the US between preschool blood lead levels and subsequent crime rates, and shows furthermore that the turning points in the time series match up over time.[28]

In the late 1970s in the US, lead was removed from gasoline under the Clean Air Act. Reyes (2007) uses the ensuing uneven state-specific reductions in lead exposure to identify the effect of childhood lead exposure on crime rates. The elasticity of violent crime with respect to childhood lead exposure is estimated to be 0.8, and this result is robust to multiple sensitivity tests. Reyes (2007) finds that the reduction in childhood lead exposure in the late 1970s and early 1980s resulted in significant declines in violent crime in the 1990s.

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[24] Braver et al. (2001), Williams et al. (2004), Davis et al. (2005), and Cecil et al. (2008).

[25] http://www.ricknevin.com/Nevin_Graphs.html Similar sorts of patterns have been identified for other nations too.

[26] http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5608a1.htm

[27] http://www.cdc.gov/nceh/lead/acclpp/blood_lead_levels.htm

[28] http://www.ricknevin.com/Nevin_Graphs.html. See also Nevin and Jacobs (2006) and Nevin et al. (2007)

Reyes (2015a) uses individual-level data on childhood lead levels and test scores in Massachusetts to link between lead levels in early childhood in the 1990s to student test scores in elementary school in the 2000s. This study was made possible by the fact that Massachusetts had mandated standardized achievement tests in public elementary schools. Unfortunately it was ruled that privacy issues forbid the use of the individual-level achievement test results (though we believe that most of the parents would have consented to that use of the data had they been asked). Nevertheless, panel data analysis conducted at the school-cohort level for children born between 1991 and 2000 and attending 3rd and 4th grades between 2000 and 2009 at more than 1,000 public elementary schools in Massachusetts show that elevated levels of blood lead in early childhood are significantly associated with poorer standardized test performance, even when controlling for community and school characteristics.

As noted already, medical research has determined mechanisms of permanent lead impact on the brains of children and animal models that would be expected to produce subsequence adverse effects on behavior and development. In her latest study on the subject, Reyes (2015b) uses data on two cohorts of children from the National Longitudinal Survey of Youth (NLSY)[29] to investigate the effect of early childhood lead exposure on behavior problems from childhood through early adulthood. She finds large negative consequences in the form of an unfolding series of adverse behavioral outcomes including pregnancy for girls and young women and aggression for boys and young men. This evidence suggests that, by increasing impulsivity and aggression, even moderate exposure to lead in early childhood can have substantial and persistent adverse effects on individual outcomes over time. Lead exposure of children is not an equal opportunity problem. Children born to lower income mothers, and to mothers who are immigrants or in certain ethnic groups, are much more likely to be exposed to lead when young.[30]

Developed countries have by now successfully protected their populations from ambient exposure to lead by banning the use of leaded gasoline, but leaded gasoline is still utilized in a

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[29] http://www.bls.gov/nls/

[30] Warniment et al. (2010) document that non-Hispanic blacks and Mexican Americans are at higher risk than non-Hispanic whites. It has also been shown that parents, by themselves, cannot effectively protect their children from lead contaminated dust simply by cleaning more, even with instruction on modes of cleaning and the provision of special cleaning supplies.

number of less developed nations.[31] Also, in developed nations including the US, there is continuing exposure to lead through chips and dust from interior paint in older homes and places of work, contaminated soil, and lead pipes and solder used to carry drinking water.[32] These effects are hard to differentiate from what is normal when most of those in a population group have been exposed. Regular monitoring blood tests for children, from birth on, could help greatly in this respect.

We suspect that the poor developmental outcomes for children documented by Heckman and his co-researchers, the changes over time in average preschool blood lead levels, the historical housing discrimination in the US that confined Blacks for decades to inner city housing where the ambient lead levels are believed to have been highest, the patterns over time in US murder rates, and the deterioration in education outcomes in the US in recent years and in the US versus other nations[33] are interrelated phenomena. In our view, lead can even explain male-female-differences in education outcomes since medical researchers have shown in animal models that male young are more seriously affected by a number of pollutants than female young.)

Concerns like this about the impacts of environmental pollutants on people can be best addressed by supplementing the SNA data on macro economic outcomes with SPA data for individuals whose attributes include where they live and work. As climate change progresses, and natural disasters become more frequent and severe while disease problems once confined to tropical regions move northward, a SPA that includes place of residence along with age and health attributes for people may also become an important health system and emergency response system planning and operational deployment tool. The combined SNA-SPA system of data would then support more timely and accurate assessment of nation-level responses and implications of local weather or health emergencies.

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[31] http://www.lead.org.au/fs/fst27.html, http://www.case.edu/magazine/fallwinter2010/gettingtheleadout.html, https://secure.avaaz.org/en/petition/Bring_about_the_elimination_of_leaded_petrol_gasoline_globally/?pv=35

[32] http://water.epa.gov/drink/contaminants/basicinformation/lead.cfm, http://water.epa.gov/drink/local/index.cfm, http://www.unitedutilities.com/about-lead.aspx, http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/lead-plomb-eng.php

[33] See Barth, Davis and Freeman (2015); Bryson, Davis and Freeman (2015); Acemoglu and Autor (2012); Haskel, Lawrence, Leamer, and Slaughter (2012); Goldin and Katz (2010); Heckman (2013); Heckman and LaFontaine (2006); Anderson (2004); and Cutler and Katz (1991).

7. Discussion

7.1 Why a SPA is a top priority

In the final section of their paper, "Measuring Individual Economic Well-Being and Social Welfare within the Framework of the System of National Accounts," Dale Jorgenson and Paul Schreyer (2015) write: "We conclude by recommending that distributional information should be incorporated into national accounts." We strongly agree with them on that point. Distributional information is needed for many of the sorts of policy analysis for which analysts are currently using SNA data. Thus it would help greatly to have distributional information available together with the SNA aggregates. We agree also with them and with Barbara Fraumeni, Michael Christian and Jon Samuels (2015) that human capital needs to be dealt with more adequately in an improved SNA.

However we disagree with Jorgenson and Schreyer (2015) on how to proceed; they write:

> "This process could begin with a household satellite system for measuring consumption expenditure and income broken down by relevant demographic and economic attributes such as household size, region, age of household members and consumption and income levels, very much in the spirit of Social Accounting Matrices that have long been present in the national accounts literature."

We fail to see how the Social Accounting Matrix (SAM) format can enable connecting, say, the pre-school investments by parents in their children that James Heckman's research has shown matter greatly to subsequent school performance and to job and crime and other outcomes that affect economic growth as well as the well-being of people. The traditional SAM is basically an extended input-output (I-O) table that contains information on interrelations between accounts. All data in a conventional SAM are expressed in relative value terms.[34]

Yet, even for developed countries like the US, there is no generally accepted way of putting even relative monetary values on the observed non-market time allocations. As Nancy Folbre (2015) observes:

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[34] For a general presentation of a SAM and how to use it as a tool for policy impact analysis, see for example, Thorbecke (1985).

> "What distinguishes both non-market work and intra-family transfers from market exchange is not their location, but their motivation, weighted more heavily with social obligation and personal affection. This motivation shapes the quality, as well as the quantity of services provided, and infuses intra-family transfers with a very different meaning…."

Time expenditures seem to us to be a more promising value metric for non-market activities.

It is true, of course, that a population of micro entities can always be formally represented using the transition matrix approach, and that representation may be as or more operationally convenient in some cases than a SPA. However, a SAM representation can always be produced given a full SPA dataset, whereas a SPA dataset cannot be recovered a SAM representation of the same underlying micro data due to the aggregation within matrix cells. Moving populations of micro level entities and their accounts (i.e., their data records) forward over time – the SPA approach -- provides greater flexibility in many policy relevant dimensions. The reasons this is so are essentially the same reasons why statistical agencies now typically strive to maintain data resources at the micro level when this is possible.[35]

Richard Stone (1970) proposed an integrated system of demographic, manpower, and social statistics which can be linked with the national economic accounts. For the purposes of analysis, Stone adopted a life sequence approach, tracing changes of state from birth to death in different aspects of life. He concerned himself with education, employment, social mobility, health, delinquency, family relationships, and migration and tourism. The social matrix for a given sequence traced out how a beginning population changed period to period. Thus, for example, a social matrix concerned with education could show the starting educational statuses of individuals grouped by sex and age, how those statuses changed during the given time period, and the final results at the end of the period. However, without redesigning that social matrix and the groups defined, the education outcomes could not be examined in terms of other attributes such as the development each person had attained at the conclusion of their preschool years.

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[35] For example, Bartelmus (1987) explains how "'microstatistics' (Ruggles and Ruggles, 1982, pp. 49-51) that can be readily manipulated" on an as-needed basis to inform the changing menu of public policy concern "lean again on SNA for a more systematic organization of its data bases and for integration with established macrostatistics."

Integration of the social matrices with each other and with the national economic accounts was achieved by Stone via linkages through common classification systems or through subdivision of a total in one system when moving to another system. Ruggles and Ruggles (1973) state that the matrix form for subsystems appealed to Stone largely because he conceived of his analytic models in terms of Markov chains with transition coefficients. However, the design of Stone's proposed integration of social and economic accounts is necessarily highly dependent on the uses to which the accounts are expected to be put. This is an inherently inflexible approach.

As social and economic problems shift or different analysts view these problems differently, the design of a SAM must be changed. Different classifications, pair-wise subsystems, and linkages will be required. Much as no single set of cross tabulations of a census is satisfactory for all users, a system of economic and social matrixes and sub-matrixes cannot meet the data requirements relevant to the wide range of social and economic problems. These are the same reasons that led official statistics agencies to begin offering Public Use Sample data sets from many person-based data collection programs.

Stone (1970) himself points out that there is a severe limitation on the number of variables and classifications which can conveniently be handled in a social matrix. If, for example, one wishes to study the interaction of 10 variables in a sociodemographic matrix, and each of these variables contains 10 classifications (both very small numbers to characterize the sociodemographic system), the number of cells in the matrix is 10^{10}, or 10 billion. Stone trims his problem down to manageable size by allowing only pair-wise interactions among variables. This though is a severe restriction. Stone (1973) himself explicitly recognized that if a continuously updated comprehensive system of individualized data were available, his social matrices and the necessity for dividing life into sequences and the subsequent restrictions they impose were unnecessary.

The satellite household production account for the US,[36] as explained by Landefeld and McCulla (2000), includes an input-output table for household production. A new set of

[36] Satellite accounts are outside the central framework of the national accounts but conceptually linked to them. As Landefeld and McCulla (2000, p. 292) state: "A satellite account can do two things: highlight or provide more detail

"industries" are identified corresponding to various kinds of productive activities carried out within households, such as "food preparation", "cleaning", and "child care". The activities consuming intermediate inputs purchased from outside the household sector, labor services provided by members of their own households, and capital services provided by the fixed assets[37] owned by the individuals in households.[38] As the US household production satellite account is set up now, the outputs of the designated industries are treated as entirely consumed within households within each given current time period.

And yet, while satellite household accounts like the US one have important uses, nevertheless for many policy applications a SPA would be more suitable. For example, at the level of individuals with family attributes, it is still relatively easy to take account of factors such as the 24-hours-per-day constraint for each person, the greater potential availability of parental time for raising children in 2-parent versus 1-parent families, and other family specific factors such as the education levels of the parents as desired in various policy applications. In contrast, once the person level data has been reduced to the sort of input-output formulation used for the US household sector production satellite account, factors explicitly represented in that compressed format are limited and cannot be easily changed once chosen.

With a SPA, it is possible to begin trying to account for the fact that human capital stocks are built up over time within individual persons. For instance, the child who misses out on needed stimulation at age one will more likely need special education help to achieve grade three threshold reading and math skills, and is more likely to be a high school dropout with a police record or to have suffered an injury or fatality traffic accident by age 18. A combination of increased use of administrative data, including school enrolment and outcome data, and

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on the transactions occurring in a given sector … or change the concepts underlying the accounts. Perhaps by adjusting the production boundary … or by using alternative valuation methods. A satellite account for nonmarket household production can do both. First, it can show greater detail than the existing accounts on the marketed output of households. Second, it can extend the definition of production to include the nonmarket production of households."

[37] As proposed in the Landefeld and McCulla (2000) paper, durables are effectively treated as household fixed assets. Households use the capital services they provide to produce goods and services for their own consumption.

[38] It is important to note that whereas households might be viewed as the owners of durables such as vacuum cleaners, owned homes and cars are the property of the individual or individuals whose names are on the titles.

household time use and other survey data can help fill in the over-time profiles for human capital development outcomes for people growing up in different sorts of circumstances.

Ruggles and Ruggles (1973) note that even in the early 1960s the Norwegian Central Bureau of Statistics faced up to the SAM limitations and instead initiated the development of a system of personal data files. In 1964 in Norway, an identification number was assigned to each inhabitant covered by the 1960 population census. The assignment of personal identification numbers has been carried out in Norway continuously ever since then as part of the current population registration. These personal identification numbers are used in almost all Norwegian statistical surveys and censuses of persons. In addition, the identification number system has been adopted by administrative agencies in Norway including the tax authorities, national social insurance, health administration, school administration, and courts. The existence of the personal identification number permits easy linkage of individual records over time and from different sources (Aukrust and Nordbotten, 1973). Lindquist et al. (2014) report, for example, that administrative register data for Norwegian households are being used to analyse the distribution of debt and assets by income, wealth and age group.

Alessandra Coli and Francesca Tartamella (2015) explain that, ideally, one would like to combine economic, social and demographic information from a wide variety of different sources for every individual within every household. They describe progress in this regard in Italy.

These realities lead us to recommend that human capital investments, including the time investments of parents, should be accounted for using a SPA companion to the SNA (though household satellite accounts or SAMs could also be constructed from the same data resources and may be more useful for some purposes).

Also, at the level of the micro entity – that is, for a person in the case of a SPA -- new types of information can be introduced. Thus, for a given household, demographic information on the age, race, and sex of each of the members of the family, together with social information such as education, occupation, health, place of residence, and place of work can all be recorded, as well as the economic information on the household's income and expenditures and their assets and liabilities. The economic accounts of the household sector aggregate only the transactions information. However, the nontransactions information is valuable for analytic purposes.

We recognize that there are nations that lack a population registration system or system of person ID numbers, or where the fears of individuals of having their data misused are too high for it to be feasible for identifiable personal data to be utilized in the creation of SPAs, requiring instead that the creation be by processes such as synthetic matching.

Ironically, whereas the citizens of some nations fear having their national statistics agency use their data, they nevertheless tolerate having multiple businesses maintain large micro entity datasets. Consumer credit rating bureaus are one such sort of business. Airlines are another. Consider the ticket sales database of an airline. The micro entity is a ticket with its ticket number, and its attributes include the name of the including passenger name, age, sex, departure airport, arrival airport, the flight routing numbers, pricing details, method of payment, and frequent flier status and account details if the passenger is enrolled in the airline frequent flier program.

Building such databases lowers the burden on households, since only information that cannot be recovered from administrative sources must be asked for in surveys. Moreover, there are potentially large gains to be realized in terms of data accuracy and timeliness in nations that invest sufficiently in their public sector information systems and where respect for the common interests of the people of the nation and mutual trust among citizens are high enough so that government administrative data are accurate, up-to-date, and available to the national official statistics system. The same conveniences that have led individuals to allow banks, consumer credit rating agencies, and other private companies to use their data in modern data management systems will hopefully soon mean that appropriately protected official statistics agencies can help citizens similarly used their own data to better support their own decision making.

7.2 The urgent need as well for System of Global Corporations Accounts (SGCA)

Throughout this paper, we have focused on household sector related enhancement of the SNA of a nation: the addition of a supplementary System of Person Accounts, referred to here as a SPA. Nevertheless the household sector relies mostly on private firms for employment, income and the products people buy with their incomes. Firms are also a main determinant of the greenhouse gases driving climate change.

It is clear there are major changes taking place in the firm sector: changes that will almost surely challenge the capabilities of each and every national government in the decades ahead to manage the money supply, collect taxes and pay for public infrastructure, health and education services, and court system and law enforcement. The quick and almost totally free communication enabled by the Internet has made it possible for a large company to let their favored personnel live in nations with good public infrastructure and services, while doing most of their manufacturing in nations with lax worker and environmental protection regulations and enforcement, and while declaring their R&D and other intangible intellectual property as being created in special purpose vehicles set up in tax haven nations (Lipsey, 2012) that have very low tax rates and collect almost no data from companies. In our view, it is only through the collection and sharing among nations -- perhaps through some trusted international body that would safeguard legitimate business secrets -- of quite full details of company activities and financial transactions that nations will be able to regulate firm activities, ranging from worker safety protections to emissions of pollutants. It is also firms that can bring to market products that can ease the conflict between societal imperatives such as countering global warming versus the desires of people everywhere to be able to have and do more (e.g., Leach, Doucet and Nickel, 2011). True democracy necessarily includes the rule of the voting citizens of a nation over firms, but there is no longer any nation where this control of firms is possible without international efforts on data collection and sharing.

Diewert and Fox (2015) document, for example, how firms have greatly increased their holdings of monetary deposits since the mid-1990s. These monetary holdings have an opportunity cost; in particular, allocating firm financial capital into monetary deposits means that investment in real assets is reduced.

Large firms are now increasingly global in their supply chains, and in many cases in their direct investment and sales activities as well. Liu, Feils and Scholnick (2011) note that the “tradability revolution” in services has led to a dramatic expansion of the offshore outsourcing of services. However, production costs alone do not seem to explain the location determinants of offshore outsourcing of services. Using Bureau of Economic Analysis data on US service outsourcing across 11 types of services to 31 countries between 1992 and 2005, Liu, Feils and Scholnick find that services that are more routine, less complex or less interactive are outsourced

more often to foreign countries, especially including countries with poorer "institutional quality." And Feils and Rahman (2011) explore regional integration effects on foreign direct investment patterns.

Bi-lateral exchange rates affect relative production costs in different nations and what households and businesses in any one nation must pay for imports. Hence governments often try to influence the exchange rates for their currencies (see e.g. Fatum and Yamamoto, 2014). However, the price index programs of nations pick up price shifts for imports poorly, especially including the imports of retail companies and the intermediate parts and services imports of producers (Nakamura et al., 2015). Business groups and supply chain networks are believed to increasingly be organizing their affairs so as to maximize the wealth of their owners. They are believed to do this partly by choosing to locate, or anyway by declaring the locations of, their activities so as to minimize their tax burdens (Morck and Nakamura, 2007; Morck, 2011; Edens et al., 2015; Rassier, 2015).

Without better laws governing the responsibilities of firms to provide information to national governments about their global operations, researchers and government officials alike are left to try to infer firm behavior indirectly from the smattering of data they manage to collect from firms. For example, Hayami, Nakamura and Nakamura (2015) use detailed nation-level input-output data for Japan to try to back out estimates of the impacts within a supply chain of upstream waste outputs. However, the Japanese input-output and pollution data utilized in that study contain no information regarding the foreign operations of the Japanese firms in each sector. Government decision making regarding the proper regulation and taxation of firms is proceeding with very incomplete information.

Among the various sorts of firm data, the financial flows are probably especially important. Nan Zhang (2015) focuses on the three main problems of Global Flow of Funds (GFF): the definition of GFF, integrating GFF statistics with SNA, and data sources and approaches. Based on the GFF definition, the paper seeks to integrate the systematic relationship of financial inter-linkages reflected in the Balance of Payments (BOP), the International Investment Position (IIP), the "rest-of-the-world" account of National Accounts, and the corresponding Balance Sheet.

De Haan et al. (2015) report that the UNECE Task Force on Global Production recently finalized a first version of the *Guide to Measuring Global Production*. Their paper presents portions of the new Guide dealing with factoryless goods production arrangements. Factoryless goods producers outsource all aspects of material transformation while managing the global value chain and providing critical services inputs derived from intellectual property investments (e.g. R&D, software, product designs).

In our view, if the economy is to serve the interests of the people rather than the people being ruled by the economy, the people of all nations need global data and oversight powers over firms. This need, in our view, bestows importance beyond SNA needs regarding the efforts to find ways to measure the global inputs and outputs (including pollution) of firms. So, whereas these firm issues lie beyond the scope of this paper, we attach as much significance to them as to our SPA proposal. Coli and Tarlamella (2015) report that the Italian statistical institute already has a consolidated tradition for the use of administrative sources on the enterprise side.

8. Concluding remarks

In closing, we note that more than 50 years ago, Theodore W. Schultz (1961) prompted the view through his research and teachings that human capital services should be regarded as a productive input. Measures of joint factor productivity were soon constructed in which education was treated as part of factor input. In growth accounts, the normal procedure has been to treat increases in education as an improvement in labor quality. And yet, in the System of National Accounts, both accumulated stocks of human capital and the means of creation of those stocks have continued to be largely ignored.

Ignoring human capital seems equivalent to us to ignoring the main engine for the creation of new knowledge. After all, the heart of any company or national R&D program are the scientists who come up with the new ideas. The production process for brilliant scientists starts in the families to which they are born. Orcutt's vision was to build microsimulation models with accounts for people and their time and the environment as well that could account for the cumulative nature over time within persons of at least the education component of human capital development. This sort of data resource could then facilitate research and policy analyses and the

production of indicators regarding the interactions of human capital development activities of various sorts over people's lifetimes with the macro economy as captured in the SNA and nation-level productivity and productivity growth measures. A similar expansion of person-level data was recommended by Herbert Simon, who in 1984 wrote:

> "In the physical sciences, when errors of measurement and other noise are found to be of the same order of magnitude as the phenomena under study, the response is not to try to squeeze more information out of the data by statistical means; it is instead to find techniques for observing the phenomena at a higher level of resolution. The corresponding strategy for economics is obvious: to secure new kinds of data at the micro level."

Many scholars have since endorsed Simon's 1984 recommendation (e.g., Williamson and Winter, 1993; Brynjolfsson and Hitt, 1996;and Coyle, 2011). In the final chapter of The Economics of Enough, Diane Coyle (2011, p. 271) also writes that:

> "The information technology revolution -- computer processing power, online databases, social networks -- mean there is a massive opportunity to collect much more and better data on our society and economies, and then to analyze and act on it."

That vision of Coyle's is our vision. Human capital, broadly defined, refers to the full range of capabilities of people to satisfy the full ranges of their needs and wants. A System of National Accounts supplemented by a System of Person Accounts could more fully account for the production and protection and uses of human capital.

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