Valuing Human Milk in GDP: Market Values for Imputation of Non Market Household Production through Breastfeeding

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ABSTRACT

This paper addresses debates about future reform of the SNA and its boundaries, through considering market valuation of human milk and breastfeeding.

For over half a century, the UN System of National Accounts (SNA) framework has shaped how economies are viewed, economic performance is measured, and public policy priorities are set. Its central element, GDP, is facing heightened pressure to make it more relevant and useful as an indicator of economic advancement.

Human milk has been demonstrated to fit SNA criteria for inclusion, yet is not counted in GDP. International trade in human milk reinforces arguments that national accounts should impute the value of non-marketed human milk into GDP.

This paper examines how market values can be used to value non market household production of human milk, and argues for experimental estimates of human milk and breastfeeding, to generate more accurate and gender inclusive measurement of economic well-being within current SNA production boundaries.

JEL Subject Codes: E01**; B**54**;** I15

Key words: national accounts, feminist economics; non-market production of households, breastmilk, breastfeeding, human capital, environmental accounting

Why is it that when we pay for childcare and house-cleaning, when we eat out, when we buy milk for our babies, or when we call in the mechanic or the plumber, these add to GDP and count toward economic growth and progress; but when we look after our own children, clear our own house, cook our own meals, breastfeed our babies, tune up our own cars, and fix our own leaking faucets, these have no value in our current measures of progress?

(Collas-Monsod 2011)

1. Introduction

This paper addresses debates about future reform of the SNA and its boundaries, through a focus on encompassing human milk in core GDP.

For over half a century, the UN System of National Accounts (SNA) framework has shaped how economies are viewed, economic performance is measured, and public policy priorities are set (Commission of the European Communities 2008). Its central element is facing heightened pressure to make it more relevant and useful as an indicator of economic advancement. Its narrow, market focus for Gross Domestic Product (GDP), raises questions about how well economic activity is evaluated.

The SNA is 'applied patriarchy' to feminist economists (Waring 1988), as core GDP does not measure non-market household production. Creation and formation of human capital, or conversely, depletion and degradation of environmental assets is not accounted for. Reforming SNA 'beyond GDP' is essential for robust, relevant and unbiased measurement of economic advancement (Stiglitz, Sen et al. 2009). As the authors of the influential French Presidential Commission on Measuring Economic Progress (henceforth S-S-F) commented,

> What we measure affects what we do; and if our measurements are flawed, decisions may be distorted. Policies should be aimed at increasing societal welfare, not GDP….This report, building on extensive earlier work, describes the additions and subtractions that can and should be made to provide a better measure of welfare.

In 2014, some key reforms to the SNA framework were implemented through national statistical offices in European countries including controversially, to measure illegal prostitution and drug trade in GDP. Reflecting on reform priorities *The Economist* asked, 'Is a nation really doing better when its sex- and drug-trades are growing more quickly?'

Beyond GDP… beginning with breastmilk

Despite reforms to SNA rules in 1993 which permitted imputations for non-market household subsistence production in estimates of core GDP, incorporating measurement of such production has not been prioritised. This includes for example, counting the non-market household production of human milk.

Breastfeeding is a globally important household productive activity. It currently represents the primal food system and food security for more than 40% of the world's infants and young

children. The issue of trade and exchange of human milk is also of increasing policy relevance. A considerable trade of human milk is emerging within and between countries. Meanwhile there is a global boom in sales of commercial breastmilk substitutes, which counts as a gain in GDP, and a decline in production of human milk, which remains invisible in such economic statistics.

Human milk has been demonstrated to fit SNA criteria for inclusion GDP (Smith and Ingham 2005; Smith 2012; Smith 2017b). The cited human milk as an example of how excluding non-market household production from GDP distorted key statistics and public policy:

> 'There is a serious omission in the valuation of home-produced goods – the value of breast milk. This is clearly within the System of National Accounts production boundary, is quantitatively non-trivial and also has important implications for public policy and child and maternal health.' (Stiglitz, Sen et al. 2009)

The contemporary expansion of trade and exchange of human milk, discussed below, reinforces arguments that national accountants should address the issue of imputing the value of non-marketed human milk into GDP in order to move beyond GDP and reform the SNA.

Breastfeeding as a gauge of care and capital

Breastfeeding is archetypal care work (Mulford 2012). The lack of measurement of lactation work illustrates epitomises gender bias in which SNA economic activity is measured (Waring 1988). Breastfeeding optimises human health and capabilities, having evolved over around 100 million years of human mammalian history to protect maternal and child health, survival and development (Volk and Atkinson 2013; Sellen 2016). Use of commercial breastmilk substitutes generates increased morbidity, mortality and health costs, including expenditures on health treatment. It is providing nourishment and care for society's most vulnerable, children. It is central to child health equity (Roberts, Carnahan et al. 2013).

Within the SNA framework, human milk can be characterised as a good which can be stored and exchanged. Human milk is not counted in GDP. Commercial milk formula is counted in GDP because it is a market activity, despite its negative health externalities. GDP rises when breastfeeding declines, and rises with greater sales of breastmilk substitutes and associated increases in health treatment costs.Breastfeeding takes time, and can be a paid job, fitting the SNA definition of a service.

Breastfeeding can also be conceived as an evolved mammalian investment of maternal resources in human health and well-being – a human capital investment (Rollins, Bhandari et al. 2016). It economises on environmental resource use (Dadhich, Smith et al. 2015), while commercial milk formula generates greenhouse gases and other environmental depletion or degradation.

Beyond GDP – Within SNA

Infant and young child feeding thus exemplifies some key issues for reforming SNA to better measure non-market household production and more fully recognise the economic contribution of women.

This paper aims to show how the SNA system could provide more conceptually sound, economically realistic, and gender inclusive accounts and indicators, through valuing lactation work, human milk and breastfeeding.

After considering the historical and economic context for contemporary trade and exchange of human milk, this paper illustrates how market values can be used to measure the economic contribution of this non-market household economic activity within the SNA framework and in GDP. It argues for countries to prioritize experimental estimates of human milk in GDP and in human capital and environmental accounts to generate more accurate, relevant and gender inclusive measurement of economic well-being.

2. Background

In 2017 the Australian government approved a local dairy entrepreneur, Neolacta, importing and selling breastmilk. The company proposes that milk donated by mothers in India will be shipped and sold to Australian hospitals. Another company has been selling breastmilk in the United States since 2015 (Jackson 2015b; Clark 2016b). In 2015, Ambrosia Milk began purchasing and exporting human milk from mothers in Cambodia to sell in the United States (Jackson 2015a; Clark 2016a). Unlike Neolacta's Indian proposal, Ambrosia Milk paid Cambodian mothers for their milk. The milk is for newborns whose mothers were returning to paid employment, for the Cambodian mothers the payments would finance better living standards and longer time with their babies. The biggest player in the US and globally remains Prolacta, a for profit company which has been collecting milk through milk banks for around US$30 a litre and turning into a commercial product sold to US hospitals for nearly US$300 a litre. There is also a reported revival of commercial wet-nursing and other human milk exchange and trading, as far afield as China and North America (Fowler and Ye 2008; Thorley 2008a; Thorley 2008b; Akre, Gribble et al. 2011; Dutton 2011; Eats On Feets 2013; Medo 2013; Only The Breast 2013; Thorley 2015).

Markets in mothers' milk have both problems and promise - for infants and mothers, for community health and welfare, and for gender equity. Trade and exchange of human milk might disempower women, and displace the breastfeeding relationships between mother and baby. While consuming human milk contributes importantly to child nutrition and health, maternal breastfeeding confers further benefits for the child, and protects the reproductive health of the lactating mother (Labbok 2001).

Distributional concerns are profound, as market exchange may redistribute mothers' milk away from vulnerable consumers (children) with biological claims to it, to those most able and willing to pay - including adults seeking sexual gratification. There is potential for exploitation of lactating women due to gender inequality in wealth and income, weak or unequal bargaining power within households and markets, and inadequate human rights protections of women and children. The most willing producers - selling the cheapest milk - may be the more desperate or dishonest suppliers, rather than those offering the most suitable milk. Markets can systematically disadvantage purchasers over sellers of certain kinds of products because of unequal information on products' characteristics such as whether a used car is a 'lemon' or whether milk is diluted or contaminated (Akerlof 1970). Market prices can provide misleading signals about the societal value of products which distorts decision-making about what is produced or consumed, for example, market prices fail to incorporate negative health and environmental cost externalities of milk formula consumption, or the social benefits of parental investments in children (Folbre 1994; Smith 2004; Dadhich, Smith et al. 2015).

On the other hand, expanded markets in mothers' milk could improve its availability, benefit nutrition and health and contribute to greater economic justice for women (Smith 2015). Breastfeeding and breastmilk production is well below its biologically potential capacity in

many countries (Smith 2013). The sale or donation of surplus human milk could improve the nutrition and health of those children otherwise deprived of it. Lactating women might gain health and financial benefit from increased breastfeeding, while mothers able to secure breastmilk through trade or exchange may be more than willing to pay for the personal satisfaction as well as for better nutrition and health for their child. The commercial model for milk exchange or wet-nursing has become uncommon in western countries but the economic inequity of the contemporary donative market in the United States, where 'everyone except the woman who donates her milk benefits', has been questioned (Fentiman 2009b, p.66).

Sensitivity to economic rewards

As conventional economics has deemed unpaid household production including breastfeeding to be a non-economic phenomenon, the existence of markets in human milk provides important evidence that economic rewards and market prices affects its supply and demand and so strengthening the case for measuring it in GDP. Feminist critiques have long emphasised that how we measure GDP reflects a gender biased interpretation of economic activity. Rather than being 'positive' or 'objective', economics reflects and privileges male experience. For example, economics has overlooked the differing experience of the female to that of the male during economic development and ignored the vital social and economic role of reproduction, care and nurture (Boserup 1970). As Marilyn Waring famously illustrated, economic statistical conventions systematically exclude much of women's economic activity from measurement in GDP (Waring 1988). Nancy Folbre has shown how from the late 19th century women's unpaid household production was deliberately categorised as 'unproductive' by economic statisticians in Europe and North America (Folbre 1991).

Feminist economists have promoted an approach based on 'social provisioning' (Power 2004) which incorporates domestic work and unpaid care work as fundamental to economic analysis and which evaluates economic process or performance on how well it achieves sustainable human development (Benería, Berik et al. 2016). However, the continued invisibility of women's crucial reproductive and productive work in conventional economic statistics perpetuates bias in economic measurement and policy perspectives, which disadvantages women and perpetuates gender inequality.

Economic analysis takes little or no account of gender power relations and their wider social institutional context (Agarwal 1997). Social institutions, public regulations and policies perpetuate elements of deep-rooted pre-capitalist patriarchal systems which have served to co-erce women's availability for unpaid reproductive and productive work (Folbre and Weisskopf 1998; Folbre 2004).

Economic exploitation of women's willingness to feed and care for children is facilitated by entrenched false dichotomies between 'altruistic' and 'market' motivations for work (Folbre and Nelson 2000; England 2005; Folbre 2013). This includes lactation work. Similarly, the 'breadwinner' focus of welfare capitalism during the past 200 years fails to address the economic risks to women in the market economy arising from their investments in child-raising (Orloff 1993; O'Connor 2013). As Nancy Folbre has pointed out (Folbre 1994), children have features of 'public goods'. As the benefits of investing in children are increasingly socialised such as through taxation and social security, parenting increasingly becomes a public service. The encroachment of market incentives on unpaid household economic activity can result in a shrinking 'Magic Pudding' of care if policymakers ignore how changing economic rewards affect production in the non-market household sector

(Folbre 2002). Breastfeeding is a key example of how market incentives can influence the economic rewards for unpaid caring and reproductive work (Smith 2004).

An important reservation by national accountants is about whether 'economic pricing' is important for demand and supply in these markets, that is, whether breastfeeding and trade in human milk meets the test of 'sensitivity to economic rewards' (Kravis 1957).

Section 3 discusses 'economic pricing' in relation to historical and contemporary markets in breastmilk and breastfeeding. After considering the validity and relevance of arguments made against including unpaid household production in GDP, contemporary market prices are used to present estimates of human milk production and indicators of the diverse ways this productive activity enters into the SNA framework for selected countries in Asia, Europe and North America.

3. Breastfeeding as a traditional food system for infants and young children

Despite wide variation in its practice, breastfeeding has been the preferred first food for children throughout human history and women have been the main producers in what can be characterised as the 'infant and young child (IYC) food economy'. Wetnurses and milk banks have at times been involved in supplying breastfeeding or breastmilk, but food or pharmaceutical companies engaged in manufacturing and retailing processed milk powder and dairy products are now more dominant players. Women's productivity in lactation work is undermined by two key market incentives in modern economies – competition against low cost dairy and producers of commercial breastmilk substitutes, and competing labour market rewards for women's time and presence (Smith 2004).

The substantial displacement of human milk supply by commercial breastmilk substitutes in the past century is a significant and ongoing loss of food production with major economic, environmental, and health significance. This is consistent with the broader problem that women's experience of economic development is poorly documented (Boserup 1970; Beneria 1996). The declining scale of women's production of breastfeeding and breastmilk within the IYC food economy over the past two centuries has remained unmeasured. Until the 1970s, the large economic losses involved in commercial milk formula displacing breastfeeding throughout the world passed unremarked.

In 1973 World Bank nutrition expert Alan Berg warned of a 'crisis in infant feeding' in economic terms (Berg 1973, p. 89). Drawing on data from countries in Asia, Africa and Latin America, Berg estimated that Singapore had lost over US$1.8 million worth of breastmilk a year in 1960 compared to US$0.8 in 1950. In the Philippines, the value of lost production had nearly doubled in a decade, to US$32.8 million by 1968. Calculations for Indonesia by nutritionist Jon Rohde highlighted the economic significance of milk provided by mothers for children in the second year of life, as well as in infancy (Rohde 1974; Rohde 1981; Rohde 1982). Economic production losses due to formula use were later estimated for India and countries in South America (Gupta and Rohde 1993; Gupta and Khanna 1999; Aguayo, Ross et al. 2001; Aguayo and Ross 2002), and Africa (Almroth, Greiner et al. 1979a; Almroth, Greiner et al. 1979b; Hatloy and Oshaug 1997).

It took until the early 1990s for the economic value of human milk to be estimated for a high income country, Norway (Oshaug and Botten 1994). Norway remains the only country to count breastmilk production in its food statistics, having tried unsuccessfully in the early 1970s to convince other countries in the UN Food and Agriculture Organisation that this

should be standard practice. Comparable estimates of the economic value of human milk production were later published and updated for Australia, the USA, (Smith 1999; Smith and Ingham 2005; Smith 2013), and selected other countries.

Several historical studies provide valuable insights into economic drivers of breastfeeding and human milk production trends by detailing changes in infant feeding practices (Wickes 1953; Minchin 1985; Fildes 1986; Apple 1987; Palmer 1988; Baumslag and Michels 1995; Golden 2001; Wolf 2003; Thorley 2008a). As shown elsewhere (Smith in Cohen and Otomo 2017) three key factors were: the disincentives and barriers to breastfeeding created by labour markets and unresponsive social institutions during 19th century industrialisation; the low valuation of human milk and lactation work by medical institutions and employers of wetnurses during the 19th and early 20th century, and; the 20th century alliance between public health regulators, medical science, and the dairy industry to create vast markets in commercial breastmilk substitutes rather than resourcing women's non-market infant care and lactation work.

Lack of long term data series on the non-market component of economic activity in the IYC food economy hinders historical analysis of the economic determinants and productivity implications of changing breastfeeding practices. Norway is the only country in which annual data has been compiled for the decades prior to 1900 (Liestøl, Rosenberg et al. 2008) and has been updated to 2013 (Bærug 2018). This data series shows that the decline in breastfeeding during industrialisation took the form of reduced breastfeeding duration rather than lower initiation of breastfeeding. Breastfeeding duration in Norway declined slowly from 1860, then more sharply throughout the country after 1920 (Figure X). While over 60% of Norwegian mothers and infants breastfed at 6 months in 1860, fewer than 20% did so in 1967. The proportion who had ceased breastfeeding by 12 months (40%) increased greatly between 1920 and the late 1960s, when virtually all Norwegian women had weaned their baby by 12 months.

The identified causes of reduced breastfeeding in Norway are illustrative of historical trends elsewhere. Return to employment contributed to shorter duration of breastfeeding by unmarried mothers in the decades from 1860 to 1920 (Liestøl, Rosenberg et al. 2008). Restrictive hospital and maternity care regimes were central to sharply reduced breastfeeding rates during the 1950s and 1960s, with increased hospitalisation of deliveries, medicated birth and strict feeding regimes all hindering the establishment of breastfeeding and reducing maternal milk supply (Liestøl, Rosenberg et al. 2008). Milk formula company marketing within health facilities during the 1970s also led to unnecessary supplementation and disrupted lactation (Helsing 2005). The return to breastfeeding arose from maternal activism from the late 1960s, regulation of marketing of breastmilk substitutes in the 1980s, and systematic introduction of 'breastfeeding friendly' hospital practices in the 1990s (Rosenberg 1989; Austveg and Sundby 1995). Breastfeeding initiation remained high and milk banks remained viable during the post war decades in part due to national policies that all infants should receive human milk during early infancy. Norway provided for 12 weeks paid maternity leave from the late 1960s (40 weeks from 1994) this helped increase breastfeeding duration to around 40% at 12 months (Helsing 2005; Norwegian Health Directorate 2015). Norway has been distinctive among OECD countries for its high rates of breastfeeding to the present time.

4. Accurate, valid and relevant measures of economic activity

Gross Domestic Product (GDP) has been a widely used concept for measuring the economy since World War II. Since the early 1950s, the 'System of National Accounts (SNA)' (Commission of the European Communities 2008) has been the agreed international statistical framework for all countries to define and measure GDP, and national economic activity.

Economists have long been aware of the limitations of measuring economic activity and material wellbeing using conventional GDP and related economic statistics. Influential early national accountants warned about the bias introduced by excluding household production (Kuznets 1941). From the early 1970s, the SNA came under increasing criticism on for providing a narrow, inaccurate and misleading measure of economic well-being, as well as for its treatment of environmental degradation (Nordhaus and Tobin 1972; Weinrobe 1974; Hawrylyshyn 1976; Zolotas 1983; Mamalakis 1996; Nordhaus 2000).

Since the 1980s, feminist critiques have also emphasised that GDP provides a gender biased interpretation of economic progress and development. Particularly by underreporting subsistence and household production, this economic accounting framework ignores the pivotal economic role of women, makes some countries seem poorer than they are, and overstates economic growth and progress by valuing market activity but not the unpaid household production that it displaces (Boserup 1970; Smith 1982; Benería 1992). In the 1980s, Marilyn Waring's damning critique of the UN system of national accounts (Waring 1988) showed how the unpaid work traditionally done by women has been systematically excluded from measurement by national economic statistical systems, alongside a comparable non-measurement of environmental pollution and depreciation or the depletion of environmental assets.

Furthermore, macroeconomic modelling and policy assumes that the labour force (human capital) comes from nowhere (Walters 1995); it is increasingly recognised that national accounting practice makes invisible the crucial economic contribution to human capital building made by families' provision of health care and education services to children (Abraham and Mackie 2005; Smith and Ingham 2005; Folbre 2012).

Many countries now collect household time use data which would facilitate the inclusion of unpaid household work in GDP. Australia has produced accounts for human capital assets from as early as the 1920s as well as for environmental assets (Ingham 1991; Treadgold 2000; Australian Bureau of Statistics 2001; Wei 2001). These estimates used both 'cost of children' and 'lifetime income' approaches to valuing the country's human capital, and concluded its value was several times the value of material capital.

A variety of practical and conceptual barriers are put forward by statistical agencies against including household work in GDP (Benería 1992; Elson 2008; Collas-Monsod 2011; Esquivel 2011; Smith 2014). For example, in 1990 the Australian Government was advised that unpaid work should continue to be excluded from GDP because the market sector was the primary concern for macroeconomic policy and because unpaid household work was not related to market forces as directly as goods (Australian Bureau of Statistics 1990, 6-7).

However, it is incorrect to apply this argument to human milk production. Production levels of human milk are closely related to market activity, with direct competition to breastfeeding

from companies selling and profiting from sale of infant feeding products. Labour market participation and breastmilk production compete directly (Mandal, Roe et al. 2012).

It is also questionable as to whether other conventional arguments for excluding unpaid work from GDP apply to human milk production. For example, Collas-Monsad (2011, 95) has identified arguments that excluding unpaid work is necessary to maintain the usefulness of the accounts to policymakers. It is said to avoid "overburdening or disrupting the central system" (Commission of the European Communities 1993, para. 21.4). This means that by excluding human milk production from GDP, policymakers focus on promoting the activities of commercial firms producing, for example in Australia, less than $500 mill of infant food products per year, whilst giving no importance to protecting household production of human milk worth $2 billion a year or more. It is difficult to see why 'disrupting' the system by comparing these values is undesirable, or why it 'overburdens' policy analysis to show the large magnitude of non-market production of infant food. Likewise, including breastfeeding in GDP would surely enhance monitoring and analysis of long term productivity trends and patterns in the food, nutrition, childcare and health sectors.

Another reason that women's work is still not measured in key economic statistics is said to be the costs involved in changing the collection and use of national accounts (Fraumeni 2010, 30). Experience in the Philippines suggests only "demand driven advocacy" will improve national accounting practices (Collas-Monsod 2007, 5-7; Virola, Encarnacion et al. 2007, 7). Unfortunately, few understand how such statistics can be used for better decision-making, or how to use them for advocacy. Without such pressures, statisticians will do little about introducing them—though "what we don't know could hurt us" (Abraham 2005, 1)).

In a sharp contrast to the lack of resources devoted to better measuring the very large household production sector, national accounting standards in Europe now require illegal sexual services to be included in GDP (Abramsky and Drew 2014), even though this is extremely difficult to measure accurately and relatively small compared to household production.[i] Countries' continued exclusion of unpaid household work reinforces concerns that an important reform agenda laid out by Waring's critique of national accounting as 'applied patriarchy' remains largely unimplemented (Saunders and Dalziel 2016).

5. Valuing breastfeeding within the SNA

Breastmilk and breastfeeding can be valued in an SNA framework using conventional national accounting methods for non-market household production.(Smith 1999) Both input cost and market output approaches to estimation are feasible.

Partly in response to feminist argument and advocacy (Smith 2014), SNA since 1993 took better account than its predecessor of "subsistence" production; GDP should include all "own account" production of goods by households. This included agricultural subsistence production such as sowing, planting, tending and harvesting field crops; growing vegetables, fruit and other trees and shrub crops; gathering wild fruits, medicinal and other plants; tending, feeding or hunting animals mainly to obtain meat, milk, hair, skin or other products; and storing or carrying to some basic processing of this produce. SNA93 also provided for any agricultural produce consumed on-farm to be included in GDP.

The national accounting framework thus includes within the GDP production boundary all non-marketed goods, including the production, processing and storage of food by households. Reflecting these guidelines, for example, the Australian Bureau of Statistics (ABS) includes the value of homegrown fruit, vegetables, eggs, beer, wine and meat in estimates of final

private consumption expenditure and therefore GDP. Australian core accounts now include "the own account production of all goods retained by their producers for their own final consumption or gross capital formation" (Australian Bureau of Statistics 1997, 46) where these are quantitatively significant, thereby following the practice set down in SNA93 (para 6.18).

With the 1993 changes to international guidelines on national accounting, women's production of breastmilk (though not breastfeeding) came within the scope of GDP measurement (Smith and Ingham 2005; Smith 2012; 2013).

Breastfeeding is similar to other unpaid household production highlighted by feminist economists, although it is unique in that the female body is the production unit.

While breastfeeding is a childcare activity classified by national accountants as an unpaid household service, to be included in 'satellite accounts' (separate from the 'core' measures of GDP), breastmilk is a commodity which meets the official criteria for inclusion in GDP. That is, human milk is a good within the SNA93 core production boundary (Smith and Ingham 2001; 2005) because, in national accounting language, it can be produced, stored, sold on markets, and thus be valued (Commission of the European Communities 1993, para. 6.7; Smith and Ingham 2001b; 2005c). The fundamental criterion for inclusion of a good in GDP is that it can be traded in a market. The existence of markets in human milk (see above) means there are prices of a closely related or analogous product - a shadow price - from which to impute its economic value.

Several studies since the 1990s have shown the practicability of estimating the economic value of human milk production, and its substantial value in relation to GDP (Oshaug and Botten 1994; Hatloy and Oshaug 1997; Smith, Ingham et al. 1998; Gupta and Khanna 1999; Smith 1999; Aguayo, Ross et al. 2001; Smith and Ingham 2001; Aguayo and Ross 2002; Smith and Ingham 2005; Smith 2012; 2013). From a national accounting methodological perspective this involves either using an 'input cost' based approach, or using the 'market value' of the output.

The three different economic valuation methodologies within national accounting practice were first discussed in a study of Australian human milk production in 1999 (Smith 1999). The preferred approach to valuing production in the national accounts system is using 'market values' of output. The 1999 study estimated that human milk production in Australia in 1992 was 33 million kg. Using a 'market value of output' approach to valuing this production, human milk production in Australia had a market value of $2.1 billion a year at that time.[ii] Estimates using input cost approaches gave consistent values of production of human milk.

This 1992 estimate for Australia was based on a price of US$50 per litre paid by milk banks in Norway, which had been used for estimating the economic value of breastfeeding in that country (Oshaug and Botten 1994). It illustrates that the value of human milk in Australia is qualitatively important compared to other goods produced for own consumption by households which were valued at $1 billion in 1997 and are counted in GDP by the ABS. This implies that the production and value of human milk should be included in core account estimates of national food production, consumption and GDP.

To do so, quantity is estimated from annual births, breastfeeding rates, and known daily intakes at various child ages. Market wage costs can be used to value maternal time as an

input to providing breastmilk or breastfeeding. Global as well as national trade of human milk is increasing, making such prices quite readily available. For example, the wage cost of employing a wet-nurse is equivalent to around US$70-$300/L. Milk is sold to hospitals or consumers for $90-300 litre, or more. Women who provide the milk are paid or reimbursed around $15-30/L. With cost-reimbursement of $20 for donors, human milk can be valued at its exchange within the Norwegian health system at $100 a litre.[15]

6. Human milk and breastfeeding as part of national food and health systems – market prices and pricing

Table 1 provides summary information comparing pricing in several key markets in human milk in 2012. These include milk banks, internet trading, commercial infant feeding products, and women's employment as wet nurses.

INSERT TABLE 1 here

In 2018 more than 500 milk banks operate in more than 37 countries worldwide (Moro 2018). In Europe, 210 active milk banks process some 220,000 litres a year, compared to around 88,720 litres reported by the North American Human Milk Bank Association (HMBANA). Brazilian milk banks process around 165,000 litres annually.

Milk banks in North America continue to sell human milk to hospitals at a price of US$3-5 per ounce (around US$85-150 per litre) or more.(Wikipedia 2018) A new entrant to this market in 2018, the International Milk Bank, offered a package to health providers including a 'bridge pack' of 2 litres human milk at a price equivalent to $100 per litre (International Milk Bank (IMB) 2018).

In Norway human milk is traded within the health system for €130 (US$100) per litre, after covering a payment of US$20 for donor 'expenses' (Grovslien and Gronn 2009). In the United Kingdom in 2015, human milk banks were reported to charge £100-200 per litre (around $200-360 per litre) for pasteurised human milk within the framework for practice of the British Association of Perinatal Medicine.(British Association of Perinatal Medicine 2015)

Pasteurised human donor milk is sold for $300 per litre to hospitals in the United States by Prolacta (Smith 2017a). Specialised human milk based fortifiers for premature infants are sold by the same company at US$1183 per litre or more (Ganapathy, Hay et al. 2011).

Sellers offering human milk on internet milk trading sites such as *Only the Breast* typically ask around US$3 per ounce ($100 a litre) if they have health certification (Only The Breast 2013). In Cambodia in late 2015, mothers were reportedly being paid $0.5-1.0 an ounce (around $15-30 a litre) for milk that was to be sold in the United States for around $3-5 per ounce (around $100-150 a litre) (Wood 2015). In October 2016 the *China Daily* reported that unpasteurized, freshly frozen milk is sold in around 100 stores in China at around $22-75 per litre, with prices ranging up to $150 a litre.

7. Estimated market value of human milk production in selected countries

Table 2 presents the updated value of imputations for the economic value of breastmilk for selected high and middle income countries. Estimates of the economic value of human milk produced in the United States, Australia and Norway were published in 2013 based on 2012

prices (Smith 2013).[iii] These estimates were among several country and global estimates presented at the 2012 Conference of the International Association for Research on Income and Wealth (Smith 2012). Here the market price for valuation is $100 per litre rather than the $85 price used in earlier estimates.

INSERT TABLE 2 here

Total baby food sales including commercial milk formula sales in these countries in 2012 was estimated by Euromonitor International to be US$108 million, US $643 million, and US 6,782 million respectively in 2012 (Euromonitor International 2017).

The annual economic value of human milk produced in India and China for 2008-12 is also presented in Table 2. India and China are large middle income countries in Asia that also provide interesting case studies in particular because their large populations mean trends in these countries drive global baby food markets. For these countries a UNICEF global data base, rather than individual country data, provides the data on country breastfeeding rates.[iv]

Human milk produced in these countries is valued here at $100 a litre. (This may be a considerable underestimate, with a price of $4 to $5 per ounce (~$120-150 per litre) charged to hospitals by donor milk banks in North America (Builes and Reuters 2015). In Asian countries such as The Philippines official milk banks supply human milk at a price of around Php 180 (around US$4) an ounce (Santos 2015)).

Breastfeeding rates are much higher in India than in China. Breastfeeding in India is near universal, with more than 90% of mothers still breastfeeding their infants at 12 months, and most 77 % continuing through to 2 years. Exclusive breastfeeding is considerably lower, though still high by international standards. There is a growing affluent middle class in India, with an increasing number of births in hospital, and a growing number of employed professional women becoming a target for marketing of breastmilk substitutes. BFHI accreditation is also not widely implemented. However, India is a lower-middle income country, most births are not in health institutions, and maternal labour force participation is very low. While maternity protection policies support breastfeeding, their implementation is weak. On the other hand, India has a comprehensive, legislated WHO Code of Marketing of Breastmilk Substitutes, which is applied including through strong and high profile NGO activism in the courts.

INSERT TABLE 3 here

Breastfeeding has traditionally been very high in China, but the use of breast milk substitutes became widespread during the 1970s, and breastfeeding fell to a low point in the 1980s. The breastfeeding rate in China started to increase in the 1990s responding to efforts to promote breastfeeding including in hospitals where nearly all Chinese babies are born. Since the mid-1990s rates of 'any breastfeeding' at four months in most cities and provinces (including minority areas) were above 80% (Xu, Qiu et al. 2009) (see also (Schulze, Zhao et al. 2009).

However, breastfeeding has declined dramatically in China in the past decade. UNICEF expressed concern in 2013 that exclusive breastfeeding prevalence for children 0-6 months has fallen from 67% in 1999 to around 27% (Hou 2014). After a period of rapid economic development, China has become an upper middle income country, with strong growth of household incomes including from high rates of female labour force participation. While maternity leave policies provide for 12 weeks of paid leave, this entitlement may not be fully

accessible or enforced (Hou 2014). Legislation restraining the marketing of breastmilk substitutes has limited scope and is not effectively enforced (Liu, Dai et al. 2014).

On the other hand, the decline in breastfeeding in China since 1999 has resulted in a dramatic but unmeasured deterioration in unpaid household production, with a loss of around 700 million litres of breastmilk per year (Shen 2016). The replacement of breastmilk in the diet of infants thus amounts to a loss of economic production value of around US$77 billion a year. Data is unavailable for breastfeeding among older infants and young children, but measuring a proportionate decline for the 6 months to 2 years age group, the annual loss of production represented by declining breastfeeding in China since the 1990s of the order of US$335 billion a year.

It can be estimated that mothers in India produce over 7 billion liters a year of human milk, double the levels estimated in 1999. Current market value of this production is around US$700 billion a year. Human milk produced in China was lower, at around 2.3 billion liters in 2012, with estimated market value of some US$227 billion. This estimate is broadly consistent with the unpublished study by Ross and colleagues (Ross, Chunming et al. 2001), which estimated about 4.2 billion liters of human milk were produced annually in China in 2001, at time when breastfeeding rates there were considerably higher.

Globally, around 23.3 billion litres of human milk are produced by women for infants and children, with an economic value at current market prices of at least $2,331 billion. This contrasts with global milk formula sales of $44 billion (Euromonitor International 2014). Production from this food source was 40% below its potential capacity if women were enabled to breastfeed in line with evolved and recommended optimal levels of exclusive and continued breastfeeding (Sellen 2001; World Health Organization (WHO)/UNICEF 2003).

INSERT TABLE 4 here

Commercial baby food sales in India totalled around $425 million a year in 2012, far lower than the value of human milk produced by Indian mothers. Currently the Indian market for commercial baby food is small at less than 1 kg per child (Euromonitor International 2014). The Chinese market for baby food, mainly formula, has doubled in 5 years from 5.5kg to 12.1kg per child p.a.(Baker, Smith et al. 2016) In China in 2014, milk formula sales were $17·8 billion (Rollins, Bhandari et al. 2016).

The global total MF sales value was $US 44·8 billion in 2014, projected to reach $US 70·6 billion by 2019 despite stagnating markets in high income countries due to growing preferences for breastfeeding.

Avoidable maternal and child nutrition and health costs

A number of epidemiological studies in in North America, Europe, and Asia Pacific estimate the attributable health costs of formula using market values for treatment and economic costs (Smith 2012)(Smith, Thompson et al. 2002; Pokhrel, Quigley et al. 2014; Walters, Horton et al. 2016; Bartick, Schwarz et al. 2017). It was recently estimated that health treatment costs of around $224 million a year could be saved by small increases in breastfeeding in China (Rollins, Bhandari et al. 2016). Milk formula consumption related health cost externalities are large, and count as GDP gains. However, these are in reality ‘defensive’ or ‘remedial’ expenditures, and would be properly accounted for in experimental accounts for breastfeeding by deducting this value from GDP (Smith and Ingham 2005) .

Capital accounts

Human capital

The Vice President of the World Bank recently commented that breastfeeding is not only a child's first inoculation against death, disease and poverty but it was also 'their most enduring investment in physical, cognitive and social capacity' (Hansen 2016).

Cognitive development is harmed by poor nutrition in infancy and early childhood, harming educational achievement, and ultimately a nation's productivity. There is now strong evidence for IQ harm of feeding non-human milk to human babies with systematic review evidence(Horta, Loret de Mola et al. 2015) of an IQ disadvantage of 3-7 IQ points for those who received formula before 4 months based on a large cluster randomized controlled trial (Kramer, Aboud et al. 2008). This is akin to missing several months of schooling with implications for educational attainment and future earnings. As shown in Table 5, based on a recent major publication in medical journal *The Lancet*, there is a considerable economic loss from cognitive deficits associated with current infant feeding practices. The estimated global losses in national income is $302 billion p.a. from cognitive deficits due to insufficient breastfeeding, using a 'lifetime incomes' approach (Rollins, Bhandari et al. 2016). In China, this loss is currently estimated at $26 billion of gross national income annually, compared to $84 billion annually in the United States. In India, where breastfeeding is near universal among children to at least 6 months, economic losses were comparatively low.

INSERT TABLE 5 here

Environmental capital

Breastmilk substitutes are made from dairy milk with high environmental costs such as greenhouse gas (GHG), pollution and land clearing. Manufacturing 1kg of milk formula creates 4 kg CO_2 eq of GHG emissions (Dadhich, Smith et al. 2015).

As illustrated in Table 6, the environmental degradation impacts are considerable. After multiplying GHG emissions by sales, the study concludes that milk formula is an important contributor to emissions. Overall, the total GHG emissions from milk formula sold in six Asia Pacific countries in 2012 was found to be 2.89 million tonnes (2.25 million tonnes being from China), roughly equivalent to driving 6,888 million miles in a car, or burning 3,107 million pounds of coal. For Australia, total emissions associated with milk formula were 31,742 tonnes CO_2 eq annually, and for India GHG emissions were 111,227 tonnes CO_2 eq.

INSERT TABLE 6 here

8. Discussion

Above it is shown that important economic losses to national food systems are invisible in SNA and GDP, distorting policies priorities, and with potentially major implications for human nutrition, health and well-being, as well as for the environment. Experimental accounts for breastfeeding and human milk would provide a vital indicator of essential food and care resources available to the most vulnerable humans. Time spent breastfeeding can also be measured using time use data, providing a foundational indicator of women's lactation work which contributes to addressing deep-seated gender bias in the SNA. This indicator is 'beyond GDP' but still 'within SNA' conceptual boundaries and measurement

practices as reflected in existing non-market household production satellite accounts. It is also shown that women's investment of time in breastfeeding can be valued for its contribution to human capital formation, using market prices. The avoided health treatment costs and environmental degradation costs of commercial breastmilk substitutes can also be indicated.

The price of milk supplied by North American milk banks to hospitals may be challenged as a proxy for the value of human milk. Human milk in this market may be more highly valued as it is used for premature or vulnerable infants rather than healthy, full term, or older infants. Using a market price for expressed breastmilk may also underestimate the economic value of breastfeeding. There are distinct, additional values for the process of breastfeeding and for using the mother's own milk rather than another mother's milk, such as for promoting maternal attachment and for strengthening the immune system.(Bertino, Giuliani et al. 2009; Strathearn, Mamun et al. 2009)

Also, the price that individual consumers are willing to pay for breastmilk may be lower than its economic value from a societal perspective, for example, because consumers are not fully informed about its health and development importance, because the optimal feeding of the child is not the only consideration in infant feeding decisions, or because personal valuations may not take into account wider societal cost impacts.

It may be argued that the price of formula, which is lower, should be used to value the lost economic value when human milk production is replaced by formula feeding, as the mothers who formula feed may not value breastmilk as highly as breastfeeding mothers. However, market prices for formula only show that consumers value bovine-based milk or plant-derived formula milk products at this price, not how much they may be willing to pay for human milk. The price of formula may be low because women consider breastmilk substitutes to have a lower economic worth. At present, some formula-feeding mothers may not be able to purchase breastmilk.

The price of milk sold by North American milk banks may reflect the particular economic and institutional characteristics of a specific, small, and restricted market. The market for human milk is admittedly still small, and most human milk production is not bought, sold or donated. Some countries may not yet have significant trading in human milk especially for older infants; in Norway for example, milk is usually only supplied by milk banks for infants under 3 months old. Pricing mechanisms may be relatively undeveloped in these markets and price may be little used in supply or demand decisions.

However it has been shown that prices of human milk derived using other valuation methods (such as using time input or wage costs) are consistent and comparable with the level of milk bank prices (Smith 1999).[10, 11] This suggests that valuing expressed breastmilk using milk bank prices is a reasonably valid representation of the market value of human milk.

Recent studies have shown that the policy focus on the new market economy masks important unaddressed tensions between paid employment and unpaid care work for women in China (Dong and An 2015). Ignoring unpaid work burdens during this economic transition is generating gender inequality, through women's unequal access to earnings and leisure (Qi and Dong 2016). For example, despite the value of essential unpaid care work in China being between a quarter and a third of GDP, as the authors observe,

> .. the overriding concern of the Chinese government in the post-reform period has been to improve the productivity of paid work and maximize growth of per capita GDP, assuming

> that the provision of domestic and care services will adjust itself accordingly (Cook and Dong 2011). As a result, the role of the state and the employers as a provider of social goods and services has been eroded; responsibility for social reproduction and "care"—a domain principally of the state in the urban sector under the planned economy—has returned to the household. This process has considerable implications for the work and status of women in both the home and the marketplace (p. 19).

Devaluation of mother's unpaid lactation work similarly expands the market economy but shrinks the total economy, and at the expense of economic justice for women. Incomplete economic statistics distort public policy in important ways. Despite the importance of breastfeeding demonstrated by the 2008 melamine crisis, in which hundreds of thousands of infants were hospitalized and six infants died, public policy in China has prioritised development of the commercial milk formula industry (Qi 2014; Xia 2014). In 2014, far too late (AAP 2013; Correy 2013; Harney 2013; Waldmeir 2013; Xu, Yining et al. 2013; Liu, Dai et al. 2014), the national government began to focus on stemming the dramatic declines in breastfeeding since the late 1990s (Wu 2014). Weak health, labour market and market regulatory policies are crucial drivers of these declines (Hou 2014). As noted above, the economic loss from cognitive deficits associated with current infant feeding practices in China were estimated at around US$24 billion a year (Rollins, Bhandari et al. 2016), an ongoing annual loss equal to 0.33% of China's GDP. However the economic losses involved are unseen, and the implied decline in breastmilk production is framed narrowly within maternal/child health, rather than perceived more broadly as corrosive of China's economic productivity and human capital formation. Perversely, extra food and health treatment costs that result from increased formula sales reduced breastfeeding and less healthy children and adults are measured as an addition to GDP under current national accounting practices.

The environmental costs of displacing breastfeeding are also rarely made apparent. In the case of China, these are particularly large because of its large population. Greenhouse gas emissions from the manufacturing of milk formula sold in China in 2012 are estimated to be 2.24 million tonnes CO^2 equivalent (Dadhich, Smith et al. 2015). On-farm greenhouse gas production from milk production should also be counted and would double such estimates.

9. Conclusion

> "If women's work as producers and reproducers is invisible as a contribution to the national accounts, women are invisible in the distribution of benefits".
>
> Marilyn Waring, Counting for Nothing, 1988, p. 77.

Breastfeeding, breastmilk and its contribution to human capital are invisible in GDP and SNA, despite its importance as a food system and an element of preventative health care and human capital formation. Experimental accounts for breastfeeding and human milk would indicate economic well-being of the most vulnerable humans, infants and young children. Breastfeeding is an indicator which addresses gender bias in the SNA at foundation and moves 'beyond GDP', but is also measurable 'within SNA conceptual frameworks.

The recent emergence of international trade in human milk might on the one hand, reinforce the valorisation of market activities at the expense of non-market economic activity including breastfeeding. Alternatively, it might underpin a renewed feminist challenge to the practice of excluding human milk from economic accounting systems. By indicating market values for breastfeeding, trade in human milk strengthens the case for its inclusion in GDP.

Increasing the visibility of women's lactation work in key economic statistics might challenge the gender bias in policy which under-prioritizes allocating resources to address the economic wellbeing of women and children.

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[i] National accounting rules in the European Union now include estimating the value of national trade in sexual services of women, though not their trafficking.

[ii] As detailed in Smith (1999) this was a conservative value, being based on current scientific opinion of the worth of human milk, and excluding the value of the process of feeding from the breast. Continual advances in scientific understanding of the importance of human milk for early human nutrition, maternal health and child health and development has contributed to increased value placed on breastmilk such as by health services (based on online postings by North American women offering to sell milk during 2016, human milk may cost

around $150 per litre Cohen, M., 2017, Regulating Milk: Women and Cows in France and the United States. *The American Journal of Comparative Law* **65**.The process of suckling also in itself has been shown to benefit mothers and children, such as through promoting positive mother-child interactions, contributing to appropriate jaw development and reduced otitis media in the child, and reducing maternal breast cancer risk. Furthermore, the components and composition of breastmilk adapt themselves to the age and the physical environment of the infant and mother, providing a uniquely individualized food for the child that is not match by milk from another mother.

[iii] The estimated daily supply of breastmilk is based on studies by WHO and Norwegian health authorities. This approach assumes a daily intake of 700ml per infant from 0-6 months, 400ml from 7-12 months and 200ml daily for the second year of life. This estimate is relatively low compared to recent studies Hartmann, P. E., J. K. Kulski, S. Rattigan, et al., 1985, Lactation in Australian women. *Breastfeeding Review* **6**(August): 21-25. and may be reduced by the common practice of early introduction of solids (< 6 months), however this is the current estimate used by international and national health agencies and by the Norwegian statistical office so is used for consistency with these authorities. As previous research indicated the cost of additional nutrition for the breastfeeding mother was small, this is not included in this estimate. The cost of maternal time is also not included, as unpaid care work is not recorded in GDP under SNA accounting rules. Recent trends in sales of commercial baby food in India and China are analysed using Euromonitor data for the baby food industry as in the section on formula sales earlier in this paper.

[iv] The method of measuring breastfeeding is slightly different from that used for the high income countries above, as it applies widely available UNICEF data on IYCF practices rather than the more detailed, and less standardized national data from individual national studies. Also, more recent data is used to update breastfeeding prevalence and the numbers of infants and young children, and therefore the quantity of human milk production.

Tables

Table 1: Market prices for human milk, $US per litre, selected countries 2012 prices and exchange rates

Online milk sharing[1]	**Internet trading**[1]		**Wet nurse**		**Human milk banks**		**Commercial human milk products**[5]	
USA, UK, AU	*USA*	*UK*	*USA*	*China*	*HMBANA*	*Norway*	*Human milk*	*Human milk fortifier*
$0	$28 - $85	$57-$227	$71-$286[2]	$121[2,3]	$85 - $128	$100	$300	$6,250

[1]Purchase price varies depending on quantity, packaging, and shipping distance; offered by sellers at prices of $1-3 per oz. in the US and $2-8 per oz. in the UK (excluding shipping costs), and $0.5-1 per oz in Cambodia. [2]Based on an assumed 700mL daily intake. [3]2008 price. [4]Milk banks in Norway pay donors a US$20 per L expenses allowance. [5]For in-hospital use only, charged to hospitals or medical insurance and distributed through a 'co-promotion' with a major formula manufacturer. Source: Personal communication, Prolacta, July 2017.

Table 2: Market value of annual production of human milk, 0-24 months, selected countries 2005-2014

Country	Quantity produced[a)]	Value US$ mill [b)]	Potential value, US$ mill [b) c)]	Lost production (as % of potential) [b)]
Norway	11	1,066	1,770	40
Australia	42	4,218	8,937	53
United States	526	52,666	126,853	58
India	7,003	700,349	1,016,950	31
China	2,344	227,388	710,051	68
World	23,315	2,331,540	3,974,426	41

a) Million litres b) 2012 prices c) optimal breastfeeding prevalence of 95% from 0 -24 months

Table 3: Infant and young child feeding, 2008-2012, %)

Age (months)	India	China
EBF<6	46	28
BF and solids 6-8	56	43
BF at 12-15	88	37
BF at 20-23	77	(19)

Table 4: Commercial baby food sales, 0-36 months, (US$ millions) 2012

	Baby food total	Milk formulas total	Infant formula	Follow on formula	Toddler formula	Dried baby food
India	425	224	89	113	18	165
China	13496	12334	3523	3480	3480	1017

Source: Euromonitor International (2014) Euromonitor Passport Global Market Information Database. London: Euromonitor International.

Table 5: Economic losses from cognitive deficits associated with current infant feeding practices

Country	Economic loss, US$ billion, 2012	Economic loss as % of GNI b)
Norway	0.57	0.42
Australia	6.3	0.46
Philippines	0.73	0.31
United States	84.24	0.53
China	26.04	0.33
India	0.63	0.03

a) compared to all children receiving some breastmilk to up to age 6 months b) Gross National Income

Source: Rollins NC, Bhandari N, Hajeebhoy N, et al. Why invest and what it will take to improve breastfeeding practices. *The Lancet 2016; Vol 387 January 30, 2016:491–504*

Table 6: Greenhouse gas emissions (kg CO2 eq) associated with milk formula, 2012, tonnes p.a

	Australia	**China**	**India**
Milk formula - Total	31,742	2,249,287	111,227
Milk formula (0-6 months)	18,281	575,515	44,621
Follow up formula (7-36 months)	13,461	1,673,772	66,606

Source: Dadhich J, Smith J, Iellemo A, Suleiman A. Report on Carbon Footprints Due to Milk Formula: A study from select countries of Asia-Pacific region. New Delhi: BPNI/IBFAN Asia 2015