Accounting for Non-market Household Production 'Beyond GDP': 20th Century Trends in Mother's Milk Production

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ABSTRACT

GDP is a flawed metric for measuring and tracking economic performance as it excludes the contributions of ecosystems and non-market household production to economic wellbeing. Reform is long overdue. GDP growth significantly overstates economic performance because of shifts from household to market economic activity over time.

The 'Beyond GDP' agenda set out by the Stiglitz-Sen-Fitoussi Commission (SSF) in 2009 included broadening national income measurement to non-market activities. The Commissioners cited breast milk to exemplify the 'measurement bias' from excluding the unpaid household economy from GDP.

A decade on, there is improved accounting for environmental asset depletion and degradation, but little progress on gender aspects. National accountants remain reluctant to count non-market household production, and the exclusion from GDP of milk produced by breastfeeding mothers for infants and young children remains unaddressed.

This paper deals with the problem of assessing trends in economic welfare and consumption possibilities when there are shifts between sectors over time, through focussing on long term trends in mother's milk production. Expansion of the digital economy during the COVID-19 pandemic reinforces previously identified imperatives to better define and understand the blurred boundaries between household and market sectors, and shifts of economic activity between them.

This paper explores the economic wellbeing implications of shifts in the locus of food production activities from the household (breastfeeding and milk) to market sourced goods ("breastmilk substitutes"), by measuring changes in the volume and value of milk production for infants and young children in two countries, Australia and Norway since 1858.

JEL Subject Codes: E01; B54; I15

Key words: feminist economics, GDP, national accounting, SNA, unpaid work, satellite accounts, Beyond GDP, human capital, time use surveys, capabilities, inequality, nutrition, wellbeing, productivity, child survival, health and cognition, breastfeeding

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INTRODUCTION

> *`An unusual depletion in the crude oil reserves of an oil producing country of Asia or Latin America would be termed a crisis. Its economic and social implications would be so apparent that actions to reverse the trend would be awarded high priority. Yet a comparable crisis, involving a valuable natural resource and losses in the hundreds of millions of dollars, is going virtually unnoticed in many of the poor countries of the world. The resource is human breast milk, and the loss is caused by the dramatic and steady decline of maternal nursing in recent decades'.*
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> *Berg A (1973) The crisis in infant feeding practices. In: Berg A (ed) The nutrition factor; its role in national development. Washington: The Brookings Institution.*

Despite the strong call by World Bank nutritionist Alan Berg in the 1970s, for the past half century economic policies have remained transfixed by increasing the size of the monetized economy, measured by Gross Domestic Product (GDP). Breastfeeding and mother's milk is excluded from GDP while commercial baby food is counted. This conforms to the institutional framework provided by the UN System of National Accounting (SNA), greatly valued due to its relevance for managing unemployment and price inflation demonstrated during the 1930s Depression and Second World War, and institutionalised in 1953. There has been rising recognition since the 1970s that this framework is no longer fit for purpose.[1] [2] In particular, boundaries marked by the SNA mean that GDP does not capture how ecosystems and non-market household production are supporting the economic wellbeing of humans. The rapid transition to 'work-from-home' during the COVID 19 pandemic, facilitated by digital communication technologies, has further blurred the boundaries for GDP measurement.[3] [4] Recent studies of extending the GDP production boundary to unpaid household services confirm that GDP significantly overstates economic growth performance because of shifts over time from household to market economic activity.[2]

It has long been recognised that omitting unpaid work from estimates of national economic production results in biased measurement of economic development and growth, and misleads policymakers on priorities.[5] Feminist economists such as Boserup, Waring and Folbre have provided strong critiques of the imposed invisibility of women's productivity by the SNA since 1953.[6-10] Federici influentially argued that women's social reproduction work subsidises the costs of the market economy.[11] Policies expanding national income without accounting for the productivity of all producers including women would result in inequitable distribution and exploitation of women.[12]

Beyond GDP: the Stiglitz-Sen-Fitoussi (SSF) Commission

Revisions to the SNA in 1993 confirmed the inclusion of own-account household production of goods within the boundary for inclusion in GDP, and added some activities; unpaid services were explicitly excluded. As summarised by OECD statistical experts, 'The production of goods within households, the main example of which relates to subsistence farming, should always be included, while the production of unpaid services is excluded …'.[2]

In SNA terms, breastfeeding is a service, yet at the same time it is a 'good'. As well as nurture and care, breastfeeding delivers food, drink, and developmentally important nutrition for an infant or young child. It undeniably meets the 'third party or 'market' criteria [13] that it could be delegated to a paid worker ('a wet-nurse') or replaced by market goods ('breastmilk substitutes', often known as 'baby milk' or 'infant formula').

The review of the measurement of economic progress commissioned by the French President in 2009 concluded that there were major biases in how GDP measured advances in material wellbeing. The 'Beyond GDP' agenda set out by the 2009 Stiglitz-Sen-Fitoussi (SSF) Commission included broadening income measures to include non-market activities.[14]

The Commission cited milk to exemplify the measurement bias from excluding the unpaid household economy from GDP:

> *"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"

It noted that such omissions had major policy consequences.

A decade on, there is improved national economic accounting for environmental asset depletion and degradation in the SNA,[15] though accounting still fails to account for ecosystem services. It also does not account for for non-market household production.[10] There is only slow progress on measuring and valuing unpaid work by producing extended accounts and time accounting.[10, 12, 16]

The omission of unpaid work (notably childcare) means that GDP growth has significantly overstated economic performance during past decades because of shifts from household to market economic activity. For example, OECD statisticians recently investigated the impact of including unpaid household services on macroeconomic indicators over recent decades and how this biased GDP measurement over time, showing that GDP growth in countries like the US, the UK, and Canada was much lower (0.1–1.8 percentage points less) than measured in official statistics since the 1980s. This mainly arose because the apparent GDP boost from growth in childcare services was not real but simply substituted for the unmeasured and unpaid childcare previously provided by households as women took up paid jobs. Such analysis unknowingly foreshadowed the massive shift in the location of economic productive work activity during the COVID-19 pandemic lockdown in early 2020, and confirmed results from studies of this kind in the 1970s and 1980s for Canada and Australia.[17-19]

There is a long tradition of accounting for unpaid household work in some countries, including in Norway and Australia.[1] In 2014 Norwegian national accounts researchers, Aslaksen and Koren[20] reported that a large part of economic growth in Scandinavian countries over the previous forty years had been as a result of increased labour market participation of women. This meant that conventional GDP growth rates overstated real consumption possibilities during the periods when household production transferred to the market sectors. For example, GDP overstated real economic progress by more than 20% between 1972 and 1990 by excluding unpaid household work. Excluding unpaid housework from measurement also understated the increase in inequality.[21] Such findings have wide-ranging ramifications for economic and public policy priorities and for the national accounting framework.

The exclusion of breastfeeding and milk from GDP raises comparable issues that also remain unaddressed in national accounting practice. During the 1950s and 1960s, there were massive declines in breastfeeding in many countries, when commercial milk formula displaced breastfeeding (see Figure 1 and Figure 2). Milk formula products were first developed in the 1850s, and by the 1930s came to be favoured by pediatricians over breastfeeding.[22] In the same way that provision of childcare services has shifted into the market economy, the provision of milk for infants and young children became a monetised market activity, a nutrition (and care) provision activity that was previously mostly conducted without remuneration in the non-market household sector.

The focus of concerns on infant feeding during the post-war decades was on developing countries, where the effects were most apparent in shockingly higher morbidity and mortality of formula or bottle fed infants and children.[23, 24] However, the same precipitous fall in breastfeeding also occurred in high income countries, as illustrated in Figures 1 and 2 below by the experience of two high income countries, Norway and Australia. In other countries such the US and New Zealand, the same trends are documented.[25, 26]

[1] Aslasken and Koren (2014) report that counting household work in the national accounts goes back to the 1890s in Norway. In 1892 and 1893, and again in 1912, Anders N. Kiær, then director of Statistics Norway compiled the first estimates of unpaid household work. Lindahl made such estimates for Sweden in 1947. Similarly, in Australia in the 1920s, Wickens, the Commonwealth statistician calculated the value of the countries' human capital, including imputations for the value of unpaid work of mothers. Nancy Folbre documents how national statisticians in the UK, the US and Australia adopted the view of housework as 'unproductive'. 7. Folbre N. The unproductive housewife: Her evolution in nineteenth-century economic thought. *Signs* 1991; 16: 463-484.

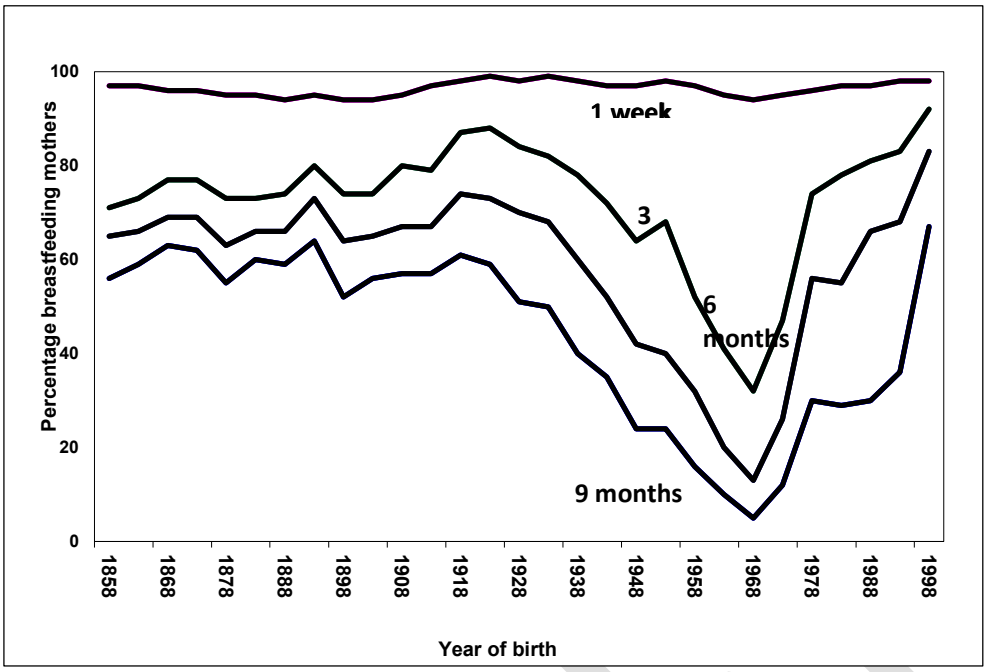

Figure 1 Breastfeeding in Norway, 1858-1998

Sources: see text

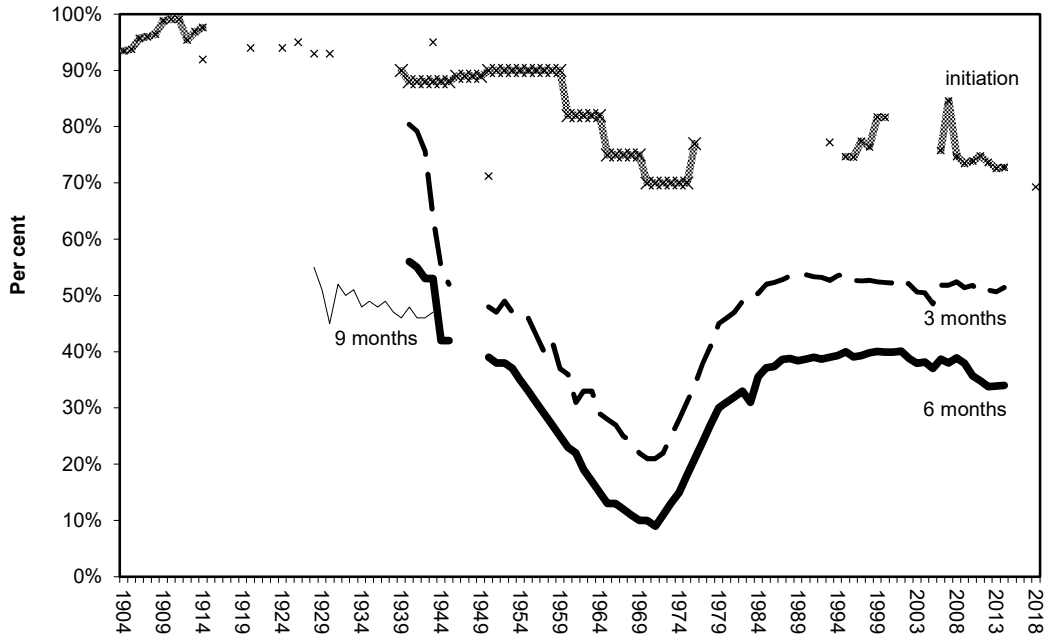

Figure 2 Breastfeeding in Australia, 1904-2018

Sources: see text

Growing understanding of the health importance of early life nutrition as well as the emergence of a global pandemic of obesity and chronic disease in the 1990s[2] has led since 2003 to greater consideration of the population health implications of infant and young child feeding practices for high- and middle-income countries (see also Rollin's et al [27] on the immune importance of encouraging breastfeeding during the COVID-19 pandemic). Rising rates of diet-related disease such as diabetes and breast cancer brought a greater focus on addressing declining breastfeeding rates globally.

A small number of epidemiological studies have specifically addressd the contemporary disease consequences for children and women of the precipitous historical decline in breastfeeding, [28, 29 30] These show that between 8-24% of some chronic diseases in Australia in 2012 and hundreds of new breast cancer and ovarian cancer cases in France and Australia can be attributed to declining breastfeeding practices during the 20th century. Estimates have now been made for a range of countries.[31-33]

In 2012, the World Health Assembly set targets to increase exclusive breastfeeding rates to 50% in all country settings.[34] Evidence is that more than 820 thousand infants and 20000 women die prematurely including in high income settings due to lack of breastfeeding [35].

A capabilities and equality framework

The 'Beyond GDP' agenda for reform of the SNA can argued to support a strong focus on children's survival, health and development, as well as on women's health and economic well-being. SSF recommended giving more prominence to economic inequalities, with a 'capabilities approach' to measuring quality of life. But how do 'freedom', 'agency', 'achievement' and 'well-being' relate to quality of life of a human infant or young child? The SSF Review noted that being adequately nourished and escaping premature mortality are 'elementary' in a capabilities approach. More complex capabilities, including those based on literacy, are reliant on early life nourishment and care that optimises cognitive development. There is strong evidence from randomised trials[36] and systematic reviews[37] of cognitive losses for children who are not sufficiently breastfed.

The mother-infant dyad have defined human rights on breastfeeding.[38] States have obligations under relevant international human rights treaties to provide 'all necessary support and protection to mothers and their infants and young children to facilitate optimal feeding practices.' In this sense, statistical systems for measuring human infants' supply and access to their mothers milk can be considered part of the 'scaffolding' required for governments to measure the quality of life and capabilities of a distinctively vulnerable group of humans to be alive, well nourished and healthy.

A focus on IYC is also supported by SSF recommendations for more attention to inequality; infants are those with greatest vulnerability to deprivation and poverty, and least 'agency' regarding how they are fed and cared for, despite this profoundly affecting their capabilities for health and development.[39]

Breastfeeding is important to child health and development, and underpins greater equity in child health.[40]

Notably too, breastfeeding as an element of quality care for infants has high time costs for women.[41, 42] Being enabled to breastfeed such as through paid maternity leave and suitable employment or work arrangements for parents of young children is therefore also an issue of gender equality, in the context for example of a significant 'motherhood pay penalty.'[43]

The infant and young child food economy

A feminist economic perspective highlights that the $71 billion market for milk formula,[44] and other commercial baby food products is only one sector of the infant and young child food economy. The other is the non-market household sector, where mothers produce their milk for infants and young children, as well as preparing other foods and meals for them.[41]

The 'infant and young child food economy' is represented in Figure 3, which shows the range of economic activity and its degree of monetisation, with Australia as an example. The diagram above does not include the significant environmental externalities of the milk formula industry,[45] which are shown to contribute significantly to greenhouse gas emissions in several recent studies [46-48]

[2] And most recently the COVID-19 pandemic. SARS-CoV-2 antibodies have been identified in breastmilk, supporting a role in immune strengthening. Lactoferrin and many other anti-infectious molecules are present in breastmilk with potential anti-SARS-CoV-2 activity.

Nor does it represent the substantial health cost externalities of milk formula use. Health economic research has identified large cost externalities of breastmilk substitutes in various countries, including economic and health treatment costs of excess mortality and morbidity.[32, 49-5253] The economic costs of cognitive losses arising from not breastfeeding are furthermore estimated at $300 billion p.a. globally.[31]

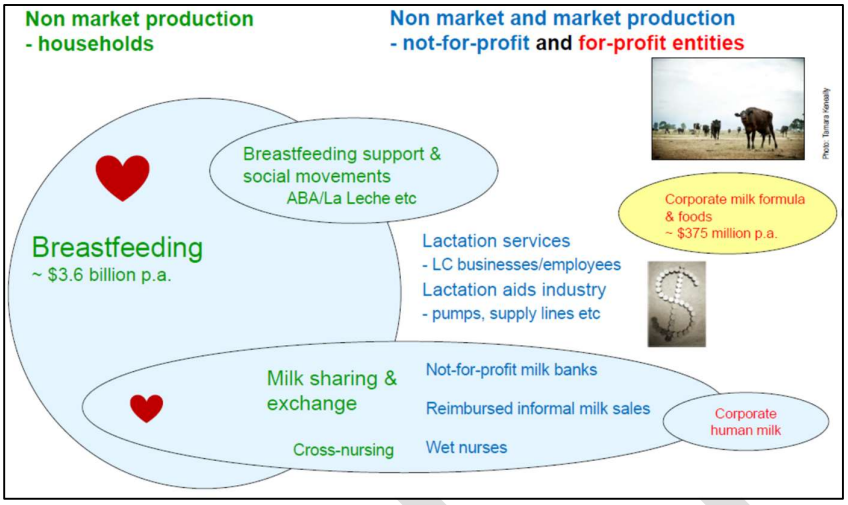

Figure 3: The infant and young child food economy – Australia

Just as the omission of non-market childcare means that GDP growth has significantly overstated economic gains due to shifts from household to market economic activity, so too does it mask the economic impacts of the 'infant nutrition transition' from breastfeeding for milk formula now underway in emerging market economies such as China and Brazil.[44]

Notably, milk is increasingly being bought, sold and exchanged, including internationally, and including by mothers seeking a substitute for breastfeeding on return to paid work (sometimes via social media or the Internet).[54] This highlights the spectrum of pricing for goods and services spanning market, not for profit and household sectors in the infant and young child economy.

The COVID 19 pandemic with its shifts to work-at-home and expansion of the digital economy reinforces the previously identified need to better measure and understand the blurred boundaries between household and market sectors, and shifts of economic activity between them.[3] It also reinforces the urgency of addressing the environmental cost externalities of the ongoing expanded market activity and GDP growth which have contributed to the heightened ongoing risks of future pandemics.

This study asks whether GDP growth in Norway and Australia would be significantly lower if the non-market production of milk had been measured and accounted for during sharp declines in breastfeeding during the 20th century. It asks in particular whether the dramatic global decline in supply identified above for developing countries by World Bank nutrition planner Alan Berg, might also have significantly impacted macroeconomic aggregates in high income countries such as Norway and Australia.

The aim of this study is to estimate trends in milk production through breastfeeding of infants and young children in Australia and Norway from the mid-late 19th century to the current time, so as to assess the implications of this shift from the non-market to the market sector in food provisioning for economic wellbeing at this most primal level, for infants and young children. Infants and young children are defined as those aged 0-24 months, in broad alignment with World Health Organization recommendations that breastfeeding continue to two years and beyond, after exclusive breastfeeding to 6 months.[55]

Estimating the economic value of breastfeeding and historical trends in milk production

Breastfeeding is the evolved system for the optimal nutrition and nurture of infants and young children, and was the norm for their nutrition and care in all countries until the early decades of the 20th century.[24] Data from several countries has documented the dramatic and worldwide change in feeding practices in the middle of the 20th century.[54] Since the 1950s, commercial breastmilk substitutes[56] have come to dominate the diets of all infants and young children globally.[44, 57 58] Such dramatic declines in breastfeeding in many countries in the

1960s and most recently in populous countries like China, Brazil and Indonesia represent a major global shift in the site of productive activity in the IYC food economy. These are driven by key structural determinants [59], as well as the significant political power of the commercial baby food industry.[60]

Studies of the economic value of breastfeeding at a single point in time have been published for around 25 different countries since 1974.[58, 61-68] These estimates value breastfeeding through estimations of milk volumes and values, and in diverse country settings such as the US, China, Norway and Australia, as well as India, Indonesia, Nigeria, and Bolivia. Some estimates explicitly demonstrate the substantial magnitude of production in relation to countries' food consumption, or compared to fiscal or economic indicators such as GDP.[69]

For example, Hatloy and Botten showed in a 1997 study [69] that the value of milk was significant in relation to GDP in Sub Saharan Africa. Given a value of US$1 per litre, 'inclusion of human milk in calculations of the gross national product for these countries would increase this value by more than 5% for Mali and nearly 2% for Senegal'. They concluded that human milk was a significant food resource to children the region and should be included in national food statistics 'due to its nutritional and economic importance'.

For such reasons Norway advocated for including it in national food balance sheets since the 1970s [70] and since the 1990s has included estimates of mother's milk ['morsmelk'] production in its annual statistics on dietary trends in Norway [71, 72].

Only a few studies consider this issue within a national accounting framework.[6, 54, 65, 73-75] Furthermore, it is not known how the magnitude of these large shifts in the locus of milk production for infants and young children compare with the measured economy, GDP and key macroeconomic aggregates.[54, 65] The question remains, how might these previously unmeasured historical and present day shifts[59] across production sectors affect key macroeconomic aggregates such as GDP and 'food balance sheets' over time.

The economic magnitude of these shifts through the spectrum of economic activity from unpaid household production of milk through breastfeeding and wet-nursing, to milk donation and market production of breastmilk substitutes, can be assessed using conventional economic approaches and methods.

This paper shows how available historical data for breastfeeding and annual births in the selected countries can be used to estimate trends over time in households' milk production and consumption. Identifying representative key time points during the 20th and 21st centuries allow historical trends in the economic value of mother's milk output for Norway and Australia to be documented and assessed. These countries are chosen as broadly representative of small-middle sized high income countries, and because of their availability of high quality historical data collections on breastfeeding and national account aggregates. The study uses established input- and output-based methods for valuation, within an SNA framework, based on available price and/or wage data. In the final section of the paper, results are presented on the lost economic value attributable to reduced milk production by mothers in the two countries studied.

DATA AND METHODS

Placing milk on national food balance sheets is relatively simple and accurate—through breastfeeding it is "the only food commodity for which production equals consumption, that is, there are no 'post-harvest losses' or 'plate waste'" (Greiner et al., 1979).

Estimating the quantities of milk produced.

The main variables in estimates of milk production are:

- the number of infants and young children of the relevant age;
- breastfeeding prevalence;
- estimated daily volumes of breastmilk production; and
- the value or 'price' of the milk.

In this study, quantities of milk produced and consumed in the selected countries is, firstly, estimated from data on annual births and breastfeeding rates dating back to 1902 for Australia and 1850 for Norway, and applying known daily intakes at various child ages to calculate annual production, at key timepoints 1858 to 2018.

The time points chosen, in the 1850s, at the turn of the 20th century, during the 1940s, 1960s and 1970s, and currently, are chosen to illustrate the historical high and low points in milk production evident in Figures 1 and

2, and represent periods of rapid decline (1943-1972), slow decline (1902-1943) and relative stability (1858-1902, 1972-2018).

Births

The number of children aged 0-24 months is taken from national statistics on live births for Norway [76], and registered births for Australia.[77] For simplicity, the number of children aged 12-24 months is taken to be the number of births in the adjacent year. No account is taken of infant and young mortality.

Breastfeeding

Both Norway and Australia have time series data on breastfeeding practices.

For Norway these go back to 1858 (from an academic study based on data collected at health services [78] later extended by Helsing and Bærug.[79]). Since 1994 data is available from official surveys every 5 or 6 years, and used for annual estimates of production of "morsmelk" (mother's milk) production in the report on trends in the Norwegian diet.[72] These are used in this study for estimates milk production for Norway from 1994.

Data is available less continuously back to 1904 for Australian jurisdictions (mainly Victorian health service data collections back to the 1920s [80], with a New South Wales survey in 1904 [81]). National data collections are available sporadically from the 1980s, including the National Health Surveys,[82] the Longitudinal Study of Australian Children,[83] and the 2010 Australian Infant Feeding Survey.[84] Australian data from 1950 is summarised in a compilation by the Australian Breastfeeding Association.

Data is available for any or full breastfeeding at 1 week at 3, 6, 9 and 18 months for the early decades in Norway, and at hospital discharge, 3 months, and 6 months in Australia. Up to the 1940s, Victorian data collections included breastfeeding at 9 months. As data were not available for every month to age 24 months for either country, monthly breastfeeding prevalence was interpolated through linear regression estimations from available data points.

Estimates of potential milk production were also made to allow assessment of productive capacity utilisation. These assumed a 95% prevalence of breastfeeding from 0 to 2 years; according to the World Health Organization (WHO), around 95% to 98% of women are physiologically capable of breastfeeding.[85]

Milk intake

A number of studies provide estimates of daily milk intake by breastfed infants and young children. More recent studies, such as by Hatloy in 1997,[69] and WHO in 2002 [86] differentiate exclusive and partial breastfeeding, and by developing or developed country settings. Estimates vary widely from around 310 litres [71] to around 450 litres [67] over a 2 year period of lactation. Research in Australia has identified much higher milk intakes among mothers who breastfeed *ad libitum*,[87] rather than scheduled feeding as became customary during the 20th century.

Table 1 summarises the assumptions about milk intakes for 0-24 and 24-36 months of breastfeeding in studies of the economic value of breastfeeding. This study used the milk intake estimates used by the Norwegian Health Directorate for that country's official statistics on mother's milk production in Norway from 1994.

As can be seen in Table 1, these are the most conservative estimates of milk intake. For consistency with Norwegian data on milk production, our estimates are based on the 0-24 milk intakes only, and do not include milk produced by breastfeeding mothers for children over 2 years of age. Nor do the milk yields used in these calculations differentiate milk intake for exclusively breastfed infants compared to partially breastfed infants.

Table 1 Milk intake during lactation (litres): summary of economic studies

Study/months of age		*0-24*	*24-36*
Rohde (1982)		288	-
Smith (2012-2018)		310	-
Norwegian Health Directorate (1994-2018)		310	-
Butte (2002) –	Developed countries	*300	-
		221	-
	Developing countries	*240	-

		219	-
Gupta and Rohde (1999)		347	110
Oshaug and Botten (1994)		351	-
Smith (1999-2005)		351	-
Hatloy and Botten (1997)		369	91
Almroth, Greiner, Latham (1979)		380	-
Aguayo and Ross (2001-2002)		*443	93
		426	93
WHO (1998)	Developed countries	*464	-
	Developing countries	434	-

*for exclusive breastfeeding 0-6 months and continued partial breastfeeding to 24 months

Additional food costs of lactation

In principle, the value-added of milk production should be net of the input cost of additional food for the lactating mother. Several previous studies have found that these costs are insubstantial.[88-92] Lactation induces changes in metabolism and activity levels which partly offset the additional energy intake needs of the mother. Furthermore, dietary intake data is not widely available for lactating women, particularly historically.[3] As incorporating the monetary cost of additional food intake into the estimates would add complexity and potential inconsistency with little gain for accuracy, additional maternal food costs of lactation are not included in these estimates.

Breastfeeding and national accounting aggregates - the monetary value of milk

After the quantity of milk produced was estimated, its monetary value was estimated, at current, national currency (Norwegian Kroner NOK, and Australian dollar AUD) prices. This was then compared with national accounting aggregates such as current price estimates of private consumption expenditure and GDP. Data on these is available in both countries for the period of time under study.

Valuation

A key methodological issue is how the milk produced by the mother and consumed by the child through breastfeeding should be valued or priced. Most milk production is not supplied to the market, and most milk consumed is not acquired in the market. For this reason, it is necessary to value production using a 'shadow price'. In this study, the monetary value of milk supply was valued in an SNA framework using conventional methods to determine a 'shadow price' for non-market household production of milk}.[93]

Valuing breastmilk as a commercial 'formula'

Older studies of the economic value of breastfeeding estimated the 'cost avoided' or 'savings' from current breastfeeding by calculating the financial cost of replacing breastmilk with artificial formula milk.[61-63, 66-68, 89, 94, 95] That is, they used the price of formula as a 'shadow price' for valuing milk produced by breastfeeding mothers.[4]

[3] Assuming an additional energy intake of 1260-1280 kJ/d (300-400kcal/day) and based on local food costs, the estimated food expenditures for lactating women in Australia in 1992 was previously estimated at A$101 for the first year and $73 for the second year. This amounted to A$15 million a year in aggregate, less than one percent of the estimated national value of milk output. Official data collections on food consumption expenditures of households do not gather specific information on food costs of lactating mothers. Dietary needs and recommendations for lactating mothers may also vary considerably.

[4] For example, to estimate the cost of replacing milk from recent declines in breastfeeding in Chile, Kenya, Singapore and the Philippines, Berg used data on breastfeeding prevalence to estimate national milk output. Its economic value was then measured using a price of US$240 per ton of formula. The study by Almroth et al. in 1979 for Ghana and the Ivory Coast estimated the value of national milk production by calculating the local cost of the formula and bovine milk necessary to provide the equivalent calorie value if breastfeeding mothers switched to artificial feeding. Likewise, studies such as those by Rohde and Gupta in the 1970s through the 1990s used the avoided cost of purchasing cows' milk for 1–2 year olds in Indonesia and India respectively to calculate that the value of extended breastfeeding equalled 80% of the country's health budget. Estimates by Aguayo and Ross similarly valued milk produced by mothers in Bolivia and Francophone West Africa at the cost of using commercial milk formula.

However, the price of artificial formula is unsatisfactory for valuation because breastfeeding and commercial breastmilk substitutes do not provide equivalent goods. Formula feeding does not match the health, nutritional, immunologic, developmental and psychological qualities of breastfeeding and mother's milk. Breastmilk is a 'species specific' infant food that is markedly different from, and 'uniquely superior' to, any artificial substitutes.[96]

Advances in the study of milk constituents showed by the 1990s that human milk should be viewed as a 'broad-spectrum medicine' as well as nutrition.[97] That expressed breastmilk or other mother's milk, not artificial formula, is WHO's recommended alternative where a mother cannot breastfeed emphasises that milk formula is not the closest substitute for mother's milk.[96, 98] From an economic valuation viewpoint, the externalities and market failures involved also make the approach of valuing breastfeeding at the price of commercial breastmilk substitutes problematic. The issues are discussed more fully elsewhere [41, 64]

Market values for milk: milk bank prices, replacement cost and opportunity cost

The preferable, more accurate approach to determining an economic value for breastfeeding or human milk is to implicitly incorporate breastfeeding's health-protective effects in the 'shadow price' by exploring ways of deriving a market value for expressed human milk, or for replicating or replacing the services of a breastfeeding mother.

Therefore, historical data was used to construct historical estimates for the monetary value of milk, based on prices charged by milk banks and wages of wet-nurses.

Prices or wages for a point in time were extrapolated across time using GDP implicit price deflators or comparable indices for each country to reflect changes in the country price level over time. Because using abstractions may be unrealistic over long periods of time, results using other pricing methods and data are also considered in order to gauge the plausibility of results.

Human milk bank price

The path-breaking study by Oshaug and Botten [70] of human milk supply in Norway was the first to use a market-based price for mother's milk to illustrate its national production value. Oshaug and Botten used the price of donated breastmilk sold by the main hospital in Oslo to private persons or other hospitals (at that time 344 NOK or US$50 per litre) to estimate the value of breastfeeding in Norway in 1992. This price is for fresh donor milk rather than heat-pasteurised milk, which more closely resembles the biochemical properties of milk taken at the mothers breast, and hospital milk distribution in this unprocessed form is customary practice in Norway and some other countries [99, 100]. A later study of Sub Saharan African countries by Hatloy and Botten in 1997 assigned a theoretical monetary value of US$1 per litre. Other estimates since then have been made using the same approach.[54, 101, 102]

This 'milk bank price' approach represents one of three conventional economic methods used by economic statisticians for valuing non-marketed products (ABS, 1990). Establishing the price of expressed breastmilk prevailing in 'the market' created by medical facilities and individuals that trade this milk represents an output-based, 'market alternative' valuation approach. The method has its problems; the price used by Oshaug and Botten for example, probably reflects in substantial part the costs of supply and the particular economic and institutional characteristics of a particular small and restricted market.[5] As discussed in detail in a later study, this is likely to be a more robust approach to obtaining the market price of an analogous product than for online sales, such by looking at online sales such as through the Only the Breast website where milk can be purchased for adults' use as well as for infants.[75, 101]

[5] Around the world, hundreds of hospitals now maintain milk banks to provide for premature or vulnerable infants or young children who cannot receive their own mothers' milk. In some cases milk is donated free by mothers, in other cases women who donate their milk receive small payments or gifts such as stationary as recompense for costs and recognition for their effort. It may be seen as a humanitarian action in addition to a gift being provided. Milk banks vary in their approach to ensuring the safety of donor milk. Pasteurisation is known to prevent the transfer of HIV and related viruses, and is practiced by UK and US milk banks. However, some vitamins and immunological properties of the milk are lost through pasteurisation, as such exposure modulated by complex components in milk is how the infant's immune system is primed to create antibody responses to pathogens and viruses. Where there is a known donor and low risk of AIDS, the use of unpasteurised milk is acceptable. Norwegian milk banks screen donors, and test initial milk samples, using fresh milk. Milk samples are also randomly tested. This has the likely advantage of being a relatively well informed 'market', comprising mainly health practitioners and medical decisionmakers.

Replacement cost

The second method of valuing non market products is using a replacement cost approach. Breastfeeding has long been a remunerated activity, and has been well documented in Western societies [103]. This points to a second method of establishing the relevant shadow price, identifying the wage of a a wet-nurse. The Oxford dictionary definition of a wet-nurse is a woman who breastfeeds and cares for another's child, but wet-nursing has been used to describe breastfeeding as an remunerated activity or occupation.[104]

For example, in the past, many upper-class European women employed wet-nurses to breastfeed their children. Even as late as the turn of this century, French and Russian foundling hospitals employed commercial wet-nurses to reduce the appallingly high death rate for abandoned infants. Average milk yields for commercial wet-nurses employed in French orphanages in the late 19th century are reported to be around 3 pints (1.875 litres) per day each, representing a maximum of 34 feeds per working day set for each wet-nurse.[105] It is therefore possible to estimate the replacement cost of a breastfeeding mother's time by the cost of employing a wet-nurse. Wet-nursing as an occupation gradually died out in Australia in the early years of the twentieth century but there is some information on their conditions of employment during the 20th century, including the wages offered.[106-108] This is used in the current study to estimate a per litre cost of milk obtained by employing a wet-nurse.

No data on wages for wet-nurses in Norway was available. In the absence of data specific to the occupation of wet-nurses, the cost of replacing the breastfeeding functions of the mother with a commercial wet-nurse (the 'replacement cost' method) might also be compared with the cost of employing a childcare worker, because breastfeeding requires certain parenting skills as well as specialised knowledge on care, handling and feeding of infants and young children. Historical data on wages of childcare workers was therefore used for this study where information on wet-nurse wages was lacking, using the same assumption that milk production would be around 1.875 litres a day. For Norway, only data on housekeeper wages was available for earlier periods, and in Australia, average earnings of female employees were used as a proxy for years where childcare worker wages were unavailable. Data sources were Statistics Norway, the Australian Bureau of Statistics and a compilation of historical estimates on wages by occupation for Norway [109] and on female average weekly earnings for Australia [110].

Opportunity cost

A third method, used to value blood or semen for national accounting purposes in countries where payment is unlawful, is to price milk at the time cost of extracting it. Blood products are a reasonable parallel because like breastmilk only a small amount is actually traded, although 'supply' and 'demand' is very large. Donating breastmilk does not involve an onerous medical procedure,

Jegier has estimated the opportunity costs of such maternal time providing milk for premature infants.[111] An estimate of the time cost of expressed breastmilk might be derived, for example, by assuming that on average, expressing 150 ml of breastmilk would take approximately 1 hour including transportation or travelling time costs.[6] An hourly wage rate can then be applied for a comparable employee to place a value on the theoretical time cost of extracting the milk. This 'opportunity cost' approach was applied in a previous study [64], but is not used in this study because identifying opportunity cost wages for women are particularly problematic in a historical context where women's employment or occupation was limited by culture or specific legislation,[43, 112]

RESULTS

Births

As can be seen in Table 2, births in Norway, have remained approximately stable at around 55-65000 annually over the 150-year period, compared to Australia where the number of births annually has increased around threefold, from 105,000 a year at the turn of the 20th century to 315000 a year by 2018.

[6] The mother of a premature baby might travel three or four times a day to a regional hospital to deliver supplies of her expressed milk for her baby for several weeks until the infant is discharged into home care. It may take this mother an hour or more to express small amounts of around 50 ml, and the time cost of supplying this milk is very high. At the other extreme would be a mother with a well-established milk supply who expresses 100–150 ml in around 15–45 min, then stores the milk for once or twice daily transportation to a milk bank, or to her sick baby in hospital.

Table 2 Summary of Births in Norway and Australia

Norway[b)], live births

1858	1902	1943	1968	1972	1983	1992	1994	1998	2007	2010	2012	2018
51,671	66,494	57,281	67350	64260	49937	60109	60092	58,352	58,459	61,442	58,995	55,120

Source: Statistics Norway
https://en.wikipedia.org/wiki/Demographics_of_Norway

Australia,
registered births

1858	1902	1943	1968	1972	1983	1992	1994	1999	2007	2010	2013	2018
-	102,776	149,295	240,906	264,969	242,570	264,151	258,051	248,870	292,152	315,147	308,065	315,147

Source: Australian Bureau of Statistics, Births, Australia, (catalogue No. 3301.0) and Australian Historical Population Statistics (catalogue No. 3105.0.65.001), 2014

Table 3 Summary of available breastfeeding datasets 1858-2019: Norway and Australia

A. Norway														
AGE (*months)*														
	1858	1902	1943	1968	1972	1983	1992*	1993**	1998	1999**	2007**	2010	2012**	2018**
1 week	97	94	97	94	95	97		98	98					
1							95			96	95	94	93	93
2							90			92	91	90	89	89
3	71	74	72	32	47	78	85	83	92	88	88	87	86	85
4							80			85	85	83	81	82
5							70			82	82	80	78	79
6	65	65	52	13	26	55	60	68	83	80	80	76	71	78
7							55			72	75	71	67	72
8							45			65	69	65	60	68
9	56	56	35	5	12	29	35	36	67	58	63	59	55	63
10							25			50	56	52	47	58
11							15			41	48	44	39	51
12	52	38	4	0	1	10	10	15	42	36	46	41	35	48
13										31	25	25	25	34
14										25	19	19	19	29
15										21	15	15	15	24
16										16	13	13	13	21
17										13	11	11	11	20
18	28	8	1	0		1				11	8	8	8	16
19										9	7	7	7	14
20										8	6	6	6	12
21										7	5	5	5	11
22										6	5	5	5	10
23										5	4	4	4	9

24										4	4	4	4	8

*As compiled by Oshaug and Botten 1994[70] ** As published by the Norwegian Health Directorate, various years. See main text.

B. Australia											
AGE (*months)*											
	1905	1943	1968	1972	1983	1992	1999	2007	2010	2013	2018
At hospital discharge		95	75			77	82	85	74	88	82
1	93										
2											
3	85	92	24	22		58	58	52	52	51	62
4											
5											
6		80	11	11		44	45	38	36	34	47
7											
8											
9		61									

Breastfeeding rates

Historical breastfeeding data identified for the study is summarised in Table 3. It can be seen that throughout the period 1858 to 2018, virtually all women breastfed in Norway, and for most of the 15 decades, the majority breastfed to at least 9 months. For two decades from the 1960s, all but a minority (32-47%) ceased breastfeeding by the time the child was three months old. By the 1980s and 1990s, breastfeeding at 9 months and 12 months had returned close to historical levels of around 40-50%, but breastfeeding rates at 18 months or older remained low in Norway, at around 10% compared to 28% in 1858.

As can also be seen in Table 3, breastfeeding at one week was similarly high in Australia in the early decades of the century, over 90%, though unlike in Norway breastfeeding at hospital discharge fell to below 75% in the 1960s. As in Norway, all but a minority had ceased breastfeeding by 3 months in the 1960s. Data for breastfeeding at 9 months was 47% in 1943, and had returned to that level by 2010.[113].

Mother's milk production in Norway 1993-94

Table 4 illustrates the methodology for calculating the quantity of milk produced, and the potential production at biologically feasible levels, using the data for 1993-94.

Table 4 Example of calculations of milk production (litres), Norway 1993-94

PRODUCTION OF HUMAN MILK NORWAY						
1998-99						
Child age (months)	Proportion of children breastfed (%)*	Number of children breastfed per month**	Volume of breast milk intake per child per day (litres)***	Volume of breast milk intake per child per month (litres)****	Production of human milk, (mill. litres) *****	Potential roduction of human milk, (mill. litres) *****
		58,352				95%
1	96	56018	0.7	21	1.18	1.2
2	92	53684	0.7	21	1.13	1.2
3	88	51350	0.8	24	1.23	1.3
4	85	49599	0.7	21	1.04	1.2
5	82	47849	0.7	21	1.00	1.2
6	80	46682	0.7	21	0.98	1.2
7	72	42013	0.6	18	0.76	1.0
8	65	37929	0.6	18	0.68	1.0
9	58	33844	0.6	18	0.61	1.0
10	50	29176	0.5	15	0.44	0.8
11	41	23924	0.5	15	0.36	0.8
12	36	21007	0.4	12	0.25	0.7
13	31	18089	0.3	9	0.16	0.5
14	25	14588	0.3	9	0.13	0.5
15	21	12254	0.3	9	0.11	0.5
16	16	9336	0.2	6	0.06	0.3
17	13	7586	0.2	6	0.05	0.3
18	11	6419	0.2	6	0.04	0.3
19	9	5252	0.2	6	0.03	0.3
20	8	4668	0.2	6	0.03	0.3
21	7	4085	0.2	6	0.02	0.3

22	6	3501	0.2	6	0.02	0.3
23	5	2918	0.2	6	0.02	0.3
24	4	2334	0.2	6	0.01	0.3
Total					10.3	17.0
					9.7	11.8
					0.8	4.0

Mother's milk production in Norway and Australia 1858-2018

The resulting estimates of mother's milk production in Norway for selected years between 1858 and 2018 are presented in Table 5. It can be seen that production fell to low levels of 4.8 million litres a year by 1972, a year when around three quarters of potential milk supply was lost. Production levels dropped during the Second World War, but were otherwise stable in Norway between 1902 and the present day at around 10-11 million liters a year, approximately half of its potential. By contrast, production levels of around 10.9 million liters of milk in Norway in 1858 was nearly three quarters of potential levels (not shown).

In Australia, a similar trend was evident, though losses were greater, and came later in the 20th century. Around two thirds of potential production is currently lost in Australia, compared to the 87% lost in the 1960s and 1970s.

Table 5 Milk production in Norway and Australia, 1902-2018

Year	1902-04*	1943-46*	1972*	1998-99*	2018-19*
		Norway			
Estimated actual production, million litres	11.0	7.7	4.8	10.3	10.2
Lost potential production	43%	54%	74%	39%	41%
		Australia			
Estimated actual production, million litres	21.4	18.0	9.8	26.8	35.1
Lost potential production	28%	58%	87%	63%	62%

*years are denoted in a range to reflect the alignment of available breastfeeding and birth data in both countries, and for consistency with official estimates for Norway by the Norwegian Health Directorate.

Figures 2 and 3 below show the drop in capacity utilisation during the 1960s and early 1970s, compared to historical levels, and against biologically feasible levels of milk production.

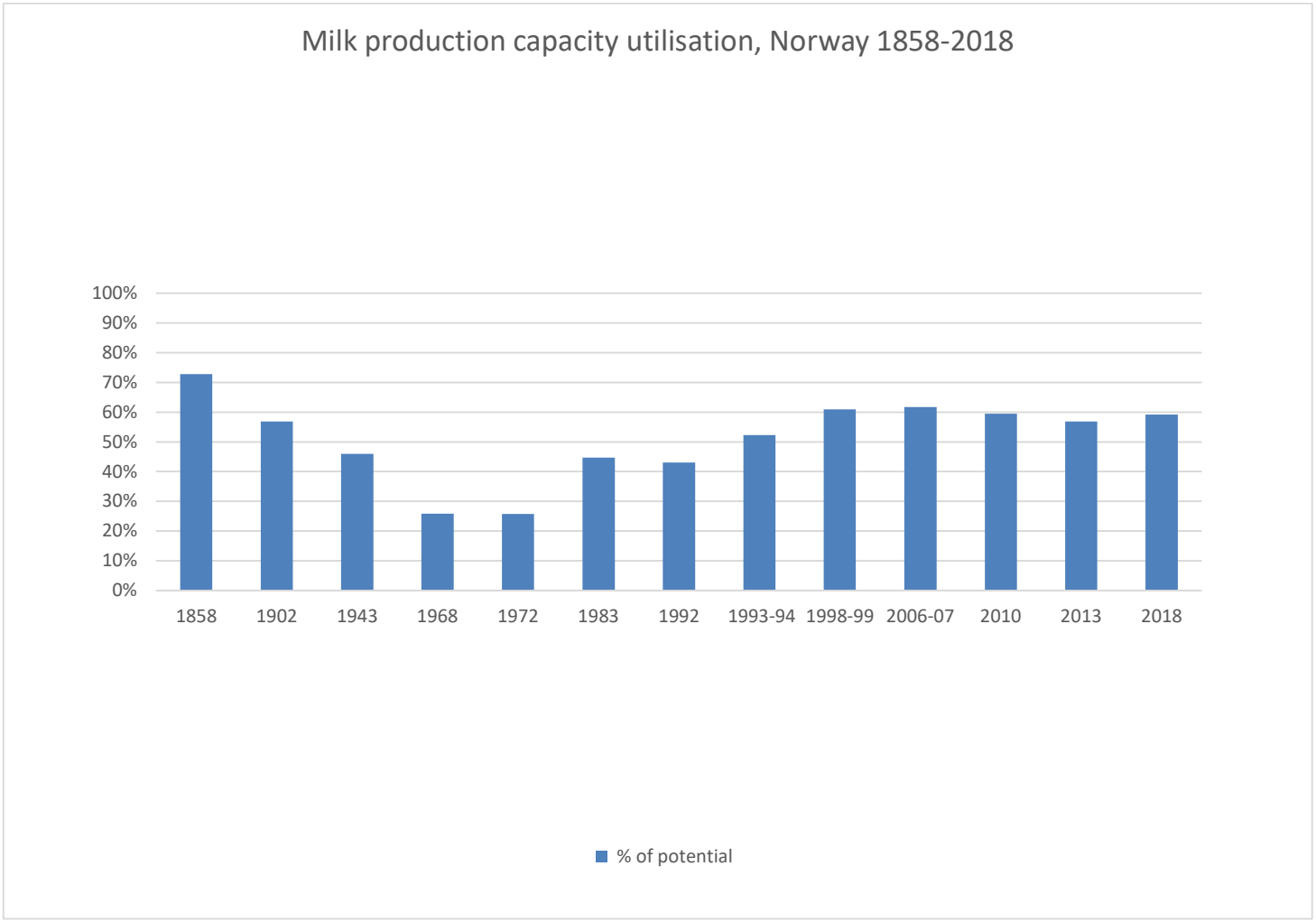

Figure 3 Milk production capacity utilisation, Norway 1858-2018

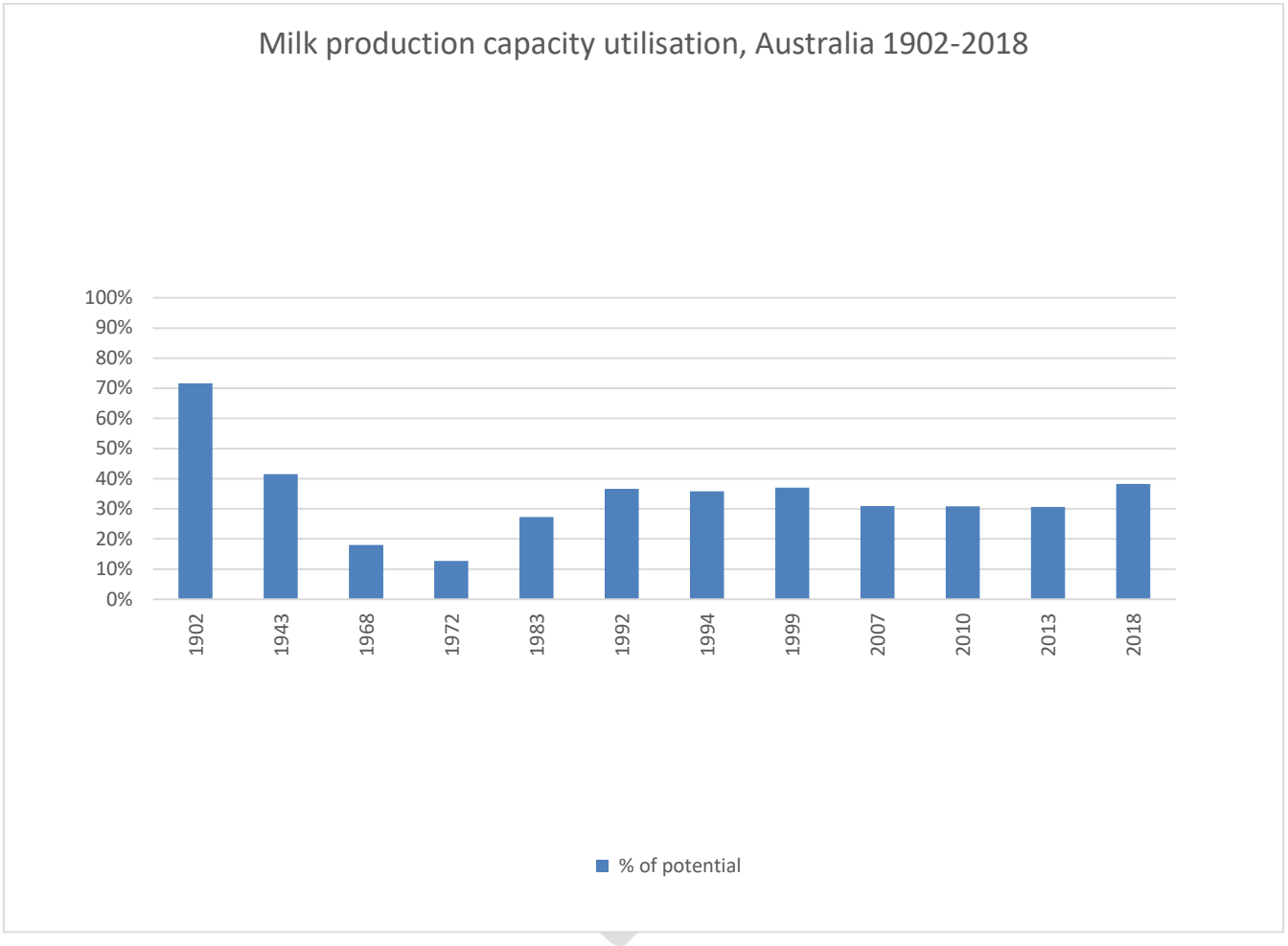

Figure 4 Milk production capacity utilisation, Australia 1904-2018

Monetary valuation

The data and estimations of prices and wages are used for placing a monetary value on the above volumes of milk production.

Milk bank prices

In Norway, a milk bank was established at the Oslo hospital in 1941, and milk exchanged through the country's expanded network of 12-18 hospital milk banks was priced consistently across the country from 2001-02.[114] The cost recovery price of donated mother's milk in Norway in 1992 was $US50, or $A67 a litre.[7] This price has been relatively stable historically, and fell below cost during the 1990s, but is now increased by the consumer price index each year; by 2009 it was $US100.[99] It is currently around 914 NOK ($US103).

Appendix Table 2 shows how these values translated into historical prices for comparisons with GDP, using the GDP implicit price deflator for private consumption expenditure.[115]

Mothers informally donated milk for a variety of uses in Australian hospitals in the post war period [116], though only in the past decade has institutionalised milk banking been established. In 2021 there are six human milk banks operating in Australia, in four states, and most associated with hospitals. One community milk bank operates independently of hospitals and supplies milk direct to the public for around $A110/L. Again, a milk bank price for the previous period (1994-2018) is calculated using the implicit price deflator for consumption expenditure (Appendix Table 2).[117]

Replacement cost

In Norway, wages for wetnurses were not available. Instead, the wage for a housekeeper might be considered as a suitable replacement cost indicator. A historical time series on the wages of housekeepers provides a relevant value for 1902. More recent data is available for childcare workers.[115] These values are summarised in Appendix Table 3, and adjusted to provide estimates of the cost per litre of milk produced.

Research on wet-nursing in Australia around the end of the 19th century has documented remuneration of 10 shillings a week being offered in advertisements in 1904,[108] which was consistent with court records which report wages of 10-20 shillings a week or more being paid during the 1870s.[106] This may have included board and lodgings in the home of the employer. Lewis reports 2 shillings a week in the 1870s was paid to poor mothers in institutions, for feeding other women's babies.[118] From the 1920s, wet-nursing was not a usual occupation, though it was occasionally reported in Australia in the 1980s.[104] Appendix Table 2 reports these indicators of the replacement cost of milk, along with some other available wage data.

For example, an alternative replacement wage for the occupation of wet-nursing is the official wage for childcare workers in Australia, which in 1992 was around A$13 per hour. This implies an approximate cost per litre of replacing mothers' milk of A$55 in 1992. This is adjusted in line with the change in average weekly earnings for females for the period to calculate a wage for a wet-nurse between 1946 and 1992 (Appendix Table 2).

The monetary value of milk production, Norway and Australia 1858-2018

Table 6 presents figures indicating the monetary value of milk production in Norway and Australia.

The monetary value of breastfeeding as indicated early in the 20th century is high, and the economic loss implied by its decline is substantial. Data deficiencies mean that the monetary figures may be taken as indicative only.

Further economic historical research is needed produce more reliable estimates, but these figures suggest that at the beginning of the 20th century, and continuing over time, mother's milk production would have added relevantly to GDP, if breastfeeding or mother's milk had been counted as economic production.

[7] All exchange conversions in this study are at a rate of $A1 = $US.75.

Table 6 Monetary values of actual and potential production of milk for Norway and Australia, 1902-2018

Country	Year	Biologically feasible potential volume of production (million liters)	Actual value of milk production, NOK million (market output valuation)	Biologically feasible potential value of production, NOK mill	Lost production value, NOK mill	Actual as % of potential production	GDP by expenditure, current prices, million NOK	GDP plus mothers milk	Addition to GDP level if included mothers milk in GDP, %	GDP plus mothers milk potential	Addition to GDP level if no milk lost and included mothers milk in GDP, %
					$ million	% of potential					
Norway	1858	15.0	84	115	31	73%	373	457	22.5%	488	30.9%
	1902	19.3	91	160	69	57%	1,088	1,179	8.4%	1,248	14.7%
	1943	16.7	124	270	146	46%	6,253	6,377	2.0%	6,523	4.3%
	1972	18.7	297	1,152	855	26%	63,749	64,046	0.5%	64,901	1.8%
	1998-99	17.0	3,557	5,835	2,278	61%	851,913	855,470	0.4%	857,748	0.7%
	2018	17.1	6,603	11,147	4,544	59%	-				
	Year	Biologically feasible potential volume of production (million liters)	Actual value of milk production, AUD million	Biologically feasible potential value of production, AUD mill	Lost production value, AUD mill	Actual as % of potential production	GDP by expenditure, current prices, AUD million	GDP plus mothers milk, AUD million	Addition to GDP level if included mothers milk in GDP, %	GDP plus mothers milk potential, AUD million	Addition to GDP level if no milk lost and included mothers milk in GDP, %
Australia	1902	29.9	2	3	1	72%	444	446	0.5%	447	0.7%
	1943	43.4	6	14	8	42%	2,935	2,941	0.2%	2,949	0.5%
	1972	77.0	53	417	364	13%	36,560	36,613	0.1%	36,977	1.1%
	1999	72.3	1,894	5,108	3,214	37%	361,087	362,981	0.5%	366,195	1.4%
	2018	91.6	3,864	10,077	6,213	38%	1,042,646	1,046,510	0.4%	1,052,723	1.0%

DISCUSSION

Significance and key findings

The milk provided by breastfeeding mothers is a commodity, and as such, should be counted in GDP according to SNA definitions. This is the first, exploratory study of long-term trends in mother's milk production, and illustrates historical experience of high income countries that is being replicated today in middle income countries such as Brazil and China. Results reemphasise the importance of Berg's findings for countries such as the Philippines and Chile in 1974.[58] The study found that in mid-19th century Norway, most infants were breastfed, and around 11 million litres a year of milk - 75% of capacity - was likely to have been contributed to the country's food supply by the unpaid lactation work of mothers. Likewise in Australia, milk production by breastfeeding mothers probably exceeded 21 million litres a year, and capacity utilisation was similarly high. From mid-19th century, when commercial breastmilk substitutes were marketed including through the medical professions, [119] production levels began declining. The loss accelerated sharply from the mid-20th century. The result was that by the 1970s, milk supplied by mothers in both Norway and Australia had fallen to 15-30% of capacity.

While the figures for the monetary values of this milk production in Table 6 are unreliable, the loss in household economic productivity due to declining breastfeeding appears to be large enough to be relevant to trends in key macroeconomic aggregates such as GDP and consumption expenditures throughout the 20th century. This is comparable with countries like Nepal today where high levels of breastfeeding currently imply levels of milk production of around 191 million litres of milk a year, which would represent nearly of the country's GDP of US$35 billion at prevailing international milk bank prices. This along with recent OECD Statistics work[2] supports the possibility stated by Aslasken and Koren in 2014 that 'the transition of women from household to markets, has led to a substantial bias in growth rates for actual output.'[20]

Strengths and limitations

This exploratory study contributes new perspectives and data to shed light on an important issue for national accounting in the "Beyond GDP' era, being the first to present estimates of trends over time in milk production in high income countries. National accounting researchers have looked at broader shifts over time,[120, 121], but few previous studies on this topic have placed milk production within the context of discussions about reforming the SNA framework or potential bias in GDP due shifts of household milk production to the market sector. The exploration has provided insights into future directions, data needs, and priorities for medical and economic historical research, that would benefit from collaboration with national accountants.

Nevertheless, the study has multiple limitations. These arise both from the sparce historical data, and the methodological techniques and assumptions needed for long term historical estimates of this kind.

Births

Birth rates overstate the number of children breastfeeding where mortality among infants and young children is high. Norway and Australia are high income countries with low neonatal and infant mortality and in modern times, this introduces little error to our estimates. This may not be the case for earlier periods, for example, the 1860s and the turn of the century were periods of particularly high infant mortality in Australia. This may introduce bias resulting in overstatement of milk production in earlier years or years of high infant mortality.

Breastfeeding data

There are many deficiencies in the data available for these calculations. The results for most years are based on prevalence data for 'any' breastfeeding for rather than full or exclusive breastfeeding, and hence will underestimate milk production. Results also rely heavily on linear interpolations. Also, the Australian data series for most years is for Victoria, which is likely to be indicative of breastfeeding trends but may differ somewhat from breastfeeding practices in other jurisdictions. Cross checking for years where national data is also available indicates that extrapolating from Victorian breastfeeding prevalances may considerably underestimate national production levels.

Milk intake

The assumptions on milk intake used for these estimates are very conservative. Furthermore, the scope of the estimates is for infants and young children aged 0-24 months when continued breastfeeding past two years is not

uncommon historically, including in what are now high income countries. Much greater milk production is implied if the total milk intake during the lactation period of 24 months is taken to be 450 litres rather than 310 litres, and if the scope of the study included milk intake by children aged 24-36 months (averaging around 90-110 litres per child). Including milk for this age group would increase estimated production levels by 25%.

Valuations

The valuations should be considered as indicative more than approximate, as a challenge to economic and social historians such as on wages for female occupations such as wet-nurses, and time spend on feeding infants. Notably, Margaret Reid's classic 1934 study of the household economy draws attention to the time intensity of caring for infants.[13] Due to data limitations and gaps in data, results rely on extrapolating from rather uncertain values for wages and prices over long periods of time. The estimates will be less accurate the further away in time they are from the relevant shadow price, which for Norway is milk bank prices in the 1990s, and for Australia is for wet-nurse wages around 1902.

Wage-based estimates calculate the price per litre of milk produced by assuming a daily milk output of 1.875 litres. This output level reflects the productivity of institutionalised European wetnurses in the 19th century,[105] and it is not known how realistic this is applied to modern conditions.

IMPLICATIONS

Breastfeeding epitomises the issues of excluding unpaid household work from measurement in GDP, and is relevant to SNA treatment of human capital as well as environmental and healthcare accounting.[75, 122, 123]

This study provides data that indicates the particular importance of infant and young child feeding for measuring unpaid work in GDP. As the 'Beyond GDP' agenda is implemented there is a need to that ensure the care and feeding of infants and young children, which makes particularly high demands on parents' time[124] is included in the improved time use and other data collections being developed.[125]

The infant feeding transition accompanying industrialisation, and the associated decline in breastfeeding, and loss of breastfeeding capabilities has had considerable implications for economic and environmental sustainability, as well as social, gender and health equity. Several authors have remarked on the equalising effects of breastfeeding, and recent studies have demonstrated that its practice is an important aspect of equitable access to health care and economic opportunities.[40, 94, 126, 127]

This reminds us that 'per capita welfare depends on the goods and services produced both in the market and non-market sectors of the economy', and this is particular evident in the case of breastfeeding which has been vulnerable to the expansion of product and labour markets, institutional deliveries/births, and urbanisation over the past 170 years.[59]

It also has important implications for economic development priorities, for example, as noted earlier, in countries such as Nepal, where the vast majority of mothers breastfeed exclusively for at least 6 months and continue breastfeeding for two or three years.

CONCLUSION

The premise of this paper is that 'money is the language of policymakers' - if the economic value of breastfeeding and the monetary losses from its decline were included in GDP, more action would be taken to address the global loss of production capacity inherent in the invisible 'crisis in infant feeding' that has been occurring since the 1950s.

The paper concludes with recommendations for data collection and national accounting, and for policy.

Firstly, all governments particularly in high income countries should regularly assess and monitor breastfeeding rates in line with the international indicators and survey methodologies.[57] Consistent and regular data collection on breastfeeding means milk production and consumption can be more easily included in national food statistics. The sparsity of data on wages for the occupation of wet-nurse and the present predominance of not for profit milk banks in the current milk trade also reinforces the need for more fine grained data collections on time use, and better information on milk bank operations. Time use data should include collections which differentiate the feeding and care of infants and young children[123].

When the amount of milk production is regularly measured, as in Norway, it can then be more easily included in national economic accounts aggregates including GDP. As World Bank Vice President Keith Hansen recently stated, economics is the language of policymakers.[128]

At the end of the day, if you want to persuade policymakers, you have to speak their language, which is usually economics, and you need to be able to justify things on the same basis at which they assess things that they can actually go out and look at.

Putting a price on mother's milk for economic accounting purposes may be seen as devaluing breastfeeding, but putting no price on it to the contrary suggests that it has no value. If breastfeeding is perceived to have no dollar value, resources are less likely be committed to realising women's and children's human rights to breastfeed.[38] A key argument for counting the milk in food- and economic statistics is also that doing so recognises one of women's unique contributions to global food security and community economic well-being, by makes this 'first-food system' more visible.

By underlining the importance of mothers' milk to broad social and economic welfare, including breastfeeding and milk in such statistical systems can also contribute to better policymaking. More comprehensive knowledge of the nature and locus of this significant economic activity assists more accurate and better informed public policy analysis, and more soundly based economic and health policies and priorities. It also brings to the fore the desirability of protecting it from replacement by commercially promoted baby foods, to remain for the future as the foundation of a more sustainable food system.[46, 47, 123]

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Appendix Table 1 Estimations for breastfeeding rates by month of age

NORWAY						
	1858	1902	1943	1972	1999	2018
Child age (	Proportion of	Proportion of	Proportion of	Proportion of	Proportion of	Proportion of chil
1 week	97	94	97	95	96	93
2	87	89	93	76	92	89
3	71	74	72	47	88	85
4	80	80	77	61	85	82
5	76	75	69	53	82	79
6	65	65	52	26	80	78
7	69	66	54	38	72	72
8	65	62	46	30	65	68
9	62	57	38	23	58	63
10	58	53	30	15	50	58
11	54	48	22	7	41	51
12	51	43	14	0	36	48
13	47	39	6	0	31	34
14	44	34	0	0	25	29
15	40	30	0	0	21	24
16	36	25	0	0	16	21
17	33	20	0	0	13	20
18	29	16	0	0	11	16
19	25	11	0	0	9	14
20	22	7	0	0	8	12
21	18	2	0	0	7	11
22	14	0	0	0	6	10
23	11	0	0	0	5	9
24	7	0	0	0	4	8

AUSTRALIA					
	1902	1943	1972	1999	2018
Child age (months)	Proportion of children breastfed (%)				
1	93	95	76	82	82
2	89	98	65	78	80
3	85	92	22	58	62
4	75	90	40	64	66
5	72	85	28	57	59
6	68	80	11	45	47
7	65	77	4	44	45
8	63	72	0	35	39
9	72	68	0	28	32
10	70	64	0	21	25
11	67	59	0	14	18
12	65	55	0	7	11
13	62	51	0	0	4
14	60	47	0	0	0
15	57	42	0	0	0
16	55	38	0	0	0
17	52	34	0	0	0
18	50	29	0	0	0
19	47	25	0	0	0
20	45	21	0	0	0
21	42	16	0	0	0
22	40	12	0	0	0
23	37	8	0	0	0
24	35	4	0	0	0

Appendix Table 2 Output-based and input-based estimates of economic prices per litre of mothers milk, Norway and Australia, 1902-2018

	Year	Implicit price deflator-private consumption expenditures 2000=100	Milk bank cost of milk per litre, NOK, using food price index	Milk bank cost of milk, NOK, per liter using PCE implicit price deflator	Childcare wages cost of milk, NOK per litre	Housekeeping wages cost of milk, NOK per litre	Childcare worker, per year, NOK	Nominal annual wages in private services; housekeeping wages, domestic cleaners and helpers, per man year, NOK
A. Norway	1858	2	-	7.7	-	0.3	-	199
	1902	2	-	8.3	-	0.4	-	292
	1939	4	-	16.2	-	1.3	-	905
	1946	7	-	25.7	-	2.3	-	1581
	1968	16	-	61.7	-	13.4	-	9151
	1972	20	-	79.5	-	19.6	-	13441
	1983	53	219	206.8	-	60.6	-	41500
	1992	84	342	331.7	-	106.2	-	72662
	1993-94	87	-	344.0	-	113.0	-	77312
	1998-99	97	-	344.0	-	140.8	-	96328
	2006-07	-	-	344.0	-	192.2	-	131561
	2010	-	-	650.0	-	-	-	-
	2013	-	-	650.0	609.3	591.6	357600	404880
	2018	-	-	650.0	648.8	630.2	380760	431280

Source: Grytten 2007 Norwegian wages 1726-2006 classified by industry, 343-384, Ch 6 in Eitrheim, Klowland & Qvigstad eds, Historical monetary statistics for Norway Part II;[109] Statistics Norway, Earnings 11418[129]

Year

B. Australia	Implicit price deflator-private consumption expenditures	Milk bank cost of milk	Wet-nurse, cost per litre, $	Wet-nurse , $ per week	Childcare worker, weekly wage, 40 hours, $	minimum weekly wage of female adults entertainment, personal services, $	average weekly earnings, per employed female, $
1858	0.1	3.5	0.2	1.5			-
1902	0.1	3.7	0.1	1.0			-
1939	0.3	4.0				4.6	-
1946	0.4	4.9	0.3			6.7	3.1
1968	1.0	5.4	3.6			28.2	34.4
1972	1.2	5.7	5.4			38.0	51.2
1983	3.1	6.2	19.7			166.4	186.0
1991-92	56	62.6	55.0		520		
1993-94	58	64.9					
1998-99	63	70.6					
2006-07	78	87.4					
2009-10	85	95.2					
2012-13	91	101.9					
2017-18	98	110.0					

Vamplew 1987 Historical Statistics[110]; Australian Bureau of Statistics (ABS), *Australian System of National Accounts; Expenditure on GDP Implicit Price Deflators*., ABS Series ID A2420886CF 1960-2020[117].