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ARTICLES IN THIS ISSUE

A SYMPOSIUM ON THE CARE ECONOMY

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Unemployment and monetary policy: a revisit and new job strategies

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This paper revisits the natural unemployment rate and some studies of labor markets with search frictions that it has inspired. New job strategies being proposed suggest a need for an enhanced labor market research agenda, which looks at additional movements in the labor force. New directions in the conduct of monetary policy beyond concerns over dangers to banks and financial markets posed by interest-rate adjustment may follow as a matter of course in the context of newly emerged labor market policy.

JEL classification: J08, J18, E52
Keywords: unemployment, monetary policy, labor market

1. Introduction

The revisit in the title of this paper is a reminder that the topic has had a long history, featuring episodes of how macroeconomic theory has influenced monetary policy since the Great Depression of the 1930s. About the influence of such theory on policy, I underscore in particular the signing into law of the Employment Act of 1946 by US President Harry Truman, committing the US government "to create employment opportunities for all Americans."

Since then, putting the conduct of monetary policy in the service of maximizing employment has been a focus of interest in macroeconomics, and to this day invites debates among macroeconomists of varying persuasions. Some approaches are called classical or neoclassical, while others are referred to as Keynesian or neo-Keynesian. Calling specific approaches by the school of thought that influenced them is useful from a historical standpoint, but I will not take that route. Instead, I will look at the main propositions that emerged from the debates related to the actual conduct of monetary policy, shining a light on the process of prominent academic writings about the subject at hand.

Given the long history of the natural rate of unemployment, I want to start somewhere. An important point of departure is the paper of Friedman [1968],

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which introduced the concept of the natural rate of unemployment or the equilibrium rate of unemployment. The latter has been widely accepted by a long line of macroeconomists and has yielded a large body of knowledge that continues to influence the actual conduct of monetary policy geared to full employment. Among labor economists, however, the failure to reduce unemployment in some countries and the worsening of income inequality, such as those in the European Union (EU), has resulted in a reconsideration of job strategies, referred to in some environments as "a Great Reversal." The main objective of this paper is to examine what labor market research agenda is opened by the reversal.

Friedman [1968] started his paper by describing what monetary policy cannot do. In case employment were to be the target of monetary policy, he referred to the natural rate of unemployment and described the term as follows:

> The 'natural rate of unemployment,' in other words, is the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is embedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the costs of mobility, and so on.

Friedman had in mind a labor market that relies on a decentralized price and wage system to coordinate and allocate labor among various economic and business activities, and in the process, determine wages and compensation. If such a labor market is embellished with imperfect information, as well as risk and uncertainty, a positive natural unemployment rate emerges, which in that labor market setting, is a real magnitude that monetary policy cannot affect. Easing monetary growth in an attempt to reduce further the unemployment rate to a level below the natural rate is likely to usher in inflation. If producers misinterpret an initial inflation rise as a relative price increase that increases the demand for their products, they may be led to expand production, resulting in an excess demand for labor, and an increase in real wages, thereby raising the unemployment rate and stoking inflation.

The natural unemployment rate that Friedman [1968] described opened up studies of the labor market with search frictions. For example, Hall [1979] formally defined the natural unemployment rate as the result of job search that workers and firms conduct. Job losses and job finds occur as a matter of course. Job search frictions have been incorporated in many formal studies that describe the equilibrium features of the natural unemployment rate.

Diamond [1982] and Mortensen and Pissarrides [1994], for instance, were awarded the Nobel Prize in Economics in 2010 for their contribution to the analysis of labor markets with search frictions. In particular, Mortensen and Pissarrides [1994] focused on equilibrium features, yielding a rigorous description of the natural unemployment rate as an equilibrium phenomenon.

The natural unemployment rate has triggered interest, for one, in alternative approaches to the conduct of monetary policy conducive to maximizing employment. An economy that is in a natural unemployment rate sees less need for active monetary policy. For another, the facts of labor markets have been focused on flows, involving job loss (whether voluntary or involuntary terminations), job finding, and job matching, instead of stocks based on merely counting the employed, unemployed, and labor force participants. In a typical job search model, the number of job losses equal the number of job finds in equilibrium, which yields a positive natural unemployment rate. Public policies and labor regulation are normally held to affect the natural unemployment rate through their effects on job-losing and job-finding rates. Minimum wage legislation (MWL) and collective bargaining (CB) actively pursued by labor unions, for example, are typically held by free market adherents as conducive to job loss and obstacles to job find.

All this has led to broader and deeper studies of the labor market effects of labor policies and regulations. On the employment effects of MWL, Card and Krueger [1994], for instance, have seen no evidence about the disemployment effects of MWL in the fast food industry in New Jersey and Pennsylvania. Meanwhile, countries that have endeavored to raise quality of life in the workplace through, for instance, employment protection and inclusiveness, have seen better economic outcomes. In consequence, the Organization of Economic Cooperation and Development (OECD) reversed its Jobs Strategy in 2018. The new OECD Jobs Strategy is a reversal of the 1994 approach, veering away from labor market flexibility, towards improved quality of the employment relationship, encompassing employment protection and collective bargaining. Given the OECD's reversal of its Jobs Strategy in 2018, the question emerges: what labor market research agenda is suggested?

This paper opens with a review of a basic model of the labor market with search friction. The incorporation of search friction draws attention to labor market flows affecting job loss and job find. Both firms and workers conduct job searches that take time before a job-worker match is consummated. Vacancies are also observed as a result. The job matching process results in a positive rate of unemployment, an equilibrium rate that an easing of monetary policy is not going to affect. The resulting unemployment, however, may improve job-worker matches, a positive externality from labor turnover. Many studies have focused on flows from employment to unemployment and vice versa; this paper suggests additional labor market flows beyond this usual movement. Furthermore, studies on the job search process suggest the need for a deeper investigation of labor market policies and regulations expected to impede job finding or accelerate job loss, resulting in an increase in the natural unemployment rate. The importance of data helpful in testing conventional thinking about impacts of labor policies and regulation, such as MWL and employment protection, is indicated.

Section 2 presents a basic job search model that yields a positive natural unemployment rate. Section 3 discusses alternative perspectives on the economic role of labor turnovers and the resulting positive externalities. Section 4 discusses the OECD's reversal in 2018 of its 1994 Jobs Strategy. Section 5 presents for consideration an enhanced labor market research agenda in consideration of the OECD's new Jobs Strategy. Section 6 makes concluding remarks.

2. A model of job search and the natural rate of unemployment

The most common model of job search inspired by Friedman's [1968] view of the natural rate of unemployment involves workers in search of a wage offer that exceeds their reservation wage. They end their job search once they get such a wage offer. Meanwhile, firms face job applicants and search for workers with marginal products that exceed the firms' reservation marginal productivity. A job-worker match is consummated once the respective goals of worker and firm are met. Some of the unemployed workers find jobs while firm vacancies are reduced. The natural rate of unemployment is positive, an offshoot of worker and firm job search (see Hall [1979]). This is a departure from the garden-variety labor market clearing model, which suggests zero unemployment rate in equilibrium.

In this simple job-search model, the natural unemployment rate (u) is affected by the rate of job loss and job find, that is,

$$u = \Delta / (\Delta + \lambda) \tag{1}$$

where Δ is the rate of job loss, and positively related to u; while λ is the rate of job find that is negatively related to u. If the labor market slackens, and Δ increases, then u rises. But once the labor market tightens and λ rises, then u declines.

The job search model of natural unemployment rate has drawn attention to factors that influence job loss and job find. Among government policies, MWL is often cited as a factor conducive to job loss, thereby raising the natural unemployment rate. MWL in a covered sector raises the real wage rate above the prevailing one. The standard thinking is that firms have an incentive to lay off workers whose productivity falls below the minimum wage. Low-skilled workers and young workers are frequently thought to be vulnerable to being fired. However, if there is a sector not covered by MWL, raising the latter may not have a disemployment effect. Traditional agriculture is widely thought to be uncovered with ease of entry and exit. Similarly, self-employment is believed to be similarly situated. Workers laid off in the covered sector may seek jobs in the uncovered sector, given ease of entry and exit therein. Unemployment in the aggregate may not rise but average real wage in the covered and uncovered sectors may decline. Any real wage gain in the sector covered by MWL may be offset by the real wage decline in the uncovered sector.

Recently, prominent labor economists studied empirically the employment effects of MWL. For example, Card and Krueger [1994] examined the 1992 effects of New Jersey's minimum wage using their own survey of employment before and after the change in fast food restaurants in New Jersey and Pennsylvania. The latter didn't change its minimum wage and was used as a control group. The main finding was employment did not change in New Jersey relative to that in Pennsylvania. The Card and Krueger critique was challenged by other studies (see, e.g., Neumark and Wascher [1995]). In any event, the employment effects of MWL remain a much-debated issue that cries out for further empirical investigation.

Similarly, labor unions are often thought to be cause of unemployment in view of their ability to raise union real wages above non-union wages in collective bargaining, raising the unemployment in the unionized sector. However, given ease of entry, in the non-unionized sector, the latter may be able to absorb laid off workers from the unionized sector and cause a decline in the average real wage in the non-unionized sector. It is also an empirical issue whether unionization is behind the aggregate unemployment in the Philippines. Unionization has been declining over time and no one has made a claim that unionization is one of the major factors behind unemployment and underemployment.

In the Philippines, there has been recurring clamor for instituting unemployment insurance (UI). Some UI bills have been filed in Congress, particularly, at the height of the COVID-19 pandemic. Laid-off workers are screened for eligibility under the UI and for determining the duration of the benefits. In the debates, detractors typically echo the arguments against UI heard in developed countries: that UI is an incentive to prolong the duration of the worker's unemployment spell. The more liberal are the UI benefits, the weaker is the incentive for job search and for ending the period of unemployment on the part of UI beneficiaries. In the debate over the high rate of unemployment in the European Union relative to that of the US, a generous UI is often cited as a key factor. Based on information from the OECD in the mid-1990s, the unemployment rate, for example, in Spain was 23 percent, 12 percent in France and Italy, compared to 5.5 percent in the US.

3. Economic role of labor turnovers

Labor turnovers lie at the center of job search. The natural unemployment rate depends a good deal on labor turnovers, whether voluntary terminations like quitting or involuntary, such as firing. One view is focused on minimizing labor turnover costs while another view engendered by the natural unemployment rate highlights positive externalities from job search.

Becker [1964] in his theory of human capital identified education and on-the-job training as an instrument for accumulating human capital, referring to the set of skills that workers bring to the workplace. The training may be specific, which is useful only to the firm hiring the workers. But the training may also

be general skills that are useful to all other firms. Under specific training, the firm has an incentive to pay for the cost, while the worker has none. It is also to the interest of the firm to minimize turnovers given the cost of specific training. Similarly, with general training, workers may be willing to pay for the cost since they can bring their skills to other firms in case they get dissatisfied with the firm that originally hired them. But since the firm also pays for general training, it is also interested in minimizing turnovers.

The natural unemployment rate, however, recognizes that job search may be more efficient if workers quit and engage in full-time job search. For instance, as the labor market tightens in the course of a recovery and as economic growth gathers strength, quits become prevalent as more workers expect job search to become remunerative. Full-time job search may be efficiency enhancing by improving job-worker matches. The economy benefits if the efficiency gains exceed all training costs. This is a positive externality emerging from labor turnovers. The resulting unemployment does not pose a social problem that must be actively reduced. Free market believers do not believe in activist monetary policy to combat this form of unemployment. Relatedly, some macroeconomists have pointed out that labor contracts tend to hold over a specific period of time and grant protection to workers against wage uncertainties during that time period. In this context, free marketeers argue that there is no need for a monetary stimulus even if some slackening of labor markets is perceptible.

This situation gives rise to questions about how to deal with involuntary terminations, particularly, if such terminations are triggered by an expected weakness in the economy. A monetary stimulus may bring the private economy to what a social planner may envision as optimal. In this regard, many observers found concerning the layoffs announced by Big Tech companies like Google, Amazon, Microsoft, and Twitter. Suspicions have been raised that layoffs are determined by artificial intelligence (AI)-based algorithms, which decide which workers are likely to be high performers in the companies or candidates for layoff. How should the monetary authority respond to these strategies of Big Tech, if true? Given that Big Tech has important sectoral complementarities and develops AI-based virtual assistants, the nature of the monetary policy response is critical.

4. Reversal in job strategies

Going back to the functioning of labor markets, there is an increasing clamor to reconsider job strategies based on labor market flexibility. The OECD, for example, reversed in 2018 its Jobs Strategy of 1994, away from labor market flexibility to one of employment protection and inclusiveness. As large data, data science, and computing advance inexorably, will a reversal in job strategies be the wave of the future?

In the 1990s, the EU posted high rates of unemployment. In 1994, the OECD issued a jobs strategy based on improving labor market flexibility. In this context, the jobs strategy counseled veering away from overregulation and policies like MWL and collective bargaining with unions. This Jobs Strategy was shared by international financial institutions like the World Bank and the International Monetary Fund. In that Jobs Strategy of the 1990s, reducing unemployment hinged on instituting flexibility in labor markets. It was held that employment protection should be reduced and collective bargaining downplayed. Meanwhile, income inequality worsened.

Seeing no evidence that the 1994 Jobs Strategy based on labor market flexibility had yielded salutary results, the OECD reversed its Jobs Strategy in 2018, citing that "countries with policies and institutions that promote job quality, job quantity, and inclusiveness perform better than countries where the focus of policy is predominantly on enhancing market flexibility" (see Evans and Spriggs [2022]). The new Jobs Strategy recognizes the positive role of collective bargaining. It also acknowledges that reducing income inequality stems not only from investing in education and training for skill acquisition, but also considers MWL and collective bargaining as helpful.

5. Enhancing the labor market research agenda

The reversal by the OECD in 2018 of its Jobs Strategy counsels continuation of studies on labor markets with search frictions. In addition, it must investigate labor turnovers beyond movements of labor from employment to unemployment and vice versa. It must also look at movements in and out of the labor force. Discouraged workers are relevant in this regard. What indicators of labor market tightness will make them end their being out of the labor market and encourage them to undertake job search again. Will those indicators of labor market tightness be accelerated by monetary policy?

As for overseas Filipino workers (OFWs) on furlough, it is useful to ask whether their reservation wages have risen, forcing them not to search actively for local jobs. Similarly, investment in higher education may lift reservation wages of graduates, thereby prolonging their search and unemployment spells. In addition, there are women, generally, highly educated, who are currently out of the labor force, having decided to drop out to raise preschoolers and invest in their children's human capital at an early age.

Studies of this sort call for new labor market data emanating from job search views of labor markets. In the absence of such data, public policy directed towards higher employment and reduced unemployment outcomes may be misled. This suggests recognizing the heterogeneity of the labor force, classified by type of worker, age, and demographic group.

6. Conclusion

This paper has revisited the natural unemployment rate and a selected body of academic work on labor markets with search frictions it inspired. The data of labor markets have been directed at flows, including voluntary and involuntary labor turnovers, rather than at the usual stock variables. Alternative perspectives on labor turnovers have been proposed, which recognize, for example, positive externalities from unemployment, in particular, the efficiency gains from improving job-worker matches. Monetary policy tended to support job strategies based on improving labor market flexibility in acceptance of the notion that most market-oriented economies guided by a decentralized price system faced natural unemployment rates.

In 2018, however, the OECD veered away from its previous Jobs Strategy of labor market flexibility after seeing the failure of that approach in reducing unemployment rates in many countries in Western Europe. Its new Jobs Strategy, adopted in 2018, now embraces the importance of employment protection, and recognizes the ability of MWL and collective bargaining to improve income distribution, all designed to improve quality of life in the workplace.

The new Jobs Strategy suggests the importance of continuing a labor market research agenda that builds on the study of labor markets with search friction.

The research agenda should, however, be enhanced to recognize additional labor market movements that acknowledge the heterogeneity of the labor force.

Developments in the labor market will continue to be an important dimension that central bankers consider in the conduct of monetary policy. This paper has suggested new directions in enhancing a labor market research agenda. It is, however, premature for this paper to indicate the new directions for monetary policy at this point. This paper is thinking beyond what Brunnermeier [2023] had proposed following the surge of inflation amid excessive public debt in the aftermath of the COVID-19 pandemic, which has been complicated recently by the dangers of interest-rate adjustments on banks and financial markets.

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Introduction to the symposium on the care economy*

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1. What is the care economy?

The articles in this Symposium on the Care Economy contend that a better understanding of the care work that households provide would deepen our understanding of how economies operate and why public policies may or may not have their desired impact. The care economy comprises a wide range of activities: from those involving direct, nurturing care activities, such as feeding an infant, assisting a child with homework, or helping a disabled family member dress, to those activities considered as indirect care or that do not entail face-to-face personal care, such as cooking meals, washing laundry, or gathering water [ILO 2018:6]. Many of these activities are undertaken by family members or by kin residing in a separate household; many are also performed by paid caregivers who work in households and in care establishments, whether private for-profit, non-profit, or government-run. In some cases, care services, such as daycare for young children, may be provided by one's employer or a community organization.

Over the past three decades, a growing number of studies have shown the strategic importance of care activities in the larger economy (Elson and Cagatay [1995]; World Bank [2011]; Alonso et al. [2019]; Blecker and Braunstein [2022]). These studies illustrate how these activities are critical for economic growth and sustainable, economic development. Such activities lay the foundation of every country's human and social capital and maintain every country's workforce. In contexts where paid or public health and social services are undeveloped or unaffordable, family members, kin, and neighbors are the primary providers of such services. In richer economies, the private sector for care services is more well-developed, but unpaid family caregiving is still significant. These points may seem obvious but the care economy, especially unpaid caregiving, tends to be invisible in policy discourse.

* Editor's note: *The Philippine Review of Economics* is grateful to Maria S. Floro and Elizabeth M. King for organizing the symposium and reviewing the papers in the collection.

One reason for the absence of care activities in national development plans and policymaking is that they are largely unpaid and nontraded. While time-use survey data from many countries globally document that a large share of people's time each day is devoted to these activities, they are not included in the System of National Accounts. Despite efforts by the UN and experts to expand the measures of a country's level of production and well-being to include the unpaid care sector, progress to do so has been limited. Taking stock of the labor engaged in services that are provided in the care economy is therefore not an easy task. Another important reason for the relative neglect of the care economy is that, as shown by the articles in this Symposium, care work worldwide, whether paid or unpaid, is predominantly performed by women and girls. The totality of women's economic contribution has been ignored in development models and growth theories.

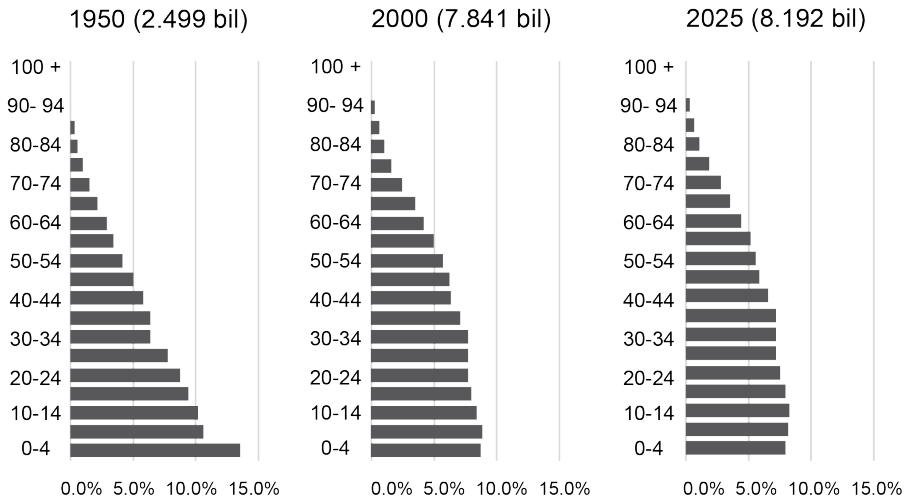
The articles in this Symposium address the challenges of, first, estimating the magnitude of the care economy and, second, integrating it in policy tools such as macroeconomic models, empirical evidence, and indicators. The authors use a variety of theoretical approaches and empirical methods to illustrate the interconnection between the market economy and the care economy as well as the short term and longer-term consequences of economic growth processes. References are made to both high-income countries like South Korea and the US, as well as middle-income countries such as Colombia, Mongolia, and Turkey.

Collectively, the articles demonstrate that care issues are central to addressing demographic, economic and social challenges in the world including the Asia-Pacific region. Growing populations, ageing societies, changing family structures, ongoing shifts in economic sectors and employment patterns, and global crises such as the COVID-19 pandemic have affected not only the demand for care but also the abilities of existing care arrangements to meet those needs. The articles also highlight possible policy solutions and the important roles of governments, the business sector, communities as well as individuals in addressing these urgent care issues.

2. Care and demographic transitions

Population pyramids for 1950, 2000, and 2025 (using the medium-variant projections of the UN) show significant shifts in the age distribution of the world population, especially during the half-century between 1950 and 2000 (Figure 1). During that period, fertility rates fell and life expectancy at birth increased. As a result, there was a ten percentage point decline in the share of the population below age 15 (from 34.7 percent to 24.5 percent) and a doubling of the share of the population aged 65 and above (from 5.1 percent to 10.5 percent). However, although fertility rates have declined, children aged zero to 14 still make up one-quarter of the world's population, especially in lower-income countries. Meanwhile, rapid aging has been occurring mostly in higher-income countries.

FIGURE 1. World population distribution, by age group



The age groups at both ends of the population distribution are highly relevant to any discussion of care. The care of children below five and even of school-age children demands a large proportion of the time, energy, and resources of households. In Korea, for example, the average weekly time spent caring for children and older adults in need of care by family members in households with dependents exceeds 50 hours on average [Cha et al. 2023]. In the US, many of those who provide care to elderly persons are themselves employed [Ahmed and Floro in this issue]. While improvements in public health have contributed to older people being healthier, longer lives have also meant an increase in the share of the superannuated—those aged 80 and above—who demand both more family caregiving and greater access to health and paid care services (Table 1).

TABLE 1. Distribution of the world's population, by age group

Percent share	1950	2000	2025
Below five years old	13.7	8.7	7.9
Below 15 years old	34.7	25.7	24.5
65 years old and above	5.1	9.4	10.5
80 years old and above	0.6	1.9	2.1

Source: UN Population Projections (medium-variant)

These demographic transitions have led to an expanding need for childcare and eldercare, challenging current care arrangements and overwhelming many families. Adults who belong to the "sandwich generation," that is, those who care for their young children as well as their aging parents, are finding themselves in a real conundrum. A study of these caregivers find that they experience financial

difficulties twice as often as other caregivers, and emotional stress, 50 percent more often [Lei et al. 2023]. Together with demographic transitions, economic phenomena, such as rapid urbanization and higher migration rates, are also changing marital patterns and family structures in many countries. One result of these changes is that more children are growing up in households with one or no parent. These single-parent households are among the most financially vulnerable groups. A significant proportion of these households do not have access to resources that enable them to get care support or assistance from either extended family networks or paid care services.

3. Aspects of the care economy

Because women typically bear the heaviest burden for caregiving in the family now and quite possibly also in the future [King et al. 2021], the tension between their unpaid care work and their labor market participation has been a topic for a growing literature (World Bank [2011, 2021]; Ferrant et al. [2014]; Beneria et al. [2016]; Connelly and Kongar [2017]; Blau and Winkler [2017]; Charmes [2019]; Alonso et al. [2019]). Empirical research shows that domestic and childcare duties, against a background of culture and social norms, constrain female labor force participation and influence the type of livelihood in which women engage. The global labor force participation rate for women is just over 50 percent compared to about 80 percent for men and has remained fairly flat over the last three decades [World Bank 2023a]. The relationships regarding the care activities, domestic work and market participation of women are the focus of several of the papers in this Symposium.

Many countries, including South Korea and Colombia, have made significant progress towards gender equality on many dimensions, yet inequalities in the care workload and the division of unpaid care labor within households have persisted. Martin Cicowiez, Hans Lofgren, Ana Tribin and Tatiana Mojica examine economic policies in South Korea and Colombia that can help improve the welfare of households with care responsibilities by freeing up time for women to take on jobs that are better paid. They break new ground by developing care-focused, gender-aware computable general equilibrium (CGE) models of the two economies. CGE models are tools commonly used by policymakers to analyze the potential impacts of specific economic policies, but they are seldom used to examine and predict the macro effects of care activities. These gendered CGE models for policy analysis or GEM-Care models for Korea and Colombia embed care services as inputs in the economy that have a direct effect on the size of the labor force and indirect effects on wage earnings, household income, and consumption. These models are used to predict the impact of policies that expand public care, provide subsidies for the care given by households or the private sector, and reduce gender gaps in labor force participation and wages, economic

growth, and household welfare. The paper on Colombia also estimates the impact of cash transfers to households with children on private consumption, unpaid care work, female labor supply, and economic growth. The two papers conclude that the impact of these policies depends on the flexibility of gender roles and the division of labor both within households and in the broader economy.

The paper by Ipek Ilkkaracan and Emel Memiş in this Symposium illustrate how different flexible work arrangements that emerged during the COVID-19 pandemic in Turkey have reset the allocation of time between market and unpaid care time for women and men in households. Using three surveys conducted before and during the pandemic, they found shifts in the work and unpaid care activities that reflected the work conditions during the lockdowns and, later, also the easing of such restrictions. After some of the work restrictions were lifted, the unpaid work time for women and men remained higher than during the pre-pandemic period, but less than under the lockdown period. Labor market hours, however, returned to pre-pandemic levels and even at slightly higher levels for employed men than before the pandemic, although it may be too early to tell where work hours would level off. Moreover, post-lockdown, there was a return to the workplace as the location of employment, but some teleworking and hybrid work have remained, especially in the case of women. This paper is relatively unique in being able to examine shifts in labor supply behavior by women and men in response to rapid changes in work arrangements.

Understanding time allocation within the household helps to predict the impact of a variety of family and social assistance programs on economic indicators such as labor force participation. Who provides unpaid care within the household is of economic and policy relevance. The paper by Elizabeth King, Hannah Randolph, and Jooyeoun Suh in this Symposium examines how childcare, domestic work, and paid work in the labor market are shared among household members, the extent to which women and men substitute for each other in these activities, and whether or not they realize economies of scale. The authors analyze nationally representative time-use survey data for Mongolia and Korea to examine these questions. The two countries differ in their level of economic development and industrial structure, demographic profile, and household composition, providing a comparative perspective on the allocation of time within households. And while traditional beliefs and social norms, as well as the market for paid care services, are important factors in those allocation decisions, these social factors are themselves evolving in response to broader demographic and economic transformations.

The paper by Tanima Ahmed and Maria Floro in this Symposium brings attention to the pressing issue of eldercare as life expectancies and dependency ratios increase; in particular, it examines this relationship in the US. Similar to low- and middle-income countries and in contrast with high-income countries, the majority of frail older adults in the US rely largely on unpaid caregivers. This is because of the inadequate prioritization of public investment in long-

term care, making the US government spending on eldercare proportionally the lowest among high-income countries. Using American Time Use Survey data, the authors show that frequent eldercare provision, that is, providing eldercare daily or several times a week, reduces the labor force participation of both women and men by nine percentage points. The tradeoff between unpaid eldercare and employment highlights the constraint imposed by the lack of public investment in care services and family leave policies.

Can paid care services substitute for a significant share of unpaid family caregiving and thus alleviate the burden on households and release time for other economic activities? In response to a growing demand for care services, governments in middle- and high-income countries have adopted various policies and programs. One of these is to expand paid care services, including childcare, early childhood education, community-based daycare, and long-term care for older adults in need of care. The paper by Shirin Arslan and her co-authors in this Symposium addresses one of the most important deterrents to a greater use of such services—concerns by families about the quality of paid services. Caregiving is distinct from other types of services in that it requires sustained personal attention. The quality of care and emotional support that a loving family member or kin can offer are difficult to replace, some would argue; on the other hand, others would argue that paid care workers may have specialized training and thus would be better able to provide the type of care needed by, say, an older adult with worsening dementia. By exploring the factors that contribute to the sense of responsibility that care workers feel, such as their working conditions (job security, work schedule predictability, and adequacy of training), the paper elucidates important dimensions of care policies and programs that deserve greater attention.

4. Care in the Philippine economy

How important are issues about the care economy in the Philippines? As with the rest of the world, over the past two decades, there have been significant changes in its demographic profile—a dramatic decline in fertility rates from 7.1 in 1960 to 2.7 births per woman in 2021 and an increase in average life expectancy at birth from 59.2 years in 1960 to 69.3 years in 2021 [World Bank 2023a]. These demographic shifts, along with large rural-to-urban and international migration flows over the past decades, have brought about profound changes in kinship network ties and household structures that have shaped the country's care economy—more households with no or single parent, parents who are absent for extended periods of time, and fewer kin in the immediate community to provide care support. According to the 2018 Philippine National Migration Survey, 12 percent of households have a member who was or had been an Overseas Filipino Worker (OFW) [National Statistics Authority 2023].

From factory and domestic workers to engineers and nurses, OFWs leave their families to earn income that provide financial assistance to those they leave behind. Their remittances totaled USD 32.8 billion in 2017, an amount equal to ten percent of the country's GDP [World Bank 2023b].

The massive migration flows frequently separate children from their parents during their early formative years of growth, threatening the healthy development of children. A study of children who are left behind finds that these children experience a vast range of poor physical (general health, hygiene, illness, and nutrition) and mental (behavioral, cognitive, and emotional) health outcomes [Dominguez and Hall 2022]. The pressure of outmigration on families, children and elders left behind needs more attention than has been given by policymakers. In 2018, less than ten percent of children aged zero to four years were enrolled in public early childhood care and development programs. Although there are private sector childcare services in major urban centers, they are generally not affordable for low-income families [Epetia 2019]. Concerns regarding the affordability and quality of care can serve as barriers to families seeking assistance from outside the household to meet their care needs.

Social expectations regarding women's role as primary caretaker in families remain prevalent, regardless of the increase in women's labor force participation in the past six decades. Data from the International Social Survey Programme's World Value and Gender Roles survey show that over 80 percent of Filipinos agree that a man's job is to earn money while a woman's job is to look after the home, and about half believe that a preschool child suffers with a working mother [World Bank 2021]. As a result of persistent gender norms and the absence of comprehensive care policies, employed women now work longer hours, on average, compared to employed men when the time for unpaid domestic and care work are combined [Abrigo and Francisco-Abrigo 2019]. The lesson is not to prevent women from participating in income-earning work but to address the barriers they face. Higher female labor force participation is instrumental to economic growth and gender equality [Philippine Institute of Development Studies 2022]. A study shows that if women's participation increased by 0.5 percentage points per year from a baseline of 45 percent in 2020, GDP and GDP per capita would increase, on average, by 0.3 percentage points per year over the period 2021–2050 [World Bank 2021]. And because the absence of care support policies hits low-income and vulnerable families the hardest, a comprehensive national care policy would be both an economic growth and poverty reduction policy.

5. A call for more research on the care economy

The studies in this Symposium illustrate some of the kinds of research that are needed to understand the care economy across different country settings. Using various sources of data—time-use surveys, household questionnaires that reveal

the nature of care needs and arrangements, labor force surveys, and surveys of paid care workers—they demonstrate the range of information and types of analysis that can expand our knowledge about the care economy. They also reveal the need to improve measures of care activities, many of which take place in the home, whether performed by family members or paid domestic workers, and are inadequately captured by labor force surveys. Because care is, by nature, a personal activity, research on the care economy would be enriched by evidence on people's beliefs and values about caregiving and on the network of care-related relationships within and across households and communities. The nature of care activities and who engage in them change over time because of demographic, technological and economic shifts, as well as unanticipated phenomena such as the COVID-19 pandemic. Research using data from panel surveys and repeated cross-section surveys can help monitor the magnitude and direction of those changes. Finally, by making the care economy not only more visible and better understood but also an integral component of micro- and macroeconomic models and other policy tools, research can help sharpen the effectiveness of social and economic policies.

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Child and elderly care in South Korea: policy analysis with a gendered, care-focused computable general equilibrium model

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The Republic of Korea is characterized by rapid growth of its elderly population, a stagnant working-age population, the world's lowest total fertility rate, and the largest gender wage gap among the OECD countries. The heavy domestic and care work performed by women who receive little or no help from male household members constrains their labor force participation. The government strives to reduce the growing care burden of households, particularly among women, and raise female labor force participation rates as well as fertility rates. We examine the impact of various policy options to attain these objectives using a gendered computable general equilibrium (CGE) model for Korea. It is the first model in the literature using time use data with a focus on care services provided by the market and households. The simulations focus on the impact of policies that expand public care, provide subsidies to care provided by households or the private sector and reduce female wage discrimination. The results indicate that these policies improve the welfare of households with care responsibilities by freeing up time for women to take on jobs that pay better. Their broader economic impact, however, depends on the flexibility of gender roles in the division of labor both in households and in the broader economy.

JEL classification: J13, J14, J16, E16, C68
Keywords: economics of care, gender, social accounting matrix, computable general equilibrium model, Asia, Republic of Korea

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1. Introduction

The Republic of Korea (hereafter Korea) is facing important gender-related policy challenges with major repercussions throughout the economy: rapid growth of the elderly population combined with close to zero growth of the working-age population and low female labor force participation rates. The latter has been attributed to the fact that women provide most of the care in households and to gender inequalities in the labor market. Consequently, policies that support care provision for the young and frail elderly and that promote gender wage equality can enhance the well-being and incomes of households in general, and women in particular. Such policies are also important for broader economic development in the coming decades. Globally, gender equality is at the center of policy debates, pointing to the need for analytical tools that make it possible to think rigorously about gender dimensions of economic policy, including the medium- to long-run consequences and trade-offs of alternative policy options.

To meet this need, this paper presents the first care-focused model in the computable general equilibrium (CGE) literature; for Korea, it is also the first gendered CGE model. For its data, the model draws on an expanded social accounting matrix (SAM) that includes non-GDP household services, disaggregates households based on care needs, and singles out service sectors for child and elderly care. The simulations focus on the impact of policies that expand publicly funded child and elderly care services and reduce female wage discrimination. The results suggest that these policies improve the welfare of households with care responsibilities, but their broader economic impact depends on the flexibility of gender roles, both in the household and the broader economy.

2. Context

The challenges faced by Korea today—including an aging population, long hours of unpaid care work of women, gender disparities, and gender-based discrimination in labor markets—make it an excellent case for an assessment of the economy-wide impact of public policies in the areas of child and elderly care. In this section, we provide the context for the simulation analysis conducted in this study.

2.1. Childcare

Korea has a universal childcare program that covers all children up to seven years old. The main feature of the program is a subsidy allowance for childcare. In 2018, it amounted to a monthly average of KRW 300,000 per child—equivalent to USD 279. Behind this average is a system of benefits that differ depending on the age of the child and on whether care is provided at home or outside the home. Table 1 summarizes the benefits offered in 2018. As a share of GDP, government

spending on childcare support amounted to 0.90 percent, which is split into 0.64 percent in the form of vouchers for use of private or public sector provided care services outside the home, and 0.26 percent in the form of home-based childcare allowances.

TABLE 1. Korean government spending on childcare (2018)

Vouchers for care outside home			
Child age (years)	**Won/month**	**US$/month**	**GDP share (%)**
0-1	825,000	750	0.19
1-2	569,000	517	0.14
2-3	438,000	398	0.12
3-5	220,000	200	0.19
Home care allowances			
Child age (months)	**Won**	**US$**	**Total GDP share (%)**
0-11	200,000	182	0.05
12-23	150,000	136	0.04
24-83	100,000	91	0.17

Source: Ministry of Health and Welfare [2019] and own calculations.

This support is sufficient to pay for childcare provided by the public sector, which is preferred by most Korean families. This preference is due to the fact that, in government-run care services, the number of children per care worker is typically smaller and working conditions are better, e.g., higher pay and better job security.[1] However, public care was only available for 17 percent of all children in 2019 [Ministry of Health and Welfare 2020]. While the average out-of-pocket monthly care service expense per child was about KRW 200,000 (USD 177 equivalent) in 2017 (Lee [2018]; Yonhap [2018]), the expenses were higher for the 83 percent who were not in public care.

Apart from this main benefit, Korean families enjoy a set of other benefits including coverage of prenatal expenses up to KRW 500,000 (USD 442 equivalent), a one-year pension credit per child, a voucher for post-birth care services, and a paid parental leave of up to 12 months per parent per child (to be taken before the child reaches 12 years). The paid leave benefit is not universal as it excludes irregular workers and self-employed. Among leave takers, only 24.5 percent were men in 2020, indicating that childcare is mainly provided by women [Korea Employment Insurance Service 2021].

Although the childcare program has expanded since 2004 and has made it less financially burdensome to access childcare, it has not reversed the decline in Korea's total fertility rate (TFR), which is the lowest in the world. This raises questions about the effectiveness of past policies aimed at increasing Korea's TFR.

[1] According to the Korean Ministry of Health and Welfare [2016], in 2015, average monthly public and private childcare staff wages were USD 2,100 and USD 1,630 equivalent, respectively.

2.2. Elderly care

The main government support for elderly care is the Long-Term Care Insurance (LTCI) system. It offers three types of benefits: home-based services, care facilities, and combinations of co-payments and vouchers. During the last decade, the program had expanded rapidly due to the significant increase in the number of elderly (defined here as those aged 65 and above) and in the share of the elderly that receives benefits under the LTCI (Table 2). The number of beneficiaries increased from 145,000 in 2008 (2.9 percent of five million elderly), to 394,000 in 2014 (6.2 percent of 6.3 million elderly) and 569,00 in 2017 (8.0 percent of 7.1 million elderly). In 2014, the cost amounted to 0.24 percent of GDP; by 2017, it had risen to 0.30 percent of GDP. In constant 2010 KRW, the benefits per beneficiary have remained roughly the same but the elderly population growth and an increased share of beneficiaries among the elderly have led to spending increases in excess of GDP growth.

TABLE 2. Korea: Long-Term Care Insurance (LTCI) costs and benefits

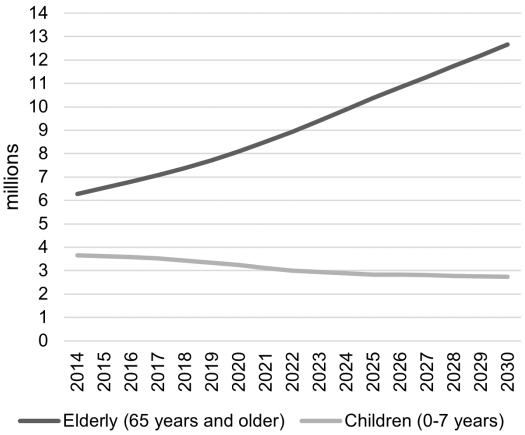
	2014	2017
LTCI cost (bn current won)	3,498	5,148
LTCI cost (% of GDP)	0.235	0.298
Elderly (65 years and older) (mn)	6.347	7.113
Share of elderly benefitting from LTCI	6.200	8.000
LTCI beneficiaries (mn)	0.394	0.569
Average benefit per elderly per month (current won)	47,016	53,625
Average benefit per beneficiary per month (current won)	740,711	753,947
Average benefit per elderly per month (2010 won)	43,111	47,434
Average benefit per beneficiary per month (2010 won)	679,195	666,910
Average benefit per beneficiary per month (current US$)	703	667

Source: Peng et al. [2021: 5, 15]; World Bank [2020]; UN [2019].

The LTCI system in Korea is publicly funded but privately delivered. In 2017, there were 20,377 private LTCI providers (5,304 institutions and 15,073 home-based care agencies) and 207 public ones (one percent of the total). Among the private providers, 81 percent were for-profit enterprises (Peng [2021], Table 4a; NHIS [2019]). In 2017, the LTCI employed 439,000 paid care workers (around 1.6 percent of Korea's total employment). Private-sector care workers face relatively poor working conditions including long workdays and low wages; in 2019, their average monthly wage was the equivalent of USD 1,300, which is far below the national average wage of USD 3,000 [NHIS 2019].

The ongoing demographic transition poses different challenges for child and elderly care in the next several years. As shown in Figure 1, according to UN population projections for the period 2014-2030, the population of children will decrease while the elderly population will grow rapidly [UN 2019].

FIGURE 1. Korea: Elderly and child population 2014-2030



Source: UN [2019].

During the last 15 years, family structure and attitudes toward care for older people have changed. The proportion of elderly parents who are living with their children decreased from 38 percent in 2008 to 29 percent in 2016. At the same time, surveys showed that the share of the population who believes that family, government, and society should share the provision of parental support has increased to 45.5 percent, exceeding the population share that cites the family as the main provider, 30.8 percent [Jeon and Kwon 2017]. This indicates a decline in the perceived obligation of children to provide care for their parents in old age.

2.3. Gender wage gap

Persistent gender inequalities in the labor market, e.g., earnings differences, is another constraint to women's labor force participation. In 2019, men in Korea earned on average 32.5 percent more than women, the largest gap among OECD countries with data [OECD 2021]. Lower wages for women are related to the concentration of female employment in occupations and sectors where pay is relatively low, including education and care-related services (e.g., medical, and welfare-related service workers and domestic chores and infant rearing helpers) [Suh 2020]. However, even within sectors, women tend to earn lower wages than men, an outcome that is ascribed to a combination of differences in productivity (which, in turn, may be due to differences in skills, experience,

and education, all related to differences in work tasks) and wage discrimination (i.e., wage differences that are not associated with productivity differences) [Choi 2019]. While wage discrimination seems to be common, it is difficult to produce exact measures since it is hard to measure productivity and quality, especially in services.[2] A few studies provide some evidence. Using the Oaxaca [1973] decomposition method, Monk-Turner and Turner [2001] estimated that, due to gender discrimination, men earn from 33.6 percent to 46.9 percent more than women with comparable skills. Using a similar method, Lee [2022] estimated that in 2017, unexplained factors accounted for 52.2 percent of the gender wage gap in Korea which, as noted, in 2019 amounted to around 32.5 percent.

3. Literature review

The small but growing literature on gendered SAM-based CGE models has demonstrated the ability of the CGE approach to generate important insights about gender-differentiated effects of economic policies.[3] This section briefly surveys the major contributions, taking note of their structure, data needs, and policy coverage. It also situates GEM-Care (General Equilibrium Model for Care Analysis), the model developed for this analysis, in the context of this literature. Additionally, some caveats and unresolved challenges for gender-sensitive CGE modeling are noted.

The gendered CGE models may be split into two groups. The first introduces a gender disaggregation of labor in the production sphere that, according to the System of National Accounts (SNA), is considered part of GDP. The second group goes beyond GDP and extends the model to cover household service production for own consumption, whose labor inputs are also disaggregated by gender. The household services include what is referred to as unpaid care or social reproduction. The second group of models considers the time that is available to different household members more comprehensively, so that time use also includes leisure. The coverage of the databases (importantly, the SAMs) that accompany the models in the two groups reflects the extent to which they are limited to or go beyond the GDP sphere.

Two seminal works serve as pioneers in the integration of gender in CGE models: Arndt and Tarp [2000] for the first group of CGE models and Fontana and Wood [2000] for the second group. The Arndt and Tarp [2000] model introduced a gender-disaggregated labor force in the agricultural sector, making it possible to analyze the gendered impacts of exogenous shocks on labor incomes and employment by gender as well as standard economic indicators, e.g., final demands and value added, both aggregate and disaggregated by sector. Their analysis also

[2] For a survey of issues related to discrimination in labor markets, see Cahuc et al. [2014: 479-550].
[3] For a more detailed review of the literature, see Fontana [2014] and Fontana et al. [2020].

considers the role that risk aversion plays in generating an overallocation of female labor to one of the agricultural sectors (cassava). The database used in the Arndt-Tarp model included gender-disaggregated wages and employment in different agricultural activities.[4]

Fontana and Wood [2000] were the first to develop a gendered CGE model that used an extended SAM by introducing household production. This extension required additional data but has the important advantage of transcending the artificial boundary between time spent on GDP production and the large amount of time spent on production of household services for own consumption as well as on leisure. As a result, it became possible to consider the gendered aspects of changes in market work on time spent in leisure and household work, all of which contribute to household and individual well-being.

The terminology for and extent of disaggregation of household work are varied but reference is often made to this set of activities as social reproduction. These activities can be further disaggregated into sub-groups, including different types of care, cooking, cleaning, washing, and shopping. Both the initial contribution by Fontana and Wood and subsequent contributions have focused on trade-related policy simulations.[5] The application of such an approach to analyzing other policy issues, such as investment in care provisioning in this paper, can enrich macroeconomic modelling and yield new insights while imposing new data requirements.

This study builds on the existing literature on gendered CGE models to address emerging policy debates. East Asia in general and Korea in particular face important gender-related policy challenges in the context of stagnant and even declining growth of the working-age population, low rates of female labor force participation, rapid growth of the elderly population needing care, and persistent gender inequalities both in the household and market spheres. It develops an innovative methodology in integrating the care sector in a gendered CGE model. Using simulation analysis, GEM-Care examines the potential impact of various policy options on wages, household production, welfare, and inequality, including both gender-specific and more aggregate indicators.

Another broad and challenging area revolves around the impact of different types of consumption and investment on the accumulation of human capital, including its gender dimensions. The education analysis in Ruggeri-Laderchi et al. [2010] on Ethiopia touches on this aspect.[6]

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[4] Other models in the first group, with gender disaggregation within the GDP sphere, also include Thurlow [2006] on South Africa, Arndt et al. [2006] on Mozambique, Cockburn et al. [2009] on multiple countries, and Arndt et al. [2011] on Mozambique.

[5] Other models in the second group, which also disaggregate households, also include Fontana [2001] on Bangladesh, Fontana [2002] on Zambia, Fofana et al. [2005] on Nepal, Cockburn et al. [2007] on South Africa, Siddiqui [2009] on Pakistan, Ruggeri-Laderchi et al. [2010] on Ethiopia, and Filipski et al. [2011] on the Dominican Republic.

[6] Gibson [2005] effectively makes the point that human capital accumulation is not only the result of formal education but also depends on many other activities, including household and informal sector services.

4. GEM-Care model and database

This section provides an overview of the GEM-Care model and database. Annex A provides additional details of the model, while Lofgren and Cicowiez [2021] provide the mathematical statement of the model.

4.1. Model

The emerging literature of gendered CGE models offers an approach that enables the analysis of gender-related issues, such as unpaid care workload and female labor force participation, in the broader economic context, which is essential for understanding the macroeconomic and sectoral impacts of various policy options. In this paper, we develop GEM-Care to address questions related to care and gender policies using Korea as a case study.

GEM-Care is a gendered dynamic CGE model designed for country-level policy analysis with a focus on issues relevant to care. The starting point for the model specification is GEM-Core, a model developed by Cicowiez and Lofgren [2017] that, in turn, draws on Lofgren et al. [2013] and Lofgren et al. [2002]. Apart from the gender- and care-related aspects, it has features in common with other CGE models: it is a system of non-linear mathematical equations and provides an economywide multi-sectoral representation of the real economy with the bulk of the data derived from a base-year SAM. The equilibrium aspect of the model refers to the fact that, under each solution, agents are assumed to have reached "optimal" decisions, meaning that, subject to budget constraints, producers and consumers maximize profits and utility respectively, while government decisions follow a set of rules (for example, to tax on the basis of policy-determined rates and make sure that spending and receipts, including borrowing, are equal). Similarly, the economy is subject to a budget constraint in its dealings with the rest of the world (represented by the balance of payments). Prices play the key role in market allocations, making sure that, in the context of government policy interventions and international trade, the quantities supplied and demanded (including stock changes) are equal.

As is the case for most CGE models, the dynamics of GEM-Care is recursive: actors are assumed to be myopic, making decisions based on data for the current year, which are influenced by past decisions. It is appropriate for medium- to long-run analysis of shocks that have significant repercussions beyond the sector or household that are affected directly. These repercussions include indirect effects via feedback, which draw upon the model's ability to capture the links between different parts of the economy. For example, CGE models make visible the links between production sectors via intermediate demands, links between household incomes from production, as well as household demands with feedback on production.

GEM-Care draws on the existing literature on gendered CGE modeling but extends it in the area of care. Compared to a standard CGE model, GEM-Care is

distinguished by the following features. First, it has a nested production structure that disaggregates time use by gender and includes leisure and household services produced for own consumption (i.e., cooking, doing laundry, providing care, etc.), in addition to GDP production (which includes paid care activities).[7] Second, it includes a nested structure of household consumption that captures household choices between own production and market supplies to meet its demands for care and other services. Third, it allows for interhousehold transfers in the form of unpaid care labor as well as transfers from government to households in the form of care services. Finally, it extends to the producer first-order conditions for labor hiring to make it possible to analyze the consequences of wage discrimination (i.e., wage differences that are unrelated to marginal productivity differences).

4.2. Database

The disaggregation of GEM-Care as applied to Korea is presented in Table 3 and reflected in the database. The major components of the database are a SAM for 2018, physical data on gendered time use, population data, and a set of elasticities (related to production, trade, and household consumption).[8] For brevity, only data on gendered time use are highlighted in what follows.

TABLE 3. Disaggregation of GEM-Care Korea database (total number of categories in parenthesis)

Sectors (activities and commodities)	*Agriculture and industry (6)*
	agriculture, forestry, fishing; mining; manufacturing; electricity and gas; water supply; construction
	Services, GDP (16)
	trade; transport; hotels and restaurants; information and communication; finance and insurance; real estate; professional, scientific and technical services; administrative and support services; public administration; education; health; other social care; other services; private care of children; private care of elderly; private service substitutes for household non-care services
	*Services, non-GDP**
	child care; elderly care; non-care

[7] Under the System of National Accounts, production that is part of GDP is referred to as being "within the production boundary." It includes (a) all production destined for the market or provided for free by the government or by NPISHs (non-profit institutions in the service of households); (b) household production of goods that are retained for final consumption within the household (such as production of agricultural goods); and (c) the production of housing services for own final consumption by owner occupiers. It does not include the production of domestic and personal services for consumption within the same household such as preparation of meals and care and training of children [UN 2009: 6-7].

[8] The process followed when building the 2018 SAM is similar to the one followed for constructing the 2014 Korean SAM. This is presented in detail in Lofgren et al. [2020].

TABLE 3. Disaggregation of GEM-Care Korea database (continued)

Factors (16)***	Labor, male by skill level (low skill/high skill) (2)
	Labor, female by skill level (low skill/high skill) (2)
	Capital, private
	Capital, government
	Land
	Extractive
Institutions (6)***	*Households (3)*
	working age with children; working age without children; elderly
	Enterprise
	Government
	Rest of the world
Taxes and subsidies (4)	Tax, activities
	Tax, commodities
	Tax, imports
	Tax, income
	Subsidies, commodities
Distribution margins (3)	Trade and transport margins, domestic
	Trade and transport margins, imports
	Trade and transport margins, exports
Investment (3)	Investment, private
	Investment, government
	Investment, change in inventories

* Non-GDP activities and commodities are disaggregated by household.
** For labor, unskilled is completed secondary school or less and skilled is more than completed secondary school.
*** The institutional capital accounts are for domestic non-government (aggregate of households and enterprises), government, rest of the world, and the financial institution.
Source: GEM-Care Korea database.

The SAM is used to define the base values for most of the model parameters, including those covering production technologies, sources of commodity supplies (domestic output or imports), commodity demands (for household and government consumption, investment, changes in inventories, and exports), transfers between different institutions, and tax rates. Apart from the extensions that cover household (non-GDP) service production, the GEM-Care SAM retains most features of SAMs used with other CGE models.

The data sources used to build the 2018 Korea SAM were: (a) 2018 supply and use tables and integrated economic accounts from the Bank of Korea; (b) the Local Area Labor Force Survey and the Household Income and Expenditure

Survey from Statistics Korea (KOSTAT);[9] (c) the Korean Labor and Income Panel Study, (d) the Korean Longitudinal Survey of Women and Families, (e) the Annual Education Statistics, (f) the Annual Statistics on Child Care Centers, (g) the Farm Household Economy Survey and Household Income and Expenditure Survey;[10] and (h) the Korean Time Use Survey from KOSTAT.[11]

In the current model and its database, GDP care sectors are split by target group (child and elderly) and ownership (private and public). Three representative households are singled out based on their care needs: (a) households with children with head in working age; (b) households without children with head in working age; and (c) households with head above working age. Note that the three-representative households have elderly individuals, with two-thirds of them in the elderly-headed household [Lofgren et al. 2020: 23]. Thus, all three households "consume" GDP and non-GDP elderly care services.

The SAM was also extended to consider (a) transfers from government to households in the form of care services, and (b) interhousehold transfers in the form of unpaid care labor. For (a), a simple incidence analysis was conducted, measuring the extent to which households with children (elderly) benefit from government spending in child (elderly) care. For (b), the interhousehold transfers in the form of unpaid care labor were determined as the difference between the supply and demand of household care services at the household level. For instance, total output of non-GDP childcare services is "consumed" only by the household with children aged zero to nine. In other words, the other two households fully transfer their output of non-GDP childcare services. On the other hand, two of the three households are net suppliers of non-GDP elderly care services. In both cases, we assume that child and elderly care needs are proportional to the number of household members aged zero to nine and 65 or more, respectively.

The need for elasticity data depends on the functional forms used in the model. In GEM-Care, household consumption is modeled in two levels with a LES (Linear Expenditure System) at the top and CES (Constant Elasticity of Substitution) functions at the bottom. CES functions are also used to model producer choice between factor inputs and the choice between imports and domestic output in domestic demand. To meet the needs of these functions, we use price elasticities for the LES component and substitution elasticities for the CES component. For the allocation of output between exports and domestic sales, the model uses CET (Constant Elasticity of Transformation) functions, which require elasticities of transformation. The economics literature provides a starting point for these elasticities, but it is important to test how the responses of the economy to policy changes are conditioned by the elasticities that are used.

[9] This is used for identifying and classifying labor in GDP activities into different categories.
[10] These datasets are used for identifying and classifying households into relevant categories.
[11] This is used for determining the time allocated to leisure and production of household services for own consumption.

The elasticities used in GEM-Care are shown in Annex B.1. To capture the observed rigidity in gender roles particularly within the household, we set the elasticities of substitution between male and female workers at 0.9 and 0.5 in the GDP and non-GDP sectors respectively (Cho and Lee [2015]; Choi [2019]). The price elasticities of demand are set as follows: -1.0 for GDP goods and services except care; -0.5 for care services, which is a composite of GDP and non-GDP care services; -0.5 for other (i.e., non-care) non-GDP services; and -0.85 for leisure. Given the absence of better data, we test the sensitivity of our results to the values assumed for these key elasticities and to the valuation of unpaid care labor.[12]

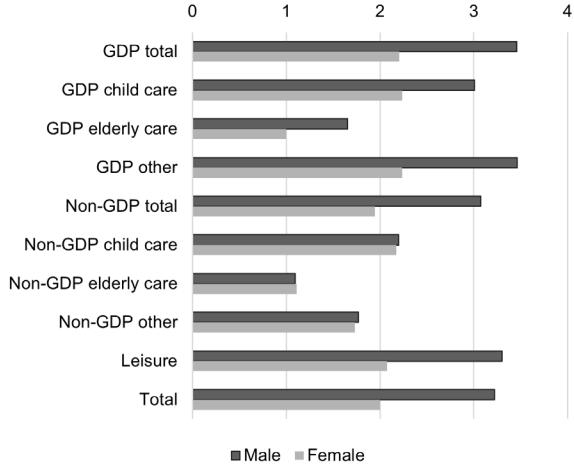
The time use data make it possible to define wages by gender and education level based on labor category and by activity. In an empirical database, payments, wages, and time use for GDP labor are generally observable even though the availability and quality of data can vary greatly across countries. It is, however, more difficult to define the wages and incomes related to non-GDP labor. For household service activities, the wage is defined as the marginal cost of the closest available market equivalent. For leisure, the wage (or price) is informed by the opportunity cost, (i.e., marginal income that is sacrificed since this time is not spent in the highest-wage alternative use). Hence, the valuation of time uses different approaches for estimating the 'wage' equivalent of time spent in different activity types. It should be noted, however, that the reasons for the allocation of time in different activities are not solely based on marginal returns.[13]

Figures 2 and 3 show relative wages and time use by gender. In Figure 2, the male and female wages (imputed wage per unit of time) for services provided by the household are at the level of the market wages in these services whereas the wages for leisure were set at the level of non-care GDP wages. For all activities, the gender wage gap by labor category matches the economy-wide wage gap in Korea. Besides, the SAM assumes that 50 percent of the wage gap is attributed to gender discrimination (see Section 2). Figure 3 shows that women have higher shares in household production (both care and other) and non-household care services than men indicating that the former spend more time in these activities. On the other hand, they have lower shares compared to men in non-care GDP production, while the share for leisure is about the same.

[12] Results of the sensitivity tests are provided in Annex C.

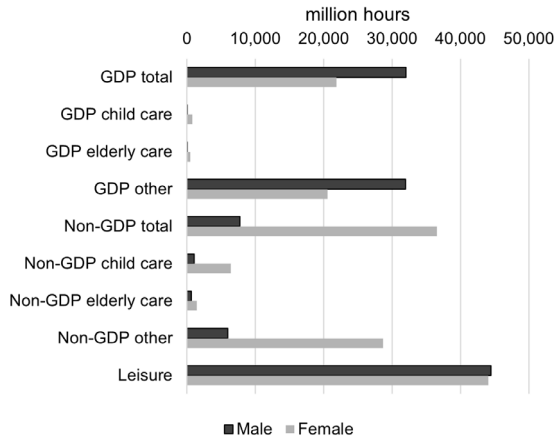
[13] For example, due to variations in the marginal utilities (or disutilities) of different types of time use (independent of what is viewed as being produced), spending time with a child may be very different from harsh physical work. Different time uses may also vary in terms of job security, status, and risk of injury, something that may end up with workers accepting to allocate time to activities with large differences in marginal value products.

FIGURE 2. Relative wages (female wage in GDP elderly care = 1)



Source: GEM-Care Korea database.

FIGURE 3. Base year: Time use for males and females (million hours)



Source: GEM-Care Korea database.

5. Simulation analysis

The simulations conducted in our study analyze the impact of expanded public child and elderly care, reduced female wage discrimination, increased wages for care workers, and an increase in the fertility rate. The latter is due to policy actions that would make it more attractive for women to work outside the home and easier for families to raise children.

5.1. Scenario definitions

In the analysis, we compare the results for a 2018-2030 base (or business-as-usual) scenario to scenarios in which different shocks are introduced. In all simulations, the model is calibrated to exactly replicate the detailed dataset for 2018. Moreover, for 2019-2021, it imposes what is known about the evolution of relevant government policies (particularly care policies) and growth in GDP at factor cost; the latter is exogenous for the base scenario but not for the other scenarios.[14] The exogenous GDP data are based on IMF [2020], including a projected annual growth rate of 2.6 percent for 2021-2030. The model also rests on several assumptions. First, the base scenario assumes that the 2021 policy regime will remain in place during the period 2022-2030. Moreover, it assumes (a) that the share of the elderly population that benefits from the LTCI is constant at the 8.0 percent level reached in 2017, and (b) that government spending per child stays constant at the values registered in 2018 (see Section 2).

The non-base scenarios start to diverge from the base in 2022, due to the imposition of policy changes. The fiscal space needed to balance government spending and receipts is created via a scaling of the rates for income taxes paid by households and enterprises. The list of different simulations is given in Table 4.

TABLE 4. Scenario definitions

Name	Description
base	business as usual 2018-2030
gspnd-c	in each year 2022-2030, government spending on child care exceeds the base level by 0.15% of base GDP
gspnd-e	same increase in government spending as for spnd-c but directed to elderly care
wcare+	50% decrease in the difference between average wage and the wage of care workers during 2022-2030
wgap-	50% gradual decrease in gender wage gap during 2022-2030
fert+	20.6% increase in fertility rate during 2022-2030, from 1.08 to 1.31
combi	combination of all previous scenarios

Source: Authors' elaboration.

As noted in Section 2, the government has put in place a program of universal childcare support. However, the level of satisfaction among service users is low and the working conditions of nursery teachers are poor [Kim 2017]. Compared to other OECD countries, the children-to-teacher ratio is much higher. For example,

[14] Technically, for the *base* scenario, the variable GDP at factor cost is fixed at the projected levels while, at the same time, the model has an endogenous variable that, in each year, scales TFP in selected production activities so that the exogenous GDP level is generated. For the *non-base* scenarios, this setting is reversed: GDP at factor cost is endogenous and the TFP scaling variable exogenous, *fixed at the levels generated by the base scenario*. The point in *italics* is important: this means that the results for the non-base scenarios are no different if the only change is a switch from exogenous to endogenous GDP. However, given that other shocks are introduced, the GDP level (and other results) will deviate from the base.

for children aged three, Korea's children-to-teacher ratio is 15:1 compared to 8:1 for the UK. In scenario gspnd-c, we increase government spending on care per child. This applies both to public and private services and assumes that more spending is needed to raise the quality of childcare. Specifically, the increase in government spending would be sufficient to cover a doubling of wages of childcare employees as stated in the guidelines provided by the Ministry of Health and Welfare. More precisely, we simulate an increase in the in-kind transfers of childcare services by the government to households with children, at no cost to the household but costing the government around 0.15 percent of GDP.[15] Alternatively, in-kind benefits for childcare increase by 26.3 percent on average for the period 2022-2030.

In the scenario gspnd-e, we impose the same increase in government spending as in the previous (gspnd-c) scenario, but in the form of in-kind government transfers of elderly care services to all households with elderly individuals provided at no cost. As a result, in-kind benefits for elderly care increase, compared to the base, by 18.4 percent on average for the period 2022-2030.

In 2019, the male median wage in Korea was 32.5 percent above the female median wage, a decline from a 39.6 percent gap ten years earlier. However, the Korean wage gap remains to be the largest among OECD countries, for which the average wage gap was 12.9 percent [OECD 2021]. In the scenario wgap-, the wage gap is gradually reduced to reach 16.25 percent in 2029, cutting the 2019 gap by half. If it is the case that roughly half of the wage gap in Korea is due to factors other than discrimination, as shown by Lee [2022], then this policy-induced shock corresponds to the elimination of the discriminatory male-female wage gap (see Section 2.3).

In Section 2, the low wage level for child and elderly care workers was also identified as a policy concern [Suh 2020]. To address this concern, the scenario wcare+ simulates an exogenous increase in the wage of care workers. Specifically, for each occupation category, we reduce the exogenous difference between the wage of care workers and the (endogenous) average wage for all labor in the economy by 50 percent. On average, this leads to a 19.2 percent increase in the wage of care workers compared to the base scenario.

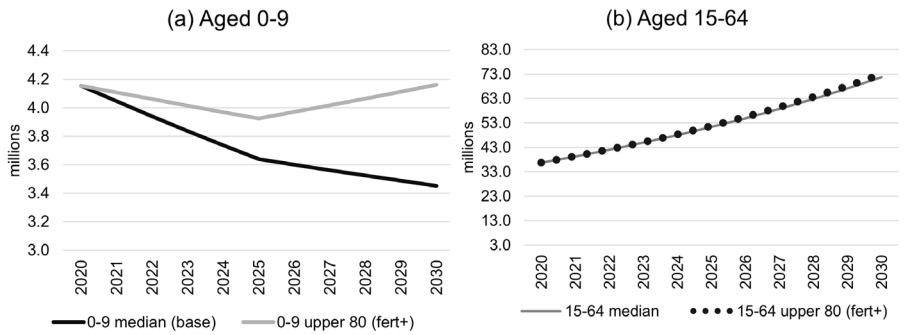
In the base scenario, population projections by age group correspond to the medium fertility variant in the UN World Population Prospects 2019 (see Figure 1).[16] In the fert+ scenario, we increase the fertility rate to the upper 80 percent of the prediction interval [UN 2019]. Figure 4 compares the population projections for the zero to nine and 15-64 age groups for fert+ and the base (and all other) scenarios. In 2030, the number of children aged zero to nine is 20.6 percent higher

[15] In 2019, total spending on childcare by the Ministry of Health and Welfare was equivalent to 0.29 percent of GDP with 20.8 percent representing wage payments.

[16] The medium fertility variant projection corresponds to the median of several distinct trajectories for the different demographic components [UN 2019]. In turn, prediction intervals reflect the spread in the distribution of outcomes across the projected trajectories.

in the fert+ scenario than in the base scenario but the impact on the 15-64 age group is minimal. This scenario assumes that government spending per child aged zero to five is kept constant at the base values; a larger child population, as a result, leads to higher government spending on childcare.

FIGURE 4. Population projections for children aged zero to nine and aged 15-64 in scenarios base and fert+ (millions)



Source: Author's elaboration based on UN [2019].

Finally, we simulate a scenario that combines the shocks of all non-base scenarios. In other words, Korea simultaneously raises spending on child and elderly care, eliminates male-female wage discrimination, increases the relative wage of care workers, and raises the fertility rate, with fiscal space provided by higher income taxes during the period 2022-2030.

5.2. Scenario analysis

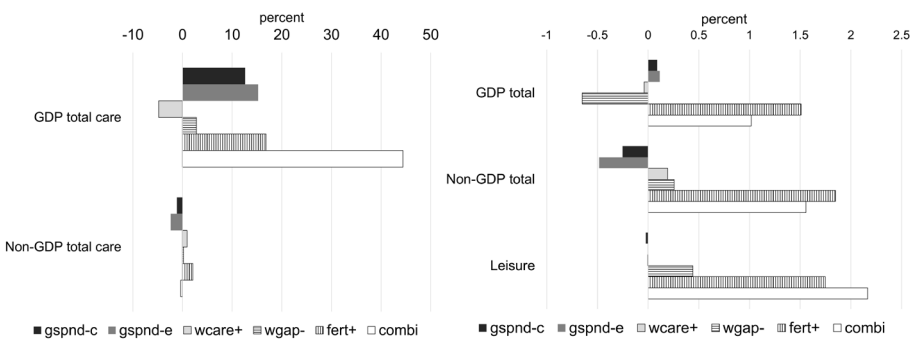
Figures 5-10 show selected simulation results. The result indicators focus on the last simulation year and cover the following indicators: time use shares and values (i.e., wage income or implicit value of time spent on household service production) that are disaggregated by gender and activity; household consumption disaggregated by item consumed; real value added disaggregated by activity; and the government budget. Annex B provides additional simulation results, both for base and non-base scenarios.

The results of the first two simulations, gspnd-c and gspnd-e, in terms of changes in time use shares for men and women are given in Figures 5 and 6. Although the direction of the changes in time use shares (i.e., the share in the total time of each gender) is similar for both groups, the changes are much larger for women since they spend considerably more time in child and elderly care work, both in the household and in the GDP (or paid) care sector. There is a reallocation of time spent from household work to GDP work, especially care work by both women and men. These changes in time use are driven by a switch in demand in response to the increase in transfers from government to households

in the form of paid child and elderly care services that makes the latter more attractive as substitute to household-provided care of children and elderly. For women, this leads to an increase in their time spent in GDP work by 0.6 and 1.1 percent in scenarios gspnd-c and gspnd-e, respectively. In terms of GDP care work, the increases are by 10.5 and 21.4 percent, respectively. The difference in magnitude reflects the fact that, in the base data set, elderly care pays lower wages for all labor categories. Moreover, elderly care is relatively intensive in the use of unskilled (low-wage) labor. For the same increase in government spending, the number of hired care workers is larger under the gspnd-e scenario than under the gspnd-c scenario, e.g., for men, the changes are roughly one-tenth the size. Overall, labor demand increases as a result of the expansion of paid child and/or elderly care services. In addition, wages for women increase since care activities are relatively intensive in female labor, while wages for men decrease. One consequence of the increase in paid work time is a small reduction in leisure time, especially for women.[17]

The changes in the valuation of time spent on GDP and non-GDP (household services and leisure) activities by gender are shown in Figure 7. This corresponds to paid labor income in the case of GDP and implicit wages in the production of household services such as child and elderly care for non-GDP. Given our study focus, we present the results disaggregated by gender. The pattern for labor income change is similar to the pattern for time use change. For the first two simulations, both male and female labor gain in GDP incomes, with the strongest gains for women (0.2 vs. 0.8 percent increase in the gspnd-c scenario, respectively). This is explained by the fact that child and elderly care are relatively intensive in female labor. For both gender groups, the total value (sum of GDP and non-GDP) also increases by 0.15 and 0.18 in gspnd-c scenario, respectively.

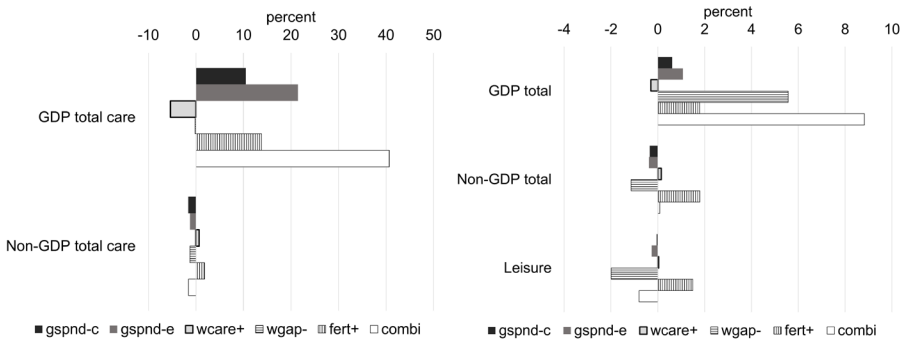
FIGURE 5. Time use – males in 2030 (percent change from base)



Source: GEM-Care Korea simulation results.

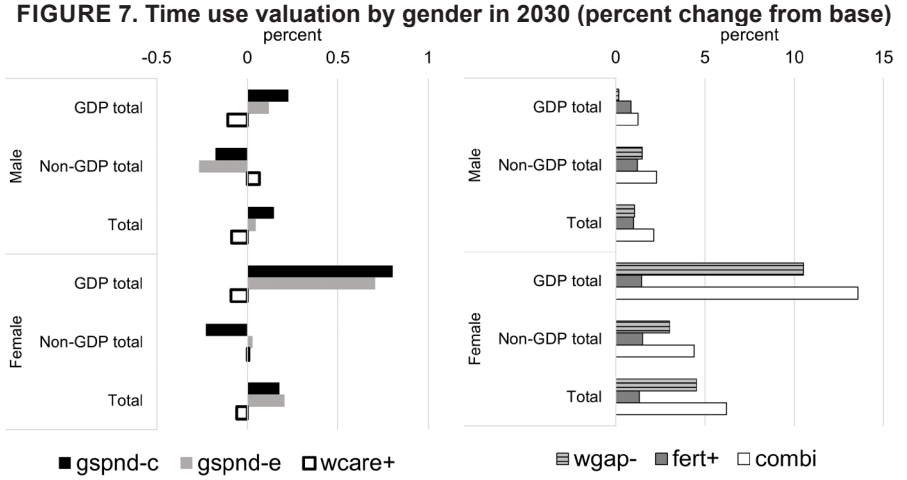
[17] These changes bring attention to the need to carefully consider the determinants of time spent on leisure, which are not only important in their own right but also influence the amount of time that is spent on other activities with impacts on the rest of the economy.

FIGURE 6. Time use – females in 2030 (percent change from base)



Source: GEM-Care Korea simulation results.

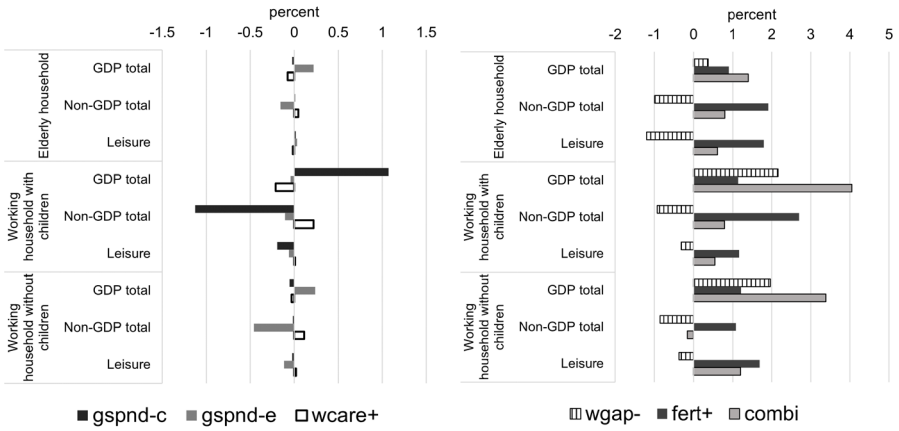
FIGURE 7. Time use valuation by gender in 2030 (percent change from base)



Source: GEM-Care Korea simulation results.

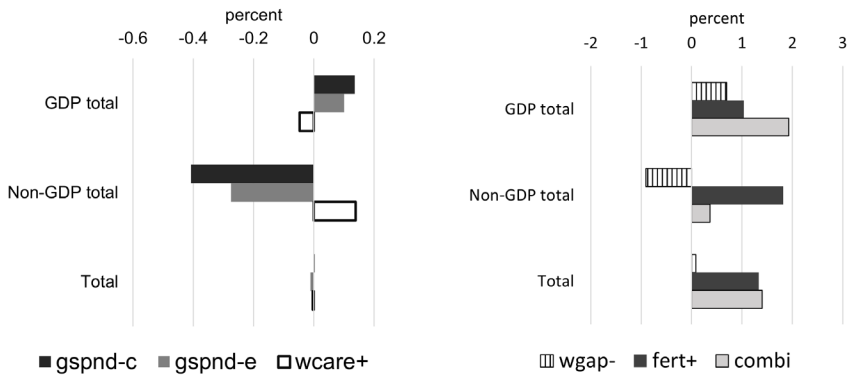
Figure 8 shows the changes in GDP, non-GDP, and leisure real household consumption. It should be noted that not all households benefit from the increase in government spending on child and elderly care. For instance, only the working household with children benefits in the gspnd-c scenario. Specifically, the increase in government spending on childcare leads to increases of 0.16 and 1.07 percent in total and GDP consumption, respectively. In turn, the non-GDP consumption decreases by 1.13 percent as time use is switched away from household service production. For the aggregate of all households, there is a net gain; given this, it may be possible to design redistributive policies such as adjustments in direct taxation for different household categories to ensure that all household groups gain. As shown in Figure 9, the changes in real value added by aggregate sector (0.13 percent increase for GDP and 0.41 decrease for non-GDP) match the preceding patterns of change, with a reallocation of labor time from non-GDP (household production and leisure) activities to GDP production activities.

FIGURE 8. Household consumption including leisure in 2030 (percent change from base)



Source: GEM-Care Korea simulation results.

FIGURE 9. Real value-added aggregates in 2030 (percent change from base)

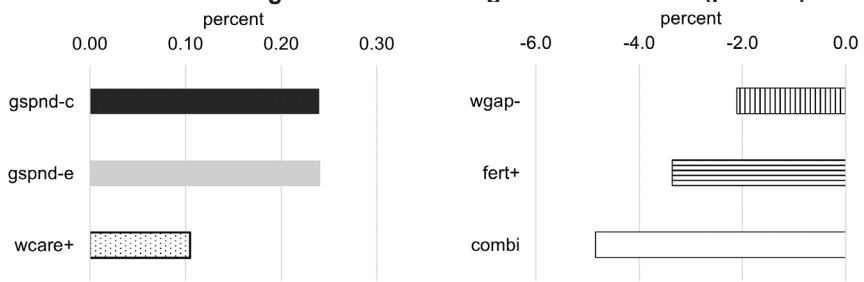


Source: GEM-Care Korea simulation results.

In the gspnd-e scenario, households with elderly persons and households without children gain in terms of their overall consumption. Interestingly, the two working households show a reduction in their transfer of unpaid care labor to the elderly household. Overall, there is a net gain in overall consumption for the household sector on the aggregate.

Finally, Figure 10 shows the change in the average income tax rate relative to the base. The gspnd-c and gspnd-e scenarios require a similar increase in income tax rates in the sense that the increase in government spending on in-kind care transfers is the same in both these scenarios. Specifically, the average income tax rate increases by 0.24 percent in both gspnd-c and gspnd-e scenarios.

FIGURE 10. Change from base average income tax rate (percent)



Source: GEM-Care Korea simulation results.

In the wcare+ scenario, we allow for an exogenous increase in the wage of all four categories of paid (GDP) care workers. Consequently, there is an increase in the supply price of child and elderly care of 7.2 and 11.2 percent, respectively. In Figures 5 and 6, this simulation shows opposite results compared to the first two simulations: time use shifts from GDP activities to household child and elderly care activities. In other words, an increase in wages for private caregivers has the expected effect of decreasing labor supply to GDP economic sectors. The change is larger for women than for men, 0.3 percent vs. 0.02 percent, respectively. Figure 7 shows that GDP income increases for both females and males by 0.09 and 0.11 percent, respectively, while the valuation of non-GDP increases by 0.01 and 0.07 percent, respectively, due to the increase in the supply and demand for unpaid care services. Figures 8 and 9 mimic these results in terms of household consumption and sectoral value-added, respectively.

In the first two scenarios described above, the impacts on the time use and labor incomes of men and women were qualitatively similar. However, as shown in Figure 5, compared to the base, elimination of wage discrimination (wgap- scenario) leads to time-use indicators moving in opposite directions for men and women: men decrease their time in GDP work by 0.65 percent and increase their time in non-GDP activities (leisure and production of household services); women increase their GDP time by 5.6 percent and decrease their time in non-GDP activities. Most of the increase in women's employment occurs in non-care GDP sectors such as agriculture and professional services.

The patterns of change in labor valuation (time use values), household consumption, and real value-added follow from the changes in time use. As indicated in Figure 7, female wages in GDP work increase by about 4.3 percent and, as a result, the value of female time in non-GDP activities also goes up, albeit to a lesser degree (by 3.0 percent). Hence, the total value of time for women increases by 4.5 percent. For men, the changes in time use move in the opposite direction. However, because men and women are complements in production, the total labor value of men still increases (by 1.0 percent). A possible consequence of these relative changes in female-male total labor values due to an increase in female market wage incomes is an increase in women's bargaining power and influence over household decisions.

As shown in Figure 8, the reallocation of time use in response to the elimination of wage discrimination leads to a net increase in total real household consumption by 0.2 percent. This gain in aggregate welfare results from an increase in consumption of GDP goods and services that offsets the slight decrease in consumption of household services. Specifically, relative to the base, private GDP and overall (GDP and non-GDP) consumption increase by 1.9 and 0.35 percent, respectively. Similarly, real value added is reallocated from household services and leisure to GDP production (Figure 9).[18] Among the households, real consumption increases for both groups with working-age members whereas the elderly household loses. In the last case, female family caregivers reduce their supply of non-GDP care services. In other words, the opportunity cost of providing non-GDP elderly care has gone up for the female members of the family.

In the fert+ scenario, we simulate an increase in the fertility rate that, by 2030, lead to increases by 20.6 percent in the population aged zero to nine and 1.7 percent in the labor force age population. The increase in the number of children aged zero to nine adds to the need for GDP and non-GDP childcare. Accordingly, in 2030, the total time spent on both GDP and non-GDP childcare increases by about 4.3 percent. Figures 5 and 6 show that both women and men increase their time devoted to childcare. For instance, women increase their GDP and non-GDP childcare time by 22.1 and 1.8 percent, respectively. Figure 8 shows that household consumption increases in all cases. However, for the working household with children, the increase in GDP consumption is smaller since it must devote additional labor time to childcare. The overall positive impact is explained by the increase in labor supply due to the increase in the population aged 15-64 (i.e., in the labor force age). In fact, this scenario shows a decrease in the income tax rates driven by the increase in GDP labor (and non-labor) incomes (see Figure 10).

6. Concluding remarks

Korea is facing multiple challenges related to care and gender, perhaps most importantly to meet the care needs of its rapidly growing elderly population, create the conditions that make it easier for its highly educated female population to participate in the labor force, and eliminate gender wage discrimination.

To better understand and address some of these challenges, this paper presents GEM-Care, a pioneering, care-focused, policy-oriented CGE model. It is also the first application of a gendered CGE model for Korea.

[18] Interestingly, the reduced gender wage gap has a negative impact on investment growth. In our simulation, this is because less female wage discrimination reduces capital rents and the incomes of enterprises, which are the institutions with the highest savings rate. Consequently, the initial positive impact on GDP may decline over time as the decrease in investment (and capital stocks) has a negative impact on growth. Complementary policies that encourage savings by both household and enterprises could reduce or eliminate this effect. It should also be noted that it is difficult to predict how a change like reduced female wage discrimination would impact savings rates.

GEM-Care is used to conduct simulations to examine the impact of several policy options on households with care responsibilities: (a) expanded government spending on child and elderly care, (b) reduced female wage discrimination, (c) increased wages for care workers, and (d) an increase in the fertility rate. Given the limited budgetary costs that are involved and the nature of the simulations, these options should be viewed as complementary, in the sense that there is nothing that prevents the government from pursuing interventions on all fronts. Regarding measures that can effectively reduce gendered wage discrimination, the experiences of other OECD countries may provide guidance [Rubery and Koukiadaki 2016].

The simulation results suggest that the policies analyzed in this paper can improve the conditions of households with care responsibilities, most importantly by freeing up time for women to take on jobs that are better paid and commensurate with their education and skills. However, the simulations also point to various trade-offs and suggest the need to consider complementary policy packages. For example, in the absence of increased government support for paid child and elderly care services outside the home, increased female wage work in the wake of reduced wage discrimination can lead to reduced care for children and elderly. While sensitivity analysis indicates that the results presented in the paper are robust to wide variations in elasticities, it is important to note that the size of adjustments depend on the flexibility of gender roles both in the household division of labor and in the broader labor market.[19] In other words, the size of the impacts of reforms that improve the incentives for women's work outside the home depend on the extent to which men take on a larger share of household chores and home-provided care. In addition, the results also depend on the extent to which women who enter the labor market are able to take on relatively high-wage jobs that currently are primarily held by men. If not, these women may end up putting downward pressure on wages in the relatively low-wage jobs that currently are dominated by women. Like the model parameters that capture wage discrimination, the elasticities of substitution between female and male labor in household and care work and market work reflect broader social and economic conditions. Ultimately, to effectively promote gender equality, the care and labor policies examined in this paper would require parallel actions by government and civil society that change the attitudes and laws that govern gender roles.

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[19] Sensitivity analysis results are available in Annex C.

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Annex A. Model structure

This annex provides additional detail on GEM-Care as applied to Korea.[20] Figure A.1 provides an overview of the structure of the payments covered by the static module of GEM-Care while Figures A.2 and A.3 show the nested structures for production and consumption that are at the core of the treatment of gender, care, and household production. The disaggregation of the database used for this paper is shown in Table 3 in the main text.

The major building blocks in Figure A.1 are activities (entities that carry out production), commodities (goods and services produced by activities and/or provided via imports), factors, and institutions (households, enterprises, the [general] government, and the rest of the world). In this figure, the arrows show the direction of payments. The payments to factors (factor services) and commodities are made in exchange for the right to use these factors and commodities. Some of the payments in the figure are only implicit, based on a market-related valuation of goods, services, and leisure that are not traded; such implicit payments are particularly important in applications that are extended to cover household services that are not part of GDP.

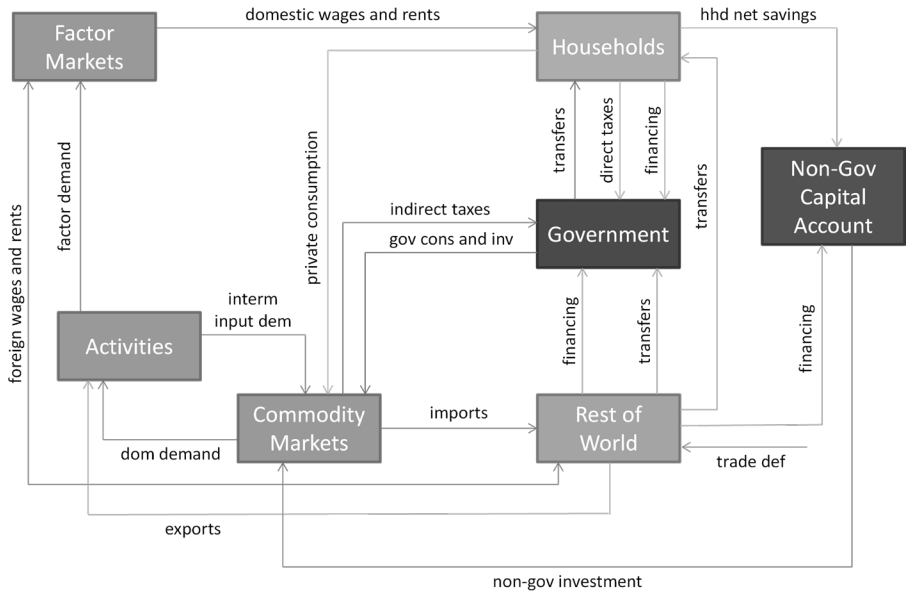
Most blocks in Figure A.1 are disaggregated, matching the disaggregation of the SAM that feeds data to the model. More specifically, given that this is an application to gendered care analysis, the factor, activity, and commodity blocks are disaggregated to capture gender and care aspects, and extended to cover both household and GDP production (cf. Table 3). Among the factors, this means that the labor components are disaggregated by gender and skill level. It is important to note that the term "labor" here refers to all time use that is covered by (and endogenous in) the model, including time spent on leisure and production within and beyond GDP. This should be seen as applying to the working age population, covering 24 hours per day net of time that in the context of the application is viewed as non-discretionary and left outside model and database. In our database for Korea, the time needed to satisfy basic needs for survival (like sleeping, eating, and personal hygiene) is non-discretionary along with time spent on education (as educational decisions are not endogenous to the model). Given the relatively detailed treatment of the financing of private investment (compared to most other CGE models), the private (non-government) capital account also has its own box.

Turning to the different blocks in Figure A.1 and their links, the activities are split into household and GDP subsets, with the former also including leisure (cf. Table 4). Across both subsets, each activity produces a commodity that is treated as having sales in (domestic) commodity markets and/or to the rest of the world (as exports). In empirical databases, government commodities tend not to have substantial export volumes. In the current database, private care services only have domestic sales, while the other private commodity has sales to both destinations; the split between the two depends on the relative sales prices in these

[20] For a more detailed model documentation, see Lofgren and Cicowiez [2021].

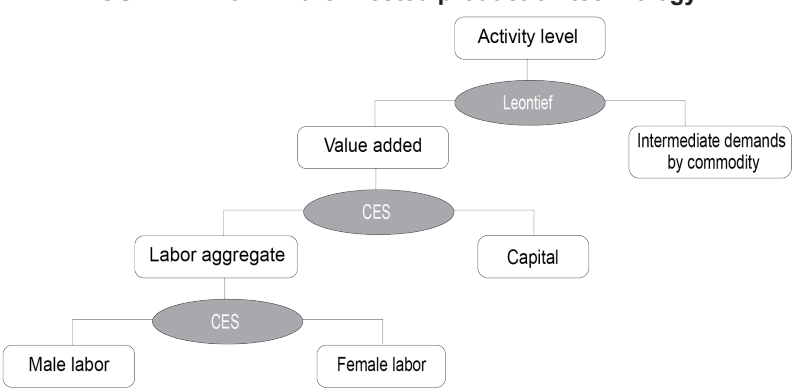
two destinations. The activities use their revenues to cover costs of intermediate inputs and to pay wages and rents to the factors that they employ.

FIGURE A.1. Overview of GEM-Care



Source: Authors' elaboration.

FIGURE A.2. GEM-Care: Nested production technology



Source: Authors' elaboration.

Figure A.2 shows the nested production technology, which applies to all activities (inside or outside GDP), which among other things is designed to make it possible to capture gendered time use. At the top level of the production nest, the activity (the level of which defines the output level) requires aggregate value-added and intermediate demands for different commodities on the basis

of Leontief technology (fixed input quantities per unit of activity). On the side of value added, Constant Elasticity of Substitution (CES) functions are used in a nested structure: at the top, the inputs are private capital and aggregate labor and, one level down, the latter is produced by male and female labor. GDP activities employ market labor while household activities employ labor from the household that consumes the output. For a given labor type, here male or female, time uses in GDP and household activities feed into the time constraint for the labor type.

The details of the technology are determined by the database. In the Korea database, only private GDP production has the full set of inputs. For other activities, the production technology is simplified to various degrees. Government GDP activities differ from private activities in that they do not have capital (private or government) in their value-added functions—according to the system of national accounts, government capital does not generate value-added. (However, in the background, the model makes sure that government investment is sufficient to ensure that the government capital stock grows at the same rate as government services.) As opposed to the GDP activities, household activities (services and leisure) are limited to labor inputs—due to a lack of data, intermediate inputs and investments are treated as part of household consumption. While household services use labor from both genders, the leisure activities, which are gender-specific, only use one labor type, i.e., for leisure activities, Figure A.2 in effect collapses to one input. In our case, the database not only disaggregates labor by gender but also by skill (see Table 3). Thus, additional nests are added to GDP and household service activities while the number of leisure activities increases so that there is one such activity per labor type.

Across all activities, profit maximization drives decisions regarding factor employment—factors are employed up to the point where the marginal value product equals the wage faced by the activity. Factor employment then determines the activity level and intermediate demands. The exact implications of this vary depending on the structure of input use, the demand structure, and elasticities of substitution between factors. Within private GDP production, the activities may have a relatively high degree of flexibility since agents decide on the output level and factor hiring in light of prices, wages, and rents. For government activities, the flexibility is limited to the combination of labor factors to use since the output level in practice is decided by government policies as long as the government is the predominant demander. Within household services, as a consequence of profit maximization, the labor mix responds to relative wage changes and prices; the latter depends on the price of alternative supply sources. To exemplify, ceteris paribus, higher female wages and lower prices for market care would on the margin shift the labor mix from women to men and reduce the level service output for the household. For leisure activities, since only one input is used, the only decision to make concerns the level, determined by household demand, which is influenced by the price (wage) and the income elasticity.

The factor demands are channeled to factor markets. At the aggregate level, for all factors, the demand curves slope downward, reflecting production activity responses to changes in wages and rents while, within the single time period, the supply is fixed, represented by a vertical supply curve. Flexible wages and rents clear these markets via demand-side adjustments. For labor, this means that there is no explicit reference to unemployment. This follows naturally from the fact that labor here refers to an exogenous quantity of time the allocation of which is endogenous within the model. Time that in other context would have been spent in unemployment (time supplied to GDP work but not employed) is here explicitly allocated to other uses (leisure or work in non-GDP activities).[21]

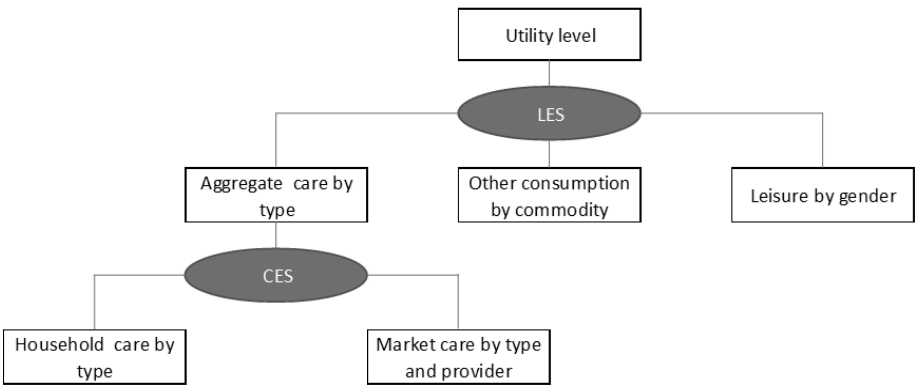
In GEM-Care, the treatment for wage discrimination against women is based on the canonical approach of Becker [1971]. Specifically, he proposed a model of "taste discrimination" according to which an aversion felt by employers, clients, or other workers toward persons belonging to certain groups may constitute a source of discrimination and leads to lower wages for discriminated workers. GEM-Care implements this approach; to the best of our knowledge, this is the first time this is done in a CGE model. This requires a modified treatment of producer hiring decisions and the definition of sectoral factor incomes so that they are based on an erroneous assessment of the marginal productivities for identified labor categories. The essence of the adjustment is that the labor hiring decisions of activities may be influenced by a discrimination rate that, if positive, leads to a perceived marginal cost of hiring a certain labor type that exceeds the wage that actually is paid. The rate is defined by labor type and activity, i.e., for any labor type, it may apply to different degrees to different activities and be totally absent from some. For the producer, this reduces profits. For labor types that face discrimination, the demand curve and wages decline—discrimination functions like a tax. However, as opposed to a labor tax, what may be termed labor discrimination revenue is not passed on to the government but stays inside the activity; this is accomplished by adding this virtual revenue to the income of private capital. (Lofgren and Cicowiez [2023] presents the firm model that underpins the representation of discrimination in GEM-Care.)

Among the institutions, the household earns incomes from factors, (net) transfers from the government, and (net) transfers from the rest of the world.[22] After paying direct taxes on market incomes (facing policy-determined rates), the household spends in fixed shares on aggregate commodity consumption (which is defined broadly to include not only GDP commodities but also non-GDP commodities and leisure) and savings. The allocation of consumption across commodities (with commodities that have both GDP and household supplies replaced by aggregates) is specified by Linear Expenditure System (LES) demand

[21] While the aggregate labor (or time) supply is vertical, the supply curve for GDP labor is upward sloping—other things being equal, a higher wage in GDP activities leads to a reallocation of time to these activities.
[22] In Figure A.1, transfers are implicitly netted (since they only go in one direction) and may therefore be negative. In the model and its database, it is possible to include transfers in both directions.

functions derived from utility maximization. After deducting net financing of the government and of changes in foreign reserves, household savings are used to finance private investment.

FIGURE A.3. GEM-Care: Nested structure of household consumption



Source: Authors' elaboration.

The treatment of household services is of particular importance to the current application. Both household production and consumption are treated as part of a general structure that has been enriched to meet the needs of the current analysis. More specifically, each household service is produced by a production activity that uses household labor and supplies its output for use by the household that provides the labor. In terms of Figure A.1, these services are viewed as being passed on from the household activities to the (domestic) commodity market for private consumption by the labor-providing household. To capture household choice between household and market supply sources, the household consumption structure was extended to have two levels (Figure A.3). At the top, it has an LES function that, in addition to commodities from the market includes aggregates of the services that have both household and market supplies; at the bottom, a CES function was added to split the demands for these aggregates into demands from these two supply sources, which depend on relative prices. On the supply side, if the only input in the production of a household service is labor (which is the case in the current database and a treatment that is likely to stay in the absence of data on the use of other inputs), the imputed sales revenue is identical to the imputed income earned by household labor.[23] The second extension, already described, is the production side nesting of selected factor demands (here male and female labor), making it possible to capture gender issues in time use across the economy, including household services. The fact that household services and gender issues are part of the general structure has the double virtue of making it

[23] The latter statement is not true if the household service uses intermediate inputs; if so, the labor income falls short of the sales revenue.

possible to enrich the model considerably with only a minor cost in complexity at the same time as the extensions that are introduced also can be employed in other areas.[24] In addition, GEM-Care allows modeling the interhousehold transfers in the form of unpaid care labor. To that end, the model allows using transfers to compensate for the fact that child (elderly) care is only "consumed" by households with children (elderly), even when it is produced by other households.

The government (as an institution, not as a producer of services, which is covered by one or more production activities) gets its receipts from taxes, transfers from abroad, and net financing from households and the rest of the world. It uses these receipts for transfers to households, consumption, and investment (to provide the capital stocks required for government services). To remain within its budget constraint, it either adjusts some part(s) of its spending on the basis of available receipts or mobilizes additional receipts to finance its spending plans. This treatment implies that government capital spending (investment) is funded within the overall government budget. In addition, GEM-Care makes it possible to consider transfers from the government to the households in the form of care services. To that end, the model introduces (a) a phantom tax that permits exogenization of household consumption of care services provided by the government, and (b) a matching transfer from the government to the households that covers the cost of care services provided by the government. Thus, it is possible to consider changes in transfers from the government to the households in the form of care services.

The non-government capital account collects funding to private investment from different sources: household (domestic private) savings net of financing of the government is augmented by financing from the rest of the world (made up of foreign direct investment [FDI] and foreign lending net of interest to the private sector). This funding is passed on to investment demand (i.e., demand for commodities used to construct new capital stock). In the current application, the account is balanced via adjustments on investment spending (and demand) driven by the availability of funding.

In the commodity markets, flexible prices ensure a balance between demands for domestic output from domestic demanders and supplies to the domestic market from domestic suppliers. Imports and exports are present for a commodity if the SAM (base-year) data has a positive value for these flows. Domestic demands are directed to domestic output and imports (if present); the ratio between demands for imports and domestic output depends on the ratio between the demander prices for commodities from these two sources—an increase in the import/domestic price ratio lowers the ratio between the demands for imports and domestic output

[24] A nesting of consumption demands is relevant whenever the analysis is focused on choices between alternative means of satisfying a more general need. (To exemplify, transportation needs may be satisfied using alternative means of transportation.)

(and vice versa).[25] Similarly, part of the domestic supplies are exported (if exports are observed in the SAM); the domestic producer allocation of output between the domestic market and exports depends on the ratio between the prices offered. For both exports and imports, the application follows the small-country assumption that international prices are exogenous.[26] The balance in the domestic market interacts with the determination of imports and exports—in the case of excess demand in the domestic market, a price increase reduces the quantity demanded (in part via a demand switch to imports) and raises the quantity supplied (in part via a supply switch away from exports).

The complexity of the response mechanisms varies across commodities. In general, in the domestic markets for domestic output, both the demand and supply sides respond to price changes. The market for the government commodity is an exception since here the demand is a policy tool that may not respond to price changes. These mechanisms are also simpler for commodities that do not have exports and/or imports. For commodities without foreign trade in either direction, only domestic demand and supply responses are relevant. Within this structure, household services (like childcare provided by female family members) are part of private commodity production for the domestic market. Like other private commodities, their prices are flexible, balancing quantities supplied and demanded. To exemplify, other things being equal, the price of household care would increase if female wages outside the home increase (leading to a leftward shift in the supply curve for the service due to a cost increase) and/or if there is an increase in the price of market substitutes to family-provided care (leading to a rightward shift in the demand curve). (The above-mentioned nesting of household consumption demand assures that these responses are present.)

Finally, the rest of the world receives and makes the payments that appear in the balance of payments. As shown in Figure A.1, imports are represented by payments from commodity markets to the rest of the world while exports appear in the form of payments from the rest of the world to activities. (As noted, commodities differ in terms of whether they are marketed domestically and/or abroad.) Foreign wages and rents are the only non-trade payments to the rest of the world. The non-trade payments received from the rest of the world are net transfers and financing to government and the private sector—each of these payment flows may be negative. Private investment financing from abroad also includes foreign investment other than FDI. The import and export responses to relative price changes, described in the preceding paragraph, underpin the clearing mechanism for the balance of payments: changes in the real exchange rate (the ratio between international and domestic price levels, which may change due to changes in the nominal exchange

[25] The demander prices are affected by taxes, subsidies, and transport margins—the latter are not explicit in the current database.

[26] Both for imports and exports, the model offers the option of endogenizing prices (in foreign currency) using constant-elasticity demand and supply functions, respectively.

rate) influence export and import quantities and values. For example, other things being equal, an exchange rate depreciation may eliminate a balance of payments deficit by raising the export quantity and reducing the import quantity (and vice versa for an appreciation).

Over time, production growth is determined by growth in factor employment and changes in total factor productivity (TFP). Growth in capital stocks is endogenous, depending on investment and depreciation. For other factors, the growth in employable stocks is exogenous. For labor and natural resources (with sector-specific factors for natural-resource-based sectors), the projected supplies in each time period are exogenous. For natural resources, they are closely linked to production projections. For labor, the projections reflect the evolution of the population in labor-force age and labor force participation rates. The unemployment rate for labor is endogenous. TFP growth is made up of two components, one that responds positively to growth in government infrastructure capital stocks and one that, unless otherwise noted, is exogenous.

Annex B. Additional base-year data and simulation results

TABLE B.1. Labor, value-added, trade, and consumption elasticities

Sector	Labor	VA	Arming-ton	CET	LES-price	Cons-Source
Agriculture	0.90	0.25	2.00	2.00	-1.00	n.a.
Mining	0.90	0.20	2.00	2.00	-1.00	n.a.
Manufacturing	0.90	0.95	1.50	1.50	-1.00	n.a.
Electricity and gas	0.90	0.95	0.80	0.80	-1.00	n.a.
Water	0.90	0.95	0.80	0.80	-1.00	n.a.
Construction	0.90	0.95	0.80	0.80	-1.00	n.a.
Trade	0.90	0.95	0.80	0.80	-1.00	n.a.
Transport	0.90	0.95	0.80	0.80	-1.00	n.a.
Hotels and restaurants	0.90	0.95	0.80	0.80	-1.00	n.a.
Information and comm	0.90	0.95	0.80	0.80	-1.00	n.a.
Finance and insurance	0.90	0.95	0.80	0.80	-1.00	n.a.
Real estate	0.90	0.95	0.80	0.80	-1.00	n.a.
Prof, scientific and tech ser	0.90	0.95	0.80	0.80	-1.00	n.a.
Administ and support ser	0.90	0.95	0.80	0.80	-1.00	n.a.
Public administration	0.90	0.95	0.80	0.80	-1.00	n.a.
Education	0.90	0.95	0.80	0.80	-1.00	n.a.
Health	0.90	0.95	0.80	0.80	-1.00	n.a.
Other social care	0.90	n.a.	n.a.	n.a.	-0.85	n.a.
Other private services	0.90	n.a.	n.a.	n.a.	-0.85	n.a.

TABLE B.1. Labor, value-added, trade, and consumption elasticities (continued)

Sector	Labor	VA	Arming-ton	CET	LES-price	Cons-Source
Priv subst for hhd non-care ser	0.90	n.a.	n.a.	n.a.	-0.85	n.a.
Priv care of elderly	0.90	n.a.	n.a.	n.a.	-0.85	n.a.
Priv care of children	0.90	n.a.	n.a.	n.a.	-0.85	n.a.
Child care, non-GDP	0.50	n.a.	n.a.	n.a.	n.a.	n.a.
Elderly care, non-GDP	0.50	n.a.	n.a.	n.a.	n.a.	n.a.
Non-care, non-GDP	0.50	n.a.	n.a.	n.a.	n.a.	n.a.
Composite, child care	n.a.	n.a.	n.a.	n.a.	-0.50	1.50
Composite, elderly care	n.a.	n.a.	n.a.	n.a.	-0.50	1.50
Composite, non-care	n.a.	n.a.	n.a.	n.a.	-0.50	1.50
Leisure, male	n.a.	n.a.	n.a.	n.a.	-0.85	n.a.
Leisure, female	n.a.	n.a.	n.a.	n.a.	-0.85	n.a.

Note:
VA = CES value-added function
Armington = CES aggregation function for domestic demand (elasticities of substitution between imports and domestic output);
CET = Constant Elasticity of Transformation function for domestic output (elasticities of transformation between exports and domestic supply)
LES-price = Linear Expenditure system (elasticities of household consumption with respect to own-price) for the household
Cons-Source=consumption source; household can decide between consuming the same (care) service from different sources (private, government, own-production).

TABLE B.2. Korea: sectoral structure and export and import intensities in 2018 (percent)

Sector	VAshr	PRDshr	EMPshr	EXPshr	EXP-OUTshr	IMPshr	IMP-DEMshr
Agriculture	1.91	1.49	1.74	0.09	1.12	1.81	16.58
Mining	0.12	0.11	0.09	0.02	3.05	19.82	97.06
Manufacturing	29.05	43.14	21.21	87.65	36.11	64.42	28.43
Electricity and gas	1.34	2.30	0.58	0.01	0.06	0.02	0.13
Water	0.75	0.56	0.67	0.06	1.99	0.00	0.10
Construction	5.92	6.05	9.23	0.02	0.07	0.00	0.00
Trade	7.82	6.39	9.78	0.48	1.34	0.43	1.28
Transport	3.35	3.66	4.08	4.45	21.60	2.94	16.24
Hotels and restaurants	2.86	3.69	4.67	1.33	6.39	2.49	12.02
Information and comm	4.57	3.51	3.45	1.22	6.19	1.05	5.52
Finance and insurance	5.91	4.23	4.60	0.56	2.34	0.41	1.83
Real estate	7.67	4.87	1.91	0.04	0.14	0.19	0.74

TABLE B.2. Korea: sectoral structure and export and import intensities in 2018 (percent) (continued)

Sector	VAshr	PRDshr	EMPshr	EXPshr	EXP-OUTshr	IMPshr	IMP-DEMshr
Prof, scientific and tech ser	6.23	5.18	8.35	2.12	7.28	3.01	10.62
Administ and support ser	3.55	2.17	3.99	1.65	13.56	2.17	18.04
Public administration	6.58	3.60	7.54	0.00	0.02	0.08	0.44
Education	4.09	2.39	6.65	0.02	0.18	0.29	2.22
Health	3.66	2.94	4.79	0.05	0.32	0.05	0.30
Other social care	0.75	0.50	1.37	0.00	0.07	0.01	0.24
Other private services	2.57	2.42	3.51	0.20	1.46	0.82	6.09
Priv subst for hhd non-care ser	0.13	0.05	0.25	0.00	0.00	0.00	0.00
Priv care of elderly	0.91	0.56	1.17	0.00	0.00	0.00	0.00
Priv care of children	0.26	0.16	0.37	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	17.77	100.00	18.10

Note:
VAshr = value-added share (%)
PRDshr = production share (%)
EMPshr = share in total employment (%)
EXPshr = sector share in total exports (%)
EXP-OUTshr = exports as share in sector output (%)
IMPshr = sector share in total imports (%)
IMP-DEMshr = imports as share of domestic demand (%)
Source: GEM-Care Korea database.

TABLE B.3. Korea: sectoral factor intensity in 2018 (percent)

Sector	Labor, male, high edu	Labor, female, high edu	Labor, male, low edu	Labor, female, low edu	Capital	Land	Extractive resources	Total
Agriculture	10.88	0.81	18.97	15.04	12.97	41.34	0.00	100.00
Mining	7.17	1.02	25.02	5.76	50.48	0.00	10.56	100.00
Manufacturing	17.41	2.65	15.16	4.85	59.93	0.00	0.00	100.00
Electricity and gas	18.29	2.06	3.30	0.70	75.65	0.00	0.00	100.00
Water	22.42	2.96	19.22	2.29	53.11	0.00	0.00	100.00
Construction	33.89	3.22	48.52	2.54	11.83	0.00	0.00	100.00
Trade	28.04	11.03	16.13	11.34	33.46	0.00	0.00	100.00
Transport	24.02	4.67	34.10	3.63	33.59	0.00	0.00	100.00
Hotels and restaurants	14.07	8.39	20.36	42.82	14.37	0.00	0.00	100.00
Information and comm	30.72	6.90	2.93	1.15	58.29	0.00	0.00	100.00
Finance and insurance	23.57	8.88	4.41	5.14	58.00	0.00	0.00	100.00

TABLE B.3. Korea: sectoral factor intensity in 2018 (percent) (continued)

Sector	Labor, male, high edu	Labor, female, high edu	Labor, male, low edu	Labor, female, low edu	Capital	Land	Extractive resources	Total
Real estate	4.30	1.19	4.40	1.95	88.16	0.00	0.00	100.00
Prof, scientific and tech ser	53.99	12.63	3.53	1.78	28.06	0.00	0.00	100.00
Administ and support ser	17.05	6.03	23.43	14.96	38.52	0.00	0.00	100.00
Public administration	34.83	12.24	12.43	3.84	36.65	0.00	0.00	100.00
Education	38.09	46.30	3.30	5.38	6.92	0.00	0.00	100.00
Health	20.84	35.90	2.04	10.10	31.12	0.00	0.00	100.00
Other social care	18.49	32.30	4.80	43.77	0.64	0.00	0.00	100.00
Other private services	25.20	13.80	18.32	14.08	28.60	0.00	0.00	100.00
Priv subst for hhd non-care ser	0.00	7.22	0.65	92.13	0.00	0.00	0.00	100.00
Priv care of elderly	5.55	59.14	0.25	6.07	29.00	0.00	0.00	100.00
Priv care of children	2.03	9.11	2.13	57.73	29.00	0.00	0.00	100.00
Total	0.00	16.05	0.00	83.95	0.00	0.00	0.00	100.00

Source: GEM-Care Korea database.

TABLE B.4. Time use by gender in 2030 (level for base and percent change from base for non-base)

	base*	gspnd-c	gspnd-e	wcare+	wgap-	fert+	combi
Male							
GDP total	5.57	0.09	0.12	-0.04	-0.65	1.51	1.02
GDP child care	0.01	17.34	0.07	-3.03	2.95	22.81	41.92
GDP elderly care	0.00	0.00	55.51	-9.53	2.31	0.96	50.93
GDP total care	0.01	12.59	15.24	-4.81	2.77	16.83	44.39
GDP other	5.56	0.06	0.08	-0.03	-0.66	1.48	0.92
Non-GDP total	1.27	-0.25	-0.48	0.19	0.26	1.85	1.56
Non-GDP child care	0.15	-2.00	-0.02	0.38	0.37	2.06	0.93
Non-GDP elderly care	0.11	-0.01	-5.53	1.68	-0.08	2.07	-2.16
Non-GDP total care	0.26	-1.15	-2.37	0.94	0.18	2.06	-0.39
Non-GDP other	1.00	-0.02	0.02	0.00	0.28	1.79	2.07
Leisure	7.47	-0.02	0.00	0.00	0.44	1.75	2.17
Total	14.30	0.00	0.00	0.00	0.00	1.66	1.66
Female							
GDP total	3.42	0.62	1.07	-0.30	5.57	1.78	8.82

TABLE B.4. Time use by gender in 2030 (continued)

	base*	gspnd-c	gspnd-e	wcare+	wgap-	fert+	combi
GDP child care	0.12	17.19	-0.01	-2.90	-0.16	22.12	36.71
GDP elderly care	0.08	0.01	54.94	-9.19	-0.17	0.79	46.85
GDP total care	0.20	10.48	21.44	-5.36	-0.16	13.80	40.67
GDP other	3.22	0.01	-0.17	0.01	5.92	1.05	6.88
Non-GDP total	5.20	-0.34	-0.37	0.15	-1.14	1.80	0.08
Non-GDP child care	0.81	-2.05	-0.11	0.41	-1.21	1.82	-1.02
Non-GDP elderly care	0.22	-0.03	-5.37	1.61	-1.48	1.96	-3.55
Non-GDP total care	1.03	-1.61	-1.24	0.67	-1.27	1.85	-1.57
Non-GDP other	4.17	-0.03	-0.16	0.02	-1.11	1.79	0.49
Leisure	6.58	-0.05	-0.26	0.04	-1.99	1.49	-0.80
Total	15.20	0.00	0.00	0.00	0.00	1.66	1.66

*Hours per day.
Source: GEM-Care Korea simulation results.

TABLE B.5. Time use valuation by gender in 2030 (level for base and percent change from base for non-base)

	base*	gspnd-c	gspnd-e	wcare+	wgap-	fert+	combi
Male							
GDP total	880.4	0.23	0.12	-0.11	0.18	0.85	1.24
GDP child care	1.2	17.50	0.11	-0.01	4.02	22.00	45.77
GDP elderly care	0.3	0.14	55.55	1.60	3.53	0.31	62.21
GDP other	878.9	0.20	0.10	-0.11	0.17	0.82	1.16
Non-GDP total	102.7	-0.18	-0.26	0.07	1.47	1.20	2.30
Non-GDP child care	15.4	-1.87	0.02	0.30	1.47	1.39	1.43
Non-GDP elderly care	5.7	0.13	-5.49	1.59	1.15	1.42	-1.53
Non-GDP other	81.6	0.12	0.05	-0.08	1.50	1.15	2.73
Leisure	1,140.4	0.11	0.02	-0.08	1.67	1.09	2.80
Total	2,123.4	0.15	0.05	-0.09	1.04	1.00	2.13
Female							
GDP total	385.8	0.80	0.71	-0.09	10.53	1.44	13.56
GDP child care	13.4	17.52	0.12	-0.01	4.37	22.08	46.40
GDP elderly care	4.0	0.14	55.60	1.62	3.82	0.34	62.78
GDP other	368.3	0.20	0.13	-0.11	10.83	0.70	11.83
Non-GDP total	475.8	-0.23	0.03	0.01	3.01	1.52	4.37

TABLE B.5. Time use valuation by gender in 2030 (continued)

	base*	gspnd-c	gspnd-e	wcare+	wgap-	fert+	combi
Non-GDP child care	89.6	-1.82	0.10	0.28	3.13	1.67	3.49
Non-GDP elderly care	12.8	0.15	-5.05	1.48	2.63	1.65	0.54
Non-GDP other	373.5	0.14	0.19	-0.11	2.99	1.48	4.72
Leisure	701.5	0.11	0.05	-0.09	2.23	1.11	3.41
Total	1,563.1	0.18	0.21	-0.06	4.52	1.32	6.21

*Trillion KRW at 2018 prices.
Source: GEM-Care Korea simulation results.

TABLE B.6. Household consumption including leisure in 2030 (level for base and per cent change from base for non-base)

	base*	gspnd-c	gspnd-e	wcare+	wgap-	fert+	combi
Elderly household							
GDP total	102.7	-0.02	0.22	-0.07	0.37	0.90	1.40
GDP child care	0.0	0.00	0.00	0.00	0.00	0.00	0.00
GDP elderly care	0.7	0.01	23.04	-8.55	0.02	1.44	14.90
GDP other	101.9	-0.02	0.05	-0.01	0.38	0.90	1.30
Non-GDP total	96.1	0.01	-0.16	0.05	-1.00	1.91	0.80
Non-GDP child care	0.0	0.00	0.00	0.00	0.00	0.00	0.00
Non-GDP elderly care	8.0	0.00	-1.23	0.54	-1.15	1.88	0.06
Non-GDP other	88.1	0.01	-0.06	0.00	-0.98	1.91	0.86
Leisure	198.5	0.02	0.03	-0.02	-1.20	1.80	0.61
Total	494.5	0.01	0.02	-0.02	-0.79	1.65	0.86
Working household with children							
GDP total	308.3	1.07	-0.04	-0.21	2.17	1.15	4.05
GDP child care	29.7	13.2	0.0	-2.2	0.1	16.1	27.2
GDP elderly care	0.2	-0.05	47.90	-8.27	0.47	1.75	41.43
GDP other	278.3	-0.22	-0.08	0.01	2.38	-0.45	1.55
Non-GDP total	178.0	-1.13	-0.10	0.22	-0.93	2.69	0.80
Non-GDP child care	92.2	-2.0	-0.1	0.4	-1.0	1.8	-0.8
Non-GDP elderly care	2.5	-0.14	-1.71	0.44	-0.73	3.45	1.19
Non-GDP other	83.3	-0.14	-0.08	0.01	-0.86	3.62	2.51
Leisure	344.5	-0.19	-0.06	0.01	-0.31	1.17	0.55
Total	1,039.5	0.16	-0.06	-0.05	0.22	2.04	2.25

TABLE B.6. Household consumption including leisure in 2030 (continued)

	base*	gspnd-c	gspnd-e	wcare+	wgap-	fert+	combi
Working household without children							
GDP total	840.3	-0.05	0.24	-0.03	1.97	1.22	3.39
GDP child care	0.0	0.00	0.00	0.00	0.00	0.00	0.00
GDP elderly care	7.5	-0.01	41.48	-6.64	0.02	0.54	35.89
GDP other	832.8	-0.05	-0.13	0.03	1.99	1.23	3.10
Non-GDP total	225.8	-0.02	-0.46	0.11	-0.86	1.09	-0.16
Non-GDP child care	0.0	0.00	0.00	0.00	0.00	0.00	0.00
Non-GDP elderly care	5.5	-0.03	-13.12	3.75	-1.11	1.49	-9.76
Non-GDP other	220.4	-0.02	-0.15	0.02	-0.85	1.08	0.08
Leisure	1,036.3	-0.02	-0.12	0.02	-0.37	1.69	1.20
Total	2,336.1	-0.03	0.03	0.00	0.38	1.40	1.78

*Trillion KRW at 2018 prices.
Source: GEM-Care Korea simulation results.

Annex C. Sensitivity analysis

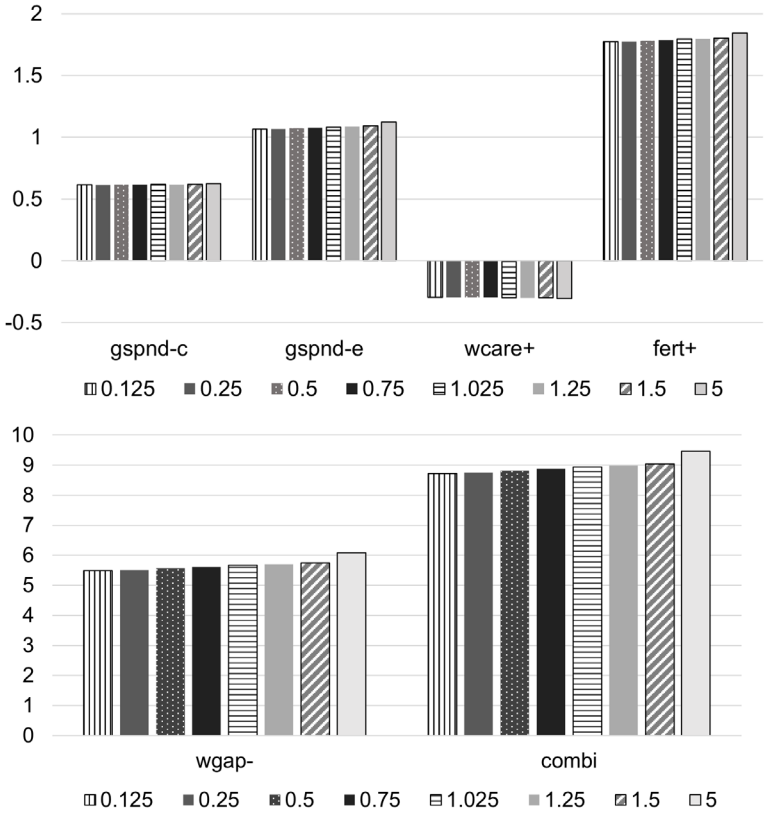
In economic simulation models, results depend on the values of the employed behavior and other parameters such as price and income elasticities. Therefore, it is often informative to analyze the sensitivity of results to selected parameter values. In this annex, we perform two sets of sensitivity analysis relative to our central case discussed in Section 5. Firstly, we test the sensitivity of our results to key elasticities. Secondly, we systematically test the sensitivity of our results to all elasticities simultaneously.

Piecemeal sensitivity analysis with respect to elasticities

In this section, we single out two key elasticities: (a) substitution between male labor and female labor in production functions, both GDP and non-GDP; and (b) substitution between GDP and non-GDP in consumption. The sensitivity analysis shows results when we change one elasticity while all other elasticities are kept unchanged. Figures C.1 and C.2 show the results and the key elasticities we consider in this Annex.

The gspnd-c and gspnd-e scenarios promote the consumption of GDP care services, which are intensive in the use of female labor. Thus, for these two scenarios, higher elasticities of substitution between men and women at home increases female labor supply to GDP activities (Figure C.1); as expected, this increase leads to reduced female wages. On the other hand, when we consider a higher elasticity of substitution between men and women not only in GDP but also in non-GDP activities, it diminishes the increase in female labor supply to GDP activities because of the smaller increase in female wages (Figure C.2).

FIGURE C.1. Sensitivity analysis with respect to elasticity of substitution between male and female workers in non-GDP production: Female GDP employment in 2030 (percent change from base)



Source: GEM-Care Korea simulation results.

FIGURE C.2. Sensitivity analysis with respect to elasticity of substitution between male and female workers in GDP and non-GDP production: Female GDP employment in 2030 (percent change from base)

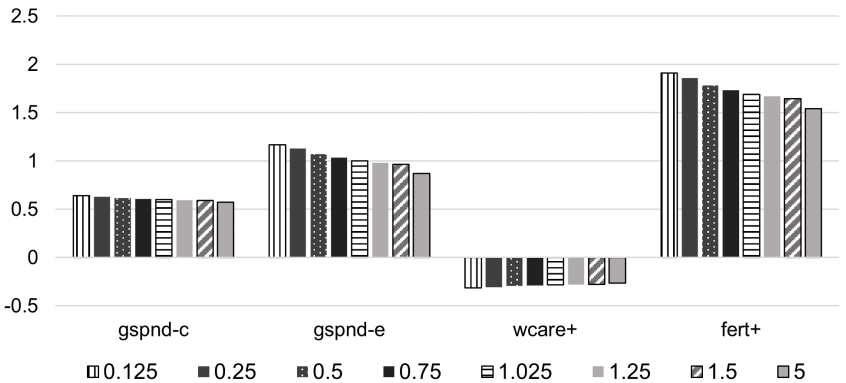
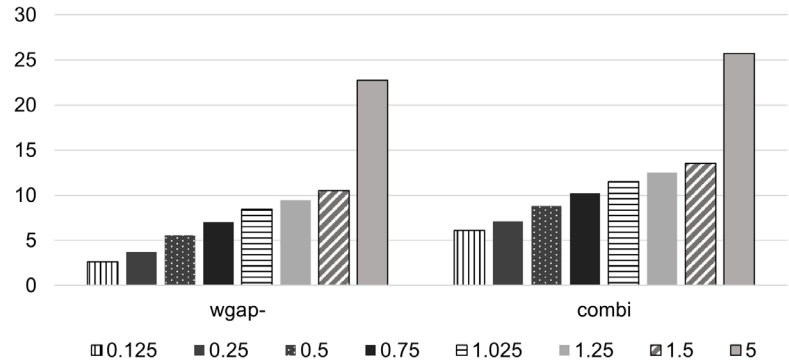


FIGURE C.2. Sensitivity analysis (continued)



Source: GEM-Care Korea simulation results.

In the wgap- scenario (i.e., reduced wage discrimination), our central case leads to an increase of 5.6 percent in female GDP work time (see Figure 6 in Section 5). Figure C.2 shows that, for the lowest elasticities tested, the increase is merely 2.6 percent and, for the highest elasticities tested, it is 22.7 percent.

Systematic sensitivity analysis with respect to elasticities

In this section, we analyze the sensitivity with regard to all model elasticities of simulated results for two major indicators: male and female GDP incomes, and time use changes (GDP, non-GDP, and leisure). To do so, we implement a variant of the method originally proposed by Harrison and Vinod [1992].

We assume that each model elasticity is uniformly distributed around the central value used to obtain the results presented in the main text. The range of variation allowed for each elasticity is +/- 75 percent; i.e., we consider a fairly wide range of variation for each model elasticity. The model is solved iteratively with different sets of elasticities. The resulting distribution of results is used to build confidence intervals for selected model results. The steps for the systematic sensitivity analysis are as follows:

1. The distribution (i.e., lower and upper bound) is computed for each model parameter that will be modified: elasticities of substitution between male and female labor both for GDP and non-GDP activities, elasticities of substitution between GDP and non-GDP care services, elasticities of substitution between primary factor of production, trade-related elasticities, and price elasticities for household demands.
2. The model is solved repeatedly, each time with a different set of elasticities following a Monte Carlo type procedure: First, the value for all model elasticities is randomly selected. Second, the model is calibrated using the selected elasticities. Third, the same counterfactual scenarios as previously described are conducted.

These three steps are repeated 1000 times, with sampling with replacement for the value assigned to the elasticities.

Table C.1 shows the percentage change in private consumption estimated (i) under the central elasticities, and (ii) as the average of the 1000 observations generated by the sensitivity analysis. For the second case, the upper and lower bounds under the normality assumption were also computed. All runs from the Monte Carlo experiment receive the same weight. As can be seen, the results reported in Figures 6 and 7 in the main text are within the confidence intervals reported in Table C.1 and Table C.2, respectively. For example, Table C.2 indicates that, if government spending on child care is expanded as in scenario gspnd-c, it is almost fully certain that the GDP income for female workers will increase between 0.33 and 1.39 percent. (In Table C.2, see the results for in the intersection between the row for Female, GDP Total, and the columns lower and upper bounds for gspnd-c.)

In other words, results given in Table C.1 and Table C.2 suggest that qualitatively, i.e., in terms of the direction of the changes for the key indicators that are shown, the results are robust to relatively large changes in the elasticities. However, as expected higher elasticity values lead to larger changes.

TABLE C.1. Systematic sensitivity analysis: 95 percent confidence interval under normality assumption for time use by gender in 2030 (percent change from base)

Male	gspnd-c				gspnd-e				wcare+			
	Mean	Std Dev	Lo bnd	Up bnd	Mean	Std Dev	Lo bnd	Up bnd	Mean	Std Dev	Lo bnd	Up bnd
GDP total	0.09	0.03	0.03	0.15	0.11	0.02	0.07	0.15	-0.04	0.01	-0.06	-0.01
GDP child care	17.98	5.11	7.96	28.00	0.08	0.06	-0.04	0.20	-2.88	1.00	-4.84	-0.92
GDP elderly care	0.01	0.05	-0.10	0.11	57.49	14.10	29.86	85.12	-9.19	2.62	-14.34	-4.05
GDP total care	12.99	3.59	5.96	20.02	15.83	3.64	8.69	22.96	-4.63	1.08	-6.75	-2.50
GDP other	0.06	0.02	0.01	0.11	0.08	0.02	0.04	0.12	-0.03	0.01	-0.05	-0.01
Non-GDP total	-0.23	0.09	-0.40	-0.05	-0.42	0.24	-0.90	0.05	0.19	0.09	0.02	0.36
Non-GDP child care	-1.82	0.89	-3.57	-0.06	-0.01	0.04	-0.10	0.07	0.38	0.26	-0.13	0.89
Non-GDP elderly care	-0.01	0.03	-0.06	0.04	-4.87	2.93	-10.62	0.87	1.70	0.97	-0.21	3.60
Non-GDP total care	-1.03	0.48	-1.97	-0.09	-2.07	1.24	-4.49	0.36	0.93	0.44	0.07	1.80
Non-GDP other	-0.02	0.03	-0.08	0.04	0.01	0.07	-0.12	0.14	0.00	0.01	-0.02	0.01
Leisure	-0.03	0.03	-0.08	0.02	-0.01	0.04	-0.09	0.07	0.00	0.01	-0.02	0.01
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Male	**wgap-**				**fert+**				**combi**			
GDP total	-0.65	0.24	-1.11	-0.18	1.52	0.27	0.98	2.06	1.03	0.39	0.26	1.80
GDP child care	3.13	1.18	0.82	5.43	22.24	2.62	17.11	27.38	42.51	8.24	26.37	58.65
GDP elderly care	2.36	0.65	1.07	3.64	0.99	0.41	0.19	1.79	53.26	15.92	22.05	84.46
GDP total care	2.91	0.87	1.20	4.62	16.37	1.82	12.81	19.93	45.32	7.45	30.73	59.92
GDP other	-0.65	0.24	-1.12	-0.19	1.49	0.27	0.95	2.03	0.94	0.39	0.17	1.70
Non-GDP total	0.28	0.31	-0.33	0.89	1.90	0.30	1.31	2.50	1.71	0.52	0.70	2.73
Non-GDP child care	0.44	0.60	-0.75	1.62	2.50	1.47	-0.39	5.39	1.57	1.75	-1.86	4.99
Non-GDP elderly care	-0.03	0.41	-0.82	0.77	2.09	0.30	1.49	2.68	-1.43	2.39	-6.11	3.26
Non-GDP total care	0.24	0.37	-0.49	0.96	2.30	0.87	0.60	4.00	0.29	1.40	-2.45	3.02
Non-GDP other	0.30	0.38	-0.44	1.04	1.81	0.34	1.15	2.46	2.09	0.55	1.01	3.18
Leisure	0.44	0.16	0.12	0.76	1.73	0.23	1.28	2.18	2.13	0.30	1.54	2.71
Total	0.00	0.00	0.00	0.00	1.66	0.00	1.66	1.66	1.66	0.00	1.66	1.66

TABLE C.1. Systematic sensitivity analysis (continued)

Female	gspnd-c				gspnd-e				wcare+			
	Mean	Std Dev	Lo bnd	Up bnd	Mean	Std Dev	Lo bnd	Up bnd	Mean	Std Dev	Lo bnd	Up bnd
GDP total	0.62	0.13	0.36	0.88	1.09	0.20	0.70	1.49	-0.29	0.07	-0.43	-0.14
GDP child care	17.81	5.00	8.02	27.60	-0.01	0.02	-0.04	0.02	-2.76	0.98	-4.67	-0.85
GDP elderly care	0.01	0.01	-0.02	0.03	56.81	13.76	29.84	83.77	-8.87	2.30	-13.39	-4.36
GDP total care	10.80	2.90	5.11	16.49	22.12	4.95	12.42	31.83	-5.16	1.12	-7.37	-2.96
GDP other	0.00	0.06	-0.12	0.11	-0.19	0.10	-0.40	0.01	0.01	0.01	-0.02	0.04
Non-GDP total	-0.32	0.09	-0.51	-0.14	-0.36	0.09	-0.53	-0.19	0.15	0.05	0.04	0.25
Non-GDP child care	-1.87	0.87	-3.57	-0.18	-0.12	0.05	-0.21	-0.02	0.40	0.26	-0.10	0.91
Non-GDP elderly care	-0.04	0.05	-0.15	0.06	-4.75	2.67	-9.99	0.49	1.63	0.90	-0.14	3.39
Non-GDP total care	-1.47	0.65	-2.74	-0.19	-1.11	0.55	-2.19	-0.02	0.66	0.28	0.11	1.22
Non-GDP other	-0.05	0.06	-0.16	0.07	-0.18	0.08	-0.34	-0.01	0.02	0.01	0.00	0.04
Leisure	-0.07	0.08	-0.22	0.08	-0.29	0.12	-0.53	-0.04	0.03	0.01	0.01	0.06
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Female	**wgap-**				**fert+**				**combi**			
GDP total	5.42	0.54	4.37	6.47	1.74	0.26	1.22	2.26	8.66	0.64	7.39	9.92
GDP child care	-0.10	0.32	-0.72	0.52	21.49	2.37	16.84	26.14	36.96	7.09	23.06	50.87
GDP elderly care	-0.18	0.27	-0.72	0.35	0.80	0.29	0.24	1.36	48.85	15.07	19.31	78.38
GDP total care	-0.13	0.22	-0.55	0.30	13.38	1.33	10.76	15.99	41.45	7.29	27.16	55.74
GDP other	5.76	0.57	4.64	6.88	1.03	0.28	0.48	1.58	6.65	0.61	5.45	7.86
Non-GDP total	-1.14	0.25	-1.62	-0.66	1.85	0.30	1.26	2.43	0.16	0.39	-0.61	0.92
Non-GDP child care	-1.19	0.39	-1.96	-0.43	2.23	1.41	-0.53	4.99	-0.49	1.60	-3.62	2.64
Non-GDP elderly care	-1.50	0.42	-2.32	-0.67	1.95	0.34	1.28	2.63	-2.97	2.11	-7.11	1.17
Non-GDP total care	-1.26	0.33	-1.91	-0.61	2.16	1.11	-0.02	4.33	-1.02	1.31	-3.59	1.54
Non-GDP other	-1.11	0.28	-1.66	-0.56	1.78	0.34	1.11	2.46	0.46	0.46	-0.45	1.37
Leisure	-1.92	0.30	-2.51	-1.34	1.48	0.26	0.97	1.99	-0.79	0.42	-1.61	0.04
Total	0.00	0.00	0.00	0.00	1.66	0.00	1.66	1.66	1.66	0.00	1.66	1.66

Source: Authors' calculations.

TABLE C.2. Systematic sensitivity analysis: 95 percent confidence interval under normality assumption for time use valuation by gender in 2030 (percent change from base)

Male	gspnd-c				gspnd-e				wcare+			
	Mean	Std Dev	Lo bnd	Up bnd	Mean	Std Dev	Lo bnd	Up bnd	Mean	Std Dev	Lo bnd	Up bnd
GDP total	0.26	0.12	0.02	0.50	0.12	0.03	0.06	0.18	-0.10	0.01	-0.12	-0.09
GDP child care	18.18	5.21	7.97	28.38	0.13	0.07	-0.01	0.27	0.15	1.05	-1.91	2.20
GDP elderly care	0.18	0.15	-0.11	0.47	57.57	14.14	29.85	85.29	2.08	3.26	-4.31	8.47
GDP total care	15.00	4.22	6.73	23.27	10.11	2.29	5.62	14.60	0.48	1.09	-1.66	2.62
GDP other	0.24	0.12	0.00	0.47	0.10	0.03	0.05	0.16	-0.11	0.01	-0.12	-0.09
Non-GDP total	-0.11	0.19	-0.49	0.26	-0.22	0.17	-0.56	0.12	0.07	0.07	-0.06	0.20
Non-GDP child care	-1.66	0.96	-3.54	0.23	0.04	0.05	-0.06	0.14	0.30	0.26	-0.22	0.82
Non-GDP elderly care	0.16	0.10	-0.03	0.34	-4.82	2.94	-10.58	0.94	1.61	0.97	-0.29	3.51
Non-GDP total care	-1.15	0.69	-2.51	0.21	-1.27	0.81	-2.86	0.31	0.65	0.33	0.00	1.30
Non-GDP other	0.15	0.09	-0.03	0.32	0.05	0.06	-0.07	0.17	-0.08	0.01	-0.10	-0.06
Leisure	0.14	0.08	-0.02	0.29	0.02	0.03	-0.04	0.08	-0.08	0.01	-0.10	-0.06
Total	0.18	0.10	-0.02	0.37	0.05	0.02	0.01	0.09	-0.08	0.01	-0.10	-0.07
Male	**wgap-**				**fert+**				**combi**			
GDP total	0.10	0.41	-0.70	0.90	0.83	0.17	0.49	1.17	1.17	0.52	0.14	2.19
GDP child care	4.11	1.14	1.88	6.34	21.42	2.54	16.43	26.40	46.28	8.26	30.08	62.47
GDP elderly care	3.50	0.65	2.23	4.76	0.31	0.35	-0.38	0.99	64.78	16.59	32.26	97.29
GDP total care	4.00	0.95	2.15	5.85	17.71	2.03	13.74	21.68	49.40	7.52	34.66	64.15
GDP other	0.09	0.41	-0.71	0.90	0.80	0.17	0.46	1.14	1.09	0.52	0.07	2.10
Non-GDP total	1.42	0.37	0.69	2.14	1.24	0.34	0.56	1.91	2.35	0.63	1.11	3.59
Non-GDP child care	1.46	0.66	0.16	2.76	1.80	1.46	-1.07	4.66	1.98	1.88	-1.70	5.66
Non-GDP elderly care	1.11	0.44	0.26	1.97	1.40	0.33	0.75	2.05	-0.88	2.42	-5.63	3.87
Non-GDP total care	1.36	0.50	0.39	2.34	1.67	1.08	-0.45	3.79	1.20	1.53	-1.79	4.20
Non-GDP other	1.43	0.42	0.60	2.26	1.13	0.35	0.44	1.82	2.66	0.63	1.42	3.89
Leisure	1.59	0.25	1.10	2.08	1.05	0.49	0.10	2.01	2.69	0.62	1.48	3.90
Total	0.96	0.25	0.47	1.46	0.97	0.27	0.44	1.50	2.04	0.45	1.16	2.93

TABLE C.2. Systematic sensitivity analysis (continued)

	gspnd-c				gspnd-e				wcare+			
Female	**Mean**	**Std Dev**	**Lo bnd**	**Up bnd**	**Mean**	**Std Dev**	**Lo bnd**	**Up bnd**	**Mean**	**Std Dev**	**Lo bnd**	**Up bnd**
GDP total	0.86	0.27	0.33	1.39	0.74	0.15	0.44	1.03	-0.08	0.05	-0.18	0.02
GDP child care	18.21	5.22	7.98	28.45	0.14	0.07	0.00	0.28	0.14	1.01	-1.83	2.11
GDP elderly care	0.19	0.15	-0.10	0.47	57.55	14.05	30.03	85.08	2.07	2.82	-3.45	7.59
GDP total care	13.99	3.93	6.30	21.69	13.40	2.98	7.55	19.25	0.59	1.06	-1.49	2.66
GDP other	0.24	0.12	0.00	0.47	0.13	0.03	0.07	0.19	-0.11	0.01	-0.12	-0.09
Non-GDP total	-0.15	0.24	-0.63	0.33	0.07	0.12	-0.17	0.31	0.01	0.06	-0.11	0.12
Non-GDP child care	-1.59	1.00	-3.55	0.38	0.12	0.07	-0.02	0.25	0.28	0.27	-0.24	0.81
Non-GDP elderly care	0.18	0.12	-0.04	0.41	-4.40	2.75	-9.80	1.00	1.50	0.90	-0.26	3.25
Non-GDP total care	-1.36	0.87	-3.07	0.35	-0.44	0.39	-1.20	0.32	0.43	0.27	-0.09	0.95
Non-GDP other	0.17	0.11	-0.04	0.38	0.20	0.08	0.06	0.35	-0.11	0.01	-0.13	-0.08
Leisure	0.12	0.07	-0.02	0.26	0.06	0.08	-0.09	0.21	-0.09	0.01	-0.11	-0.06
Total	0.22	0.15	-0.07	0.51	0.23	0.08	0.08	0.38	-0.06	0.02	-0.09	-0.03
Female	**wgap-**				**fert+**				**combi**			
GDP total	10.40	0.88	8.67	12.12	1.41	0.21	0.99	1.83	13.48	1.02	11.49	15.47
GDP child care	4.44	0.58	3.31	5.57	21.47	2.53	16.51	26.43	46.83	7.80	31.55	62.11
GDP elderly care	3.84	0.38	3.10	4.57	0.35	0.34	-0.32	1.02	65.37	16.50	33.03	97.70
GDP total care	4.30	0.48	3.36	5.24	16.55	1.87	12.87	20.22	51.01	7.26	36.77	65.25
GDP other	10.69	0.91	8.90	12.47	0.69	0.19	0.33	1.05	11.70	0.95	9.83	13.56
Non-GDP total	3.03	0.33	2.38	3.68	1.58	0.49	0.63	2.53	4.55	0.68	3.20	5.89
Non-GDP child care	3.16	0.45	2.28	4.04	2.09	1.51	-0.86	5.05	4.14	1.85	0.51	7.77
Non-GDP elderly care	2.64	0.42	1.82	3.45	1.65	0.38	0.91	2.39	1.23	2.27	-3.22	5.68
Non-GDP total care	3.09	0.40	2.30	3.88	2.03	1.33	-0.58	4.63	3.77	1.66	0.52	7.02
Non-GDP other	3.01	0.37	2.29	3.74	1.48	0.49	0.51	2.44	4.77	0.67	3.45	6.09
Leisure	2.29	0.46	1.39	3.19	1.10	0.67	-0.21	2.41	3.47	0.86	1.78	5.16
Total	4.52	0.42	3.70	5.34	1.32	0.39	0.56	2.08	6.27	0.64	5.01	7.52

Source: Authors' calculations.

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Women's market work and childcare policies in Colombia: policy simulations using a computable general equilibrium model

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In recent decades, Colombia has made significant progress towards achieving gender equality in its labor market. However, persistent inequalities in unpaid care work remain a significant challenge, resulting in heavy care workload for women. This study evaluates the impact of three government policy options that can help reduce women's unpaid work: subsidy for childcare services provided by the market, an increase in public provision of childcare services, and cash transfers to households with children using a care-extended computable general equilibrium model (CGE) calibrated to Colombian data. The results show that while all policies improve family economic situations by increasing private consumption, childcare provision, whether through subsidies or as a public good, has a more significant impact on increasing female market work while cash transfers increase unpaid work performed inside the home. These findings underscore the importance of policy design and their analysis regarding their impact on gender inequalities, labor supply, and economic growth.

JEL classification: E6, J16
Keywords: economic modeling, computable general equilibrium, social accounting matrix, feminist economics, care, unpaid care work, time use, Latin America, Colombia

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1. Introduction

In recent decades, Colombia has made significant progress towards achieving gender equality in its labor market. Women's participation in the workforce has increased considerably, and several indicators are now comparable to those of high-income countries [Iregui et al. 2021]. In fact, according to Elias and Ñopo [2010], Colombia experienced the highest increase in women's labor force participation throughout Latin America, transitioning from having one of the lowest female participation rates in the region, nearly 40 percent in 1985, to one of the highest female participation rates at 60 percent in 2017 [Iregui et al. 2021]. Despite these advances, the gender-based participation gap continues to persist. Women's participation rate in Colombia for 2022 was 51.8 percent compared to men's participation rate of 76.5 percent, notwithstanding the fact that women have higher levels of education.[1] Furthermore, Colombia has one of the highest rates of female unemployment in Latin America, reaching 14.3 percent in 2022 compared to the unemployment rate of 8.4 percent on average for the region for 2022.[2]

One of the main reasons why gender equality has not been fully achieved in the labor market is the unequal distribution of unpaid care responsibilities, which primarily fall on women. Household work, which is a non-GDP productive activity, presents a significant obstacle for women's participation in paid work, reducing their productivity, limiting their career advancement, and perpetuating gender inequality. Colombia's time use survey from 2021 shows that women account for most of the unpaid care work.[3] The average woman spent seven hours per day on paid work, while the average man spent 8.57 hours. In contrast, women spent seven hours and 44 minutes per day on unpaid care work, while the average man only spent three hours and six minutes [ENUT 2020-2021].

Moreover, women with children often face significant challenges and constraints in advancing professionally, as they bear a disproportionate responsibility for unpaid care work. As such, policies aimed at supporting this group are crucial for promoting gender equality in the labor market, enhancing women's economic empowerment, and contributing to overall economic development. In practice, such policies can include subsidies for families with young children and the provision of accessible, affordable, and high-quality childcare services.

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[1] Data for Colombia is sourced from the National Administrative Department of Statistics [DANE 2022].

[2] Data for Latin America and the Caribbean is sourced from the International Labour Organization [2023] and for Colombia from DANE [2022].

[3] Unpaid care work is not included in the calculations of the GDP and includes direct, indirect, and passive unpaid care. Direct care includes activities such as feeding, bathing, dressing, or taking other household members to places they require. Indirect care includes activities such as cooking, cleaning, and grocery shopping for the household. Finally, passive care includes monitoring and watching over dependent household members (children, elderly, or disabled).

The COVID-19 pandemic has brought attention to the unequal burden placed on women in both unpaid and paid care work and highlighted the critical importance of care services. The pandemic has revealed that a lack of support for unpaid care work can have significant economic and social consequences, including the reversal of progress made in reducing gender gaps observed in previous decades [Garcia-Rojas et al. 2020]. The pandemic also exposed the imbalances and precarious conditions in the paid care sector. In Colombia, the care sector is highly feminized, with women constituting 75 percent of the workforce. Additionally, much of this employment is informal and done under precarious conditions. In 2020, only two percent of the total number of women working in the paid care sector were employed by the government compared to three percent of men.[4] Therefore, efforts investing in the care economy could serve a dual purpose: closing gaps in the labor market and enabling women to regain their pre-pandemic momentum, while simultaneously improving the labor conditions for care workers. This includes providing better wages, access to benefits, training opportunities, and other supportive measures.

While the government of Colombia has made some progress in addressing care needs, including the institutionalization of a comprehensive state policy for early childhood development in 2011 [Meurs 2020], there is still a lack of a comprehensive framework for a care system in the country. The burden of care provisioning falls disproportionately on families, while other key actors, such as governments, underinvest in this area. Economic, social, and demographic changes such as urbanization and growing nuclearization of families, aging population, and increasing need for women to take on income-earning roles, have posed difficulties for families to meet their care needs on their own. However, there is little information available on the macroeconomic effects of policy options aimed at redistributing care responsibilities among households, governments, and businesses. A gender-aware, comprehensive policy analysis of possible interventions can shed light on their macro- and micro-level impacts.

However, to date, the vast majority of the models used in policymaking do not consider gender in labor markets and overlook the impact of care work on the economy, thus rendering such policy tools unsuitable for analyzing policies addressing the care and gender equality in Colombia and in other contexts. To tackle this issue, we employ a Gendered Computable General Equilibrium model (CGE) called GEM-Care, first developed by Cicowiez and Lofgren in 2017, and we calibrate for the Colombian context. GEM-Care Colombia extends the scope of activities beyond GDP to consider unpaid care work as well as personal and leisure activities. It emphasizes the importance of unpaid care work in producing and maintaining the labor force, its interconnection with paid work in terms of time use, and demonstrates its significant impact on the economy as a whole.

[4] The paid care sector in Colombia includes services such as health and medical assistance, childcare, elderly care, and food preparation and cleaning services [Herrera-Idárraga et al. 2020].

Ignoring unpaid care work in policy analyses can yield misleading predicted outcomes and limit the effectiveness of policies aimed at promoting female labor participation and advancing gender equality. Overall, by incorporating unpaid care work into our analysis through GEM-Care Colombia, we can enhance the effectiveness of economic policies, generating sustainable growth with greater equality and well-being for both women and men.

We use GEM-Care Colombia to investigate the impact of three common policies aimed at reducing the care burden on families with young children. Specifically, we compare the effects of equal increases in government spending on a subsidy for childcare services provided by the market, an increase in public provision of childcare services, and cash transfers from the government to households with children. Our findings indicate that while these policies improve the economic situation of families with children, they have different impacts on the amount of time spent on work performed inside and outside the household. Subsidies and public provision of childcare services increase private consumption and investment, as both men and women shift working hours from unpaid care work to GDP production. However, cash transfers to households with young children lead to a reduction in work performed outside the home and an increase in unpaid care work by both men and women. In this scenario, the production levels of all GDP activities decreased due to the decrease in economic activities resulting from the increase in hours spent on unpaid care work. Moreover, both men and women, but particularly men, increase their leisure time. Hence, to foster potential benefits for gender equality and economic development, our results suggest that public policy could consider prioritizing the development and implementation of programs aimed at distributing government-provided childcare services to households and potentially increasing the State's provision of public care.

Our paper's contribution to the literature is twofold. Firstly, we implement simulation analysis using GEM-Care Colombia, a unique and pioneering analytical tool that enables us to assess various care policies' macroeconomic and sectoral effects. Secondly, we compare different policies that have been used and are currently being discussed for the redistribution of unpaid care in Colombia. The findings and methods used in this study may have implications for other developing countries. Given that other Latin American and Caribbean countries face similar challenges in this area, the findings in this study might be relevant to the region as a whole.

2. Background

The economic, social, and cultural context of a Latin American developing country such as Colombia makes it an interesting case study to analyze the economic and welfare effects of fiscal policies that support childcare provisioning. Socially ascribed gender roles continue to significantly affect individual decisions regarding time use. Feminization of unpaid care work persists despite

the government's efforts to reduce, redistribute, and recognize the unpaid care burden. The feminization of unpaid care work, the persistent gender gap in labor force participation, and occupational segregation are common features throughout Latin America [UN Women n.d.].

In 2010, the Colombian government enacted the Law 1413 that made an important contribution for the recognition and visibility of unpaid care work. The Law's objective is to measure women's contribution to the country's economic and social development by including the care economy (which encompasses all unpaid work activities such as cooking, childcare, doing the laundry, sick care, house cleaning, etc.) in its System of National Accounts. To achieve this objective, the collection of time use data that include unpaid domestic work and care activities performed by household members is required. With that purpose, the National Department of Statistics (or DANE, its acronym in Spanish) conducts, the National Time Use Survey (or ENUT, its acronym in Spanish) on a periodic basis. According to Meurs et al. [2020], the Law 1413 was the first of its kind in the Latin America and Caribbean region and enabled DANE to begin developing an extensive set of gender-disaggregated data that could potentially be used systematically in the design of macroeconomic and social policies.

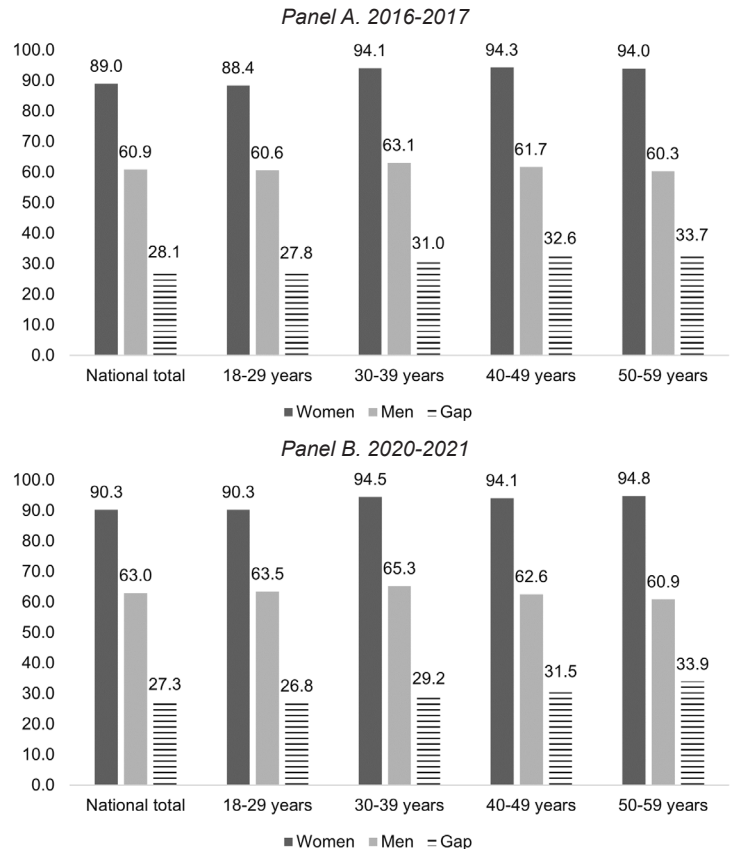
Currently, families still meet most of the care needs in the country. However, wealthier households have access to private, paid services such as daycare centers and domestic workers, while poorer households depend on the women to provide much of the care themselves [Meurs et al. 2020]. The quality, quantity, and type of care services available to households not only vary between low-income and high-income households; they also depend on the geographical area of residence since there are significant differences in the services available in urban and rural areas. These differences in care provisioning across households are considered in GEM-Care Colombia.

The public provision of childcare services is led by the Colombian Institute of Family Welfare (or ICBF for its acronym in Spanish). The ICBF provides public education and care services for vulnerable children through different channels including institutional centers such as Child Development Centers, Children's Homes, and Social Kindergartens. The Community Mothers Program (or *Madres Comunitarias*) is another channel, and the largest to date, with approximately 69,000 community-based female care workers (called "mothers" for their care service) and a few community-based male care workers (called "fathers" for their care service) attending to the needs of 1,077,000 children [ICBF n.d.]. These "mothers" and "fathers" provide home-based childcare that targets nutrition, health, protection, and psychosocial development of children. However, the coverage and quality of those programs remain insufficient as families clearly need more government support in the provision of care services [Meurs et al. 2020].[5] In addition, the influx in the past several years of more than two million

[5] See Meurs et al. [2020] for a more in-depth and detailed summary of the government's efforts to reduce, redistribute, and recognize the unpaid care burden in Colombia.

Venezuelan immigrants, including families with children, has further increased the demand for care, making increasing government participation in the provision of childcare service particularly urgent.

FIGURE 1. Participation rates in unpaid care work by gender and age groups



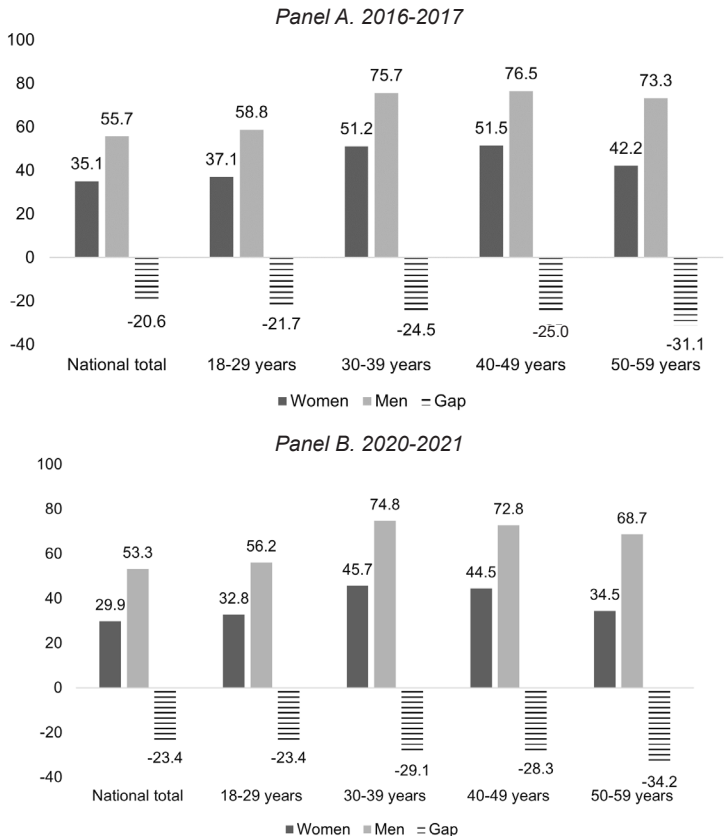
Source: Authors' calculations using the annexes from ENUT 2016-2017 and ENUT 2020-2021.
Note: Unpaid work comprises all the unpaid activities carried out with the objective of providing services for family and community members. Unpaid work is not included in the calculations of the GDP and includes direct, indirect, and passive unpaid care. Direct care includes activities such as feeding, bathing, dressing, or taking household member dependents to places they require. Indirect care includes domestic chore activities such as cooking, cleaning, and grocery shopping, etc. for the household. Finally, passive care includes monitoring and watching over dependent household members (minors, elderly, or disabled).

According to data from the National Survey of Time Use for 2016-2017, 61 percent of working-age male respondents engage in unpaid care work, compared to 89 percent of female respondents in the same age group.[6] Moreover,

[6] In Colombia, the working-age population is defined beginning at ten in rural areas and at 12 in urban areas. Therefore, the time use section in the questionnaire for the ENUT is applied to household members ten years old and above and the national-level calculations are for the population beginning at that age.

women spend an average of six hours and 52 minutes per day in unpaid care activities, while men spend only three hours and 19 minutes, resulting in a gender gap of three hours and 33 minutes in unpaid care activities. This gap increased by more than an hour during the COVID-19 pandemic [ENUT 2016-2017, ENUT 2020-2021]. As shown in Figure 1, the gender gap in participation in unpaid care work increases with the age range of the sampled respondents. In particular, the largest gap is found in the 50 to 59 years old age group, while the lowest gap is in the 18 to 29 years old age group.

FIGURE 2. Participation rates in paid work by gender and age groups



Source: Authors' elaboration using the annexes from ENUT [2016-2017] and ENUT [2020-2021].
Note: Paid work refers to all the activities carried out by individuals, aimed at producing goods and services to obtain a compensation (often monetary) of some kind. It does not include the time household members spend producing goods for their own consumption, making paid work a subset of the activities included in the NAS.

The reverse pattern is seen in paid work activities, where men participate more than women (see Figure 2). According to data from the National Survey of Time Use for 2020-2021, 53 percent of male respondents from the working

age population engage in paid work activities, compared to 30 percent of female respondents in the same age group. Moreover, women spend an average of seven hours and 37 minutes per day in paid activities, while men spend eight hours and 57 minutes, resulting in a gender gap of one hour and 20 minutes in paid work. The gender gap in participation in paid activities increases depending on factors such as the geographic region of residence, the economic sector of occupation, and age. As shown in Figure 2, the largest gender gap in participation in paid work is found in the 50 to 59 age range, and the lowest in the 18 to 29 age range.

TABLE 1. Participation rates and time spent in unpaid and paid work by gender and age groups

	2016-2017			2020-2021		
	Women	**Men**	**Gap**	**Women**	**Men**	**Gap**
	Panel A. Time in unpaid work per day (hh:mm)					
National total	6:52	3:19	3:33	7:44	3:06	4:38
18-29 years	8:14	3:05	5:09	9:50	2:50	7:00
30-39 years	8:56	4:12	4:44	10:45	3:51	6:54
40-49 years	7:07	4:01	3:06	7:52	3:43	4:09
50-59 years	6:33	3:30	3:03	6:39	3:19	3:20
	Panel B. Time in paid work per day (hh:mm)					
National total	7:36	9:13	-1:37	7:37	8:57	-1:20
18-29 years	8:02	9:18	-1:16	7:44	8:50	-1:06
30-39 years	8:04	9:44	-1:40	8:00	9:28	-1:28
40-49 years	7:57	9:39	-1:42	8:10	9:19	-1:09
50-59 years	7:33	9:36	-2:03	7:25	9:11	-1:46

Source: Authors' calculations using the annexes from ENUT [2016-2017] and ENUT [2020-2021].

Table 1 compares the daily time that women and men spend on average doing unpaid and paid work. It shows that, for all age groups, women spend more time per day on average in unpaid care work activities than men (six hours and 52 minutes vs. three hours and 19 minutes in 2016-2017; seven hours and 44 minutes vs. three hours and 6 minutes in 2020-2021), and men spend more time per day on average in paid work activities than women (nine hours and 13 minutes vs. seven hours and 36 minutes in 2016-2017; eight hours and 57 minutes vs. seven hours and 37 minutes in 2020-2021). The largest gender gaps in unpaid care work are among the 18 to 29 years old individuals (seven hours on average in 2020-2021), followed by the 30-39 years old cohort (six hours and 54 minutes). This may be explained mainly by the unpaid childcare burden faced by women in their childbearing years.[7] The largest gender gap in paid work on average is among

[7] The fertility rate in Colombia has been decreasing during the last few decades, a pattern seen in many parts of the world, and is currently 1.74 births per woman.

the 50 to 59 years old individuals (one hour and 46 minutes in 2020-2021). A plausible explanation for the latter is the fact that the retirement age for women in Colombia is 57, while for men, it is 62.

The time use patterns suggest that the heavy unpaid domestic chores and childcare workload serve as a barrier for women in childbearing ages to participate and remain in the labor market. Approximately 60 percent of unpaid caregivers in Colombia are between 20 and 40 years of age, and half of caregivers between 20 and 54 years of age also have paid jobs [DANE 2020]. Over the second half of the 20th century, the female participation in the labor market has increased. However, the increase in women's participation in paid work has not been accompanied by a significant increase in men's participation in unpaid care work [Meurs et al. 2020]. As a result, female caregivers face a "double shift" (or *doble-jornada*), which can lead to long working days and time poverty thus adversely affecting their well-being (Floro [1995]; Bardasi and Wodon [2010]; Hirway [2010]).[8]

Overall, increasing household's access to affordable childcare services, whether public or private, can help reduce the unpaid workload of women, allowing them to spend their time on paid activities and leisure. Reducing gender inequality within the household can also result in the reduction of gender gaps outside the household. The simulation analysis presented in Section 5 evaluates the extent to which a better sharing of the responsibility for childcare among the State, the community, the family, and businesses help reduce gender inequalities.

3. Literature review

This paper contributes to three key areas of the literature. First, it contributes to the literature on gender-sensitive policy modeling by applying a care-focused CGE model to the analysis of various options for care policy in a developing-country setting. Second, it provides a better understanding of the macroeconomic as well as welfare effects of public spending on childcare services. Third, it contributes to the growing body of literature on the effects of government spending on childcare and early childhood education, whether through subsidies to market-based childcare services, public provision of childcare services, or cash transfers to households with young children.

CGE models have been used to assess the impacts of policy changes on a wide range of standard economic indicators, including value added, employment, trade, consumption, investment, and household welfare, both at the macro and more disaggregated levels. Over the last 20 years, researchers have started to further develop their model structures and databases to address the effects of policies and economic shocks from a gender perspective.[9]

[8] Time poverty is defined as the insufficiency of time available for rest and leisure, taking into account the time allocated to work obligations, including labor market activities, domestic chores, and other responsibilities like collecting water and firewood.

[9] See Fontana et al. [2020] for a recent survey of the literature.

Gender-aware CGE models in the literature can be divided into two groups. The first group includes models that only cover the part of labor or time use that falls under GDP production (Arndt and Tarp [2000]; Arndt et al. [2006]; Arndt et al. [2011]). From a gendered perspective, they are limited to analyses of male-female differences in terms of employment, wages, and labor incomes at both the sectoral and economy-wide levels. The second group extends the scope to include leisure and household services production for own consumption and related time use of individuals. Household services production refers to reproductive activities performed by household members, such as care for children and elderly (direct and passive care), and cooking, cleaning, and shopping (indirect care).

Those models are able to also analyze the impact of policies on women's and men's time in leisure and in the production of goods and services, both included and excluded from GDP. The allocation of time across these three dimensions affects both individual and household well-being. Fontana and Wood [2000] were the first to develop a model with this extension. To date, gender-aware models in this group have been applied to analyze issues related to international trade, capital flows, and education (Fontana [2004]; Cockburn et al. [2007]; Siddiqui [2009]; Ruggeri-Laderchi et al. [2010]; and Mosa et al. [2020])

GEM-Care Colombia, the version of GEM-Care used in this paper, differs from the models in the second group in terms of its treatment of care services, which involves both changes in the model structure and additional disaggregation of the household sector in the database. On the demand side, we assume that households consider care services produced by their own members and those produced outside the household as imperfect substitutes. Outside the household, such services are provided by the private and public sectors such as daycare centers. This allows us to differentiate the effects of reducing the care workload performed by household members, particularly women, through public spending on childcare or by means of cash transfer programs to households with childcare needs.

In recent years, there has been increasing interest in the benefits of expanding childcare infrastructure, not only in terms of children's development but also in terms of enhanced well-being of their parents and society as a whole. For instance, Noboa-Hidalgo and Urzua [2012] analyzed the effects of public childcare centers on children's cognitive and socio-emotional development in Chile, finding significant positive effects.[10] Similarly, Bernal and Fernández [2013] studied the impact of a subsidized childcare program on children's nutritional status, cognitive and socioemotional development in Colombia, and found that cognitive and socio-emotional skills improved significantly after 15 months of program exposure.

[10] The authors measured cognitive and socio-emotional development using the Battelle Development Inventory Test (BDITT), a comprehensive psychological assessment that evaluates fundamental dimensions of cognitive and socioemotional development for children aged zero to eight. Some of the dimensions it considers are the ability of children to regulate their emotions and their receptive and expressive communication skills.

Expanding public childcare programs can also have positive effects on parents, particularly mothers. Zoch and Schober [2018] found that the expansion of public childcare for children under the age of three in Germany was associated with changes in gender ideologies among mothers without a college degree.[11] Similarly, Müller and Wrohlich [2020] estimated the causal effect of expanded subsidized childcare for children up to three years old on mothers' employment in Germany, and found that a one percentage point increase in childcare slots led to a 0.2 percentage point increase in the labor market participation rate of mothers. A study by Ilkkaracan et al. [2015] for Turkey found that expanding the early childhood care and preschool education sector creates more jobs and does so in a more gender-equitable way than an expansion in the construction sector. Similar results on the effects of expanded childcare services on mothers' labor supply are found in Berlinski and Galiani [2007], Lefebvre and Merrigan [2008], Bauernschuster and Schlotter [2015], and Eckhoff-Andresen and Havnes [2019].

The findings of these studies suggest that making childcare services more widely available can have multiple positive effects on children, parents, and society as a whole. Nevertheless, further research is needed to better understand the mechanisms through which such programs operate, and to analyze the consequences of alternative designs for expanded public childcare programs.

Evaluations of cash transfer programs show mixed results regarding their impacts on children and parents, particularly mothers. For instance, Rønsen [2009] and Hardoy and Schone [2010] found that a cash transfer program to parents of one- to two-year-olds in Norway had little effect on mothers' labor supply in the short run, and negative effects in the long run. Negative impacts on female labor force participation have also been identified in the impact evaluation of several cash transfer programs across Latin America. For example, Garganta et al. [2017] analyzed a cash transfer program in Argentina and found a negative and statistically significant effect on the labor force participation of married women. Medeiros et al. [2008] also found a reduction in the probability of labor participation among eligible women in Brazil's *Bolsa Familia* program. Similar results have been found for other countries by Ferro et al. [2010], Teixeira [2010], Scarlato et al. [2014], and D'Agostino and Scarlato [2019]. However, as shown in Molina-Millan et al. [2019], the effects of these programs on female labor participation and work hours depend on the design of the program.

The papers discussed above estimate partial equilibrium effects of increasing the public spending on public childcare services and cash transfer programs. General equilibrium effects, however, can provide crucial information and new insights for public policy discussions that partial equilibrium estimates fail to provide [Acemoglu 2010]. For one, they consider the interrelationships among the actors in the economy and hence the direct and indirect effects that could be

[11] The authors use the term gender ideologies to denote individuals' level of support for the division in paid and unpaid care work based on the belief in multiple gendered separate spheres.

generated. The CGE method also enables us to assess both the short- and long-run macro and meso-economic effects of different shocks within a framework of analytical consistency that alternative methods do not allow.

4. Model and data

In this section, we present a brief description of GEM-Care Colombia and its database. A detailed presentation of GEM-Care Colombia, including its variables and equations, is given in Cicowiez and Lofgren [2022].[12]

4.1. Model

GEM-Care is a gendered dynamic recursive CGE model designed for policy analysis at the country level, with a special focus on issues related to the care economy.[13] Apart from the gender- and care-related aspects, which will be discussed next, the bulk of the structure of GEM-Care is similar to that of other CGE models: it is a system of non-linear equations that is solved numerically providing an economy-wide and multi-sectoral representation of the real sphere of the economy, with the bulk of the data derived from a base-year social accounting matrix (SAM). The equilibrium aspect of the model refers to the fact that, under each solution, agents are assumed to have reached "optimal" decisions, meaning that, subject to budget constraints, producers and consumers maximize profits and utility, respectively, while government decisions respect a set of rules such as, for example, to tax on the basis of policy-determined rates and to make sure that spending and receipts, including borrowing, are equal. Similarly, the economy is assumed to operate under a budget constraint in its dealings with the rest of the world (represented by the balance of payments). Prices play a key role in market allocation, making sure that, in the context of government policy interventions and international trade, the quantities supplied and demanded (including stock changes) are equal. Production and household consumption are modelled using constant-elasticity-of substitution (CES) and linear-expenditure-system (LES) functions, both of which permit adjustments in response to changes in prices and wages, the sizes of which depend on elasticity values. Similarly, in foreign trade, buyer choice between imports and purchases of domestic output are covered by CES functions (in this context called Armington functions) while constant-elasticity-of-transformation (CET) functions are used to capture producer decisions about the allocation of output between exports and domestic sales.

[12] Documentation of a similar model in English is available on request from the authors.

[13] GEM-Care is an extension of GEM-Core [Cicowiez and Lofgren 2017] which, in turn, takes elements from Lofgren et al. [2013] and Lofgren et al. [2002]. GEM-Care, like other CGE models, can be classified as a multipurpose model. That is, although it focuses on the care economy, it can be used to analyze, with a gender perspective, a broad range of issues for which CGE analysis is typically relevant.

As is the case for most CGE models, the dynamics of GEM-Care is recursive: actors are assumed to be myopic, making decisions based on data for the current year, which are influenced by past decisions. The model is appropriate for medium- to long-run analysis of shocks that have significant repercussions beyond the sector or household that is affected directly. GEM-Care also has the ability to capture links between different parts of an economy such as those between production sectors via intermediate demands, or between household incomes (from production) and household demand with feedback on production.

The model incorporates several aspects of gender in general and of the care economy in particular. We highlight here the model's key features. First and most importantly, the model disaggregates production activities, including their use of labor, into GDP and non-GDP, the latter being represented by household services that are produced for own consumption (referred to as household services in the rest of the paper).[14] These services are further disaggregated into childcare, elder care, and other domestic work. The inclusion of these non-GDP activities makes it possible to examine how they are impacted by government policies and other types of shocks. GDP activities, market and non-market, refer to activities whose output are part of GDP; among these, the non-market GDP segment are the activities for which the bulk of demand and supply is driven by government decisions.

If both the GDP sphere and the non-GDP household sphere produce services that meet similar needs (for example childcare), households face a choice—services from these different sources are treated as imperfect substitutes.[15] Similarly, in all production activities, whether GDP or non-GDP, male and female labor are treated as imperfect substitutes. Apart from working in GDP and non-GDP production, men and women allocate time to leisure and self-maintenance, the latter being exogenous.[16] Persons who are defined as "unemployed" (a concept related to GDP work) allocate their time to activities other than GDP production.

Figure 3 shows the technology that determines the level of GDP production activities in GEM-Care Colombia. At the top, a Leontief (fixed coefficient) function combines aggregate value added (generated by factors of production, most importantly labor and capital) and intermediate inputs in fixed proportions. The next level shows that aggregate value added is generated by aggregate labor and capital using a CES function. At the bottom level, male and female labor are combined to generate the labor aggregate. The CES functions permit the proportions between the different factor inputs to change in response to changes in wages and rents. For household services, the structure is much easier since the only input is male and female labor. In other words, we assume that the production

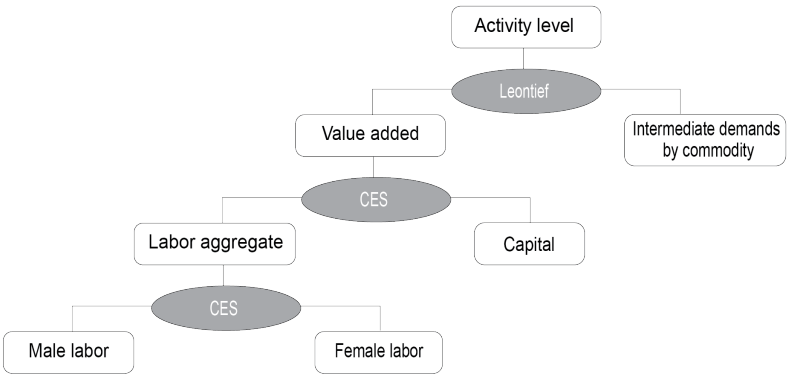
[14] It should be noted that the disaggregation to which we refer depends on the specifics of the database, which are discussed in Section 4.2.

[15] In particular, households face a choice between own production and drawing on domestic help (for care and other domestic work) and/or childcare centers to meet some of their service needs.

[16] Leisure includes time spent on socializing, sports, religious practices, and cultural activities. Self-maintenance is the time spent on activities necessary for sustained functioning such as sleeping, hygiene, eating, and drinking.

of unpaid care work services does not use capital and intermediate inputs.[17] Implicitly, the use of intermediate inputs in the production of non-GDP services is recorded as household consumption.[18]

FIGURE 3. Production technology in GEM-Care Colombia



Source: Authors' elaboration.

Figure 4 summarizes the treatment of household consumption in GEM-Care Colombia. Taking prices and wages as given, each household is assumed to maximize utility, represented by a two-level nesting of utility functions, Stone-Geary (which generates LES demand functions) at the top and CES at the bottom. The diagram indicates that, at the top, the household makes a choice across four items: (a) an aggregate of household services and their GDP substitutes, (b) other goods and services, and (c) male and female leisure (treated as separate items). The bottom of the diagram shows the composition of care services, which is determined by allowing for (imperfect) substitution between services provided by the household itself, the market, and the government (non-market). Consequently, if market-provided care services become cheaper or if the government increases the provision of free care services, households will reduce the time they spend on unpaid care services.

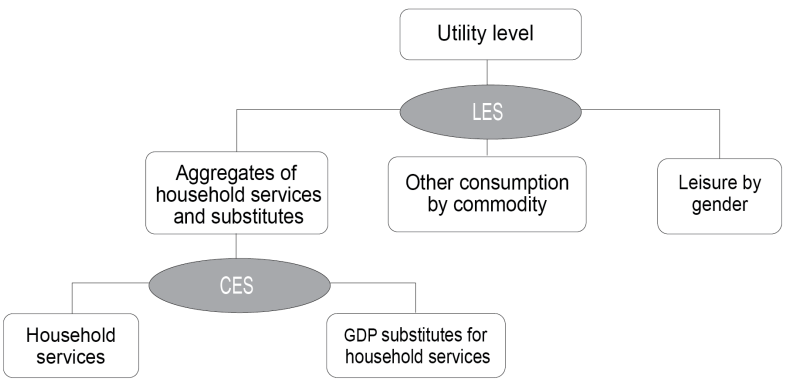
GEM-Care Colombia also models government income sources (for example taxes) and expenditures (for example public provision of care services) as policy instruments that can be used to design counterfactual scenarios. Importantly, unlike other CGE models, GEM-Care Colombia brings attention to alternative sources of financing for government spending, including domestic and foreign government borrowing.

[17] This assumption is made due to lack of data and information.

[18] If data on non-labor input use for household service production were available, the technology would be adjusted to take on the more complex structure shown in Figure 3.

In summary, GEM-Care Colombia can serve as a "laboratory" in which controlled experiments can be conducted. For example, we can examine what would happen if the Colombian government introduced a subsidy to the private provision of care services that is financed in a specified way while keeping everything else (including other public policies) unchanged. By comparing the before and after situations, we can then identify (and quantify) (a) the expected effects of such a policy intervention, and (b) the relative importance of the different macro and meso transmission channels of the policy intervention.

FIGURE 4. Household consumption in GEM-Care Colombia



Source: Authors' elaboration.

4.2. Data

GEM-Care Colombia is calibrated to a 2017 SAM that incorporates the unpaid care work.[19] The SAM building process is described in detail in Cicowiez et al. [2022].[20] The disaggregation of the SAM is shown in Table 2. The production is disaggregated into 76 activities and outputs, 22 of which count as part of GDP. Among the services with imperfect GDP and non-GDP substitutes, it distinguishes between childcare, elderly care, and other domestic services. The households are split into six representative types based on location (rural or urban) and care needs: (i) working-age head (15-64 years old) without children under six, (ii) working-age head with children under six, and (iii) non-working-age head (more than 64 years old). The production activities demand, and the households supply six types of labor categories, split by gender (male and female) and education level (primary, secondary, and tertiary education).

[19] At the time of writing, 2017 was the latest year with all the information required to build a gendered and care-extended Colombian SAM available.

[20] As part of the building of the SAM, it was necessary to estimate the monetary values of time used in the different production activities and leisure. The time spent in GDP production was valued on the basis of official statistics while the valuation of household service time was based on the input-based replacement cost method used by DANE, i.e., the imputed wages were set equal to the wages earned by those working in the GDP care services. Leisure time was valued on the basis of the opportunity cost defined as the market wage of the person enjoying the leisure.

TABLE 2. Disaggregation of GEM-Care Colombia

Sectors (activities and commodities)	*Agriculture and industry (8)*
	agriculture; mining; food industry; textiles; petrochemical; metals and metallic products; construction; other industry
	Services, GDP (14)
	trade; hotels and restaurants; transport; professional services; support services; public administration; private basic education; private other education; public basic education; public other education; health; elderly and disabled; domestic services; other services
	Services, non-GDP (18)*
	child care (6); elderly care (6); other (6)
	Leisure (36)
	by household (6) and labor category (6)
Factors (10)***	Labor, male by education level (primary, secondary, and tertiary) (3)
	Labor, female by education level (primary, secondary, and tertiary) (3)
	Capital, private
	Capital, government
	Land
	Extractive
Institutions (6)**	*Households (6)*
	working age with children; working age without children; elderly (rural and urban)
	Enterprise
	Government
	Rest of the world
Taxes and subsidies (4)	Tax, activities
	Tax, commodities
	Tax, imports
	Tax, income
	Subsidies, commodities
Distribution margins (3)	Trade and transport margins, domestic
	Trade and transport margins, imports
	Trade and transport margins, exports
Investment (3)	Investment, private
	Investment, government
	Investment, change in inventories

*Non-GDP activities and commodities are disaggregated by household.
**The institutional capital accounts are for domestic non-government (aggregate of households and enterprises), government, rest of the world, and the financial institution.
Source: Authors' elaboration.

In addition to the SAM, the GEM-Care Colombia database includes a set of elasticities data and data on time use.[21] The elasticities are used to model substitutability in production and household consumption as well as decisions related to foreign trade. The production and consumption elasticities indicate the ease with which a production factor or commodity (good or service) can be replaced by another in response to relative price changes in the context of the production and consumption structures shown in Figures 3 and 4; the trade elasticities determine the ease with which (a) domestic output can be switched between exports and domestic sales (CET elasticities) and (b) domestic demand can be switched between purchases of imports and domestic output.

As is typical of CGE analysis, while these elasticities draw on the results from econometric analysis, the specific values used are based on analyst judgement. In our case, the elasticities that matter most are those related to the substitution between male and female labor in the value-added functions, both in household services and GDP production. These elasticities, which may be influenced by government policies, are related to social norms regarding the roles of men and women in production inside and outside the home. Given their importance, we test the sensitivity of key results to the values of these elasticities.[22]

It should be noted that, in GEM-Care Colombia, the distribution of household service work between men and women depends on (a) the information recorded by the ENUT regarding the time spent by women and men on these activities, and (b) the elasticities of substitution between female and male labor in these activities.

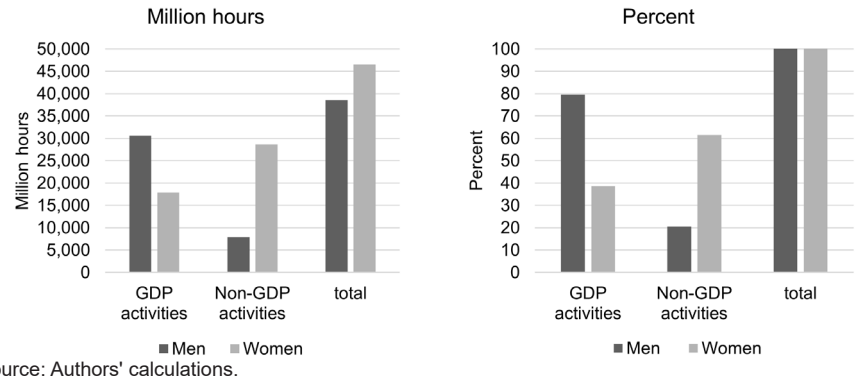
The time use data are summarized in Figure 5, which shows the total annual time spent by men and women in GDP and non-GDP activities in 2017. It shows that women predominate in non-GDP activities (contributing 78 percent of the total labor time) while men predominate in GDP activities (contributing 63 percent of the total labor time). Overall, the unpaid care work in 2017 is valued at 20.2 percent of GDP.[23]

Figures 6 and 7 summarize the data on wages and GDP employment, respectively. Figure 6 shows the average hourly wages of women and men in 2017 by aggregate sector, indexed to a value of one for male work in agriculture. It should be noted that, for household services, wages and incomes are imputed on the basis of the GDP wages of care work whereas leisure is valued on the basis of the opportunity cost, defined by the market wage of the persons who enjoy the leisure. The normalized hourly wages of male and female domestic workers are 1.3 and 0.9, respectively. In turn, the normalized hourly wages of male and female unpaid caregivers are 1.3 and 1.2, respectively. In general, the estimated wage differentials between men and women employed in GDP activities are

[21] The elasticities used are provided in Table B.1 in Annex B.
[22] The results are reported in Annex A.
[23] These statistics are similar to the estimates in the household production satellite account prepared by DANE (DANE [2021]).

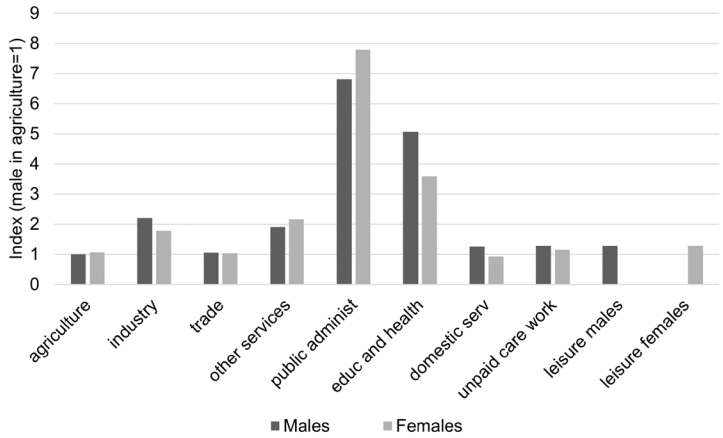
small compared to those in other Latin American countries [Centro de Estudios Distributivos, Laborales y Sociales 2021]. Consequently, the opportunity costs of leisure for men and women are also similar.

FIGURE 5. Time use for men and women (million hours and percent)



Source: Authors' calculations.

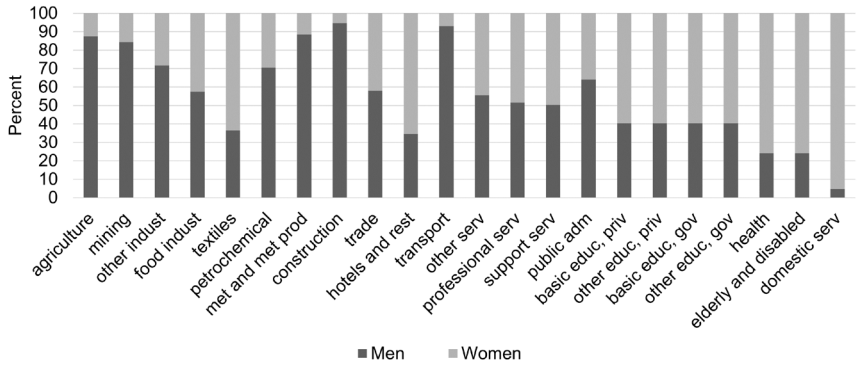
FIGURE 6. Relative wages (male wage in agriculture = 1)



Source: Authors' elaboration.

Figure 7 shows the composition of employment for GDP activities, using the full model and SAM disaggregation (shown in Table 2). The activities with the highest percentage contribution of labor (work hours) by women are domestic service, health, hotels and restaurants, textiles, and education. These are the sectors that would likely benefit the most from policies promoting female employment.

FIGURE 7. Gender composition of labor demand in GDP activities (percentage)



Source: Authors' elaboration.

5. Simulations

In this section, we use GEM-Care Colombia to analyze the various care policy options discussed in Section 3. First, we generate a base or business-as-usual scenario that projects the growth of the Colombian economy until 2030. The base scenario is generated under the assumption that existing policies in the base-year remain unchanged. Second, we show results for non-base scenarios that simulate the impact of three policies: i) the introduction of a subsidy for childcare services provided by the market, ii) an increase in public provision of childcare services, and iii) cash transfers from the government to households with children. In the first case, we also consider three financing alternatives. Drawing on the simulation results, we assess the impact of these three policies with a focus on time use, macroeconomic indicators, household consumption, and sectoral output.

5.1. Policy scenarios

The policy scenarios we consider are described in Table 3. In all cases, we assess the impact of different policy options that benefit households with children under six. The first three scenarios assess the impact of introducing a subsidy to childcare services provided by the market and financed in different ways. In the scenario *sub-tx*, the additional government spending is financed by an increase in income (or direct) taxes on households and enterprises. For *sub-inv*, the additional government spending is financed by a reduction in government investment in basic infrastructure (for example roads) which, in the absence of other changes, has a negative impact on the overall total factor productivity (TFP). In the scenario *sub-ef*, the additional government spending is financed by reduced government consumption which is assumed to be accompanied by an increase in government efficiency, making it possible to provide the same volume of government services in spite of this consumption cut.

In the scenario *gsupply*, the public provision of childcare services is increased. This is modeled in GEM-Care Colombia as an in-kind transfer from the government to households with children. Finally, the scenario *trnsfr* simulates an increase in cash transfers from the government to households with children. This scenario is based on the government program *Ingreso Solidario* that started in April 2021 and ended in December 2022 [Gallego et al. 2021].[24] In the *gsupply* and *trnsfr* scenarios, the increase in public spending is also financed by increases in income taxes paid by households and enterprises.

In all five scenarios, the increase in government spending during 2022-2030 period is equivalent to 0.5 percentage points of the base GDP. All scenarios (including the base) are identical during the 2017-2021 period. Moreover, the increase in government spending is assumed to be distributed among households (urban and rural) in proportion to the number of children. None of the scenarios directly benefits households with no children.

TABLE 3. Description of the non-base policy scenarios

#Name	Description
1 **subtx**	Childcare subsidy equivalent to 0.5 percentage of base GDP during 2022-2030 financed with income tax on households and enterprises
	Same as sub except...
2 **sub-inv**	...financed with reduced government investment in infrastructure
3 **sub-ef**	...financed with increased government efficiency
4 **gsupply**	Increase in government provision of childcare services equivalent to 0.5 percentage of base GDP during 2022-2030 financed with income tax on households and enterprises
5 **trnsfr**	Transfer to households with working head and children equivalent to 0.5 percentage of base GDP during 2022-2030 financed with income tax on households and enterprises

Source: Authors' elaboration.

5.2. Simulation results

5.2.1. Changes in time use patterns of women and men

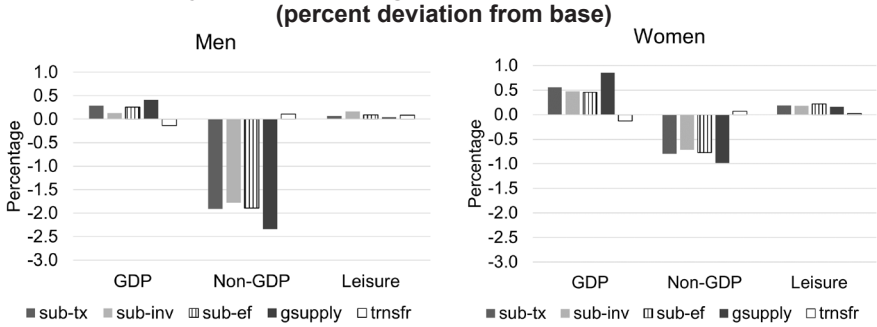
Regardless of the source of government funding, a reduction in the cost of market-provided childcare services (scenarios *sub-tx*, *sub-inv*, and *sub-ef*) encourages female GDP work. This is due to the fact that that the services that are encouraged—GDP care—are intensive in female labor at the same time as the services that are discouraged—non-GDP care—also are intensive in female labor. As shown in Figure 8, women increase their time in GDP work by 0.5 to 0.6 percentage, depending on the financing source, as well as their leisure time. The growth in

[24] The program *Ingreso Solidario* was a cash transfer provided by the national government to households living in poverty, extreme poverty, and economic vulnerability to mitigate the impact of the emergency caused by COVID-19.

paid employment is larger for women than for men. In 2030, the number of full-time jobs (40 hours per week) for men and women increases by around 52,000 and 62,000, respectively. The results are qualitatively similar when we simulate an increase in the public provision of childcare services (*gsupply*). However, the magnitude of the effects is larger because public provision of childcare services is more labor intensive than private provision of childcare services. In other words, for the same increase in government spending, the increase in (female) labor demand is larger for *gsupply* scenario than for the *sub-* scenarios. As a result, for this scenario, women increase their time in market (GDP) work by 0.9 percent (Figure 8).

Under the scenario *trnsfr*, which involves providing a cash transfer to households with children, the effect is a reduction in the time spent by women in GDP work by 0.13 percent and an increase in their time spent on household service by 0.07 percent. The changes are similar for men. The cash transfer allows households to increase their GDP consumption even though they work fewer hours in GDP production—this is due to the income gain from the cash transfer being larger than the income loss due to less GDP work. In addition, men especially, but also women, increase their leisure time. These overall results are mainly due to changes in the time use in households with children under six years of age.

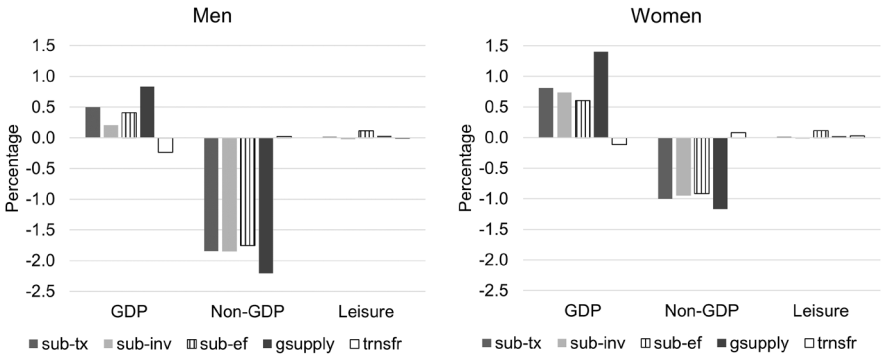
FIGURE 8. Policy scenario 5 changes in time use for men and women in 2030 (percent deviation from base)



Source: Authors' calculations.

The left and right panels of Figure 9 show changes in labor income for men and women, respectively. The results are consistent with the preceding discussion. Thus, for the first three scenarios (*sub-tx*, *sub-inv*, and *sub-ef*), we see the increase in the labor income of women who increase their working hours in GDP activities. At a disaggregated level, the largest increase is for work in care activities included in the GDP. Consequently, the imputed income from household service work decreases for both men and women.

FIGURE 9. Policy scenario-induced changes in labor income for men and women in 2030 (percent deviation from base)



Source: Authors' calculations.

5.2.2. Impact on macroeconomic indicators

For the first three scenarios (*sub-tx*, *sub-inv*, and *sub-ef*), the increase in the subsidy on childcare services purchased in the market leads to substitution away from care services produced within the household. Consequently, household labor income and total household income increase. Figure 10 shows the impacts on private (or household) GDP consumption (panel a), and private GDP and non-GDP consumption (panel b). As indicated, for all three scenarios, private GDP consumption increases compared to the base. However, the size and timing of the increase is influenced by the financing source: except initially, the strongest gains are realized when the source is increased government efficiency (*sub-ef*) followed by direct taxes (*sub-tx*). Financing via reduced infrastructure investment (*sub-inv*) leads to the strongest initial consumption gain but over time the gain shrinks due to the negative impact of this investment decline on TFP and GDP. Figure 5.3 also shows the results for the scenarios *gsupply* and *trnsfr*. For *gsupply*, the addition to the government supply of childcare leads to stronger gains in GDP work, both for men and women, generating higher income gains, something that also is reflected in higher gains in private consumption and investment. For *trnsfr*—a government increase in transfers to households with working-age heads and children financed by an increase in direct taxes—private consumption increases initially but falls below the base towards the end of the simulation period.

The resulting effect on private investment is negative due to the crowding out effect on private investment generated by the increase in income tax (Figure 11). This reduces the stock of private capital and consequently, GDP. The preceding discussion has focused on private GDP consumption, the standard measure of private consumption in economic analysis. Thanks to the extension of our analysis to cover household service production, we also simulated the impact on total private consumption, also including the consumption of household services. As shown in Figure 10b, total private consumption increases in all five scenarios, including the scenario *trnsfr*, which records higher consumption throughout the simulation period.

Moreover, for all scenarios except *trnsfr*—that is, for all scenarios with a decline in the consumption of care services provided by the household—the consumption growth gains compared to the base are considerably lower.

Interestingly, given that the scenario *trnsfr* does not lead to a reallocation of time in favor of activities included in GDP, the tax base of the income tax does not increase. Consequently, the tax collection effort required to finance this scenario is greater than in the first three policy scenarios.

FIGURE 10a. Private GDP consumption by scenario and year (percent deviation from base)

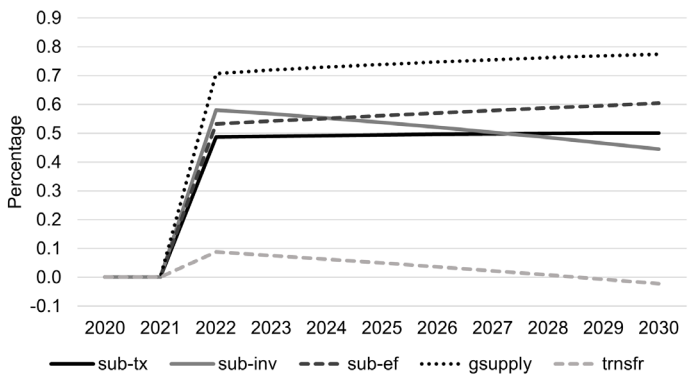
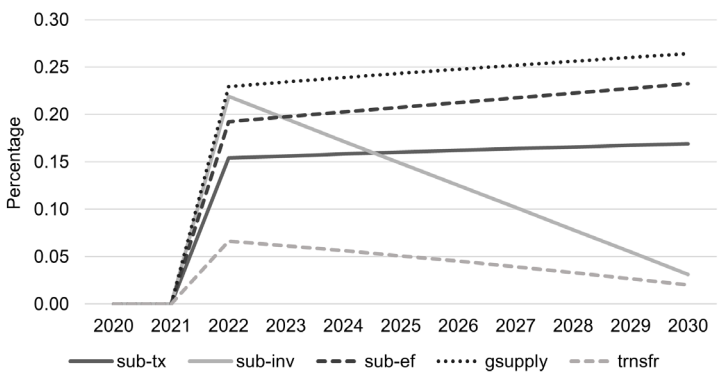


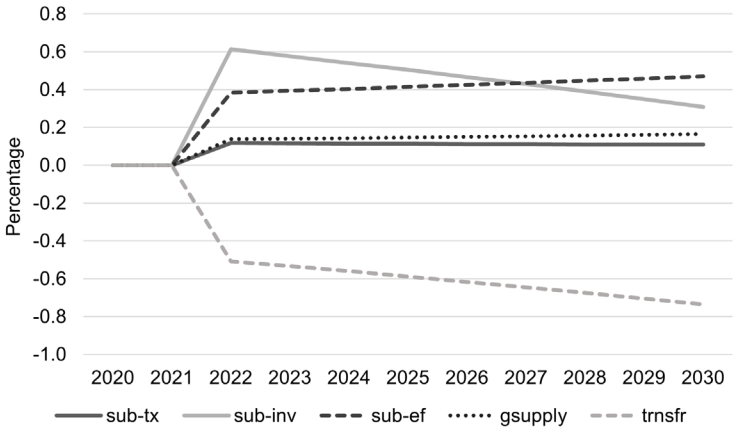
FIGURE 10b. Private GDP and non-GDP consumption (goods and services in GDP and non-GDP) by scenario and year (percent deviation from base)



Source: Authors' calculation.

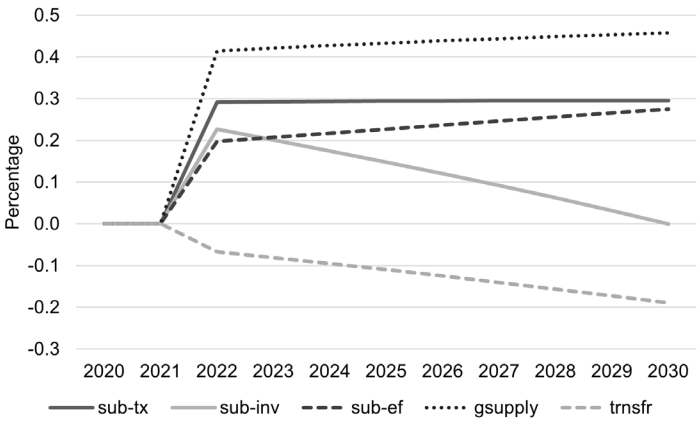
Figure 12 shows the impacts on GDP. In all scenarios except *trnsfr*, the production of GDP care services increases. However, the forward and backward linkages of the childcare sector (private and public) are relatively small since it uses few intermediate inputs and is not an important intermediate input in other production activities. Consequently, the impact on the growth of non-care sectors is relatively small. In the case of the *trnsfr* scenario, the output of all GDP activities decline due to a switch in labor time from GDP to non-GDP productive activities.

FIGURE 11. Private investment by scenario and year (percent deviation from base)



Source: Authors' calculation.

FIGURE 12. GDP by scenario and year (percent deviation from base)



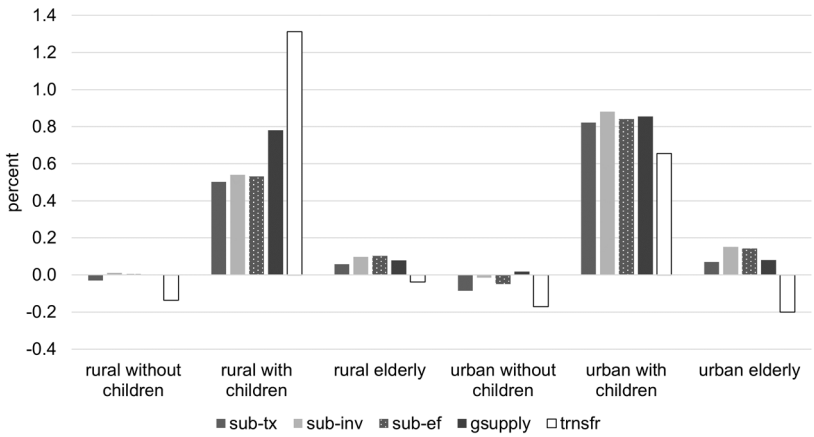
Source: Authors' calculation.

5.2.3. Distributional impacts across households

We next focus on the changes in total household consumption for each of the six representative households in GEM-Care Colombia (Figure 13). In the *trnsfr* scenario, only households that receive the cash transfer (i.e., households with a working-age head and children under six) increase their consumption of both GDP and non-GDP goods and services. In all scenarios, we see positive welfare effects on all households with children. However, we see that the positive welfare effect is stronger for urban households with children compared to rural households with children. This is explained by the fact that urban households with children have considerably higher expenditures on market-provided childcare services and

therefore benefit more from the subsidy. In all scenarios except *sub-ef*, households without children experience a welfare loss as a result of the increase in their tax burden (scenarios *sub-tx*, *gsupply*, and *trnsfr*) or the reduction in public investment in infrastructure (scenario *sub-inv*). However, for the scenario *sub-ef*, the welfare gain for households without children is due to the efficiency gain—their welfare gain would have been stronger if the efficiency gain would have been used for some other purpose such as an increase in public infrastructure investment.

FIGURE 13. Household total (GDP and non-GDP) consumption by representative household type in 2022 and 2030 (percent deviation from base)



Source: Authors' calculation.

6. Conclusion

In recent decades, Colombia has made significant strides in achieving gender equality in its labor market. The country has undergone significant social, economic, and demographic changes. Women's participation in the workforce has increased substantially, reaching levels comparable to high-income countries. Despite this progress, a gender-based participation gap still persists. Women's participation rate in Colombia remains lower than men's, even though women tend to have higher levels of education. Additionally, Colombia faces a high rate of female unemployment compared to the regional average in Latin America. Persistent inequalities in unpaid care work present a major obstacle to continued progress, especially in the labor market.

Economic models typically fail to consider gender in labor markets and issues related to care work, rendering them unsuitable for analyzing the impact of economywide policies addressing care and gender equality in Colombia and other contexts. To address this shortcoming, this paper develops a care-extended CGE model calibrated to the Colombian context, including a pioneering social accounting matrix with labor disaggregated by gender, and extensions covering

unpaid childcare and domestic work. Using the model, we perform simulations designed to analyze and compare the impacts of equal increases in government spending on three policies: i) the introduction of a subsidy for childcare services provided by the market, ii) an increase in public provision of childcare services, and iii) cash transfers from the government to households with children.

The results show that subsidies for private childcare lead to an increase in women's time spent in market work by 0.5 percent to 0.6 percent, depending on the financing source, as well as an increase in their leisure time. The growth of paid employment for women is larger than the employment growth for men since care services are relatively female-labor intensive. For the public provision of childcare, the results are qualitatively similar to the subsidies for private childcare, but the magnitude of the effects is somewhat larger because public provision of childcare services is more labor-intensive than private provision. In this scenario, women increase their time in GDP activities by 0.9 percent. The findings of this research align with previous literature on the impact of government actions in support of childcare, in particular its positive impact on women's participation in the labor market (Berlinski and Galiani [2007]; Lefebvre and Merrigan [2008]; Staab and Gerhard [2010]; Bauernschuster and Schlotter [2015]; Eckhoff-Andresen and Havnes [2019]; Müller and Wrohlich [2020]).

In contrast, the cash transfers to households with young children reduce the time spent by women on market work by 0.13 percent while increasing their time spent on unpaid domestic and care work by 0.07 percent. The changes are similar for men. Men and women both increase their leisure time, with men showing a greater increase. The results are consistent with the evidence of cash transfer programs: while they may alleviate some household constraints, they can have negative impacts on women's labor supply (Medeiros et al. [2008]; Rønsen [2009]; Hardoy and Schone [2010]; Teixeira [2010]; Scarlato et al. [2014]; Garganta et al. [2017]).[25] However, the unintended increase in unpaid care work resulting from cash transfer programs could be avoided if the program is accompanied by additional measures, such as workforce-training or mentoring to improve their capabilities and skills for entering the labor market. Another option is to make the cash transfers conditional on enrolling children in early education programs, for business start-up and growth or for search assistance and finding work [Baird et al. 2018].

Overall, policies aimed at supporting families with children need to be carefully designed to mitigate potential unintended consequences. The results of this study show that policies that expand the care infrastructure or reduce the cost of childcare services can have positive employment effects, particularly by increasing the labor force participation of women. However, gender-based occupational segregation remains a persistent issue, and complementary labor policies such as training and increased wages in female-labor dominated

[25] These results should be treated with caution, however, since the impact on women's employment depends on the design of the cash transfer program and in some cases, can be positive [Molina-Millán et al. 2019].

occupations, including childcare work, can help reduce this. To avoid the potential negative effects of cash transfers on women's labor market participation and the increase in unpaid care work, it is crucial to design cash transfer programs in a way that incentivizes women's labor participation (Salehi-Isfahani and Mostafavi-Dehzooei [2018]; Mostert and Castello [2019]; Fruttero et al. [2020]). For instance, the implementation of cash transfer programs that specifically target economically disadvantaged women actively participating in the labor market, whether in formal or informal sector, has been shown to have a positive impact on and increase female labor force participation rates [World Bank 2017]. Additionally, providing intensive skills training alongside cash transfers has also been found to yield positive impacts on labor [Baird et al. 2018].

Finally, our results suggest that policymakers need to recognize and promote the redistribution of unpaid care work within households to transform social beliefs and norms about gender roles. This shift in societal values requires recognition of the vital role that care work plays in our economies and societies.

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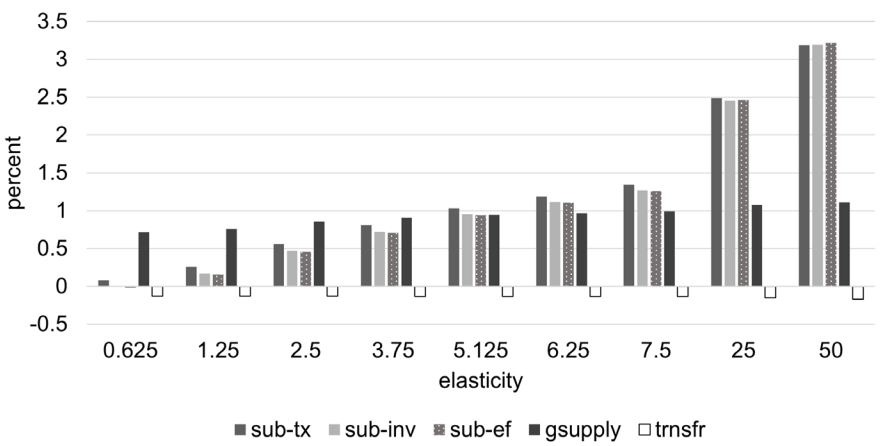
Annex A. Sensitivity analysis

Like any other CGE model, GEM-Care Colombia requires data on several elasticities. The uncertainty regarding the value of these elasticities, in this and other model analyses, implies uncertainty about simulation results. Consequently, it is important to analyze the sensitivity of key results, in this analysis, the level of female GDP work, to selected parameter values. On an a priori basis, the following elasticities were singled out as having the strongest impact on the strength of the links between shocks affecting childcare services and female GDP work:

(a) substitution between GDP and non-GDP in the consumption of domestic and care services; and (b) substitution between male and female labor in both GDP and non-GDP production. Figures A.1 and A.2 show how the size of the change in female GDP work is affected by changes in these three elasticities: consumption elasticity (Figure A.1), and both labor substitution elasticities together (Figure A.2).

Figure A.1 shows the relation between the elasticity of substitution between GDP and non-GDP services in consumption and female labor supply to GDP activities. The subsidy (*sub*) and *gsupply* scenarios promote the consumption of GDP care services, which are intensive in the use of female labor. At the same time, reduced consumption of home care releases female time for other uses. Figure A.1 shows that, for the subsidy scenarios, the value of this elasticity has a relatively strong impact on the female GDP labor supply. For the wide range of elasticities that are tested (from 0.625 to 50 with 2.5 as the central value, used in the paper), the changes in this supply range from close to zero to 3 percent. For the *gsupply* scenario, the impact of higher elasticities on the change in the female GDP labor supply is also positive but less strong; the increases range between roughly 0.7 and 1.1 percent. For the scenario *trnsfr*, changes in this elasticity do not matter.

FIGURE A.1. Sensitivity analysis with respect to elasticity of substitution between consumption of GDP and non-GDP services: Female time use in GDP activities in 2030 (percent change from base)

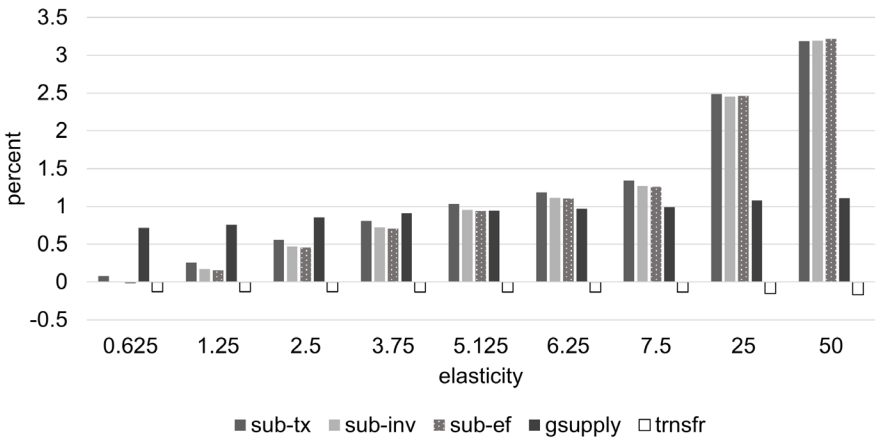


Source: Authors' calculation.

Figure A.2 shows that, for the *sub* and *gsupply* scenarios, the shift from the minimum to the maximum values of the elasticity of substitution between men and women both at home and in GDP activities (from 0.175 to 14 with 0.5 as the central value for home activities and 0.9 for GDP activities) increases female labor supply to GDP activities by a modest 0.1-0.2 percent. For the *trnsfr* scenario, a higher elasticity leads to a larger reduction in the female GDP labor supply,

from -0.1 percent to -0.2 percent. In Figure A.2, higher elasticities mean that the responses to changes in female wages relative to male wages are stronger. For the *sub* and *gsupply* scenarios, the increase in female GDP employment is due to a relative decline in female wages; for the *trnsfr* scenarios, the decrease in female GDP employment is due to a relative increase in female wages. In addition to the results reported in Figure A.2, we also tested the impact of individually changing the GDP and the non-GDP labor substitution elasticities. As expected, the changes were smaller. The results are available on request.

FIGURE A.2. Sensitivity analysis with respect to elasticity of substitution between male and female workers in GDP and non-GDP production: Female time use in GDP activities in 2030 (percent change from base)



Source: Authors' calculation.

In sum, the direction of change in female GDP work is the same across all scenarios for the wide range of elasticities that were tested. The elasticity of substitution in consumption is the key elasticity: if the elasticity is very low, home and GDP care are used in near fixed proportions, the policies that depend on responses to price incentives – the subsidy and *gsupply* scenarios—have little impact. On the other hand, if the elasticity is very high, home and GDP care are viewed as close substitutes and a decline in the relative price of GDP care leads to a substantial switch in care demand from the home to GDP production, reducing demand for female work at home but increasing demand in the GDP labor market since GDP care is intensive in female labor. The sensitivity analysis results indicate, from a policy perspective, the need to better understand the determinants of these elasticities. With regard to the elasticities for male-female labor substitution, the impact of changing the values is very small. The reason is that, for these elasticities to matter, relative wages of male and female labor have to change. However, the scenarios examined in this paper yield impacts on the labor market that are too small to have any strong differential impact on male and female wages.

Annex B. Elasticities

The elasticities used are provided in Table B.1. They were defined on the basis of the literature and authors' assessments, drawing on a combination of econometric evidence and experience from similar country applications.

TABLE B.1. Labor, value-added, trade, and consumption elasticities

Sector	Labor	VA	Armington	CET	LES-price	Cons-Source
Agriculture	0.9	0.25	2	2	-1	n.a.
Mining	0.9	0.2	2	2	-1	n.a.
Other industry	0.9	0.95	1.5	1.5	-1	n.a.
Food industry	0.9	0.95	1.5	1.5	-1	n.a.
Textiles	0.9	0.95	1.5	1.5	-1	n.a.
Petrochemical	0.9	0.95	1.5	1.5	-1	n.a.
Metals and metallic products	0.9	0.95	1.5	1.5	-1	n.a.
Construction	0.9	0.95	0.9	0.9	-1	n.a.
Trade	0.9	0.95	0.9	0.9	-1	n.a.
Hotels and restaurants	0.9	0.95	0.9	0.9	-1	n.a.
Transport	0.9	0.95	0.9	0.9	-1	n.a.
Other services	0.9	0.95	0.9	0.9	-1	n.a.
Professional services	0.9	0.95	0.9	0.9	-1	n.a.
Support services	0.9	0.95	0.9	0.9	-1	n.a.
Public administration	0.9	0.95	0.9	0.9	-1	n.a.
Basic education, private	0.9	0.95	0.9	0.9	n.a.	n.a.
Other education, private	0.9	0.95	0.9	0.9	-1	n.a.
Basic education, government	0.9	0.95	0.9	0.9	n.a.	n.a.
Other education, government	0.9	0.95	0.9	0.9	-1	n.a.
Health	0.9	0.95	0.9	0.9	-1	n.a.
Elderly and disabled	0.9	0.95	0.9	0.9	n.a.	n.a.
Domestic services	0.9	0.95	0.9	0.9	n.a.	n.a.
Child-care, non-GDP	0.5	n.a.	n.a.	n.a.	n.a.	n.a.
Elderly care, non-GDP	0.5	n.a.	n.a.	n.a.	n.a.	n.a.
Other care, non-GDP	0.5	n.a.	n.a.	n.a.	n.a.	n.a.
Composite, child care	n.a.	n.a.	n.a.	n.a.	-0.50	1.50
Composite, elderly care	n.a.	n.a.	n.a.	n.a.	-0.50	1.50
Composite, other care	n.a.	n.a.	n.a.	n.a.	-0.50	1.50
Leisure, male	n.a.	n.a.	n.a.	n.a.	-0.85	n.a.
Leisure, female	n.a.	n.a.	n.a.	n.a.	-0.85	n.a.

Notes:
Labor is CES function between male and female labor.
VA is CES value-added function.
Armington is CES aggregation function for domestic demand (elasticities of substitution between imports and domestic output).
CET is Constant Elasticity of Transformation function for domestic output (elasticities of transformation between exports and domestic supply).
LES is Linear Expenditure system (own-price elasticities of household consumption) for the household.

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The enduring impact of the pandemic on gender patterns of paid and unpaid work: evidence from time-use data in Turkey

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This paper examines changes in the gender patterns of paid and unpaid work in Turkey from the pre-pandemic period to the early pandemic phase under lockdown conditions and the late pandemic phase under relative normalization. We analyze data from three surveys fielded during these periods. We first adjust for demographic shifts during the pandemic to isolate the changes in paid and unpaid work. We then examine the impact of new work arrangements during the pandemic. Pooled regression analysis shows that paid work time has largely returned to pre-pandemic levels under partial normalization. Unpaid work time has decreased relative to the lockdown period, but it remains higher than pre-pandemic, particularly for women but also for men. The more enduring effects of the pandemic pertain to paid work, attitudes toward teleworking, and the provisioning of social care services. The share of teleworking has increased for women and men.

JEL classification: J16, J22, O52
Keywords: COVID-19, work, gender gaps, care

1. Introduction

An important gender economic impact of the COVID-19 pandemic has manifested itself in unpaid and paid work patterns among women and men. There was a substantial increase in demand for household production under lockdown conditions due to school closures, limited or no access to paid domestic and care services, and greater care needs due to COVID-related health problems. Time-use data collected in different countries during the early phase of the pandemic show that, while in many cases women took on a higher share of the increase in demand for unpaid domestic and care work, there was also a relatively substantial increase in men's unpaid work time (see, for example, Aloe et al. [2021] and Meraviglia

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and Dudka [2021] for Italy; Andrew et al. [2020] for the UK; Biroli et al. [2021] for the UK, Italy and the US; Deshpande [2020] for India; Farré et al. [2020] for Spain; Ilkkaracan and Memiş [2021] for Turkey). Shorter paid work hours and teleworking emerged as increasingly accessible options during the major disruptions in employment, and they increased time available for unpaid work at home, particularly for men. Parents of young children spent longer hours at home, and in some instances, fathers' share of care and domestic work increased from the pre-pandemic phase (Carlson et. al. [2021]; Deshpande [2022]). Such changes encouraged expectations of a more egalitarian division of care and domestic work at home persisting into the post-pandemic era.

Emerging evidence, however, suggests that the patterns in unpaid and paid work time are reversing in the second phase of the pandemic after lockdown conditions were lifted. These shifts signal a possible return to the pre-pandemic norms, but whether or not this happens depends on power relations within families, on whether or not the partner with less bargaining power will still carry more of the work burden [Croda and Grossbard 2021]. More flexible work and a higher prevalence of teleworking, however, seem to be a more enduring outcome of the pandemic. The flexible work arrangements adopted by businesses are expected to persist, which may lead to real changes in the gender division of housework and childcare [Alon et al. 2020]. This new trend could have significant implications for the landscape and experiences of paid and unpaid work in Turkey.

This paper uses a unique database collected by three field surveys. These surveys were conducted during the pre-pandemic period, early pandemic period with lockdowns, and late pandemic period with relative normalization. All three surveys included a standard recall time-use question. Using the first two surveys, Ilkkaracan and Memiş [2021] assessed the changes in the gender gaps in unpaid and paid work time due to COVID-19 from the pre-pandemic period to the early pandemic period with lockdown. Here, we analyze the third survey to explore whether the transformations in gendered unpaid and paid work patterns that we observed under lockdown persist in the post-lockdown pandemic period. Of particular interest in this paper is the impact of increased adoption of teleworking and shorter work hours on women's and men's allocation of time.

Summarizing the main findings of our earlier study [Ilkkaracan and Memiş 2021], foremost we observed a significant increase in unpaid domestic work by both women and men, but more by women, thus increasing the gender gap in unpaid care by about an hour a day. Within-group differences among women and men are noteworthy: among women, the differences in unpaid work time by their education level, employment status, or household income narrowed or even disappeared under lockdown. As purchasing power for paid care services ceased to matter, the unpaid work time of women with higher education, who were employed or living in high-income households, converged towards time similarly spent by women with lower education, not employed or living in low-

income households. Among men, the location of work had a significant influence on their unpaid work time. The increase in the unpaid work hours of men who switched to working from home was double that of men who continued to work in the workplace. Based on this finding, our earlier study proposed that flexible work practices, such as teleworking and shorter work weeks, could increase men's participation in household production and promote more equal sharing of unpaid work at home.

Ilkkaracan and Memiş [2021] also found that paid work time decreased, on average, for both women and men (whether employed or non-employed during the pandemic), but it decreased less for women than for men. Almost a third (31 percent) of women and a fifth (18 percent) of men who were employed before the pandemic reported that they suffered job and income losses due to dismissal or unpaid leave. For those who remained employed during the pandemic, however, paid work time increased slightly among women (by 0.3 hours/day) but decreased among men (by 0.8 hours/day). Having no data on occupation, we attributed this disparity to the higher concentration of women's employment in "essential" sectors such as health, education, and food retail, and to more women being able to work remotely. Forty-nine percent of employed women were working from home fully or partially, while 39 percent for employed men did so during the pandemic.

In sum, women on average worked more total hours (paid and unpaid) compared to the pre-pandemic period, while men worked fewer hours. The increase in total work hours was more pronounced for women who remained employed during the lockdown; they worked 1.4 hours more daily, that is, 1.1 hours more in unpaid work and 0.3 hours more in paid work. By contrast, the total work hours of men who remained employed remained the same or decreased slightly as the increase in their unpaid work time was offset by the decrease in their paid work hours.

In this paper, we examine the third field survey, conducted in October 2021 under partial normalization, after some lockdown measures were lifted. We explore whether the above findings about the early pandemic phase have persisted. For example, to what extent did the shifts in the allocation of time to paid and unpaid work by women and men continue after stay-at-home measures had been lifted? Did work patterns return to their pre-pandemic levels? For what share of women and men in employment has teleworking become permanent, and to what extent does it still influence the allocation of time of women and men? Finally, because the third survey fielded additional questions about the views and preferences of women and men concerning policies on the care economy and work-life balance, we are able to explore whether the pandemic experience changed views about gender equality.

2. Data and methodology

As mentioned above, this paper analyzes data collected by three consecutive field surveys in Turkey conducted in the pre-pandemic period (April 2018), early pandemic under lockdown conditions (May 2020), and late pandemic under relative normalization (October 2021). All three surveys used a standard recall time-use question. Rather than panel surveys, each is a cross-section survey with a different sample. The first two surveys were the Life Styles Survey (LSS), conducted on a monthly basis with a national sample defined by the private survey company KONDA in 2010. These surveys included two parts: one part which was a series of repeated questions each month on political voting preferences and attitudes defining lifestyles, and another part which was a set of rotational questions that pertain to participants' opinions on selected topics [KONDA 2008]. For example, in March and April 2020, the rotational questions focused on the COVID-19 pandemic. The LSS conducted in May 2018 included for the first time a time-use question using a recall method: the respondents were asked to recount their activities over 24 hours on a typical weekday in the previous week. This time-use question was repeated in KONDA's survey in May 2020 which focused on how the pandemic had changed time use. At the time, Turkey was under a partial lockdown during the week and total lockdown on weekends, and schools were closed at all levels including pre-primary schools. In October 2021, the third household survey was fielded; it was not an LSS, but a special survey entitled "Home Care and Time Use during the Pandemic," and was sponsored by the Turkish office of the Heinrich Boell Foundation. The recall time-use question of the May 2020 survey was repeated. At this time, schools were open again and the stay-at-home measures had been lifted with a return to partial normalization except for regulations on wearing masks. All abovementioned surveys were conducted through face-to-face interviews.

The survey samples included 2,523 randomly selected individuals in October 2021, 2,407 individuals in May 2020, and 5,793 individuals in April 2018. The Annex presents the summary statistics for all three samples based on age groups, education, and household types (Table A1 and A2 in Annex). The respondents were predominantly individuals over 18 years old and living in couple households with children, with three to five co-residents, as is typical in the modal household structure in Turkey.

The rest of the paper is organized as follows: we first explore the changes in average paid, unpaid, and total work time by gender and employment status from the pre-pandemic phase (2018) to the two different phases of the pandemic (the lockdown in 2020 and relative normalization in 2021). We then conduct multivariate regression analysis using pooled and single cross-section data to assess the impact of the pandemic on the time allocation to work by women and men. Because the occurrence of the pandemic and the duration of its different phases are exogenous to individuals and households, the results of our regression analysis can be interpreted as causal.

2.1. Changes in the mean duration of work time of women and men

For our first analysis, to be confident that the observed changes in time use over time are due to behavioral changes in response to the pandemic and not to differences in sample compositions across the three surveys, we adjust for demographic changes. We use two decomposition methods proposed by Aguiar and Hurst [2006] to do so. The first decomposition method estimates the change over time in the mean duration of work time of women and men between two components, using constant weights that are derived from pooling the three rounds of time-use data and computing the percentage of the population that belongs to each demographic cell constructed along three categorical variables, namely, sex (two categories), age group (four categories), and education (three categories). The result is a 24x1 demographic vector, W, that contains fixed weights which we use to calculate the weighted means for each activity in each year. The four age categories represent ages 15-17 years, 18-32 years, 33-48 years, and 49 years and over. The three education categories correspond to less than high school education, high school, and more than high school. Specifically, if T_{it}^{j} is the 24x1 vector of cell means for activity j in year t, then the demographically-adjusted average time spent in activity j in year t for individual i is $W'T_{it}^{j}$.

The second decomposition method proposed by Aguiar and Hurst [2006] involves an econometric estimation which conditions on demographic factors to observe how time spent in a given category changed from 2018 to 2020 and then to 2021, adjusted for demographic changes. Formally, we estimate:

$$T_{it}^{j} = \alpha + \beta_{2020} D_{2020} + \beta_{2021} D_{2021} + \gamma_{age} Age_{it} + \gamma_{educ} Educ_{it} + \varepsilon_{it} \quad (1)$$

where T_{it}^{j} is the time spent in activity j for individual i in survey t and D_{2020} and D_{2021} are year dummies equal to one if individual i participated in a time use survey conducted in year 2020 or 2021. As in the first method, the disaggregation by age groups and education levels yields demographic cells with four age categories and three education categories. The coefficients of the year dummies represent changes over time, isolated from changes in demographic factors. The results from both methods show consistent findings; in the next section, we focus our discussion on the findings from this second method.[1]

2.2. Impact of the phases of the pandemic on work time

The second part of our analysis assesses the impact of the pandemic at its different phases on paid and unpaid work time of men and women. Because the pandemic might affect individuals and households in different ways, we add control variables such as education, household income, marital status,

[1] Consistent findings based on the first method adjusting for demographic weights are presented in the Annex (Figure A1 and Table A5). We mainly focus on the findings of the October 2021 survey, reflecting on whether the effects observed in the early pandemic persisted under the late pandemic period and to what extent.

employment status, and location of employment. We estimate a regression model using two samples of pooled data. First, we pooled all three rounds of survey data from 2018, 2020, and 2021, using year dummies for 2020 and 2021 to obtain pooled estimators for the impact of the lockdown (2020) and partial normalization (2021). Data on location of employment (i.e., remotely, in the workplace, or in hybrid form), a variable of focus for this study, were collected by the pandemic surveys (2020 and 2021) but not in the pre-pandemic survey (2018). Hence, we also conduct a pooled estimation for data from 2020 and 2021 to explore the impact of emerging forms of employment on unpaid work time. Since time data can only be greater than or equal to zero, we use Tobit estimation to analyze changes in time use patterns. Formally, we estimate:

$$T_{i\,t}^{j} = \alpha + \beta_{2020}\, D_{2020} + \beta_{2021}\, D_{2021} + \gamma_{age}\, Age_{it} + \gamma'_{x} X_{it} + \varepsilon_{it} \tag{2}$$

where $T_{i\,t}^{j}$ is the time spent in activity j by individual i in survey t. D_{2020} and D_{2021} are year dummies equal to one if the individual i participated in the 2020 or 2021 time-use survey. Age_{it} is a vector of age group dummies, and $Educ_{it}$ is a vector of educational attainment dummies. X_{it} stands for the demographic, household, and employment status variables, including marital status, whether the household has co-habiting children, the age of children and household income. The equation for estimation is,

$$y_{i\,t}^{*} = \beta'_{x}\, X_{i} + \in_{ji} \tag{3}$$

where $y_{i\,t}^{*}$ is the latent variable representing time allocated to activity j by individual i. X_i is a vector of explanatory variables demographic, household, employment status variables. The Tobit model assumes that there is a latent continuous variable that cannot be observed over its entire range as in time-use data. A large fraction of paid work time for women is zero due to the gender-based division of labor in Turkey which means that the labor force participation rates of married women with small children is quite low. For the same reason, a significant proportion of observations on unpaid work time for men is zero. β_j is a vector of parameters and $\in_{ji}$ is the error term. The observed time allocation (y_{ji}) variables are related to the corresponding latent time allocation variables by

$$y_{ji} = y_{i\,t}^{*} \text{ if } y_{i\,t}^{*} > 0 \tag{4}$$

Because employment status, which we include as one of the control variables in the time-use equations, is endogenous and thus not independent of the other control variables, its coefficient is likely to be biased.[2] In order to address this

[2] We first employed an instrumental variable approach to address this endogeneity issue by using regional unemployment rates as instruments for employment status. Disaggregated by sex and age groups, we obtain 194 different regional unemployment rates using data from Turkey's Household Labour Force Surveys. The Household Labor Force Survey data is compiled by Turkish Statistics Agency TURKSTAT, the most comprehensive information source on the Turkish labor market. The Wald test showed that the null hypothesis of no endogeneity is rejected.

endogeneity problem, we use Heckman's two-step model [Heckman 1979] and the double-hurdle model [Cragg 1971] to address both the endogeneity issue and the potential issue that a factor might have different effects on the decision to be employed and on the decision about work hours. The double-hurdle model allows this potential difference and assumes that positive hours of work time are observed only if the individual's decision passes the two hurdles. To correct for sample selection bias, again we use the regional unemployment rates as instruments for the employment status that varies by age group and gender. In particular, this estimation technique allows us to explore any changes in the impact of demographic variables on unpaid work time, such as education, marital or employment status under lockdown and partial normalization with cross-sectional data, separately for each year (2018, 2020, and 2021).

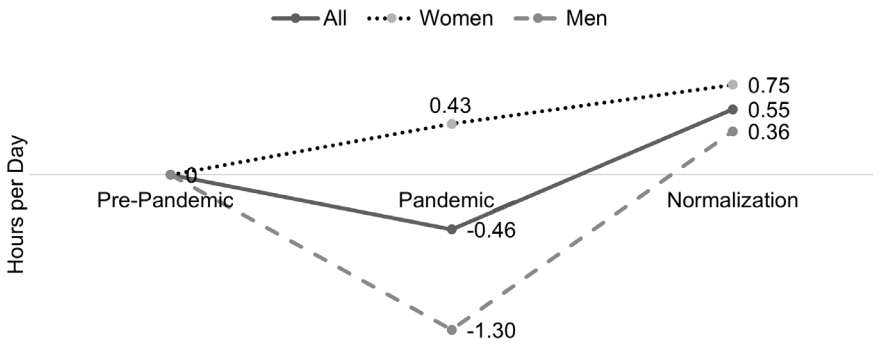
Empirical studies using pre-pandemic data have found that, under normal circumstances, having higher education and being employed reduces unpaid work time for women, while being married increases it (Ilkkaracan [2012]; Dayioglu [2000]; Ozar and Gunluk-Senesen [1998]). Ilkkaracan and Memiş [2021] find that these within-group differences were eliminated under lockdown with statistically insignificant coefficients for these control variables. We add the cross-section estimation for 2021 to explore whether within-group differences re-emerge under partial normalization, and add controls that signify when remote and hybrid employment arrangements were allowed.

3. Findings

3.1. Gender patterns in time-use during the pandemic

The findings from the two decomposition approaches based on Aguiar and Hurst [2006] show behavioral changes, i.e., how average paid, unpaid, and total work time would change, if the demographic weights were fixed as in 2018. Figures 1-3 show the changes in total, unpaid, and paid work time from the pre-pandemic phase to the early phase of the pandemic with lockdown measures and then to the late pandemic phase with partial normalization. We find that both women and men spend more time in paid and unpaid work combined (Figure 1), (0.75 and 0.36 hours/day, respectively) in the late pandemic phase (October 2021), as compared to the pre-pandemic period of April 2018. For the overall population, the increase in total work time was 0.55 hours/day. Under lockdown (May 2020), by contrast, total work time decreased for men by 1.30 hours/day, and it decreased an average of 0.46 hours/day for the total population. In contrast, at that time there was an increase in total work for employed women of 0.43 hours/day compared to the later phase of near-normalization. This difference was because under the lockdown, the relative decrease in women's paid work (-0.81 hours/day) was more than offset by a dramatic increase in their unpaid work hours (1.23 hours/day).

FIGURE 1. Change in total work time conditional on age and education, hours/day



The increase in total work reflects the increase in unpaid work to a large extent. During the late pandemic period, unpaid work remained higher for both men and women compared to the pre-pandemic period, although not to the same extent as under lockdown (Figure 2). In October 2021, women's and men's average unpaid work time were longer than during the pre-pandemic period by 0.69 and 0.28 hours per day, respectively. For the total population, an average of 0.53 hours per day more was spent on unpaid work as compared to the pre-pandemic era. These numbers indicate a persistent increase in unpaid work time under partial normalization, though not to the same extent as under lockdown. Under lockdown in May 2020, the increase in unpaid work time was 1.23 hours per day for women and 0.60 hours for men, or almost one more hour per day, on average, for the total population. At that time, paid work time decreased by as much as 1.90 hours per day for employed men and by 0.81 hours per day for employed women, or a decrease of 1.43 hours per day, on average, for the population. After some normalization, however, we observe a recovery toward pre-pandemic levels in paid work time (Figure 3).

FIGURE 2. Change in unpaid work time, conditional on age and education, hours/day

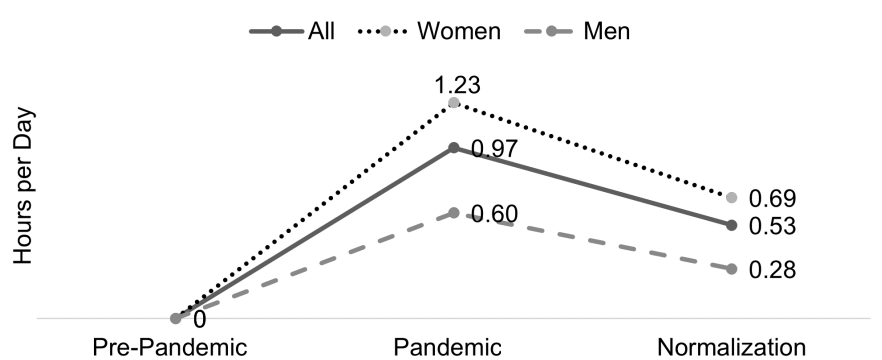
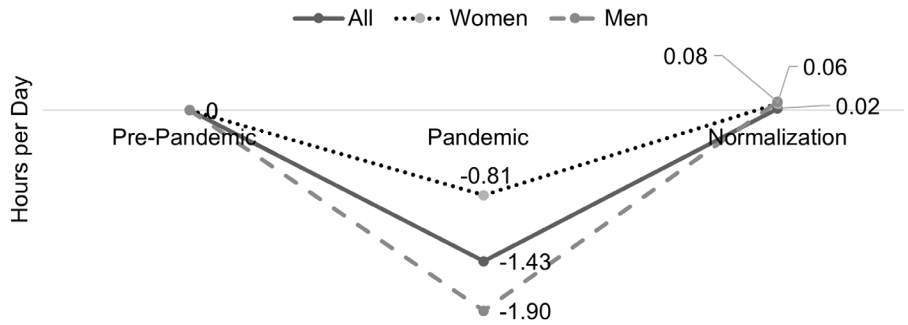


FIGURE 3. Change in paid work time, conditional on age and education, hours/day



3.2. Impact of the pandemic on work

Tables 1-3 show the results for work hours, using the pooled sample from the three surveys, on the impact of the two phases of the pandemic and of the location of work after controlling for a range of individual and household characteristics (age, education, marital and employment status, presence of children and age of children, household income) (Equation 2). The significant and positive coefficients of year dummies on unpaid work time reflect the gender impact of the lockdown period on unpaid work time relative to the pre-pandemic period (Table 1a). Under lockdown, men's unpaid work time increased by 0.49 hours per day (see the marginal effects), but women's unpaid work time rose by 0.9 hours per day. With normalization in late pandemic, we again observe a persistently longer duration of unpaid work for both men and women than the pre-pandemic. However, the absolute effect and the gender gap are lower as compared to the lockdown with an increase of 0.14 hours/day for men and 0.52 hours/day for women. The magnitudes of the changes in unpaid work, controlling for the range of variables in Equation 2, are lower than the changes we obtain using the method based on Aguilar and Hurst [2006] as presented in Figure 1 controlling for endogeneity. We reject the null hypothesis for the correlation between selection and outcome equations for the paid work time (atrho) and total work time estimations, which supports the selection model to be used. However, the test results do not support the unpaid work time selection model.

The negative effect of the lockdown on employment hours of men was stronger (at -0.688) when compared to women (-0.568). Women in employment spent longer hours at work (1.55 hr./day) while no significant change is observed in men's paid work time. The selection equation presents a negative and significant change in employment of the lockdown at a higher degree for men compared to women. Paid work time, on the other hand, presents a positive change for employed women (0.50 hours/day), unlike its impact on men's paid work time (-0.57 hours/day). Under partial normalization, we observe that paid work time

rises for men by 0.87 hours/day relative to its pre-pandemic level while for women, the change is higher at 1.26 hours/day. The selection equation results support a better recovery in men's jobs; year dummies coefficients in selection equations present a higher positive coefficient for men (by 0.25) when compared to women (by 0.21). Table 1b presents the estimation results using a double-hurdle model.

Table 2 presents estimation results for unpaid, paid, and total work time for women and men, respectively, in the smaller pooled sample (2020 and 2021), this time including also the location of paid work as a control variable. We use remote and hybrid employment as two separate controls against the base of being employed in the workplace. We also have a year dummy for 2021, which shows the change in work time from lockdown to normalization. Women's remote and/or hybrid paid work decreased from 45 percent in 2020 to 25 percent in 2021, while men's remote and/or hybrid paid work decreased from 42 percent of employed men in 2020 to 13 percent in 2021 [Ilkkaracan 2022]. When questioned about their preferences, 42 percent of women stated they prefer teleworking, 30 percent stated they prefer hybrid forms (partly teleworking and partly working at the workplace), and 28 percent stated a preference for working at the workplace. The distribution of preferences for men is 21 percent, 29 percent, and 50 percent, respectively. As expected, women's preferences for teleworking are higher than men. Yet at the same time, it is striking that almost one in every two men prefers some form of teleworking [Ilkkaracan 2022].

This time we only use the double-hurdle estimation technique as our focus is mainly on unpaid work time. The results in Table 2 indicate that women working from home or remotely spend 1.83 hours/day more on unpaid work than the base group who employed in the workplace. The coefficient for hybrid employment is positive, but we find a lower effect with 0.59 hours/day compared to remote work. Among the non-employed groups, homemakers spend the most unpaid work time at 2.4 hours/day longer than women working in the workplace. Women's unpaid work time decreased by 0.63 hours/day under normalization (year dummy 2021) as compared to the lockdown.

TABLE 1a. Estimation results for daily work time, by gender, with Heckman correction: pooled samples for 2018, 2020 and 2021

	Total work time			Paid work Time			Unpaid work time		
	Coefficients	**Marginal effects**	**Selection equation**	**Coefficients**	**Marginal effects**	**Selection equation**	**Coefficients**	**Marginal effects**	**Selection equation**
Women (n=5,154)									
2020	2.316*** (0.475)	1.21***	-0.572*** (0.0632)	1.555*** (0.482)	0.50	-0.568*** (0.0632)	0.969*** (0.247)	0.900***	-0.577*** (0.0633)
2021	1.406*** (0.333)	1.97***	0.215*** (0.0599)	0.905*** (0.321)	1.26***	0.207*** (0.0599)	0.503*** (0.177)	0.526**	0.205*** (0.0601)
athrho	-0.468*** (0.120)			-0.560*** (0.141)			-0.0627 (0.102)		
lnsigma	1.527*** (0.0402)			1.509*** (0.0494)			0.855*** (0.0225)		
Constant	8.228** (3.343)		-2.755*** (0.336)	8.181** (3.282)		-2.723*** (0.335)	1.184 (1.798)		-2.746*** (0.338)
Men (n=5,265)									
2020	0.357 (0.284)	-016	-0.692*** (0.0504)	-0.0165 (0.298)	-0.57***	-0.688*** (0.0504)	0.494*** (0.0782)	0.488***	-0.690*** (0.0505)
2021	0.853*** (0.202)	1.21***	0.248*** (0.0561)	0.708*** (0.200)	0.87***	0.249*** (0.0560)	0.139** (0.0604)	0.141**	0.251*** (0.0561)
athrho	-0.235*** (0.0909)			-0.309*** (0.110)			-0.0109 (0.0552)		
lnsigma	1.502*** (0.0159)			1.500*** (0.0191)			0.293*** (0.0130)		
Constant	7.801*** (1.079)		-2.322*** (0.200)	7.418*** (1.157)		-2.328*** (0.200)	0.940*** (0.283)		-2.346*** (0.201)

Note: Standard errors in parentheses. ***, **, * denote statistical significance at the one, five, and ten percent levels, respectively. Control variables are age, education, marital status, household size, and household composition variables, categorical variable for income group, existence of children in the household disaggregated by age group region, and the regional unemployment rates by gender and age group as the instrumental variable. The significance of artrho suggests that the null hypothesis of no correlation between error terms of time duration and selection equation is rejected for total work time and paid work time, but not for unpaid work time. Any estimation of work time without controlling for sample selection bias would turn biased results in the case of total work time and paid work time but not for unpaid work time. Lnsigma provides information on the correlation between residuals, suggesting dependence between the time duration and selection equations.

TABLE 1b. Estimation results for daily work time, by gender, using a double-hurdle model: samples for 2018, 2020 and 2021

	Total work time			Paid work Time			Unpaid work time		
	Coefficients	Marginal effects	Selection equation	Coefficients	Marginal effects	Selection equation	Coefficients	Marginal effects	Selection equation
Women (n=5,154)									
2020	1.286*** (0.208)	0.969***	0.257*** (0.065)	0.835** (0.397)	-0.500***	-0.663*** (0.062)	1.173*** (0.195)	1.325***	0.623*** (0.062)
2021	1.097*** (0.218)	0.757***	0.138* (0.074)	0.166 (0.298)	-0.059	-0.097* (0.057)	1.075*** (0.226)	0.642***	0.164** (0.188)
Men (n=5,265)									
2020	-0.889*** (0.206)	-0.347**	-0.113** (0.051)	-0.087 (0.246)	-1.02***	-0.615*** (0.051)	1.888** (0.873)	0.536**	0.519*** (0.047)
2021	0.372** (0.194)	0.571***	0.246*** (0.064)	0.361 (0.200)	0.240*	0.024 (0.059)	0.051* (0.846)	0.229*	0.318*** (0.052)

Note: Standard errors in parentheses. ***, **, * denote statistical significance at the one, five, and ten percent levels, respectively. Control variables are age, education, marital status, household size, and household composition variables, categorical variable for income group, existence of children in the household disaggregated by age groups region and the regional unemployment rates by gender and age groups as the instrumental variable.

TABLE 2. Double-hurdle estimation results of work time by gender and employment type: pooled sample for women and men (2020 and 2021)

	Women (n=2,168)		Men (n=2,120)	
	Unpaid work time	**Marginal effects**	**Unpaid work time**	**Marginal effects**
Employed-hybrid	1.414** (0.688)	0.595***	2.504 (1.926)	0.248*
Employed-remote	3.761*** (0.841)	1.827***	1.274 (1.389)	0.212**
Non-employed- retired	3.645*** (0.600)	1.913***	3.136** (1.454)	0.473***
Non-employed- homemaker	4.198*** (0.467)	2.375***	-	-
Non-employed- student	1.473** (0.583)	1.034***	1.497*** (0.375)	0.379**
Unemployed	2.884*** (0.529)	1.819***	2.068*** (0.430)	0.625***
2021.year	-0.495*** (0.091)	-0.627***	-0.418*** (0.206)	-0.209**

Note: Standard errors in parentheses. ***, **, * denote statistical significance at the one, five, and ten percent levels, respectively. Control variables are age, education, marital status, household size, and household composition variables, categorical variable for income group, existence of children in the household disaggregated by age group, region, and the regional unemployment rates by gender and age group as the instrumental variable.

Table 2 also presents the estimation results for men in the smaller pooled sample (2020 and 2021). Compared to the base group of those employed at the workplace, men working from home or remotely spend an additional 0.21 hours/day on unpaid work, and men working in hybrid jobs, an additional 0.25 hours/day. The positive impact of remote/hybrid work on men's unpaid work time is smaller than that observed for women, but this is still substantial in relative terms to men's average unpaid work time. On a weekly basis (five days a week), men working remotely or hybrid spend one hour to 1.2 hours per week more time on unpaid work than men working in the workplace. Among the non-employed groups, unemployed men spend around three hours longer per week than those employed in their workplace, while students spend almost two hours more and the retired spend 2.5 hours more per week. We also find a statistically significant decline in men's unpaid work time under normalization (year dummy 2021) as compared to the lockdown period even though it is low at around one hour per week; this is more evidence that men's increased participation in unpaid work during the lockdown does not persist into the late pandemic period of partial normalization.

Table 3 shows cross-sectional estimation results separately for each year (2018, 2020, and 2021). Confirming our previous results in Ilkkaracan and Memiş [2021], the coefficients on education continue to remain statistically insignificant under partial normalization (2021) as they did for the lockdown period.

The cross-section for the pre-pandemic (2018), however, reveals that women with higher education spend less time on unpaid work (consistent with other studies using pre-pandemic time-use data) than their counterparts with lower education. Married women consistently spend more time on unpaid work than non-married women in all three time periods. The association between being employed and unpaid work time for women changed from being negative pre-pandemic to positive and statistically insignificant under lockdown. Under partial normalization in 2021, being employed at the workplace or in hybrid form is once again negatively associated with women's unpaid work time, while the coefficient on remote employment is positive and insignificant. Even with the lockdown measures lifted, the within-group differences among women by education and employment status in unpaid work time seem to be less pronounced than in the pre-pandemic period (see Tables A4 and A3 and Figure A1 in Annex).

The cross-section estimation results for men show the positive influence of higher education on unpaid work time during the pre-pandemic period, with university graduates doing more unpaid work than their less educated counterparts. This relationship faded under lockdown, and persists under partial normalization. In the pre-pandemic period, employed men also spent substantially less time on unpaid work, but this effect also dissipated under lockdown. Under partial normalization, the pre-pandemic pattern has reappeared for men employed in the workplace, but not for men who are working remotely or hybrid; we see no relative negative influence on unpaid work time as compared to their non-employed counterparts.

Finally, the survey data on attitudes towards policies on care provision and work-life balance show an overwhelmingly positive support.[3] The policy questions were posed under five headings: provisioning of daycare centers for children by local and central governments; measures to keep these services intact under extraordinary circumstances such as the pandemic; legal regulations for employed parents to take childcare leave when necessary; such legal provisions for childcare leave should be equally accessible for fathers and mothers; provisioning of home-based care services and also daycare services (through active living centers) for elderly and disabled by local and central governments.

About four-fifths (83 percent) of the respondents supported the statement that "Quality nurseries and kindergartens should be provided to all families with children," whereas 17 percent did not. A lower percent of respondents (59 percent) agreed with the statement, "Nurseries and kindergartens should remain open by taking necessary precautions in extraordinary situations such as the pandemic." The relatively lower support for the latter statement can be ascribed to concerns about contagion risk [Ilkkaracan 2022].

[3] See Ilkkaracan [2022] for detailed results.

TABLE 3. Double-hurdle estimation results of work time by gender and employment type: cross-sectional samples (2018, 2020, and 2021)

Dependent variable: Daily unpaid work time	2021				2020				2018			
	Women		Men		Women		Men		Women		Men	
	Amount	Selection	Amount	Selection	Amount	Selection	Amount	Selection	Amount	Selection	Amount	Selection
Educational attainment (Base: Less than high school)												
High School	0.224 (0.393)	-0.006 (0.125)	-2.479 (1.541)	0.054 (0.097)	0.00460 (0.346)	0.210 (0.180)	0.010 (0.830)	0.210* (0.108)	-0.611* (0.312)	-0.111 (0.0730)	-2.094 (2.816)	-0.026 (0.067)
University	-0.506 (0.694)	-0.054 (0.148)	-3.357 (2.376)	0.017 (0.112)	-0.0456 (0.436)	0.533** (0.218)	1.428 (1.041)	0.287** (0.123)	-0.961** (0.482)	-0.0369 (0.0971)	-0.708 (1.547)	0.240*** (0.079)
Marital Status (Base: Single)												
Married	1.349 (0.838)	0.924*** (0.150)	1.503 (2.088)	0.086 (0.143)	3.159*** (0.545)	1.240*** (0.221)	0.658 (1.298)	0.301* (0.175)	2.425*** (0.516)	0.853*** (0.0969)	0.707 (1.718)	0.114 (0.103)
Separated/ Widow(er)	0.232 (0.986)	0.163 (0.202)	2.385 (2.559)	0.248 (0.243)	1.517*** (0.565)	0.037 (0.220)	3.028 (1.900)	0.019 (0.222)	1.683*** (0.580)	0.554*** (0.111)	-1.802 (2.576)	0.094 (0.128)
Employment Status (Base: Non-employed)												
Employed in workplace	0.137*** (0.020)		0.086*** (0.019)		-2.370*** (0.496)	-0.869*** (0.159)	-2.015*** (0.704)	-0.377*** (0.103)	-2.782*** (0.372)	-0.551*** (0.070)	-0.208 (1.155)	-0.266*** (0.064)
Employed hybrid	0.827 (1.017)		5.474* (3.233)									
Employed remote	5.935*** (1.260)		-0.694 (2.313)									

A majority (87 percent) of survey respondents supported the statement that "It should be made legal for employed parents to take leave for childcare, when necessary," and 80 percent supported the egalitarian approach of "Facilitating childcare practices of employed parents should include not only mothers but also fathers."

There was overwhelming support (94 percent) for the statement that "Public institutions and municipalities should provide home care services for the elderly, disabled and sick." Similarly, the statement "Public institutions and municipalities should provide care services for the elderly and disabled through day centers (such as active living centers, community centers)" was supported by 91 percent of the respondents.

We analyze the scores on these six propositions on a scale from one to five (with five being very true, and one very false), and find that the average scores of men and women are largely similar. Of these six propositions, men and women differ most on, "Facilitating childcare practices of employed parents should include not only mothers but also fathers." However, even on this issue, support is very high with 4.22 out of five for women and 4.12 for men, a negligible difference [KONDA 2022].

There is no comparable pre-pandemic data on public attitudes towards similar policies. Hence, it is not possible to determine the extent to which support for the care economy and work-life balance policies was impacted by the pandemic conditions. However, it is possible that the overwhelming support for these policies, from all segments of men and women, can be partially attributed to an enhanced awareness of the importance of access to care which was triggered by the pandemic.

4. Conclusions

Summarizing our main findings, under partial normalization in the late pandemic period, the unpaid work time for women and men remains higher than during the pre-pandemic period, but less than under the lockdown period. The persistent increase is more than double for women than for men (at 0.63 hours/day for women versus 0.30 hours/day for men). Paid work time, however, returned to pre-pandemic levels and even at slightly higher levels for employed men than before the pandemic. The combined paid and unpaid work time for women and men are higher (0.77 hours/day and 0.65 hours/day, respectively) under some normalization. However, the increase for women is due more to a change in unpaid work, while for men the increase is due to equal increases in unpaid and paid work time.

Overall, in the post-lockdown phase, there has been a return to the workplace as the location of employment, but some teleworking and hybrid work have remained. A substantial share of employed women (25 percent) and a non-negligible share of employed men (13 percent) are still working under these flexible arrangements. Many more, however, would prefer fully remote or hybrid forms of employment—72 percent of women and 49 percent of men.

We find that working remotely increases the unpaid work time of both women and men and decreases their paid work time (including travel time), and that hybrid work has a similar effect for men, as compared with their counterparts whose location of employment is the workplace. The influence of remote employment on unpaid work time is much more pronounced for women than for men. It has increased unpaid work time by 1.56 hours/day for women versus 0.64 hours/day for men. In comparison, the influence on paid work time is larger for men, reducing their paid work time by 0.55 hours/day, than for women, by 0.32 hours/day.

Our findings about the increasing practice of, and overwhelming preference for, home-based and hybrid work by women and men in the late pandemic era pose an opportunity and a threat. Lack of appropriate policy intervention may result in a widening of the gender gaps in unpaid and paid work time, with implications also for jobs and earnings. To avoid this trap, remote work options can be promoted and incentivized for men as a form of work-family balance, such as hybrid work options for fathers of small children or for men with long-term care responsibilities.

As mentioned above, one of the important findings of the May 2020 survey is that awareness of the importance of household production and care work increased during the pandemic. This occurred regardless of gender, education, household income and employment status, for all segments of society. This is a historical moment for change and for stronger social support for care policies. Data from the third survey during the late pandemic period show an overwhelmingly positive public support by women and men for an expansion of care services and care leave for better work-life balance.

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Annex

TABLE A.1. Sample proportions by demographic characteristics

	2018		2020		2021	
	Women (n=2816)	**Men (n=2977)**	**Women (n=1186)**	**Men (n=1221)**	**Women (n=1262)**	**Men (n=1239)**
Age group						
15-17	3.9	3.3	3.9	3.3	1.2	2.2
18-32	32.9	30.4	32.9	30.4	32.8	32.4
33-48	34.8	30.0	34.8	30.0	35.0	32.3
49+	28.5	36.2	28.5	36.2	31.0	33.1
Educational attainment						
Less than high school	48.2	62.0	43.5	53.3	44.1	56.7
High school	33.2	24.7	35.0	29.0	33.3	25.8
University and over	18.7	13.4	21.5	17.7	22.7	17.4
Marital status						
Single	20.4	32.3	41.5	43.2	19.8	31.8
Engaged	1.6	1.6	2.1	2.4	1.9	2.1
Married	67.6	62.1	49.1	51.6	66.7	62.5
Widow/er	8.4	2.2	5.4	1.3	9.3	2.3
Divorced	1.9	1.7	2.0	1.5	2.4	1.3

TABLE A.2. Sample proportions by employment type

Women	**2020 (n=1126)**	**2021 (n=1170)**	**Pooled (n=2296)**
employed in office	7.4	18.7	13.2
employed hybrid	1.9	3.8	2.8
employed remote	4.3	2.5	3.4
non-employed retired	4.5	7.2	5.9
non-employed homemaker	42.0	51.7	47.0
non-employed student	27.5	8.2	17.7
unemployed	10.9	6.7	8.8
non-employed on leave	1.5	1.3	1.4
Total	100.0	100.0	100.0

TABLE A.2. Sample proportions by employment type (continued)

Men	2020 (n=1044)	2021 (n=1204)	Pooled (n=2248)
employed in office	25.5	57.1	42.4
employed hybrid	4.5	5.4	5.0
employed remote	11.2	3.2	6.9
non-employed retired	17.1	15.7	16.4
non-employed homemaker	1.0	0.5	0.7
non-employed student	27.2	8.8	17.3
unemployed	11.6	7.9	9.6
non-employed on leave	1.9	1.4	1.6
Total	100.0	100.0	100.0

TABLE A.3. Mean durations of paid and unpaid work time, hours/day (2021)

Hours per Day	Relative normalization (October 2021)		
	Paid	Unpaid	Total
All Women	1.79	3.90	5.70
Employed Women	7.16	1.89	9.05
Working in the workplace (66 percent of all employed women)	6.91	1.93	8.84
Hybrid (15 percent of all employed women)	7.52	5.03	12.55
Working from home / remotely only (19 percent of all employed women)	6.03	3.85	9.88
Not employed	0.17	4.53	4.70
4.Neither pre- nor during pandemic	0.22	4.3	4.52
5.Was in employment pre- pandemic but not during pandemic	0.62	4.2	4.82
All Men	5.30	0.79	6.09
Employed Men	7.94	0.58	8.52
Working in the workplace (77 percent of all employed men)	8.10	0.50	8.60
Hybrid (7 percent of all employed men)	6.57	1.31	7.88
Working from home / remotely only (14 percent of all employed men)	7.38	0.82	8.21
Not employed	0.59	1.20	1.78
4.Neither pre- nor during pandemic	0.41	1.22	1.63
5.Was in employment pre- pandemic but not during pandemic	2.06	1.21	3.27

TABLE A.4. Gender gap in work time over the pre- to during pandemic periods and relative normalization periods by workplace, hours/day

Gender Gap	Gender Gap - 2021			Gender Gap - 2020			Gender Gap - 2018		
Hours Spent by Women - Hours Spent by Men	Paid	Unpaid	Total	Paid	Unpaid	Total	Paid	Unpaid	Total
ALL	-3.51	3.11	-0.39	-2.32	3.36	1.04	-3.46	2.58	-0.88
Employed	-0.78	1.30	0.52	-0.29	1.73	1.44	-1.37	1.31	-0.06
Pre- and during pandemic employed, working at workplace	-1.19	1.43	0.24	0.28	1.45	1.73			
Pre- and during pandemic employed, working from home (at least partly)	0.95	3.73	4.67	-0.77	1.99	1.22			
Not in employment pre-pandemic, but employed during pandemic	-1.35	3.03	1.67	-1.43	2.21	0.78			
Non-employed	-0.42	3.33	2.91	-0.73*	3.48	2.75	-0.92*	2.86	1.94
Neither pre- nor during pandemic	-0.19	3.08	2.89	-0.17*	3.46	3.29			
Was in employment pre- pandemic but not during pandemic	-1.44	2.99	1.55	-1.53*	3.35	1.82			

FIGURE A.1. Gender gap in work time over the pre- to during pandemic periods and relative normalization periods, hours/day

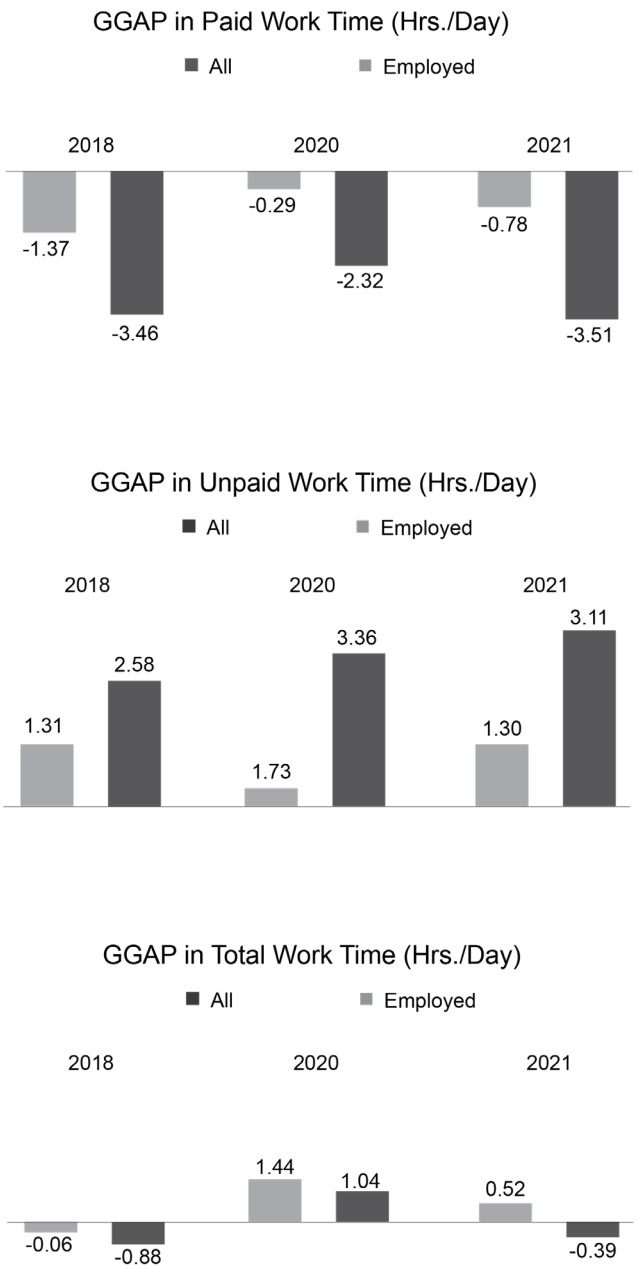

TABLE A.5. Decomposition of change over time – fixed weights (by education and age) for pre-pandemic periods, hours/day

WOMEN	Total Change				Behavioral Changes			Demographic Factors		
RAW	2020-2018	2021-2018	2021-2020		2020-2018	2021-2018	2021-2020	2020-2018	2021-2018	2021-2020
Total	0.35	0.86	0.52	Total	0.79	0.72	-0.07	-0.44	0.15	0.59
Unpaid	0.86	0.67	-0.19	Unpaid	1.36	0.69	-0.67	-0.50	-0.02	0.48
Paid	-0.52	0.19	0.71	Paid	-0.57	0.02	0.60	0.06	0.17	0.11
MEN	Total Change				Behavioral Changes			Demographic Factors		
RAW	2020-2018	2021-2018	2021-2020		2020-2018	2021-2018	2021-2020	2020-2018	2021-2018	2021-2020
Total	-1.3	0.5	1.9	Total	-1.18	0.37	1.55	-0.14	0.16	0.30
Unpaid	0.6	0.3	-0.3	Unpaid	0.61	0.32	-0.29	-0.01	-0.02	-0.01
Paid	-1.9	0.2	2.2	Paid	-1.79	0.05	1.84	-0.13	0.18	0.31

TABLE A.6. Decomposition of change over time – estimation method coefficients of year dummies, hours/day

All (n=1443)	Total Work					
	Coef.	Std.Err.	t	P>t	[95 percent Conf.	Interval]
2020	**-0.15**	0.34	-0.45	0.66	-0.83	0.52
2021	**0.19**	0.27	0.71	0.48	-0.34	0.72
Women (n=666)						
2020	**0.05**	0.49	0.10	0.92	-0.90	1.00
2021	**0.41**	0.37	1.08	0.28	-0.33	1.14
Men (n=775)						
2020	**-0.28**	0.47	-0.58	0.56	-1.21	0.65
2021	**0.09**	0.37	0.24	0.81	-0.65	0.83
All (n= 1443)	Unpaid Work					
	Coef.	Std.Err.	t	P>t	[95 percent Conf.	Interval]
2020	**0.84**	0.25	3.32	0.00	0.34	1.33
2021	**0.35**	0.20	1.77	0.08	-0.04	0.73
Women (n=666)						
2020	**0.80**	0.42	1.92	0.06	-0.02	1.62
2021	**0.29**	0.32	0.92	0.36	-0.34	0.92
Men (n=775)						
2020	**0.96**	0.19	5.00	0.00	0.58	1.34
2021	**0.45**	0.15	2.94	0.00	0.15	0.74
All (n= 1443)	Paid Work					
	Coef.	Std.Err.	t	P>t	[95 percent Conf.	Interval]
2020	**-0.99**	0.33	-2.98	0.00	-1.64	-0.34
2021	-0.16	0.26	-0.61	0.54	-0.67	0.35
Women (n=666)						
2020	**-0.75**	0.37	-2.01	0.05	-1.49	-0.02
2021	0.11	0.29	0.39	0.70	-0.45	0.68
Men (n=775)						
2020	**-1.23**	0.47	-2.64	0.01	-2.15	-0.32
2021	-0.36	0.37	-0.96	0.34	-1.08	0.37

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Unpaid eldercare and its impact on the US labor supply

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Globally, the dependency ratio is rising due to increase in aging population. Individuals, especially women are challenged when choosing between participating in the labor market and providing care. Using 2011-2017 American Time Use Survey data for a subsample of individuals aged 25-61 years, we examine the effect of frequent eldercare provision on labor force participation in the US using bivariate probit instrumental variable approach. Our findings suggest that unpaid eldercare performed frequently reduces labor force participation. Female frequent providers are likely to have lower labor force participation compared to their male counterparts. Robustness and sensitivity checks confirm these findings.

JEL Classification: J14, J16, J22
Keywords: aging, eldercare, labor supply, United States

1. Introduction

The world is facing a demographic turn. The number of persons aged 65 and older is expected to rise from 703 million in 2019 to 1.5 billion in 2050, i.e., one in six people worldwide will be 65 and older by the year 2050, increasing from one in 11 in 2019 [United Nations 2019]. The rate of increase in the older population is highest in Eastern and Southeastern Asia, with the largest growth estimated to be in the Republic of Korea (23 percent). With the increase in the aging population and declining fertility, the old-age dependency ratio is projected to rise in all regions of the world, with Japan and Korea estimated to be having the highest old-age dependency ratio of 81 and 79 persons aged 65 years and older, depending on 100 persons aged 20-64 years by 2050, respectively.

The US will also follow—soon facing a significant demographic turn by the year 2035. The 2018 US Census Bureau report predicts that the elderly, aged 65 years and older, will outnumber children, aged 18 years and younger for the first time

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in the US history (78 million elderly vs. 76.4 million children) [US Census Bureau 2018]. Due to aging, the dependency ratio in the population is expected to increase to 41 percent by the year 2060, nearly four times the level in 1940 (11 percent) [Vespa et al. 2018]. This change in demographic composition poses a unique set of challenges for long-term care for frail elderly. Many low and middle-income countries either lack or have inadequate government support for long-term care services, and so the burden of eldercare largely falls upon family members (e.g., children, spouse, niece or nephew, and grandchildren).

In many low- and middle-income countries, family members (e.g., children, spouse, niece or nephew, and grandchildren) shoulder the heavy burden of caregiving. This is in large part due to the prevailing cultural norms involving filial piety or familial obligations to care for elderly parents. It is also due to the high cost of private long-term care insurance and of institutional forms of elder care such as nursing homes, given the weak or no government support for such services.

On the other hand, the increasing prevalence of nuclear families and urbanization in high-income countries and in some middle-income countries have weakened the ability of families to provide eldercare on their own. As a result, their governments are also increasingly providing support for long-term care insurance and are investing in eldercare supply. Not surprisingly, nursing homes, community-based eldercare services, and private residential care facilities have grown in these countries in the past few decades.

In the US, nursing homes care for nearly three million elderly persons each year, with government-funded Medicaid paying the majority of the USD 235 billion in annual cost. However, millions more Americans needing long-term care support largely rely on services provided by unpaid caregivers [Mitchell et al 2022].[1] This is because US government spending on long-term care is proportionally the lowest among high-income countries [Commonwealth Fund 2023]. There is, by now, a general consensus that inadequate prioritization of public investment in long-term care in the US has led to a highly variable quality of care, critical staff shortages, racial and ethnic disparities, and wasteful spending, all of which have become evident during the COVID-19 pandemic [Mitchell et al. 2022].

Eldercare has become a pressing issue given the increase in life expectancies and the fact that as population ages and the elderly live longer, many of the elderly will live with limited functionalities and disabilities, which increases the complexity and duration of care tasks (Hagen [2013]; National Alliance for Caregiving and AARP Public Policy Institute (2015); Reinhard et al. (2015)]. Care for older adults involves a wide range of activities—from assisting with daily living activities such as eating, bathing, getting dressed, continence, and moving

[1] In all states, US Medicaid gives health coverage to eligible individuals and families based on incomes and family size, including children, parents, pregnant women, and elderly persons below a certain income level, as well as people with disabilities. See: https://www.hhs.gov/answers/medicare-and-medicaid/who-is-eligible-for-medicaid/index.html.

around, performing medical and nursing tasks, to assistance with financial, housing, as well as legal issues. It also involves providing emotional support and companionship, which includes activities such as listening or taking the elderly out for a walk.

Studies by Arora and Wolf [2014], Zagheni et al. [2016], Hammersmith and Lin [2016], and Bott et al. [2017] point to the challenges and difficulties that many eldercare providers face in balancing care responsibilities with their employment. Other studies show that an increase in unpaid eldercare is likely to lead to withdrawal from the labor force or a shift from full-time to part-time employment, and decline in earnings (Butrica and Karamcheva [2015]; Chari et al. [2015]; Feinberg [2016]; Feinberg and Choula [2012]; Reinhard et al. [2015]; US Bureau of Labor Statistics [2017]). However, the impact on labor force participation is likely to be underestimated, for two reasons. First, several of these studies, e.g., Johnson and Lo Sasso [2006], Houtven et al. [2013], and Butrica and Karamcheva [2015] focus only on individuals 50 years and older, leaving out prime-aged adults who also provide unpaid eldercare. Second, these studies do not distinguish the effects on labor supply between those providing frequent (daily or several times a week) eldercare and those who perform infrequent eldercare (once a month or a few times a year), which results in a pooled average effect. The distinction is important since the frequency of care provision is closely related with the level and intensity of unpaid care provided and the extent to which caregiving poses a serious time constraint in performing other activities such as market work. On the other hand, the labor supply effect may be overestimated if the issues of selection bias and endogeneity are not addressed (Lam and Garcia-Roman [2017]; Yamashita et al. [2018]).

This study addresses the above methodological and data issues in our analysis of the impact of unpaid eldercare on labor supply. First, it examines the relationship between frequent eldercare and labor force participation using a subsample of individuals aged 25 to 61 years. Second, it makes a distinction between infrequent and frequent eldercare providers and focuses on the labor supply effect in the latter case, thus providing a more accurate, albeit nuanced assessment. The study is distinct from other studies in that it uses the eldercare module of the 2011-2017 American Time Use Survey (ATUS) dataset rather than special survey datasets, e.g., the Health and Retirement Study (HRS) or other time use surveys, which do not collect specific data on eldercare. ATUS's time diary approach along with an eldercare module allows for a more accurate measure of the amount of time spent on eldercare; and its design includes not just spouse and parents as care recipients but also other family members e.g., aunts, uncles, grandparents, friends, and neighbors. While Johnson and Lo Sasso [2006], Houtven et al. [2013], Skira [2015], and Butrica and Karamcheva [2015] used panel data to deal with the selection bias, in this paper we address the problem using a bivariate probit with instrumental variable (IV) approach. Our findings suggest that frequent eldercare provision reduces the labor force participation of

individuals aged 25 to 61 years old by nine percentage points. Interestingly, we also find that frequent male providers reduce their labor force participation more than frequent female providers. A series of robustness tests confirm our results.

2. Background

Most people nowadays provide care for an elderly family member, friend, or neighbor at some point in their lives. For a growing number of individuals, this occurs while they are still economically active and thus its provisioning can affect the labor supply, as demonstrated by studies in high-income countries such as the US. Using the HRS longitudinal data, Johnson and Lo Sasso [2006], Houtven et al. [2013], Skira [2015], and Butrica and Karamcheva [2015] show that providing eldercare leads to lower labor force participation of those aged 51 years and older in the US. Houtven et al. [2013] and Butrica and Karamcheva [2015] point out that the effect of providing eldercare on labor force participation varies by types and the intensity of care. Butrica and Karamcheva [2015] show that the likelihood of the labor force participation of women fall by 3.9 percent if women provide intensive care. Houtven et al. [2013] find that female caregivers are more likely to be retired, and male caregivers are more likely to reduce their labor force participation by around 2.4 percentage points.

Studies outside the US that explore the impact of caregiving on the paid work hours of elder caregivers show mixed results. Maurer-Fazio et al. [2011] find that an elderly living in the household increases the likelihood of market work of prime-aged married women in urban China. Leigh's [2010] and Nguyen and Connelly's [2014] research on Australian working-age population, and Crespo and Mira's [2014] study of European mature women, on the other hand, find a negative effect of eldercare on labor force participation. Jacobs et al. [2014] show that providing higher intensity eldercare in Canada increases the likelihood of retirement for the age 55-69 years. However, the studies by Schneider et al. [2013] (on working population in Austria) and Meng [2013] (on age 36-63 individuals in Germany) find that eldercare has no effect on labor force participation.

The ambiguous findings may be due to differences in the sample and methodology and the fact that there is great variation in the level and intensity of unpaid eldercare provisioning. It can be given infrequently, say a few times a year or during once a month visits, or on a daily (or near daily) basis by a household member. The latter is likely to take on a greater toll on the provider in terms of the amount of time spent in providing basic (e.g. dressing, feeding, giving bath, etc.), instrumental (shopping, cleaning house, doing laundry, answering phone calls, etc.) and emotional (talking and listening, etc.) support and therefore may have a different impact on labor supply. In our study, we take into account the heterogeneity in eldercare giving and distinguish between frequent and infrequent eldercare. We also consider whether the impact on labor supply is likely to differ between female and male providers.

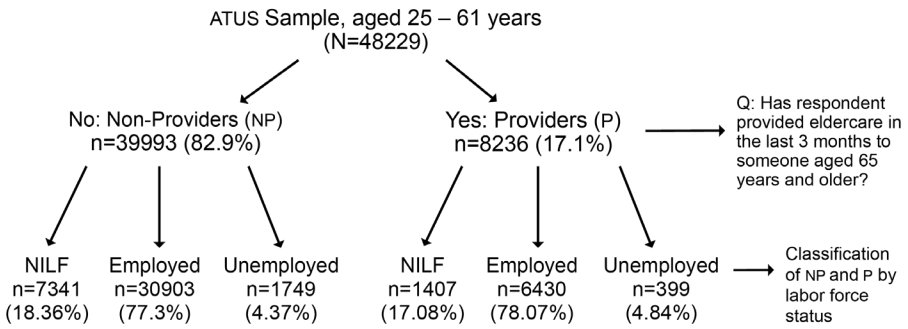
2.1. Data and sampling

This paper analyzes the 2011-2017 ATUS data collected by the US Census Bureau (US Bureau of Labor Statistics 2018a). ATUS interviews one randomly selected individual aged 15 years and older from a subset of households that have completed their eighth and final month of interviews with the Current Population Survey (CPS). The ATUS collects time diary and socio-demographic and labor market information. Since 2011, ATUS has collected information on eldercare using a supplementary module. ATUS defines eldercare as "not including financial assistance or help that one provided as part of her paid job, whether one has provided any other care or assistance in the last three to four months for an adult who needed help because of a condition related to aging" (US Bureau of Labor Statistics 2018a). The caregiver can be a family member or a non-family member. Eldercare includes activities such as assisting with grooming and feeding, preparing meals, arranging medical care, providing transportation, providing companionship, and being available ("on call") to assist whenever help is needed. The ATUS eldercare module also collects information on the care recipient including age, frequency of care provided by the respondent-caregiver, relationship with the caregiver, whether co-residing with the caregiver or not, and the length of time the respondent has provided for each activity.

We examine the impact of eldercare on labor force participation among adults in their prime working ages (25 to 61 years). We restrict the upper bound of the prime working age to 61 years because an individual in the US can retire with partial social security benefits starting at 62. Since the retirement eligibility for workers 62 years or older may lead to bias in our estimation of the impact on labor force participation, we exclude them from the analysis. We also consider the possibility that the labor supply effect of unpaid eldercare is more likely to occur when it is performed on a regular basis. The frequency in which individuals do eldercare, whether for a few days during the year or several days a week, matters since the caregivers have to adjust their daily routine schedule to accommodate their care work. Figure 1 presents the distribution of 48,229 ATUS sample respondents aged 25-61 years as to whether they provided eldercare or not, based on their response to the following question: "Has respondent provided care to an elderly person (aged 65 years or older) in the last three to four months?" It also shows the distribution of the elder care provider (P) and non-provider (NP) respondents according to their labor force status. About 8,236 respondents[2] (17.1 percent) are considered providers (P), i.e. individuals who have provided care to an elderly person (aged 65 years or older) in the last three to four months; out of which 1,407 (17.08 percent) are not in the labor force; 6,430 (78.07 percent) are employed and 399 (4.84 percent) are unemployed. A significant proportion (82.9 percent) of the sample consists of non-providers (NP), with 7,341 (18.36 percent) not in the labor force, while 30,903 or 77.3 percent employed and 1,749 (4.37 percent) unemployed.

[2] Respondents with inconsistent and missing responses are also excluded from the sample.

FIGURE 1. Distribution of 2011-17 ATUS respondents aged 25 to 61 years, by eldercare provision and labor force status



Eldercare providers (P) are further divided into two groups: frequent providers (FP) and infrequent providers (IP). FP provide care either on a daily basis or several times a week while those who provide care once a week, several times a month, once a month or several times a year are considered IP. Table 1 shows the distribution of P by frequency type and by labor force status. FP are more likely to be not in the labor force (22.6 percent) compared with IP (17.1 percent). IP on the other hand are more likely to be full-time employed (64.5 percent or higher) compared with the FP (58.1 percent).

TABLE 1. Distribution of eldercare providers (P), by frequency of eldercare and labor force status[a,b]

Labor Force Status/ Frequency	Not in Labor Force (NILF)	Employment		Unemployed		Subtotal
		Full-time	Part-time			
	Daily	362 (29.1)	627 (50.4)	171 (13.7)	84 (6.8)	1,244 (100.0)
Frequent Providers (FP)	Several times a week	385 (18.6)	1296 (62.7)	276 (13.4)	110 (5.3)	2,067 (100.0)
	Subtotal	**747 (22.6)**	**1923 (58.1)**	**447 (12.5)**	**194 (5.8)**	**3311 (100.0)**
	Once a week	218 (13.5)	1083 (67.3)	239 (14.8)	70 (4.3)	1,610 (100.0)
	Several times a month	240 (13.6)	1226 (69.6)	218 (12.4)	77 (4.4)	1,761 (100.0)
Infrequent Providers (IP)	Once a month	137 (13.9)	762 (67.8)	149 (13.9)	37 (4.5)	1,085 (100.0)
	Others[c]	65 (17.1)	318 (64.5)	65 (13.6)	21 (4.8)	469 (100.0)
	Subtotal	**1,407 (17.1)**	**5,312 (64.5)**	**1,118 (13.6)**	**3,99 (4.8)**	**8,236 (100.0)**

[a] Row percentages in parentheses.
[b] Not survey weight adjusted.
[c] Others refer to several times a year.

Table 1 indicates that as the frequency of eldercare increases, the likelihood of being in the labor force declines, implying that providing eldercare on a frequent basis can impose time constraints on the caregiver. FP and IP represent 40.1 percent and 59.9 percent respectively of P in the sample.

Table 2 provides the pertinent characteristics of the FP subsample. For comparison, we also include the characteristics of IP and non-providers (NP). Not surprisingly, the majority of P, whether FP or IP, are women. More than half of FP (58.8 percent) are women; they also constitute 53.9 percent of IP. Table 2 also shows that the likelihood of being an FP increases with age and then slightly falls as the FP gets older. The average age of FP (48.2 years) is higher compared to the NP (42.2 years) and IP (46.3 years). IP on the other hand have higher education level, with 43.1 percent having a bachelors' degree or higher compared with FP (34.3 percent) and NP (36.8 percent). More than half (58.9 percent) of FP are married, most of whom have their spouses present. Nearly half (49.3 percent) of FP and half (50 percent) of IP have annual family incomes below USD 60,000, compared to 39.7 percent of IP.[3] Other significant differences in the characteristics between FP and NP can be noted. Women are 8.8 percent more likely to be FP than NP. The average age of FP is higher than that of NP by six years. Around 4.1 percent of individuals who are widowed, divorced or separated are more likely to be FP than NP. Additionally, FP belong to households with more adult female members compared with NP.

Table 2 also shows the characteristics of the elderly cared for by frequent and infrequent providers. The majority of FP (70.1 percent) and IP (66.6 percent) care for only one elderly person; however, more than one-fifth (22.3 percent) of FP and one-fourth (25.8 percent) of IP provide care to two elderly and another 7.6 percent care for more than two persons, suggesting that a number of P may be subject to stress. A higher proportion of elderly persons live with the FP (26.0 percent), compared to 3.2 percent living with the IP. Nearly a quarter (73.4 percent) of FP care for their parents or in-laws, compared to 62.3 percent of IP.

TABLE 2. Characteristics of sample respondents aged 25-61 years, by occurrence of care provision (percent of total)

	Frequent Providers (FP)	Non - Providers (NP)	FP vs. NP (test)	Infrequent Providers (IP)
A. Characteristics of Respondents				
Sex				
Male	41.2	50.2	-8.8***	45.8
Female	58.8	49.8	8.8***	53.9

[3] The median family income in the US (in current dollars) ranged from USD 50,054 in 2011 to USD 61,372 in 2017 [US Census Bureau n.d.].

TABLE 2. Characteristics of sample respondents aged 25-61 years, (continued)

	Frequent Providers (FP)	Non - Providers (NP)	FP vs. NP (test)	Infrequent Providers (IP)
Age (in years)				
25 to 34	11.5	29.8	-18.3***	17.8
35 to 44	18.9	27.0	-8.1***	19.8
45 to 54	38.3	26.0	12.3***	37.7
55 to 61	31.1	17.1	14.0***	24.6
Mean Age	48.2	42.2	6.0***	46.3
Educational Level				
Less than grade 1	0.4	0.2	0.2	0.01
Grade 1 to 12	6.1	10.0	-4.0***	4.3
High school diploma	30.6	28.2	2.4**	25.7
Some college or associate degree[a]	28.6	24.9	3.8***	26.7
Bachelor degree and above	34.2	36.8	-2.4**	43.1
Disability				
Has disability	7.6	7.1	0.5	6.2
Race				
White only	70.4	63.2	7.2***	77.1
Black only	13.1	11.7	1.4**	10.6
Asian only	3.0	5.4	2.5***	2.6
Hispanic only	11.4	17.6	-6.2***	8.2
Mixed	1.9	1.9	0.02	1.5
Marital Status				
Married - spouse present	57.7	59.6	-0.2	66.31
Married – spouse absent	1.2	1.5	-0.4*	1.15
Widowed/divorced/separated	19.1	15.0	4.1***	14.88
Never married	21.9	23.9	-2.0*	17.52
Family Income (in USD)				
Below 25000	17.4	17.9	-0.4	12.2
25000 to below 35000	10.8	9.8	1.0	7.7
35000 to below 60000	21.1	22.3	-1.2	19.8
60000 to below 100000	26.1	24.9	1.2	27.8
100000 and above	24.4	25.0	-0.6	32.6
Average number of children under 6 in household	0.1	0.3	-0.2***	0.2
Average number of adult males aged 16 and older in household	1.1	1.1	0.0	1.1
Average number of adult females aged 16 and older in household	1.3	1.1	0.2***	1.1

TABLE 2. Characteristics of sample respondents aged 25-61 years, (continued)

	Frequent Providers (FP)	Non - Providers (NP)	FP vs. NP (test)	Infrequent Providers (IP)
B. Eldercare				
Number of Eldercare Recipients				
1	70.1			66.6
2	22.3			25.8
More than 2	7.6			7.4
Living Arrangement[b]				
Same household as caregiver	26.0			3.2
Not living with caregiver	76.3			97.3
Duration of Care Provision[b]				
0 to 5 months	18.4			19.6
6 to 11 months	9.5			9.0
1 year	10.5			15.1
More than 1 year	71.2			66.6
Relation to Elderly[b]				
Parents/ in-laws	73.4			62.3
Spouse / Partner	2.3			0.3
Other[c]	88.1			84.1
Number of observations	3,311	39,993	43,304	4,925
	(100.0)	(100.0)	(100.0)	(100.0)

[a] Some college or associate degree includes individuals with occupational/vocational and associate degree.
[b] Some caregivers have provided care to more than one individual. Hence, the column percentages for living arrangement of care recipients, relationship to the recipients and the duration of providing care are greater than 100.
[c] Refers to aunt/uncle, grandparent, neighbor, etc.
[d] ***, ** and * denote level of significance at one percent, five percent and ten percent respectively.
[e] Statistics are survey weight adjusted.

3. Empirical analysis

We test whether providing eldercare affects the probability of participating in the labor force using probit regression and bivariate probit methods. In the first approach, we estimate the impact of frequent eldercare provision on labor force participation for individual i with the following model (Model 1) specification:[4]

$$LF_i^* = \beta_0 + \beta_1 E_i + \beta_X X_i + \gamma + t + \varepsilon_1 \qquad LF_i = \mathbb{I}(LF_i^* > 0); \tag{1}$$

[4] In our study, we only compare the labor force participation of FP with those of NP. Results of similar analyses comparing the labor force participation between IP and NP indicate no statistical significance. They are provided in Table A1, Appendix A. The empirical model already controls for race, education, and age.

where,

LF_i^* refers to the latent variable labor force participation of an individual i taking the value of one if the individual participates in the labor force and zero otherwise;

E_i refers to frequent eldercare giving, taking the value of one if the individual is a frequent eldercare provider and zero if non-provider;

X_i is a vector containing individual and household level control variables;

γ is a vector of state fixed effects;

t is a vector of time fixed effects; and

ε_1 is the error term.

The vector X_i includes the following variables namely: lifecycle stage (age and age squared), sex (female=1), level of education categories, disability status (controls for health-related issues), race/ethnicity, marital status, annual family income categories, and household composition (number of children in the household aged six and younger, number of male adults 16 years and older, and number of female adults 16 years and older).

3.1. Endogeneity issue and bivariate probit model

The relationship between eldercare provision and labor force participation, however, is endogenous, as both are simultaneously determined. In other words, it is also possible that individuals not in the labor force are more likely to provide eldercare on a frequent basis. To address the endogeneity problem, we simultaneously estimate the LF Equation 1 with the probability of providing frequent eldercare as shown in the following specification (Model 2):

$$LF_i^* = \beta_0 + \beta_1 E_i + \beta_X X_i + \gamma + t + \varepsilon_2 \qquad LF_i = \mathbb{I}(LF_i^* > 0); \tag{2a}$$

$$E_i^* = \alpha_0 + \alpha_1 Z_i + \alpha_X X_i + \gamma + t + \varepsilon_3 \qquad E_i = \mathbb{I}(E_i^* > 0); \tag{2b}$$

$$\begin{pmatrix} \varepsilon_2 \\ \varepsilon_3 \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix} \cdot \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right]$$

where the error terms are ε_2 and ε_3.

Model 2 is estimated by a recursive bivariate probit model that allows a structural equation modeling of a binary outcome (labor force participation) as a function of a binary endogenous variable (frequent eldercare provision, E_i^*). The binary endogenous variable is, in turn, expressed in a set of reduced form equations. Although Equation 2a is similar to Equation 1, Equation 2b explicitly models the selection into eldercare provision. Identification of the model is achieved by excluding the Z_i variable from Equation 2a. The correlation coefficient ρ measures the correlation between disturbances in the equations. Disturbances in the equations capture the omitted factors. The recursive bivariate model is estimated by full information maximum likelihood.

We use the ATUS sample weights throughout our regression analyses. The ATUS weights take into account a) the issue of oversampling of some of the demographic groups, b) variation in the sampling of weekends and weekdays, and c) non-responses [US Bureau of Labor Statistics 2018b].

3.2. Selection of instrumental variable (IV)

In selecting the IV, we take into account the following conditions that the IV must satisfy: it is exogenous and not affected by other variables ($\text{Cov}(Z,\varepsilon) = 0$), and it is correlated with eldercare giving, which is the endogenous explanatory variable ($\text{Cov}(Z,E) \neq 0$).

Johnson and Lo Sasso [2006] use the age of parents as one of the instruments for identifying childcare obligation in the US. Alternatively, Meng [2013] uses parental residence, i.e., whether parents live in the household or not, as instrument for determining the likelihood of providing informal care in Germany. In the absence of information on parental residence or age in ATUS, we use parental birthplace as a proxy in deducing whether parents live nearby and thus may need care from the respondent. We use the parental birthplace (at least one of the parents is foreign-born versus both parents are US-born) as instrument to determine the selection into frequent eldercare provision.

Based on the parental birthplace information, FP and NP subsamples are sorted into the first, second and third-generation respondents living in the US. The first-generation (immigrants) are foreign-born themselves. The second-generation respondents are native-born with at least one foreign-born parent, while the third-generation respondents constitute the native-born with both US-born parents. The exclusion variable Z_i is equal to one for both first and second-generation respondents. More than 99 percent of foreign-born individuals in our sample have at least one foreign-born parent. The Z_i compares the frequent eldercare provision of the third-generation (Z=0) subsample with the combined first and second-generation subsample (Z=1).

In the US, the third generation mainly comprises Baby Boomers born from 1946 to 1964. The youngest boomers will turn 65 by the year 2030 [Passel and Cohn 2017]. The exogenous demographic shift in the US population (towards older age cohort) makes the third generation older than individuals in the first and second generations. As such, third-generation individuals are likely to have parents or families who are older and demand care. Additionally, foreign-born parents of the first generation are more likely to reside outside the US. As such, the instrument is expected to have a negative correlation with frequent eldercare provision. Individuals with at least one foreign-born parent are less likely to provide frequent eldercare.

The potential strength of the instrument is tested by the estimation of Equation 2b using the probit model with and without the control variables and the results are given in Table B2 in Appendix B. The sample distribution of the FP and NP

sample by the exclusion variable *Z* and the covariate balance statistics are given in Tables B1 and B3 of Appendix B. The marginal effects of the probit model with control variables show that individuals with at least one foreign-born parent are three percentage points less likely to be a frequent eldercare provider and these are statistically significant (see Table B2 in Appendix B).

In addition to the relevance of the instrument, it is essential that the instrument be exogenous. Parental birthplace satisfies the exogeneity condition of the instrument and therefore cannot be influenced by the labor force participation or frequent eldercare provision. It is also critical to argue that the instrument only affects the labor force participation through selection into frequent eldercare provision. Without the availability of a direct statistical technique to test whether the instrument only influences labor force participation through eldercare, it is difficult to establish such criteria. Instead, we review the literature for supporting evidence.

We examine whether there is any evidence of parental birthplace directly determining the labor force participation in the US. Trevelyan et al. [2016] show that the average labor force participation rate of the first and second generations in the US is 62.4 percent, whereas the labor force participation rate of the third generation is 63.2 percent. The very small gap in the labor force participation rates across generations negates the idea that the instrument has a direct influence on the outcome. Enchautegui [2014] argues that the difference in the labor force participation across generations is predominantly due to the exogenous demographic shift related to the aging of the Baby Boomers. The control variables namely age and age squared in Model 2 capture this impact of lifecycle on labor force participation.

Taking the above study findings into account, we then estimate a probit model that takes into account the effect of the IV on labor force participation. The results of our estimation with control variables are given in Appendix B, Table B2 and shows that parental birthplace does not influence the respondents' labor force participation.

We also examine other potential channels through which the instrument may determine labor force participation. The US Bureau of Labor Statistics [2018c], Trevelyan et al. [2016], Americans [2013], and Myers et al. [2013] studies show that first, second and third generation cohorts differ by race, age, marital status, educational attainment, household income, fertility, and household sizes. Model 2 controls for race, age, marital status, educational attainment, and annual family income. The number of children under six years in the model is used as proxy for fertility rate, and the number of adult males and females above 16 years for household size.

It is also possible that the nativity of the individual affects labor force participation and is highly correlated with parental birthplace. Non-natives are more likely to have at least one parent born outside the US. In 2017, the labor force participation of the foreign-born was 74 percent, and the native-born was 71.8 percent in the US (OECD [2017a], OECD [2017b]). According to the US Bureau of Labor Statistics (2018c) report, the gap in the labor force participation between the foreign-born and US-born (native) workers is mainly due to differences in

race, education, and age.[5] Except for Johnson and Lo Sasso [2006] study, none of the existing studies that examine the relationship between eldercare and labor force participation controlled for nativity. In fact, Johnson and Lo Sasso [2006] find no evidence of the effect of nativity on the working hours of respondents. Thus, the lack of correlation between the respondent's birthplace and labor force participation is indirectly confirmed by these study findings. Therefore, parents' nativity is also unlikely to be related to labor force participation.

Finally, whether or not the instrument influences labor force participation through other unobservables is examined. For instance, cultural differences across generations can be a potential channel through which the instrument can influence labor force participation. In this study, we use state fixed effects and race/ethnicity variables to control for any variation in cultures across states and ethnicity. The presence of a potential unobservable is also tested by examining the covariate balances and evaluating the standardized difference,[6] variance ratio,[7] and the overlap coefficient[8] between the two groups, i.e., individuals with at least one foreign-born parent and individuals with both US-born parents. The idea is to demonstrate that a balance in the covariates[9] by parental birthplace also suggests a balance in the unobservables. As such, the unobservables may not be an issue in the empirical analysis. Similar to what is suggested in the literature, the standardized difference test shows covariate imbalance for White, Asian, Hispanic and individuals with educational attainment of grade 1 to 12 (See Table B3 in Appendix B). For the other covariates, all three test results show a balance in the sample. Hence, we conclude that the exclusion variable, parental birthplace meets the IV criteria.

3.3. Gender dimensions of frequent eldercare impact on labor force participation

We next analyze the gendered impact of frequent eldercare on labor force participation by extending Models 1 and 2 in the previous section. The extended models take into account the gender differences in providing eldercare and in labor market participation. Gender norms around care responsibilities and household division of labor and persistence of gender-based occupational segregation in the labor market are likely to lead to different outcomes for women and men [Neumark 2018]. In particular, we expect women are less likely to be in the labor market and more likely to be frequent eldercare providers.

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[5] The empirical model already controls for race, education, and age.

[6] Standardized difference assesses differences of selection groups in the means.

[7] Variance ratio is the ratio of the variances of the characteristics by two groups determined by IV.

[8] Overlap coefficient is a measure of the closeness of the location of two distributions.

[9] We do not use *t*-test to examine the characteristics balance across the IV groups. In this paper, the observations across FP and NP are unbalanced. When distributions are sensitive to the variance differences between the groups, *t*-test with the assumption of equal variance or even unequal variance can be misleading. The sensitivity of the distributions is also evident in the estimated overlap coefficients provided in Table B3, Appendix B.

Models 1 and 2 are re-estimated by including two interaction variables: female dummy interacted with frequent elder caregiving and female dummy interacted with family income category. This is expressed as follows (Model 3):

$$LF_i^* = \beta_0 + \beta_1 E_i + \beta_2 F_i + \beta_3 (F_i \times E_i) + \beta_4 Y_i + \beta_5 (Y_i \times Fi) + \beta_x X_i + \gamma + t + \varepsilon_4$$

$$LF_i = \mathbb{I}(LF_i^* > 0); \tag{3}$$

whereby:

F_i refers to the sex of respondent, female takes the value of 1 and male is 0;

E_i refers to frequent eldercare provision (=1);

$F_i \times E_i$ refers to the interaction variable between sex and frequent eldercare provision;

Y_i refers to the dummies for family income ranges (in USD), e.g., below 25,000 (reference), 25,000 to below 35,000, 35,000 to below 60,000, 60,000 to below 100,000, and 100,000 and above;

$Y_i \times F_i$: interaction variable between sex and family income categories; and

X_i: is a vector containing other individual and household level control variables.

The coefficient of the interaction $F_i \times E_i$ helps identify whether or not frequent eldercare performed by women is associated with lower labor force participation, more so than among male frequent providers. The interaction variable $Y_i \times F_i$ is added in order to examine whether women are more likely to work in the labor market when they have to (belong to a lower income group) compared to men.[10] In other words, it captures the extent to which the economic necessity to earn income is greater for women compared to men. We expect that although caregiving is considered to be women's primary responsibility, female FP in lower income households may be more compelled to earn income in order to help meet basic needs even if they also provide eldercare, compared to men FP. Men on the other hand are socially expected to be breadwinners or economic providers, regardless of economic status. This gender norm is challenged, however, when men provide frequent eldercare, say to their spouse or a parent and so to ease their workload, they withdraw from the labor market.

As mentioned earlier, there is an endogeneity problem given that labor force participation and eldercare provision are simultaneously determined. To address this issue, we estimate a bivariate probit with IV model (Model 4), which is an extension of Model 2:

$$LF_i^* = \beta_0 + \beta_1 E_i + \beta_2 F_i + \beta_3 (F_i \times E_i) + \beta_4 Y_i + \beta_5 (Y_i \times Fi) + \beta_X X_i + \gamma + t + \varepsilon_5$$

$$LF_i = \mathbb{I}(LF_i^* > 0); \tag{4a}$$

[10] Bradbury and Katz [2008], Albanesi and Prados [2011], and Hua [2014] studies show that spousal or family income is an important determinant of labor force participation of married women in the US. However, the ATUS data does not include spousal income for married women; moreover, the sample includes respondents with different marital status, e.g., never married, separated, divorced, widowed, married with spouse absent and married with a spouse present.

$$E_i^* = \alpha_0 + \alpha_1 Z_i + \alpha_2 F_i + \alpha_3 (F_i \times Z_i) + \alpha_4 FY_i + \alpha_5 (Y_i \times Fi) + \alpha_X X_i + \gamma + t + \varepsilon_6$$

$$E_i = \mathbb{I}(E_i^* > 0); \qquad \begin{pmatrix} \varepsilon_5 \\ \varepsilon_6 \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix} \cdot \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right] \tag{4b}$$

Note that Model 4 includes an additional endogenous variable of interest namely the interaction variable ($F \times E$) along with the endogenous explanatory variable E. The exclusion variable Z in Equation 4b helps identify the impact of frequent eldercare giving on labor force participation. In the same way, the sex dummy interacted with the exclusion variable ($F \times Z$) allows for the effect of parental birthplace on eldercare provision to be different between men and women. Generally, the care burden falls on women. Hence, we expect, that when at least one of the parents of a female respondent is foreign-born, she is more likely to provide frequent eldercare than a male respondent.

4. Empirical result

The results for the probit and recursive bivariate probit models, which test Hypotheses 1 and 2, are given in Table 3. Columns 1 and 3 show the marginal effects estimates for both Model 1 probit (column 1) and Model 2 bivariate probit estimations (column 3) for the sample respondents who are either FP or NP. Separate models are estimated for the difference in the relationship between providing eldercare and (LFP) by gender. The results for Models 3 and 4 estimations are presented in columns 4-6, also with and without interaction variables.

TABLE 3. Probit and bivariate probit results: marginal effects of providing frequent eldercare on labor force participation, with and without interaction variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Frequent Provider	Labor Force Participation	Labor Force Participation	Frequent Provider	Labor Force Participation
At least one parent is foreign-born=1		-0.03*** (0.01)			-0.04*** (0.01)	
Frequent provider = 1	-0.04*** (0.01)		-0.09** (0.04)	-0.07*** (0.01)		-0.18*** (0.05)
Female	-0.15*** (0.01)	0.02*** (0.004)	-0.15*** (0.01)	-0.11*** (0.01)	-0.01 (0.01)	-0.11*** (0.01)
Female x At least one parent is foreign-born					0.02* (0.01)	

TABLE 3. Probit and bivariate probit results (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Frequent Provider	Labor Force Participation	Labor Force Participation	Frequent Provider	Labor Force Participation
Female x Frequent provider				0.05*** (0.02)		0.05*** (0.02)
Age	0.01*** (0.002)	0.01*** (0.002)	0.02*** (0.002)	0.01*** (0.002)	0.01*** (0.002)	0.02*** (0.002)
Age-squared	-0.0002*** (0.00002)	-0.0001** (0.00002)	-0.0002*** (0.00002)	-0.0002*** (0.00002)	-0.00005** (0.00002)	-0.0002*** (0.00002)
Ref: Less than grade 1						
Grade 1 to 12	-0.05 (0.05)	-0.07 (0.05)	-0.05 (0.05)	-0.05 (0.05)	-0.07 (0.05)	-0.06 (0.05)
High school diploma	-0.01 (0.05)	-0.04 (0.05)	-0.01 (0.05)	-0.02 (0.05)	-0.04 (0.05)	-0.02 (0.05)
Some college or associate degree	0.01 (0.05)	-0.03 (0.05)	0.01 (0.05)	0.01 (0.05)	-0.03 (0.05)	0.00 (0.05)
Bachelor's degree and above	0.04 (0.05)	-0.03 (0.05)	0.03 (0.05)	0.03 (0.05)	-0.03 (0.05)	0.03 (0.05)
Disability=1	-0.28*** (0.01)	-0.02*** (0.01)	-0.28*** (0.01)	-0.28*** (0.01)	-0.02*** (0.01)	-0.28*** (0.01)
Ref: White only						
Black only	0.01 (0.01)	-0.01* (0.01)	0.01 (0.01)	0.01 (0.01)	-0.01* (0.01)	0.01 (0.01)
Asian only	-0.05*** (0.01)	-0.02 (0.01)	-0.05*** (0.01)	-0.05*** (0.01)	-0.02 (0.01)	-0.05*** (0.01)
Hispanic only	0.02** (0.01)	-0.004 (0.01)	0.02** (0.01)	0.02** (0.01)	-0.004 (0.01)	0.01** (0.01)
Mixed	0.01 (0.01)	-0.001 (0.01)	0.01 (0.01)	0.01 0.02**	-0.0002 (0.01)	0.01 (0.01)
Ref: Married – spouse present						
Married – spouse absent	0.05** (0.02)	0.01 (0.01)	0.05** (0.02)	0.05** (0.02)	0.01 (0.01)	0.05** (0.02)
Widowed/ divorced/ separated	0.06*** (0.01)	0.02*** (0.01)	0.06*** (0.01)	0.06*** (0.01)	0.01*** (0.004)	0.06*** (0.01)
Never married	0.04*** (0.01)	0.03*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.03*** (0.01)	0.04*** (0.01)
Ref (in USD): Below 25000						
25000 to below 35000	0.08*** (0.01)	0.01 (0.01)	0.08*** (0.01)	0.10*** (0.01)	-0.01 (0.01)	0.10*** (0.01)
35000 to below 60000	0.11*** (0.01)	-0.01** (0.01)	0.11*** (0.01)	0.14*** (0.01)	-0.02** (0.01)	0.14*** (0.01)
100000 and above	0.17*** (0.01)	-0.02*** (0.01)	0.17*** (0.01)	0.22*** (0.01)	-0.05*** (0.01)	0.21*** (0.01)

TABLE 3. Probit and bivariate probit results (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Frequent Provider	Labor Force Participation	Labor Force Participation	Frequent Provider	Labor Force Participation
Ref (in USD): Female x Below 25000						
Female x 25000 to below 35000				-0.03** (0.01)	0.02* (0.01)	-0.03** (0.01)
Female x 35000 to below 60000				-0.06*** (0.01)	0.02 (0.01)	-0.05*** (0.01)
Female x 60000 to below 100000				-0.06*** (0.01)	0.02 (0.01)	-0.06*** (0.01)
Female x 100000 and above				-0.09*** (0.02)	0.05*** (0.01)	-0.08*** (0.02)
Number of children under 6 in household	-0.05*** (0.003)	-0.02*** (0.004)	-0.05*** (0.003)	-0.05*** (0.003)	-0.02*** (0.004)	-0.05*** (0.003)
Number of adult males aged 16 and older in household	-0.03*** (0.004)	0.02*** (0.003)	-0.03*** (0.004)	-0.03*** (0.005)	0.01*** (0.003)	-0.03*** (0.01)
Number of adult females aged 16 and older in household	0.03*** (0.004)	0.03*** (0.003)	0.03*** (0.01)	0.02*** (0.004)	0.03*** (0.003)	0.03*** (0.01)
Number of observations	43,304	43,304	43,304	43,304	43,304	43,304
ρ			0.13 (0.10)			0.27** (0.13)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

[a] Standard errors are in parentheses.
[b] ***, ** and * denote level of significance at one percent, five percent and ten percent respectively.
[c] Estimates are survey weight adjusted.

Both the probit and the bivariate probit estimates with instrument confirm that providing frequent eldercare is associated with a decline in labor force participation. Specifically, the results in columns 1 and 3 indicate that the impact of frequent eldercare provision on labor force participation is statistically significant. In fact, our basic probit model (Model 1) estimate shows that frequent eldercare provision reduces labor force participation by four percentage points. After endogenizing the explanatory variable *E* by estimating the bivariate probit

model (Model 2), this effect is heightened to nine percentage points. This implies that there are economic consequences of frequent eldercare in terms of loss of earning and job benefits.

The results in Table 3 also indicate that gender significantly influences the probability of being an eldercare provider. Column 2 shows that after controlling for individual and household characteristics as well as state and time fixed effects, women tend to provide more frequent eldercare than men. More specifically, women are two percentage points more likely to be frequent providers compared to men, reinforcing the findings of other studies that women are more likely to shoulder the burden of care work. Not surprisingly, female frequent providers are likely to have lower labor force participation compared to their male counterparts.

Other individual and household characteristics significantly influence the labor force participation of the sample respondents. Both columns 1 and 3 show that the marginal effects of age, disability status, marital status, family income and the number of household members to be statistically significant. Being older, not disabled, being married with spouse absent/widowed/divorced/never married, belonging to higher income household increase the probability of labor force participation. Fewer male members and more female members in the household increase the likelihood of participating in the labor force by three percentage points, suggesting that additional female help in caregiving (or the presence of fewer male members) reduces the care burden, thus enabling the individual to participate in the labor market.

The results in columns 4 (Model 3 estimates) and 6 (Model 4 estimates) of Table 3 indicate that frequent eldercare by women is associated with higher labor force participation, more so than among male frequent providers, which is different from the predicted outcome. Among frequent providers, women are less likely to reduce their labor force participation compared to men, a difference of five percentage points.

The significance of ρ (=0.27) in the bivariate model confirms a slight selection effect. Table 3, column 6 shows that providing frequent eldercare (E=1) reduces male labor force participation by 18 percentage points; however, it reduces female labor force participation only by 13 percentage points. This finding implies that more women chose to stay in the labor market compared to men even when they are providing frequent care. One possible explanation is that providing unpaid care to an elderly and also working to earn income are both economic necessities for some women. Giving up her job to care for an elderly can put her and her household's needs at risk and at the same time, she is either unable to find another person to provide unpaid eldercare or is unable to pay for one.

The marginal effect of the interaction variable between family income and gender shown in column 6 of Table 3 helps illuminate the likely effect of economic necessity for women to have a job. The probability of labor force participation of women with a family income of USD 100,000 and above is eight percentage

points lower than the women with a family income below USD 25,000 and this is found to be statistically significant.

The higher labor force participation rate among female FP compared to male FP is consistent with the gender-based pattern in US labor force participation. Geiger and Parker [2018] show that the labor force participation of women in the US has risen in general from 33.9 percent to 57 percent over the period 1950 to 2017. However, over the same period, the labor force participation of men followed a downward path. Labor force participation of men has fallen from 86.4 percent to 69.1 percent from 1950 to 2017. The reasons for such a change in labor market composition is still less understood in the literature.

A more detailed analysis of the factors that account for higher labor force participation of female frequent providers in the US requires further research and is beyond the scope of this paper. Nevertheless, our results are consistent with the findings of other studies. For example, Albanesi and Şahin [2018] suggest that the growing labor market attachment of women as compared to men over time is also a part of the reason for the contrasting trend in labor force participation by men and women. The likelihood of women leaving employment has also reduced. However, the likelihood of men leaving the labor force, e.g., due to prolonged periods of unemployment has escalated. Once men exit the labor force, they are less likely to re-enter. Moreover, Geiger and Parker [2018] highlight the rise in the labor force participation of mothers with dependent children in the US. The growing number of working mothers indicates that many women choose to stay in the labor market, irrespective of their domestic obligations.

4.1. Robustness and sensitivity analysis

We perform robustness and sensitivity checks to validate the results in Table 3. The robustness of our findings is examined using different categories of regular eldercare providers. Specifically, we test whether our findings on the impact of frequent eldercare giving on their labor force participation, in comparison with NP, also hold for other categories of eldercare givers by changing the subsample. First, we increase the eldercare providers' subsample (Subsample A) by adding 'once a week providers' to the FP (daily and several times a week providers) subsample and therefore increasing the sample to 4,921 observations. The inclusion of "once a week providers' lowers the frequency (or intensity) threshold of regular eldercare giving. Next, we raise the frequency (or intensity) threshold of eldercare by focusing only on daily providers and excluding 'several times a week providers' (Subsample B). This yields a sample size of 1,244 observations for eldercare providers. The results presented in Table 3 are robust if the subsample (A) that includes "once a week providers," has a lower effect on labor force participation than that of FP subsample. Alternatively, the impact of providing daily eldercare subsample (B) on labor force participation is expected to be no less than the results for the FP subsample in Table 3.

Table 4 gives the summary results for the robustness and sensitivity checks. Columns 1 and 3 provide the marginal effects for probit (Model 1) and bivariate probit (Model 2) regressions without interaction variables. Columns 4 and 6 provide the marginal effects for Models 3 and 4 that include interaction variables. Focusing on bivariate results, Table 4 column 3 shows that providing eldercare, whether at lower frequency (Subsample A) leads to a decline of eight percentage points in labor force participation as compared to NP while FP shows a decline of nine percentage points (Table 3, column 3). The opposite is true when we compare the effect on labor force participation using the daily providers only subsample (Subsample B) with the frequent provider subsample. Table 4 column 3 shows a much higher reduction in LFP (15 percentage points) among the daily providers (Subsample B) compared to the nine percentage point reduction in labor force participation among frequent providers.

Table 4, columns 4 and 6 present the main results for the robustness checks using interactions in the empirical models (Models 3 and 4). The interaction coefficients of both Subsamples A and B probit regressions confirm the gender-differentiated impact of frequent eldercare on labor force participation to be robust. Similar to the results given in Table 3 (columns 4 and 6), the marginal effects in Table 4 show that the reduction in labor force participation for men is lower than that for women when providing eldercare. Focusing on the bivariate probit results, female eldercare providers in both Subsamples A and B are five percentage points more likely to participate in the labor market as compared to male eldercare providers. The results in columns 4 and 6 also confirm the results obtained without interaction variables in that eldercare reduces the probability of participating in the labor force as compared to the non-providers and that the magnitude of this effect increases (to 23 percentage points) as the frequency of providing care intensifies.

TABLE 4. Summary results of robustness tests: Marginal effects of eldercare on labor force participation, with and without interaction variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Frequent Provider	Labor Force Participation	Labor Force Participation	Frequent Provider	Labor Force Participation
A. Eldercare providers' sample that includes frequent providers and 'once a week' providers[a]						
At least one parent is foreign-born=1		-0.04*** (0.01)			-0.05***	
Eldercare provider= 1	-0.02*** (0.01)		-0.08* (0.04)	-0.04*** (0.01)		-0.16*** (0.05)
Female	-0.15*** (0.01)	0.02*** (0.01)	-0.15*** (0.01)	-0.11*** (0.01)	-0.01 (0.01)	-0.11*** (0.01)

TABLE 4. Summary results of robustness tests (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Frequent Provider	Labor Force Participation	Labor Force Participation	Frequent Provider	Labor Force Participation
Female x At least one parent is foreign-born					0.01 (0.01)	
Female x Eldercare provider				0.04*** (0.01)		0.05*** (0.01)
ρ			0.15 (0.10)			0.30** (0.13)
Number of observations	44,914	44,914	44,914	44,914	44,914	44,914
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
B. Eldercare providers' sample that includes daily providers only[b]						
At least one parent is foreign-born=1		-0.01*** (0.004)			-0.02*** (0.01)	
Daily provider = 1	-0.07*** (0.01)		-0.15** (0.06)	-0.10*** (0.02)		-0.23*** (0.07)
Female	-0.16*** (0.00)	0.01*** (0.003)	-0.15*** (0.004)	-0.11*** (0.01)	-0.01** (0.01)	-0.11*** (0.01)
Female x At least one parent is foreign-born					0.01 (0.01)	
Female x Daily provider				0.05** (0.02)		0.05** (0.02)
ρ			0.17 (0.13)			0.29** (0.15)
Number of observations	41,237	41,237	41,237	44,914	44,914	44,914
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes

[a] Full results are provided in Appendix C, Table C1.
[b] Full results are provided in Appendix C, Table C2.
[c] Standard errors are in parentheses.
[d] ***, ** and * denote level of significance at one percent, five percent and ten percent respectively.
[e] Estimates are survey weight adjusted.

5. Conclusion

The world is expected to encounter a major demographic turn in the next two decades: the elderly population will outnumber the number of younger people in almost all the world's regions. This demographic trend poses a unique set of challenges not only for the US but also for other countries throughout the world, especially those with a rapidly aging population including Japan, Korea, and China. Eldercare continues to be mainly provided by family caregivers, many of whom struggle to balance market work with care responsibilities.

This paper examines the effect of frequent eldercare provision on labor supply using the 2011-2017 ATUS with eldercare module data for individuals aged 25 to 61 years. We use a bivariate probit model with instrumental variable in order to address the endogeneity and selection bias problems. Our findings suggest that frequent eldercare provision is associated with a significantly lower labor supply of individuals aged 25 to 61 years old. This finding is consistent with the existing literature which show that providing eldercare has a negative effect on labor force participation and/or working hours (Johnson and Lo Sasso [2006]; Leigh [2010]; Houtven et al. [2013] Nguyen and Connelly [2014]; Jacobs et al. [2014]). We also find that frequent eldercare provision is associated with a much lower probability of labor force participation among men, compared to women. This may be explained by the fact that for some women, i.e., those in lower income households, withdrawing from the labor force while providing eldercare on a frequent basis is not an option. The robustness test results show that providing care with higher frequency only intensifies the negative effect of eldercare giving on labor supply.

Our study findings have important policy implications. Increasing old-age dependency and the negative economic impact on unpaid care providers suggest the importance and urgency of public investment in quality elder care services and long-term care insurance. Public policies that reduce unpaid care work can help address the adverse effect on labor supply as well as unpaid female carers' disadvantage in the labor market; at the same time, they can enhance the welfare of those receiving care [Addati et al. 2018]. Such policies are likely to produce demand-side effects that expand job opportunities and create employment [Addati et al. 2018].

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Annex

ANNEX A. Probit and bivariate probit results: marginal effects of providing infrequent eldercare (IP) on labor force participation

	(1)	(2)
	Bivariate Probit	
	Infrequent Provider	Labor Force Participation
At least one parent is foreign-born=1	-0.03***	
	(0.006)	
Infrequent Provider = 1		0.04
		(0.05)
Female	0.02***	-0.15***
	(0.004)	(0.005)
Age	0.01***	0.01***
	(0.002)	(0.002)
Age-squared	-0.00004**	-0.0002***
	(0.00002)	(0.00002)
Ref: Less than grade 1		
Grade 1 to 12	0.12**	-0.02
	(0.05)	(0.05)
High school diploma	0.16***	0.02
	(0.05)	(0.05)
Some college or associate degree	0.17***	0.04
	(0.05)	(0.05)
Bachelor degree and above	0.19***	0.06
	(0.05)	(0.05)
Disability=1	-0.02***	-0.27***
	(0.01)	(0.01)

ANNEX A. Probit and bivariate probit results (continued)

	(1)	(2)
	Bivariate Probit	
	Infrequent Provider	Labor Force Participation
Ref: White only		
Black only	-0.01** (0.01)	0.01 (0.01)
Asian only	-0.05*** (0.01)	-0.05*** (0.01)
Hispanic only	-0.02*** (0.01)	0.02*** (0.01)
Mixed	-0.01 (0.02)	0.01 (0.01)
Ref: Married – spouse present		
Married – spouse absent	0.00 (0.01)	0.04** (0.02)
Widowed/divorced/separated	-0.01** (0.01)	0.06*** (0.01)
Never married	-0.00 (0.01)	0.04*** (0.01)
Ref (in USD): Below 25000		
25000 to below 35000	0.01 (0.01)	0.08*** (0.01)
35000 to below 60000	0.01 (0.01)	0.11*** (0.01)
60000 to below 100000	0.02** (0.01)	0.15*** (0.01)
100000 and above	0.02*** (0.01)	0.16*** (0.01)
Number of children under 6 in household	-0.01*** (0.003)	-0.05*** (0.003)
Number of adult males aged 16 and older in household	0.002 (0.004)	-0.04*** (0.002)
Number of adult females aged 16 and older in household	0.005 (0.004)	0.02*** (0.004)
Number of observations	44918	44918
ρ		-0.02
(0.13)		
State FE	Yes	Yes
Time FE	Yes	Yes

[a] Standard errors are in parentheses.
[b] ***, ** and * denote level of significance at one percent, five percent and ten percent respectively.
[c] Estimates are survey weight adjusted

ANNEX B1. Distribution of the FP and NP sample, by parental birthplace (exclusion variable)

	Both the parents are US-born = 0	At least one parent is foreign born =1	*t*-test (At least one parent is foreign-born - both the parents are US-born)
Frequent Provider (FP)	8.55	5.10	- 3.45***
Non-providers (NP)	91.45	94.90	
Observations	31,917	11,387	43,304

[a] ***, ** and * denote level of significance at one percent, five percent and ten percent respectively.

ANNEX B2. Summary of probit estimates: marginal effects of the impact of the instrument on being a frequent eldercare provider and participating in the labor force

	Dependent Variable		
	Frequent Provider (FP)	Frequent Provider (FP)	Labor Force Participation
Effect of instrument			
At least one of the parents is foreign-born =1	-0.05*** (0.004)	-0.03*** (0.01)	0.01 (0.01)
Observations	43,304	43,304	43,304
State FE	No	Yes	Yes
Time FE	No	Yes	Yes
Other control variables?	No	Yes	Yes

[a] Standard errors are in parentheses.
[b] ***, ** and * denote level of significance at one percent, five percent and ten percent respectively.
[c] Estimates are survey weights adjusted.

ANNEX B3. Covariate balance statistics, by parental birthplace (exclusion variable)

	Both parents are US- born = 0		At least one parent is foreign-born = 1		Absolute Standardized Difference (Cohen d)	Variance Ratio Mean	Overlap Coefficient	
	Mean	Variance	Mean	Variance			Equal Variance	Unequal Variance
Female=1	0.54	0.25	0.54	0.25	0.00	1.00	100.0	100.0
Age	41.81	96.56	43.65	109.25	0.18	0.88	0.99	0.92
Less than grade 1	0.01	0.01	0.00	0.00	0.10	43.22	0.08	0.28
Grade 1 to 12	0.18	0.15	0.05	0.05	0.42	3.09	0.38	0.70
High school	0.21	0.17	0.25	0.19	0.08	0.90	0.92	0.96
Associate degree	0.20	0.16	0.30	0.21	0.24	0.76	0.77	0.89
Bachelor and above	0.40	0.24	0.40	0.24	0.00	1.00	100.0	100.0
Disability=1	0.04	0.04	0.09	0.08	0.18	0.52	0.67	0.83
White only	0.23	0.18	0.77	0.18	1.29	0.99	0.12	0.52
Black only	0.08	0.08	0.16	0.13	0.24	0.57	0.68	0.84
Asian only	0.18	0.15	0.00	0.00	0.64	45.51	0.03	0.26
Hispanic only	0.50	0.25	0.05	0.04	1.17	5.61	0.03	0.44
Mixed	0.01	0.01	0.02	0.02	0.04	0.75	0.88	0.93
Married - spouse present	0.60	0.24	0.53	0.25	0.13	0.97	0.89	0.95
Married – spouse absent	0.03	0.03	0.01	0.01	0.14	2.62	0.55	0.77
Widowed/Divorced/Separated	0.16	0.13	0.22	0.17	0.16	0.78	0.83	0.92
Never Married	0.21	0.17	0.23	0.18	0.06	0.92	0.94	0.97
Below 15000	0.23	0.18	0.19	0.15	0.10	1.16	0.90	0.95
15001 to 35000	0.12	0.11	0.09	0.08	0.10	1.29	0.86	0.93

ANNEX B3. Covariate balance statistics, by parental birthplace (continued)

	Both parents are US- born = 0		At least one parent is foreign-born = 1		Absolute Standardized Difference (Cohen d)	Variance Ratio Mean	Overlap Coefficient	
	Mean	Variance	Mean	Variance			Equal Variance	Unequal Variance
35001 to 60000	0.22	0.17	0.22	0.17	0.01	1.01	0.99	100.0
60001 to 100000	0.20	0.16	0.26	0.19	0.12	0.85	0.88	0.94
Above 100000	0.22	0.17	0.24	0.18	0.06	0.93	0.95	0.97
Number of children under 6	0.41	0.49	0.32	0.42	0.13	1.15	0.92	0.94
Number of adult male 16 and older	1.05	0.42	0.92	0.34	0.21	1.24	0.86	0.91
Number of adult female 16 and older	1.08	0.40	0.98	0.32	0.16	1.24	0.89	0.92

[a] For the standardized difference test, there is no fixed rule for the cut point to determine the imbalance. Normand et al. [2001], suggest that a standardized difference greater than 0.10 shows imbalance, whereas Rubin [2001] suggests a cut-off of 0.25 for imbalance. Alternatively, since the standardized difference is a version of Cohen's d statistic for effect size, one could also argue for a cut-off of 0.20 [Cohen 1988], which Cohen termed a "small" effect [Linden 2016]. Given the unbalance in the sample of frequent providers and non-providers, a standardized difference greater than 0.25 is considered to show imbalance.
[b] For the variance ratio, any statistic below 0.5 and above 2.0 shows imbalance [Linden 2016].
[c] For the overlap coefficient, the higher the overlap the better.

ANNEX C1. Marginal effects of providing eldercare (includes frequent providers and once a week providers) on labor force participation, with and without interaction variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Eldercare Provider	Labor Force Participation	Labor Force Participation	Eldercare Provider	Labor Force Participation
At least one parent is foreign-born=1		-0.04*** (0.01)			-0.05***	
Eldercare provider = 1	-0.02*** (0.01)		-0.08* (0.04)	-0.04*** (0.01)		-0.16*** (0.05)
Female	-0.15*** (0.01)	0.02*** (0.01)	-0.15*** (0.01)	-0.11*** (0.01)	-0.01 (0.01)	-0.11*** (0.01)
Female x at least one parent is foreign-born					0.01 (0.01)	
Female x Frequent provider				0.04*** (0.01)		0.05*** (0.01)
Age	0.01*** (0.002)	0.01*** (0.002)	0.02*** (0.002)	0.02*** (0.002)	0.01*** (0.002)	0.02*** (0.002)
Age-squared	-0.0002*** (0.00002)	-0.0001*** (0.00002)	-0.0002*** (0.00002)	-0.0002*** (0.00002)	-0.0001*** (0.00002)	-0.002*** (0.00002)
Ref: Less than grade 1						
Grade 1 to 12	-0.05 (0.05)	-0.08 (0.06)	-0.05 (0.05)	-0.05 (0.05)	-0.08 (0.06)	-0.06 (0.05)
High school diploma	-0.01 (0.05)	-0.04 (0.06)	-0.01 (0.05)	-0.01 (0.05)	-0.04 (0.06)	-0.02 (0.05)
Some college or associate degree[a]	0.01 (0.05)	-0.02 (0.06)	0.01 (0.05)	0.01 (0.05)	-0.02 (0.06)	0.00 (0.05)
Bachelor degree and above	0.03 (0.05)	-0.02 (0.06)	0.03 (0.05)	0.03 (0.05)	-0.02 (0.06)	0.03 (0.05)
Disability=1	-0.28*** (0.01)	-0.03*** (0.01)	-0.28*** (0.01)	-0.28*** (0.01)	-0.03*** (0.01)	-0.28*** (0.01)
Ref: White only						
Black only	0.01 (0.01)	-0.01* (0.01)	0.004 (0.01)	0.01 (0.01)	-0.01* (0.01)	0.003 (0.01)
Asian only	-0.05*** (0.01)	-0.04*** (0.01)	-0.05*** (0.01)	-0.05*** (0.01)	-0.04*** (0.01)	-0.05*** (0.01)
Hispanic only	0.02** (0.01)	-0.01* (0.01)	0.01** (0.01)	0.02** (0.01)	-0.01 (0.01)	0.01* (0.01)
Mixed	0.01 (0.01)	-0.001 (0.01)	0.01 (0.01)	0.01 (0.01)	-0.0002 (0.01)	0.01 (0.01)

ANNEX C1. Marginal effects of providing eldercare (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Eldercare Provider	Labor Force Participation	Labor Force Participation	Eldercare Provider	Labor Force Participation
Ref: Married – spouse present						
Married – spouse absent	0.05*** (0.02)	0.01 (0.01)	0.05*** (0.02)	0.05*** (0.02)	0.01 (0.01)	0.05*** (0.02)
Widowed/ divorced/ separated	0.06*** (0.01)	0.01 (0.01)	0.06*** (0.01)	0.06*** (0.01)	0.01 (0.01)	0.06*** (0.01)
Never married	0.04*** (0.01)	0.03*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.03*** (0.01)	0.04*** (0.01)
Ref (in USD): Below 25000						
25000 to below 35000	0.08*** (0.01)	0.01 (0.01)	0.08*** (0.01)	0.09*** (0.01)	-0.01 (0.01)	0.09*** (0.01)
35000 to below 60000	0.11*** (0.01)	-0.01 (0.01)	0.11*** (0.01)	0.14*** (0.01)	-0.02* (0.01)	0.14*** (0.01)
60000 to below 100000	0.16*** (0.01)	-0.003 (0.01)	0.16*** (0.01)	0.19*** (0.01)	-0.01 (0.01)	0.19*** (0.01)
100000 and above	0.17*** (0.01)	-0.02** (0.01)	0.17*** (0.01)	0.22*** (0.01)	-0.04*** (0.01)	0.22*** (0.01)
Ref (in USD): Female x Below 25000						
Female x 25000 to below 35000				-0.03** (0.01)	0.04** (0.02)	-0.03* (0.01)
Female x 35000 to below 60000				-0.05*** (0.01)	0.02 (0.01)	-0.05*** (0.01)
Female x 60000 to below 100000				-0.06*** (0.01)	0.02 (0.01)	-0.06*** (0.01)
Female x 100000 and above				-0.09*** (0.02)	0.04*** (0.01)	-0.09*** (0.02)
Number of children under 6 in household	-0.05*** (0.003)	-0.02*** (0.004)	-0.05*** (0.003)	-0.05*** (0.003)	-0.02*** (0.004)	-0.05*** (0.003)
Number of adult males aged 16 and older in household	-0.03*** (0.004)	0.01*** (0.004)	-0.03*** (0.004)	-0.03*** (0.004)	0.01*** (0.004)	-0.03*** (0.004)
Number of adult females aged 16 and older in household	0.02*** (0.004)	0.03*** (0.004)	0.03*** (0.004)	0.02*** (0.004)	0.03*** (0.004)	0.02*** (0.004)

ANNEX C1. Marginal effects of providing eldercare (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Eldercare Provider	Labor Force Participation	Labor Force Participation	Eldercare Provider	Labor Force Participation
Number of observations	44,914	44,914	44,914	44,914	44,914	44,914
ρ			0.15			
(0.10)			0.30**			
(0.13)						
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

[a] Standard errors are in parentheses.
[b] ***, ** and * denote level of significance at one percent, five percent and ten percent respectively.
[c] Estimates are survey weight adjusted.

ANNEX C2. Marginal effects of providing frequent eldercare (excludes several times a week providers) on the labor force participation, with and without interaction variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Eldercare Provider	Labor Force Participation	Labor Force Participation	Eldercare Provider	Labor Force Participation
At least one parent is foreign-born=1		-0.01*** (0.004)			-0.02*** (0.01)	
Daily provider = 1	-0.07*** (0.01)		-0.15** (0.06)	-0.10*** (0.02)		-0.23*** (0.07)
Female	-0.16*** (0.00)	0.01*** (0.003)	-0.15*** (0.004)	-0.11*** (0.01)	-0.01** (0.01)	-0.11*** (0.01)
Female x At least one parent is foreign-born					0.01 (0.01)	
Female x Frequent provider				0.05** (0.02)		0.05** (0.02)
Age	0.01*** (0.002)	0.01*** (0.002)	0.01*** (0.002)	0.01*** (0.002)	0.01*** (0.001)	0.02*** (0.002)
Age-squared	-0.0002*** (0.00002)	-0.00003*** (0.00001)	-0.0002*** (0.00002)	-0.0002*** (0.00002)	-0.00003*** (0.00001)	-0.0002*** (0.00002)

ANNEX C2. Marginal effects of providing frequent eldercare (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Eldercare Provider	Labor Force Participation	Labor Force Participation	Eldercare Provider	Labor Force Participation
Ref: Less than grade 1						
Grade 1 to 12	-0.05 (0.05)	-0.05** (0.02)	-0.06 (0.05)	-0.06 (0.05)	-0.05** (0.02)	-0.07 (0.06)
High school diploma	-0.01 (0.05)	-0.03 (0.02)	-0.02 (0.05)	-0.02 (0.05)	-0.03 (0.02)	-0.03 (0.06)
Some college or associate degree[a]	0.01 (0.05)	-0.03 (0.02)	0.001 (0.05)	0.002 (0.05)	-0.03 (0.02)	-0.01 (0.06)
Bachelor degree and above	0.03 (0.05)	-0.03 (0.02)	0.03 (0.05)	0.03 (0.05)	-0.03 (0.02)	0.02 (0.06)
Disability=1	-0.28*** (0.01)	-0.01* (0.004)	-0.28*** (0.01)	-0.28*** (0.01)	-0.01* (0.004)	-0.28*** (0.01)
Ref: White only						
Black only	0.01 (0.01)	-0.01* (0.003)	0.01 (0.01)	0.01 (0.01)	-0.01* (0.003)	0.004 (0.01)
Asian only	-0.05*** (0.01)	0.001 (0.01)	-0.05*** (0.01)	-0.05*** (0.01)	0.0001 (0.01)	-0.05*** (0.01)
Hispanic only	0.02*** (0.01)	-0.001 (0.004)	0.02*** (0.01)	0.02*** (0.01)	-0.001 (0.004)	0.02** (0.01)
Mixed	0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)
Ref: Married – spouse present						
Married – spouse absent	0.04** (0.02)	-0.003 (0.01)	0.04** (0.02)	0.04** (0.02)	-0.003 (0.01)	0.04** (0.02)
Widowed/ divorced/ separated	0.06*** (0.01)	0.01*** (0.003)	0.06*** (0.01)	0.06*** (0.01)	0.01*** (0.003)	0.06*** (0.01)
Never married	0.04*** (0.01)	0.03*** (0.003)	0.04*** (0.01)	0.04*** (0.01)	0.03*** (0.003)	0.04*** (0.01)
Ref (in USD): Below 25000						
25000 to below 35000	0.07*** (0.01)	0.001 (0.004)	0.07*** (0.01)	0.09*** (0.01)	-0.01 (0.01)	0.09*** (0.01)
35000 to below 60000	0.11*** (0.01)	-0.01*** (0.004)	0.11*** (0.01)	0.14*** (0.01)	-0.03*** (0.01)	0.14*** (0.01)
60000 to below 100000	0.16*** (0.01)	-0.02*** (0.004)	0.15*** (0.01)	0.19*** (0.01)	-0.03*** (0.01)	0.19*** (0.01)
100000 and above	0.17*** (0.01)	-0.02*** (0.004)	0.16*** (0.01)	0.22*** (0.01)	-0.04*** (0.01)	0.21*** (0.01)

ANNEX C2. Marginal effects of providing frequent eldercare (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Without interaction variables			With interaction variables		
	Probit	Bivariate Probit		Probit	Bivariate Probit	
	Labor Force Participation	Eldercare Provider	Labor Force Participation	Labor Force Participation	Eldercare Provider	Labor Force Participation
Ref (in USD): Female x Below 25000						
Female x 25000 to below 35000				-0.03** (0.02)	0.01 (0.01)	-0.03** (0.02)
Female x 35000 to below 60000				-0.05*** (0.01)	0.02** (0.01)	-0.05*** (0.01)
Female x 60000 to below 100000				-0.06*** (0.02)	0.02*** (0.01)	-0.06*** (0.02)
Female x 100000 and above				-0.09*** (0.02)	0.04*** (0.01)	-0.08*** (0.02)
Number of children under 6 in household	-0.05*** (0.003)	-0.01*** (0.003)	-0.05*** (0.003)	-0.05*** (0.003)	-0.01*** (0.003)	-0.05*** (0.003)
Number of adult males aged 16 and older in household	-0.03*** (0.004)	0.01*** (0.002)	-0.03*** (0.01)	-0.03*** (0.004)	0.01*** (0.002)	-0.03*** (0.004)
Number of adult females aged 16 and older in household	0.03*** (0.004)	0.02*** (0.002)	0.03*** (0.01)	0.02*** (0.004)	0.02*** (0.002)	0.03*** (0.004)
Number of observations	41,237	41,237	41,237	41,237	41,237	41,237
ρ			0.17			
(0.13)			0.29**			
(0.13)						
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

[a] Standard errors are in parentheses.
[b] ***, ** and * denote level of significance at 1 percent, 5 percent and 10 percent respectively.
[c] Estimates are survey weight adjusted.

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Care work and the demographic composition of households: two Asian cases

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Who provides unpaid caregiving within the household is of economic and policy relevance. This paper examines how care activities are shared among household members, the extent to which women and men substitute for each other in care and work activities, and whether or not they realize economies of scale in care work. Mongolia and South Korea have nationally representative time-use survey data that allow an exploration of these questions. These two countries differ in their level of economic development and industrial structure, demographic profile, and household composition, providing a comparative perspective on the allocation of time to childcare, domestic work and market work within households. The maximum likelihood estimation results reveal significant evidence of substitution between men and women in childcare, but much less so in domestic work or indirect care, and economies of scale in the care of young children and in women's domestic work.

JEL classification: D13, J22, J13
Keywords: household time allocation, household composition and care work, economies of scale

1. Introduction

Understanding the dynamics of unpaid caregiving within the family is of enormous economic and policy relevance. To illustrate, when the COVID-19 pandemic closed schools, forced workers to work from home, and shuttered businesses and public services, families stepped in as the sole provider of care, comfort, and even survival worldwide. But even in more normal times, in both poorer and richer contexts, and especially where public and private social services are scarce or unaffordable to many, the family serves as the principal caregiver of young children and disabled or frail relatives. It performs the essential domestic

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tasks associated with living and work. While governments and the private sector can influence the family's roles and activities through incentive schemes such as subsidized care services, their degree of influence depends on social norms, beliefs and preferences, as well as family size, structure and wealth. For this reason, financial and non-financial incentives to alter individual and household behaviors and choices, including whether to increase labor supply, to reduce or increase family size, or to purchase care services, may not elicit the expected responses.

The economic literature usually frames the allocation of time to care and work activities as dependent primarily on individuals' preferences, wages, and constraints. This paper instead uses the household as the unit of observation. It contributes to the literature on the economics of the household by examining which family members provide care in the family, who shares in that work, which responsibilities are shared, and how household structure and its demographic composition matter in these. Time allocation decisions are made with the family's needs and wants in mind against a background of culture, gender norms, and economic institutions (Tsuya et al. [2000]; Folbre [2004], [2012]; Gimenez-Nadal et al. [2012]; Do et al. [2015]; Alesina and Giuliano [2015]).[1] In Asian countries, for example, the family income distribution is determined not only by who earns income but also by the willingness of family members to pool their resources, resulting in a more equal distribution of family earnings [Ku et al. 2018].

This paper compares the patterns of time use within the household in two countries, Mongolia and South Korea. These two countries differ in their level of economic development and industrial structure. South Korea is a high-income country, largely urban and highly industrialized, with 25 percent of its workers employed in manufacturing and 70 percent in services in 2019, and with families having at most one child.[2] In contrast, Mongolia is a middle-income country whose economy outside the Ulaanbaatar metropolitan area has traditionally depended on nomadic, pastoral agriculture, where men are responsible for long-distance herding, building, and repairing winter and spring shelters, often taking their young sons with them [Cooper and Gelezhamstin 1994].[3] Despite their large economic differences, we find similarities between these countries in the time allocation of women and men. Their labor force participation rates are strikingly similar among women, for example: 51.4 percent in Mongolia and

[1] Folbre [2004: 7] reminds us that "[d]istributional conflict influences decisions made by families and also shapes the social institutions that govern the allocation of time. Time allocation does not conform to the idealized processes of competitive markets because it involves important coordination problems that cannot be solved entirely by the independent decisions of individuals. … The social institutions that evolve to help solve these coordination problems are shaped by collective action, and often prove resistant to change even when they lead to inefficient outcomes."

[2] The total fertility rate in South Korea is 0.78 births per woman, the lowest in the world, and 2.9 in Mongolia [World Bank 2022].

[3] In pastoral areas, women are responsible for herding small stock and milking, in addition to performing domestic tasks such as product processing, cleaning, washing, and sewing [Cooper and Glezhamstin 1994]. Older boys and girls help collect wood for fuel and water [Terbish and Floro 2016].

54 percent in Korea in 2021 [World Bank 2022]. Unsurprisingly, childcare and home production activities fall most heavily on women in the household, as in many other countries (ILO [2018]; King et al. [2021])—but there is substitution between the time of women and men, particularly in childcare, although an additional male in the household would not reduce women's childcare time by as much as an additional female would reduce men's childcare time. We also find significant economies of scale in childcare. Previous studies have found similar evidence that having two children compared to one child does not double the amount of care time (Gustafsson and Kjulin [1994] on Sweden; Holmes and Tiefenthaler [1997] on the Philippines; Kalenkoski et al. [2005] on the UK). With respect to domestic work or indirect care activities such as meal preparation and housecleaning, the evidence for economies of scale is statistically significant for women's time in Korea but not for men in Korea nor for women and men in Mongolia.[4]

2. Theoretical framework

Our estimation model is based on a simple model of the household in which members produce as well as consume a nonmarket good called *care* which is a function of time and goods inputs. Because time is constrained, work is assigned among household members depending on their relative (shadow) wages, productivity, physical limitations, and preferences, and on the relationships among household members that are built on affection, interdependence, trust, and power.[5] These factors lead to a substitution between time and goods inputs in the production of direct and indirect care, and also to a distribution of time to activities among household members.[6] In meeting the care needs of the household, market goods and services may substitute for household time spent on domestic work, but purchased care services such as paid childcare, elder care, and care for members with disabilities may not be regarded as sufficient substitutes for family caregiving. The choice between paid and unpaid family care is a decision made with respect not only to prices and foregone earnings but also to social and cultural norms and personal preferences. Parents, for example, may prefer to

[4] Domestic work such as cooking meals, cleaning house or doing laundry is regarded as a good illustration of economies of scale in household production because the time required for doing these activities is not proportionate to the number of household members. Hence, cooking for four does not necessarily require twice the time of cooking for two, holding the quality of meals constant. Gustafsson and Kjulin [1994] do not find any economies of scale in non-childcare work, whereas Couprie and Ferrant [2015] do.

[5] Folbre [1986] argues that a household model needs to take into account the role of power relations, sharing, reciprocity, nurturance, and authority. Similarly, Apps [2003] points to the limitations of the New Household Economics approach, with "its estimation of aggregate household demands, in analyzing the intra-household distribution of welfare and its determinants" and not recognizing that individuals have opportunities, preferences, and constraints that affect their choices as individuals but also as members of the household.

[6] Microeconomic studies, especially those that examine labor supply behavior, have tended to ignore the significance of household production activities and how these activities compete with labor market work. In those studies, the key determinant of labor supply is market wages, and the factor that determines the relative engagement of women and men is their relative wages.

provide childcare themselves even in the presence of affordable paid care services (Hallberg and Klevmarken [2003]; Hook [2010]).

In a basic form of the household model, two independent adults share a public good Z between them, such as housing, thus benefiting from the economies of doing so and the gains from division of work according to their comparative advantage (Becker [1965]; Cherchye et al. [2020]). The utility function of each adult i depends on consuming a good *care* (C) which he or she produces using care time t_C and a public good Z,

$$C_i = C_i(t_{Ci}, Z) \quad i \in \{1, 2\}, \tag{1}$$

subject to two constraints—a time constraint T_i and a budget constraint Y_i,

$$\begin{aligned} T_i &= t_{Ci} + t_{Wi} \\ Y_i &= w_i\, t_{Wi} \geq \frac{p}{2} Z \end{aligned} \tag{2}$$

where t_w represents adult i's time on paid work and w is the market wage for time worked. Adult i's income from market work, Y, is used to purchase Z at the market price $p/2$, on the assumption that the two adults share equally in the cost of Z. The standard optimization condition in this model is that each adult will allocate time to own-care t_{Ci} up to the point at which the ratio of the marginal product of own-care time to that of paid work (the marginal rate of substitution) is equal to the ratio of the wage to the (one-half) price of the purchased input Z.

Expanding the model, if the two adults care for one another such that each adult's well-being depends also on the other person's well-being, then each adult will produce not only own-care but also care for the other adult, and the care consumed by each adult i will then be a function of own-care time, t_C, the care time *received* from adult j, τ_c^j, and the shared (public) good Z. In Becker's [1991] model of an altruistic household, the household head maximizes the well-being of all members, but that model requires a further assumption that the altruistic head of the household is able to control the distribution of resources [Pollak 1985]. For the purpose of this paper, we ignore the sources and distribution of this control. Regardless of assumptions about control within the household, one possible (and probable) outcome of the household time allocation model is that a household member, most likely a woman, takes on most care responsibilities in exchange for receiving goods or money from household members who are able to earn more in the labor market [Apps 2003]. The effect of market forces that predict this distribution of care responsibilities is either reinforced or attenuated by preferences and social norms.

Numerous studies have shown that the presence of young children profoundly changes the labor supply decisions and care responsibilities of adults in the household, and the dynamics between them (e.g., Behrman [1997]; Blundell

et al. [2005]; Connelly [1992]; Guryan et al. [2008]; Zangger et al. [2021]). Translating this finding into our model, total childcare (C_c) depends on the time inputs *received* by children from each adult i (τ_{Ci}^{c}), purchased child-specific input Z_c (e.g., anything from diapers to paid childcare) for price p_c , and the public good Z. That is, the production of childcare in a household with two adults is

$$C_c = C_c(\tau_{C1}^{c}, \tau_{C2}^{c}, Z, Z_c). \tag{3a}$$

Folding into own-care and care for adult j other activities such as domestic work, the time constraint of each adult i is now a function of own-care time, care time given to the other adult j (t_C^{j}), time for childcare (t_C^{c}), and market work time (t_W),

$$T_i = t_{Ci} + t_{Ci}^{j} + t_{Ci}^{c} + t_{Wi}, \quad i, j \in \{1,2\}, \quad i \neq j \tag{3b}$$

In this model, who cares more for the child and who shares in that responsibility depend on the relative market wages of the adults at home and their relative marginal productivities in care work. Per this condition, the adult with a lower wage compared to other adults or a higher relative marginal productivity in care work will likely provide more childcare. Moreover, the higher the price of Z_C (e.g., paid childcare) relative to wages, less of Z_C will be purchased and more time for childcare will be given by the adult whose wage is lower than either the price of Z_C or the wage of the other adult. This is the reason why a subsidy for paid childcare which lowers the price of Z_C would be a condition for women to increase their labor supply. But market wages and the price of paid services are not the only important factor affecting childcare decisions in households. In their review of a rich literature, Monna and Gauthier [2008] conclude that family traditions and society's expectations about the appropriate roles and behaviors of parents mediate (and perhaps mitigate) the effect of the market on parental care. Arslan et al. [2023], in this issue, also argue that the perceived quality of paid care services can be a critical factor in the decision of the family to use paid childcare services.

Is the burden of childcare on the household mitigated by economies of scale?[7] The empirical estimation in the next section examines how the time allocation to childcare changes with the number of children in the household. The addition of a second child in the household increases the marginal productivity of time for childcare by both adults. If a second child also lowers the average childcare time, then there is evidence of economies of scale. Previous studies have long recognized that as the number of children in the family increases, the cost per child decreases (e.g., Aalto and Varjonen [2006], Kalenkoski et al. [2005]). However, there are limits to such economies. In the Philippines, economies of scale do

[7] Economies of scale can exist even without children. As applied to time allocation instead of household expenditures, Couprie and Ferrant [2015: 9] define the concept as follows: "Economies of scale measure the extra time that two singles living apart need to have to be as well off as when living together." In this paper, we focus the analysis on economies of scale in childcare.

not extend beyond a total of three children [Holmes and Tiefenthaler 1997]. The age composition of children also likely affects the possibility of economies of scale. If there is a substantial age gap among them, childcare would involve age-appropriate care activities that may be different enough as to not lower parents' per-child care time. Any parent would know that caring for an infant is not the same as caring for a school-age child of eight or a teen in terms of attention and physical care. Rosenzweig and Zhang [2009] point to another reason why there may be no economies of scale in childcare time. They find economies of scale in a sample of twins in China with respect to purchased inputs, such as clothing and books, but not with respect to parents' per-child time assisting with homework. Unequal aspirations about the schooling of boys and girls, they find, may dilute economies of scale in parental time for homework.

If we consider time spent for caring for infants or toddlers and older children as two different care activities and if parents are able to engage in both care activities at the same time, is this evidence of economies of scope? When are simultaneous or overlapping activities evidence of economies of scope in household production? The definition of economies of scope requires that the cost of doing both activities at the same time must be less than the sum of the cost of doing each activity separately, *without loss of effectiveness*.[8] Adults frequently engage in simultaneous or overlapping activities, such as cooking a meal while listening to the radio, or watching a toddler while helping an older child with homework, but the condition about loss of quality is important and harder to measure. Ascertaining economies of scope is difficult. While the total time spent is observable and measurable, direct measures of the total (physical and mental) cost of overlapping activities and their effectiveness are generally not available (Floro and Miles [2003]; Folbre and Yoon [2007]; Suh and Folbre [2016]).

Economies of scale and economies of scope exist not only with respect to time but also with respect to purchased inputs. For example, siblings (even of different ages) can share a room; toys and books can be shared by children of similar ages; parents may be able to employ a childminder for less than double the price for the care of twins. Without data on expenditures related to time for care work, we do not examine these economies. In the next sections, we examine the presence of economies of scale and scope in time allocation, but we hesitate to conclude about economies of scope for reasons mentioned above.

[8] To illustrate what is meant by economies of scope, consider one definition in agricultural production: "when a farmer can use the same input(s) to produce two or more products, and lower the cost of producing them separately. To achieve this end the inputs have to be complementary. By developing cost complementarities between different crops or livestock species, diversified farms can become more efficient than specialised farms" [de Roest et al. 2018: 222]. In the literature on childcare, possible evidence of economies of scope is confounded by unobserved costs associated with simultaneous activities. For there to be economies of scope in childcare, the energy tax (cost) on parents of caring for two children *at the same* time must be less than the sum of the cost of caring for each child separately. In addition, there should be no loss in the quality of simultaneous caregiving.

3. Estimation model

In our model, the household is the unit of production and consumption in which decisions are made collectively or are negotiated among its members as in a bargaining model, and where such decisions hinge on the total time resources and wealth of the household and on markets and public goods that are available. We examine how childcare and domestic work are influenced by the size and demographic composition of the household. The starting point of our empirical model is given by Equation 4, which is estimated separately for women (f) and men (m). For ease of presentation, we drop the subscript for the household.

$$\ln(t_h^j) = \alpha_{hj} + \boldsymbol{\eta_{hj}}\boldsymbol{X} + \gamma_{hj}(N_j - 1) + \beta_{hj}N_C + \epsilon_{hj}\,, \quad j = \{f, m\} \tag{4}$$

where t_h^j is the total time spent by adults aged 15-64 of gender j in the household on activities in category h (either childcare, indirect care, or market work); N_j−1 is the total number of co-resident adults who are potential caregivers; N_c is the total number of children; and ϵ_{hj} is a stochastic error.[9] The dependent variables pertain only to time for a main or primary activity. We use a logged specification of the dependent variables which has the benefit of being able to interpret the coefficients as elasticities.[10] So as not to lose the sample households that reported zero time for any of the three activity groups, we assign them a value of one minute per day for the dependent variable (thus, a log value of zero). The coefficients of the count variables indicate the percentage change in time spent for activity h by adults aged 15-64 of gender j with respect to a unit change in any of the count variables.

$\boldsymbol{X}$ is a vector of household characteristics (the age, gender and education of the household head, measures of household wealth, and urban or rural location). These household variables are common controls used in household demand models. The education of the household head, household wealth and location can proxy for missing variables such as wages. The gender of the household head may indicate the relative power of women and men in the household, but previous studies of female headship caution against reading too much into this variable (e.g., Handa [1994]; Budlender [2003]; Klasen et al. [2015]), Brown and van de Walle [2021]). Some of the reasons for female headship (e.g., singlehood, widowhood, divorce, and separation) which imply the absence of adult males may render the female head and her household to be more vulnerable to risks of poverty. Because of absent data in time surveys on wages, previous employment, market for paid care services, and disabilities and chronic illness within the family, $\boldsymbol{X}$ does not include these variables.[11]

[9] Annex Table 2 lists the types of activities included in the time-use surveys.

[10] This is similar to studies that have examined the allocation of household expenditures within the household (e.g., Nelson [1988]; Lanjouw and Ravallion [1995]; Brown and van de Walle [2021]).

[11] For example, Pagán [2013] finds that "disability steals time:" disabled individuals devote less time to market work (especially females), and more time to domestic work such as cooking, cleaning and child care, to tertiary activities such as personal care and medical treatment. On wage measures, Mas and Pallais [2019] rightly argue that the market wage is only an approximation of the opportunity cost of employed workers but not of unemployed workers' opportunity cost which is difficult to measure since it reflects activities that happen outside the market.

In Equations 5, we show our full specifications. The estimated system of time-use equations has a common set of regressors. We add gender-specific count variables for adults in order to explore the presence of substitution and/or complementarity in work between women and men, and the presence of economies of scale and scope in childcare. The term N_j is the number of adults aged 15-64 of gender j in the household, minus one if j is of the same gender. In other words, the equation for the time use of women includes the number of adult women in the household minus one ($N_f - 1$), as well as the number of adult men, N_m, to examine whether other women or men share in the time for activity h.

$$\ln(t_h^f) = \alpha_{fh} + \boldsymbol{\eta_{fh}} \boldsymbol{X} + \gamma_{fh}(N_f - 1) + \varphi_{fh} N_m + \sum_c (\beta_{hf}^c N_c + \delta_{hf}^c N_c^2 + \theta_{hf}^c N_c N_k) + \epsilon_{hf}$$

$$\ln(t_h^m) = \alpha_{mh} + \boldsymbol{\eta_{mh}} \boldsymbol{X} + \gamma_{mh} N_f + \varphi_{mh}(N_m - 1) + \sum_c (\beta_{hm}^c N_c + \delta_{hm}^c N_c^2 + \theta_{hm}^c N_c N_k) + \epsilon_{hm} \quad (5)$$

where h pertains to the three broad activity groups of childcare, domestic work, and market work, and c refers to two child groups, namely, ages zero to four and five to 14 for South Korea and ages zero to 11 and 12 to 14 for Mongolia, as defined by their respective time-use surveys. We distinguish between young children and older children by referring to the other child group as k, where $k \neq c$; caring for them presumably requires a different type and intensity of care work. By including a quadratic term for each child count, we test a simple form of economies of scale in activity h with respect to each child age group c. We interpret a negative coefficient δ_{ij} for this term as suggesting economies of scale, that is, an additional child (of the same age group) would increase time for activity h only by $(\beta_{hj}^c + 2\delta_{hj} N_c)$.

We also consider a simple test for the presence of the economies of scope in childcare by adding an interaction variable of the age-specific child count variables in Equations 5, but as we discuss above, this test rests on the assumption that the care of young and older children are two distinct care activities. A negative coefficient of the interaction term θ would mean that an additional child of one age group would increase childcare time by less than that coefficient multiplied by the count of children of the other age group. Since one alternative explanation for a negative coefficient is measurement error in reporting or recording the time for secondary or simultaneous activities, we interpret our findings with a fair degree of caution. Another source of a measurement error is the possibility that the older child may be helping to care for the younger sibling, thus reducing the reported or observed adult care time for the younger child.

4. Data and descriptive statistics

We analyze time-use survey data from Korea [Statistics Korea 2014] and Mongolia [NSO Mongolia 2011] separately. These nationally representative time-use surveys cover all household members (ages ten and above for Korea, 12 and above for Mongolia) instead of only one randomly selected member of a household, allowing us to use the whole household as our unit of analysis. Descriptions of the collection dates, methods, sampling, and sample size of the time-use surveys are presented in Annex Table 1. Time-use survey data are extremely useful for documenting the types and levels of care activities, but they also have important limitations that apply to our study.[12] First, as mentioned earlier, although the two surveys we use collect time data on secondary or simultaneous activities, such data are more likely to suffer from measurement error (Charmes [2019]; Folbre and Yoon [2007]; Gauthier et al. [2004]), so they would underestimate care work at home.[13] Second, time-use surveys generally do not collect data on prices of goods, occupation, or wages of household members who are employed, physical health of household members, and so on, thus limiting our ability to predict the allocation of time across the activity groups and between women and men.

4.1. Country differences in household composition and time use

Table 1 shows striking differences in the composition of households in Mongolia and Korea. Of the full survey samples, 42.5 percent of households in Mongolia and 57.8 percent in Korea have no children aged zero to 14 years, reflecting Korea's extremely low fertility rate. Tracing the transformation of the Korean household over the past decades, Kweon [1998] notes that between 1975 and 1995/6, the share of the traditional Korean extended family (of the eldest son and his family living with his elderly parents) fell from 78 percent to 20 percent, while the share of one-generation families doubled and that of elderly-only households rose more than sevenfold. Two decades later, the share of single-person households had risen to 28.7 percent and had grown at a rate faster than in other OECD countries [Seo 2019], and nearly one-fourth of households include only adults aged 65 and older. Rapid urbanization accompanied by massive outmigration from rural areas of young people and deep changes in attitudes toward extended families and gender roles are regarded as main reasons.

[12] Time-use researchers have been developing different methods since the 1980s to address many of the challenges and difficulties of time-use data collection and measurement. A review and comparison of data collection methods can be found in Floro and King [2016] and Buvinic and King [2018].

[13] For example, Fedick et al. [2005], using Canadian data, find that for every childcare hour recorded as a primary activity, three to four more hours of childcare are performed as a secondary activity. Supervisory care in particular is likely to be considered secondary, which often leads to significant underestimates of childcare time. The time-use surveys of Mongolia and Korea collect time spent in secondary activities, but the accuracy of that time data would depend on the training of interviewers and/or clear instructions provided to respondents about using time diaries. Collecting the time for simultaneous activities seems more sensitive to such factors.

TABLE 1. Age composition of time-use surveys

	Mongolia	South Korea
Full time-use survey samples (households)	1322	11787
Households with no children aged 0-14	562 (42.5%)	6815 (57.8%)
Households with only members aged 65 and over	62 (4.7%)	2793 (23.7%)
Households with members aged 0-64 (estimation samples)	754 (57.0%)	2179 (18.5%)

Sources: Authors' calculations using the 2011 Mongolia Time-Use Survey [NSO Mongolia 2011] and 2014 South Korea Time-Use Survey [Statistics Korea 2014].
Notes: The analysis samples include households with one or more members aged 15-64 and one or more children under 15, but no members above 65.

Fertility rates have also fallen dramatically in Mongolia—from 7.1 births per woman in 1970 to 2.6 in 2011 [World Bank 2022]. Rapid urbanization in response to expanding employment opportunities in cities has been transforming its household composition. Household size has shrunk to 3.6 but it is still 50 percent larger than the average household size in Korea. The share of single-person households is half that in Korea; 62.3 percent are nuclear family households, 24.9 percent are extended families, and 2.1 percent are mixed family households [NSO Mongolia n.d.]. The share of elderly-only households is five percent, as compared with 23.7 percent in Korea.

Table 2 shows the gender-disaggregated means and standard deviations of total household time spent in the three care categories, measured in minutes per day, from the two time-use surveys.[14] Several patterns emerge from just these averages: In both countries, women perform the bulk of unpaid care work.[15] On average, the total time for childcare by women in households with at least one child aged less than 15 is 68 minutes per day in Mongolia and 168 minutes in Korea. The corresponding averages for men are far lower—15 minutes in Mongolia and 42 minutes in Korea. We note that 58 percent of households in Mongolia have at least one child younger than 15, whereas only 42 percent of households in Korea do. Interestingly too, the childcare numbers between columns 2 and 3 are not similar. For Mongolia, the average childcare time is larger in column 3, suggesting that some households with children report zero childcare time by adults aged 15 to 64. In Korea, the opposite seems to be case: many more households report positive time for childcare but have no children younger than 15 living in the same household. These findings point to the existence of inter-household care arrangements in which childcare duties are shared also with non-resident adults, such as grandparents (aged less than 65) who reside on their own.

[14] The specific activities included in the aggregate categories of childcare and domestic work are described in Annex Table 2.

[15] Older children do care for younger siblings (e.g., East [2010]; Yi et al. [2012]). They also help with domestic work and may even be employed in some contexts, but here we follow the UN definition that children under 15 are not in the labor market.

TABLE 2. Mean unpaid time for childcare, domestic work or indirect care, and market work by household members aged 15-64 (minutes per day)

		All households	Households with children aged <15 years old	Households with childcare time > 0
	Activity	**(1)**	**(2)**	**(3)**
Mongolia				
Women	Childcare	44.9 (93.13)	68.1 (108.86)	98.7 (117.38)
	Domestic work	61.5 (125.49)	59.7 (124.72)	74.2 (133.57)
	Market work	277.3 (317.14)	298.4 (314.52)	292.2 (319.11)
Men	Childcare	10.4 (37.18)	15.1 (43.32)	22.8 (52.52)
	Domestic work	51.6 (93.07)	52.1 (90.78)	59.3 (99.55)
	Market work	312.1 (339.68)	343.9 (337.23)	308.4 (324.28)
	N	1322	802	601
South Korea				
Women	Childcare	34.9 (88.10)	167.9 (131.95)	126.9 (128.54)
	Domestic work	140.2 (134.15)	198.4 (107.17)	214.5 (109.69)
	Market work	92.5 (159.39)	66.5 (118.73)	78.5 (123.22)
Men	Childcare	8.7 (30.84)	42.3 (57.62)	31.4 (52.34)
	Domestic work	26.9 (50.74)	29.8 (47.97)	30.6 (49.87)
	Market work	132.0 (168.10)	165.7 (122.63)	166.8 (131.59)
	N	11787	2254	3244

Data sources: Authors' calculations using the 2011 Mongolia Time-Use Survey [NSO Mongolia 2011] and 2014 South Korea Time-Use Survey [Statistics Korea 2014].
Notes: Standard deviations in parentheses. Childcare pertains to direct care given to children under 15. Only time for primary activities is included in these numbers.

In Mongolia, the gender gap in the time spent for domestic work is significantly smaller than the corresponding gender gap in Korea. In Korea, women's average time for domestic work is five times that of men's across all households. When focusing only on households with children (column 2) or on households that spend time on childcare (column 3), the gender gap is even wider, with women spending about seven times more time on domestic work. The presence of children

increases the time that women spend on domestic work, while men's contribution to domestic work is hardly affected by the presence of children.

Aggregate data show that women's labor force participation in Korea is far lower than that of men, 54.0 percent v. 72.7 percent in 2021, even though Korean men and women have about equal years of schooling [World Bank 2022]. Korea's gender gap in labor force participation rates is larger than Mongolia's, 51.5 percent v. 67.0 percent in 2021. Time-use data indicate that this gender disparity is evident also at the intensive margin: in Mongolia, the average market hours of employed men exceed those of women by 12.5 percent across all households and by 15.2 percent in households with children. In Korea, the gender difference in market hours is much more pronounced; men work 42.7 percent more hours in the market than women across all households and 149 percent more in households with children.

4.2. Household characteristics of the estimation samples

Because our analysis focuses on how care work, particularly childcare, is shared within households, our estimation samples include only those households that have at least one child aged zero to 14, at least one adult aged 15 to 64, and no adult aged 65 years and above. We impose this selection rule on the two countries for the purpose of comparing households with more similar demographic composition. This rule is perhaps more restrictive in Korea than in Mongolia because of the low fertility rate in Korea and its rapidly aging population. Omitting the households with elderly members aged 65 and over reduces our sample only by a small fraction of the households with young children in the two countries—in Mongolia, by three percent, and in Korea, zero percent. In the reduced samples of households, we do not include the time of older adults because their time-use data would reflect not only differences in time allocation behavior between the two countries but also the large gap between their life expectancies at birth (Mongolia, 73, and Korea, 83) and household structure [World Bank 2022]. Excluding the elderly-only households, as Table 1 indicates, reduces the Mongolia sample by 4.7 percent and the Korea sample by 23.7 percent.

In our estimation sample for Mongolia, 31 percent of households have female heads, as compared with Korea where just 13 percent of households are headed by females (Table 3). This disparity in the prevalence of female headship in the two countries may be reflecting the differences between an economy where the principal livelihood outside the capital city is associated with a nomadic lifestyle and an economy that is largely urban and industrial. There is also a wide gap of ten years of schooling between the average education levels of the household heads in the two countries. The average years of education of the head is 4.2 years in Mongolia, as compared with over 14.4 years in Korea. This gap is due partly to differences in the gender composition of the household heads and partly to the difference in the level of educational development between the two countries.

Using data from several years of the Korea Time Use Survey, Park [2021] finds that both mothers and fathers have increased their childcare between 1999 and 2014, irrespective of their education levels. However, the increase over time has been greater among parents with a university degree, as compared with parents with less education. Similarly, Dotti Sani and Treas [2016] find that in 11 Western countries between 1965 and 2012, mothers and fathers with more education showed larger increases in childcare time than parents with lower education.

TABLE 3. Summary statistics for estimation samples

	Mongolia		South Korea	
	Mean (s.d.)	**Min, max**	**Mean (s.d.)**	**Min, max**
Number of children aged 0-4[a]	1.47 (0.91)	0, 5	0.78 (0.72)	0, 3
Number of children aged 5-14[a]	0.33 (0.54)	0, 3	0.71 (0.70)	0, 3
Number of female adults aged 15-64	1.34 (0.67)	0, 6	1.06 (0.37)	0, 4
Number of male adults aged 15-64	1.15 (0.69)	0, 5	0.97 (0.34)	0, 3
Household head is female (binary)	0.31 (0.46)	0, 1	0.13 (0.33)	0, 1
Head's age	37.92 (9.94)	12, 64	38.95 (6.39)	20, 64
Head's highest completed schooling (years)	4.23 (1.84)	1, 8	14.43 (2.47)	0, 23
Wealth index	0.70[b] (0.18)	0, 1	--	--
Size of house (sq. ft.)	--	--	80.51 (28.04)	16,347
Owns house (binary)	--	--	0.57 (0.49)	0, 1
Double earner household (binary)	--	--	0.41 (0.49)	0, 1
Urban (binary)	0.35 (0.48)	0, 1	0.46 (0.50)	0, 1
N	*754*		*2179*	

Sources: Authors' calculations using the 2011 Mongolia Time-Use Survey [NSO Mongolia 2011] and 2014 South Korea Time-Use Survey [Statistics Korea 2014].
Notes: The subsample used is households with at least one child and one member 15-64, but without elderly members.
[a] The age cut-offs for children differ for Mongolia; instead of zero to four, the youngest child group pertain to children zero to 11, and the second group is for children ages 12-14.
[b] This is a normalized index of household assets, created using principal component analysis to binary variables regarding the ownership of various assets. For Mongolia, the assets include ownership and size of agricultural land; ownership of livestock or farm animals, horses, cattle, camels, sheep, goats, pigs, and poultry; ownership of a renewable energy generator, computer, TV, washing machine, refrigerator, microwave, telephone, cell phone, car, bus or minivan, and motorcycle; and household access to internet or cable TV. The Korean Time-Use Survey does not have sufficient asset information to allow the calculation of a wealth index.

In our estimation samples, urban residence is lower in Mongolia at 35 percent, compared with 46 percent in Korea. These rates are significantly lower than the population-based urbanization rates [World Bank 2022] which were 68 percent in 2011 for Mongolia and 82 percent in 2014 for Korea. The disparity in the rates is likely due to the differences in the demographic composition of households that reside in urban areas. For example, one might expect that a higher share of single households and couple-only households resides in urban areas because of the higher cost of living in those areas; these are the households that are excluded from our estimation samples.

With respect to household wealth, detailed information on the ownership of pre-specified assets is available for Mongolia, allowing us to use principal component analysis to construct a wealth index with values between zero and one; the mean value of the index is 0.70.[16] For Korea, similar detailed information about asset ownership is not available, but we use the size of the house in which the household lives,[17] house ownership (57 percent) and the presence of more than one earner in the household (41 percent) as proxy variables for wealth.

5. Regression results

In this section, we examine whether the disparities in time use between the two countries are associated with household differences in demographic composition and socioeconomic characteristics. We assume that the decisions about the household's time on different activities are jointly determined, so we estimate a Seemingly Unrelated Regression (SUR) model using maximum likelihood to account for correlated error terms in the equations for childcare, domestic work or indirect care, and market time for women and for men. The omitted time categories are eldercare and household time spent on residual activities, including self-care, leisure, voluntary work, and, among older children, school hours.

Our focus here is on the results for the count variables but there are some noteworthy findings about the control variables. Annex Tables 3 and 4 show that, across the specifications, female headship is associated with a more traditional allocation of time: significantly more time for childcare and domestic work by women in the household, significantly less time for childcare and domestic work among men, but significantly more market time by women than men. This finding seems contrary to a naïve expectation that having a female head may result in a more gender-equal allocation of time. For Mongolia, it is likely explained by the fact that rural males spend considerable time away from home due to their livelihood of livestock raising.

[16] Details on which assets are included in the construction of each index are given in the notes for Tables 3 and 4.

[17] According to Statistics Korea [2011], the home ownership rate in Korea was 56 percent of households, a far lower rate than in other countries with comparable average income.

With respect to the education of the household head, in Mongolia both women and men in households with more education spend more time in market work and less time in childcare. In contrast, in Korea, in households where the head has more education, both women and men spend significantly more time in childcare and domestic work, and women spend significantly less time in market work. Previous studies have similarly noted that, holding other household characteristics constant, more education is associated with more time for childcare by both women and men compared with households with less education, possibly because greater value is placed on investments in children (Guryan et al. [2008]; Dotti Sani and Treas [2016]; Park [2021]).

Table 4 presents the coefficient estimates for the full specification. Panel A presents the estimates for the childcare equations, Panel B for domestic work or indirect care, and Panel C for market work.[18] Since the dependent variables are in log values, the coefficients of the child count variables show the percent increase in the time allocated by males or females in response to an additional child, and the coefficients of the adult count variables indicate the marginal contribution of an additional adult. In Panel A, considering both the linear coefficients of the child count variables and the coefficients of the quadratic terms (that is, $\beta_{hj}^{c} + 2\delta_{hj} N_c$), an increase from one child to two children aged zero to four years old, holding other variables constant, would increase women's total time spent on childcare by 76.6 percent in Mongolia and by only 6.3 percent in Korea. Less than a hundred percent increase indicates economies of scale in time for childcare, so the economies of scale are substantial in Korea. The corresponding numbers for men are 32.3 percent and 0.9 percent, respectively, also showing significant economies of scale. The estimates for older children are not significant except in Korea: having two children aged five to 14 instead of one would increase women's total childcare time by 7.2 percent.

TABLE 4. SUR results: Coefficients of full regression specifications, using the estimation samples

	Mongolia		South Korea	
	Females	**Males**	**Females**	**Males**
A. Total household time spent on childcare by gender (in logs)				
Children 0-4 (0-11)	1.730***	0.803***	1.891***	1.417***
	(0.314)	(0.234)	(0.266)	(0.376)
Children 5-14 (12-14)	-0.161	-0.0472	1.004***	-0.174
	(0.423)	(0.316)	(0.261)	(0.369)
Female adults 15-64	0.260**	-0.150*	1.287***	-0.286**
	(0.118)	(0.0882)	(0.080)	(0.114)
Male adults 15-64	-0.199*	0.0734	-0.167	0.641***
	(0.115)	(0.0857)	(0.101)	(0.144)
Children 0-4 (0-11) squared	-0.241***	-0.120**	-0.457***	-0.352***
	(0.0698)	(0.0521)	(0.085)	(0.120)
Children 5-14 (12-14) squared	0.0747	0.0486	-0.233***	0.054
	(0.234)	(0.175)	(0.082)	(0.116)

[18] The full results of all specifications (with the control variables included) are provided in the Annex Tables 3 and 4.

TABLE 4. SUR results: Coefficients of full regression specifications (continued)

	Mongolia		South Korea	
	Females	**Males**	**Females**	**Males**
Children 0-4 (0-11) x Children 5-14 (12-14)	-0.0145 (0.170)	-0.161 (0.127)	-0.564*** (0.141)	-0.189 (0.199)
Adjusted R^2	0.199	0.201	0.255	0.216
B. Total household time spent on indirect care by gender (in logs)				
Children 0-4 (0-11)	0.0540 (0.141)	0.00721 (0.260)	0.560** (0.245)	-0.574 (0.397)
Children 5-14 (12-14)	-0.199 (0.190)	-0.0875 (0.351)	0.697*** (0.240)	-0.713* (0.389)
Female adults 15-64	-0.0863 (0.0530)	-0.209** (0.0979)	1.397*** (0.074)	-0.204* (0.120)
Male adults 15-64	0.0157 (0.0514)	-0.0809 (0.0950)	-0.088 (0.093)	0.963*** (0.151)
Children 0-4 (0-11) squared	0.0113 (0.0313)	0.00654 (0.0578)	-0.133* (0.078)	0.170 (0.127)
Children 5-14 (12-14) squared	0.0987 (0.105)	-0.179 (0.194)	-0.186** (0.076)	0.179 (0.123)
Children 0-4 (0-11) x Children 5-14 (12-14)	-0.122 (0.0760)	0.0970 (0.141)	-0.287** (0.129)	0.385* (0.210)
Adjusted R^2	0.854	0.444	0.173	0.0850
C. Total household time spent on market work by gender (in logs)				
Children 0-4 (0-11)	-0.250 (0.414)	0.114 (0.299)	-0.720** (0.354)	0.268 (0.371)
Children 5-14 (12-14)	-0.228 (0.558)	0.236 (0.403)	-0.279 (0.347)	0.512 (0.364)
Female adults 15-64	0.819*** (0.156)	-0.0260 (0.113)	1.116*** (0.107)	-0.281** (0.112)
Male adults 15-64	0.0169 (0.151)	0.323*** (0.109)	-0.366*** (0.135)	1.944*** (0.142)
Children 0-4 (0-11) squared	-0.0193 (0.0920)	-0.0274 (0.0665)	0.203* (0.113)	-0.029 (0.119)
Children 5-14 (12-14) squared	-0.234 (0.308)	0.0219 (0.223)	0.030 (0.110)	-0.128 (0.115)
Children 0-4 (0-11) x Children 5-14 (12-14)	0.242 (0.224)	-0.272* (0.162)	0.217 (0.187)	-0.205 (0.196)
Adjusted R^2	0.142	0.603	0.547	0.270
N	754	754	1984	1984

Data sources: Authors' calculations using the 2011 Mongolia Time-Use Survey and the 2014 South Korea Time-Use Survey.

Notes: Standard errors in parentheses. Asterisks represent statistical significance: * p<0.10, ** p<0.05, ***<0.01. Estimates are calculated using a seemingly unrelated regression (SUR) specification. The outcome variables are logged total household time spent on the specified activity by either men or women as indicated. The subsample used from each survey is those households with at least one child and one member 15-64, but without elderly members. Control variables include an indicator for whether or not the household head is female; the head's age and age squared; the head's highest years of education completed; and an indicator for whether or not the household resides in an urban area. Additional controls by country are: Mongolia: wealth index (see notes for Table 2); South Korea: size of house (sq. ft.) and indicator for whether or not the household owns their house (proxies for wealth); indicator for whether or not the household is a dual-earner household. To estimate the effect of the child counts, use the individual coefficients of the linear, quadratic and interaction terms, as explained in Equation 5.

The rows for the number of female adults and male adults indicate the degree of substitution between them. Focusing first on childcare time, in the regressions for total female time, an additional female adult in the household would increase the total time for childcare by women in the household by 26 percent in Mongolia and by 128.7 percent in Korea. One possible explanation for the large percentage increase in women's time for childcare in Korea is that an additional woman (in an otherwise nuclear family household) might be a grandmother (younger than 65, so as to be included in our estimation sample) or another female relative who has joined the household for the primary purpose of providing childcare. Analyzing panel data in Korea, Park [2022] finds that the rate of grandparent care for grandchildren has been increasing, and that the amount of this time commitment for this activity is large in Korea. The presence of an additional male adult would not increase total childcare time by men in Mongolia, but it would increase it by 64 percent in Korea.

Turning to the cross-gender coefficients, a negative coefficient for the male adult count in the regression for women's childcare time (or for the female adult count in the regression for men's childcare time) indicates substitution between adult men and women in childcare. We find statistically significant negative cross-gender coefficients: holding constant the child count variables, an additional adult male in the household would decrease women's total time spent on childcare by 20 percent in Mongolia and by 17 percent in Korea (though the latter is not statistically significant). In the case of total male time on childcare, the coefficients for an additional female adult are also negative, implying substitution (by 15 percent in Mongolia and 29 percent in Korea). The results suggest asymmetry in the substitutability between men's and women's time in childcare: an additional male in the household would not reduce women's childcare time by as much as an additional female would reduce men's childcare time.

Panel B pertains to domestic work or indirect care time. The presence of young and older children in Korea is significantly associated with the total time spent on domestic work, particularly by women. Having two children aged zero to four instead of one child would increase total domestic work of women by 2.8 percent. Considering now also the coefficient θ of the interaction term of the child variables indicates the presence of economies of scope, an interpretation discussed in Section 2. These coefficients are significant for women's childcare and domestic work and also for men's domestic work in Korea. To illustrate, assume that a family has an older child and a young child comes along. The total time for childcare by women in the household would increase by 41.3 percent instead 97.7 percent. The total time for domestic work by women would rise only by 0.7 percent instead of 71.3 percent, suggesting that older children are more independent or may even be helping with domestic work. For Mongolia, only one of the coefficients is statistically significant; the age range of the child count variables may not be differentiating enough between young children who are going to be more dependent on adults and older children who would be more independent.

The results for the cross-gender counts suggest less substitution between women's and men's domestic work than in the case of childcare in Korea. An additional female adult in the household would increase the total time of women on domestic work by nearly 140 percent and would decrease men's time by 20 percent. An additional male would nearly double men's total time contribution to domestic work but would not decrease women's time. The results suggest that while men and women may share in childcare, domestic work which includes tasks such as meal preparation and housecleaning is regarded as "women's work," to be done by women when they are present.

In Panel C, considering again the coefficients of the child count variables, that is, β, δ and θ, the results indicate that having two young children aged zero to four instead of just one would decrease the total market hours of women in Korea by 31.4 percent, but an additional child in the older age group does not have a significant coefficient. The number of children does not appear to affect men's market work in Korea. Women's or men's market work in Mongolia is also not significantly associated with the number of older children, possibly because older children (age group 12-14 years) are likely to be in school and so are not a hindrance to labor supply. The negative relationship between female labor supply and the presence of young children is well documented by other studies (e.g., Connelly [1992]; Lilly et al. [2007]; Morrissey [2017]).

The coefficients of the count variables for adults of the same gender are large and statistically significant in both countries, signifying that an additional adult who may be co-residing to supplement childcare time may allow a parent to increase the total time for market work. The coefficients are larger for women than for men in Mongolia (82 percent v. 32 percent) and larger for men than for women in Korea (194 percent v. 112 percent), providing support to previous findings that co-residence with other adults can raise market participation for both women and men [Tsuya et al. 2000]. Evidence of cross-gender substitution in market work is limited to Korea: An additional female would reduce the total market hours of men by 28 percent, while an additional male would reduce the total market hours of women by 37 percent. The disparity in results for the two countries is revealing of the country-specific gender allocation of time within the household.

6. Concluding remarks: care and family policy

This study has focused on the relationship between the size and demographic composition of the household and time spent for childcare, domestic work or indirect care, and market work by adult family members. The two countries we study differ greatly with respect to their household characteristics and economy. In 2022, the average family size was 3.6 in Mongolia and 2.4 in Korea [World Bank 2022]. Mongolia is a lower-middle-income country whose economy is still largely based on livestock-raising and a relatively nomadic lifestyle, while Korea is a mostly urban, industrial, high-income country where the average education

level is about thrice that in Mongolia. The gender patterns in time allocation are broadly similar in these two countries, but there are also clear differences between them based on our analysis of time-use survey data.

Using a household perspective and controlling for household characteristics, our findings show that women do most of the childcare in the family, sharing that work with co-resident women and, to a lesser degree, with men. Women and men substitute for each other in childcare, but more so in Korea than in Mongolia, and not to an equal degree. There is an asymmetry in this substitution: an additional male in the household would not reduce women's childcare time by as much as an additional female would reduce men's childcare time. Our results reveal significant economies of scale in the care of young children by women, and possibly also economies of scope. Domestic work or indirect care, unlike childcare, is primarily the domain of women and is barely shared by men, whatever the size and composition of the household. Recent research on Korea, however, shows that gender patterns in childcare have been shifting over time with changes in the demographic composition and structure of households (Peng [2018]; Park [2022]).

All in all, the results show the benefits of a household perspective on time allocation. Depending on traditions and norms, individuals within a household can call upon time and financial resources beyond their own. Women who must juggle hours of market work, domestic work and childcare can rely on co-resident adults to ensure that young children receive a certain level of total care or that necessary domestic work is met. In both Mongolia and Korea, caregiving, domestic work, and market work could be shared with one co-resident adult such as a spouse or a co-resident grandparent, lightening the total burden for each adult and allowing some reallocation of time. Research indicates that caregivers generally are able to balance their market work and caregiving if their care responsibilities are manageable. In Korea, Do et al. [2015] find that women who provide more than ten hours of care per week are 15.2 percentage points less likely to participate in the labor force than other women.[19]

Governments have used a variety of policies and programs that use both demand and supply forces to mitigate the cost of family caregiving and to expand the market participation of adults. For example, work leave policies allow employed parents time to care for their infants and young children without having to terminate their employment. At least 185 countries now mandate paid maternity leave, with different duration and entitlements [Del Rey et al. 2021]. In Europe, these leave policies provide universal, long, and paid entitlements; in much of the developing world, the entitlements are selective, short, and generally unpaid. An increasing number of countries have also adopted paternity leave policies [Sevilla 2020], although many provide for very limited duration. Paternity leave policies

[19] Two systematic reviews of empirical studies on the US, UK, and Canada conclude that caregiving is generally associated with a negative effect on female labor force supply that varies from almost negligible to six fewer hours of labor market work per week for each additional hour of caregiving (Lilly [2007]; Meng [2013]).

are meant to encourage the sharing of care work in the family (Farré and Gonzalez [2019]; Tamm [2019]; Corekcioglu et al. [2020]). An alternative to a gender-specific leave policy is parental leave that allows parents to assume childcare responsibilities on a more egalitarian basis. In countries that have adopted this more flexible policy, women have made career choices that are possible because couples are able to share care work (Boll et al. [2014]; Broadway et al. [2020]).

In developing countries where the formal economy is small, only a small percentage of working parents can benefit from leave policies, so it is imperative to explore other policies. Governments have provided childcare benefits directly to parents through investments in childcare services, childcare allowances, personal income tax deductions or credits, tax deductions for childcare fees in 41 percent of countries; to childcare centers through corporate income tax deductions or credits, financial and nonmonetary support in 35 percent; and to employers through corporate or income tax deductions or credits, nontax benefits or subsidies in 24 percent [World Bank 2019]. Reviews of past studies show that public programs and subsidies for childcare have increased female labor force participation (Del Boca [2015]; Morrissey [2017]). These policies, however, can sometimes crowd out informal care arrangements that local communities may be better able to, and more cheaply, provide.[20]

Who ultimately finances the cost of leave entitlements and childcare subsidies can be the critical factor determining their impact. If the cost of these programs falls mostly and ultimately on the family, and on women in particular, they will not reduce gender inequality in the recruitment of women, wages, and time for caregiving in the home [Olivetti and Petrongolo 2017]. The risk is that those costs will be, at least partially, passed on to beneficiaries in terms of discriminatory hiring, glass ceilings in occupations, and lower wages, mostly at the disadvantage of married women of childbearing age (e.g., Baker et al. [2008]; Baker and Milligan [2008]; Schönberg and Ludsteck [2014]; Olivetti and Petrongolo [2017]).[21]

Our empirical analysis does not examine other aspects of family caregiving, such as caring for elderly adults who are frail because age is not a reliable measure of the need for caregiving. The global trend of population aging is expected to raise the future burden of eldercare so this issue has to figure in future research on family caregiving. Already, an increasing number of men and women are assuming caregiving for elderly relatives in place of paid caregivers because of cost reasons and concerns about the quality of available care services.[22]

[20] In Chile and Ecuador, for example, local childcare centers adjust their schedules to fit the needs of working parents, and they accept younger children [Mateo Díaz and Rodriguez-Chamussy 2016]. For different policy scenarios about female labor supply, see also Cicowiez and Lofgren [2023] and Tribin et al. [2023] in this issue.
[21] Mandated employer provision of childcare services has been shown to reduce women's starting wages by ten to 20 percent in Chile [Prada et al. 2015] and possibly also to lower the recruitment of women.
[22] According to the *World Population Prospects*, one in six people worldwide will be over age 65 by 2050, up from one in 11 in 2019, and the number of persons aged 80 years and older will triple to 426 million [United Nations 2019].

To conclude, a household perspective on care decisions and labor supply reveals how a family meets and allocates its care responsibilities among members. And while traditional beliefs and social norms, as well as the market for paid care services, are also factors in those decisions, these contextual factors are themselves evolving in response to broader demographic and economic transformations. Understanding the family dynamics of time allocation in the face of such changes helps to predict the impact of a variety of family and social assistance programs and employment policies, such as flexible work arrangements, family leave entitlements, publicly funded childcare, and subsidies to care suppliers.

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Annex

ANNEX TABLE 1. Description of Time-use Surveys

	Mongolia	South Korea
Survey period	March – December 2011	July, September, December 2014
Collected by…	National Statistical Office of Mongolia	Statistics Korea
Sample selection procedure	Stage 1: Probability sampling proportional to size of 400 primary sampling units (lowest administrative units) Stage 2: 10 households from each PSU selected using systematic sampling	Households drawn randomly from Korea census
Time use collection method	Recall method for last week	Recall method for last two consecutive days, 24-hour time diary in 10-minute intervals
Total number of households surveyed	3,998	12,000
Household members surveyed	All members 12+	All members 10+
Nationally representative?	Yes	Yes

Notes: Information taken from statistical agency websites, time use survey documentation, and data reports.

ANNEX TABLE 2. Specific activities included in time categories in Mongolia and South Korea

	Child Care	Domestic Work or Indirect Care
Mongolia	Caring for pre-school age and school-age chil-dren/physical care	Preparing meals/snacks and cleaning up after food preparation/meals/ snacks
	Reading, playing and talking to children	Hand-washing; loading/unloading washing machine
	Assisting with school work	Indoor and outdoor cleaning
	Meeting with teachers and attending parent-teacher meetings	Shopping for/purchasing of goods and related activi-ties
	Other activities related to childcare	Improvement, maintenance and repair of dwellings personal and household goods including computers
		Vehicle maintenance and minor repairs
		Collecting water, preparing fuel and heat for dwelling
		Other activities related to household management

ANNEX TABLE 2. Specific activities included in time categories in Mongolia and South Korea (continued)

	Child Care	Domestic Work or Indirect Care
South Korea	Physical care of children aged 0-9 Educational activities with children aged 0-9 Reading and playing with children aged 0-9 Providing medical care for children aged 0-9 Other care for children aged 0-9 Physical care of children aged 10-17 Helping with homework and study for children aged 10-17 Providing medical care for children aged 10-17 Other care for children aged 10-17 Travel related to childcare	Cooking and washing dishes Laundry and clothing repair Home cleaning and taking out trash Home repairs and maintenance Shopping Organizing and managing the household Other household chores Travel related to indirect care

Sources: NSO Mongolia [2011] and Statistics Korea [2014].

ANNEX TABLE 3. SUR estimates of household time allocation (in logs) using four specifications: Mongolia estimation samples

A. Basic specification	Childcare		Domestic work or Indirect care		Market work	
	Female	Male	Female	Male	Female	Male
Children 0-11	0.829***	0.290***	0.0542	0.0613	-0.252**	-0.112
	(0.0877)	(0.0649)	(0.0389)	(0.0719)	(0.116)	(0.0830)
Children 12-14	-0.243*	-0.265**	-0.212***	-0.197*	-0.299	-0.123
	(0.144)	(0.107)	(0.0640)	(0.118)	(0.191)	(0.136)
Female-headed household	0.687***	-1.282***	4.734***	-3.104***	0.425*	-4.781***
	(0.167)	(0.124)	(0.0741)	(0.137)	(0.221)	(0.158)
Head age	0.0186	-0.0178	0.0274	-0.0204	0.297***	0.193***
	(0.0455)	(0.0337)	(0.0202)	(0.0373)	(0.0602)	(0.0430)
Head's age squared	-0.0000976	0.000259	-0.000232	0.000429	-0.00340***	-0.00226***
	(0.000569)	(0.000421)	(0.000252)	(0.000466)	(0.000753)	(0.000538)
Highest grade completed	-0.0650	-0.101***	0.00460	-0.0554	0.273***	0.108**
	(0.0505)	(0.0373)	(0.0224)	(0.0413)	(0.0668)	(0.0477)
Wealth index	3.031***	2.784***	-0.131	0.929*	-4.101***	-2.343***
	(0.586)	(0.434)	(0.260)	(0.480)	(0.776)	(0.554)
Urban	-0.0446	-0.242*	-0.142*	-0.401**	-0.312	0.163
	(0.191)	(0.141)	(0.0846)	(0.156)	(0.253)	(0.181)
Constant	-1.219	-0.165	-0.588	2.936***	0.0190	2.864***
	(0.950)	(0.703)	(0.421)	(0.778)	(1.257)	(0.898)
R^2	0.174	0.191	0.853	0.439	0.109	0.597

ANNEX TABLE 3. SUR estimates of household time allocation (continued)

B. Substitution specification	Childcare		Domestic work or Indirect care		Market work	
	Female	Male	Female	Male	Female	Male
Children 0-11	0.825***	0.291***	0.0537	0.0563	-0.242**	-0.102
	(0.0874)	(0.0648)	(0.0389)	(0.0717)	(0.114)	(0.0826)
Children 12-14	-0.224	-0.277***	-0.217***	-0.210*	-0.245	-0.129
	(0.144)	(0.107)	(0.0640)	(0.118)	(0.188)	(0.136)
Female adults 15-64	0.248**	-0.157*	-0.0853	-0.210**	0.817***	-0.0285
	(0.119)	(0.0885)	(0.0530)	(0.0978)	(0.156)	(0.113)
Male adults 15-64	-0.185	0.0790	0.0133	-0.0795	0.0215	0.322***
	(0.116)	(0.0859)	(0.0515)	(0.0950)	(0.151)	(0.109)
Female-headed household	0.563***	-1.220***	4.755***	-3.102***	0.291	-4.635***
	(0.175)	(0.130)	(0.0778)	(0.144)	(0.229)	(0.165)
Head age	0.0179	-0.0182	0.0264	-0.0256	0.310***	0.200***
	(0.0454)	(0.0337)	(0.0202)	(0.0372)	(0.0593)	(0.0429)
Head's age squared	-0.000120	0.000293	-0.000198	0.000570	-0.00380***	-0.00241***
	(0.000572)	(0.000424)	(0.000254)	(0.000469)	(0.000747)	(0.000541)
Highest grade completed	-0.0632	-0.102***	0.00416	-0.0561	0.277***	0.107**
	(0.0502)	(0.0372)	(0.0223)	(0.0412)	(0.0656)	(0.0475)
Wealth index	3.054***	2.768***	-0.140	0.904*	-4.010***	-2.340***
	(0.584)	(0.433)	(0.259)	(0.479)	(0.762)	(0.551)
Urban	-0.0623	-0.225	-0.128	-0.352**	-0.462*	0.121
	(0.192)	(0.142)	(0.0854)	(0.157)	(0.251)	(0.181)
Constant	-1.258	-0.0860	-0.503	3.306***	-1.011	2.438***
	(0.971)	(0.720)	(0.432)	(0.797)	(1.268)	(0.918)
R^2	0.182	0.195	0.853	0.443	0.140	0.602
C. Economies of scale specifiction	**Childcare**		**Domestic work or Indirect care**		**Market work**	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
Children 0-11	1.714***	0.631***	-0.0764	0.111	0.00788	-0.176
	(0.257)	(0.192)	(0.115)	(0.213)	(0.339)	(0.245)
Children 12-14	-0.177	-0.231	-0.338**	0.0229	0.0474	-0.0729
	(0.377)	(0.282)	(0.169)	(0.312)	(0.497)	(0.360)
Female adults 15-64	0.260**	-0.152*	-0.0878*	-0.208**	0.822***	-0.0292
	(0.118)	(0.0883)	(0.0530)	(0.0979)	(0.156)	(0.113)
Male adults 15-64	-0.199*	0.0735	0.0157	-0.0810	0.0168	0.323***
	(0.115)	(0.0858)	(0.0515)	(0.0951)	(0.151)	(0.110)
Children 0-11 squared	-0.239***	-0.0909*	0.0330	-0.0107	-0.0624	0.0210
	(0.0629)	(0.0470)	(0.0282)	(0.0521)	(0.0830)	(0.0601)

ANNEX TABLE 3. SUR estimates of household time allocation (continued)

C. Economies of scale specifiction	Childcare		Domestic work or Indirect care		Market work	
	Female	Male	Female	Male	Female	Male
Children 12-14 squared	0.0710	0.00746	0.0675	-0.154	-0.172	-0.0475
	(0.230)	(0.172)	(0.103)	(0.190)	(0.303)	(0.220)
Female-headed household	0.576***	-1.214***	4.751***	-3.097***	0.300	-4.635***
	(0.173)	(0.130)	(0.0778)	(0.144)	(0.229)	(0.166)
Head age	0.0221	-0.0168	0.0265	-0.0268	0.310***	0.200***
	(0.0450)	(0.0336)	(0.0202)	(0.0373)	(0.0593)	(0.0430)
Head's age squared	-0.000145	0.000285	-0.000202	0.000584	-0.00379***	-0.00240***
	(0.000567)	(0.000423)	(0.000254)	(0.000469)	(0.000748)	(0.000541)
Highest grade completed	-0.0696	-0.105***	0.00584	-0.0580	0.273***	0.107**
	(0.0498)	(0.0372)	(0.0224)	(0.0413)	(0.0657)	(0.0476)
Wealth index	3.038***	2.763***	-0.141	0.910*	-4.006***	-2.337***
	(0.578)	(0.432)	(0.259)	(0.478)	(0.762)	(0.551)
Urban	-0.0521	-0.221	-0.131	-0.347**	-0.454*	0.121
	(0.190)	(0.142)	(0.0853)	(0.157)	(0.251)	(0.181)
Constant	-1.982**	-0.363	-0.398	3.265***	-1.210	2.499***
	(0.981)	(0.733)	(0.440)	(0.812)	(1.294)	(0.936)
R^2	0.199	0.199	0.854	0.443	0.141	0.602
D. Economies of scope specifiction	**Childcare**		**Domestic work or Indirect care**		**Market work**	
	Female	Male	Female	Male	Female	Male
Children 0-11	1.730***	0.803***	0.0540	0.00721	-0.250	0.114
	(0.314)	(0.234)	(0.141)	(0.260)	(0.414)	(0.299)
Children 12-14	-0.161	-0.0472	-0.199	-0.0875	-0.228	0.236
	(0.423)	(0.316)	(0.190)	(0.351)	(0.558)	(0.403)
Female adults 15-64	0.260**	-0.150*	-0.0863	-0.209**	0.819***	-0.0260
	(0.118)	(0.0882)	(0.0530)	(0.0979)	(0.156)	(0.113)
Male adults 15-64	-0.199*	0.0734	0.0157	-0.0809	0.0169	0.323***
	(0.115)	(0.0857)	(0.0514)	(0.0950)	(0.151)	(0.109)
Children 0-11 squared	-0.241***	-0.120**	0.0113	0.00654	-0.0193	-0.0274
	(0.0698)	(0.0521)	(0.0313)	(0.0578)	(0.0920)	(0.0665)
Children 12-14 squared	0.0747	0.0486	0.0987	-0.179	-0.234	0.0219
	(0.234)	(0.175)	(0.105)	(0.194)	(0.308)	(0.223)
Children 0-11 x Children 12-14	-0.0145	-0.161	-0.122	0.0970	0.242	-0.272*
	(0.170)	(0.127)	(0.0760)	(0.141)	(0.224)	(0.162)
Female-headed household	0.575***	-1.219***	4.747***	-3.094***	0.307	-4.644***
	(0.174)	(0.130)	(0.0777)	(0.144)	(0.229)	(0.165)
Head age	0.0219	-0.0184	0.0253	-0.0259	0.312***	0.197***
	(0.0450)	(0.0336)	(0.0202)	(0.0373)	(0.0593)	(0.0429)

ANNEX TABLE 3. SUR estimates of household time allocation (continued)

D. Economies of scope specifiction	Childcare		Domestic work or Indirect care		Market work	
	Female	Male	Female	Male	Female	Male
Head's age squared	-0.000143	0.000308	-0.000185	0.000570	-0.00382***	-0.00236***
	(0.000567)	(0.000423)	(0.000254)	(0.000470)	(0.000748)	(0.000541)
Highest grade completed	-0.0695	-0.105***	0.00604	-0.0582	0.273***	0.107**
	(0.0498)	(0.0372)	(0.0223)	(0.0413)	(0.0657)	(0.0475)
Wealth index	3.038***	2.768***	-0.137	0.907*	-4.014***	-2.329***
	(0.578)	(0.431)	(0.259)	(0.478)	(0.761)	(0.550)
Urban	-0.0530	-0.231	-0.139	-0.342**	-0.440*	0.105
	(0.190)	(0.142)	(0.0853)	(0.158)	(0.251)	(0.181)
Constant	-1.997**	-0.528	-0.524	3.365***	-0.961	2.220**
	(0.996)	(0.744)	(0.446)	(0.825)	(1.313)	(0.949)
N	754	754	754	754	754	754
R^2	0.199	0.201	0.854	0.444	0.142	0.603

ANNEX TABLE 4. SUR estimates of household time allocation (in logs) using four specifications: South Korea estimation samples

A. Basic specification	Childcare		Indirect care		Market work	
	Female	Male	Female	Male	Female	Male
Children 0-4	0.559***	0.576***	0.077	0.029	-0.159**	0.037
	0.056	0.075	0.052	0.079	0.072	0.077
Children 5-14	0.052	-0.264***	0.089*	-0.076	-0.050	0.110
	0.057	0.076	0.053	0.080	0.073	0.078
Female-headed household	0.187**	-1.724***	0.154*	-1.214***	1.035***	-2.648***
	0.091	0.121	0.085	0.128	0.116	0.124
Head age	-0.089**	-0.122**	-0.039	-0.061	-0.128**	-0.129**
	0.039	0.052	0.036	0.055	0.050	0.053
Head's age squared	0.001*	0.001**	0.001	0.001	0.002***	0.001**
	0.000	0.001	0.000	0.001	0.001	0.001
Highest grade completed	0.018	0.036**	0.011	0.055***	-0.069***	-0.023
	0.013	0.018	0.012	0.018	0.017	0.018
Size of house (sq. ft.)	0.002	0.002	0.003***	-0.000	-0.001	-0.001
	0.001	0.001	0.001	0.002	0.001	0.002
Owns house	0.031	-0.038	0.042	-0.005	-0.122	0.096
	0.062	0.083	0.058	0.087	0.079	0.085
Urban	0.144**	-0.110	0.050	0.010	-0.164**	-0.079
	0.059	0.079	0.056	0.084	0.076	0.081

ANNEX TABLE 4. SUR estimates of household time allocation (continued)

A. Basic specification	Childcare		Indirect care		Market work	
	Female	Male	Female	Male	Female	Male
Double-earner household	-0.425***	0.007	-0.237***	0.274***	3.384***	0.181**
	0.061	0.081	0.057	0.086	0.078	0.083
Constant	6.036***	4.513***	5.201***	2.269**	3.574***	7.772***
	0.820	1.096	0.768	1.156	1.051	1.122
R^2	0.146	0.199	0.0204	0.0634	0.519	0.197
B. Substitution specification	**Childcare**		**Indirect care**		**Market work**	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
Children 0-4	0.555***	0.584***	0.074	0.042	-0.165**	0.062
	0.053	0.074	0.048	0.078	0.070	0.073
Children 5-14	0.070	-0.265***	0.110**	-0.073	-0.036	0.118
	0.053	0.075	0.049	0.079	0.071	0.074
Female adults 15-64	1.290***	-0.292**	1.402***	-0.209*	1.117***	-0.276**
	0.081	0.114	0.074	0.120	0.107	0.112
Male adults 15-64	-0.168	0.627***	-0.081	0.957***	-0.362***	1.951***
	0.102	0.144	0.094	0.151	0.135	0.142
Female-headed household	-0.141	-1.260***	-0.137	-0.547***	0.607***	-1.313***
	0.109	0.154	0.100	0.162	0.145	0.152
Head age	-0.023	-0.115**	0.037	-0.037	-0.078	-0.071
	0.037	0.052	0.034	0.055	0.049	0.051
Head's age squared	-0.000	0.001**	-0.001	0.001	0.001**	0.001
	0.000	0.001	0.000	0.001	0.001	0.001
Highest grade completed	0.024**	0.035**	0.017	0.055***	-0.064***	-0.022
	0.012	0.017	0.011	0.018	0.016	0.017
Size of house (sq. ft.)	0.000	0.002	0.001	-0.000	-0.003*	-0.002
	0.001	0.001	0.001	0.002	0.001	0.001
Owns house	0.016	-0.050	0.023	-0.027	-0.129*	0.048
	0.058	0.082	0.053	0.086	0.077	0.081
Urban	0.094*	-0.088	-0.003	0.035	-0.211***	-0.033
	0.056	0.079	0.051	0.083	0.074	0.078
Double-earner household	-0.522***	-0.001	-0.347***	0.243***	3.311***	0.105
	0.058	0.082	0.053	0.086	0.077	0.080
Constant	3.854***	4.004***	2.657***	1.039	2.054*	4.974***
	0.807	1.138	0.738	1.196	1.068	1.118
R^2	0.244	0.209	0.170	0.0834	0.546	0.269

ANNEX TABLE 4. SUR estimates of household time allocation (continued)

C. Economies of scale specifiction	Childcare		Indirect care		Market work	
	Female	Male	Female	Male	Female	Male
Children 0-4	0.943***	1.100***	0.079	0.072	-0.355**	-0.075
	0.123	0.173	0.113	0.183	0.163	0.171
Children 5-14	0.085	-0.481***	0.231**	-0.087	0.075	0.179
	0.126	0.177	0.115	0.187	0.167	0.175
Female adults 15-64	1.294***	-0.284**	1.401***	-0.209*	1.113***	-0.278**
	0.081	0.114	0.074	0.120	0.107	0.112
Male adults 15-64	-0.159	0.643***	-0.084	0.958***	-0.369***	1.947***
	0.102	0.144	0.094	0.152	0.135	0.142
Children 0-4 squared	-0.185***	-0.261***	0.005	-0.016	0.098	0.069
	0.052	0.073	0.047	0.077	0.068	0.072
Children 5-14 squared	0.016	0.137*	-0.059	0.009	-0.066	-0.038
	0.054	0.076	0.050	0.081	0.072	0.075
Female-headed household	-0.133	-1.244***	-0.140	-0.546***	0.600***	-1.317***
	0.109	0.154	0.100	0.162	0.145	0.152
Head age	-0.006	-0.079	0.030	-0.034	-0.094*	-0.081
	0.038	0.053	0.035	0.056	0.050	0.052
Head's age squared	-0.000	0.001	-0.000	0.001	0.001**	0.001
	0.000	0.001	0.000	0.001	0.001	0.001
Highest grade completed	0.024*	0.033*	0.018	0.055***	-0.064***	-0.021
	0.012	0.017	0.011	0.018	0.016	0.017
Size of house (sq. ft.)	0.000	0.002	0.001	-0.000	-0.003*	-0.002
	0.001	0.001	0.001	0.002	0.001	0.001
Owns house	0.017	-0.043	0.020	-0.027	-0.132*	0.046
	0.058	0.082	0.053	0.087	0.077	0.081
Urban	0.092*	-0.092	-0.002	0.035	-0.210***	-0.032
	0.056	0.079	0.051	0.083	0.074	0.078
Double-earner household	-0.518***	0.011	-0.350***	0.244***	3.306***	0.102
	0.058	0.082	0.053	0.086	0.077	0.080
Constant	3.347***	3.069***	2.784***	0.981	2.433**	5.226***
	0.820	1.156	0.753	1.220	1.089	1.141
Wealth index	3.038***	2.763***	-0.141	0.910*	-4.006***	-2.337***
	(0.578)	(0.432)	(0.259)	(0.478)	(0.762)	(0.551)
Urban	-0.0521	-0.221	-0.131	-0.347**	-0.454*	0.121
	(0.190)	(0.142)	(0.0853)	(0.157)	(0.251)	(0.181)
Constant	-1.982**	-0.363	-0.398	3.265***	-1.210	2.499***
	(0.981)	(0.733)	(0.440)	(0.812)	(1.294)	(0.936)
R^2	0.199	0.199	0.854	0.443	0.141	0.602

ANNEX TABLE 4. SUR estimates of household time allocation (continued)

D. Economies of scope specifiction	Childcare		Indirect care		Market work	
	Female	Male	Female	Male	Female	Male
Children 0-4	1.891***	1.417***	0.560**	-0.574	-0.720**	0.268
	0.266	0.376	0.245	0.397	0.354	0.371
Children 5-14	1.004***	-0.174	0.697***	-0.713*	-0.279	0.512
	0.261	0.369	0.240	0.389	0.347	0.364
Female adults 15-64	1.287***	-0.286**	1.397***	-0.204*	1.116***	-0.281**
	0.080	0.114	0.074	0.120	0.107	0.112
Male adults 15-64	-0.167	0.641***	-0.088	0.963***	-0.366***	1.944***
	0.101	0.144	0.093	0.151	0.135	0.142
Children 0-4 squared	-0.457***	-0.352***	-0.133*	0.170	0.203*	-0.029
	0.085	0.120	0.078	0.127	0.113	0.119
Children 5-14 squared	-0.233***	0.054	-0.186**	0.179	0.030	-0.128
	0.082	0.116	0.076	0.123	0.110	0.115
Children 0-4 x Children 5-14	-0.564***	-0.189	-0.287**	0.385*	0.217	-0.205
	0.141	0.199	0.129	0.210	0.187	0.196
Female-headed household	-0.138	-1.245***	-0.142	-0.543***	0.602***	-1.319***
	0.109	0.154	0.100	0.162	0.145	0.152
Head age	-0.006	-0.079	0.030	-0.034	-0.094*	-0.081
	0.038	0.053	0.035	0.056	0.050	0.052
Head's age squared	-0.000	0.001	-0.000	0.001	0.001**	0.001
	0.000	0.001	0.000	0.001	0.001	0.001
Highest grade completed	0.021*	0.033*	0.016	0.057***	-0.063***	-0.022
	0.012	0.017	0.011	0.018	0.016	0.017
Size of house (sq. ft.)	0.000	0.002	0.001	-0.000	-0.003*	-0.002
	0.001	0.001	0.001	0.002	0.001	0.001
Owns house	0.014	-0.044	0.018	-0.024	-0.131*	0.045
	0.058	0.082	0.053	0.086	0.077	0.081
Urban	0.088	-0.093	-0.004	0.037	-0.208***	-0.033
	0.056	0.079	0.051	0.083	0.074	0.078
Double-earner household	-0.516***	0.011	-0.349***	0.242***	3.305***	0.103
	0.058	0.081	0.053	0.086	0.077	0.080
Constant	2.697***	2.852**	2.454***	1.424	2.683**	4.990***
	0.833	1.179	0.767	1.243	1.109	1.163
N	1984	1984	1984	1984	1984	1984
R^2	0.255	0.216	0.173	0.0850	0.547	0.270

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Care workers' sense of responsibility, working conditions, and the quality of care in South Korea

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As countries like South Korea expand their paid care services, ensuring quality care has become critical. Since care work involves significant emotional labor, a worker's sense of responsibility for the care recipient's well-being affects the quality of care delivered. In this study, we explore this particular determinant of quality care that has been underexplored to better understand its nature. However, a worker's sense of responsibility or commitment level is not static and varies depending on various factors including working conditions. Using 2018 Korean childcare and eldercare survey data, we empirically examine the relationship between a worker's commitment levels and working conditions by conducting Tobit and generalized maximum entropy (GME) analyses. Results indicate that training, shorter commutes, predictable schedules, and easy interactions with the care recipient's family are associated with higher levels of commitment. Our findings highlight the importance of supportive working conditions in promoting quality care.

JEL classification: J13, J14, J81, D91, J28, J490
Keywords: quality of care, childcare, eldercare, paid caregivers, working conditions, South Korea

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1. Introduction

As populations have grown, the demand for care services has also increased. Governments in middle- and high-income countries have responded by expanding paid care services, including childcare, early childhood education, and long-term care for older adults in need of care. A significant portion of unpaid care work, however, still falls on family members, with women shouldering much of the workload. In Korea, for example, the average weekly time spent caring for children and older adults in need of care exceeds 50 hours (Kang et al. [2021]; Cha et al. [2022]; Suh [2021]). One reason for the continuing heavy reliance on unpaid care is the concern about the quality of paid care services, making families less willing to substitute paid services for family caregiving. Studies on childcare in Korea show that the lack of affordable care of adequate quality has compelled even dual-earning households to rely heavily on women's unpaid care labor (Kim and Jeong [2006]; Sung [2018]). Adult children, particularly daughters and daughters-in-law, are opting to provide eldercare themselves, citing severe concerns regarding the quality of paid care as the main reason for this choice (Choi and Kim [2013]; Lee [2018]; Song [2014]).

This persistent reliance on women's unpaid labor worldwide to meet care needs has serious economic, social, and welfare consequences. Women face long working hours and stress as they try to balance paid work and caregiving, particularly among low-income workers (Himmelweit [1995]; England [2005]; Folbre [2011]). This reliance reinforces gender gaps in the labor market by decreasing women's labor force participation and earnings. In Korea, women's unpaid workload has kept its female labor force participation rate below those of other OECD countries (OECD [2021]; Statistics Korea [2023a]). Moreover, the reliance on women's unpaid care labor has contributed to the ultralow fertility rate in Korea, which has an adverse long-term impact on economic growth, social security systems, and reproduction.[1] For these reasons, governments must address not only the need for accessible care services but also for good quality care.

There is good reason for the concern about the quality of paid care. Caregiving is distinct from other types of paid care services in that it requires personal attention, is typically provided on a face-to-face basis, and is often for persons needing assistance in performing daily activities and bodily functions [Waerness 1984]. These features make the paid care sector particularly susceptible to quality problems [Folbre 2006]. While some argue that paid care workers may be unlikely to provide the same quality of care and emotional support that a loving family member or kin can offer [Moon and Cha 2020], others point to a contrasting view—due to their specialized training, paid care workers can be equally, or more, effective in providing quality care [Banuri et al. 2019].

[1] In 2021, it dropped to 0.81 births per woman, which is way below the 2.1 births per woman replacement rate and is now the lowest in the world.

If appropriately trained, such workers may be better able to provide the type of care that, say, an older adult with worsening dementia needs.

In this paper, we explore factors that may influence the quality of paid care services. In particular, we focus on a less studied factor, namely, the worker's sense of responsibility for the well-being of the care recipient. This sense of responsibility felt by the caregiver is, in our view, the key to providing good quality care. Commitment or a strong sense of responsibility in the delivery of care services plays a critical role in determining the quality of care work, whether paid or unpaid. Moreover, a care worker's sense of responsibility for the recipient may increase as more time is spent together, but it can also decline over time as stressful working conditions take their toll on the caregiver. Long working hours, long commute times, inadequate training, job insecurity, and difficulty in dealing with the recipient's family members can all adversely affect a worker's level of commitment.

To better understand care workers' commitment, we estimate the relationship between care workers' expressed level of responsibility towards the care recipient's well-being and their working conditions in South Korea. We examine the extent to which this sense of responsibility is associated with the working conditions of the caregiver, such as job security, work schedule predictability, and adequacy of training, as well as with care work intensity and the nature of the relationship with the recipient and the recipient's family. In focusing on this critical factor that affects the quality of care, we fill a gap in the literature. Using the population-weighted 2018 Care Work and the Economy Project survey data collected by Gallup Korea among 600 childcare and eldercare workers, we undertake Tobit and general maximum entropy (GME) analyses.

This paper proceeds as follows: Section 2 examines the role of worker's sense of responsibility in quality care provisioning, while Section 3 discusses the relationship between care workers' sense of responsibility and their working conditions. Section 4 presents our case study set in Korea, including the data collection and analytical methods used. Finally, Section 5 concludes with policy implications based on the findings of this study.

2. Context: the role of worker's commitment in quality care delivery

Caregiving, whether for young children or older or disabled adults, is a fundamental aspect of human life that facilitates the development of individuals, the continuity of social relations, and the reproduction of the labor force [Folbre 2011]. In the context of providing quality care, care workers must offer not only sufficient practical care but also enriching emotional support to recipients. Care work involves the utilization of communication skills, emotional exertion, and a strong sense of commitment or responsibility for the well-being of those receiving care (Tronto [1998]; Steinberg [1999]). For these reasons, the caregiver's own well-being is inseparable from the quality of care provided (Folbre [2006];

Nelson [2010]; Himmelweit [1995]). This factor, however, is often overlooked in assessing the quality of care [Steinberg 1999].

Measuring the quality of care is challenging, owing in part to the subjective and context-dependent nature of care provision [Nelson 2011].[2] Nevertheless, one consistent ingredient of quality care across diverse contexts and subjective opinions is the presence of a strong sense of responsibility in the care worker. Whether it is in the context of childcare or eldercare, a care worker's sense of responsibility influences the level of effort that care workers provide and their interactions with the care recipients (Tronto [1987]; Folbre and Weisskopf [1998]; Nelson [1999]; England [2005]; Meagher [2007]; Himmelweit and Land [2010]). This relationship between worker's commitment and job performance has been explored in various settings, including healthcare (Somers and Birnbaum [1998]; Brooke et al. [1988]; Teng et al. [2009]; Ruano et al. [2012]), but it has received less attention in the context of eldercare and childcare.

3. Understanding a care worker's sense of responsibility

One's sense of responsibility determines a care worker's approach and attitude in performing fundamental tasks such as dressing, feeding, bathing, administering medication to the care recipient, and addressing their emotional and developmental needs. In addition, it shapes the kind of relationship the care worker develops with recipients, and it ensures that care work is performed at a high level and with the recipient's best interest in mind [Nelson 1999]. Childcare workers committed to the well-being and development of the children in their care are likely to approach their duties with enthusiasm, motivation, and a positive attitude. Similarly, eldercare workers with a strong sense of responsibility are more likely to take time to listen to the older adult's stories and provide comfort when the care recipient is distressed [Eaton 2005].

A care worker's sense of responsibility itself reflects several factors or characteristics of the individual, such as the capacity for empathy, patience, and conscience. These intrinsic factors help care workers develop a positive relationship with the families of care recipients. Getting along with parents is crucial for high-quality childcare services (Garrity and Canavan [2017]; Zulauf-McCurdy and Zinsser [2022]). Similarly, a positive relationship between eldercare workers and older adults who receive care enables emotional and social support in addition to practical care (Walsh and Shutes [2013]; Teshuva et al. [2019]; Timonen and Doyle [2010]).

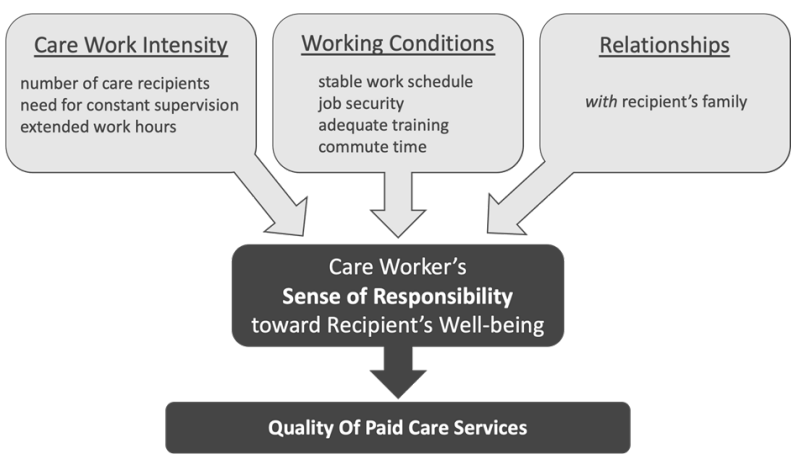
Working conditions can strengthen or erode a worker's sense of responsibility in affecting the quality of care. For example, studies have shown that adequate

[2] Quality care service provisioning depends on a variety of factors, as noted in the literature (O'Kane [2005]; Hotz and Xiao [2011]; Bowblis and Ghattas [2017]). These include: a) a robust care infrastructure, b) professional development and training, c) stringent standards, and d) effective regulations.

staffing (in the case of nursing homes and daycare centers), lower care recipient-worker ratios, job security, and supportive management are associated with higher quality care in both childcare and eldercare settings (Blau [2000]; de Schipper et al. [2006]; Bjørnestad and Os [2018]; Totenhagen et al. [2016]; Shin and Hyun [2015]; Cho et al. [2020]; Kwon and Hong [2017]; Holden et al. [2011]; Harrington et al. [2012]; Perruchoud et al. [2021]). Conversely, unpredictable work hours, job insecurity, long commute times to one's place of work (as in Korea), and the absence of benefits can worsen a worker's healthy work-life balance and adversely affect his or her commitment level [Folbre and Weisskopf 1998], and therefore, the quality of care delivered. Intensely demanding care work can lead to worker burnout and negatively impact a care worker's mental health (Linnan et al. [2017]; Kumagai [2017]), resulting in higher absenteeism and turnover [Barford and Whelton 2010].

Ongoing professional development and training programs for care workers are also essential in equipping workers with the knowledge and skills necessary to deliver quality care services (Burchinal et al. [2002]; de Schipper et al. [2007]; Bjørnestad and Os [2018]; Nolan et al. [2008]; Fernández-Puebla et al. [2022]; Sanjuán et al. [2023]). In contrast, inadequate or lack of training can lower a worker's confidence in performing their job, thereby negatively affecting their commitment level and, consequently, the quality of care delivered.

FIGURE 1. Understanding the factors influencing care worker's sense of responsibility



In Figure 1, we hypothesize that the care worker's level of responsibility towards the recipient's well-being is closely related to the realities of the work environment, including the working conditions, work intensity, and ease in dealing with the recipient's family. Concerning the latter, the direction of the relationship can be mixed: while higher intensity of care work is likely to be more stressful

and therefore can lead to burnout, possibly eroding a worker's commitment level, it can also strengthen the emotional bond between the care worker and recipient and thus heighten the care worker's sense of commitment (Kim et al. [2018]; Kim and Yeom [2016]). Care workers with a strong sense of responsibility may also be willing to take on intense care jobs, such as caring for persons with severe dementia or immobility.

4. The case of childcare and long-term care workers in Korea

4.1. Background

By 2060, Korea's population aged 65 and over is predicted to exceed 80 percent of the working-age population [OECD 2020]. Over the last decade, its population of older adults aged 80 and over has more than doubled. Alongside Korea's rapid population aging, the total fertility rate (TFR), i.e., the number of children born to a typical woman over her lifetime, has consistently declined since 1960, reaching a record low of 0.84 births per woman in 2020,[3] with the total number of 272,337 births compared to 444,849 in 2010 (Figure 2). These demographic shifts have raised significant economic and social concerns about the country's future labor supply, pensions, economic growth, and social reproduction. There has also been a steady increase in women's labor force participation, and rising living standards over the last few decades have increased demand for quality care services, such as enriched and educationally focused childcare and quality eldercare services. Now, the government is expected to provide affordable and quality eldercare. According to the 2002-2018 national social statistics survey, only 27 percent of Koreans agreed that the family should be solely responsible for caring for older adult family members in need of assistance [Kim 2019].

In recent years, the Korean government has made significant investments in improving care provisioning for children and older adults who need assistance with daily living. The universal childcare system, which includes daycare, nursery schools, and after-school programs, was further expanded in 2018 with the establishment of a cooperative childcare program rooted in the traditional Korean concept of *poom-asi*—taking care of children in neighborhoods in Korean society [Ministry of Gender Equality and Family 2012]. The long-term care insurance (LTCI) system has also been improved, with an increase in the number of in-home care services and a reduction in waiting times. In 2018, Korea's Ministry of Health and Welfare released a community care plan, focusing on customized care services in local communities [Ministry of Health and Welfare 2020a].

[3] In 2020, South Korea's population declined for the first time, with the number of births down 10 percent from 2019 [Lee 2021]. In 2021, Korea's TFR dropped even further to 0.81; the global average fertility rate is 2.4, while the OECD average is 1.61 [OECD 2023a].

The plan is being piloted in 16 local governments from 2019 to 2022 [Ministry of Health and Welfare 2020b].

The Korean government's effort to expand and improve the country's care infrastructure is apparent in the steady increase of the country's Early Childhood Education enrollment rate and the rising number of long-term care (LTC) recipients (See Figure 2). This is also reflected in the growth of the LTC workforce, serving individuals that need assistance with daily living activities due to physical, cognitive, or functional impairments. The number of formal LTC workers doubled between 2010 to 2020, from 178,223 to 366,261.[4]

However, the working conditions for care workers in South Korea remain challenging and stressful. Care workers often have to manage complex tasks and relationships with care recipients, while facing low pay and job insecurity, long hours, and other challenges such as long commutes (Peng et al. [2020]; Suh [2020]; Kim et al. [2022]). As for family members who provide care, despite the expansion of government support and the rapid growth of the private care sector, their workload continues to be heavy [Cha et al. 2022].

Recent studies indicate that family caregivers view caregiving as a burden and experience with significant opportunity costs [Moon and Cha 2020]. As in other countries, the primary family caregivers in Korea are typically women who continue to bear a large share of the total care work, even with the utilization of paid care services (Choi et al. [2014]; Lee et al. [2015]; Song [2016]; Chung [2018]; Cha et al. [2022]). Before the COVID-19 pandemic, family members provided 48.3 percent of total childcare in South Korea [KICCE 2018]; more than a third of women in their 30s and 40s reported having to carry a double burden of care, that is, taking care of both their children and their older parent(s) in need [Song 2014]. Cultural practices, a work culture that involves long hours spent in jobs, and socially ascribed gender norms that expect mothers, daughters, and daughters-in-law to provide care for their children, older parents, and parents-in-law continue to persist.

The most cited reason, however, for the continued heavy reliance on family caregiving relates to the affordability and quality of paid care services (Kim and Jeong [2006]; Sung [2018]; Choi and Kim [2013]; Lee [2018]; Song [2014]). Persistent concerns about neglect and abuse by care workers, including daycare teachers and *yoyangbohosas*,[5] led to the implementation of monitoring protocols using surveillance cameras. However, it is still being determined if such protocols have led to higher usage rates of paid care services.

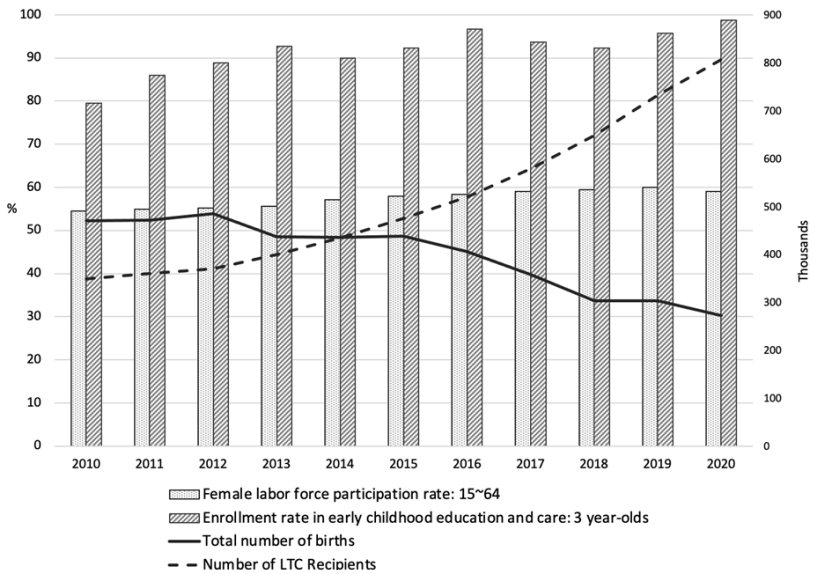
The heavy unpaid care workload on women has hindered Korea's progress toward achieving gender equality. Women returning from career breaks from

[4] Long-Term Care Resources and Utilization, Formal LTC workers (Headcounts), Health theme data, from OECD [2023b].

[5] The term *yoyangbohosa* is a newly defined job category in South Korea that refers to certified care workers in both homes and institutions.

childbirth or childcare often re-enter the labor market as non-regular workers with low-paying jobs. The gender wage gap continues to be one of the largest among OECD countries, at 31.5 percent in 2020 compared to the OECD average of 12.5 percent (in 2019) [OECD 2023c]. Additionally, women's labor force participation rate has also stagnated, hovering between 55 percent to 59 percent over the last decade (2010–2020).

FIGURE 2. Demographic and workforce trends in the context of Korea's Early Childhood Education (ECE) and Long-Term Care Insurance (LTCI) systems



Sources: Statistics Korea [2023a]; OECD [2023]; Statistics Korea [2023b]; National Health Insurance Corporation [2023]

These trends are puzzling in a country where paid care services have been made widely available in recent years through government policies. That, in theory, should have reduced the unpaid care workload of women. This expectation has yet to materialize, however, due to serious concerns regarding the quality of paid care services available, which make families reluctant to substitute unpaid care with those purchased in the care market (Kim and Jeong [2006]; Sung [2018]; Choi and Kim [2013]; Lee [2018]; Song [2014]).

As the review of the literature in the previous section shows, existing studies on the quality of paid care services have examined several measurable factors, such as standards and regulations, care workers' training and education, and working conditions, while focusing on their potential impact on the quality of care delivered. The care worker's sense of responsibility for the recipient in their care, a pertinent ingredient in quality care provisioning, has received little attention in empirical studies involving childcare and eldercare.

Our case study focuses on this less-studied aspect of quality care. We examine the extent to which this is associated with their working conditions, such as job security, work schedule predictability, and adequacy of training, while taking into account the care worker's demographic characteristics, geographical context, the intensity of care work, and ease in dealing with the recipient's family.

4.2. Empirical analysis

4.2.1. Data description

Our analysis uses the 2018 Care Work and the Economy survey data collected by Gallup Korea. The sample consists of 300 eldercare workers and 300 childcare workers in public and private care institutions across South Korea, including Seoul/Metropolitan Area (Seoul, Incheon, Gyeonggi-do, and Gangwon-do), Chungcheong Area (Daejeon, Sejong, Chungbuk, and Chungnam), Honam Area (Gwangju, Jeonbuk, and Jeonnam), Gyeongbuk Area (Daegu and Gyeongbuk), and Gyeongnam Area (Busan, Ulsan, and Gyeongnam). The sampling design of childcare and eldercare workers took into account the stratification by geographical region and occupational categories (institutional worker, home-based worker, or informal worker) [Jun et al. 2021].[6] To make the samples representative of the childcare and long-term care workers population in South Korea, we constructed inverse sampling probability weights using care workers' data by geographical region and type of care arrangement using information from the 2017 Day Care Centre Statistics Yearbook [National Statistics Office 2017] and the 2017 Long-Term Care Insurance Statistical Yearbook [National Health Insurance Corporation 2017].[7] Annex 1 describes the methodology for constructing the sampling weights.

Responses to the survey question "How much responsibility do you feel for the health and safety of your care recipient(s)?" is used as our measure of expressed commitment or sense of responsibility by the care worker. There are some caveats about the survey data that are worth mentioning. First, the primary variable of interest is based on the respondent's self-report response, bounded between zero percent (not my responsibility at all) and 100 percent (entirely my responsibility). Moreover, the data is cross-sectional; hence, we cannot evaluate the direction of change over time.

Table 1 provides the characteristics and working conditions of the care workers in our sample. Reflecting the dominance of women in Korea's paid care sector, a vast majority (95 percent) of the respondents are women, with eldercare

[6] Eldercare workers in institutional facilities work in nursing homes and daycare centers, excluding hospitals. Home-based eldercare workers work in the older person's home and are funded by National LTCI. In contrast, informal eldercare workers are hired by families or older people without written or formal contracts, e.g., live-in carers. Institutional childcare workers are employed in public, private, or corporate daycare centers. Home-based childcare workers are hired through agencies, while families hire informal childcare workers without formal contracts, e.g., informal babysitters.

[7] For informal workers, the regional informal worker population was estimated using the informal sector share of GDP. See Annex 1 for details.

workers being older on average (54.4 years) compared to childcare workers (47.3 years). Most of the care workers completed at least high school education (71.8 percent), live with a spouse (85.3 percent), and are in dual-earning households (77.2 percent). The majority work in a metropolitan area (73.3 percent), and about half (50.4 percent) are regular or contract employees with a signed contract.

TABLE 1. Characteristics and working conditions of care workers, by type of worker

	All Workers	Childcare Workers	Eldercare Workers
A. Worker Characteristics			
Average Age (years)	52.5	47.3	54.4
Care Work Experience (mean, in years)	4.7	5.62	4.4
Gender (% distribution)			
Female	94.8	95.0	94.8
Education (% distribution)			
No schooling	0.1	0.0	0.2
Primary	1.9	1.5	2.0
Middle School	6.3	0.5	8.4
High School	71.8	56.6	77.3
College	19.3	40.1	11.8
Graduate	0.6	1.3	0.4
Number of care work licenses (% distribution)			
0	16.2	35.4	9.3
1	68.0	46.0	76.0
2	12.1	14.0	11.4
3+	3.6	4.6	3.3
Has a Spouse (% distribution)			
Yes	85.3	87.0	84.7
Dual-Earner Household (% distribution)			
Yes	77.2	83.2	75.1
B. Working Conditions			
Number of care recipients (mean)[1]	2.7	2.3	2.9
Work hours (mean)[2]	39.4	37.3	40.2
Average commuting time to work (mean in minutes)[3]	46.2	41.3	48
Need to watch recipient at all times (% distribution)[4]			
Yes	49.0	68.9	41.7
Extra work hours (% distribution)[5]			
Yes	26.7	36.6	23.2
Metro (% distribution)[6]			
Yes	73.3	78.3	71.5

TABLE 1. Characteristics and working conditions of care workers (continued)

	All Workers	Childcare Workers	Eldercare Workers
Care work is physically difficult (% distribution)[7]			
Yes	65.7	57.6	68.7
Has a predictable work schedule (% distribution)[8]			
Yes	61.2	61.5	61.1
Has regular holiday leaves (% distribution)[9]			
Yes	80.6	83.2	79.7
Family is relatively easy to deal with (% distribution)[10]			
Yes	28.9	37.5	25.4
Regular or contractual employee with a signed contract (% distribution)[11]			
Yes	49.6	38.2	53.7
Institution-based worker (% distribution)[12]			
Yes	51.6	32.7	58.4

Note: Calculated using the 2018 CWE-GAM Korean Childcare and Eldercare Workers Survey data based on respondent's answer to the following survey questions:
1. How many care recipients have you taken care of over the past week?
2. Over the past month, how many hours per day did you do care work on average? (Sum of weekday and weekend hours)
3. How much time does it take to commute to work from your home on average?
4. I need to watch my care recipient at all times (agree/strongly agree =1, yes)
5. I work more hours than the standard number of hours (agree/strongly agree=1, yes)
6. Opening survey question completed by survey investigator on the location of care work provided.
7. In general, how much physical difficulty do you have taking care of the child or elderly person? (Slightly/very difficult=1, yes)
8. There are times when my work schedule gets cancelled without notice (strongly /somewhat disagree=1, yes)
9. I can apply for holidays when I want to (strongly/somewhat agree=1, yes)
10. It is very difficult to deal with the care recipient's family members (strongly/somewhat disagree=1, yes)
11. What type of employment do you have at your current workplace (regular employee or contract up to 2 years), and have you signed an official written labor contract related to your current care work (yes or don't know)?
12. Main workplace (Work at an institution or care center)

Childcare workers, on average, have a higher percentage of college degree holders (40.1 percent) compared to eldercare workers (11.8 percent). About 65 percent of childcare workers and 91 percent of eldercare workers work with at least one professional license in terms of work experience; childcare workers have more years of care work experience on average (5.6 years) compared to eldercare workers (4.4 years). Most eldercare workers (58.4 percent) are institution-based and spend more time commuting to work, whereas childcare workers are more likely to work in the care recipient's home.

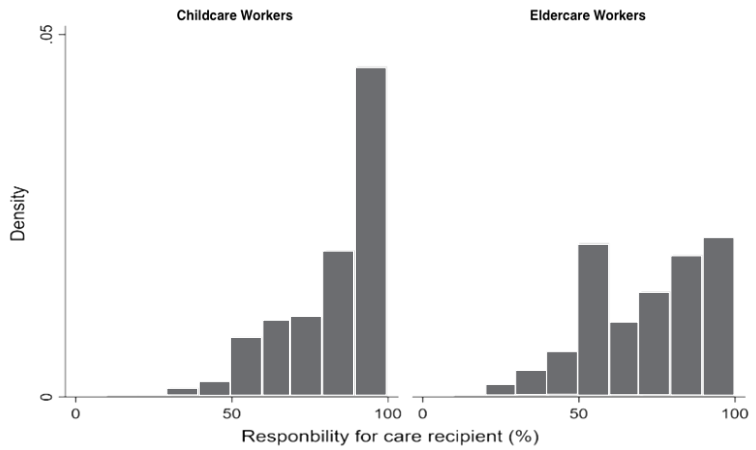
On average, the care worker respondents in our sample care for two to three recipients, work about 40 hours a week, and spend roughly 46 minutes commuting daily. Compared to childcare workers, eldercare workers tend to care for more recipients and work more hours per week. About a quarter (26 percent) of the

sample reported working more hours than the original employment agreement stated. Nearly 40 percent reported having an unpredictable work schedule. More than half of the paid care workers face job insecurity (i.e., they don't have a signed labor contract or regular employment) and lack work schedule predictability. Less than one-third of respondents agreed that it is relatively easy to deal with the recipient's family, which we use as a proxy for the relationship with the recipient's family.

In terms of care work intensity, about half (49 percent) of the paid care workers reported that their care recipient requires constant supervision (i.e., the recipient needs to be "watched at all times") during working hours. This is more pronounced among childcare workers (68.9 percent) than among eldercare workers (41.7 percent). More than a quarter of care workers responded that they worked more than the standard 40 hours; nearly two in three responded that care work is physically difficult. These findings suggest that care work is intense and challenging for a significant portion of the workforce, with some notable differences between eldercare and childcare.

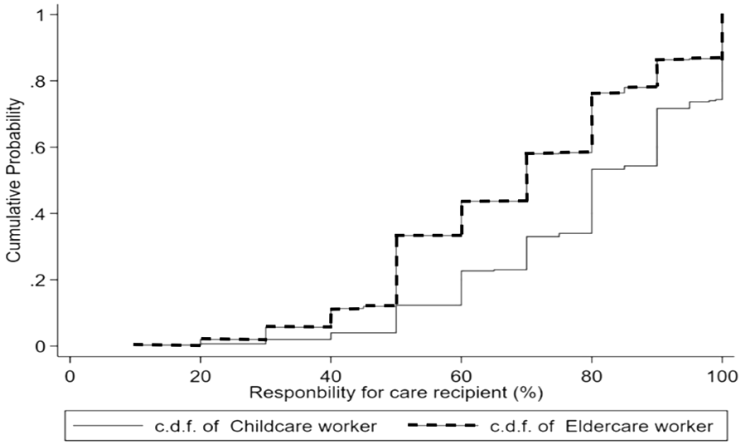
The frequency and cumulative distributions of our main variable of interest, i.e., level of expressed commitment or sense of responsibility of the care workers, are given in Figures 3 and 4, respectively, and ranges in value from zero percent (not my responsibility at all) to 100 percent (entirely my responsibility). Overall, the mean percentage level of responsibility reported by the respondents is 71.6 percent. Childcare workers tend to report a higher level of responsibility (79.5 percent on average), compared to eldercare workers (68.7 percent on average), as shown in Table 2.

FIGURE 3. Frequency distribution of care worker's reported level of responsibility for well-being of recipient, by type of care worker



Sources: Care Work and the Economy Project Field Work Data [2021a]; Care Work and the Economy Project Field Work Data [2021b].

FIGURE 4. Cumulative distribution of care workers' reported level of responsibility for well-being of recipient, by type of care worker



Sources: Care Work and the Economy Project Field Work Data [2021a]; Care Work and the Economy Project Field Work Data [2021b].

TABLE 2. Average care workers' reported level of responsibility for care recipient, by type of worker (in percent)

Responsibility for Care Recipient	Mean	Std. Dev
All Workers	71.60	20.60
Childcare Workers	79.50	17.30
Eldercare Workers	68.70	21.00

Note: Statistics are based on 2018 CWE-GAM Korean Childcare and Eldercare Worker Survey respondent's answer to the following question: "*How much responsibility do you feel for the health and safety of your care recipient(s)?*" The responses ranged between zero percent (not my responsibility at all) and 100 percent (entirely my responsibility).

4.2.2. Methodology

An underlying argument of this paper is that the commitment or sense of responsibility exhibited by a care worker constitutes a crucial element in providing quality care services. This commitment is influenced by the realities of the care worker's working conditions, as well as by intrinsic characteristics of the care worker, such as patience and consciousness, for which we do not have direct measures. In this section, we test the hypothesis that better working conditions are associated with a higher level of expressed commitment toward the recipient's well-being. We use the following indicators for working conditions, including work schedule stability, job security, which is proxied by a dummy variable indicating regular employment status or having either a labor contract for up to two years or a signed written agreement, and adequacy of training, proxied by a

dummy indicating if a worker lacks adequate training. We also consider the care worker's commute time based on care workers' concern regarding long commutes to and from their place of work.[8]

Since our dependent variable, a care worker's sense of responsibility, is bounded between zero percent and 100 percent, we use two estimation methods that can accommodate this censoring of the data. We use Tobit regression and the censored Generalized Maximum Entropy proposed by Golan et al. [1997].[9] For the Tobit model, we assume that the observed dependent variable,

$$y_i = \begin{cases} 0 \; if \; y_i^* < 0 \\ y_i^* \; if \; 0 < y^{t*} \leq 1 \\ 1 \; if \; y_i^* > 1 \end{cases} \tag{1}$$

That is, our observed values y_i are bounded between zero and one for the underlying latent variable y_i^* where y_i^* which is the level of responsibility the care recipient would theoretically "choose" if the response was not bounded between zero percent and 100 percent). We then estimate the model using a maximum likelihood (ML) approach.

Given the small sample size, we also conduct an entropy-based econometric analysis. This method is deemed appropriate because it does not require restrictive assumptions on the distribution of the error terms, unlike conventional linear regression models, and is a more efficient estimator than the ML estimator. Specifically, it draws inferences from limited or small data using the available observed information to yield a non-uniform distribution with minimal assumptions that is consistent with the observed sample moments [Golan 2007].

In this study, we follow the generalized maximum entropy (GME) approach by Golan et al. [1997]. The entropy of a probability distribution $\tilde{p}$ is given by:

$$H(\tilde{p}) = -\sum(p_i \log p_i) \tag{2}$$

where $0 \cdot \log 0 \stackrel{\text{def}}{=} 0$. We seek to maximize this objective function (the entropy) subject to constraints including the constraint ($\sum_i p_i = 1$). The probability distribution is over the vector of parameter estimates $\widehat{\beta}$. For each parameter estimate $\widehat{\beta_k}$, we propose a support $[-\widehat{\beta_k}, \widehat{\beta_{nk}}]$ centered on zero. We then maximize the entropy subject to the data and the added constraint that

$$y_i = \begin{cases} 0 \; if \; y_i^* \leq 0 \\ 1 \; if \; y_i^* \geq 1 \end{cases} \tag{3}$$

[8] Based on one of the authors' field interviews with and roundtable presentations by representatives from Seoul Supporting Center for Eldercare Workers, Childcare Workers Chapter of the Korean Confederation of Trade Unions, Seoul LTC Care Workers Association, and Korean Domestic Workers' Association, at the International Conference on Empowerment of Care Workers: Issues and Challenges, Seoul National University, Seoul, February 25, 2019. See Moon et al. [2021] for qualitative methodology and survey instruments used in the Care Work and the Economy project's fieldwork in South Korea.

[9] See Annex 2 for further discussion of Generalized Maximum Entropy.

In addition to the proxy variables and indicators for working conditions, we include the following variables of interest, namely, commute time and care work intensity as proxied by a) whether the recipient requires constant supervision, b) the number of recipients currently being cared for, and c) regular occurrence of working extra hours. Controls for selected worker *i* characteristics, such as life cycle (age and age-squared), experience proxied by the number of years since the start of care service employment, years of education, whether the worker resides in a metro area, and if the worker has a spouse, are included along with job characteristics such as whether performing eldercare or childcare and the ease in dealing with care recipient's family.

The basic model is expressed as:

$$\begin{aligned} Y_i = {} & \beta_0 + \beta_1 Age_i + \beta_2 Age_i^2 + \beta_3 Educ_i + \beta_4 Experience_i + \beta_5 Spouse_i + \\ & \beta_6 Metro_i + \beta_8 Eldercare_i + \beta_9 ExtraHours_i + \beta_{10} NumRecipients_i + \\ & \beta_{11} NeedsConstantWatch_i + \beta_{12} CommuteTime_i + \beta_{13} StableSched_i + \\ & \beta_{14} FamilyRelation_i + \beta_{15} SecureJob_i + \beta_{16} InadequateTraining_i + \epsilon_i \end{aligned} \quad (4)$$

where Y_i is the observed (reported) level of responsibility, Age_i is the care worker's age, $Educ_i$ is the worker's years of education, $Experience_i$ is the worker's years of experience in providing care work (calculated from the survey question: "years since care work first started"), $Spouse_i$ is a dummy variable for whether the care worker has a spouse, $Metro_i$ is a dummy variable for whether care work is performed in a metro area, $Eldercare_i$ dummy indicates whether the worker is providing eldercare (as opposed to childcare), $ExtraHours_i$ dummy indicates whether or not the care worker regularly works extra hours more than was originally agreed to (self-reported), $NumRecipients_i$ refers to the number of care recipients being cared for, $NeedsConstantWatch_i$ dummy indicates whether the recipient needs to be watched at all times (i.e., care worker response's is "agree" or "strongly agree"), $CommuteTime_i$ refers to weekly average commute time, $StableSched_i$ dummy indicates whether the care worker has a predictable (or stable) work schedule (self-reported), $FamilyRelation_i$ is a dummy variable on whether the care worker reports that it is easy to deal with recipient's family members, $InadequateTraining_i$ dummy indicates if the worker lacks adequate training, $SecureJob_i$ dummy indicates whether the worker is a regular (full-time) employee, a contract worker with up to two-year labor contract or a dispatched employee with a signed written agreement, and ϵ_i is the random error term.

4.2.3. Results and discussion

The results of both Tobit and GME models using the entire sample (both eldercare and childcare workers) are reported in Table 3. The standard errors of the estimates of the latter are smaller since the GME estimators are more efficient. Our results are consistent for both regression analyses; however, we focus our discussion on the GME results.

TABLE 3. Tobit and Generalized Maximum Entropy (GME) regression estimates: association between care worker's level of responsibility for recipient's well-being and working conditions, by type of worker

Variables	All Care Workers	
	Tobit	GME
Age	-1.823* (1.097)	-0.091 (0.889)
Age-squared	0.0174 (0.0112)	0.000 (0.009)
Years of education	1.325** (0.634)	1.417*** (0.504)
Years since first started care work	0.558 (0.349)	0.085 (0.245)
Has a spouse	5.762 (3.752)	1.291 (2.944)
Metro area worker	-9.574*** (2.685)	-5.777*** (2.207)
Institution-based worker	-0.957 (2.665)	-2.712 (2.345)
Eldercare worker	-5.024** (2.489)	-5.093** (2.326)
Worked extra hours	6.464** (2.651)	5.424** (2.147)
Number of recipients under one's care	-1.376 (0.881)	-0.926 (0.790)
Need to watch recipient at all times (agree and strongly agree)	5.185** (2.278)	3.455* (1.975)
Daily average commute time (minutes): to and from work	-0.0918** (0.0415)	-0.08** (0.036)
Predictable work schedule	10.29*** (2.192)	7.946*** (2.018)
Easy to deal with recipient's family members	5.465** (2.339)	4.117** (2.065)
Job security proxy[1]	5.329** (2.544)	3.982 (2.434)
Received enough training (somewhat or strongly disagree)	-3.520* (2.814)	-4.242** (2.356)
Constant	98.68*** (26.75)	59.848 (22.594)
Observations	600	600

[1] Dummy variable for worker who is a regular employee, with a signed contract up to two years or a dispatched employee with a signed labor contract.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Several of the working conditions variables examined are statistically significant. A predictable work schedule is associated with a 7.9 percentage point increase at one percent level of statistical significance in the reported level of commitment towards the safety and well-being of the care recipient, while a lack of adequate training leads to a 4.24 percentage point decline at five percent level of statistical significance. The ease in dealing with the recipients' family is associated with a 4.1 percentage point increase at a five percent level. This indicates the importance of maintaining a predictable work schedule that helps avoid sudden and unanticipated changes in the care worker's schedule. Adequate training is also paramount in reducing accidents and building the worker's confidence in dealing with emergencies. The results also imply that relationships with the recipient's guardians (parents or children) can affect the care worker's level of commitment.

Table 3 results also show that longer commute times are associated with lower reported levels of commitment; that is, an increase in commute time is associated with an 0.08 percentage point decrease in the respondent's sense of responsibility. These results give support to the Korean care workers' associations' concern about the lack of travel allowance that compels workers to use the cheapest, albeit longer, means of travel to their workplace and about their need for adequate training.

Interestingly, working more than the standardized 40 hours a week is associated with a 5.4 percentage point increase in the worker's sense of responsibility, while constant supervision (i.e., the need to watch the care recipient at all times) is associated with a 3.4 percentage point increase. We acknowledge that the relationship between the worker's sense of responsibility (the dependent variable) and these care work intensity indicators may be bi-directional. On the one hand, as workers attempt to meet the intense caregiving needed by the recipient, their sense of commitment also increases. At the same time, workers who feel a strong sense of responsibility for recipients may self-select into or stay in positions where the recipient requires constant supervision.

Table 3 results suggest that higher education may positively influence workers' sense of responsibility, with an additional year of schooling correlating with a 1.4 percentage point increase (significant at the one percent level). Conversely, living in a metropolitan area is associated with a 5.8 percentage point decrease (significant at the one percent level). This may, in part, reflect the regional differences in educational attainment, professional training, and working conditions and confirm the findings of other studies. For instance, Kim and Kim [2017] found that care workers in urban areas face poorer work conditions than rural areas in Korea, especially those caring for older adults.

Another possible explanation is the market density effect, i.e., there are more job opportunities and competition among care workers in urban areas compared to rural areas, where opportunities tend to depend on kinship and community networks. Overall, performing eldercare is associated with a lower sense of responsibility

toward the safety and well-being of the recipient compared to childcare. This may reflect the differences in the performance of eldercare and childcare, with more complexity and challenges in the case of caring for older persons.

We next examine the possibility that the relationship between the worker's sense of responsibility and working conditions may differ for eldercare and childcare workers. We conduct separate Tobit and GME regressions for the childcare and eldercare subsamples, and the results are given in Table 4. Note that the standard errors in the subsamples' estimates are larger compared to those for the whole sample in Table 3 due to the smaller sample sizes. We note that working extra hours is positively associated with a higher reported level of commitment for both childcare and eldercare workers by 5.1 and 6.6 percentage points, respectively.

TABLE 4. Tobit and Generalized Maximum Entropy (GME) regression estimates: association between worker's level of responsibility for recipient's well-being and working conditions, by type of care worker

	Childcare Workers		Eldercare Workers	
Variables	**Tobit**	**GME**	**Tobit**	**GME**
Age	-1.399 (1.327)	0.356 (1.183)	-2.095 (2.108)	1.256 (2.214)
Age-squared	0.0153 (0.0141)	-0.004 (0.013)	0.0187 (0.0203)	-0.013 (0.021)
Years of education	1.112 (0.866)	**1.647**** **(0.698)**	**1.432*** **(0.818)**	1.034 (0.752)
Years since first started care work	0.394 (0.386)	-0.067 (0.311)	0.813 (0.503)	0.656 (0.435)
Has a spouse	**-6.661*** **(3.665)**	-7.307 (4.586)	**8.683**** **(4.369)**	**7.635**** **(3.803)**
Metro area worker	**-7.192*** **(4.105)**	-3.198 (3.284)	**-9.583***** **(3.168)**	**-7.513**** **(2.962)**
Institution-based worker	1.336 (3.430)	-3.141 (3.194)	-1.083 (3.621)	-0.745 (3.544)
Worked extra hours	**5.111*** **(2.881)**	**5.106*** **(2.792)**	**7.159**** **(3.622)**	**6.583**** **(3.317)**
Number of recipients under one's care	**-2.697**** **(1.146)**	-1.403 (1.218)	-0.884 (1.108)	-1.161 (1.094)
Need to watch care recipient at all times (agree and strongly agree)	**9.908***** **(2.972)**	3.597 (2.907)	3.523 (2.813)	3.656 (2.68)
Daily average commute time (minutes): to and from work	-0.0666 (0.0465)	**-0.083*** **(0.047)**	**-0.120**** **(0.0579)**	-0.094 (0.059)
Predictable work schedule	1.984 (2.860)	3.542 (2.934)	**13.12***** **(2.669)**	**11.803***** **(2.795)**
Easy to deal with recipient's family member	1.668 (2.617)	1.776 (2.756)	**7.730**** **(3.079)**	**8.113***** **(3.11)**

TABLE 4. Tobit and Generalized Maximum Entropy (GME) (continued)

	Childcare Workers		Eldercare Workers	
Variables	**Tobit**	**GME**	**Tobit**	**GME**
Job security proxy[1]	**8.158****	3.454	3.673	3.547
	(3.495)	(3.695)	(3.041)	(3.211)
Received enough training (somewhat or strongly disagree)	**-6.034***	**-6.78***	-2.694	-2.702
	(3.179)	**(3.532)**	(3.389)	(3.143)
Constant	100.0***	56.398**	98.59*	16.47
	(34.76)	(27.948)	(53.53)	(58.56)
Observations	300	300	300	300

[1] Dummy variable for worker who is a regular employee, with a signed contract up to two years or a dispatched employee with a signed labor contract.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

The effect of commute time is negatively associated with childcare workers' level of commitment at ten percent level, but not for eldercare workers. This is likely because most childcare workers in Korea work in daycare centers, often far from their residences. In contrast, eldercare workers have more flexibility to work with recipients within proximity to their homes. Lack of adequate training is also associated with a 6.8 percentage point decline in the childcare worker's level of commitment at ten percent level, but not for eldercare workers. This underscores the importance of training and professional guidance in improving the quality of paid childcare services.

Results in Table 4 show that having a predictable work schedule and ease in dealing with the recipient's family member(s) are associated with an increase of 11.8 percentage points and 8.1 percentage points, respectively, in the level of commitment among eldercare workers, but have no statistically significant effect on childcare workers. This disparity may be due to the more complex and heterogeneous nature of eldercare compared to childcare. Workers caring for older persons are, therefore, more likely to experience difficulties or dilemmas not only in dealing with the recipient's family members but also directly with the recipient. Moreover, older adults in need of care may experience sudden changes in mental, emotional, and physical conditions without warning. Since most eldercare workers visit their clients at home, maintaining a predictable work schedule can be challenging depending on the mobility and health condition of the recipient. Such challenges can eventually lead to heightened stress or exhaustion on the part of the care worker, which can affect her level of commitment.

4.2.4. Addressing endogeneity issues

The preceding discussion notes that some control variables suffer from endogeneity problems, particularly those indicating that the worker "usually works extra hours than discussed" and "need to watch care recipients at all times."

That is, workers who are intrinsically more committed or dedicated might self-select into jobs where they need to work extra hours or constantly watch the recipient, and so the control variables about working conditions are not independent of the disturbance term. This contrasts with the general expectation that more intense working conditions are associated with lower quality of care (as proxied by the worker's level of commitment variable) and may highlight the interrelated nature of the factors influencing the quality of care.

We address this problem by focusing on the subsample of care workers who work for institutions that match them to their care recipient, as compared with those who are self-employed.[10] This subsample includes both workers who provide care work at a facility and workers who provide home care but work through an institution.[11] About 22 percent of home care workers and 55 percent of institutional care workers are assigned to their recipients by their institution. We acknowledge that self-selection could still be a problem if institutions match the most committed workers to recipients who need the most care but assume institutional matching will reduce the bias compared to cases when the care worker has chosen the care recipient on their own.

Another potential source of endogeneity is that less dedicated workers might leave if the job is too demanding, leaving the more dedicated workers to work with recipients who need more time or need to be constantly watched (a form of survivorship bias). We attempt to correct for this by adding a variable for years of experience in our regression. We note that we observe only the total years of experience rather than experience with the current care recipient. However, even controlling for total years of experience should reduce survivorship bias in our results.

We then conduct Tobit and GME regression analyses using this subsample; the results are given in Table 5. We note that "working longer hours than discussed" is no longer associated with a higher sense of responsibility to the recipient. Interestingly, however, the need for constant supervision remains statistically significant, suggesting that constant supervision of the care recipient may increase the care worker's sense of responsibility towards the recipient.[12]

[10] Survey question: How did you meet the care recipient to whom you're currently providing care?

[11] We note that these variables can suffer from other forms of endogeneity. For example, care workers who feel less committed might refuse care work at higher rates when working conditions are intense, leaving only the more committed workers in our sample (survivor bias). In addition, workplaces might try to match more dedicated workers with more difficult cases, in which case, our assumption that "workplace assignment" would serve as a randomizing mechanism no longer holds.

[12] For the subsample of institutionally assigned workers, we also examine the group mean of the reported level of responsibility for the bottom 20 percent of workers by experience (those with zero to two years of experience) and the top 20 percent of workers by experience (those with eight to 30 years of experience). The mean level of responsibility for those with zero to two years of experience is 72.9 percent, and for those with eight to 20 years of experience is 72.2 percent. The differences in means are not statistically significant. Note that the cases whereby spending more time or watching the care recipient causes the care worker to feel more responsible for the recipient is not endogenous. We believe this is the causal effect of spending more time with the recipient.

TABLE 5. Tobit and GME regression estimates for institutionally assigned subsample

Variables	Childcare Workers		Eldercare Workers	
	Tobit	GME	Tobit	GME
Age	-2.630 (1.659)	2.116 (4.626)	**-11.37***** (2.675)	1.256 (2.214)
Age-squared	**0.0347*** (0.0196)	-0.031 (0.054)	**0.108****** (0.0270)	-0.027 (0.048)
Years of education	**3.904****** (1.279)	-1.263 (2.651)	-0.849 (1.264)	2.777 (2.037)
Years since first started care work	-0.248 (0.483)	0.318 (1.02)	0.612 (0.648)	0.587 (0.977)
Has a spouse	-5.027 (5.839)	-0.633 (13.537)	**25.78****** (5.717)	-1.306 (9.191)
Metro area worker	**-13.51**** (5.952)	-10.12 (13.1)	-3.497 (5.089)	-7.909 (7.239)
Worked 40 hours or more	0.444 (8.109)	-2.494 (20.005)	8.762 (6.842)	-9.501 (10.636)
Worked extra hours	**3.097*** (4.313)	2.525 (10.288)	-0.415 (5.769)	-6.248 (8.91) -4.04
Number of recipients under one's care	-1.226 (2.184)	-1.979 (4.705)	**-3.433****** (1.709)	(2.904) 3.048
Need to watch care recipient at all times (agree and strongly agree)	**14.81****** (5.662)	0.847 (12.265)	**13.20****** (4.983)	(7.063) 0.162
Daily average commute time (minutes): to and from work	-0.0651 (0.0825)	0.075 (0.176)	-0.0630 (0.0662)	(0.134) -40.84
Predictable work schedule	2.719 (4.395)	4.993 (11.435)	**16.84****** (3.968)	(6.908) -4.818
Easy to deal with recipient's family member	7.098 (4.606)	-2.755 (10.466)	**9.345****** (4.437)	(7173) -9.485
Job security proxy[1]	1.779** (4.731)	-7.603 (14.089)	-0.136 (5.477)	(8.223) -11.051
Received enough training (somewhat or strongly disagree)	**-17.46****** (5.495)	7.643 (14.785)	-5.506 (5.319)	(7.272) -0.368
Constant	**72.92*** (39.21)	13.58 (93.294)	**345.8****** (68.50)	(139.753) -9.501
Observations	200	200	250	250

[1] Dummy variable for worker who is a regular employee, with a signed contract up to two years or a dispatched employee with a signed labor contract.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

We note a third potentially endogenous variable in our analysis: ease in dealing with the care recipient's family members. Care workers who appear to be more patient and more conscientious could be better treated by family members than others. Thus, the quality of care provided by the care worker might be causing the difficulty or ease of dealing with family members rather than the other way around. On the other hand, family members might try to take advantage of care workers who seem more dedicated, saddling them with more care responsibility and souring the relationship between care workers and family members. Given data limitations, we are unable to address this particular issue in our study, and so, our findings should be treated with caution. Future research can explore this relationship and help shed light on the relational aspect of care work.

5. Concluding remarks

Despite the wide availability of paid care services and a large care workforce, a heavy reliance on family care—performed mainly by women for young children and older adults in need of care—continues to persist in middle- and high-income countries such as South Korea. This reliance is fueled by concerns regarding the perceived quality of paid care services, making it challenging for families to transition from traditional unpaid care to paid care services. Significant developments in the past few decades, such as aging populations, and rising healthcare needs, further signal the growth of care needs affecting not only high-income countries, such as South Korea, but also middle-income countries, such as the Philippines. To address this pressing issue, it is crucial for governments to implement regulations and invest in the provision of affordable and high-quality childcare and eldercare services.

Our research has examined a relatively unexplored aspect of quality care, namely, the worker's sense of responsibility for the care recipient. The emotional labor involved in care work makes it essential for care workers to have a strong commitment to the recipient's well-being [Nelson 1999]. This commitment is influenced by working conditions and other factors, as our case study of Korean childcare and eldercare workers reveals.[13]

Policies that promote decent working conditions are crucial in attracting and retaining care workers who possess a robust sense of responsibility and commitment towards their recipients, thereby facilitating the provision of high-quality care services. Essential measures to achieve this may include ensuring living wages, establishing predictable work schedules, providing pension and health benefits, offering adequate training opportunities, implementing respite care for care workers, granting commute travel allowances (where applicable), and establishing guidelines

[13] These findings should be viewed with some caution, however, due to data limitations. We hope future research on this critical issue will focus on collecting better data.

that foster positive relationships between care workers and the families of care recipients. By implementing policies that improve the working conditions of care workers alongside government support for care services, policymakers can address the challenges faced by middle- and high-income countries in providing affordable, quality childcare and eldercare. Such measures also have the potential to alleviate the heavy workload primarily borne by female family caregivers and facilitate a smoother transition towards a more balanced utilization of paid care services.

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Annex 1. Construction of survey weights

The eldercare and childcare worker survey data collection in Korea for the Care Work and the Economy (CWE-GAM) Project was performed in 2018 using a purposive sampling design [Jun et al. 2021]. The 600 samples were evenly split between eldercare and childcare workers. For eldercare workers, of the 300 workers surveyed, 150 samples were allocated to institutional workers, 100 to in-home care workers and 50 to informal workers. These samples were further stratified by region namely, Seoul Metro, Chungcheong, Honam, Gyungbuk, and Gyungnam. For childcare workers 100 samples were allocated to institutional workers (50 to public daycare centers, 50 to private daycare centers), 100 samples were allocated to in-home care workers and 100 samples were allocated to informal workers. These samples were again further stratified by region.

TABLE 1.1. Sample allocation

	Eldercare Workers			Childcare Workers			
	Institution	In-home	Informal	Institution		In-home	Informal
				Public	Private		
Seoul Metro	80	42	10	25	27	20	20
Chungcheong	20	11	10	6	6	20	20
Honam	18	23	10	8	5	20	20
Guyngbuk	16	10	10	5	4	20	20
Guyngnam	16	14	10	6	8	20	20
Total	150	100	50	50	50	100	100

We weighted the purposive sample used in the paper to make it representative of the eldercare and childcare worker population in Korea by calculating the inverse sampling probability weight for each observation. For institutional eldercare workers, the relevant subpopulation was the number of institutional workers in each region published in the *2017 Eldercare Facility Statistics* [Ministry of Health and Welfare 2017]. For in-home eldercare workers, the relevant subpopulation was the number of in-home care workers in each region as published in the *2017 Long-Term Care Insurance Statistical Yearbook* [National Health Insurance Corporation 2017]. For childcare workers, the relevant subpopulation was the number of care workers (excluding administrative staff and instructors) for each type of institution (private facility, private in-home, or public) in the region, as published in the *2017 Day Care Centre Statistics* [National Statistics Office 2017].

TABLE 1.2. Survey weights for eldercare workers

	Institutional Workers			In-Home Workers			Informal Workers		
Region	Total Workers N_i	Workers Surveyed n_i	Weight pi	Total Workers	Workers Surveyed	Weight	Total Workers	Workers surveyed	Weight
Seoul/Metro	47,688	80	596.10	10,955	42	260.83	19,372	27	717.49
Chungcheong Area	11,969	20	598.45	2,736	11	248.73	5,010	6	834.97
Honam Area	11,206	18	622.56	6,005	23	261.09	3,383	5	676.62
Gyungbuk Area	9,707	16	606.69	2,409	10	240.90	3,376	4	843.93
Gyungnam Area	9,373	16	585.81	3,739	14	267.07	5,918	8	739.71
Total	89,943	150		25,844	100		37,055	50	

TABLE 1.3. Survey weights for childcare institutional care workers

Region	Public	Non-Profit	Workers Surveyed	Weight	Private	Workers Surveyed	Weight
Seoul/Metro	2,179	218	25	95.88	6,988	27	258.81
Chungcheong Area	195	277	6	78.67	1,614	6	269.00
Honam Area	191	426	8	77.13	1,326	5	265.20
Gyungbuk Area	212	203	5	83.00	1,532	4	383.00
Gyungnam Area	351	193	6	90.67	2,352	8	294.00
Total	3,128	1317	50		13,812	50	

TABLE 1.4. Survey weights for childcare in-home and informal care workers

	In-Home			Informal		
Region	In-Home	Workers Surveyed	Weight	Informal	Workers Surveyed	Weight
Seoul/Metro	10,998	20	549.90	9,382	20	469.08
Chungcheong Area	2,591	20	129.55	2,426	20	121.31
Honam Area	1,767	20	88.35	1,638	20	81.92
Gyungbuk Area	1,424	20	71.20	1,635	20	81.74
Gyungnam Area	2,741	20	137.05	2,866	20	143.29
Total	19,521	100		17,945	100	

The number and distribution of informal care workers across Korea is unknown, so we use the estimates on the number of informal childcare and eldercare workers using the method in Suh [2020] paid care sector in Korea study. We assumed that the distribution of informal care workers among childcare and eldercare worker subpopulation follows the same pattern as that of formal care workers. That is, about a third were employed in childcare while the rest were employed in eldercare. We next assumed that the regional distribution of workers follows the regional GDP share. The relevant subpopulation for informal care workers is the estimated number of informal workers in each region for each type of care work (childcare or eldercare).[14]

The sampling probability p_i for an observation in subpopulation i is simply the number of samples allocated to the subpopulation n_i divided by the size of the subpopulation N_i.

$$p_i = \frac{n_i}{N_i} \qquad \text{(c1–1)}$$

The inverse sampling probability weight is $1/p_i$.

Annex 2. Discussion of the Generalized Maximum Entropy (GME) model

In the case of the GME model, we assume that the $\widetilde{\beta}$ are discrete random variables drawn from a support space $\mathcal{L} \subset \mathcal{R}^k$ where k is the number of parameters in the problem. Then $\widetilde{\beta}$ maybe expressed as

$$\widetilde{\beta} = \begin{bmatrix} z_1 & 0 & \cdot & 0 \\ \cdot & z_2 & \cdot & 0 \\ \cdot & \cdot & \cdot & \cdot \\ 0 & 0 & 0 & z_k \end{bmatrix} \begin{bmatrix} p_1 \\ p_2 \\ \cdot \\ p_k \end{bmatrix} \qquad (2.1)$$

Similarly, we assume that the errors from the model are being drawn from some discrete bounded distribution. Thus, the error distribution maybe written as

$$e = V_w = \begin{bmatrix} v_1 & 0 & \cdot & 0 \\ \cdot & v_2 & \cdot & 0 \\ \cdot & \cdot & \cdot & \cdot \\ 0 & 0 & 0 & v_k \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ \cdot \\ w_k \end{bmatrix} \qquad (2.2)$$

where w are the probability weights associated with each outcome. Then our objective function becomes (bold-faced variables indicate vectors or matrices)

[14] For example, to obtain the survey weight for informal childcare workers in Chungcheong Area: we use the total number of informal childcare workers: 27,500; and Chungcheong's share of Korean GDP: 13.45 percent; to get estimated number of informal childcare workers: 3,700 = 27,500*13.45 percent. We then divide this by the number of informal childcare workers surveyed in Chungcheong (20) to obtain the survey weight 2700/20 = 185.

$$\max_{p,\, w_1,\, w_2,\, w_3} \; -\boldsymbol{p}^T \log \boldsymbol{p} - \boldsymbol{w}_1^T \log \boldsymbol{w}_1 - \boldsymbol{w}_2^T \log \boldsymbol{w}_2^T - \boldsymbol{w}_3^T \log \boldsymbol{w}_3 \tag{2.3}$$

subject to the constraints

$$\boldsymbol{y}_1 = \boldsymbol{X}_1 \boldsymbol{Z}_p + \boldsymbol{V}_1 \boldsymbol{w}_1 \tag{2.4}$$

$$\mathbf{0} = \boldsymbol{\mu}_1 \leq \boldsymbol{X}_2 \boldsymbol{Z}_p + \boldsymbol{V}_2 \boldsymbol{w}_2 \tag{2.5}$$

$$\mathbf{1} = \boldsymbol{\mu}_2 \geq \boldsymbol{X}_3 \boldsymbol{Z}_p + \boldsymbol{V}_3 \boldsymbol{w}_3 \tag{2.6}$$

and the adding up constraints described in Golan et al. [1997] eq. 4.6 – 4.8. Note that our responses are bound on both sides, so we have an additional data constraint and adding up constraint.

The estimation procedure requires the researcher to make several choices. For the support space $\boldsymbol{Z}$, we choose

$$\boldsymbol{Z} = \begin{bmatrix} -100 & -50 & 0 & 100 \\ -100 & -50 & 0 & 100 \\ . & . & . & . \\ -100 & -50 & 0 & 100 \end{bmatrix} \tag{2.7}$$

where $\boldsymbol{Z}$ is of dimension 20×5. Golan et al. [1997] show that if $Z_{1k} \leq \beta_k \leq Z_{Hk}$, the estimates are not very sensitive to the specification of the support space. (In our case, $H = 5$ and we assume the β_k are bound between [-100,100]. For the error supports, we use the 3-sigma rule for v_1 and choose uniform errors between [-10,10] for v_2 and v_3. That is:

$$V_2 = V_3 \begin{bmatrix} -10 \\ 0 \\ 10 \end{bmatrix} \tag{2.8}$$

We test with alternative specifications of V_2 and V_3 and note they do not significantly change the result.

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