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MATERNAL EMPLOYMENT PREFERENCES IN POLAND AND SLOVAKIA

Hana Třísková[1)]

Abstract
This study examines the preferences of men and women towards maternal employment, focusing on mothers with pre-school-age and school-age children in Poland and Slovakia and utilising data from the Family and Changing Gender Roles V module (2022) in the International Social Survey Programme. Despite progress in achieving gender-equal access to paid leave and the increasing number of pre-school facilities, maternal employment has remained low in these countries, especially among mothers with children aged 0–2. The results indicate that Poles exhibit a stronger preference for mothers with a child under school age staying at home, while Slovaks are more supportive of maternal employment, particularly on a part-time basis. For mothers with school-age children, full-time employment is broadly supported in both countries. These findings highlight persistent cultural barriers in Poland and the positive impact of policy measures implemented in Slovakia to increase and support maternal employment.

Keywords: maternal employment, gender roles, traditional and egalitarian attitudes, parental leave, pre-school facilities, family policy, work-life balance
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INTRODUCTION

Maternal employment plays a key role in supporting gender equality, individual well-being, and family economic security. It provides economic autonomy, facilitates access to health, pension, and social security benefits, and offers opportunities for both social and personal development (*UNICEF,* 1999). In addition to being beneficial for child development (e.g. cognitive skills or academic achievement), maternal employment can promote a more equitable distribution of childcare and household responsibilities between partners (*e.g. Bernal,* 2008; *Hsin – Felfe,* 2014; *Brooks-Gunn et al.,* 2010; *Yu – Lee,* 2013).

The collapse of the communist regime led to major political, economic, and social transformations in Central European countries, which particularly influenced the balance between paid work and childcare and domestic responsibilities for women (*Saxonberg – Sirovátka,* 2006). In CEE countries, including Poland and Slovakia, the employment of women was actively promoted by the state during the communist era. This state-promoted employment was often framed as emancipation, but, in reality, it primarily served the economic need for female labour to sustain communist industrial growth (*Pascall – Kwak,* 2005; *LaFont,* 2001).

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Comprehensive social welfare programmes established by the governments in these countries facilitated the return of women to the workforce after childbirth. These initiatives included maternity leave and accessible, affordable childcare facilities (*Hašková – Saxonberg,* 2016).

The transition to a market economy in the 1990s precipitated significant changes in the labour markets and social policies in these countries, including maternal employment (*Szikra – Tomka,* 2009). These changes led to increased unemployment rates and economic instability (*Deacon,* 2000). In response to economic restructuring, governments consciously chose to limit state involvement in family support and adopted refamilisation policies as part of their welfare reforms (*Saxonberg – Sirovátka,* 2006).

Cuts were made to public funding for childcare services, which resulted in a decline in their availability and quality (*Matynia,* 1994). Consequently, the absence of affordable and accessible childcare options became a barrier to maternal employment in numerous Central European countries, as this decrease in support made it more challenging for mothers to return to work after childbirth (*Koucourková,* 2002).

Poland and Slovakia's accession to the European Union in 2004 prompted reforms in parental leave and childcare policies, as both countries aligned with EU directives supporting work-life balance and gender equality (*De La Porte et al.,* 2020; *Chieregato,* 2020). Nevertheless, in Poland and Slovakia, employment rates among mothers with children under age two remain among the lowest in the OECD (*Plomien,* 2004), partly owing to the length of parental leave and the enduring strength of traditional gender norms in childcare and household roles (*Thévenon – Solaz,* 2013).

Poland and Slovakia were selected for comparison owing to their shared socialist past and differing trajectories in family policy and gender norms since the 1990s. While both countries experienced similar ideological frameworks during the communist era, they have adopted contrasting approaches in recent decades – making them suitable cases for a comparative analysis of public attitudes towards maternal employment.

Previous research has confirmed that public and maternal attitudes towards employment in Poland reflect a persistent tension between evolving preferences and structural limitations. Between 1994 and 2012, Polish mothers increasingly expressed a desire to engage in paid work, particularly part-time, yet found it difficult to fulfil these preferences because of limited labour-market flexibility and a lack of institutional childcare. At the same time, Poland experienced a partial resurgence of traditional family values and anti-feminist discourse, which may have reinforced conservative public attitudes (*García-Faroldi,* 2021). In the case of Slovakia, research shows that maternal employment during the first three years after childbirth remains relatively low, largely owing to structural barriers such as insufficient childcare provision, a lack of flexible work arrangements, and long parental leave with limited paternal involvement (*Hídas – Horváthová,* 2018).

This study examines the impact of cultural norms, gender role attitudes, and sociodemographic factors on the perception of maternal employment. By focusing on the general adult population (men and women, childless and with pre-school-age or school-age children) the analysis aims to identify the differences between Poland and Slovakia, particularly in relation to traditional versus egalitarian perspectives, and people's preferences for full-time, part-time, or no maternal employment depending on the child's age.

The International Social Survey Programme (ISSP 2022) provides harmonised, high-quality cross-national data on public attitudes towards family roles and gender norms. Its standardised format makes it especially suitable for comparing societal preferences across countries with differing cultural and policy contexts. The 2022 wave provides the most recent cross-national data available at the time of writing and allows for post-pandemic insights into public attitudes, particularly in the context of recent policy reforms implemented in both countries during the 2010s.

The article is structured into four sections. Following the introduction, the theoretical concepts and contextual background are presented, encompassing gender roles, maternal employment, and paid leave. Descriptive statistics and the results of the regression analysis are presented in the analytical section. The fourth section provides a final review and summary of the results of the analysis in the context of the stated study objectives.

THEORETICAL CONCEPTS

Welfare State Typology and Family Roles

Comparative welfare state research underscores the influence of policy frameworks on women's employment patterns (*Kreyenfield,* 2015). While CEE countries are considered welfare states today, the term historically referred to Western capitalist democracies with high living standards (*Aidukaite,* 2009).

Esping-Andersen's typology remains a widely used and influential framework in welfare regime theory, distinguishing three ideal types: liberal regimes (e.g. US, UK) with minimal state intervention and market reliance; conservative regimes (e.g. Germany, France) preserving traditional family roles; and social-democratic regimes (e.g. Sweden, Denmark) promoting equality through universal benefits (*Esping-Andersen,* 1990). However, this framework was not designed with CEE countries in mind, and scholars have long debated how these countries fit into or deviate from established typologies (*Aspalter et al.,* 2009).

Since the early 1990s, Poland and Slovakia have undergone major socioeconomic and political transformations that have reshaped their welfare systems. Common challenges included high unemployment, falling living standards, and limited funding for maternal support and childcare infrastructure (*Ferrarini – Sjöberg,* 2010).

Aidukaite (2011) summarises four major approaches to classifying CEE welfare regimes. One perspective suggests these countries are gradually aligning with Esping-Andersen's conservative or liberal models. Another views them as forming a distinct 'post-communist' or 'Eastern European' regime, marked by a blend of socialist legacies (e.g. family-centred care) and emerging market features (*Fenger,* 2007; *Aidukaite,* 2009). A third strand emphasises similarities across CEE countries based on a shared history and institutional patterns. The fourth argues for internal differentiation, emphasising socioeconomic differences and unique welfare outcomes that resist simple typology (*Aidukaite,* 2011).

Building on Esping-Andersen, Lewis (1992) introduced a gender-sensitive lens through the male breadwinner model. She distinguishes strong male breadwinner states, modified models that allow limited female employment, and dual-earner/carer regimes that promote gender equality through policies like universal childcare and parental leave.

Family policies in CEE countries have long aimed to support both fertility and maternal employment. However, cross-country differences persist, both historically and in the post-socialist era, complicating any singular classification (*Ferrarini – Sjöberg,* 2010).

The generally accepted classification of family policies in CEE countries is the one presented by *Frejka and Gietel-Basten et al.* (2016). They divide family policies in these countries into four groups. The first of these is the comprehensive family policy model, in which the authors include, for example, Estonia and Slovenia, and which is characterised by accessible and sufficient institutional care for young children, support for the employment of mothers with children, and a range of other financial and material benefits for mothers and fathers. The second group of countries, such as the Russian Federation and Belarus, represent a pro-natalist policy model, which is characterised primarily by efforts to increase fertility, especially with the help of generous financial support. The third model, the temporary male breadwinner model, to which the authors assign Slovakia and the Czech Republic, is characterised by long paid parental leave, where institutional care for children under the age of three has been virtually abolished in these countries. Women/mothers are often discriminated against in the labour market and finding ways to successfully combine childcare and employment is difficult. The last model, the conventional family policy model, which includes, for example, Poland and Hungary, is characterised by a considerable amount of existing support for raising and caring for young children, but this support is very inadequate, and, as with the preceding model, it is difficult for mothers in these countries to combine childcare and employment.

We compare two countries that differ within this typology primarily in terms of financial generosity and institutional support: Poland provides relatively higher financial assistance to families but offers limited support for maternal employment, whereas Slovakia offers less financial support and exhibits even weaker structural conditions for combining work and childcare.

MATERNAL EMPLOYMENT AND POLICY IMPLICATIONS IN POLAND AND SLOVAKIA

Table 1 shows the employment rates of women aged 20–49 by the age of their youngest child in Poland, Slovakia, and the EU in 2012 and 2022. In both Poland and Slovakia, maternal employment increased across all child age groups. In Poland, the employment rate of mothers with children under six rose from 58.4% to 71.3%, and in Slovakia from 34.4% to 68.8%. Among mothers of children aged 6–11, in Poland their employment rate rose from 72.3% to 79.5% and in Slovakia from 74.9% to 79.0%. Among those with children aged 12 and over, the rates rose from 71.9% to 79.5% in Poland and from 74.8% to 78.2% in Slovakia.

Compared to the EU average, which saw more modest increases (e.g. from 60.9% to 67.0% for children under six), both countries – especially Slovakia – show significant convergence towards or even surpass EU levels. The data confirm a continuing pattern of higher employment with increasing child age, but also point to a narrowing gap across child age categories over time.

Table 1 **The employment rate of women aged 20–49, by age of the youngest child, Poland and Slovakia, in %**

	Less than 6 years		**From 6 to 11 years**		**12 years and over**	
	2012	**2022**	**2012**	**2022**	**2012**	**2022**
Poland	58.4	71.3	72.3	79.5	71.9	79.5
Slovakia	34.4	68.8	74.9	79.0	74.8	78.2
EU	60.9	67.0	68.7	75.4	67.8	72.2

Source: Eurostat, 2025.

Family policies are a key determinant in shaping women's employment decisions. They influence the ability of women to balance work and family responsibilities by encouraging mothers to remain in or re-enter the workforce after childbirth (*Vuri,* 2016). In this context, *Gornick and Meyers* (1997) developed a comprehensive framework to analyse the relationship between maternal employment and social policies, particularly regarding work-family balance. Their model emphasises the role of both the availability of parental leave and affordable childcare services in shaping women's employment outcomes. Countries with generous leave entitlements and robust childcare systems show higher maternal employment rates, as these reduce the work–care conflict. Their theory also reflects prevailing cultural attitudes towards gender roles and women's economic participation (*Gornick – Meyer*, 1997).

Since 2010, Poland has introduced significant reforms to its system of parental leave. Additional maternity leave was introduced and gradually extended – from two weeks in 2010 to six weeks by 2013. A key innovation was the introducing the possibility for fathers to take a portion of maternity leave once the mother has taken at least 14 weeks. In 2011, a 2-week paternity leave was added. A major reform was implemented on 16 June 2013 granting parents an additional 26 weeks of parental leave. In total, families can access up to 54 weeks of leave, with the option of receiving 80% wage compensation for the entire period or 100% during the first half and 60% during the second. Initially, the reform excluded women who had given birth in the first quarter of 2013, but following public protests, these mothers were granted access to parental leave as well. As of 2016, additional maternity leave and parental leave were merged into a single category termed 'parental leave'. These changes sought to address Poland's low fertility rate, the relatively low employment rate among women, and the shortage of formal childcare services for children under the age of three, while also encouraging the greater involvement of fathers in early childcare responsibilities (*Zajkowska,* 2019).

In Poland in 2022, the period of maternity leave was 20 weeks, with up to 6 weeks to be taken before birth and at least 14 weeks required postnatally. Mothers could choose between full compensation (100% of prior gross earnings) or a lower flat rate (81.5%), which influenced the level of compensation received during their subsequent parental leave. Maternity leave could be extended in cases of multiple births (up to 37 weeks) and partially transferred to the father if the 81.5% option was selected (*Kurowska – Godlewska-Bujok – Michoń,* 2023).

Paternity leave offered fathers two weeks of fully paid leave at 100% of their average gross earnings, available at any point within 12 months after childbirth, and it could be split into two one-week periods. Eligibility mirrored maternity leave requirements. Parental leave extended to 41 weeks in total, of which 23 weeks were a shared family entitlement and 18 weeks were reserved individually – —nine for the mother and 9 for the father. The payment structure depended on the earlier maternity leave option: those who received 100% during maternity leave were paid 70% during parental leave, while those who chose 81.5% continued at that same level. Leave was flexible and could be divided into up to five periods and extended through part-time work (up to 82 weeks proportionally), and it was available until the child reached the age of six. In special cases, such as multiple births or when the child had a life-threatening condition, leave could be extended to 43 or even 67 weeks (*Kurowska – Godlewska-Bujok – Michoń,* 2023).

Between 2011 and 2022, Slovakia undertook a series of reforms to strengthen financial support and caregiving entitlements for families as well. In 2011, maternity leave was extended across several categories: from 28 to 34 weeks for standard cases, from 37 to 43 weeks for mothers of multiple children caring for mothers caring for at least two children. The maternity benefit was also increased from 55% to 60% of the daily assessment base. Subsequent financial improvements followed: in 2016, maternity benefits rose from 65% to 70% of the daily base, resulting in an effective net replacement rate of over 91% of prior income. In 2017, the benefit was further increased to 75%, allowing most parents to receive nearly 100% of their net pre-leave earnings. By 2019, legislative changes allowed both parents to receive maternity benefits concurrently if the father was caring for one child while the mother simultaneously was caring for another. In compliance with EU Directive 2019/1158, in 2022 fathers gained the right to a two-week paid maternity-type benefit within six weeks of the child's birth in 2022, regardless of whether the mother was receiving maternity or parental benefits (*MPRiPS,* 2025). Although Slovakia introduced a daddy quota in 2011, it has remained relatively unknown and underutilised. As noted by *Dančíková* (2023b), the policy was originally tailored more for adoptive fathers, rather than having been designed to promote broader gender equality in caregiving.

In Slovakia, in 2022 maternity leave was set at up to 34 weeks, with 6–8 weeks taken before childbirth and 26–28 weeks after. At least 14 weeks were mandatory and could not end earlier than six weeks post-birth. The benefit amounted to 75% of the mother‘s average previous net earnings, capped at €1,851 per month, and was funded through sickness insurance (*Dančíková,* 2023a).

Paternity leave entitled fathers to 28 weeks of leave after the child‘s birth. Within the first six weeks, they could take two weeks of compensated paternity leave, also at 75% of previous net earnings. Fathers were additionally eligible for a non-transferable maternity benefit during the remainder of their leave, by which the mother‘s entitlement was correspondingly decreased. If not taken concurrently, the maternity benefits could still be drawn while the father was on paternity leave. Paternity leave could be extended to 31 weeks for single fathers and 37 weeks if they were caring for two or more children. Like maternity benefits, payments were tax-free and funded from sickness insurance (*Dančíková,* 2023a).

Parental leave was available until a child reached the age of three and was non-transferable between parents. It could be interrupted and resumed multiple times and combined with full- or part-time employment. The parental allowance, set at €413 per month, was available to parents who had previously received maternity benefits; those without such an entitlement received €301. The benefit was provided to just one parent at a time (*Dančíková,* 2023a).

Another crucial aspect is the expansion of childcare services, particularly for children under the age of three. Table 2 shows the enrolment rates of children in early childhood education and care services in Poland, Slovakia, and the OECD, based on their age group (0–2 and 3–5 years) for selected years. In Poland, the enrolment of children aged 0–2 increased from 10.9% in 2012 to 17.1% in 2022. In Slovakia, it declined from 4.7% to just 2.6%. In contrast, the OECD average for this age group was significantly higher at 35.9% in 2022. For children aged 3–5 years, enrolment is much higher across all countries. Poland reached 87.0% in 2021 and Slovakia 77.4%, and both these figures are relatively close to the OECD average of 86.4%. Overall, while enrolment rates for children aged 3–5 in Poland and Slovakia are comparable to the OECD average, participation among the youngest children (0–2 years) remains low – especially in Slovakia.

One of the primary programmes in this context in Poland is the 'Toddler+' initiative, launched in 2011 by the Polish Ministry of Labour and Social Policy. It was designed to support the development of childcare infrastructure for children under the age of three. The programme's primary objective was to expand access to early childhood care by financially supporting municipalities in the creation and operation of nursery schools, children's clubs, and day-care facilities. With an initial allocation of PLN 40 million, the programme offered co-financing for the construction, adaptation, furnishings, and equipment of childcare facilities (*MPRiPS,* 2019).

In 2022, the programme underwent a major reform, shifting from an annually operated initiative to a long-term, multi-year strategy. As part of the new edition, the programme was allocated a budget of PLN 5.5 billion, which is expected to result in the creation of an additional 102,000 childcare places for children under the age of three. At the time of the reform, Poland had approximately 8,000 nurseries and children's clubs, offering around 228,000 places, a significant increase from 2015, when there were fewer than 3,000 facilities providing only 84,000 places (*MPRiPS,* 2022).

Like in Poland, modifications have also been made to the pre-school education system in Slovakia. Slovakia had long been the subject of criticism owing to the low enrolment of children in pre-school facilities, as this participation rate had long been one of the lowest in Europe (*European Commission,* 2023). A new law introduced in Slovakia in 2021 made pre-school attendance compulsory for all children who had turned age 5 by the month of August in a given year

Table 2 **Enrolment rates in early childhood education and care services in Poland and Slovakia, 2010–2022, in %**2) 3)

	0–2 years		**3–5 years**	
	2012	**2022**	**2010**4)	**2021**5)
Poland	10.9	17.1	59.6	87.0
Slovakia	4.7	2.6	71.2	77.4
OECD	X	35.9	X	86.4

Source: OECD, Family Database – Enrolment in childcare and pre-school, 2024.

2) Percentage of children enrolled in early childhood education and care services (ISCED 0 and other registered ECEC services), 0- to 2-year-olds – 'Data for Poland and Slovakia are OECD estimates based on information from EU-SILC. Data refer to children using centre-based services (e.g. nurseries or day care centres and pre-schools, both public and private), organised family day care, and care services provided by (paid) professional childminders, and exclude those using unpaid informal services provided by relatives, friends or neighbours' (*OECD,* 2024b).

3) Percentage of children enrolled in early childhood education and care (ISCED 2011 level 0) or primary education (ISCED 2011 level 1), 3- to 5-year-olds.

4) Data for the year 2010 were used because they are the earliest available for both Poland and Slovakia.

5) The year 2021 represents the most recent year for which comparable data are available.

(*slovensko.sk,* 2021). This policy was implemented with the aim of ensuring that children are ready to join primary school education by the time they enter the formal education system. This compulsory preschool year has greatly increased the number of children attending pre-school facilities, as every 5-year-old is adequately prepared to start school (*Ministerstvo Financií Slovenskej Republiky,* 2022). However, Slovakia continues to face a severe shortage of places for children and high fees, a high proportion of children living in poverty, regional variations in the quality of facilities, and violence among children. The newly implemented National Strategy for the Development of Early Intervention and early care 2022–2030 aims to address these problems (*Eurochild,* 2023).

HYPOTHESES

In relation to the selected conceptual framework and previous research, we formulated the following hypotheses:

1. In line with Frejka and Gietel-Basten's typology of family policy models, we expect Slovak respondents to be more supportive of maternal employment – especially part-time – —compared to Polish respondents, reflecting differing institutional frameworks and gender role expectations. Slovakia is classified as a 'temporary male breadwinner' model with slightly more structural support for combining care and work, while Poland belongs to the 'conventional model', with stronger financial incentives but weaker institutional childcare infrastructure. These differences are likely to be reflected in public attitudes.
2. Women, younger respondents, and individuals with tertiary education will show greater support for maternal employment than men, older individuals, and people with lower educational attainment.
3. Respondents who believe that both parents are equally suited to care for young children will be more likely to support maternal employment, while those who believe mothers are inherently better suited will be less likely to support it. Beliefs about parenting roles reflect deeper gender ideologies. Traditional beliefs about maternal caregiving are strongly associated with a preference for stay-at-home motherhood, as shown in earlier studies and in our own regression results.

DATA AND METHODS

Data presentation

This study utilises data from the Family and Changing Gender Roles V module of the International Social Survey Programme (ISSP) in 2022. This module covered a wide range of subjects, such as gender ideology, attitudes towards female employment over the life-cycle, the gendered division of housework, social policy, and the preferred and actual division of paid and unpaid work. We used descriptive statistics in the first part of the analysis to examine individual attitudes towards the employment of mothers with a pre-school-age child and mothers whose youngest child is of school age in Poland and Slovakia. Table 1 presents the descriptive statistics for these variables. The sample size was 1711 respondents; 921 from Poland (437 males, 484 females) and 790 from Slovakia (391 males, 399 females). The age range of respondents is 18–91 years (18–91 years for males, 18–91 years for females). The method of data collection used in both countries was CAPI (face-to-face). The sample used included a representative stratified clustered sample of adults registered as residents in Poland and Slovakia.

Dependent variables

Our first dependent variable, **the workload of a mother with a child under school age**[6], was derived from the following item: *Do you think that women should work full-time, part-time, or not at all under the following circumstances? – When there is a child under school age.* Answers were coded into three categories: work full-time, work part-time, and stay at home. We derived the second dependent variable, **the workload of a mother whose youngest child is in school**[7], from

6) Under school age means under the age of regular/compulsory school attendance (i.e. 0–5 years).

7) Above school age means aged 6–17 years.

the following item: *Do you think that women should work full-time, part-time, or not at all under the following circumstances? – After the youngest child starts school.* Answers were coded into three categories: work full-time, work part-time, and stay at home.

This wide age range represents a limitation, as public attitudes towards maternal employment may vary depending on the specific age of the child. It is likely that respondents will differentiate, for example, between mothers of infants and mothers of older preschoolers, or between mothers of young schoolchildren and teenagers. However, the ISSP dataset does not allow for more detailed age-specific distinctions.

Independent variables

The selection of independent variables such as gender, age, education, and traditional gender role beliefs reflects previous studies that have shown these factors to be critical in shaping attitudes towards maternal employment. The sociodemographic variables measured as dummies include **sex** (0 = male [Ref.], 1 = female), **country** (0 = Poland [Ref.], 1 = Slovakia), **marital status** (0 = not married [Ref.], 1 = married), **children in the household by age** with 4 categories (0 = no child, 1 = child (ren) below school age, 2 = child(ren) of school age, 3 = both, child(ren) below and above school age), and the **provider of childcare for a child below school age**, which was constructed from the question *'People have different views on childcare for children under school age. Who do you think should primarily provide childcare'* and has two categories: 0 = family and other providers, 1 = state. Age was coded into three categories: 1 = 18–44 years, 2 = 45–64 years, and 3 = 65+ years. We categorised **education** into two groups: 0 = primary/secondary, 1 = tertiary.

The variable **impact on the family** was constructed from the statement: *'All in all, family life suffers when the woman[mother] has a full-time job'*. It has three categories: 1 = agree, 2 = neither agree nor disagree, 3 = disagree. **Which parent is better suited to look after children** reflects responses to the question *'Is the mother or the father better suited to look after children'* and the answers were recoded into three categories: 1 = The mother is much better, 2 = The mother is somewhat better, 3[8)] = the mother and father are equally suited.

Method

To examine preferences regarding the working time of mothers with pre-school-age children and those whose youngest child is already in school, we applied a multinomial logistic regression. This statistical method makes it possible to compare the likelihood of choosing different categories of the dependent variable relative to a designated reference group, while simultaneously accounting for multiple predictors. We selected 'stay at home' as the reference category owing to its theoretical importance and prevalence in the data. This approach allowed us to explore how sociodemographic factors and personal attitudes relate to preferences for part-time or full-time employment, in contrast to the more traditional choice of unpaid caregiving.

8) Due to a lack of responses in categories 4 = Fathers are somewhat better suited and 5 = Fathers are much better suited, these responses were recoded as mother and father equally.

Table 3 **Descriptive statistics on the dependent and independent variables**

	Poland		Slovakia	
	N	%	N	%
Dependent variables				
Workload of a mother with a child under school age				
Full-time	201	21.8%	284	35.9%
Part-time	246	26.7%	331	41.9%
Stay at home	474	51.5%	175	22.2%
Workload of a mother whose youngest child is in school				
Full-time	642	69.7%	512	64.8%
Part-time	226	24.5%	229	29.0%
Stay at home	53	5.8%	49	6.2%
Predictor variables				
Country	921	100.0%	790	100.0%
Sex				
Male	437	47.4%	391	49.5%
Female	484	52.6%	399	50.5%
Age				
18–44 years	339	36.8%	272	34.4%
45–64 years	326	35.4%	302	38.2%
65+ years	256	27.8%	216	27.3%
Education				
Primary/Secondary	705	76.5%	646	81.8%
Tertiary	216	23.5%	144	18.2%
Marital status				
Not married	372	40.4%	371	47.0%
Married	549	59.6%	419	53.0%
Child(ren) in the household by age				
No child	625	67.9%	600	75.9%
Child (ren) below school age	62	6.7%	36	4.6%
Child (ren) above school age	177	19.2%	120	15.2%
Both, child (ren) below and above school age	57	6.2%	34	4.3%
Impact on the family				
Agree	233	25.3%	261	33.0%
Neither agree nor disagree	123	13.4%	181	22.9%
Disagree	565	61.3%	348	44.1%
Which parent better suited to look after children				
Mothers much better	160	17.4%	199	25.2%
Mothers somewhat better	224	24.3%	292	37.0%
Mothers and fathers equally	537	58.3%	299	37.8%
Provider of childcare below school age				
Family and other providers	786	85.3%	323	40.9%
The state	135	14.7%	467	59.1%
N	921	100.0%	790	100.0%

Source: ISSP, 2022.

RESULTS

Descriptives

Impact on the family

Figure 1 displays the distribution of the answers of Polish and Slovak respondents to the question 'All in all, family life suffers when the woman has a full-time job'. There are statistically significant differences in the responses between the two countries. Poles (61.3%) are more likely to disagree with this statement compared to Slovaks (44.1%). Conversely, Slovaks (33.0%) exhibit a greater tendency to agree with the statement compared to Poles (25.2%).

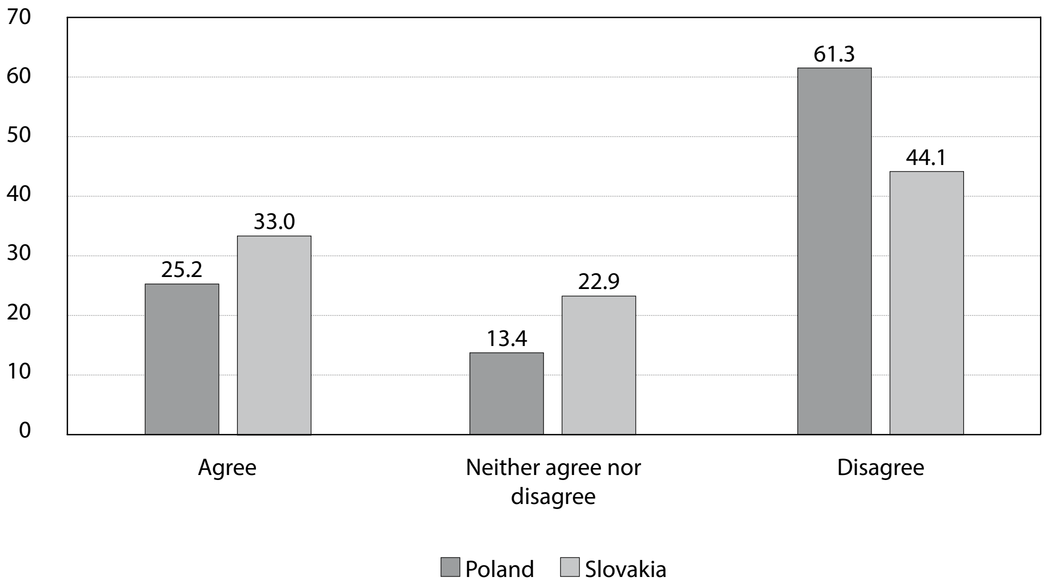
Regarding gender[10], a greater proportion of men (31.2%) agree with the statement compared to women (26.7%). Conversely, 57.8% of women disagree with it, in contrast to 48.7% of men.

With respect to age[11], the youngest are more likely to disagree with the statement (59.2% of those aged 18–44) compared to the oldest generations (47.5% of those aged 65+). In contrast, 23.2% of those aged 18–44 years agree with the statement, compared to 35.0% of those aged 65+.

If we look at the differences in attitudes for the two countries separately, there is a statistically significant[12] difference in the attitudes of men and women in the case of Poland. Men (30.0%) are more likely than women (21.1%) to agree with the statement, while women (66.7%) are more likely to reject the statement (vs 55.4% of men). No statistically significant difference between men and women was found for Slovakia.

Statistically significant differences[13] among age groups were found in the case of Poland, but not

Figure 1 **Attitudes to the statement 'All in all, family life suffers when the woman has a full-time job', in %[9]**



Source: ISSP, 2022.

9) Statistically significant – p-value < 0.000.
10) Statistically significant – p-value < 0.01.
11) Statistically significant – p-value < 0.000.
12) Statistically significant – p-value < 0.01.
13) Statistically significant – p-value < 0.01.

Slovakia. Here, the group of respondents aged 18–44 most often disagreed with the statement (68.1%), while 18.3% of this group agreed. In the case of the oldest age group 65+, 54.7% of respondents disagree with the statement, while 31.6% agree.

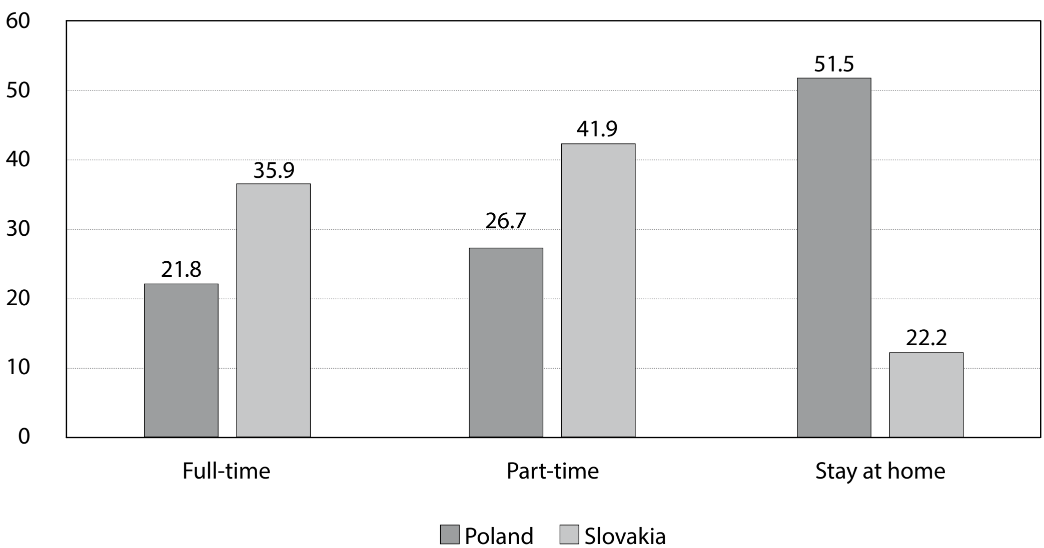
The preferred workload for a mother with a child under school age

Figure 2 illustrates the preferred workload for a mother with a child under school age in Poland and Slovakia. Differences in preferences can be observed between countries. In Poland, over half (51.5%) of respondents believe that a woman should stay at home with a pre-school-age child, in Slovakia the predominant response is that she should work part-time (41.9%). The least frequent response among Slovaks is that with a child this age she should stay at home (22.2%), while in Poland the least frequent response is that she should work full-time (21.8%). These results indicate significant disparities in opinions regarding the employment of women with a pre-school-age child, with Poles adhering to a traditional stance that a woman should stay at home, while Slovaks tend to support women's employment, both part-time and full-time.

Gender-based differences in preferences are statistically significant.[14)] Men are more inclined (42.9%) than women (33.3%) to endorse the view that a mother with a child under school age should stay at home. Conversely, women (30.1%) are more inclined than men (26.4%) to support full-time time and part-time employment (36.6% of women vs 30.7% of men), which indicates that women's attitudes towards the employment of mothers with pre-school-age children are more progressive.

In terms of age[15)], statistically significant differences between age groups were observed. Individuals aged 65+ predominantly hold the belief (45.8%) that a woman with a child under school age should stay at home. One-fourth of respondents in this age category think she should work full-time. Respondents in the 18–44 age group are the ones most inclined to believe

Figure 2 **The preferred workload for a mother with a child under school age in Poland and Slovakia, in %**



Note: Statistically significant – p-value < 0.000.
Source: ISSP, 2022.

14) Statistically significant – p-value < 0.000.

15) Statistically insignificant – p-value < 0.000.

that a woman with a child under school age should work parti-time (39.0%), while 31.6% think she should stay at home. Those aged 45–64 are the most likely to say women should stay at home (38.2%), while 32.5% say they should work part-time. The findings suggest that the younger generations endorse at least the partial involvement of women in the labour market when they have a pre-school-age child.

The preferred workload for a mother whose youngest child is in school

While there are differences in preferences between countries in the employment of mothers with a pre-school-age child, the differences are not significant for a school-age child. In both Poland (69.7%) and Slovakia (64.8%), more than half of the respondents believe that a woman with a child of this age should work full-time. Approximately a quarter of respondents believe that a woman with a child this age should work part-time (see Figure 3).

In terms of gender, there are statistically[17)] weak differences between men and women. Women (70.1%) are more likely than men (64.6%) to think that a mother with a school-age child should work full-time, while men (7.5%) are more likely than women (4.5%) to think that a woman should stay at home.

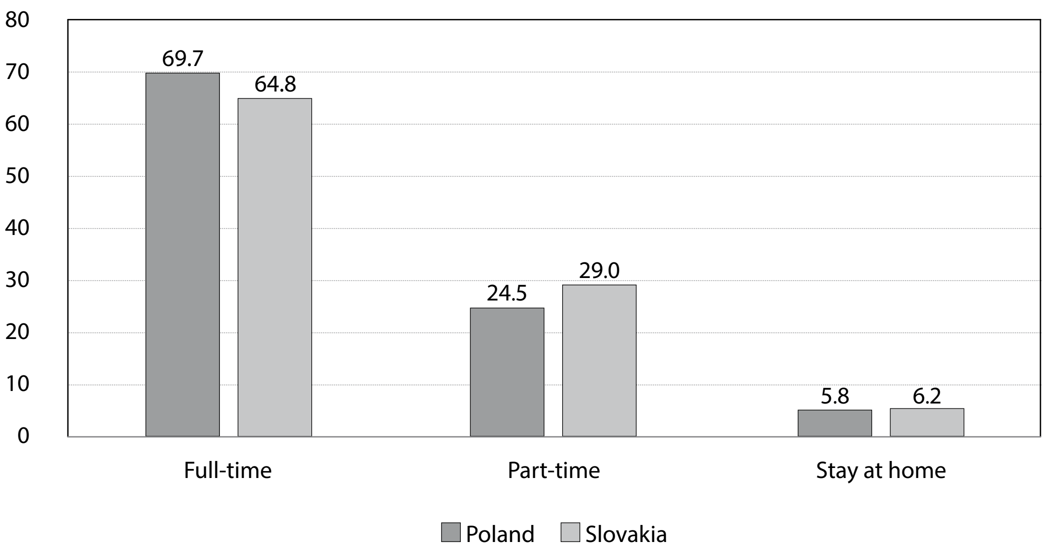
In terms of age[18)], respondents aged 18–44 are more likely to think a woman should work full-time (70.9%) compared to respondents aged 65+ (59.3%), who are then more likely to think a woman should stay at home (10.0%) than are respondents aged 18–44 (4.1%).

Regression results

The preferred workload for a mother with a child under school age

Model 1 in Table 4 displays the outcomes predicting the preferred workload for a mother with a child under school age in 2022. The analysis reveals that Slovaks, compared to Poles, exhibit a greater inclination towards both full-time and part-time employment

Figure 3[16)] **The preferred workload for a mother whose youngest child is in school in Poland and Slovakia, in %**



Note: Statistically significant – p-value < 0.05.
Source: ISSP, 2022.

16) Statistically insignificant – p-value > 0.05.
17) Statistically significant – p-value < 0.05.
18) Statistically significant – p-value < 0.000.

for women with a child under school age. Examining gender disparities, women demonstrate stronger support for part-time work arrangements than men. Education emerged as a crucial variable, as respondents with tertiary education are significantly more likely to support both full-time and part-time work for mothers compared to those with primary or secondary education. Other sociodemographic characteristics, such as marital status and the age composition of children in the household, were not statistically significant. However, age showed a significant effect in the case of part-time work preferences: respondents aged 18–44 were more likely to prefer part-time employment for mothers with a child under school age compared to those aged 65 and older.

Another statistically significant variable is the impact of women's paid work on the family. Respondents who agree with the statement that 'All in all, family life suffers when a woman has a full-time jobs' are less likely to favour the full-time employment of mothers; similarly, those who maintain a neutral stance are less inclined to favour full-time employment compared to those who disagree with the statement. The same results also apply to the part-time employment category. Both respondents who agree with the statement and those who take an undecided position are less likely to favour part-time employment for mothers with a pre-school-age child than respondents who disagree with the statement.

Additionally, respondents who believe that mothers are much better suited to look after children are significantly less supportive of both full-time and part-time employment for mothers. A less extreme but still negative association was found among those who think mothers are somewhat better suited. Also, respondents who think that care for pre-school-age children should be provided by the state are more likely to support part-time employment for mothers with pre-school-age children than those who think that care should be provided by the family.

The preferred workload for a mother whose youngest child is in school

Model 2 in Table 4 presents the results predicting the preferred workload for a mother whose youngest child is in school. The results show that a statistically significant difference in preferences emerged between men and women, with women more likely than men to support full-time employment for mothers with a child at this age.

In this model, age becomes significant. Respondents aged 18–44 and 45–64 are more likely to favour full-time employment for mothers with a school-age child compared to those aged 65+. These age groups also show a preference for part-time work. Education level again plays a significant role. Respondents with tertiary education are more supportive of both full-time and part-time employment than those with primary/secondary education.

The results show that respondents who believe that the family suffers if a woman works full-time are less supportive of both full-time and part-time employment. A weaker but still significant negative association is also seen among those who have a neutral attitude towards the statement. Interestingly, respondents who perceive mothers as somewhat better suited to childcare than fathers are significantly more likely to support part-time employment, while those who view mothers as much better suited tend to oppose full-time employment, though their view on part-time work was not significant.

CONCLUSION

This study examined public attitudes towards maternal employment in Poland and Slovakia using data from the 2022 ISSP module on Family and Changing Gender Roles. The main objective was to explore whether, and how, sociodemographic factors, beliefs about caregiving roles, and the national context shape support for the employment of mothers with pre-school-age and school-age children.

The results confirm that attitudes towards maternal employment remain differentiated along both cultural and structural lines. In line with our first hypothesis, Slovak respondents were significantly more likely than Polish respondents to support maternal employment – both full-time and part-time – but this difference was only observed in relation to mothers of pre-school-age children. No statistically significant difference was found between the two countries in attitudes towards the employment of mothers of school-age children.

The second hypothesis was also supported. Gender, age, and education proved to be significant predictors

Table 4 **Results of the multinomial logistic regression (odds ratios)**

	Model 1: Preferred workload for a mother with a child under school age		Model 2: Preferred workload for a mother whose youngest child is in school	
	Work full-time (ref. stay at home)	Work part-time (ref. stay at home)	Work full-time (ref. stay at home)	Work part-time (ref. stay at home)
Country				
Poland	Ref	Ref	Ref	Ref
Slovakia	9.406***	5.055***	1.164	1.137
Sex				
Male	Ref	Ref	Ref	Ref
Female	1.285	1.524***	1.623*	1.496
Age				
18–44 years	1.160	1.704**	2.281*	1.974*
45–64 years	1.119	1.237	2.311**	1.713*
65+ years	Ref	Ref	Ref	Ref
Education				
Primary/Secondary	Ref	Ref	Ref	Ref
Tertiary	2.799***	2.435***	5.350***	3.463*
Marital status				
Not married	Ref	Ref	Ref	Ref
Married	1.266	1.128	1.189	1.012
Child (ren) in the household by age				
No child (ren)	1.506	0.891	1.677	1.325
Child (ren) below school age	1.278	0.648	1.671	1.146
Child (ren) above school age	1.222	0.780	0.969	0.668
Both, child (ren) below and above school age	Ref	Ref	Ref	Ref
Impact on the family				
Agree	0.112***	0.426***	0.114***	0.418**
Neither agree nor disagree	0.252***	0.628**	0.271***	0.623
Disagree	Ref	Ref	Ref	Ref
Parent better suited to look after children				
Mothers much better	0.190***	0.462***	0.423***	0.628
Mothers somewhat better	0.455***	0.995	1.510	1.882*
Mothers and fathers equally	Ref	Ref	Ref	Ref
Provider of childcare below school age				
Family and other providers	Ref	Ref		
The state	1.188	1.400*		
N	1,711	1,711		
Nagelkerke R	0.328	0.190		

Source: ISSP, 2022.

of support. Women, younger respondents, and those with higher levels of education were more likely to support maternal employment, which is consistent with findings from previous studies.

The third hypothesis focused on the role of individual beliefs about caregiving. The analysis showed that respondents who believe that both parents are equally suited to provide care are substantially more likely to support maternal employment. In contrast, those who see mothers as the primary caregivers were more likely to oppose it, especially in the case of preschool-age children.

These attitudinal differences also reflect broader value orientations and cultural expectations shaped by both institutional arrangements and post-socialist legacies. As discussed earlier, both Poland and Slovakia inherited a legacy of high female labour force participation from the socialist era. However, in the decades following 1989, their trajectories diverged. Slovakia introduced policy measures that, while not fully supportive of dual-earner families, allowed for a certain level of reconciliation between work and care – placing it within Frejka and Gietel-Basten's 'temporary male breadwinner' model. In contrast, Poland followed a more conservative path, with policy emphasising maternal care and financial support for families, but offering limited institutional childcare, which places it in the 'conventional' model.

References

- Aidukaite, J. 2009. Old welfare state theories and new welfare regimes in Eastern Europe: Challenges and implications. *Communist and post-communist studies,* 42(1), 23–39. DOI: https://doi.org/10.1016/j.postcomstud.2009.02.004.
- Aidukaite, J. 2011. Welfare reforms and socio-economic trends in the 10 new EU member states of Central and Eastern Europe. *Communist and post-communist studies,* 44(3), 211–219. DOI: https://doi.org/10.1016/j.postcomstud.2011.07.005.
- Aspalter, C. – Jinsoo, K. – Sojeung, P. 2009. Analysing the Welfare State in Poland, the Czech Republic, Hungary and Slovenia: An Ideal-Typical Perspective. *Social policy & administration,* 43(2), 170–185. DOI: https://doi.org/10.1111/j.1467-9515.2009.00654.x.
- Bernal, R. 2008. The effect of maternal employment and child care on children's cognitive development. *International Economic Review,* 49(4), 1173–1209. DOI: https://doi.org/10.1111/j.1468-2354.2008.00510.x.
- Brooks-Gunn, J. – Han, W. – Waldfogel, J. 2010. First-Year Maternal Employment and Child Development in the First 7 Years. *Monographs of the Society for Research in Child Development,* 75(2), 1.
- Dančíková, Z. 2023a. Slovak Republic country note. In Blum, S. – Dobrotić, I. – Kaufman, G. – Koslowski, A. – Moss, P. (eds.) *International Review of Leave Policies and Research 2023.* Available: http://www.leavenetwork.org/lp_and_r_reports/.
- Dančíková, Z. 2023b. *Understanding daddy quotas as a part of the gender structure: the case of the Slovak leave policy for fathers.* Doctoral dissertation, London School of Economics and Political Science. Available. http://etheses.lse.ac.uk/4751/1/Dancikova_201619287.pdf.
- De La Porte, C. – Larsen, T. P. – Szelewa, D. 2020. A Gender Equalizing Regulatory Welfare State? Enacting the EU's Work-Life Balance Directive in Denmark and Poland. Online. *The Annals of the American Academy of Political and Social Science.* 691(1), pp. 84–103. ISSN 0002-7162. DOI: https://doi.org/10.1177/0002716220956910.
- Deacon, B. 2000. Eastern European welfare states: the impact of the politics of globalization. *Journal of European social policy,* 10(2), 146-161. DOI: https://doi.org/10.1177/a012487.
- Esping-Andersen, G. 1990. *The three worlds of welfare capitalism.* Cambridge: Polity Press. ISBN 978-0-7456-0665-1.
- Eurochild. 2023. Country Profile 2022 – Slovakia. *(In)visible children.* Online. Available: https://eurochild.org/uploads/2023/01/Slovakia_Invisible-children-Eurochild-2022-report-on-children-in-need-across-Europe.pdf.
- European Commission. 2023. *Education and Training Monitor 2023 – Slovakia*. European Union. ISBN 978-92-68-06241-8
- Eurostat. 2025. *Employment rate of adults by sex, age groups, educational attainment level, number of children and age of youngest child (%).* Available: https://ec.europa.eu/eurostat/databrowser/view/lfst_hheredch__custom_17474038/default/table?lang=en.
- Fenger, M. 2007. Welfare regimes in Central and Eastern Europe: Incorporating post-communist countries in a welfare regime typology. *Contemporary issues and ideas in social sciences,* pp. 1–30.

- Ferrarini, T. – Sjöberg, O. 2010. Social policy and health: transition countries in a comparative perspective. *International journal of social welfare,* 19(s1), S60–S88. DOI: https://doi.org/10.1111/j.1468-2397.2010.00729.x.
- Frejka, T. – Gietel-Basten, S. et al. 2016. Fertility and family policies in Central and Eastern Europe after 1990. *Comparative population studies,* 41(1), 3–56. DOI: https://doi.org/10.12765/CPoS-2016-03en.
- García-Faroldi, L. 2021. Diverging Paths among Central Eastern European Mothers? The Degree of Incongruity between Employment Preferences and Their Actual Experiences (1994–2012). *Sociologický časopis / Czech Sociological Review,* 57(6), 707–736. DOI: 10.13060/csr.2021.043.
- Gornick, J. C. – Meyers, M. K. – Ross, K. E. 1997. Supporting the employment of mothers: Policy variation across fourteen welfare states. *Journal of European social policy,* 7(1), 45–70.
- Hašková, H. – Saxonberg, S. 2016. The Revenge of History – The Institutional Roots of Post-Communist Family Policy in the Czech Republic, Hungary and Poland. *Social policy & administration,* 50(5), 559–579. DOI: https://doi.org/10.1111/spol.12129.
- Hídas, S. – Horváthová, V. 2018. *Women Still Can´t Have It All: Barriers to Higher Maternal Employment in Slovakia.* Ministerstvo financií SR – Inštitút finančnej politiky.
  Available: https://www.mfsr.sk/files/archiv/priloha-stranky/21121/89/Women_employment_20180511_final.pdf.
- Hsin, A. – Felfe, C. 2014. When Does Time Matter? Maternal Employment, Children's Time With Parents, and Child Development. *Demography,* 51(5), 1867–1894. DOI: https://doi.org/10.1007/s13524-014-0334-5.
- Chieregato, E. 2020. A work–life balance for all? Assessing the inclusiveness of EU Directive 2019/1158. *International Journal of Comparative Labour Law and Industrial Relations,* 36(1).
- ISSP Research Group 2025. International Social Survey Programme: Family and Changing Gender Roles V – ISSP 2022 *(ZA10000; Version 1.0.0) [Data set]. GESIS, Cologne.* DOI: https://doi.org/10.4232/5.ZA10000.1.0.0.
- Kocourková, J. 2002. Leave arrangements and childcare services in Central Europe: Policies and practices before and after the transition. *Community, work & family,* 5(3), 301–318. DOI: https://doi.org/10.1080/1366880022000041793.
- Kreyenfield, M. – Kosslyn, S. M. – Scott, R. A. 2015. *Maternal and Paternal Employment across the Life Course.* John Wiley & Sons. DOI: https://doi.org/10.1002/9781118900772.etrds0210.
- Kurowska A. – Godlewska-Bujok, B. – Michoń, P. 2023. Poland country note. In Blum, S. – Dobrotić, I. – Kaufman, G. – Koslowski, A. – Moss, P. (eds.) *International Review of Leave Policies and Research 2023.*
  Available: https://www.leavenetwork.org/annual-review-reports/.
- Lafont, S. 2001. One step forward, two steps back: women in the post-communist states. Online. *Communist and post-communist studies,* 34 (2), pp. 203–220. ISSN 0967-067X. DOI: https://doi.org/10.1016/S0967-067X(01)00006-X.
- Lewis, J. 1992. Gender and the Development of Welfare Regimes. *Journal of European Social Policy,* 2(3), 159–173. DOI: https://doi.org/10.1177/095892879200200301.
- Matynia, E. 1994. Women after communism: A bitter freedom. *Social Research,* pp. 351–377.
- Ministerstvo Financií Slovenskej Republiky. 2022. *National Reform Programme of the Slovak Republic 2022*.
  Available: https://www.mfsr.sk/en/finance/institute-financial-policy/strategic-documents/national-reform-program/.
- Ministerstvo Práce, sociálnych vecí a rodiny Slovenskej republiky. 2025. *Najvýznamnejšie zmeny v sociálnom poistení.*
  Available: https://www.employment.gov.sk/sk/socialne-poistenie-dochodkovy-system/socialne-poistenie/legislativne-zmeny/.
- Ministerstwo Rodziny, Pracy i Polityki Społecznej. 2019. *Maluch 2011.* Available: https://www.gov.pl/web/rodzina/maluch-2011.
- Ministerstwo Rodziny, Pracy i Polityki Społecznej. 2022. *MPRiPS przedstawia założenia nowej edycji programu Maluch+*.
  Available: https://www.gov.pl/web/rodzina/mrips-przedstawia-zalozenia-nowej-edycji-programu-maluch.
- OECD Family Database. 2024. *Enrolment in childcare and pre-school.* Available: https://www.oecd.org/en/data/datasets/oecd-family-database.html.
- Pascall, G. – Kwak, A. 2005. *Gender regimes in transition in Central and Eastern Europe.* Policy Press.
- Plomien, A. 2004. *From socialism to capitalism: Women and their changed relationship with the labor market in Poland.* Available at (consulted 19 February 2009): http://web. uni-bamberg. de/sowi/soziologie-i/globalife/downloads/wp_zipped/wp068.pdf.
- Saxonberg, S. – Sirovátka, T. 2006. Failing family policy in post-communist Central Europe. *Journal of comparative policy analysis,* 8(2), 185–202. DOI: https://doi.org/10.1080/13876980600682089.

- Szikra, D. – Tomka, B. 2009. Social policy in East Central Europe: Major trends in the twentieth century. In: *Post-communist welfare pathways: Theorizing social policy transformations in Central and Eastern Europe.* London: Palgrave Macmillan UK. Pp. 17–34
- Thévenon, O. – Solaz, A. 2013. Labour Market Effects of Parental Leave Policies in OECD Countries. In *Labour Market Effects of Parental Leave Policies in OECD Countries.* OECD Publishing.
- Vuri, D. 2016. Do childcare policies increase maternal employment? *IZA World of Labor.* DOI: https://doi.org/10.15185/izawol.241.
- Yu, W. – Lee, P. 2013. Decomposing Gender Beliefs: Cross-National Differences in Attitudes Toward Maternal Employment and Gender Equality at Home. *Sociological inquiry,* 83(4), pp. 591–621. DOI: https://doi.org/10.1111/soin.12013.
- UNICEF. 1999. *UNICEF annual report 1999.* UNICEF. Available: https://digitallibrary.un.org/record/286688?v=pdf&ln=en.
- Ústredný portal verejnej správy. 2021. Pre-primary education in kindergartens. Available: https://www.slovensko.sk/en/life-situation/life-situation/_pre-primary-education-in-kinde/.
- Zajkowska, O. 2019. Parental leaves in Poland: goals, challenges, perspectives. *Problemy polityki społecznej.* DOI: https://doi.org/10.31971/16401808.46.3.2019.6.

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PROBABILISTIC INTERVALS AROUND POPULATION FORECASTS: A NEW APPROACH WITH A SUBNATIONAL EXAMPLE USING WASHINGTON STATE COUNTIES

David A. Swanson[1] – **Jeff Tayman**[2]

Abstract

Population forecasts produced by governments at all levels are used in the public sector, the private sector, and by researchers. They have been primarily produced using deterministic methods. This paper shows how a method for producing measures of uncertainty can be applied to existing subnational population forecasts while meeting several important criteria, including the concept of utility. The paper includes an assessment of the efficacy of the method by: (1) examining the change in uncertainty intervals it produces by population size and population growth rate; and (2) comparing the width and temporal change of the uncertainty intervals it produces to the width and temporal change of uncertainty intervals produced by a Bayesian approach. The approach follows the logic of the Espenshade-Tayman method for producing confidence intervals in conjunction with ARIMA equations to construct a probabilistic interval around the total populations forecasted from the Cohort Component Method, the typical approach used by demographers. The paper finds that population size and population growth rate are related to the width of the forecast intervals, with size being the stronger predictor, and the intervals from the proposed method are not dissimilar to those produced by a Bayesian approach. This approach appears to be well-suited for generating probabilistic population forecasts in the United States and elsewhere where these forecasts are routinely produced. It has a higher level of utility, is simpler, and is more accessible to those tasked with producing measures of uncertainty around population forecasts.

Keywords: ARIMA, Bayesian Methods, Cohort Forecasting Methods, Espenshade-Tayman Method, Forecast Uncertainty, Utility
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INTRODUCTION

As *Wu et al.* (2023) observe, population forecasts produced by governments at all levels are used in the public sector, the private sector, and by researchers. However, until recently, these widely used forecasts have primarily been produced using deterministic methods in conjunction with the Cohort Component Method (CCM) and its algebraic equivalent, the Cohort Change Ratio (CCR) approach (see Appendix A) – a practice consistent with an observation made by *Baker, Alcantara, and Ruan* (2011: 10): "Demographic modeling occurs without consideration of statistical uncertainty." They noted that this oversight applied specifically to population forecasting. Regarding subnational forecasting, we find that the exception to their observation consists of five studies that have presented methods for developing probabilistic population forecasts: *Cameron and Poot* (2011); *Swanson and Beck* (1994); *Swanson and Tayman* (2014); *Wilson* (2012); and *Yu et al.* (2023). Notably, four of these studies link probabilistic uncertainty to the CCM approach (*Cameron – Poot,* 2011; Wilson, 2012; Yu et al., 2023) or the CCR approach (*Swanson – Tayman,* 2014). The linkage found in these four studies is significant because it means that the measures of uncertainty are linked to the fundamental demography equation, whereby a population at a given point in time, P_{t+k}, is equal to the population at an earlier point in time, P_t, to which is added the births and in-migrants that occur between time *t* and time *t+k,* and to which is subtracted the deaths and out-migrants that occur during this same time period (*Baker et al.,* 2017: 251–252).

The fundamental equation is the cornerstone of demographic theory (*Canudas-Romo et al.,* 2008; Swanson et al., 2023) and the foundation upon which the CCM rests (*Baker et al.,* 2017: 23–24; Burch, 2018). A probabilistic approach to population forecasting based on this theoretical foundation yields benefits not found in methods lacking this foundation (e.g., *Burch,* 2018; *Land,* 1986). This observation is also consistent with one made by *Swanson et al.* (2023), who argue that a given method's strengths and weaknesses largely stem from four sources: (1) its correspondence to the process by which a population moves forward in time; (2) the information available relevant to these dynamics; (3) the time and resources available to assemble relevant information and generate a forecast; and (4) the information needed from the forecast.

Like their counterparts in the private sector and at the national level, state and local demographers are constrained by resources and time. Because of these constraints, *Tayman and Swanson* (1996) pointed out the importance of considering the concept of utility in producing population forecasts. *Swanson, Burch, and Tedrow* (1996) added more specificity to this issue by introducing the "triple constraint" perspective, which can be applied to population forecasting:

1. Performance specification – the explanatory/predictive precision sufficient to support a given decision-making situation.
2. Time – the schedule requirements under which the performance specification must be accomplished.
3. Resources – the budget requirements under which the performance specification must be accomplished.

The performance specification is directly related to the four sources identified by *Swanson et al.* (2023), as well as the strengths and weaknesses of a given approach to forecasting, such as the time and resource specifications.

It is important to note that population forecasting is considered to be part of applied demography (*Swanson – Burch – Tedrow,* 1996), where problems come not from demographic theory or empirical research traditions but from a person (or set of persons) in government, business, or some other organizational sector who needs demographic analysis to assist him or her in making good, informed decisions. A corollary identified by *Swanson, Burch, and Tedrow* (1996) is that the decision-making process is client-driven in that the definition of the problem and an adequate answer are determined primarily by the decision-maker, not by the demographer or demographic research traditions. This corollary means that the primary audience for population forecasts comprises decision-makers and their constituents, not professors and academic researchers – two groups to which the triple constraint perspective applies, but differently. Professors and academic researchers pursue ever-improved knowledge, more precise and reliable measurements, better theoretical systems, and more refined techniques. They see costs and time as constraints to overcome to achieve high performance specification levels. Decision-makers are interested in acquiring the minimal amount of information needed to make correct decisions. They want to optimize the performance specification within the constraints generated by time and resource limitations. This latter view underlies the approach to generating uncertainty information we present here.

Turning to the five exceptions, we start with *Cameron and Poot* (2011), who developed a stochastic method for subnational population forecasts. They applied it to five demographically distinct administrative areas within the Waikato region of New Zealand. The uncertainty measures found in this approach are generated around the components of population change, which means this approach is linked to the fundamental population equation. Their results are compared to official subnational deterministic forecasts, which revealed the instability of migration as a component of population change.

Swanson and Beck (1994) proposed a lagged regression-based method to generate short-term county population forecasts. It is based on modifying the ratio-correlation method of population estimation and partly on earlier work by *Swanson* (1989). The modified ratio-correlation method produces forecasts without requiring substantial data and intensive intellectual labor inputs. Tests found that this approach delivered accurate forecasts (*Swanson – Beck,* 1994).

Swanson and Tayman (2014) examined state-level forecasts using a lagged regression approach in conjunction with the Cohort Change Ratio Method (CCR). As *Baker et al.* (2017) discuss, the CCR approach is algebraically equivalent to the CCM approach but uses cohort change ratios to capture mortality and migration; and to capture fertility, it uses child-adult ratios. This equivalency means the CCR approach is linked to the fundamental population equation. *Swanson and Tayman* (2014) found that the uncertainty measures associated with their lagged-regression CCR approach were not too wide in that they captured reported totals and age groups in accordance with expectations.

Wilson (2012) used the empirical approach to develop uncertainty measures for the subnational forecasts he constructed in Australia. It is based on empirical analyses of errors from past forecasts (*Smith – Tayman – Swanson,* 2013; Stoto, 1983). Although not a formal method for generating uncertainty measures, it is valid and Wilson applied it to CCM forecasts, which means that they are linked to the fundamental population equation. Importantly, Wilson's application provides uncertainty measures for age groups. This work has a precedent in which *Wilson* (2005) applied time series methods and judgment to develop uncertainty measures for New Zealand's national population forecasts.

Using the 39 counties of Washington state as an example, *Yu et al.* (2023) show that a Bayesian approach can be used in conjunction with the CCM to provide probabilistic county-level population forecasts. Like *Wilson* (2012), this approach measures uncertainty for age groups. To our knowledge, this is the first application of Bayesian inference to the CCM approach for projecting county populations. It is a seminal contribution. However, using experience as a guide, we also believe that it will take time for this approach to be widely adopted by the state and local demography communities, in part because Bayesian inference can be complex, effortful, opaque, and even counter-intuitive (*Goodwin,* 2015).

This paper adds to the sparse literature on subnational probabilistic population forecasting that has been reviewed here by describing a new approach for constructing uncertainty measures that is relatively simple and can be linked directly to either the CCM or CCR approach. Importantly, unlike Bayesian inference, we believe this new approach is likely to meet essential evaluation criteria routinely used by state and local demographers (*Smith – Tayman – Swanson,* 2013: 301–322), such as low production costs (particularly staff time), application and explanation ease, a high level of face validity, and intuitive. The approach we propose employs the ARIMA method in conjunction with work by *Espenshade and Tayman* (1982) to translate the uncertainty information in the ARIMA method's forecast to the population forecast provided by the CCM approach.

DATA

Following *Yu et al.* (2023), we use data for the 39 Washington state counties to demonstrate our new approach to placing probabilistic intervals around forecasts produced using CCM. We also evaluate our new approach by comparing its results to those reported by *Yu et al.* (2023). Figure 1 provides a map of Washington's counties. According to the 2020 decennial census, Washington state had a population of 7.7 million, the thirteenth largest state in the U.S. Its growth rate between 2010 and 2020 was 14.6%, the seventh fastest growth rate among states. Washington's 39 counties reflect a broad range of population sizes and growth rates and provide a diverse data set for evaluating the new approach, which places intervals around CCM forecasts. According to the 2020 decennial census, the average county population was 197,571, ranging from 2,286 in Garfield County to 2,267,675 in King County. Forty-six percent of the counties were smaller than 50,000, and only three counties exceeded 500,000 persons. The average county growth rate from 2010–2020 was 9.5%, ranging from –4.9% in Ferry County to 23.8% in Franklin County. Eight counties (20%) experienced growth rates below 5%, and seven counties (18%) experienced growth rates above 15%.

Figure 1 **Washingon State Counties**

Source: Washington Association of County Officials (https://countyofficials.org/192/County-Map)

We use annual intercensal estimates from 1960 to 2020 produced by the Forecasting Division of the Office of Financial Management (OFM) to implement the ARIMA model (*Washington,* 2024). Intercensal estimates are developed between census years and are considered more accurate than other estimates because either decennial census counts by the U.S. Census Bureau or state-certified special census counts on both sides bracket them. The intercensal estimates are based on the housing unit method (e.g., *Swanson – Tayman,* 2012: 137–164). The housing unit method assumes that the change in the number of people varies with the change in the number of housing units and counts of the population living in group quarters facilities, as reported to OFM by local governments and institutions over the decade.

We launched the forecasts from 2020 to match the launch year (2020) of the 2022 Growth Management Act (GMA) county forecasts (*Washington,* 2022). These GMA forecasts contain scenario-based, not probability-based, intervals around the medium forecast and have a 30-year forecast horizon to 2050.

Population forecasts for the GMA are produced every five years and developed with county officials. Directed by state statute (House Bill 1241), OFM prepares a reasonable range of possible population growth for Washington state's counties. County officials, also by law, are responsible for selecting a 20-year GMA planning target from within the range of high and low prepared by OFM.

Our approach follows the logic of the Espenshade-Tayman method (*Espenshade – Tayman,* 1982) for producing confidence intervals around postcensal population estimates by age. Their method employs time-series regression equations to construct probabilistic intervals around age-specific death rates over a postcensal estimation period. These results, combined with the number of deaths during this period and the most recent census counts, were translated into confidence intervals around the corresponding estimated age structure. Our use of the Espenshade-Tayman method is not unique. It has been employed by *Swanson* (1989) and *Roe, Swanson, and Carlson* (1992) in demographic applications.

Our approach uses ARIMA models to generate confidence intervals around population densities.[3] We use "density" because the *Espenshade-Tayman* (1982) method for translating uncertainty information does so from an estimated "rate," which in this case is the "rate" of population density. Other "rates" could be used, such as the ratio of the population to the number of housing units. However, using the land area as the denominator provides a virtually constant denominator over time, thereby reducing the effort in assembling the "rate" data. It also serves as a stabilizing element regarding the use of ARIMA in that it dampens the effect of short-term population fluctuations more effectively than, say, housing units, which also can fluctuate over time and not always in concert with population fluctuations.

Three steps are needed to generate a confidence interval around the GMA point forecast produced by the CCM, which we label here as "GMAPOP." First, ARIMA models produce a point forecast for population density (which we label here as "PFPD"), along with a lower limit (which we label here as "LLPD"), and an upper limit (which we label here as "ULPD") for each county and Washington state. Second, relative differences (proportions) are determined for each lower limit (which we label here as "RLLPD") and upper limit (which we label here as "RULPD"). These relative differences are found as follows:

RLLPD = (LLPD – PFPD) / PFPD and (1)

RULPD = (ULPD – PFPD) / PFPD. (2)

The third and final step translates the confidence intervals generated by the ARIMA county "density" forecasts to the medium GMA county forecasts to produce confidence intervals around the CCM point total population forecast (GMAPOP):

LLPOP = GMAPOP – (RLLPD × GMAPOP) and (3)

UUPLP = GMAPOP + (RULPD × GMAPOP). (4)

Appendix B contains the three different forecasts used in the ARIMA approach to measuring uncertainty in forecasts for Washington state and its 39 counties, and the Appendix B includes a numerical example of equations 1 through 4. Forecasts for 2030, 2040, and 2050 (10-to-30-year horizon lengths) are shown in three tables: Table B1 contains the ARIMA population density forecast and 95% confidence limits; Table B2 contains the GMA point forecast; and Table B3 includes the GMA point forecast and the translated 95% confidence limits.

Underlying the Espenshade-Tayman method is the idea that a sample is taken from a population of interest. In this case, the ARIMA results represent the sample, and the CCM forecasts represent the population. This interpretation is derived from the idea of a "superpopulation" (*Hartley – Sielken,* 1975; *Sampath,* 2005; *Swanson – Tayman,* 2012: 32–33). This concept can be traced back to *Deming and Stephan* (1941), who observed that even a complete census,

3) It is more common to use the term "forecast interval" or "prediction interval" in the context of forecasting, because a "confidence interval," strictly speaking, applies to a sample (*Swanson – Tayman,* 2014: 204). However, underlying our approach is the concept of a "super population," which describes a population as one sample from the infinity of populations (*Deming – Stephan,* 1941). Viewing a forecast as a sample leads us to choose "confidence interval" rather than forecast or prediction interval because it distinguishes the new approach from those discussed in the **Introduction**.

for scientific generalizations, describes a population that is but one of the infinities of populations that will result by chance from the same underlying social and economic causal systems. It is a theoretical concept that we use to simplify the application of statistical uncertainty to a population forecast that is considered a statistical model in this context.

ARIMA MODELS

Univariate ARIMA (Auto-Regressive Integrated Moving Average) time series models are the basis for the new approach for placing confidence intervals around CCM total population forecasts. The ARIMA model is described by *Box and Jenkins* (1976). It been used in the analysis and forecast of business, economic, and demographic variables (e.g., *Box et al.,* 2016; *Hyndman – Athanasopoulos,* 2024: Chapter 9; *Montgomery – Kulahci,* 2016). In recent years, ARIMA models have been developed using deep learning techniques (*Gridin,* 2022). Examples of its use in demographic forecasting include *McNown et al.* (1995); *Pflaumer* (1992); *Swanson* (2019); *Tayman, Smith, and Lin* (2007); and *Zakria and Muhammad* (2009). ARIMA models attempt to uncover the stochastic processes that generate a historical data series. The most general ARIMA model is usually written as ARIMA (p, d, q), where p is the order of the autoregression, d is the degree of differencing, and q is the order of the moving average. The autoregressive process has a memory in the sense that it is based on the correlation of each value of a variable with all preceding values. The moving average represents a "shock" to the system – an event with a substantial but short-lived impact on the time series pattern. The differencing process creates a stationary time series (i.e., one with a constant mean and variance over time). The d-value must be determined first because a stationary series is required to correctly identify the autoregressive and moving average processes.

We use the augmented Dickey-Fuller test (*Dickey – Fuller,* 1979) to identify the differencing required to achieve a stationary time series. The null hypothesis of this test is that a unit root is present in the time series, and the alternative hypothesis is that the time series is stationary. The patterns of the autocorrelation (ACF) and partial autocorrelation functions (PACF) are used to find the correct values for p and q (*Brockwell – Davis,* 2016: Chapter 3), and the autoregressive and moving average parameters have to be statistically significant. An adequate ARIMA model will have random residuals and the smallest possible values for p, d, or q. The Ljung-Box test (*Ljung – Box,* 1979) is used to evaluate the residuals of the estimated ARIMA model. The null hypothesis of this test is that the residuals are randomly distributed, and the alternative hypothesis is that the residuals are correlated with one another.

RESULTS

Table 1 presents selected statistics from the ARIMA models for each county and Washington state as a whole. The time series from 1960–2020 for all 39 counties and the state as a whole required differencing to become stationary. A significant Dickey-Fuller statistic ($p \leq 0.10$) based on first differences indicated a d = 1 in 29 counties and the state as a whole. The remaining ten counties required a second difference (difference of the first differences) in order to reject the null hypothesis of the presence of a unit root.[4) There is variation in the ARIMA parameters across counties. The most common specification was a model that contained only a first-order autoregressive term (19 counties). Nine counties contain only a first-order moving average term, while additional nine counties along with Washington state as a whole contain both first-order autoregressive and first-order moving average terms. Two counties have no autoregressive or moving average terms, referred to as random walk models. All counties and Washington state have

4) With the complete time series (1960–2020), Ferry County required a second difference to make the series stationary (Dickey Fuller p = 0.001). An ARIMA (1,2,1) for Ferry County showed illogical interval widths as the lower limit turned and stayed negative from 22- to 30-year forecast horizons. A graph comparing the first and second differences suggested that the non-stationarity in the time series occurred between 1960 and 1969. Table 1 shows that the restricted sample required only a first difference to achieve stationary (Dickey Fuller p = 0.036).

Ljung-Box p-values that exceed 0.10, indicating random residuals in all.

We conduct three analyses. First, we investigate the range of uncertainty in the county forecasts by analyzing county-specific half-widths (a half-width is defined as the width of the entire uncertainty interval divided by two). Second, to compare the examples discussed by *Yu et al.* (2023), Ferry, King, and Whitman counties, and Washington state as a whole, we compare their Bayesian-based intervals to our ARIMA-based intervals. We also include in the comparison the deterministic scenario-based intervals from the GMA forecasts. Finally, this analysis consists of a preliminary investigation of the effect of population size, growth rate, and horizon length on interval width.

Range of Uncertainty Across Counties

We begin by presenting the range of uncertainty in the county forecasts by analyzing half-widths (a half-width is defined as the width of the entire uncertainty interval divided by two. It represents the distance for the point estimate to either the upper or lower limit of the confidence interval) for 10-, 20-, and 30-year forecast horizons, as shown in Table 2. This Table also includes various summary measures of the half-width distribution across the counties for each of the three forecast horizons. As expected, the confidence intervals get wider with an increase in the forecast horizon for every county, as seen in the rise in the half-widths going from 10-year to 30-year forecast horizons. The percentage increases in the half-widths comparing the 10-year and 30-year forecast horizons range from 35.4% in Island County to 303.7% in Okanogan County; the average percent increase across counties is 111.1 (data not shown).

The summary measures of the half-widths tell a similar story: the average half-width increases from 10.5% in the 10-year forecast to 24.5% in the 30-year forecast, an increase of 133.3%. The half-width distributions are right skewed as the median half-widths are less than the mean half-widths in all forecast horizons. In the 10-year horizon, two counties have half-widths that exceed 20%. In the 20-year horizon, six counties have half-widths that exceed 35%, and in the 30-year horizon, six counties have half-widths that exceed 50%. The averages recomputed removing these cases are close to the median values reported in Table 2. Along with the average half-widths, the half-width variability across counties also increases with longer forecast horizons, with the coefficient of variation (abbreviated as "CV" in Table 2) rising from 48.3% in the 10-year forecast horizon to 75.5% in the 30-year forecast horizon. The direct relationship between the degree of forecast uncertainty and the length of the forecast horizon is well known. To our knowledge, this is the first study to empirically show that the variability of uncertainty also increases with the length of the forecast horizon.

A higher value of the d parameter causes wider ARIMA intervals and intervals that increase more rapidly with lengthening forecast horizons. For example, forecasts from an ARIMA model with first differences follow a linear trend, while forecasts from an ARIMA model with second differences will follow a quadratic trend (*Hyndman – Athanasopoulos,* 2024: Chapter 9; *Tayman – Smith – Lin,* 2007).

Table 1 **ARIMA Equations, Washington State and Counties**

		Coefficients				**Dickey Fuller Test p-Value**		
County	**ARIMA Specification**	**Auto Regressive**	**p-Value**	**Moving Average**	**p-Value**	**First Difference**	**Second Difference**	**Ljung-Box p-Value**
Adams	(1,1,1)	–0.430	0.001	–0.961	0.000	0.008		0.173
Asotin	(1,1,0)	0.338	0.004			0.009		0.159
Benton	(1,1,0)	0.814	0.000			0.005		0.546
Chelan	(0,2,1)			0.628	0.000	0.135	0.000	0.485
Clallam	(1,1,0)	0.560	0.000			0.055		0.857
Clark	(0,2,1)			0.277	0.031	0.202	0.001	0.857
Columbia	(1,1,0)	–0.209	0.100			0.006		0.890
Cowlitz	(1,1,0)	0.580	0.000			0.014		0.124
Douglas	(1,1,0)	0.347	0.004			0.002		0.285
Ferry[a]	(1,1,1)	0.857	0.000	0.558	0.004	0.036		0.120
Franklin	(1,2,0)	–0.350	0.004			0.424	0.001	0.841
Garfield	(0,1,1)			–0.441	0.000	0.003		0.168
Grant	(0,2,1)			0.776	0.000	0.171	0.000	0.211
Grays Harbor	(0,1,1)			–0.700	0.000	0.004		0.358
Island	(1,1,0)	0.224	0.077			0.024		0.766
Jefferson	(0,2,1)			0.550	0.000	0.143	0.001	0.112
King	(1,1,1)	0.558	0.000	–0.355	0.031	0.023		0.629
Kitsap	(1,1,0)	0.459	0.000			0.065		0.387
Kittitas	(1,2,1)	0.494	0.003	0.887	0.000	0.531	0.000	0.827
Klickitat	(0,2,1)			0.540	0.000	0.141	0.002	0.231
Lewis	(1,1,0)	0.436	0.000			0.006		0.739
Lincoln	(0,2,1)			0.584	0.000	0.120	0.000	0.111
Mason	(1,1,0)	0.733	0.000			0.087		0.365
Okanogan	(0,2,1)			0.487	0.000	0.132	0.001	0.897
Pacific	(1,1,0)	0.244	0.051			0.019		0.838
Pend Oreille	(1,1,1)	0.924	0.000	0.331	0.020	0.047		0.132
Pierce	(1,1,0)	0.341	0.005			0.002		0.492
San Juan	(1,1,0)	0.638	0.000			0.012		0.500
Skagit	(1,1,1)	0.902	0.000	0.390	0.010	0.105		0.608
Skamania	(0,1,0)					0.002		0.256
Snohomish	(1,1,0)	0.705	0.000			0.016		0.106
Spokane	(1,1,0)	704	0.000			0.097		0.925
Stevens	(1,1,0)	0.823	0.000			0.077		0.150
Thurston	(1,1,0)	0.584	0.000			0.004		0.219
Wahkiakum	(0,1,0)					0.004		0.113
Walla Walla	(1,1,1)	0.820	0.000	0.622	0.013	0.034		0.265
Whatcom	(1,1,0)	0.719	0.000			0.056		0.955
Whitman	(1,2,1)	–0.343	0.024	0.664	0.000	0.176	0.000	0.941
Yakima	(1,1,1)	0.932	0.000	0.450	0.001	0.099		0.722
Washington	(1,1,1)	0.687	0.000	–0.340	0.022	0.014		0.396

Note: a) The ARIMA model for Ferry County used an annual time series from 1970 to 2020, ten years shorter used for the other counties (see Footnote 4).

Table 2 **95% Half-Widths, ARIMA Alternative by Horizon Length Washington State and Counties, 2030–2050**[a)]

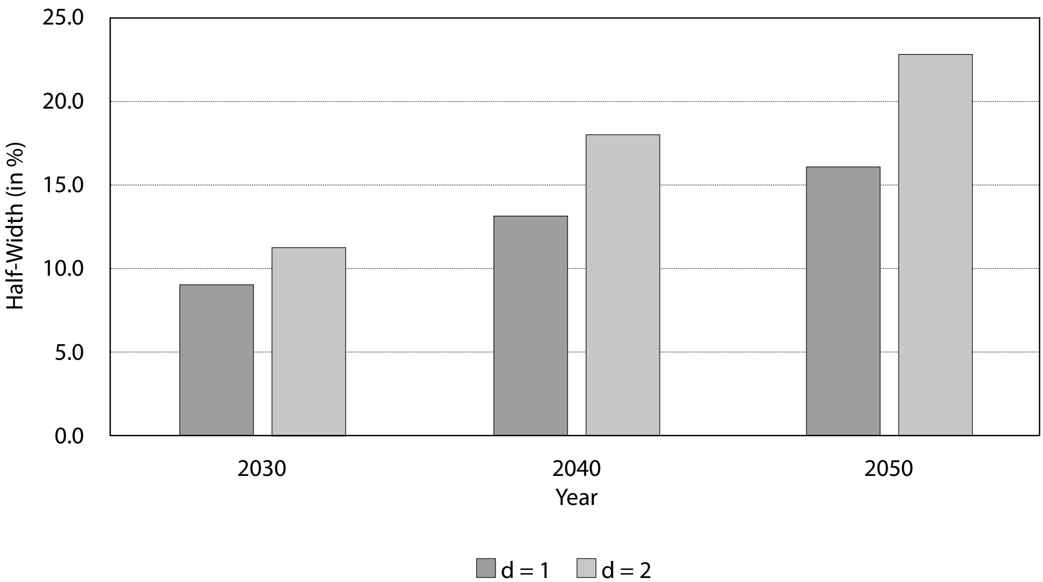
	Horizon Length		
County	**10-Year**	**20-year**	**30-year**
Adams	6.0%	8.0%	9.3%
Asotin	6.9%	9.0%	10.3%
Benton	13.0%	19.6%	23.3%
Chelan	11.5%	28.0%	43.9%
Clallam	7.8%	10.4%	11.8%
Clark	12.2%	24.3%	38.9%
Columbia	7.8%	12.5%	15.1%
Cowlitz	5.9%	8.2%	9.5%
Douglas	6.4%	8.2%	9.2%
Ferry	20.6%	29.7%	35.0%
Franklin	17.6%	37.7%	57.8%
Garfield	28.3%	41.4%	53.7%
Grant	12.6%	24.4%	36.7%
Grays Harbor	6.4%	8.6%	10.1%
Island	7.7%	9.5%	10.5%
Jefferson	16.0%	35.3%	56.1%
King	6.9%	9.3%	10.7%
Kitsap	8.6%	11.0%	12.2%
Kittitas	10.8%	19.1%	27.1%
Klickitat	17.4%	37.3%	58.2%
Lewis	5.4%	7.1%	8.1%
Lincoln	16.3%	38.2%	64.4%
Mason	8.7%	12.0%	13.7%
Okanogan	16.5%	39.2%	66.5%
Pacific	6.6%	8.7%	10.0%
Pend Oreille	17.0%	31.1%	40.9%
Pierce	5.2%	6.6%	7.4%
San Juan	10.7%	14.1%	15.6%
Skagit	10.2%	17.1%	21.6%
Skamania	6.5%	8.9%	9.2%
Snohomish	7.4%	10.1%	11.5%
Spokane	7.2%	10.3%	12.1%
Stevens	13.8%	21.4%	25.4%
Thurston	5.5%	7.2%	8.0%
Wahkiakum	11.0%	15.3%	17.9%
Walla Walla	6.6%	9.7%	11.7%
Whatcom	6.9%	9.7%	11.1%
Whitman	11.9%	25.7%	41.0%
Yakima	7.4%	13.7%	18.4%
Washington	5.5%	7.8%	8.9%

	Summary Statistics, Counties		
Mean	10.5%	17.9%	24.5%
Median	8.6%	12.5%	15.1%
Std. Dev.	5.1%	11.1%	18.5%
CV[b)]	48.3%	61.8%	75.5%

Notes: a) Calculated from Appendix Table B3 – Half Width = (High – Low) / 2 / Point Forecast × 100.
b) Std. Dev. / Mean × 100.

Turning to a verbal description of Figure 2, we first note that the average half-width for ARIMA models with first differences (the darker columns) is smaller than ARIMA models with second differences (the lighter columns) in all forecast years. Moreover, the gap between them increases with the lengthening of the forecast horizon. In 2030, the average half-widths are relatively similar (9.3% for d = 1 vs 10.9% for d = 2). By 2050, the gap has widened considerably (16.0 vs 23.2%). Put another way, the average of the half-width for ARIMA models with first differences increased by 173% compared to an increase of 214% for ARIMA models with second differences. In addition, the increase in the variability of the average half-width was much more significant for the ARIMA models with second differences. The percentage increase in the coefficients of variation from 2030 to 2050 is 122% (ARIMA with d = 1) and 211% (ARIMA with d = 2).

Figure 2 **Average Half-Width by Difference Parameter**



Comparison to Other Uncertainty Intervals for Selected Areas

As a means of evaluating the performance of our proposed method, we compare our forecast results to: (1) those that correspond with the results discussed by *Yu et al.* (2023), which are for Ferry, King and Whitman counties and the state of Washington as a whole; and (2) the judgmental intervals (the "low" and "high" values) that were placed by the OFM forecasters around their "middle" range projections (which were selected as the GMA forecasts) for all of the counties and the state as a whole. The comparisons are based on the "half-widths" of confidence intervals in Table 3. We focus on the "narrowness" of the half-widths because 95% confidence intervals may produce widths so wide as to be useless (*Swanson – Tayman,* 2014).

Table 3 **95% Half Width by Method and Horizon Length, Selected Counties and Washington State**[a)]

Ferry County				King County			
Horizon Length	**GMA[b)] Forecast**	**Bayes[c)] CCM**	**ARIMA[d)] Based**	**Horizon Length**	**GMA Forecast**	**Bayes CCM**	**ARIMA Based**
10 years	11.8%	9.7%	20.6%	10 years	10.6%	7.0%	6.9%
20 Years	21.6%	19.1%	29.7%	20 Years	15.2%	14.2%	9.3%
30 Years	32.0%	28.2%	35.0%	30 Years	19.3%	21.0%	10.7%

Whitman County				Washington State			
Horizon Length	**GMA Forecast**	**Bayes CCM**	**ARIMA Based**	**Horizon Length**	**GMA Forecast**	**Bayes CCM**	**ARIMA Base**
10 years	9.3%	4.9%	11.9%	10 years	9.6%	3.0%	5.5%
20 Years	11.8%	8.8%	25.7%	20 Years	13.4%	6.3%	7.8%
30 Years	14.3%	12.6%	41.0%	30 Years	16.6%	9.7%	8.9%

Note: a) Half Width = (High – Low) / 2 / Point Forecast × 100.
Sources: b) *Washington* (2022).
c) *Yu, et, al.* (2023).
d) Computed from Appendix Table B3.

Regarding Ferry County, Table 3 shows that the confidence intervals (half-widths) are widest for our approach (labeled as "ARIMA Based") for all horizon lengths, and those for the Bayes CCM approach (labeled as "Bayes CCM") are the narrowest for all three horizon lengths. The GMA judgmental half-width (labeled "GMA Forecast") falls between the other two approaches but tends to be closer to the Bayes CCM than ours. For all three approaches, the widths increase over time, per the expectation that forecast uncertainty increases as the horizon lengthens.

For King County at the 10-year horizon, the confidence intervals produced by our method are slightly narrower than the intervals reported both for the Bayesian method and those reported by OFM for the GMA forecast and substantially narrower at 20 and 30 years. The GMA intervals are somewhat narrower than the Bayes intervals at the 30-year horizon lengths but are not as narrow as our approach at any of the three horizon lengths. As was the case for Ferry County, the widths increase over time for all three approaches.

For Whitman County, the Bayes CCM approach produces the narrowest widths for all three horizon lengths. The GMA intervals are narrower than the intervals for our approach at all three horizon lengths, and those differences increase with the horizon length (2.6 percentage points for a 10-year horizon and 26.7 percentage points for a 30-year horizon).[5)] It should be noted, however, that *Yu et al.* (2023) held the age groups associated with college attendance constant in counties such as Whitman, where these populations significantly impact the county's overall age structure. Once again, the widths increase over time for all three approaches.

Considering Washington state as a whole, the intervals for the Bayes CCM approach are the narrowest for the 10- and 20-year horizon lengths, while our approach produces the narrowest interval for the 30-year horizon length. The GMA boundaries produce the widest intervals across all three horizon lengths by a sizable margin. Once again, the widths increase over time for all three approaches.

5) Whitman county's ARIMA model required second differences; and as expected, its interval width increased much faster than the other areas whose ARIMA models required first differences. From the 10-year to 30-year horizons, Whitman's half-width increased by 240% compared to 60% or 70% for the other two counties and Washington state.

These comparisons suggest that our approach produces uncertainty measures for county population forecasts similar to those generated by the Bayes CCM approach. Moreover, we find that all three approaches produce uncertainty intervals that are not so wide as to be useless, which is a point brought up by *Swanson and Tayman* (2016) in an earlier examination of forecast uncertainty.

Another example of the viability of our approach is Ferry County, which has the smallest population of the three counties. It has a 2020 population of 7,178 and a forecasted 2050 population of 6,986 (*Washington*, 2022). To see a 10-year horizon length half-width of 20.6 % and a half-width of 35.0% for the 30-year horizon length per our approach is not unexpected. Moreover, except for the 30-year horizon for Whitman County, all three methods across all three horizon lengths produce the widest uncertainty intervals in Ferry County, with the smallest population.

Impact of Population Size and Growth Rate on Interval Width

It has been established by ex-post evaluations that population size and growth rate affect forecast precision and bias (see *Smith – Tayman – Swanson,* 2013: 338–341 for a review of these findings). Consistent with these results and adding to them, we find that:

1. Forecast precision improves as population size increases, but this relationship weakens or disappears once the population reaches a certain size. However, population size has no predictable relationship with forecast bias.
2. Population growth rate affects both forecast precision and bias. Forecast precision is greatest for areas with small population changes, and declines as growth rates deviate in both a positive and negative direction from these low levels.
3. Bias is also strongly affected by differences in population growth rates. Areas losing population tend to be under-forecasted, whereas rapidly growing areas tend to be over-forecasted.

Now that we have shown our method produces intervals that are consistent with the idea that forecast interval width should increase temporally in conjunction with the increase in uncertainty expected as one looks further into the future, we turn to an examination of the effect that population size and growth rate have on forecast interval width. A review of the literature shows that such an examination has not yet been conducted with any specificity. To this end, we use a regression framework with the half-width as the dependent variable and population size and growth rate as the dependent variables, following the approach used in *Tayman, Smith, and Rayer* (2011). Separate models are estimated for 10- 20- and 30-year forecast horizons using single-variable regressions containing population size and growth rate and multiple regressions with both variables. Population size is measured at each forecast horizon, and growth rate is the percent change from 2020 to each forecast horizon.

We analyzed the functional form of the two independent variables at each forecast horizon length using graphs and the adjusted multiple coefficient of determination (adjR^2). The adjustment to the multiple coefficient of determination takes into account the complexity of a given regression model relative to the complexity of its input data (*Poston – Conde – Field,* 2024: 137–138). We determined the same functional form was appropriate for each horizon length. We illustrate this process using the 10-year forecast horizon, but the information for the 20- and 30-year horizons is available from us. Figure 3 shows the relationship between the natural log of population size (x axis) and half-width (y axis) for counties in Washington state at the 10-year forecast horizon. We use the natural log of the population to accommodate the skewed distribution of population size, which in 2030 ranges from 2,247 in Garfield County to 2,487,380 in King County. Also, the natural log of the population is more closely associated with the half-width than the unlogged population. In a single variable regression, the logged population has an adjR^2 of 0.272 compared to 0.067 for the unlogged value. As can be seen in Figure 3, the relationship tends to weaken around a population size of 36,000 (exp (ln (10.5)), suggesting the need for a squared term. However, adding a squared term slightly increases the adjR^2 from 0.213 to 0.231, which is not statistically significant.

Figure 4 shows the relationship between the decennial growth rate (x axis) and half-width (y axis) for counties in Washington state at the 10-year forecast horizon. The natural log of growth rate specification did not add to the explained variation of the half-width beyond the unlogged growth rate; both

Figure 3 **Relationship Between Ln(Population Size) and Half-Width, 2030**

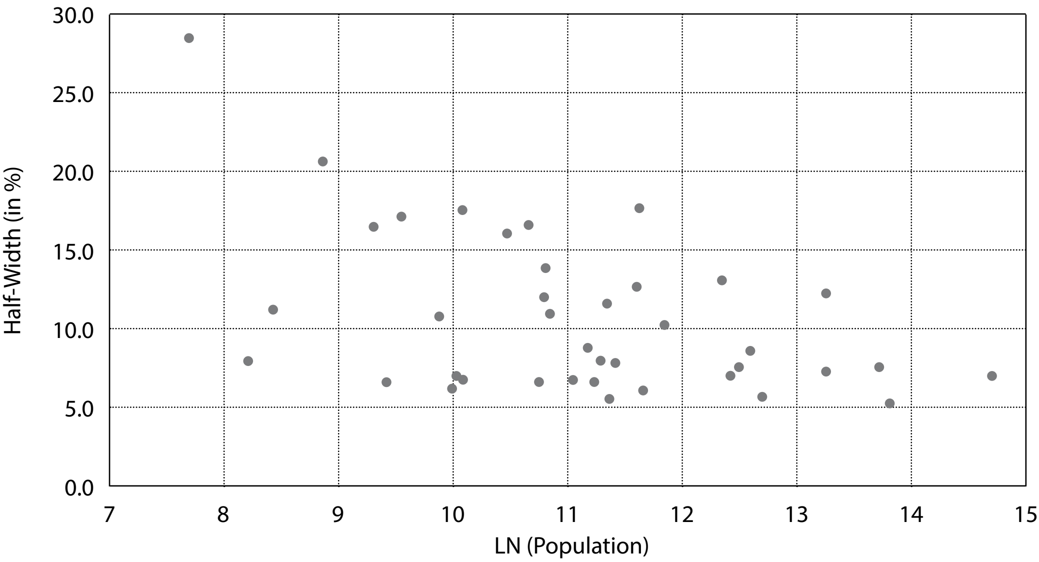
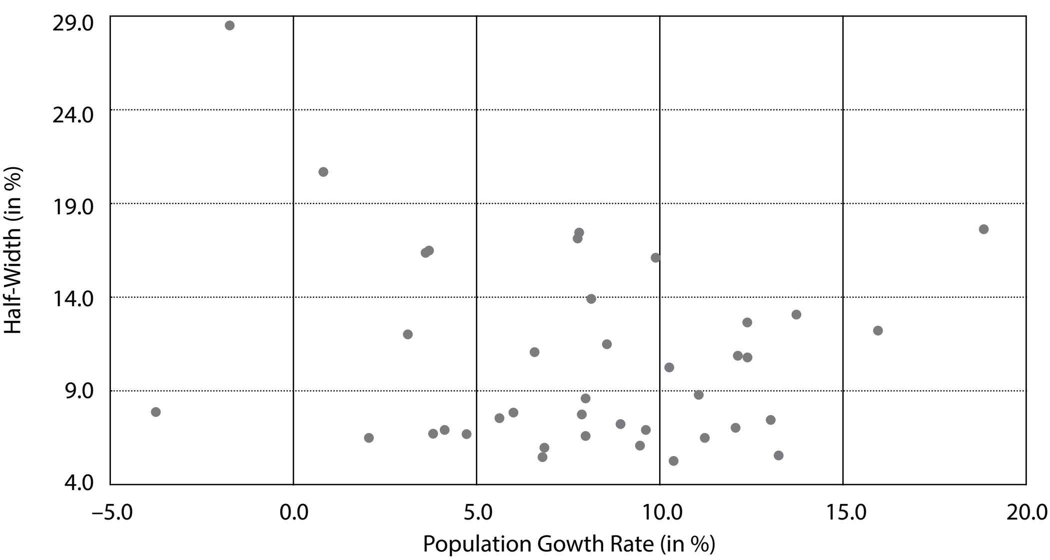


Figure 4 **Relationship Between Population Growth Rate and Half-Width, 2030**



specifications had an adjR^2 of 0.056. Growth rate and half-width rate have a u-shaped relationship with the half-width. Adding the squared term raises the adjR^2 substantially compared to an equation without it (0.006 vs 0.119).

The regression statistics are shown in Table 4, with the top two sections showing the adjR^2. The explanatory power of the models declines as the horizon length increases, similar to the results of *Tayman, Smith, and Rayer* (2011). However, contrary to the literature on population forecast error, population size has greater explanatory power than population growth rate in explaining the width of forecast intervals. The adjR^2 declines between –20% and –27% when the model includes only population size compared to the model that consists of both size and growth rate. The decline in adjR^2 is substantially greater when the model contains only growth rate, ranging from –65% in the 30-year forecast horizon to –55% in the 10-year forecast horizon.

Table 4 **Regression Models Predicting Half-With By Horizon Length Adjusted R^2 and Unstandarized Regression Coefficients**

	Adjusted R^2		
Model	*10-Year*	*20-Year*	*30-Year*
Ln (Size)	0.213	0.122	0.076
Growth Rate, Growth Rate^2	0.119	0.064	0.036
Ln (Size), Growth Rate, Growth Rate^2	0.267	0.166	0.104

	Reduction in R^2 From Size and Growth Rate Model		
Model	*10-Year*	*20-Year*	*30-Year*
Ln (Size)	–20.2%	–26.5%	–26.9%
Growth Rate, Growth Rate^2	–55.4%	–61.4%	–65.4%

	Unstandardized Regression Coefficients		
Variables	*10-Year*	*20-Year*	*30-Year*
Constant	0.291**	0.514**	–0.719**
Ln (Size)	–0.016**	–0.031**	–0.045*
Growth Rate	–0.539	–0.365	–0.255
Growth Rate^2	4.548*	2.051	1.254

Note: * P < 0.10, ** P < 0.05.

The last panel in Table 4 shows the regression coefficients for the model, containing both size and growth rate. The results for population size and growth rate are consistent across horizon lengths. The coefficients have the same signs, but their magnitudes vary less for population size than for population growth rate. The signs of the size coefficients are consistent with changes both in half-width and population size. They are also consistent with the parabolic relationship between growth rate and half-width. Half-width decreases as population losses moderate and increases as growth rates accelerate. Most coefficients are not statistically significant, partly due to the small sample size (39) and the number of variables in the regression equation. Four of the nine size and growth rate coefficients across all horizon years on the independent variables are significant at the 0.10 level. Three of the four significant coefficients are found in the population size variable.

DISCUSSION

The approach we propose can be linked directly not only to the CCM method but also to its algebraic equivalent, the CCR method. Unlike the approach found in *Swanson and Beck* (1994), neither the CCM nor the CCR approach is inherently conjoined with a method for generating statistical uncertainty. Thus, we believe this linkage represents a step forward on the path to generating probabilistic forecasts based on the fundamental population equation. In addition, this new approach is simpler than the methods described by *Cameron and Poot* (2011) and *Wilson* (2012) and far simpler than the Bayes CCM approach described by *Yu et al.* (2023). Moreover, it is neither opaque nor counter-intuitive, criticisms directed at Bayesian methods by *Goodwin* (2015). Notably, the ARIMA method is widely available in software packages used by state and local demographers and is more in line with their existing programming and other skills. They also have historical data that will support the construction of county ARIMA forecasts.

Analysis of the interval widths (as measured by the half-widths) is consistent with the expectation that probabilistic forecast intervals widen with increases in the forecast horizon. We found that the variability of the uncertainty across counties also increases as the forecast horizon increases. This represents a novel finding in that it does not appear in the literature. We examined the well-known non-linear relationships between population size and growth rate and forecast accuracy and bias using regression techniques with half-width as the dependent variable. Population size had a logarithmic relationship with half-width, and growth rate had a parabolic relationship (linear and squared terms). Interval width declined with increases in population size, but the interval width plateaued when counties reached a population of 36,000 or so. Interval widths were narrowest for slow-changing counties and increased as counties increased their rate of population decline or population increase. These findings are consistent with the relationships between population size and growth rate with forecast accuracy. What differs is that population size has a more substantial effect than population growth rate on interval width. The opposite occurs in the relationships with forecast accuracy. Keep in mind, however, these findings are based on a sample made up of the 39 counties in Washington state. They should be investigated in a larger sample of U.S. counties.

The strength of relationships between, on the one hand, population size and growth rate with, on the other, interval width was relatively weak and became weaker as the forecast horizon lengthened. Although not shown, the addition of a dummy variable representing counties with first and second-difference ARIMA models into the regression equations markedly raised the explained variance. Unlike the equations without the dummy variable, the explained variance increased as the forecast horizon lengthened. These results suggest that ARIMA model specification may be a more critical factor in explaining interval width than population size and growth rate. Future research should investigate and quantify the impact of these and other factors on interval widths from ARIMA models.

The approach we propose does not produce uncertainty intervals by age and gender, births, death, and migration, which are produced by the Bayes CCM approach described by *Yu et al.* (2023) and the CCR approach discussed by Swanson and Tayman (2014). Neither the Bayes CCM nor our approach, however, considers uncertainty in the input data themselves, a similarity also shared with the work by *Cameron and Poot* (2011), *Swanson and Tayman* (2014), and *Wilson* (2012). However, as *Yu et al.* (2023) implied, these are not likely to be among the most important sources of uncertainty for data in the United States and other countries where subnational population forecasts are routinely produced.

Regarding our approach not providing uncertainty intervals by age and gender, *Deming's* (1950: 127–134) "error propagation" was used to translate uncertainty in age group intervals found in the regression-based CCR forecasts reported by *Swanson and Tayman* (2014) to the total populations in question. In different forms, "error propagation" has been used by *Alho and Spencer* (2005), *Espenshade and Tayman* (1982), and *Hansen, Hurwitz, and Madow* (1953), among others. It may be possible to reverse-engineer error propagation and develop uncertainty measures by age and gender using our approach. It may be worthwhile to explore this possibility As an approximation, one could generate age uncertainty intervals by controlling the county "low" and "high" numbers in the 2017 GMA series to their corresponding 95%

lower and upper limits, respectively, of our proposed approach.

CONCLUSION

Smith, Tayman, and Swanson (2002: 373) opined that future research should focus increasingly on measuring uncertainty in population forecasts. Machine learning and AI may be significant in these endeavors (*Baker – Swanson – Tayman*, 2023). They noted that while such research may not directly improve forecast accuracy, it will enhance our understanding of the uncertainty inherent in population forecasts. They stated that this change would imply a shift from "population projections" to "population forecasts," a guideline we have followed in this paper.

In closing, we argue that the approach we propose and have described in this paper is well-suited for generating probabilistic subnational population forecasts in the United States and elsewhere where these forecasts are routinely produced. Because it can be applied to both the CCM and the CCR approaches, our method for producing forecast uncertainty information provides a path to a reasonable level of forecast accuracy as identified by *Swanson et al.* (2023). It also has the potential to optimize forecast utility, which as described in the **Introduction** is in accordance with the "triple constraint perspective" that underlies our approach. None of this is meant to imply that forecast uncertainty measures derived from ARIMA models using the Espenshade-Tayman method are more accurate than those generated from a Bayesian method. Rather, the findings herein suggest that our approach has a higher level of utility than a Bayesian approach while providing forecast intervals that are similar in width relative to both population size and forecast horizon length. As such, it offers a viable alternative to the Bayesian approach in that our results indicate that it produces similar measures of uncertainty, is simpler to implement, and, at this point in time, is likely to be more accessible to many of those who have been tasked to produce formal measures of uncertainty for their population forecasts.

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References

- Alho, J. – Spencer, B. 2005. *Statistical demography and forecasting.* Springer B.V. Press: Dordrecht, Heidelberg, London, and New York.
- Baker, J. – Swanson, D. A. – Tayman, J. 2023. Boosted regression trees for small-area population forecasting. *Population Research and Policy Review* 42, 51. https://doi.org/10.1007/s11113-023-09795-x.
- Baker, J. – Alcantara, A. – Ruan, X. 2011. A stochastic version of the Brass PF Ratio Adjustment of age-specific fertility schedules. *PLOS One* 6(8): 23222. https://doi.org/10.1371/journal.pone.0023222.
- Baker, J. – Swanson, D. A. – Tayman, J. – Tedrow, L. 2017. *Cohort change ratios and their applications.* Springer B.V. Press: Dordrecht, Heidelberg, London, and New York. https://doi.org/10.1007/978-3-319-53745-0.
- Box, G. – Jenkins, G. 1976. *Time series analysis – Forecasting and control.* Holden-Day: San Francisco, CA.
- Box, G. – Jenkins, G. – Reinsel, G. – Ljung, G. 2016. *Time series analysis forecasting and control, 5th edition.* Wiley: Hoboken, NJ.
- Brockwell, P. J. – Davis, R. A. 2016. *Introduction to time series and forecasting, 3rd edition.* Springer Texts in Statistics: Switzerland. https://doi.org/10.1007/978-3-319-29854-2.
- Burch, T. 2018. *Model-based demography: Essays on integrating data, technique, and theory.* Demographic Research Monographs. Springer B.V. Press: Dordrecht, Heidelberg, London, and New York.
- Cameron, M. – Poot, J. 2011. Lessons from stochastic small-area population projections: The case of Waikato subregions in New Zealand. *Journal of Population Research,* 28: 245–265. https://doi.org/10.1007/s12546-011-9056-3.
- Canudas-Romo, V. – Land, K. – Yang, Y. – Yi, Z. 2008. Mathematical Demography. pp. 164–209. In Z. Yi (ed.). *Demography: Encyclopedia of Life Support Systems.* UNESCO-EOLSS.
- Deming, W. E. 1950. *Some theory of sampling.* New York, NY: Dover Publications.
- Deming, W. E. – Stephan, F. 1941. On the interpretation of censuses as samples. *Journal of the American Statistical Association,* 36(213): 45–49. https://doi.org/10.1080/01621459.1941.10502070.
- Dickey, D. A. – Fuller, W. A. 1979. Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association,* 74(366): 427–431. https://doi.org/10.2307/2286348.
- Espenshade, T. – Tayman, J. 1982. Confidence intervals for postcensal population estimates. *Demography,* 19(2): 191–210. https://doi.org/10.2307/2061190.
- George, M. V. – Smith, S. – Swanson, D. A. – Tayman, J. 2004. Population Projections. pp. 561–601. In J. Siegel – Swanson, D. (eds.). *The Methods and Materials of Demography, Condensed Edition, Revised.* 2004. Academic/Elsevier Press. https://doi.org/10.1016/B978-012641955-9/50055-2.
- Gridin, I. 2022. *Time series forecasting using deep learning.* BPB Publications: India.
- Goodwin, P. 2015. When simple alternatives to Bayes formula work well: Reducing the cognitive load when updating probability forecasts. *Journal of Business Research,* 68: 1686–1691. https://doi.org/10.1016/j.jbusres.2015.03.027.
- Hansen, N. – Hurwitz, W. – Madow, W. 1953. *Sample survey methods and theory, Volume I, methods and applications.* John Wiley and Sons: New York, NY (re-published in 1993).
- Hartley, H., – Sielken, R. Jr. 1975. A "super-population viewpoint" for finite population sampling. *Biometrics,* 31(2): 411–422. https://doi.org/10.2307/2529429.
- Hyndman, R. J. – Athanasopoulos, G. 2021. *Forecasting: principles and practice, 3rd edition,* OTexts: Melbourne, Australia. (OTexts.com/fpp3). Accessed on 9/17/2024.
- Land, K. 1986. Methods for national population forecasts: A review. *Journal of the American Statistical Association,* 81 (December): 888–901. https://doi.org/10.1080/01621459.1986.10478347.
- Ljung, G. M. – Box, G. E. 1978. On a measure of lack of fit in time series models. *Biometrika,* 65(2): 297–303. https://doi.org/10.1093/biomet/65.2.297.
- Montgomery, D. – Kulahci, M. 2016. *Introduction to time series analysis and forecasting, 2nd edition.* Hoboken, NJ: Wiley.
- McNown, R. – Rogers, A. – Little, J. 1995. Simplicity and complexity in extrapolative population forecasting models. *Mathematical Population Studies,* 5: 235–257. https://doi.org/10.1080/08898489509525404.
- Pflaumer, P. 1992. Forecasting U.S. population totals with the Box-Jenkins approach. *International Journal of Forecasting,* 8: 329–338. https://doi.org/10.1016/0169-2070(92)90051-A.

- Poston, D. – Conde, E. – Field, L. 2024. *Applied regression models in the social sciences.* Cambridge University Press. Cambridge, UK. https://doi.org/10.1017/9781108923071.
- Roe, L. – Swanson, D. A. – Carlson, J. 1992. A variation of the housing unit method for estimating the population of small, rural areas: A case study of the local expert procedure. *Survey Methodology,* 18(1):155–163.
- Sampath, S. 2005. *Sampling theory and methods.* Alpha Science International Ltd. Harrow, England.
- Smith, S. – Tayman, J. – Swanson, D. A. 2001. *State and local population projections: Methodology and analysis.* Kluwer Academic /Plenum Press: New York. https://doi.org/10.1007/0-306-47372-0.
- Smith, S. – Tayman, J. – Swanson, D. A. 2013. *A practitioner's guide to state and local population projections.* Springer B.V. Press: Dordrecht, Heidelberg, London, and New York. https://doi.org/10.1007/978-94-007-7551-0_11.
- Stoto, M. 1983. The accuracy of population projections. *Journal of the American Statistical Association,* 78(381): 13–20. https://doi.org/10.1080/01621459.1983.10477916.
- Swanson, D. A. 2019. *Hopi tribal population forecast.* Report prepared for the Apache County Superior Court of the state of Arizona, in RE: The General Adjudication of all rights to use water in the Little Colorado River System and Source. CIVIL NO. 6417-203.
- Swanson, D. A. 1989. Confidence intervals for postcensal population estimates: A case study for local areas. *Survey Methodology,* 15(2): 271–280.
- Swanson, D. A. – Beck, D. 1994. A new short-term county level projection method. *Journal of Economic and Social Measurement,* 20: 25–50. https://doi.org/10.3233/JEM-1994-20102.
- Swanson, D. A. – Tayman, J. 2012. *Subnational population estimates.* Springer B.V. Press: Dordrecht, Heidelberg, London, and New York. https://doi.org/10.1007/978-90-481-8954-0.
- Swanson, D. A. – Tayman, J. 2014. Measuring uncertainty in population forecasts: A new approach. pp. 203–215 in Marco Marsili and Giorgia Capacci (eds.) *Proceedings of the 6th EUROSTAT/UNECE Work Session on Demographic Projections.* National Institute of Statistics, Rome, Italy.
- Swanson, D. A. – Burch, T. – Tedrow, L. 1996. What is applied demography? *Population Research and Policy Review,* 15 (December): 403–418. https://doi.org/10.1007/BF00125862.
- Swanson, D. A. – Bryan, T. – Hattendorf, M. – Comstock, K. – Starosta, L. – Schmidt, R. 2023. An example of combining expert judgment & small area projection methods: Forecasting for Water District needs. *Spatial Demography,* 11(8). https://doi.org/10.1007/s40980-023-00119-3.
- Tayman, J. – Swanson, D. A. 1996. On the utility of population forecasts. *Demography,* 33(4), 523–528. https://doi.org/10.2307/2061785.
- Tayman, J. – Smith, S. – Lin, J. 2007. Precision, bias, and uncertainty for state population forecasts: An exploratory analysis of time series models. Population Research and *Policy Review,* 26(3): 347–369. https://doi.org/10.1007/s11113-007-9034-9.
- Tayman, J. – Smith, S. – Rayer, S. 2011. Evaluating population forecast accuracy: A regression approach using county data. *Population Research and Policy Review,* 30(2): 235–262. https://doi.org/10.1007/s11113-010-9187-9.
- U.S. Census Bureau. 2023. State-produced population projections. https://www.census.gov/programs-surveys/popproj/about/related-sites.html.
- Washington 2020. 2019 *data book.* Forecasting and Research Division, Office of Financial Management, Washington state, Olympia, WA, https://ofm.wa.gov/sites/default/files/public/dataresearch/databook/pdf/databook.pdf.
- Washington 2022. Growth Management Act population projections for counties: 2020 to 2050 (last updated March 12, 2023): 2022 projections/population by age and sex, five-year age groups, medium series. Forecasting and Research Division, Office of Financial Management, Washington state, Olympia, WA. https://ofm.wa.gov/washington-data-research/population-demographics/population-forecasts-and-projections/growth-management-act-county-projections/growth-management-act-population-projections-counties-2020-2050.
- Washington 2024. Historical estimates of April 1 population and housing for the state, counties, and cities/intercensal estimate: 1960–2020. Forecasting and Research Division, Office of Financial Management, Washington state, Olympia, WA. https://ofm.wa.gov/washington-data-research/population-demographics/population-estimates/historical-estimates-april-1-population-and-housing-state-counties-and-cities.

- Wilson, T. 2012. Forecast accuracy and uncertainty of Australian Bureau of Statistics state and territory population projections. *International Journal of Population Research.* https://doi.org/10.1155/2012/419824.
- Wilson, T. 2005. Application of a probabilistic framework to New Zealand's official national population projections. *New Zealand Population Review,* 57(1): 51–76.
- Yu. C. – Ševčíková, H. – Raftery, A. – Curran, S. 2023. Probabilistic county-level population projections. *Demography,* 60(3): 915–937. https://doi.org/10.1215/00703370-10772782.
- Yusuf, F. – Martins, J. – Swanson, D. 2014. *Methods of Demographic Analysis.* Springer B.V. Press. https://doi.org/10.1007/978-94-007-6784-3.
- Zakria, M. – Muhammad, F. 2009. Forecasting the population of Pakistan using ARIMA models. *Pakistan Journal of Agricultural Sciences,* 46(3): 214–223.

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APPENDIX

Appendix A: The Cohort Component Method of Population Projection

As its name suggests, the Cohort Component Method (CCM) requires the application of the components of population change – fertility, mortality, and migration to the age-gender structure at the projection's launch year (*George et al.,* 2004; *Smith – Tayman, – Swanson,* 2013: 155–182; *Yusuf – Martins – Swanson,* 2014: 231–253). There are three *components of change* in a population: mortality, fertility, and migration. The overall growth or decline of a population is determined by the interplay among these three components. The exact nature of this interplay can be formalized in the *basic demographic equation:*

$$P_l - P_b = B - D + IM - \mathrm{OM} \qquad [1]$$

Where P_l is the population at the end of the time period; P_b is the population at the beginning of the time period; and *B, D, IM,* and *OM* are the number of births, deaths, in-migrants, and out-migrants during the time period, respectively. The difference between the number of births and the number of deaths is called *natural change (B – D);* it represents population growth coming from within the population itself. It may be either positive or negative, depending on whether births exceed deaths or deaths exceed births. The difference between the number of in-migrants and the number of out-migrants is called net *migration (IM – OM);* it represents population growth coming from the movement of people into and out of the area. It may be either positive or negative, depending on whether in-migrants exceed out-migrants or out-migrants exceed in-migrants.

The basic demographic equation can also be extended to apply to age groups, age-sex groups, and age-sex-race groups, as well as age-sex-ethnicity groups. This type of extension forms the logical basis of the and can be used to project a population into the future by age, age and sex, or by age, sex, and race. Once launched, these components (which are frequently modified as the projection moves into the future based on assumptions about their direction) are applied to the resulting age-gender structure at each cycle of the projection.

The Cohort Change Ratio Method of Population Projection

Unlike the CCM approach, its algebraic equivalent (*Baker et al.,* 2017: 251–252). The Cohort Change Ratio (CCR) method does not apply the separate components of population change to the age-sex structure at the launch year. Instead, it computes cohort change ratios (CCRs) using two counts of the age-structure in question, typically five or ten years apart, which directly capture mortality and migration. The fertility component uses a "child-adult ratio" from the most recent age structure data or a "child-woman ratio" for a projection by gender. It is well- suited for generating a projection of the population of the world, per the framework found in *Swanson et al.* (2023): (1) It corresponds to the dynamics by which a population moves forward in time; (2) there is information available relevant to these dynamics; (3) the time and resources needed to assemble relevant information and generate a projection is minimal; and (4) the information needed from the projection is generated by the CCR method.

The CCR method moves a population by age (and sex) from time t to time t+k using cohort-change ratios (CCRs) computed from data in the two most recent data points (e.g., censuses or estimates). It consists of two steps. The first uses existing data to develop CCRs, and the second applies the CCRs to the cohorts of the launch year population to move them into the future. The formula for the first step, the development of a CCR, is:

$${}_nCCR_{x,i} = {}_nP_{x,i,t\,/\,nPx-k,i,t-k}, \qquad [2]$$

where

${}_nP_{x,i,t}$ is the population aged x to $x+n$ in area i at the most recent census/estimate *(t)*,

${}_nP_{x-k,i,t-k}$ is the population aged $x-k$ to $x-k+n$ in area i at the 2nd most recent

census/estimate *(t–k)*,

k is the number of years between the most recent census/estimate at time t

for area i and the census/estimate preceding it for area i at time $t-k$.

The basic formula for the second step, moving the cohorts of a population into the future, is:

$${}_{n}P_{x+k,i,t+k} = ({}_{n}CCR_{x,i}) \times ({}_{n}P_{x,i,t}), \qquad [3]$$

where

${}_{n}P_{x+k,i,t+k}$ is the population aged $x+k$ to $x+k+n$ in area i at time $t+k$

Given the nature of the CCRs, they cannot be calculated for the youngest age group (e.g., ages 0–4 if it is a five-year projection cycle; 0–9 if it is a ten-year projection cycle), because this cohort came into existence after the census/estimate data collected at time $t-k$. To project the youngest age group, we use the "Child-Adult Ratio" (CAR), where the number in the youngest age group at time t is divided by the number of adults at time t who are of childbearing age (e.g., 15–44). It does not require any data beyond what is available in the census/estimate sets of successive data.

The CAR equation for projecting the population aged 0–4 is:

$$\text{Population 0–4: } {}_{5}P_{0,t+}k = ({}_{5}P_{0,t} / {}_{30}P_{15,}t) \times ({}_{30}P_{15,t+k}), \qquad [4]$$

where

P is the population,

t is the year of the most recent census, and

$t+k$ is the estimation year.

Projections of the oldest open-ended age group differ slightly from the CCR projections for the age groups beyond age 10 up to the oldest open-ended age group. If, for example, the final closed age group is 80–84, with 85+ as the terminal open-ended age group, then calculations for the CCRi,x+ require the summation of the three oldest age groups to get the population age 75+ at time $t-k$:

$${}_{\infty}CCR_{75,i,t} = {}_{\infty}P_{85,i,t} / {}_{\infty}P_{75,i,t-k} \qquad [5]$$

The formula for estimating the population of 85+ of area i for the year t+k is:

$${}_{\infty}P_{85,i,t+k} = ({}_{\infty}CCR_{75,i,t}) \times ({}_{\infty}P_{75,i,t}). \qquad [6]$$

Appendix B: Forecasts Used in the ARIMA Approach to Measuring Uncertainty

Three different forecasts are used in the ARIMA approach to measure forecast uncertainty in the county and Washington state forecasts. Table B1 provides the population density forecasts for 2030, 2040, and 2050 by county and Washington state generated by the ARIMA method described in the paper. This Table also provides the land area of each county and Washington state. Table B2 provides the medium series of 2022 GMA (CCM) forecasts by county in 2030, 2040, and 2050, as well as for Washington state. These are the point forecasts used in translating the density confidence intervals to population confidence intervals. Finally, Table B3 shows the translation result. It provides the medium series GMA (CCM) forecasts by county for 2030, 2040, and 2050, as well as for Washington state, along with their 95% confidence intervals.

Forecast intervals for the 2030 Adams County population illustrate the ARIMA-based approach to measuring uncertainty. The lower limit, point forecast, and upper limit for the population density from Table B1 are 10.9, 11.6, and 12.3. respectively. Based on these densities, the relative distance between the limits and point forecast is derived by:

Lower Limit Distance (10.9 – 11.6) / 11.6 = –0.060345 and

Upper Limit Distance (12.3 – 11. 6) / 11.6 = 0.060345.

The Adams County 2030 Growth Management population "point" forecast is 22,565, as shown in Table B2. The confidence intervals around the 2030 population point forecast shown in Table B3 are derived by:

Lower Limit Population 22,565 + (–0.060345 × 22,565) = 21,203 and

Lower Limit Population 22,565 + (0.060345 × 22,565) = 23,927.

Table B1 **ARIMA Population Density Forecasts, Washington State and Counties, 2030–2050**[a)]

		2030			2040			2050		
County	**Land Area**[b)]	**LL95%**	**Point**	**UL95%**	**LL95%**	**Point**	**UL95%**	**LL95%**	**Point**	**UL95%**
Adams	1,924	10.9	11.6	12.3	11.5	12.5	13.5	12.1	13.4	14.6
Asotin	636	35.2	37.8	40.4	37.0	40.6	44.3	39.0	43.5	48.0
Benton	1,703	121.6	139.7	157.8	124.5	154.9	185.3	130.2	169.7	209.2
Chelan	2,921	26.2	30.1	33.1	23.9	33.2	42.5	20.3	36.2	52.1
Clallam	1,745	45.1	48.9	52.7	48.1	53.7	59.3	51.6	58.5	65.4
Clark	628	868.3	988.9	1,109.4	876.3	1,157.4	1,438.5	833.0	1,363.4	1,893.8
Columbia	869	4.1	4.5	4.8	3.8	4.4	4.9	3.6	4.3	4.9
Cowlitz	1,139	99.1	105.3	111.6	103.6	112.8	122.0	108.8	120.2	131.6
Douglas	1,820	24.7	26.4	28.1	26.8	29.2	31.6	29.0	32.0	34.9
Ferry	2,210	2.7	3.4	4.1	2.6	3.7	4.8	2.6	4.0	5.4
Franklin	1,242	77.7	94.3	110.9	69.0	110.7	152.4	53.6	127.1	200.6
Garfield	710	2.2	3.0	3.9	1.7	2.9	4.1	1.2	2.7	4.1
Grant	2,676	36.5	41.8	47.0	35.1	46.5	57.8	32.4	51.2	70.0
Grays Harbor	1,917	38.5	41.2	43.8	39.2	42.9	46.6	40.1	44.6	49.1
Island	209	439.3	475.8	512.8	484.6	535.6	586.7	533.2	595.4	657.7
Jefferson	1,808	16.8	20.0	23.2	14.1	21.8	29.5	10.3	23.6	36.8
King	2,126	1,101.4	1,182.8	1,264.1	1,163.0	1,282.5	1,402.0	1,234.0	1,382.2	1,530.4
Kitsap	396	718.9	786.2	853.5	780.8	877.1	973.3	849.6	968.0	1,086.3
Kittitas	2,297	21.1	23.7	26.2	21.7	26.9	32.0	21.9	30.1	38.2
Klickitat	1,871	11.4	13.8	16.2	9.6	15.4	21.1	7.1	17.0	26.9
Lewis	2,408	35.2	37.2	39.2	37.3	40.1	43.0	39.6	43.1	46.6
Lincoln	2,313	4.1	4.9	5.7	3.2	5.1	7.1	2.0	5.2	8.7
Mason	961	70.5	77.2	83.9	76.4	86.8	97.2	83.2	96.4	109.6
Okanogan	5,273	6.8	8.2	9.5	5.1	8.3	11.6	2.9	8.5	14.2
Pacific	974	23.9	25.6	27.3	24.8	27.1	29.5	25.8	28.6	31.5
Pend Oreille	1,400	8.5	10.3	12.0	7.7	11.1	14.6	7.1	12.1	17.0
Pierce	1,675	579.3	610.9	642.4	626.5	671.0	715.5	676.7	731.2	785.6
San Juan	175	105.3	117.9	130.6	115.1	133.9	152.8	126.5	150.0	173.4
Skagit	1,735	75.4	83.9	92.5	77.0	92.9	108.8	79.8	101.7	123.7
Skamania	1,658	7.2	7.7	8.2	7.7	8.4	9.2	8.3	9.2	10.0
Snohomish	2,090	419.6	453.2	486.7	456.5	508.0	559.5	498.1	562.8	627.5
Spokane	1,764	311.5	335.6	359.8	323.7	360.8	397.9	339.1	385.7	432.7
Stevens	2,477	17.8	20.7	23.5	18.0	22.9	27.8	18.8	25.2	31.6
Thurston	727	439.8	465.4	490.9	485.9	523.4	560.9	535.0	581.4	627.9
Wahkiakum	264	15.3	17.2	19.1	15.0	17.7	20.4	14.9	18.2	21.4
Walla Walla	1,271	48.9	52.3	55.8	50.0	55.4	60.8	51.6	58.5	65.3
Whatcom	2,120	112.0	120.4	128.7	120.7	133.6	146.5	130.6	146.9	163.2
Whitman	2,159	21.0	23.9	26.7	18.9	25.5	32.0	16.0	27.1	38.2
Yakima	4,296	59.2	63.9	68.7	59.2	68.6	78.0	60.0	73.5	87.1
Washington	**66,589**	**122.6**	**129.8**	**137.0**	**131.3**	**142.4**	**153.4**	**141.0**	**154.9**	**168.7**

Note: a) Population per square mile.
Source: b) Land area in square miles (Washington, 2020); Also see discussion in text.

Table B2 **2022 GMA Medium Forecasts, Washington State and Counties, 2030–2050**

County	2030	2040	2050
Adams	22,565	24,387	26,100
Asotin	23,214	23,815	24,111
Benton	235,177	262,587	288,887
Chelan	85,889	91,914	97,195
Clallam	81,791	85,374	87,800
Clark	583,307	660,653	735,724
Columbia	3,806	3,625	3,366
Cowlitz	118,309	125,320	130,993
Douglas	47,750	52,256	56,461
Ferry	7,239	7,169	6,986
Franklin	114,907	132,930	150,970
Garfield	2,247	2,172	2,061
Grant	111,367	123,116	134,321
Grays Harbor	77,203	77,614	76,892
Island	93,670	99,870	105,250
Jefferson	36,226	39,170	41,719
King	2,487,380	2,690,851	2,879,176
Kitsap	297,608	317,694	335,268
Kittitas	52,091	57,521	62,643
Klickitat	24,511	26,059	27,376
Lewis	87,746	92,313	95,871
Lincoln	11,270	11,459	11,496
Mason	72,981	79,792	85,947
Okanogan	43,676	44,660	45,101
Pacific	24,475	25,033	25,183
Pend Oreille	14,442	15,311	16,009
Pierce	1,015,395	1,104,062	1,186,146
San Juan	19,986	22,046	23,957
Skagit	142,805	155,142	166,281
Skamania	12,529	13,322	14,006
Snohomish	935,370	1,039,254	1,138,649
Spokane	587,377	630,994	669,671
Stevens	50,215	53,502	56,278
Thurston	333,783	371,542	407,392
Wahkiakum	4,713	4,925	5,070
Walla Walla	64,977	66,695	67,645
Whatcom	254,158	280,275	304,836
Whitman	49,489	50,698	51,459
Yakima	271,120	283,351	293,279
Washington	8,502,764	9,248,473	9,937,575

Source: Washington, 2022

Table B3 **ARIMA 95% Intervals Applied to the GMA Medium Forecasts, Washington State and Counties, 2030–2050**

	2030			2040			2050		
County	**LL95%**	**Point**	**UL95%**	**LL95%**	**Point**	**UL95%**	**LL95%**	**Point**	**UL95%**
Adams	21,203	22,565	23,927	22,436	24,387	26,338	23,568	26,100	28,437
Asotin	21,617	23,214	24,811	21,703	23,815	25,985	21,617	24,111	26,605
Benton	204,707	235,177	265,647	211,053	262,587	314,121	221,645	288,887	356,129
Chelan	74,761	85,889	94,449	66,167	91,914	117,661	54,504	97,195	139,886
Clallam	75,435	81,791	88,147	76,471	85,374	94,277	77,444	87,800	98,156
Clark	512,171	583,307	654,384	500,199	660,653	821,107	449,507	735,724	1,021,941
Columbia	3,468	3,806	4,060	3,131	3,625	4,037	2,818	3,366	3,836
Cowlitz	111,343	118,309	125,387	115,099	125,320	135,541	118,569	130,993	143,417
Douglas	44,675	47,750	50,825	47,961	52,256	56,551	51,168	56,461	61,578
Ferry	5,749	7,239	8,729	5,038	7,169	9,300	4,541	6,986	9,431
Franklin	94,679	114,907	135,135	82,856	132,930	183,004	63,666	150,970	238,274
Garfield	1,648	2,247	2,921	1,273	2,172	3,071	916	2,061	3,130
Grant	97,246	111,367	125,221	92,933	123,116	153,035	85,000	134,321	183,642
Grays Harbor	72,144	77,203	82,075	70,920	77,614	84,308	69,134	76,892	84,650
Island	86,484	93,670	100,954	90,360	99,870	109,398	94,255	105,250	116,263
Jefferson	30,430	36,226	42,022	25,335	39,170	53,005	18,208	41,719	65,053
King	2,316,199	2,487,380	2,658,351	2,440,125	2,690,851	2,941,577	2,570,470	2,879,176	3,187,882
Kitsap	272,132	297,608	323,084	282,813	317,694	352,539	294,260	335,268	376,241
Kittitas	46,376	52,091	57,586	46,402	57,521	68,426	45,577	62,643	79,500
Klickitat	20,248	24,511	28,774	16,245	26,059	35,704	11,434	27,376	43,318
Lewis	83,028	87,746	92,464	85,867	92,313	98,989	88,086	95,871	103,656
Lincoln	9,430	11,270	13,110	7,190	11,459	15,953	4,422	11,496	19,234
Mason	66,647	72,981	79,315	70,232	79,792	89,352	74,178	85,947	97,716
Okanogan	36,219	43,676	50,600	27,442	44,660	62,416	15,387	45,101	75,345
Pacific	22,850	24,475	26,100	22,908	25,033	27,250	22,718	25,183	27,737
Pend Oreille	11,918	14,442	16,826	10,621	15,311	20,139	9,394	16,009	22,492
Pierce	962,872	1,015,395	1,067,752	1,030,842	1,104,062	1,177,282	1,097,737	1,186,146	1,274,393
San Juan	17,850	19,986	22,139	18,951	22,046	25,158	20,204	23,957	27,694
Skagit	128,337	142,805	157,443	128,589	155,142	181,695	130,474	166,281	202,251
Skamania	11,715	12,529	13,343	12,212	13,322	14,591	12,636	14,006	15,224
Snohomish	866,022	935,370	1,004,511	933,897	1,039,254	1,144,611	1,007,749	1,138,649	1,269,549
Spokane	545,196	587,377	629,733	566,111	630,994	695,877	588,762	669,671	751,275
Stevens	43,180	50,215	57,007	42,054	53,502	64,950	41,985	56,278	70,571
Thurston	315,423	333,783	352,071	344,922	371,542	398,162	374,879	407,392	439,975
Wahkiakum	4,192	4,713	5,234	4,174	4,925	5,676	4,151	5,070	5,961
Walla Walla	60,753	64,977	69,325	60,194	66,695	73,196	59,666	67,645	75,508
Whatcom	236,426	254,158	271,679	253,213	280,275	307,337	271,011	304,836	338,661
Whitman	43,484	49,489	55,287	37,576	50,698	63,621	30,382	51,459	72,536
Yakima	251,178	271,120	291,486	244,524	283,351	322,178	239,411	293,279	347,546
Washington	**8,031,116**	**8,502,764**	**8,974,412**	**8,527,560**	**9,248,473**	**9,962,892**	**9,045,824**	**9,937,575**	**10,822,911**

Sources: Data from Tables B1 and B2, calculations of intervals by authors.

The 2025 (eng)aging! Conference & Technology Fair

The eighth edition of the (eng)aging![1] international conference on population ageing associated with a technology fair, took place in Prague and was streamed online on 5–6 June 2025. The event was attended by 105 participants from 18 countries, bringing together policymakers, researchers, practitioners, civil society leaders, and technology innovators. The conference was held under the auspices of Marian Jurečka, Minister of Labour and Social Affairs of the Czech Republic, and Alexandra Udženija, Councillor of the City of Prague, and was co-organised by the Active Aging Centre and the KEYNOTE company.

The 2025 edition of the conference explored the central theme of *Intergenerational Cohesion* and featured four keynote lectures by leading international experts. Kai Leichsenring (European Centre for Social Welfare Policy and Research, Vienna) opened with *"Aspects of Intergenerational Cohesion in the Context of Longevity – Towards a Caring Society?"*, urging a shift from crisis narratives to constructive agendas centred on fairness and solidarity. "We must move away from crisis narratives and towards a constructive agenda centred on intergenerational fairness and a caring society," he stated. Ruth Šormová (ŽIVOT 90, CZ) delivered *"Old Age Belongs with Us: Dignity, Autonomy, Fellowship, Support"*, highlighting that ageing should be seen as central to community life rather than marginal. "Old age belongs at the centre of our communities, not at their margins," she emphasised, outlining four pillars for dignified ageing. Lisa Warth (United Nations Economic Commission for Europe, Geneva) in her keynote *"Harnessing Intergenerational Solidarity: Regional Perspectives on Ageing Policy"* underlined that solidarity must underpin ageing policy. "Intergenerational solidarity is a cornerstone of ageing policy—demographic change requires cooperation between generations, not competition," she noted, while presenting best practices across the region. Kristina Barczik (University of Applied Sciences – CBS with EUFH, Gemeinsam Digital e.V.) concluded with *"The Door to the Digital World is Open – A Look at Future Technologies for Successful Ageing and the Importance of Entering the Digital World Together"*. She highlighted that digital participation is now a prerequisite for equitable ageing: "The door to the digital world is open, but many older adults cannot step through it unaided."

Thematic sessions covered a wide spectrum of topics, from family dynamics and dependency to caregiving, loneliness, and social integration. Merril Silverstein, Betti Bayer, Mareike Bünning, and Mariana Buciuceanu-Vrabie discussed intergenerational support within families and the role of public services in sustaining care. Tornike Gavasheli, Marcela Petrová Kafková, Lisa Joanne Klasen, and Martin Lakomý examined caregiving practices, online and offline social relations, and the impact of crises such as COVID-19 on loneliness and social integration. Sessions under the title *Redefining Old Age* focused on identity, transitions, discrimination, and social bonds. Leyla Mavi, Mirko Sporket, and Alexandra Husivargová Theofanidis addressed identity and transitions into retirement and health. Lucie Vidovićová, Frederike Gerdes, Marlen Drewitz, and Laura Romeu Gordo explored ageism, loneliness, and the socio-economic implications of late-career caregiving. Finally, three sessions on *Intergenerational Solidarity and Economic Resilience in an Aging Society* gathered contributions from Oleksandr Poliakov, Dmytro Shushpanov, Elena Șoldan, Iryna Kurylo, Joseb Archvadze, Oliver

1) The long-term *(eng)aging!* project focuses on fostering a society-wide debate about accelerating demographic change and population ageing. The project aims to stimulate a constructive discussion about these trends and to look for ways to make use of them for the benefit of society.

Platt, Olga Gagauz, Artiom Samohvalov, and Izabela Warwas, discussing health, skills, wartime resilience, pension systems, and intergenerational fairness in the context of demographic change.

The associated Technology Fair highlighted how gaming, virtual reality, and communication technologies can enhance quality of life, independence, and social connectedness in later life, while also serving as practical tools for caregivers and health professionals. Among the presenters were Jaroslav Cibulka (Czech Technical University), Markéta Zakurdajeva and Natálie Nevřelová (National Institute of Mental Health, CZ), Ármin Kondor (University of Pannonia, HU), Peter Grajcar (SK), and Vasillii Moigne (CZ). The Fair was opened by Kristina Barczik's keynote and moderated by Professor Olga Štěpánková (Czech Technical University). Like the main programme, it was streamed online, allowing broad international participation.

The event was co-organised by the Active Ageing Centre and the KEYNOTE company.

The partners of the conference were the International Visegrad Fund, Czech-German Future Fund, Liaison Office of the Free State of Saxony and Česká spořitelna.

Detailed outputs from the Conference & Technology Fair, including a report, photo and video gallery, and presentation materials, are available at www.engagingprague.com.

SAVE THE DATE – The 9th edition of the (eng)aging! Conference & Technology Fair will take place in Prague in May 14–15, 2026, and will again be streamed online.

Martin Špáta

Pozvánka na konferenci RELIK 2025

Katedra demografie Fakulty informatiky a statistiky Vysoké školy ekonomické v Praze srdečně zve odbornou i širší veřejnost na **17. ročník mezinárodní vědecké konference *Reprodukce lidského kapitálu – vzájemné vazby a souvislosti (RELIK 2025)***, která se uskuteční ve dnech **13.–14. listopadu 2025** v prostorách VŠE v Praze.

Konference RELIK je již řadu let tradiční a oblíbenou událostí, která spojuje akademické pracovníky, studenty, představitele veřejných institucí i neziskových organizací a také zájemce z komerční sféry. Atmosféra setkání bývá přátelská a otevřená diskusi, což umožňuje navazování nových spoluprací i sdílení inspirativních zkušeností.

Jednacími jazyky konference budou čeština, slovenština a angličtina. Součástí programu je i speciální sekce „Mladí vědci“, která dává prostor studentům, doktorandům a začínajícím badatelům pro prezentaci jejich výzkumu.

Účast na konferenci je bezplatná. Přijaté příspěvky budou publikovány v recenzovaném sborníku s ISBN, jenž bude zaslán k indexaci do databáze Web of Science.

Organizátoři se těší na všechny účastníky a zvou k aktivnímu zapojení do tohoto tradičního setkání, které každoročně potvrzuje, že spojení odbornosti a přátelské atmosféry je tou nejlepší cestou k inspirativní výměně názorů i k rozvoji demografického výzkumu.

Více informací včetně důležitých termínů naleznete na webových stránkách konference relik.vse.cz.

Jana Vrabcová

THE DEMOGRAPHIC DIVIDEND AND DEMOGRAPHIC WINDOW OF OPPORTUNITY: A CROSS-NATIONAL COMPARATIVE ANALYSIS

Elena Şoldan[1)]

Abstract
This study presents an empirical analysis of the demographic dividend (DD) and the demographic window of opportunity (DWO), examining their distinct roles in analysing the economic implications of age-specific population dynamics. The study proposes a mixed-methods approach that combines National Transfer Accounts (NTA) with a demographic assessment of the beneficial period – the DWO. Through an empirical analysis, the study illustrates the distinctions between the demographic dividend (DD) and the demographic window of opportunity (DWO). Drawing on evidence from eight selected countries, the study reveals time lags between the opening of the DWO and the emergence of the DD, as well as cross-country variations in the magnitude of both the DWO and the DD. The proposed analytical framework offers a replicable model for evaluating population dynamics within the context of the demographic dividend.

Keywords: demographic window of opportunity, demographic dividend, NTA, age structure, support ratio
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INTRODUCTION

The analysis of population age structure and its macroeconomic implications has become a central theme in demographic and developmental research, particularly in light of ongoing demographic global shifts. This interest has been reinforced by the emergence of the concept of the demographic dividend (DD). When a nation reaches a specific age structure in which the working-age population predominates over other age groups, economic growth can be accelerated – an effect called the demographic dividend. The complexity of the impact of demographic change on economic outcomes, however, framed in the demographic dividend concept, requires careful consideration.

Within the framework of the demographic transition, the point at which the working-age population prevails is referred to as the demographic window of opportunity (DWO). Despite the wide use of the demographic dividend concept in development discourse, however, the period in which the age structure becomes favourable – the demographic window of opportunity (DWO) – remains underutilised. The

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DWO is frequently treated as synonymous or interchangeable with the DD, leading to analytical simplifications and policy ambiguities. As a result, existing frameworks often fail to capture the timing, interaction, and variability of both the DWO and the DD phenomena across diverse national contexts.

This study builds upon previous conceptual work (*Şoldan,* 2023a) that distinguishes the DWO and DD as interconnected yet distinct phenomena. Exploring this matter further, the present article develops and applies a revised analytical framework that combines the demographic approach and the National Transfer Accounts (NTA) methodology to assess both the DD and DWO. Using comparative evidence from eight countries – Singapore, South Korea, Brazil, Mexico, Ireland, Slovakia, Moldova, and Georgia – the study investigates the timing, magnitude, and the overlap of the DWO and the DD. The findings contribute to the literature by clarifying conceptual boundaries of DD and the DWO and providing a replicable tool of analysis across diverse national contexts.

A DISCUSSION OF THE LITERATURE

The emergence of the demographic dividend concept has changed the way economic development and the population are viewed and has become the dominant paradigm in the population and development debate (*Pace – Ham-Chande eds.,* 2016). Moreover, the concept of the demographic dividend has become increasingly prominent in public discussions of international development as a particular way of looking at the effects of current demographic changes on economic development (*Lutz et al.,* 2019).

The idea of the demographic dividend emerged in the late 1990s, when *Bloom and Williamson* (1998) explained the economic miracle of East Asia, attributing about one-third of its accelerated economic growth to the demographic factor. The explanation of demographic dynamics provided by the demographic transition and its potential effect has given rise to a large body of literature analysing the phenomenon of the demographic dividend from different perspectives, including the various variables and factors by which a favourable age structure can accelerate economic development (*Pace – Ham-Chande eds.,* 2016). Reviewing the demographic dividend a decade later, *Williamson* (2013) discussed a wider range of aspects of the demographic dividend, including emigration, the brain drain, poverty, and inequality, drawing attention to its complexity. *Kelley and Schmidt* (2005), for example, advanced the demographic dividend debate by decomposing the model into the labour participation rate effect and the productivity effect. While the participation rate effect captures income gains from increased labour force participation at a constant productivity level, the productivity effect reflects broader influences such as economies of scale, population density, life-cycle savings and investment responses, and human capital (ibid.).

The National Transfer Account (NTA) framework is used to analyse the demographic dividend due to its ability to capture variations in labour force participation and wealth accumulation, while distinguishing between the first and second demographic dividends. The increase in the working-age population determines the labour participation effect, referred to as the first demographic dividend (DD1), while the productivity effect of the demographic dividend, i.e. the growth in output per worker, represents the second demographic dividend (DD2) (*Dramani – Oga,* 2017; *Mason et al.,* 2017; *Prskawetz – Sambt,* 2014). This second demographic dividend is typically identified after the first demographic dividend (*Lee – Mason,* 2006), although they may overlap (ibid.).

Since its inception, the concept of the demographic window of opportunity has been closely linked to that of demographic dividend. Growing interest in age-related population change and its positive economic implications led the United Nations to formalise the window of opportunity in 2004. It is defined as the period during which the proportion of children and young people under 15 falls below 30 per cent, and the proportion of people aged 65 and over is still below 15 per cent (*United Nations,* 2004). For several decades (usually 30–40 years), the proportion of the population of working age is particularly pronounced, usually between 40 and 60 per cent. According to this method, most European countries entered the demographic window before 1950 and are now exiting it, while many African countries will not enter the demographic window until 2045 or even later (ibid.). *Vallin* (2005) also used population projections to analyse the phenomenon of the demographic window, while

M. Carella and A. Parant (2016) assessed the DWO in Mediterranean countries using different methods. Despite these analyses, the focus on the DWO as a demographically specific period remains relatively uncommon, especially when compared to the extensive literature on DD.

A key issue in the literature is the tendency to treat the DD and the DWO as interchangeable concepts, which has led to conceptual and analytical inconsistencies. In this regard, a meta-analysis of the DWO and DD definitions and interpretations has been undertaken more recently (*Şoldan,* 2023a). Moreover, the question of the difference between the demographic dividend and the demographic window of opportunity is not just one of conceptual confusion, as it also has implications for the need to revise the frameworks for the analysis of the DWO and the DD. This is because the method selected for analysing the demographic dividend can influence its interpretation and, consequently, the policies formulated to achieve the demographic dividend (*Williamson,* 2013).

A review work on the demographic dividend, which includes methods for its assessment, has been published by *Oosthuizen and Magero* (2021) and by *James* (2018). While describing the primary methodologies for assessing the demographic dividend, *Oosthuizen and Magero* ask to what extent a specific methodological framework, given country-specific issues, can provide proper guidance for policy formulation for achieving the demographic dividend. In his review, James concluded that while every method has its strengths and weaknesses, there are two important aspects of the demographic dividend that attention should also be paid to: first, the aspect of timing, that is, when the specific age-structure occurs, and second, assessing the causality between age-structure changes and economic impact. Against this background, and based on earlier reviews of the DD and the DWO, the study proposes the following revised definitions:

- ➢ The **demographic window of opportunity (DWO)** represents a specific period when the dynamics of the working-age population predominate over the dependent age groups (children and the elderly), creating favourable demographic conditions for economic development.
- ➢ The **demographic dividend (DD)** is the accelerated economic development resulting from a specific population age structure, realised under supportive institutional conditions.

This study empirically explores the distinctions between the demographic window of opportunity and the demographic dividend by applying a revised methodological framework within a comparative analysis.

THE AIM OF THE STUDY AND THE RESEARCH QUESTIONS

This article aims to present a revised methodological framework for the demographic dividend and the window of opportunity, employing both the NTA and demographic approaches to observe the distinctions between the two phenomena.

To address this aim, the following key questions are examined:

1. How has the DWO manifested itself in selected countries?
2. What are the differences in the dynamics of the demographic and economic support ratio indicators?
3. What are the dynamics of the DWO as opposed to the first, second, and combined demographic dividends in selected countries?

METHODS AND DATA

Methods

This article presents a revised methodological framework for the analysis of the DD and the DWO. It incorporates, in addition to the NTA approach[2)] for estimating the DD, the demographic assessment of the beneficial period of the DWO. The presented framework aims to compare the DD and the DWO based on empirical data from selected countries.

2) The demographic dividend, i.e. the economic gain resulting from demographic changes, can be assessed through various approaches, and the NTA represents one such method (see *Oosthuizen and Magero,* 2021; *James,* 2018).

Assessing the demographic dividend (DD) – the NTA approach

Accounting for the DD requires assessing the interlinkage between age-structure dynamics and economic characteristics. The NTA methodology presents the mainstreaming framework for assessing the DD, and the economic support ratio (ESR) represents the main proxy.[3)] This composite indicator captures the characteristics of the population's age-specific production and consumption patterns (*Abio et al.*, 2023). The economic support ratio is defined as the ratio of the effective number of producers *(L)* to the effective number of consumers *(N)*:

$$ESR(t) = \frac{L(t)}{N(t)} = \frac{\sum_x y(x) \text{ x } P(x,t)}{\sum_x c(x) \text{ x } P(x,t)}$$

where *y (x)* is the age-specific weight of production; *c (x)* is the age-specific weight of consumption; and *P(x, t)* is the population of age x in year t. The economic support ratio is then used to assess the demographic dividend (*Mason et al.,* 2017).

To estimate the DD, the NTA approach utilises the decompositional model (*James,* 2018). Per capita income is written as:

$$\frac{Y(t)}{N(t)} = \frac{L(t)}{N(t)} \times \frac{Y(t)}{L(t)}$$

where per capita income Y/N is determined by workforce participation (L/N) and productivity (Y/L); Y, L, and N stand for income, workers, and total population, respectively. Further, the income per effective consumer, y(t) = Y(t)/N(t), can be written as a function of two multiplicative factors:

$$y(t) = ESR(t) \text{ x } y_l(t)$$

where *ESR(t) = L(t)/N(t)* is the ratio of the number of effective workers to the number of effective consumers, and $y_l(t) = Y(t)/L(t)$ is the average income per worker (*Dramani – Oga,* 2017). Assuming gr is the growth rate, the logarithmic transformation of these identities can be expressed as follows:

$$gr[y(t)] = gr[ESR(t)] + gr[y_l(t)]$$

The growth rate in income per effective consumer *gr [y(t)]* is the sum of the rate of growth of the economic support ratio *gr [ESR(t)]* and the rate of growth in income per worker $gr\ [y_l(t)$. Assuming a constant income per worker, the growth of the economic support ratio equals the growth rate of effective labour less the growth rate of the number of effective consumers:

$$gr[ESR(t)] = gr[L(t)] - gr[N(t)]$$

Accordingly, the demographic dividend occurs when the effective number of producers is growing more rapidly than the effective number of consumers, and the growth rate of the economic support ratio is positive (ibid.).

This methodological description refers to the calculation of the labour supply effect and defines what is referred to as the ***first demographic dividend (DD1)***. The full extent of the DD in this methodological framework, outside of the compositional effects of increasing the productive population over the total population, is completed with the productivity effect (*Mason et al.,* 2017). In the NTA approach, the productivity effect is called the second demographic dividend (DD2) and is assessed through lifetime savings and wealth effects. The methodology of the first demographic dividend outlined above and of the second demographic dividend in the NTA approach is described in detail in *Mason et al.* (2017). The second dividend is the expected capital accumulation due to the increase in life expectancy, the size of which will depend on the accumulation of savings and the shift in the age profile of wealth (*Mason,* 2005, cited in *James,* 2018). The NTA flows allow the second demographic dividend to be estimated on the basis of some assumptions about macroeconomic variables (*Oosthuizen – Magero,* 2021).

Assessing the demographic window of opportunity (DWO)

The demographic window of opportunity (DWO) is a purely demographic phenomenon, defined by

3) The primary aim of the NTA methodology is not to measure demographic dividends directly, but to map the flows of economic resources across age groups. However, its structure—disaggregating economic flows by age—allows for the estimation of both first and second demographic dividends.

the configuration of a population's age structure and particularly by the balance between the working-age population and dependent age groups. The standard threshold for the working-age population is typically set at ages 15–64, according to the United Nations (2004), though alternative definitions may also be used. While various methods exist for assessing the DWO, this study adopts a growth rate approach, in line with the NTA approach, and proposes two complementary methods to assess the DWO.

The first method is the comparative growth rate method, where the DWO is the period during which the growth rate of the working-age population (15–64 years) exceeds the combined growth rates of the dependent age groups (0–14 and 65+ years)[4]. This method is expressed as:

DWO phase = *gr* [(15 – 64 years)% > *gr* (0 – 14 years) + *gr* (65 + years)]%

It captures the dynamic demographic advantage as it emerges and intensifies, reflecting shifts in population shares by age groups but also in the dynamics of age-structure change.

The second approach is the support ratio growth method, which focuses on the dynamics of the support ratio (SR).

Proxies to assess the demographic window of opportunity are demographic indicators such as the support ratio and the dependency ratios (*James,* 2018; *Oosthuizen – Magero,* 2021). These metrics are used to assess the predominance of the working-age population within a society. A higher ratio implies a lower dependency burden and potentially more economic output per capita.

The NTA framework uses the Economic Support Ratio (ESR) as its core indicator for assessing the demographic dividend as described above. It shows the ratio between effective producers and consumers based on age-specific profiles of production and consumption. To reflect purely the demographic structure and isolate the age composition effect, this study introduces the Support Ratio (SR), which is calculated as:

$$SR(t) = \frac{P(15-64)(t)}{P(\text{total})(t)}$$

An increase in the support ratio will indicate the positive event of the opening and occurrence of the period of the demographic window of opportunity. Despite relying on distinct metrics – the first focusing on population share-specific growth dynamics and the second on the support ratio – their empirical application suggests that the periods identified by both methods coincide (*Şoldan,* 2024). Such convergence of the two methods might not typically be observed in analyses of the demographic window of opportunity, where methodological differences often result in divergent timelines for the DWO. This observation adds to the relevance of dynamic approaches for identifying the DWO and suggests the potential value of a temporally sensitive analytical framework.

Furthermore, the trends of the first and second demographic dividends, as accounted for using the NTA methodology, are compared with those of the demographic window of opportunity (DWO), which is assessed based on the growth rate of the support ratio (SR). The inclusion of the latter enables the integration of DWO trends into the analysis of the first and second demographic dividends, resulting in a unified analytical framework that encompasses both DWO and DD.

Data

This analysis draws on the World Population Prospects (2022) and the National Transfer Accounts (NTA) data series (2022) to examine age-structure dynamics – specifically the demographic window of opportunity (DWO) and its potential economic effect – the demographic dividend (DD).[5] While the NTA data

4) The method stems from the initial findings on the economic implications of age-related population dynamics (*Bloom and Williamson,* 1998), as well as from the review by *James* (2018).

5) A more precise assessment of demographic dividends would ideally rely on national-level projections and national NTA estimates. However, the objective of this article is to propose a replicable comparative framework, and such consistency across countries requires harmonised and internationally available data – for which national-level NTA projections are often not available or remain incomplete for many countries.

are employed to assess the DD, the World Population Prospects are used to identify and analyse the DWO. The two datasets are compatible for the analysis, as the latest NTA series has been aligned with the 2022 revision of the World Population Prospects (www.ntaccounts.org).

Country selection

The study includes eight countries, which were selected to reflect diverse regional experiences and trajectories of the demographic transition and realisation of the demographic dividend. The sample comprises two countries from each of four distinct regions: East Asia (Singapore and South Korea), Latin America (Brazil and Mexico), Western and Central Europe (Ireland and Slovakia), and post-Soviet Eastern Europe (Moldova and Georgia).

The selection of the countries was based on their comparability in terms of the onset of their demographic transition, which occurred after 1950. This criterion ensured that the analytical basis for examining the dynamics of the demographic window of opportunity (DWO) and the demographic dividend (DD) was within a relatively comparable economic context. The comparative analysis covers the period 1950–2050, which allows for cross-national comparisons at different stages of the demographic transition and makes it possible to trace the evolution of both the DD1 and the DD2 in relation to the DWO, both before and after the demographic transition. Moreover, the diversity of countries allows for the representation of varying outcomes in terms of the realisation of the demographic dividend, as shown in prior studies:

- **Singapore and South Korea** illustrate successful experiences of significant economic boosts during their demographic transition, like other East Asian tigers, representing a hallmark example of DD achievement (*Bloom et al.,* 2003; *Bloom – Williamson,* 1998).
- **Brazil and Mexico** offer contrasting examples in which, despite the demographic transition occurring in the same period, the beneficial period remained underutilised (*Bloom et al.,* 2003).
- **Ireland and Slovakia** provide a European comparative base – with Ireland representing a case of the efficient harnessing of the DWO (the 'Celtic Tiger') (ibid.), and Slovakia presenting more moderate results (*Şoldan,* 2023b).
- **Moldova and Georgia** both represent post-Soviet contexts and exemplify specific demographic dynamics shaped by their respective political and economic transitions, offering distinct comparative insights.

The cross-country selection enables an empirical comparison across regional, institutional, and demographic dimensions, demonstrating the application of a replicable methodology that supports the integration of the DWO into DD estimation, in alignment with the NTA approach.

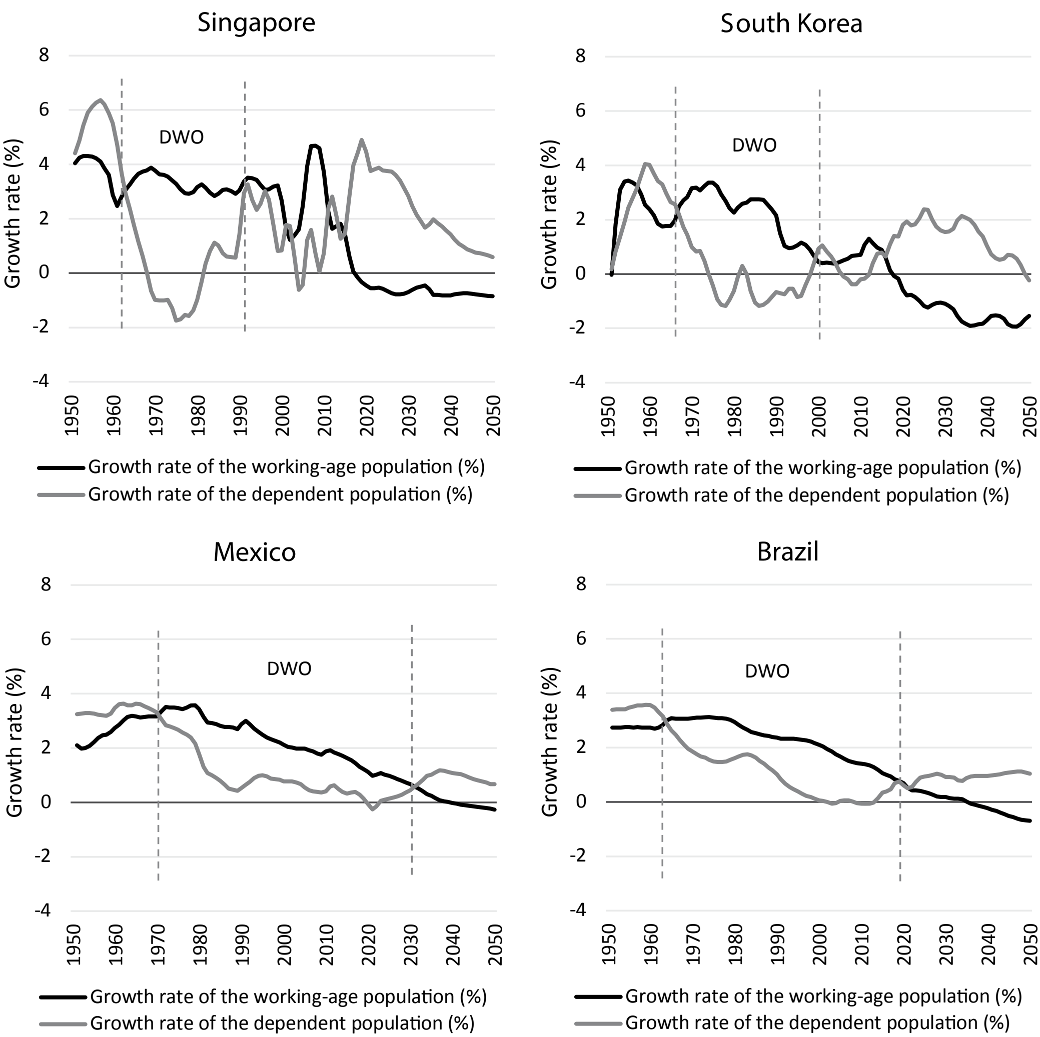
RESULTS

The demographic window of opportunity in selected countries

Age-specific population dynamics during the demographic transition shape the configuration of the demographic window of opportunity (DWO). Specifically, changes in the proportion of working-age and dependent populations over time serve as proxies for identifying the DWO. The DWO is identified as the period during which the growth rate of the working-age population exceeds that of the dependent population (see Figures 1 and 2). This period also corresponds to a positive growth rate of the support ratio (SR) (see below). However, this method also offers additional insights by allowing the separate dynamics of the working-age and dependent populations to be examined.

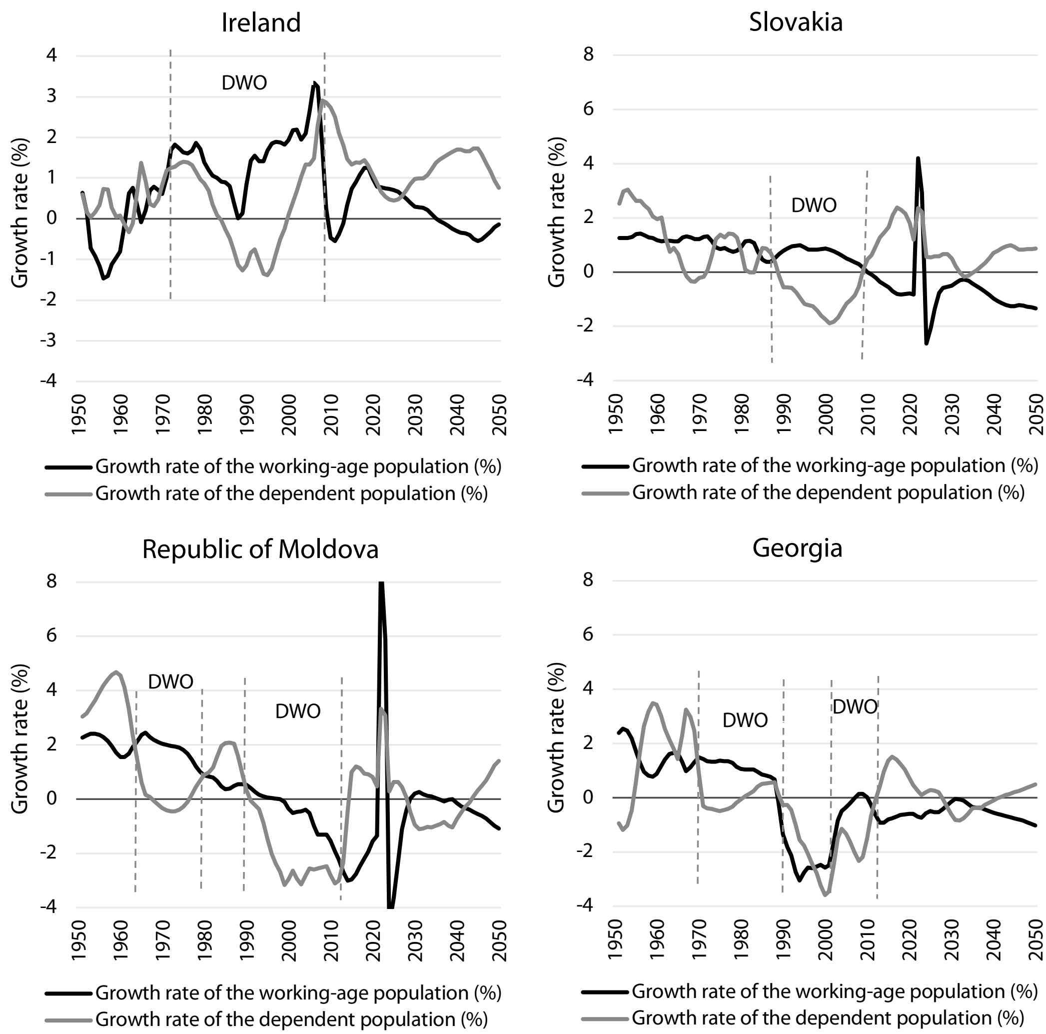
Figures 1 and 2 present the demographic window of opportunity for the selected countries. What is observed here is that while in the two Latin American countries, Brazil and Mexico, the magnitude of the DWO is indeed smaller than in the two Asian countries, the dynamics of the dependent population also vary significantly. While the size of the working-age population remains large, in Singapore and South Korea, the growth rate of the dependent population during the period of the DWO actually decreased, registering negative values. By contrast, in Mexico and Brazil, the pace of the decrease in the dependent population was small, leading to a less pronounced DWO. Likewise, in Singapore, South Korea, Ireland, and Slovakia, the dynamics of the dependent population growth rate

Figure 1 **The existence of the demographic window of opportunity between 1950 and 2050 – selected East Asian and Latin American countries (%)**



Source: *World Population Prospects (2022) of the UN DESA; author's calculations.*

Figure 2 **The existence of the demographic window of opportunity between 1950 and 2050 – selected European countries (%)**



Source: *World Population Prospects (2022) of the UN DESA; author's calculations.*

registered negative values, which gave rise to a pronounced DWO.

In Moldova and Georgia, these dynamics are quite specific. A decrease in both age groups at different paces produces a DWO for a small period between 1964 and 1979 in Moldova and between 1970 and 1987 in Georgia (Fig. 2). The population started to decrease after 1990 in both countries. However, the demographic situation remains beneficial, as the working-age population is decreasing at a slower pace than that of the dependent population, with a DWO between 1990 and 2011 in Moldova and between 1998 and 2012 in Georgia (Fig. 2).

Demographic and economic support ratio dynamics in selected countries

Demographic and economic support ratios serve as proxies for analysing the demographic window of opportunity and the demographic dividend. A positive growth rate in the support ratio (SR) indicates the opening of the demographic window of opportunity (DWO), while a positive growth rate in the economic support ratio reflects the first demographic dividend (DD1).

Figures 3 and 4 illustrate the demographic window of opportunity (DWO) and the first demographic dividend (DD1) for the selected countries. The DWO and the DD1 in Singapore, South Korea, Mexico, and Brazil are presented as two separate processes. A key observation is that the DWO tends to emerge earlier than the DD1, which aligns with the generally accepted idea that labour market adjustments require time, even though the DWO has opened. Thus, even if the demographically beneficial period has occurred, the dynamics of the ESR may exhibit different trends. Following the opening of the DWO, the demographic dividend may occur with different delays and with varying intensities as observed in Figures 3 and 4. Hence, Singapore and South Korea have registered important DDs that exceed the magnitude of their DWOs (Fig. 3).

Usually, in the literature, the Asian tigers are compared with Latin American countries, which, having experienced the demographic transition in the same period, have lost the possibility of gaining the demographic dividend. Indeed, unlike the Asian Tigers, the DD in Mexico and Brazil is much smaller than that in East Asian countries (Fig. 3). Nevertheless, the DWO in selected Latin American countries is also much smaller than the magnitude of the DWO in the two selected Asian countries. This finding shows that differences in the configuration and the DWO can also influence the magnitude of the DD.

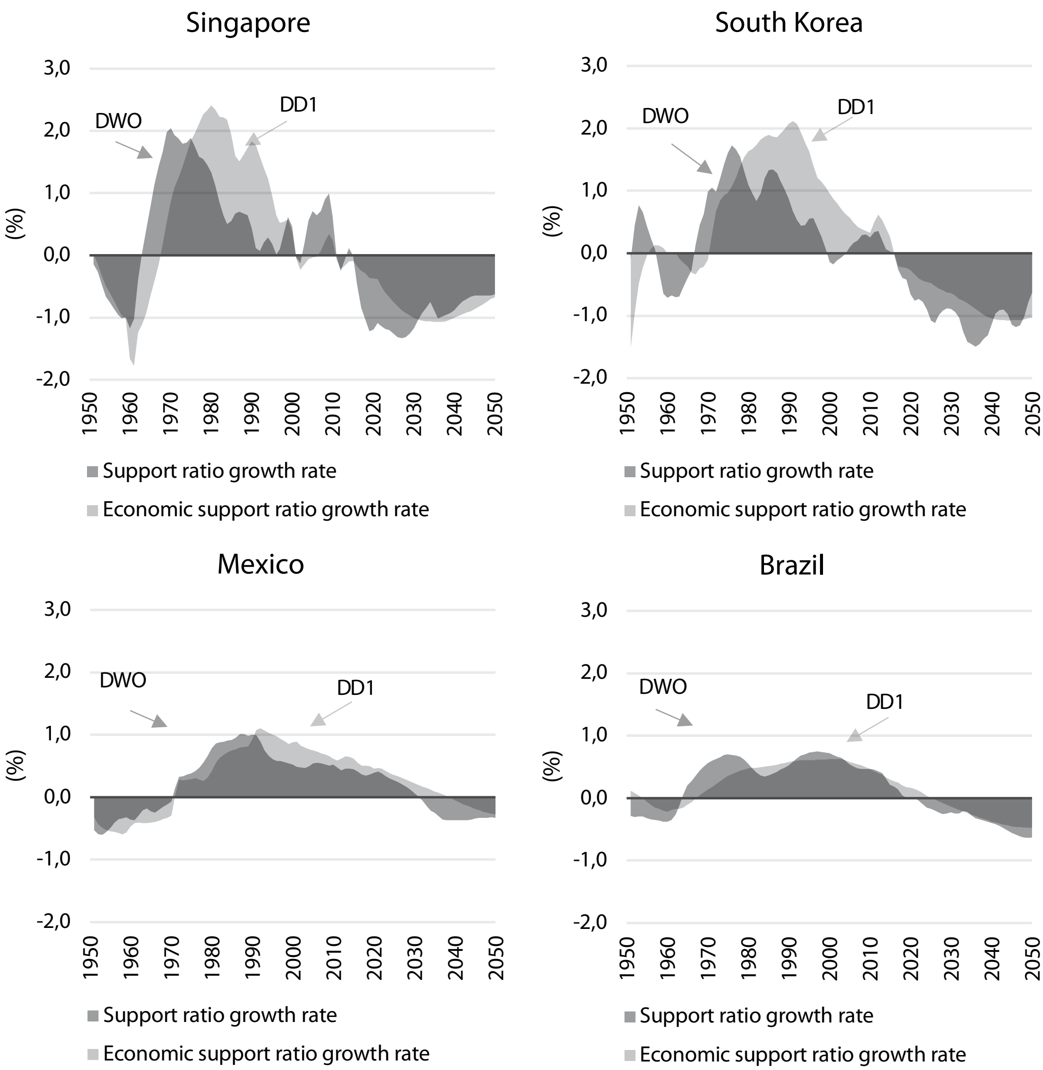
The configuration of the DWO compared to the DD for the selected European countries exhibits the same trends, except for Ireland. As in the Asian tigers, the Celtic tiger‘s DD is more pronounced than the DWO, but what is specific to Ireland is that its DWO and DD1 periods occur concurrently. It seems that the dynamics of the economic support ratio responded well to the demographic dynamics, with good harnessing of the beneficial period of the DWO in this country (Fig. 4).

For Slovakia, Moldova, and Georgia, the comparison of the DD and the DWO presents the same pattern as for the other countries: the magnitude of the DD1 will depend on the magnitude of the DWO, and the DD1 will occur sometime later after the demographic window opens. In these countries, the beneficial period, with its fluctuating cohort flows, led to more than one DWO (Fig. 4). The magnitude of the beneficial period in Brazil and Mexico was much smaller than in Ireland, Singapore, or South Korea. Notably, in Georgia and Moldova, the first demographic dividend (DD1) is smaller even relative to the demographic window of opportunity (DWO), indicating that the potential benefits of the window were harnessed to a limited extent. Thus, comparing the SR and the ESR demonstrates their utility for analysing the DD. Except for Ireland, the DD1 occurs after the DWO in all the selected countries, showing the challenges for market and institutional adaptation to harness the beneficial period. Further, the ESR dynamics observed in Singapore, South Korea, and Ireland suggest a well-adapted response to demographic changes, marked by a high level of attainment of DD1. In contrast to these countries, Moldova, Georgia, and Slovakia present a small demographic dividend, which is determined not only by the smaller magnitude of the DWO but also by the lower growth rate of the ESR compared with the magnitude of the DWO.

The demographic dividends and demographic window of opportunity in selected countries

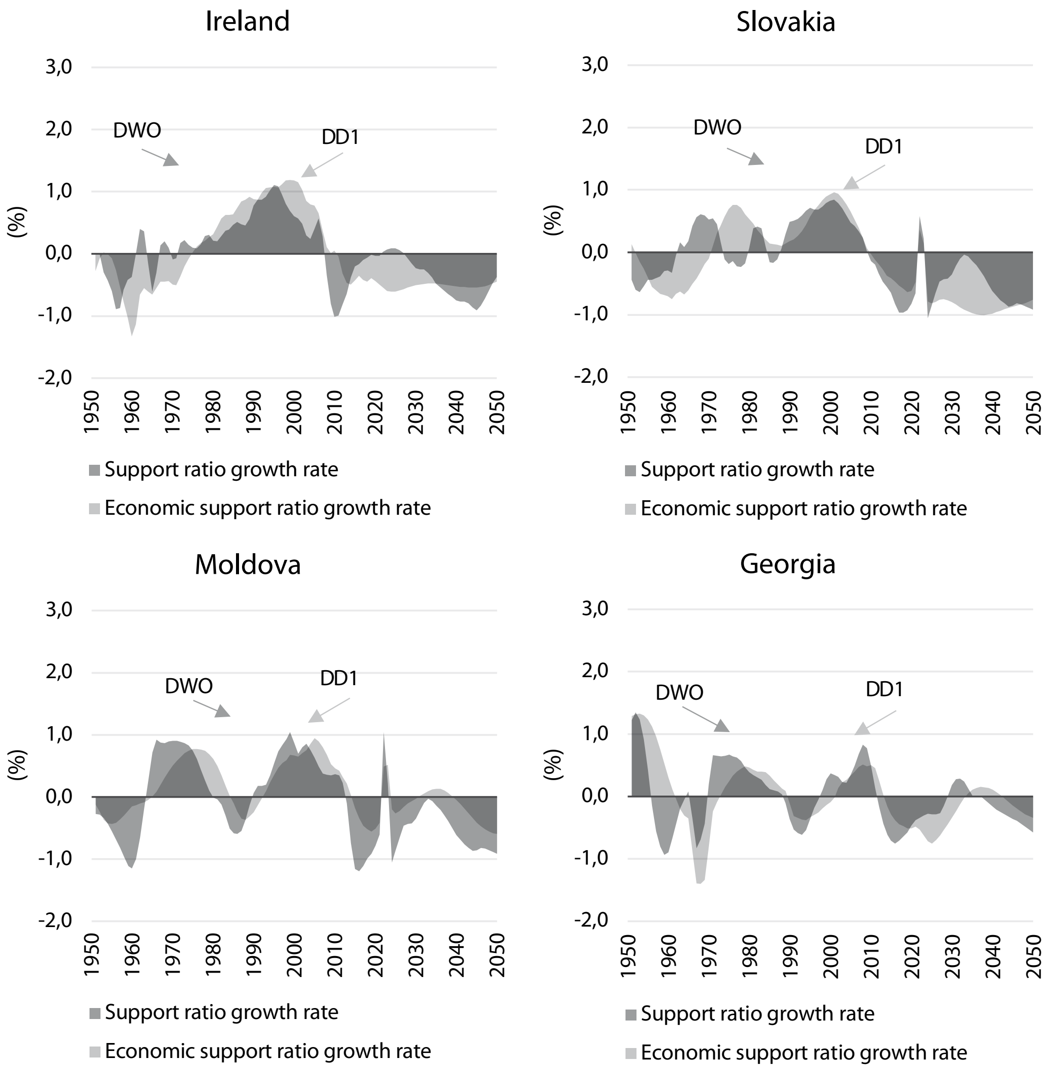
This study compares the DWO period with the dynamics of both DD1 and DD2, as well as with the combined

Figure 3 **Growth rates of the demographic and economic support ratios – selected East Asian and Latin American countries**



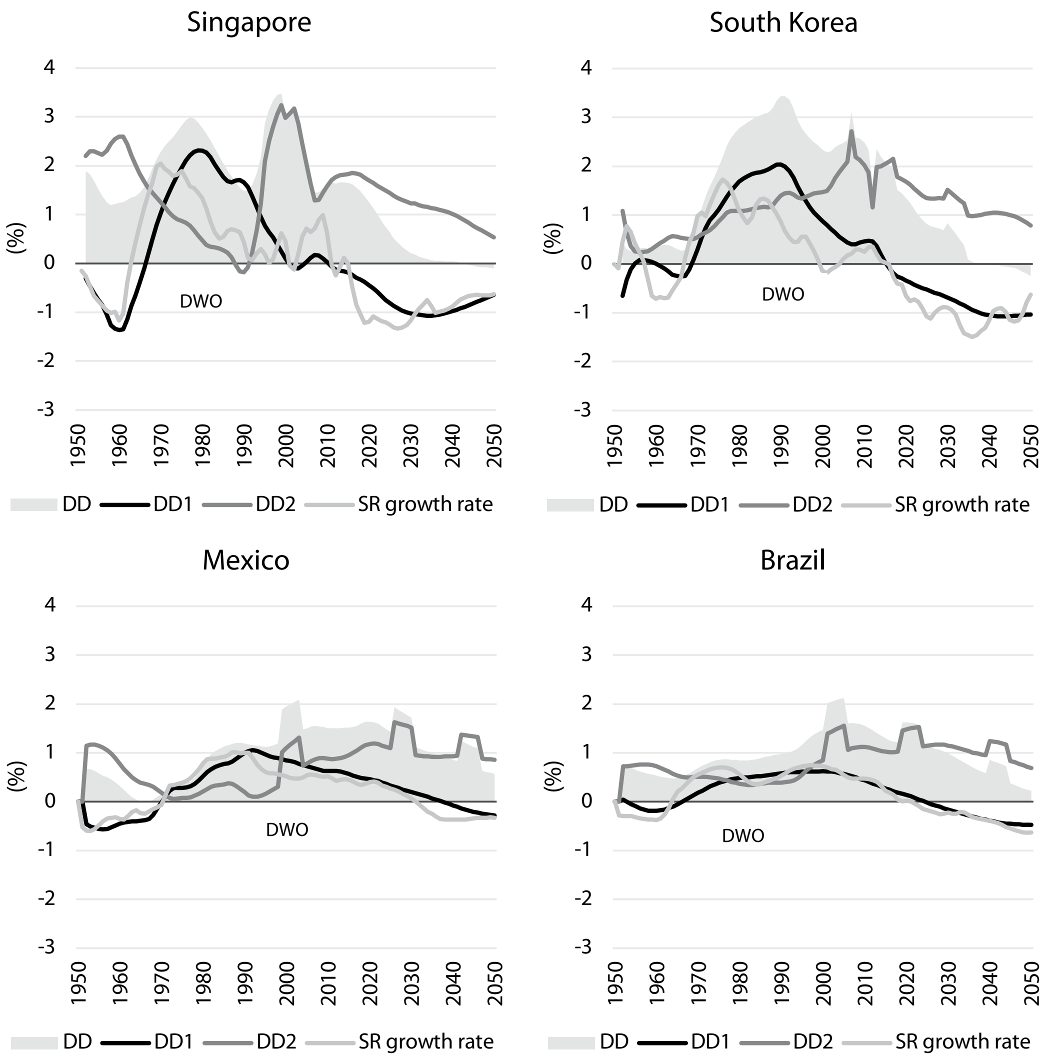
Source: *World Population Prospects (2022) of the UN DESA and NTA Network (2022), NTA Indicators, accessed 15.08.2024, www.ntaccounts.org; author's calculations.*

Figure 4 **Growth rates of the demographic and economic support ratios – selected European countries**



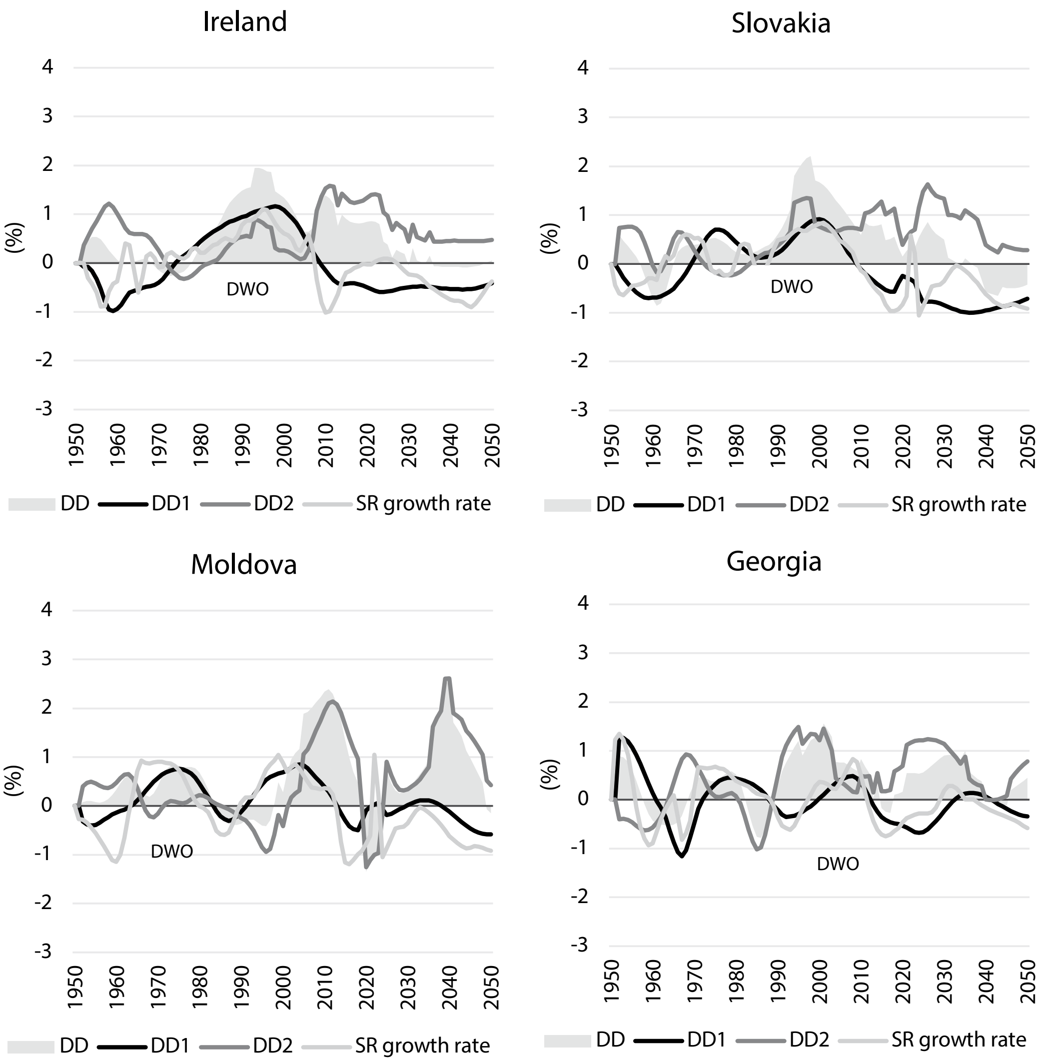
Source: *World Population Prospects (2022) of the UN DESA and NTA Network (2022), NTA Indicators, accessed 15.08.2024, www.ntaccounts.org; author's calculations.*

Figure 5 **The combined demographic dividend (DD), the first and second demographic dividends (DD1 and DD2), and the support ratio (SR) growth rate – selected East Asian and Latin American countries, 1950–2050 (%)**



Source: *World Population Prospects (2022) of the UN DESA (author's calculations) and the NTA Network (2022) (NTA Indicators accessed on 15.08.2024, www.ntaccounts.org).*

Figure 6 **The combined demographic dividend (DD), the first and second demographic dividends (DD1 and DD2), and the support ratio (SR) growth rate – selected European countries, 1950–2050 (%)**



Source: *World Population Prospects (2022) of the UN DESA (author's calculations) and the NTA Network (2022) (NTA Indicators accessed on 15.08.2024, www.ntaccounts.org).*

demographic dividend (DD1 plus DD2) (Figs. 5 and 6). The overall DD is more than the compositional effect of the increase in the participation rate (DD1), but is also the result of the effect of an increase in productivity (DD2). The second demographic dividend (DD2) is not directly related to age-structure dynamics, and that is why the particular aim here is to observe this productivity effect during the DWO period.

As can be observed, the magnitude of the overall demographic dividend (DD) varied considerably between the selected countries. These differences also result from the level of the DD2 (Figs. 5 and 6). Therefore, as well as the specific configuration of the DWO in selected countries, the extent to which the DWO is harnessed and the level of DD attained will depend on the level of the productivity effect (i.e. the second demographic dividend) during this period. In the countries that, during the DWO, obtained a higher level of DD (Singapore, South Korea, Brazil, Ireland, and Slovakia), the productivity effect has also been important. Similarly, in the countries that had a negative or insignificant productivity effect (Moldova, Georgia, Mexico, Brazil), the overall DD was much smaller compared with the magnitude of the DWO, and, as such, the DD was not fully realised.

It is also possible to observe a continuation of the DD resulting from the high level of the DD2 for each of the selected countries after the DWO is closed. This high productivity effect offsets the negative effect of the age structure after the period of the DWO for the selected countries (Figs. 5 and 6). The factors determining these productivity effects may vary significantly across countries, depending on their economic structure, levels of human capital, migration patterns, remittances and other context-specific variables. What remains essential for the analysis, however, is that the second demographic dividend constitutes an important component in assessing the overall demographic dividend during the DWO period.

DISCUSSION

In contrast to the mainstream literature, this study proposes an analytical framework that demonstrates that the demographic window of opportunity (DWO) and the demographic dividend (DD) do not necessarily align in timing or magnitude, thereby reinforcing the conceptual distinction between the two (*James,* 2018; *Şoldan,* 2023a). In this empirical analysis of the DD and the DWO, the DWO tends to emerge earlier than the DD, suggesting that institutions, labour markets, and broader systems must adjust to the evolving age structure in order for the DD to be achieved.

The comparison between the DWO and the DD provides additional insight into our understanding of the factors that determine the differences in the level of the DD achieved across countries. While it is often suggested that countries perform differently in terms of the DD attained because of the policies they implement, the findings here indicate that the configuration of the DWO and the specific patterns of age-structure dynamics also play a central role. Once the DWO opens, its duration and magnitude directly influence the size and timing of the DD1, as the analytical framework used in this analysis demonstrates. This further supports the integration of demographic indicators, such as the demographic support ratio, alongside the NTA approach in DD assessments.

The level of the DD2 – understood as the productivity-related component of the demographic dividend – proves to be a key explanatory factor for the differing degrees of DD realised during the DWO period in the selected countries. The effect of the DD2 can be quite substantial, as evidenced by the selected countries. It thus confirms the above statement that the demographic dividend is more than just an effect of increased labour force participation. How countries respond to the need to increase productivity will influence the extent to which the favourable period of the demographic window of opportunity (DWO) can be used to offset the negative effects of age structure dynamics that follow.

It should be noted that assessing the DWO and the DD is not just a methodological or conceptual concern. It is a practical matter with implications for the state and its ability to understand, anticipate, and respond to demographic change. Whether states take (full) advantage of the demographically favourable period depends on whether they are able to respond to demographic change with the necessary policies and programmes – this is the core idea of the demographic dividend and its non-deterministic nature.

Estimating the DWO remains relatively straightforward because of its inherently demographic nature. One of the advantages of demographic phenomena is their considerable predictability, even over long periods. By contrast, economic forecasts tend to be less precise, especially in the case of long-term projections. Many factors influence the course of economic development, making it more difficult to predict. Irrespective of the method used to assess the DD, whether it is the National Transfer Accounts (NTA) method or some other approach, such estimates are quite hypothetical and will vary according to the method chosen. When examining fluctuations in the age structure and, in particular, the phenomenon known as the DWO, these assessments can serve as preliminary tools for decision-making at the government level.

CONCLUSIONS

This study offers a comparative analysis of the demographic dividend (DD) and the demographic window of opportunity (DWO) across selected countries. The estimation of DD using the National Transfer Accounts (NTA) methodology was complemented by a demographic approach that identifies the DWO, enabling a more integrated assessment. The empirical findings confirm that DD and DWO are distinct phenomena, each following its own trajectory.

DD have inherent policy implications. Achieving the demographic dividend requires that governments respond to the demographically favourable period with development policies – covering areas such as health, education, and labour market adjustments (*Bloom et al.,* 2003). The distinction is important: referring to the 'demographic dividend' (i.e. economic growth acceleration resulting from a favourable demographic phase) as the 'demographic window of opportunity' (i.e. the period itself) risks obscuring the need for such targeted adjustments and policy design.

Representing the DD and the DWO within the proposed integrated framework makes it possible to capture additional tendencies for future policy insights. (i) The favourable period of the demographic window of opportunity (DWO) typically precedes the realisation of the first demographic dividend (DD1), as time is required for labour market adjustments. Anticipating such age-specific dynamics can help policymakers mitigate this delay. In a wider perspective, the introduction of the DWO analysis aims to underline the strategic relevance of age-specific population dynamics in development planning for achieving the DD. (ii) Cross-country differences between the magnitude of the DWO and the level of the DD are shaped by each country's specific conditions during the DWO period. While some contexts are supportive, others may not be. This entails further policy research and a policy design that enables a supportive environment. Further, (iii) the proposed method of integrating the demographic window of opportunity (DWO) into analysis of the demographic dividend (DD) enables a more nuanced understanding of cross-country differences observed within the NTA framework. These differences are not solely the result of economic or institutional factors but also reflect the specific dynamics of age structures – an aspect often overlooked when the focus is exclusively on DD estimations. The study shows that countries that achieve a significant demographic dividend typically experience a pronounced DWO, and, conversely, limited demographic dividends are often associated with weaker demographic windows. While the magnitude of the DWO is not a policy-driven factor, the role of the DWO in shaping the demographic dividend suggests that age structure dynamics specifically should be taken into account in developmental discourse and comparative analyses to support more balanced and realistic policy expectations regarding the demographic dividend.

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References

- Abio, G. – Patxot, C. – Souto, G. 2023. Using national transfer accounts to face aging. *Population and Development in the 21st Century - Between the Anthropocene and Anthropocentrism.* https://doi.org/10.5772/intechopen.1002930.
- Bloom, D. E. – Williamson, J. G. 1998. Demographic transitions and economic miracles in emerging Asia. *The World Bank Economic Review,* 12(3), 419–455. https://doi.org/10.1093/wber/12.3.419.
- Bloom, D. – Canning, D. – Sevilla, J. 2003. *The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change.* https://doi.org/10.7249/mr1274.
- Carella, M. – Parant, A. 2016. Age-structural transition and demographic windows around the Mediterranean. In: *Demographic Dividends: Emerging Challenges and Policy Implications,* 83–113. https://doi.org/10.1007/978-3-319-32709-9_5.
- Dramani, L. – Oga, I. J.-B. 2017. Understanding demographic dividends in Africa: The NTA approach. *Journal of Demographic Economics,* 83(1), 85–101. https://doi.org/10.1017/dem.2016.30.
- James, K. S. 2018. Measuring demographic dividend: *Measuring demographic dividend: Approaches and Methods. In *Janasamkhya: Vols. XXXVI–VII.* https://janasamkhya.net/online/1819/001.pdf.
- Kelley, A. C. – Schmidt, R. M. 2005. Evolution of recent economic-demographic modeling: A synthesis. *Journal of Population Economics,* 18(2), 275–300. https://doi.org/10.1007/s00148-005-0222-9.
- Lee, R. D. – Mason, A. 2006. What is the demographic dividend? *Finance and Development,* 43(3), 16–17. https://www.imf.org/external/pubs/ft/fandd/2006/09/basics.htm.
- Lutz, W. – Cuaresma, J. C. – Kebede, E. – Prskawetz, A. – Sanderson, W. C. – Striessnig, E. 2019. Education rather than age structure brings demographic dividend. *Proceedings of the National Academy of Sciences of the United States of America,* 116(26), 12798–12803. https://doi.org/10.1073/pnas.1820362116.
- Mason, A. 2005. *Demographic transition and demographic dividends in developed and developing countries.* https://www.un.org/en/development/desa/population/events/pdf/expert/9/mason.pdf.
- Mason, A. – Lee, R. – Abrigo, M. – Lee, S. H. 2017. Support ratios and demographic dividends: Estimates for the World. 2017. In *Technical Paper* (Vol. 1). https://www.un.org/en/development/desa/population/publications/pdf/technic al/TP2017-1.pdf.
- Oosthuizen, M. – Magero, J. 2021. *Modelling the Demographic Dividend: A Review of Methodologies.* https://esaro.unfpa.org/sites/default/files/pub-pdf/modelling_the_demographic_dividend-_a_review_of_ methodologies_v5_1.pdf.
- Pace R. – Ham-Chande R. (Eds.). 2016. *Demographic Dividends: Emerging Challenges and Policy Implications. Demographic Transformation and Socio-Economic Development* (Vol. 6). Springer International Publishing. https://link.springer.com/book/10.1007/978-3-319-32709-9.
- Prskawetz, A. – Sambt, J. 2014. Economic support ratios and the demographic dividend in Europe. *Demographic Research*, 30, 963–1010. https://doi.org/10.4054/demres.2014.30.34.
- Șoldan, E. 2023a. Insights into the demographic dividend and the window of opportunity: a conceptual overview. *Economy and Sociology,* 1, 65–78. https://doi.org/10.36004/nier.es.2023.1-06.
- Șoldan, E. 2023b. The economic life cycle and the demographic dividend under the NTA approach, evidence from European countries. In Gagauz Olga; Stratan Alexandru [et al.]. (Ed.), *Proceedings of International Scientific-Practical Conference, Economic growth in the conditions of globalization. 17th Edition, October 12–13, 2023.* Vol. 3. (pp. 77–89). [SEP ASEM], Chisinau. https://doi.org/10.36004/nier.cdr.V.2023.17.30.

- Şoldan, E. 2024. Demographic window of opportunity, first and second demographic dividends: Evidence from the world. In Gagauz Olga; Stratan Alexandru [et al.]. (Ed.), *Proceedings of International Scientific-Practical Conference, Economic growth in the face of global challenges. Consolidation of national economies and reduction of social inequalities. 18th Edition, October 10–11, 2024.* Vol. 4. (pp. 93–101). [SEP ASEM], Chisinau. https://doi.org/10.36004/nier.cdr.18.2024.20.
- United Nations. 2004. *World Population to 2300, Department of Economic and Social Affairs, Population Division.* ST/ESA/SER. A/236, United Nations, New York, NY. https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/files/documents/2020/Jan/un_2002_world_population_to_2300.pdf.
- Vallin, J. 2005. The demographic window. *Asian Population Studies,* 1(2), 149–167. https://doi.org/10.1080/17441730500317170.
- Williamson, J. G. 2013. Demographic dividends revisited. *Asian Development Review,* 30(2), 1–25. https://doi.org/10.1162/adev_a_00013.

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SUMMARY

This study examines the demographic dividend (DD) and the demographic window of opportunity (DWO) as interconnected yet distinct phenomena. Often treated as synonymous in the mainstream literature, this analysis draws attention to their distinctiveness, as the temporal and magnitude dynamics of each one differ. The research drew evidence from eight countries: Singapore, South Korea, Brazil, Mexico, Ireland, Slovakia, Moldova, and Georgia. The comparative evidence presents the differences between the DWO and the DD, which are manifested to varying degrees in the selected countries. The evidence for the selected countries shows that the DWO often precedes the DD, suggesting that for the economic benefit to occur, markets and institutions first need time to adapt.

The study follows the trends of the demographic dividend as calculated using the NTA approach. Two demographic dividends are distinguished: the DD1 and the DD2. Unlike the DD1, which is largely determined by the dynamics of the working-age population, the DD2 is indirectly linked to the dynamics of the age structure. The second demographic dividend (DD2) can significantly contribute to the total demographic dividend during the demographic window of opportunity and in the period that follows, due to its foundation in productivity gains.

This study sought to present a revised analytical framework for the demographic dividend and the demographic window of opportunity, employing, along with the NTA approach to the assessment of the demographic dividend, a demographic approach to assessing population age-structure dynamics. The revised framework incorporates, along with the economic support ratio, the demographic support ratio for the assessment of the two phenomena.

The article contributes to the debate on the topic by refining the conceptual distinction between the DWO and the DD and demonstrating the importance of demographic timing in policy planning. The proposed analytical framework provides a replicable model for assessing population dynamics in the context of the demographic dividend.

Pohyb obyvatelstva v České republice v roce 2024 podle krajů a okresů | Population and vital statistics of the Czech Republic 2024: regions and district

Území / *Region*	Počet obyvatel 1.7. *Population 1 July*	Počet obyvatel 31.12. *Population 31 December*	Sňatky *Marriages*	Rozvody *Divorces*	Živě narození *Live births*	Zemřelí / *Deaths* celkem *total*	Zemřelí / *Deaths* do 1 roku *under 1 years*	Zemřelí / *Deaths* do 28 dnů *under 28 days*	Přírůstek (úbytek) / *Increase (decrease)* přirozený *net*	Přírůstek (úbytek) / *Increase (decrease)* stěhováním *net migration*	Přírůstek (úbytek) / *Increase (decrease)* celkový *total*	Sňatky *Marriages* (na 1 000 obyvatel / *per 1,000 inhabitants*)	Rozvody *Divorces* (na 1 000 obyvatel / *per 1,000 inhabitants*)	Živě narození *Live births* (na 1 000 obyvatel / *per 1,000 inhabitants*)	Zemřelí *Deaths* (na 1 000 obyvatel / *per 1,000 inhabitants*)	Celkový přírůstek *Total increase* (na 1 000 obyvatel / *per 1,000 inhabitants*)
Česko	**10 886 531**	**10 909 500**	**44 486**	**20 796**	**84 311**	**112 211**	**196**	**133**	**–27 900**	**36 845**	**8 945**	**4,1**	**1,9**	**7,7**	**10,3**	**0,8**
Hlavní město Praha	**1 387 354**	**1 397 880**	**6 189**	**2 380**	**12 085**	**11 792**	**18**	**9**	**293**	**12 855**	**13 148**	**4,5**	**1,7**	**8,7**	**8,5**	**9,5**
Středočeský kraj	**1 459 625**	**1 466 215**	**5 658**	**2 946**	**10 981**	**13 754**	**18**	**10**	**–2 773**	**13 048**	**10 275**	**3,9**	**2,0**	**7,5**	**9,4**	**7,0**
Benešov	103 564	103 908	378	146	791	1 059	-	-	–268	817	549	3,6	1,4	7,6	10,2	5,3
Beroun	102 157	102 562	374	211	717	954	-	-	–237	1 051	814	3,7	2,1	7,0	9,3	8,0
Kladno	170 795	171 506	684	337	1 255	1 810	1	1	–555	1 789	1 234	4,0	2,0	7,3	10,6	7,2
Kolín	107 908	108 281	458	230	842	1 095	2	1	–253	803	550	4,2	2,1	7,8	10,1	5,1
Kutná Hora	78 334	78 565	312	152	572	859	2	1	–287	421	134	4,0	1,9	7,3	11,0	1,7
Mělník	114 409	114 783	458	213	842	1 151	5	3	–309	977	668	4,0	1,9	7,4	10,1	5,8
Mladá Boleslav	136 635	137 726	528	276	993	1 256	1	1	–263	1 509	1 246	3,9	2,0	7,3	9,2	9,1
Nymburk	106 804	107 638	405	207	922	1 039	1	1	–117	1 204	1 087	3,8	1,9	8,6	9,7	10,2
Praha-východ	203 193	204 547	738	447	1 549	1 418	1	-	131	2 349	2 480	3,6	2,2	7,6	7,0	12,2
Praha-západ	161 401	161 920	563	413	1 197	1 229	4	1	–32	1 326	1 294	3,5	2,6	7,4	7,6	8,0
Příbram	118 056	118 285	507	211	889	1 260	1	1	–371	506	135	4,3	1,8	7,5	10,7	1,1
Rakovník	56 369	56 494	253	103	412	624	-	-	–212	296	84	4,5	1,8	7,3	11,1	1,5
Jihočeský kraj	**653 120**	**653 227**	**2 684**	**1 270**	**5 082**	**6 938**	**13**	**9**	**–1 856**	**578**	**–1 278**	**4,1**	**1,9**	**7,8**	**10,6**	**–2,0**
České Budějovice	201 710	202 172	859	396	1 707	2 068	6	5	–361	607	246	4,3	2,0	8,5	10,3	1,2
Český Krumlov	61 844	61 655	255	117	468	609	1	-	–141	–276	–417	4,1	1,9	7,6	9,8	–6,7
Jindřichův Hradec	89 763	89 564	354	168	658	1 045	1	1	–387	–295	–682	3,9	1,9	7,3	11,6	–7,6
Písek	72 828	72 912	308	141	530	785	1	1	–255	316	61	4,2	1,9	7,3	10,8	0,8
Prachatice	51 179	51 061	197	95	391	558	1	1	–167	–246	–413	3,8	1,9	7,6	10,9	–8,1
Strakonice	71 635	71 602	277	132	549	821	2	-	–272	110	–162	3,9	1,8	7,7	11,5	–2,3
Tábor	104 161	104 261	434	221	779	1 052	1	1	–273	362	89	4,2	2,1	7,5	10,1	0,9

Pohyb obyvatelstva v České republice v roce 2024 podle krajů a okresů | Population and vital statistics of the Czech Republic 2024: regions and district

Území / *Region*	Počet obyvatel 1.7. *Population 1 July*	Počet obyvatel 31.12. *Population 31 December*	Sňatky *Marriages*	Rozvody *Divorces*	Živě narození *Live births*	Zemřelí / *Deaths*			Přírůstek (úbytek) / *Increase (decrease)*			Sňatky *Marriages*	Rozvody *Divorces*	Živě narození *Live births*	Zemřelí *Deaths*	Celkový přírůstek *Total increase*
						celkem *total*	do 1 roku *under 1 years*	do 28 dnů *under 28 days*	přirozený *net*	stěhováním *net migration*	celkový *total*	na 1 000 obyvatel / *per 1,000 inhabitants*				
Plzeňský kraj	**611 601**	**614 640**	**2 561**	**1 229**	**4 569**	**6 256**	**10**	**9**	**−1 687**	**2 953**	**1 266**	**4,2**	**2,0**	**7,5**	**10,2**	**2,1**
Domažlice	55 844	55 914	231	131	407	568	-	-	−161	−45	−206	4,1	2,3	7,3	10,2	−3,7
Klatovy	86 769	86 722	352	165	605	953	2	2	−348	−168	−516	4,1	1,9	7,0	11,0	−5,9
Plzeň-město	206 250	208 461	857	391	1 588	2 049	3	3	−461	2 909	2 448	4,2	1,9	7,7	9,9	11,9
Plzeň-jih	71 485	71 728	302	154	557	757	1	1	−200	335	135	4,2	2,2	7,8	10,6	1,9
Plzeň-sever	83 345	83 649	385	150	671	813	1	1	−142	370	228	4,6	1,8	8,1	9,8	2,7
Rokycany	50 623	50 796	198	105	331	571	1	-	−240	232	−8	3,9	2,1	6,5	11,3	−0,2
Tachov	57 285	57 370	236	133	410	545	2	2	−135	−680	−815	4,1	2,3	7,2	9,5	−14,2
Karlovarský kraj	**293 279**	**293 195**	**1 210**	**632**	**1 814**	**3 401**	**2**	**1**	**−1 587**	**−295**	**−1 882**	**4,1**	**2,2**	**6,2**	**11,6**	**−6,4**
Cheb	93 471	93 536	368	187	569	1 054	-	-	−485	−203	−688	3,9	2,0	6,1	11,3	−7,4
Karlovy Vary	114 420	114 567	469	247	678	1 342	2	1	−664	48	−616	4,1	2,2	5,9	11,7	−5,4
Sokolov	85 388	85 092	373	198	567	1 005	-	-	−438	−140	−578	4,4	2,3	6,6	11,8	−6,8
Ústecký kraj	**809 061**	**808 356**	**3 399**	**1 655**	**6 132**	**9 493**	**24**	**16**	**−3 361**	**548**	**−2 813**	**4,2**	**2,0**	**7,6**	**11,7**	**−3,5**
Děčín	126 168	125 790	545	239	903	1 543	5	3	−640	−104	−744	4,3	1,9	7,2	12,2	−5,9
Chomutov	123 587	123 453	496	282	969	1 376	1	1	−407	−87	−494	4,0	2,3	7,8	11,1	−4,0
Litoměřice	119 158	119 104	471	246	887	1 451	4	3	−564	182	−382	4,0	2,1	7,4	12,2	−3,2
Louny	86 653	86 723	355	188	651	981	1	1	−330	154	−176	4,1	2,2	7,5	11,3	−2,0
Most	107 742	107 536	453	195	855	1 330	6	3	−475	59	−416	4,2	1,8	7,9	12,3	−3,9
Teplice	127 653	127 739	574	259	959	1 459	3	3	−500	321	−179	4,5	2,0	7,5	11,4	−1,4
Ústí nad Labem	118 100	118 011	505	246	908	1 353	4	2	−445	23	−422	4,3	2,1	7,7	11,5	−3,6
Liberecký kraj	**449 377**	**449 494**	**1 815**	**880**	**3 253**	**4 730**	**3**	**-**	**−1 477**	**243**	**−1 234**	**4,0**	**2,0**	**7,2**	**10,5**	**−2,7**
Česká Lípa	103 009	102 860	405	213	754	1 104	1	-	−350	−300	−650	3,9	2,1	7,3	10,7	−6,3
Jablonec nad Nisou	93 043	93 048	372	172	672	1 019	1	-	−347	83	−264	4,0	1,8	7,2	11,0	−2,8
Liberec	180 526	180 955	749	369	1 321	1 770	-	-	−449	595	146	4,1	2,0	7,3	9,8	0,8
Semily	72 799	72 631	289	126	506	837	1	-	−331	−135	−466	4,0	1,7	7,0	11,5	−6,4

Pohyb obyvatelstva v České republice v roce 2024 podle krajů a okresů | Population and vital statistics of the Czech Republic 2024: regions and district

Území / *Region*	**Počet obyvatel 1.7. *Population 1 July***	**Počet obyvatel 31.12. *Population 31 December***	**Sňatky *Marriages***	**Rozvody *Divorces***	**Živě narození *Live births***	**Zemřelí / *Deaths***			**Přírůstek (úbytek) / *Increase (decrease)***			**Sňatky *Marriages***	**Rozvody *Divorces***	**Živě narození *Live births***	**Zemřelí *Deaths***	**Celkový přírůstek *Total increase***
						celkem *total*	**do 1 roku *under 1 years***	**do 28 dnů *under 28 days***	**přirozený *net***	**stěhováním *net migration***	**celkový *total***	**na 1 000 obyvatel / *per 1,000 inhabitants***				
Královéhradecký kraj	**555 467**	**555 923**	**2 270**	**1 078**	**4 142**	**5 882**	**10**	**8**	**–1 740**	**714**	**–1 026**	**4,1**	**1,9**	**7,5**	**10,6**	**–1,8**
Hradec Králové	167 761	168 401	691	320	1 313	1 739	4	4	–426	926	500	4,1	1,9	7,8	10,4	3,0
Jičín	80 390	80 413	330	171	593	901	1	1	–308	–25	–333	4,1	2,1	7,4	11,2	–4,1
Náchod	109 873	109 747	435	200	782	1 171	2	1	–389	–317	–706	4,0	1,8	7,1	10,7	–6,4
Rychnov nad Kněžnou	80 759	80 808	356	140	634	842	3	2	–208	132	–76	4,4	1,7	7,9	10,4	–0,9
Trutnov	116 684	116 554	458	247	820	1 229	-	-	–409	–2	–411	3,9	2,1	7,0	10,5	–3,5
Pardubický kraj	**529 503**	**530 469**	**2 107**	**1 024**	**4 201**	**5 442**	**9**	**8**	**–1 241**	**1 150**	**–91**	**4,0**	**1,9**	**7,9**	**10,3**	**–0,2**
Chrudim	106 373	106 659	397	209	821	1 121	5	4	–300	343	43	3,7	2,0	7,7	10,5	0,4
Pardubice	180 674	181 213	691	300	1 436	1 778	1	1	–342	667	325	3,8	1,7	7,9	9,8	1,8
Svitavy	104 439	104 541	476	183	875	1 146	-	-	–271	143	–128	4,6	1,8	8,4	11,0	–1,2
Ústí nad Orlicí	138 017	138 056	543	332	1 069	1 397	3	3	–328	–3	–331	3,9	2,4	7,7	10,1	–2,4
Kraj Vysočina	**516 973**	**517 647**	**1 985**	**888**	**4 184**	**5 408**	**8**	**6**	**–1 224**	**911**	**–313**	**3,8**	**1,7**	**8,1**	**10,5**	**–0,6**
Havlíčkův Brod	95 656	95 877	373	167	753	1 036	3	3	–283	302	19	3,9	1,7	7,9	10,8	0,2
Jihlava	117 778	118 465	409	205	923	1 138	1	1	–215	952	737	3,5	1,7	7,8	9,7	6,3
Pelhřimov	74 275	74 218	278	115	568	824	-	-	–256	–101	–357	3,7	1,5	7,6	11,1	–4,8
Třebíč	110 279	110 209	457	203	908	1 141	1	1	–233	–61	–294	4,1	1,8	8,2	10,3	–2,7
Žďár nad Sázavou	118 985	118 878	468	198	1 032	1 269	3	1	–237	–181	–418	3,9	1,7	8,7	10,7	–3,5
Jihomoravský kraj	**1 225 888**	**1 229 343**	**5 044**	**2 288**	**9 868**	**12 239**	**20**	**13**	**–2 371**	**4 965**	**2 594**	**4,1**	**1,9**	**8,0**	**10,0**	**2,1**
Blansko	111 062	111 267	456	203	895	1 172	1	1	–277	519	242	4,1	1,8	8,1	10,6	2,2
Brno-město	400 756	402 739	1 777	695	3 450	4 097	4	1	–647	2 820	2 173	4,4	1,7	8,6	10,2	5,4
Brno-venkov	233 824	234 615	868	484	1 811	2 051	6	5	–240	1 326	1 086	3,7	2,1	7,7	8,8	4,6
Břeclav	118 046	118 084	486	234	840	1 190	3	3	–350	–394	–744	4,1	2,0	7,1	10,1	–6,3
Hodonín	151 043	150 954	583	250	1 119	1 623	2	1	–504	–156	–660	3,9	1,7	7,4	10,7	–4,4
Vyškov	95 230	95 637	398	186	809	899	1	1	–90	650	560	4,2	2,0	8,5	9,4	5,9
Znojmo	115 927	116 047	476	236	944	1 207	3	1	–263	200	–63	4,1	2,0	8,1	10,4	–0,5

Pohyb obyvatelstva v České republice v roce 2024 podle krajů a okresů | Population and vital statistics of the Czech Republic 2024: regions and district

Území / *Region*	Počet obyvatel 1.7. *Population 1 July*	Počet obyvatel 31.12. *Population 31 December*	Sňatky *Marriages*	Rozvody *Divorces*	Živě narození *Live births*	Zemřelí / *Deaths*			Přírůstek (úbytek) / *Increase (decrease)*			Sňatky *Marriages*	Rozvody *Divorces*	Živě narození *Live births*	Zemřelí *Deaths*	Celkový přírůstek *Total increase*
						celkem *total*	do 1 roku *under 1 years*	do 28 dnů *under 28 days*	přirozený *net*	stěhováním *net migration*	celkový *total*	na 1 000 obyvatel / *per 1,000 inhabitants*				
Olomoucký kraj	**631 453**	**631 500**	**2 419**	**1 236**	**4 943**	**6 967**	**17**	**13**	**−2 024**	**660**	**−1 364**	**3,8**	**2,0**	**7,8**	**11,0**	**−2,2**
Jeseník	36 680	36 492	145	74	259	449	3	2	−190	−267	−457	4,0	2,0	7,1	12,2	−12,5
Olomouc	238 868	239 399	886	480	1 920	2 460	5	4	−540	1 096	556	3,7	2,0	8,0	10,3	2,3
Prostějov	108 941	108 923	435	196	846	1 210	4	3	−364	357	−7	4,0	1,8	7,8	11,1	−0,1
Přerov	127 465	127 286	473	283	971	1 500	2	1	−529	−489	−1 018	3,7	2,2	7,6	11,8	−8,0
Šumperk	119 499	119 400	480	203	947	1 348	3	3	−401	−37	−438	4,0	1,7	7,9	11,3	−3,7
Zlínský kraj	**579 168**	**578 998**	**2 229**	**1 062**	**4 447**	**6 306**	**13**	**11**	**−1 859**	**113**	**−1746**	**3,8**	**1,8**	**7,7**	**10,9**	**−3,0**
Kroměříž	104 150	104 130	433	206	837	1 202	3	3	−365	85	−280	4,2	2,0	8,0	11,5	−2,7
Uherské Hradiště	141 248	141 198	501	254	1 088	1 504	3	2	−416	−122	−538	3,5	1,8	7,7	10,6	−3,8
Vsetín	141 815	141 645	542	243	1 059	1 545	2	1	−486	−170	−656	3,8	1,7	7,5	10,9	−4,6
Zlín	191 955	192 025	753	359	1 463	2 055	5	5	−592	320	−272	3,9	1,9	7,6	10,7	−1,4
Moravskoslezský kraj	**1 184 662**	**1 182 613**	**4 916**	**2 228**	**8 610**	**13 603**	**31**	**20**	**−4 993**	**−1 598**	**−6 591**	**4,1**	**1,9**	**7,3**	**11,5**	**−5,6**
Bruntál	88 685	88 288	327	156	575	1 099	3	1	−524	−356	−880	3,7	1,8	6,5	12,4	−9,9
Frýdek-Místek	214 132	213 997	903	460	1 519	2 238	5	5	−719	117	−602	4,2	2,1	7,1	10,5	−2,8
Karviná	239 346	238 419	993	490	1 671	3 101	2	1	−1 430	−982	−2 412	4,1	2,0	7,0	13,0	−10,1
Nový Jičín	151 350	151 331	641	259	1 138	1 604	5	3	−466	16	−450	4,2	1,7	7,5	10,6	−3,0
Opava	174 661	174 423	716	307	1 347	1 878	2	2	−531	−285	−816	4,1	1,8	7,7	10,8	−4,7
Ostrava-město	316 488	316 155	1 336	556	2 360	3 683	14	8	−1 323	−108	−1 431	4,2	1,8	7,5	11,6	−4,5

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Pohyb obyvatelstva ve městech nad 20 tisíc obyvatel v roce 2024 | Population and vital statistics of the Czech Republic 2024: towns with more than 20 thous, Inhabitants

Město / *Town*	**Počet obyvatel 1.7.** *Population 1 July*	**Počet obyvatel 31.12.** *Population 31 December*	**Sňatky** *Marriages*	**Rozvody** *Divorces*	**Živě narození** *Live births*	**Zemřelí** *Deaths*	**Přírůstek (úbytek) / *Increase (decrease)*: přirozený** *net*	**stěhováním** *net migration*	**celkový** *total*	**Sňatky** *Marriages* (na 1 000 obyvatel / *per 1,000 inhabitants*)	**Rozvody** *Divorces*	**Živě narození** *Live births*	**Zemřelí** *Deaths*	**Celkový přírůstek** *Total increase*
Praha	1 387 354	1 397 880	6 189	2 380	12 085	11 792	293	12 855	13 148	4,5	1,7	8,7	8,5	9,5
Brno	400 756	402 739	1 777	695	3 450	4 097	–647	2 820	2 173	4,4	1,7	8,6	10,2	5,4
Ostrava	283 582	283 187	1 190	475	2 140	3 363	–1 223	–355	–1 578	4,2	1,7	7,5	11,9	–5,6
Plzeň	185 830	187 928	786	351	1 458	1 883	–425	2 754	2 329	4,2	1,9	7,8	10,1	12,5
Liberec	107 699	108 090	428	230	801	1 061	–260	368	108	4,0	2,1	7,4	9,9	1,0
Olomouc	102 687	103 063	363	214	862	1 073	–211	981	770	3,5	2,1	8,4	10,4	7,5
České Budějovice	96 995	97 231	416	196	860	1 116	–256	110	–146	4,3	2,0	8,9	11,5	–1,5
Hradec Králové	93 771	94 311	366	167	731	1 051	–320	725	405	3,9	1,8	7,8	11,2	4,3
Pardubice	92 234	92 319	368	139	702	1 014	–312	269	–43	4,0	1,5	7,6	11,0	–0,5
Ústí nad Labem	90 959	90 866	399	189	717	1 083	–366	–110	–476	4,4	2,1	7,9	11,9	–5,2
Zlín	74 347	74 684	259	139	516	846	–330	759	429	3,5	1,9	6,9	11,4	5,8
Kladno	69 419	69 664	289	129	537	793	–256	842	586	4,2	1,9	7,7	11,4	8,4
Havířov	69 065	68 674	299	147	498	925	–427	–593	–1 020	4,3	2,1	7,2	13,4	–14,8
Most	63 669	63 474	269	117	532	744	–212	–196	–408	4,2	1,8	8,4	11,7	–6,4
Opava	55 300	55 109	230	107	404	659	–255	–236	–491	4,2	1,9	7,3	11,9	–8,9
Jihlava	54 088	54 624	162	83	398	525	–127	765	638	3,0	1,5	7,4	9,7	11,8
Frýdek-Místek	53 704	53 590	213	117	350	589	–239	–109	–348	4,0	2,2	6,5	11,0	–6,5
Teplice	50 791	50 912	198	109	374	559	–185	138	–47	3,9	2,1	7,4	11,0	–0,9
Karlovy Vary	48 927	49 073	173	100	290	612	–322	42	–280	3,5	2,0	5,9	12,5	–5,7
Karviná	49 230	48 937	180	89	328	752	–424	–363	–787	3,7	1,8	6,7	15,3	–16,0
Mladá Boleslav	46 686	47 346	167	74	338	453	–115	1 033	918	3,6	1,6	7,2	9,7	19,7
Chomutov	46 842	46 771	187	111	351	555	–204	–48	–252	4,0	2,4	7,5	11,8	–5,4
Děčín	46 613	46 376	175	109	315	582	–267	–156	–423	3,8	2,3	6,8	12,5	–9,1
Jablonec nad Nisou	46 164	46 209	193	95	363	505	–142	125	–17	4,2	2,1	7,9	10,9	–0,4
Prostějov	43 410	43 408	174	86	300	485	–185	30	–155	4,0	2,0	6,9	11,2	–3,6
Přerov	41 039	40 906	163	83	279	518	–239	–516	–755	4,0	2,0	6,8	12,6	–18,4
Česká Lípa	36 908	36 815	137	71	305	352	–47	–621	–668	3,7	1,9	8,3	9,5	–18,1
Třebíč	34 628	34 530	132	66	251	357	–106	–161	–267	3,8	1,9	7,2	10,3	–7,7

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Město / ***Town***	**Počet obyvatel 1.7.** ***Population 1 July***	**Počet obyvatel 31.12.** ***Population 31 December***	**Sňatky** ***Marriages***	**Rozvody** ***Divorces***	**Živě narození** ***Live births***	**Zemřelí** ***Deaths***	**Přírůstek (úbytek) /** ***Increase (decrease)***			**Sňatky** ***Marriages***	**Rozvody** ***Divorces***	**Živě narození** ***Live births***	**Zemřelí** ***Deaths***	**Celkový přírůstek** ***Total increase***
							přirozený ***net***	**stěhováním** ***net migration***	**celkový** **total**	**na 1 000 obyvatel /** ***per 1,000 inhabitants***				
Tábor	34 372	34 356	142	69	245	333	−88	74	−14	4,1	2,0	7,1	9,7	−0,4
Znojmo	34 061	34 172	110	73	270	370	−100	112	12	3,2	2,1	7,9	10,9	0,4
Třinec	34 029	33 852	147	65	259	412	−153	−261	−414	4,3	1,9	7,6	12,1	−12,2
Kolín	33 325	33 444	157	66	248	336	−88	303	215	4,7	2,0	7,4	10,1	6,5
Cheb	32 657	32 808	128	57	202	329	−127	110	−17	3,9	1,7	6,2	10,1	−0,5
Příbram	32 699	32 773	133	69	219	359	−140	−79	−219	4,1	2,1	6,7	11,0	−6,7
Písek	30 996	31 121	133	62	234	291	−57	192	135	4,3	2,0	7,5	9,4	4,4
Trutnov	29 591	29 607	115	65	226	299	−73	96	23	3,9	2,2	7,6	10,1	0,8
Kroměříž	28 028	27 917	118	54	209	369	−160	−12	−172	4,2	1,9	7,5	13,2	−6,1
Orlová	27 649	27 540	118	60	212	347	−135	−119	−254	4,3	2,2	7,7	12,6	−9,2
Vsetín	25 176	25 185	86	45	203	284	−81	11	−70	3,4	1,8	8,1	11,3	−2,8
Uherské Hradiště	24 858	24 887	96	47	188	304	−116	70	−46	3,9	1,9	7,6	12,2	−1,9
Šumperk	24 796	24 735	102	38	182	321	−139	−95	−234	4,1	1,5	7,3	12,9	−9,4
Břeclav	24 564	24 538	107	46	167	268	−101	−224	−325	4,4	1,9	6,8	10,9	−13,2
Havlíčkův Brod	23 649	23 791	83	37	184	296	−112	157	45	3,5	1,6	7,8	12,5	1,9
Chrudim	23 474	23 564	86	44	173	219	−46	169	123	3,7	1,9	7,4	9,3	5,2
Hodonín	23 555	23 517	106	40	171	232	−61	−79	−140	4,5	1,7	7,3	9,8	−5,9
Český Těšín	23 129	23 075	104	42	149	273	−124	−83	−207	4,5	1,8	6,4	11,8	−8,9
Nový Jičín	22 992	23 005	95	31	170	230	−60	72	12	4,1	1,3	7,4	10,0	0,5
Litoměřice	22 842	22 767	91	47	173	314	−141	−75	−216	4,0	2,1	7,6	13,7	−9,5
Klatovy	22 772	22 763	79	44	142	253	−111	−64	−175	3,5	1,9	6,2	11,1	−7,7
Valašské Meziříčí	22 678	22 580	77	42	162	220	−58	−195	−253	3,4	1,9	7,1	9,7	−11,2
Krnov	22 614	22 518	90	29	141	271	−130	−68	−198	4,0	1,3	6,2	12,0	−8,8
Litvínov	22 470	22 387	90	35	161	336	−175	50	−125	4,0	1,6	7,2	15,0	−5,6
Strakonice	22 408	22 355	94	35	168	255	−87	−80	−167	4,2	1,6	7,5	11,4	−7,5
Sokolov	22 064	22 007	102	56	134	269	−135	−13	−148	4,6	2,5	6,1	12,2	−6,7
Kutná Hora	21 494	21 642	72	42	167	224	−57	143	86	3,3	2,0	7,8	10,4	4,0
Beroun	21 373	21 521	82	52	158	210	−52	301	249	3,8	2,4	7,4	9,8	11,7

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							přirozený ***net***	**stěhováním** ***net migration***	**celkový** **total**	**na 1 000 obyvatel** / ***per 1,000 inhabitants***				
Kopřivnice	21 474	21 374	92	32	150	244	–94	–136	–230	4,3	1,5	7,0	11,4	–10,7
Vyškov	20 531	20 645	90	48	158	219	–61	208	147	4,4	2,3	7,7	10,7	7,2
Jindřichův Hradec	20 628	20 540	78	51	164	215	–51	–156	–207	3,8	2,5	8,0	10,4	–10,0
Žďár nad Sázavou	20 458	20 404	89	35	157	249	–92	–29	–121	4,4	1,7	7,7	12,2	–5,9
Bohumín	20 408	20 315	82	36	151	276	–125	–79	–204	4,0	1,8	7,4	13,5	–10,0
Brandýs nad Labem-Stará Boleslav	20 126	20 313	73	46	152	163	–11	251	240	3,6	2,3	7,6	8,1	11,9
Mělník	20 296	20 278	95	46	114	234	–120	48	–72	4,7	2,3	5,6	11,5	–3,5
Blansko	20 035	20 002	85	34	129	218	–89	–94	–183	4,2	1,7	6,4	10,9	–9,1

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Výběr z české demografické literatury za 2. pololetí 2024 a 1. pololetí 2025

I. Knižní publikace, studie, výzkumné zprávy

1. Barvíková, J. – Bareš, P. *Příčiny a souvislosti umísťování dětí mimo rodiny.* Praha: RILSA, 2024, 276 s. Dostupné z: https://katalog.vupsv.cz/fulltext/vz_574.pdf.
2. Čevela, R. – Čeledová, L. *Stáří ve zdraví.* Praha: Karolinum, 2025. 204 s. ISBN 9788024660288.
3. Georgi, H. – Dragomirecká, E. – Jarolímová, E. *Psychologie stárnutí a stáří.* Praha: Grada, 2025. 432 s. ISBN 978-80-271-5065-6.
4. Hon, F. a kol. *Teorie demografických projekcí.* Praha: Vysoká škola ekonomická, 2024. 66 s. ISBN: 978-80-245-2552-5. Dostupné z: https://oeconomica.vse.cz/wp-content/uploads/Hon_2024_Teorie-demografickych-projekci.pdf.
5. Hora, O. – Suchanec, M. *Postavení starších osob v nezaměstnanosti – podkladová studie.* Praha: RILSA, 2024, 50 s. Dostupné z: https://katalog.vupsv.cz/fulltext/vz_573.pdf.
6. Höhne, S. – Barvíková, J. – Křečková Tůmová, N. – Paloncyová, J. – Frömmelová, T. *Dítě v rodičovském konfliktu II. Rodičovství před a po rozchodu.* Praha: RILSA, 2023, 295 s. Dostupné z: https://katalog.vupsv.cz/fulltext/vz_561.pdf.
7. Höhne, S. – Paloncyová, J. – Křečková Tůmová, N. *Nízkopříjmové rodiny s dětmi.* Praha: RILSA, 2024, 205 s. Dostupné z: https://katalog.vupsv.cz/fulltext/vz_571.pdf.
8. Höhne, S. – Paloncyová, J. – Křečková Tůmová, N. *Pěstounská péče ve veřejném mínění.* Praha: RILSA, 2024, 105 s. Dostupné z: https://katalog.vupsv.cz/fulltext/vz_578.pdf.
9. Kaczor, P. *Trh práce v ČR.* Praha: VŠE, nakladatelství Oeconomica, 2024. 216 s. ISBN 978-80-245-2513-6.
10. Langhamrová, J. a kol. *Demografie v kostce.* Praha: Vysoká škola ekonomická, 2025. 155 s. ISBN: 978-80-245-2554-9. Dostupné z: https://oeconomica.vse.cz/wp-content/uploads/publication/24836/Langhamrova-a-kol_Demografie-v-kostce.pdf.
11. Lochmanová, A. a kol. *Porod – Ztráty současné i minulé.* Červený Kostelec: Pavel Mervart, 2024. 288 s. ISBN 978-80-7465-644-6.
12. Musilová, B. – Paloncyová, J. *Zprostředkování náhradní rodinné péče u dětí romského etnika 2024.* Praha: RILSA, 2025, 75 s. Dostupné z: https://katalog.vupsv.cz/fulltext/vz_576.pdf.
13. Nešporová, O. *O smrti a pohřbívání.* 2., revidované vydání. Brno: Centrum pro studium demokracie a kultury, 2024. 364 s. ISBN 978-80-7325-584-8.
14. Ondrášek, S. – Kozlová, L. – Hricová, A. – Urban, D. *Sociální politika.* Praha: Grada, 2024. 192 s. ISBN 978-80-271-5138-7.
15. Ptáček, R. – Pemová, T. *Sdílené rodičovství.* Praha: Portál, 2024. 232 s. ISBN 9788026222163.
16. Rákoczyová, M. – Šimíková, I. – Bareš, P. *Mapování praxe sběru dat o romské populaci v České republice.* Praha: RILSA, 2024, 99 s. Dostupné z: https://katalog.vupsv.cz/fulltext/vz_557.pdf.
17. Sirovátka, T. – Horáková, M. – Trbola, R. – Vyhlídal, J. *Podpora starších pracovníků na trhu práce: příklady z vybraných zemí.* Praha: RILSA, 2024, 81 s. Dostupné z: https://katalog.vupsv.cz/fulltext/vz_577.pdf.
18. Sládek, M. *Gramotnost, farní školy a výuka náboženství v Čechách na přelomu 17. a 18. století.* Praha: Filozofická fakulta Univerzity Karlovy, 2025. 230 s. ISBN 9788076711822.
19. Steinlauf, B. *Zákon o umělém přerušení těhotenství.* Praha: Wolters Kluwer, 2024. 108 s. ISBN 978-80-286-0033-4.
20. Svobodová, K. – Janurová, K. – Bubeníková, M. – Frömmelová, T. – Höhne, S. – Paloncyová, J. *Maminkou před 18. narozeninami: žvotní zkušenosti a potřeby nezletilých matek v České republice.* Praha: RILSA, 2025, 189 s. Dostupné z: https://katalog.vupsv.cz/fulltext/vz_580.pdf.
21. Šimíková, I. – Katrňák, T. – Rákoczyová, M. – Fónadová, L. *Metodika sběru dat o socioekonomické situaci romské populace v České republice.* Praha: RILSA, 2024, 72 s. Dostupné z: https://katalog.vupsv.cz/fulltext/vz_558.pdf.
22. Štípek, V. *Principy sociální politiky.* Praha: Grada, 2025. 200 s. ISBN 978-80-271-5571-2.

23. Tóthová, V. – Tóth, A. – Novotný, L. *Zdravotní systém první Československé republiky.* České Budějovice: Tomáš Halama, 2024. 1 232 s. ISBN 978-80-87082-44-7.
24. Vyhlídal, J. *Stárnutí populace a jeho dopady na nezaměstnanost.* Praha: RILSA, 2024, 62 s. Dostupné z: https://katalog.vupsv.cz/fulltext/vz_572.pdf.

II. Soubory údajů a analýzy

25. *Cizinci v Česku podle výsledků sčítání lidu – 2021.* Praha: ČSÚ, 2024.
26. *Cizinci v ČR – 2024.* Praha: ČSÚ, 2024.
27. *Demografická příručka – 2023.* Praha: ČSÚ, 2024.
28. *Demografická ročenka České republiky – 2023.* Praha: ČSÚ, 2024.
29. *Demografická ročenka krajů – 2014 až 2023.* Praha: ČSÚ, 2024.
30. *Demografická ročenka měst – 2014 až 2023.* Praha: ČSÚ, 2024.
31. *Demografická ročenka okresů – 2014 až 2023.* Praha: ČSÚ, 2024.
32. *Demografická ročenka správních obvodů obcí s pověřeným obecním úřadem – 2014 až 2023.* Praha: ČSÚ, 2024.
33. *Demografická ročenka správních obvodů obcí s rozšířenou působností – 2014 až 2023.* Praha: ČSÚ, 2024.
34. *Ekonomická aktivita obyvatelstva podle výsledků sčítání lidu – 2021.* Praha: ČSÚ, 2025.
35. *Jak bydlí domácnosti podle výsledků sčítání lidu – 2021.* Praha: ČSÚ, 2024.
36. *Naděje dožití podle pohlaví – roční ČŘ – 2024.* Praha: ČSÚ, 2025.
37. *Obyvatelstvo – měsíční ČŘ – 2024.* Praha: ČSÚ, 2025.
38. *Obyvatelstvo, domy, byty a domácnosti podle výsledků sčítání lidu –2021.* Praha: ČSÚ, 2025.
39. *Obyvatelstvo Plzeňského kraje – 2024.* Praha: ČSÚ, 2025.
40. *Obyvatelstvo podle místa bydliště v době narození podle výsledků sčítání lidu – 2021.* Praha: ČSÚ, 2024.
41. *Obyvatelstvo podle pohlaví a jednotek věku – 2024.* Praha: ČSÚ, 2025.
42. *Obyvatelstvo podle pohlaví a pětiletých věkových skupin – 2024.* Praha: ČSÚ, 2025.
43. *Obyvatelstvo podle pohlaví a základních věkových skupin – 2024.* Praha: ČSÚ, 2025.
44. *Obyvatelstvo podle způsobu bydlení z výsledků sčítání lidu – 2021.* Praha: ČSÚ, 2024.
45. *Obvyklý a registrovaný pobyt ve sčítání lidu – 2021.* Praha: ČSÚ, 2025.
46. *Počet obyvatel v obcích – k 1. 1. 2025.* Praha: ČSÚ, 2025.
47. *Počet zemřelých (týdenní a měsíční časové řady).* Praha: ČSÚ, 2024; 2025.
48. *Pohyb obyvatel – 2024.* Praha: ČSÚ, 2025.
49. *Pohyb obyvatelstva v obcích Jihočeského kraje – 2024.* Praha: ČSÚ, 2025.
50. *Projekce obyvatelstva v krajích ČR – do roku 2080.* Praha: ČSÚ, 2024.
51. *Rodička a novorozenec 2023.* Praha: ÚZIS, 2025.
52. *Sčítání lidu, domů a bytů – Pramenné dílo – 2021.* Praha: ČSÚ, 2024.
53. *Senioři v Praze – vybrané kapitoly – 2023.* Praha: ČSÚ, 2024.
54. *Statistický lexikon obcí – 2024.* Praha: ČSÚ, 2024.
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81. *Život cizinců v ČR – 2024.* Praha: ČSÚ, 2024.

III. Výběr statí

82. Barvíková, J. – Bareš, P. Analýza příčin umísťování dětí mimo rodinu v širších souvislostech. *RILSA Policy Papers,* 2025, č. 1. https://katalog.vupsv.cz/fulltext/PP_01-2025.pdf.
83. Barvíková, J. – Höhne, S. – Paloncyová, J. – Křečková Tůmová, N. – Frömmelová, T. Rodičovský konflikt v souvislosti s rozchodem a jeho prevence. *Rilsa Policy Briefs,* 2024, č. 7.
84. Broul, M. – Hujová, A. – Liegertová, M. Pokroky v diagnostice a léčbě mužské neplodnosti – přehled současných možností. *Časopis lékařů českých,* 2025, 164(2), s. 43–49.
85. Bursa, O. Migrační trajektorie mladých dospělých v pražském zázemí. *Sociologický časopis / Czech Sociological Review,* 2024, 60(5), s. 507–530. https://doi.org/ 10.13060/csr.2024.006.
86. Gorný, D. Active commuting as a form of sustainable urban mobility: The case of the Brno Metropolitan Area. *Moravian Geographical Reports,* 2024, 32(3), s. 152–163. https://doi.org/10.2478/mgr-2024-0013.
87. Hašková, H. Nakolik mají, chtějí a mohou otcové pečovat? *Rovné příležitosti v souvislostech,* 2024, č. 1. https://zpravodaj.genderstudies.cz/nakolik-maji-chteji-a-mohou-otcove-pecovat/.
88. Hellerová, V. – Bártlová, S. – Brabcová, I. – Bejvančická, P. Health in the context of healthy ageing among people aged 65+ in South Bohemia. *Kontakt,* 2025, 27(2), s. 103–109. https://doi.org/10.32725/kont.2025.012.
89. Hnilicová, H. Romové v Česku a kulturní odlišnosti ve zdraví a zdravotní péči. *ČLČ,* 2024, 163(5), s. 203–208.
90. Holpuch, P. Důvody a kontext úspěch při řešení situace v bydlení lidí, kteří překonali vlastní bezdomovectví. *RPB,* 2025, č. 6.
91. Höhne, S. – Paloncyová, J. – Křečková Tůmová, N. Děti v rodinách s nízkými příjmy. *RPB,* 2025, č. 1.
92. Horbulák, Z. – Demeter, G. Demografický obraz Uhorska v 18. storočí na základe súpisu duší z rokov 1715 a 1720. *Historická demografie,* 2025, 46(1), s. 59–82. https://doi.org/10.21104/HD.2025.1.02.
93. Johnson, S. From economic turbulence to demographic change: Tracing the pathways of the second demographic transition in post-socialist contexts. *AUC Geographica,* 2025, 60(1), s. 24–45. https://doi.org/10.14712/23361980.2024.15.
94. Jonáková, J. Use it or lose it: Jak evropské země motivují otce k péči o děti. *RP,* 2024, č. 4. https://zpravodaj.genderstudies.cz/use-it-or-lose-it-jak-evropske-zeme-motivuji-otce-k-peci-o-deti/.
95. Kampichter, M. K čemu je raná výchova a péče? Jak se v ČR ne/diskutuje o rané výchově a péči o děti ve věku do tří let. *SČ,* 2024, 60(5), s. 481–505. https://doi.org/10.13060/csr.2023.048.
96. Katrňák, T. The Gender-gap Reversal in Tertiary Education and Its Implications for Inequality of Educational Opportunity in European Countries. *SČ,* 2024, 60(6), s. 551–576. https://doi.org/10.13060/csr.2024.008.

97. König, B. – Doválová, G. – Košta, J. Receiving Assistance in Material Need versus Active Participation in the Labour market: Who Will Win? *Politická ekonomie,* 2025, 73(1), s. 1–30. https://doi.org/10.18267/j.polek.1451.
98. Korec, P. – Plešivčák, M. Are Slovak Regions Ready for Crises? Analysis of Their Socio-economic Resilience. *PE,* 2024, 72(5), s. 780–811. https://doi.org/10.18267/j.polek.1433.
99. Kovářová, E. – Vašenková, T. Incidence of Poverty in Working-age Population in EU Countries: A Gender Perspective. *Prague Economic Papers,* 2024, 33(4), s. 444–477. https://doi.org/10.18267/j.pep.864.
100. Kolářová Veverková, M. Prekarita práce v období pandemie Covid-19 v perspektivě struktury a subjektivity. *Sociální studia / Social Studies,* 2024, 21(2), s. 65–86. https://doi.org/10.5817/SOC2024-39531.
101. Kotková, A. Jak pečovat o pečující? Ženy a muži sendvičové generace. *RP,* 2024, č. 4. https://zpravodaj.genderstudies.cz/jak-pecovat-o-pecujici-zeny-a-muzi-sendvicove-generace/.
102. Krbcová, D. Migrace v České republice. *Veřejná správa a sociální politika,* 2024, 4(1), s. 41–59. https://doi.org/10.25142/vssp.2024.003.
103. Kužel, P. Is There Really Unequal Pay for Equal Work Between Men and Women in the Czech Republic? Problems with the Decomposition of Wage Determinants. *SČ,* 2024, 60(6), s. 577–601. https://doi.org/10.13060/csr.2024.032.
104. Liczbińska, G. – Rachwał, P. The Impact of Wars and Epidemics of Infectious Diseases on Selected Demographic Parameters of the Roman Catholic Population in Lublin in the 19th Century. *HD,* 2025, 46(1), s. 59–82. https://doi.org/10.21104/HD.2025.1.03.
105. Liška, A. Vlna cholery 1831–1832 v urbárnom prostredí Spiša v percepcii matričných záznamov rímskokatolíckej cirkvi – historickodemografická sonda. *HD,* 2024, 45(2), s. 103–126. https://doi.org/10.21104/HD.2024.2.01.
106. Maier, K. – Franke, D. Development of socio-spatial polarisation in Czechia. *Geografie,* 2025, 130(1), s. 35–63. https://doi.org/10.37040/geografie.2025.004.
107. Marada, M. – Zévl, J. J. – Šimbera, J. Sociogeographic regionalisation of Czechia 2021: Changes in regional development or temporary stabilisation? *G,* 2025, 130(1), s. 163–191. https://doi.org/10.37040/geografie.2025.005.
108. Mini, P. Searching for the Stability of Healthcare Systems under Ageing Population Conditions in Germany, Austria and Czechia. *Fórum sociální politiky,* 2025, č. 1, s. 34–56.
109. Přenosilová, L. K nepřenosné části rodičovské dovolené. *RP,* 2024, č. 4. https://zpravodaj.genderstudies.cz/k-neprenosne-casti-rodicovske-dovolene/.
110. Řídka, A. Změny zákoníku práce mění i podmínky pro osoby na mateřské a rodičovské dovolené. *RP,* 2024, č. 3. https://zpravodaj.genderstudies.cz/zmeny-zakoniku-prace-meni-i-podminky-pro-osoby-na-materske-a-rodicovske-dovolene/.
111. Smith, M. L. Gender Differences in Intergenerational Occupational Persistence and Mobility in Central Europe. *SČ,* 2024, 60(6), s. 623–663. https://doi.org/ 10.13060/csr.2024.041.
112. Svobodová, K. – Janurová, K. – Bubeníková, M. – Frömmelová, T. – Höhne, S. – Paloncyová, J. Nezletilé matky v České republice. *RPB,* 2025, č. 4.
113. Špeciánová, Š. The Czech Legislation on Surrogacy and its Comparison with Foreign Standards. *K,* 2024, 26(3), s. 300–308. https://doi.org/10.32725/kont.2024.040.
114. Teska Arnoštová, L. – Tlapák Navrátilová, A. – Galovcová, I. Význam regulace surogátního mateřství z hlediska občanského, zdravotnického i trestního práva. *ČLČ,* 2025, 164(2), s. 50–56.
115. Turek, V. – Zhereb, A. Transnationals and the "Wall of Czechness": expats and their self-perception in the Czech Republic. *Scientia et Sociates,* 2024, 20, s. 64–72. https://www.sets.cz/index.php/ojs/article/view/14/17.
116. Turoň, L. Struktury obyvatelstva Jablunkova podle sčítání z roku 1900. *HD,* 2024, 45(2), s. 127–154. https://doi.org/10.21104/HD.2024.2.02.
117. Večerník, J. Příjmy, životní spokojenost a sociální identita českých seniorů v mezinárodním porovnání. FSP, 2024, č. 3, s. 8–41.
118. Wichterlová, L. Od velmi špatných rozhodnutí v rodinné politice k těm lepším. *RP,* 2024, č. 3. https://zpravodaj.genderstudies.cz/od-velmi-spatnych-rozhodnuti-v-rodinne-politice-k-tem-lepsim/.
119. Závadová, I. – Hlaváček, J. Institucionální vývoj přednemocniční neodkladné péče v českých zemích (1792–2003): od dobrovolných záchranných spolků ke zdravotnické záchranné službě. *HD,* 2024, 45(2), s. 155–185. https://doi.org/10.21104/HD.2024.2.03.

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Potraty. 2005. Praha: Ústav zdravotnických informací a statistiky.

Články v časopisech

Dudová, R. – Vohlídalová, M. 2018. Muži a ženy pečující o seniory v rodině. Sociologický časopis, 54(2), s. 219–252. https://doi.org/10.13060/00380288.2018.54.2.400.

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