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Perceived unmet healthcare needs among older Europeans in the COVID-19 pandemic and beyond: the telemedicine solution

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Abstract

This study explores the determinants of unmet healthcare needs among older Europeans following the pandemic. Using data from the SHARE study involving 37,225 individuals aged 50 and above, we examine the barriers to healthcare access during the COVID-19 pandemic and the utilization of telemedicine. Approximately 15% of older adults reported unmet healthcare needs after the pandemic, while almost one in three utilized telemedicine during that period. Interestingly, those who used telehealth during the pandemic were more likely to report ongoing unmet healthcare needs. Persistent inequalities in healthcare access were observed for women, those living alone, individuals with financial challenges, and in poorer health. While telemedicine played an important role in enhancing healthcare access, its impact was limited, buffering only a part of unmet healthcare needs in the pandemic. Despite challenges in telemedicine adoption among older adults, it remains a promising tool for ensuring healthcare access in future emergencies.

Keywords: telemedicine, unmet healthcare needs, older adults, SHARE, COVID-19

1 INTRODUCTION

The COVID-19 pandemic compelled healthcare systems to adjust and implement a range of strategies, primarily following the guidelines of the World Health Organization (WHO, 2020). While these strategies helped slow the spread of the virus, they substantially scaled down and disrupted healthcare provision. More stringent containment and closure policies, leading to postponed or denied care and heightened concerns about infection, had an impact on healthcare accessibility, particularly among older adults (Powell, Bellin and Ehrlich, 2020; Smolić, Čipin and Međimurec, 2022). To mitigate restricted access and shortages in healthcare services, healthcare systems adopted the rapid integration of telemedicine (TM) as a strategy, enabling remote consultations, prescriptions, and medical services. Telemedicine can be defined as a healthcare approach that uses technology for patient communication and treatment delivery at a distance (WHO, 2010).

In this paper, TM is analysed in the context of healthcare access for older adults – a population group particularly affected by the pandemic (Barnay and Defebvre, 2023; Pentaris et al., 2020; Hoffmann and Wolf, 2021). Numerous studies have confirmed the importance of TM in improving access to healthcare, whether for young populations (Barbosa et al., 2021), disadvantaged individuals (Qian et al., 2022) or older adults (Hoffman, 2020; Kruse et al., 2020). TM played an important role in maintaining access to healthcare for older adults during the COVID-19 pandemic (Powell, Bellin and Ehrlich, 2020; Smolić, Blaževski and Fabijančić, 2022). However, the utilization of TM among this population group during the pandemic's early stages was not substantial (Frydman et al., 2022), and there were significant disparities in TM use based on patient age and other factors (Ortega et al., 2020; Cantor et al., 2021; Ng et al., 2022).

In order to address the shortage of in-depth studies that can provide a nuanced and accurate picture of TM adoption among older adults and its association with

unmet healthcare needs after the pandemic, we examine data from the multicountry and interdisciplinary Survey of Health, Ageing and Retirement in Europe (SHARE) (Börsch-Supan et al., 2013). Our research aims to investigate the factors contributing to perceived unmet healthcare needs in the wake of the pandemic, emphasising the association with TM utilization and the experience of unmet healthcare during the pandemic, as well as the effects of the pandemic. The specific objective of the paper is to explore the utilization of TM within the COVID-19 pandemic, focusing on people aged 50 and over from 27 European countries and Israel. We seek to understand how TM has been employed during the COVID-19 pandemic in different European countries. By investigating the use of TM among older adults in Europe, our study highlights the importance of remote healthcare delivery in improving healthcare access, especially in the aftermath of the initial and subsequent waves of the pandemic (Vinceti et al., 2021). Furthermore, our research addresses a crucial aspect of unmet healthcare needs during and after the COVID-19 pandemic using three rounds of the SHARE study – SHARE Corona Surveys (SCS) in 2020 and 2021 (Scherpenzeel et al., 2020) and regular SHARE Wave 9 in 2022. The overarching goal of this paper is to initiate discussions on whether TM can enhance healthcare access for older adults and strengthen health system preparedness for future health emergencies.

The structure of our paper from this point onward is as follows: We commence by reviewing relevant literature concerning TM and barriers to healthcare access for older adults. Following that, we provide an overview of data and research methods, and present our findings in the subsequent section. The paper closes with a discussion of results from a policy perspective and conclusion.

2 LITERATURE REVIEW

Unmet healthcare encompasses situations where individuals do not receive necessary healthcare due to barriers or personal choices (e.g., distance, financial reasons, fear of infection, lack of supply) (Chen and Hou, 2002; Smolić, Fabijančić and Blaževski, 2023). The unmet need for healthcare is also a frequently used outcome variable in health research (Ayanian et al., 2000), especially within the framework of declining health (Ko, 2016) and the rise in health inequalities (Arnault, Jusot and Renaud, 2022). Zavras et al. (2016) demonstrated that limited access to healthcare can have severe, long-lasting health consequences, impair the quality of life, lead to poorer health, and exacerbate health inequalities. In addition, many studies have indicated that the presence of unmet healthcare needs among older adults elevates the risk of mortality and morbidity (Alonso et al., 1997; Herr et al., 2014; Lindström, Rosvall and Lindström, 2020).

During the initial stages of the COVID-19 pandemic, access to healthcare was limited for many non-communicable diseases, as reported by the WHO (WHO, 2020). Access to chronic care has declined due to the diversion of medical specialists to urgent COVID-19 cases, with diseases like chronic obstructive pulmonary disease, diabetes, and hypertension being heavily impacted (Núñez, Sreeganga

and Ramaprasad, 2021). Multiple studies have uncovered concerning findings when investigating the impact of COVID-19 on healthcare services reduction (De Rosa et al., 2020; Thaler et al., 2020; Moynihan et al., 2021). Many studies have also explored the effects of the pandemic on older adults' healthcare access and unmet healthcare needs. They have shown that factors such as a poor economic situation, poor overall health status, and higher healthcare utilization were consistent predictors of unmet healthcare needs (Arnault, Jusot and Renaud, 2022; Smolić, Čipin and Međimurec, 2022). Furthermore, shelter-in-place orders – despite being an effective response to the COVID-19 pandemic for older people – negatively affected their healthcare access (Bailey et al., 2021). Also, income-related inequalities in access to healthcare were detected among older adults (González-Touya, Stoyanova and Urbanos-Garrido, 2021), while existing health disparities were exacerbated (Okonkwo et al., 2021).

As a result of the challenges in healthcare access during the pandemic, TM, among other strategies, emerged as a critical means to deliver regular care to individuals with chronic conditions, particularly those more susceptible to severe COVID-19 complications (Bashshur et al., 2020; Cantor et al., 2021; Núñez, Sreeganga and Ramaprasad, 2021). A framework for TM in outbreaks was developed in 2015, with an updated version for COVID-19, but many countries still lack regulatory frameworks for TM integration (Ohannessian, Duong and Odone, 2020).

TM has evolved with technological advancements, including live video and text messaging and – despite being present and caring for remote patients for decades – gained significant importance during the COVID-19 pandemic, allowing for continuity of care while maintaining social distancing and quarantine measures (Colbert, Venegas-Vera and Lerma, 2020; Monaghesh and Hajizadeh, 2020). The experiences of the general population with TM during the COVID-19 pandemic proved to be similar to those of traditional, in-person medical appointments (Isautier et al., 2020), and TM is recognized as an important tool that can enhance the delivery of healthcare services, increase healthcare accessibility in remote areas, and reduce healthcare expenses by preventing the aggravation of medical emergencies (Charles, 2000; Monaghesh and Hajizadeh, 2020; Wootton, 2001). However, regarding healthcare expenses, Bali (2018) argues that developing countries quickly adopted TM technology without adequate planning and strategy and that these nations have not witnessed significant success in cost reduction or improved healthcare accessibility compared with developed countries.

Simultaneously, during the initial wave of the COVID-19 pandemic, many older adults refrained from availing themselves of telehealth services (Choi et al., 2022). There are several reasons for that; for example, some frequently encountered barriers include issues related to technical literacy, a lack of willingness to use TM and cost concerns (Kruse et al., 2020). The study by Lebrasseur et al. (2021) showed that twice as many seniors chose in-person appointments over video consultations. Their research – which cannot be broadly generalized – also suggested that the adoption of TM was less common among individuals with lower levels of education, those without a spouse or partner, and those residing in non-metropolitan regions.

The analyses of the second Survey of Health, Ageing and Retirement in Europe (SHARE) Corona Survey, conducted by Smolić, Blaževski and Fabijančić (2022), showed that older individuals in poor health, dealing with multiple chronic illnesses or those who had been hospitalized recently or had delayed healthcare due to infection concerns, were more likely to embrace TM. Moreover, nations with reduced healthcare coverage and lower healthcare expenditures experienced a higher rate of TM utilization. In the US, approximately 84% of Medicare[1] beneficiaries aged 65 and over reported that their regular healthcare providers offered TM services during COVID-19, and among those offered the TM, 43% reported using TM services (Ng et al., 2022).

The application of TM brought about evident advantages for older adults during the pandemic. Older adults with specific vulnerabilities to COVID-19 (e.g., those with chronic illness) found that TM enabled them to maintain their engagement in medical practice through roles requiring minimal contact (Goldberg et al., 2021), while home telehealth visits enhanced their well-being and reduced the commuting time losses (Hawley et al., 2020). Findings by Chu et al. (2022) suggest that TM was crucial in helping older adults maintain access to health care during the pandemic; for example, they found that TM visits outnumbered in-person visits among older adults during the pandemic in Ontario, Canada. Kruse et al. (2020) reveal that telehealth interventions were associated with medical outcomes such as decreased psychological stress, increased autonomy, and enhanced cognitive ability. Bhatia et al. (2022) used an increase in TM utilization among older adults during the COVID-19 pandemic as an opportunity to learn from their experiences. While individuals in their study encountered difficulties with TM technology and preferred in-person care, they recognized the convenience of TM, reported satisfaction with primary care delivered through TM and expressed a desire for TM to remain accessible.

3 DATA AND METHODS

3.1 DATA

We use publicly available data from the first and the second SHARE Corona Survey (SCS) and preliminary data from regular SHARE Wave 9. The Survey of Health, Ageing and Retirement in Europe (SHARE) is a research infrastructure and cross-national panel survey collecting microdata on the health, social and economic status of individuals aged 50 and older in 28 European countries and Israel. Probability sampling methods were employed within countries, utilizing population registers to include noninstitutionalized adults aged 50 years or older and, if applicable, their partners. In the majority of countries, a multistage stratified sampling design was implemented (Börsch-Supan et al., 2013; Bergmann and Börsch-Supan, 2021). The SCS, created as a swift response within the broader SHARE study to comprehend the impacts of the COVID-19 pandemic, included a series of questions addressing various aspects of life affected by the pandemic, including, but not limited to, healthcare accessibility and the utilization of remote medical consultations. Data for the first SCS (SCS1) were collected through 20 to 25-minute telephone interviews (CATI) conducted between June and August 2020. Furthermore, participants who

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[1] Government national health insurance program in the United States.

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took part in the first SCS were reinterviewed during the second SCS (SCS2), which occurred between June and August 2021 (Scherpenzeel et al., 2020). With the most recently completed Wave 9 of the SHARE study, which was conducted from October 2021 to September 2022 via computer-assisted face-to-face interviews (CAPI), we gain insights into the lives of those individuals aged 50 years and older in the post-pandemic times, i.e. we gain valuable insights into the enduring effects of the COVID-19 pandemic on the lives of older adults.

We applied several sample restrictions to refine our data sets. Firstly, within the SHARE Wave 9 sample, we retained only those participants who completed their interviews in this specific wave while excluding those who were interviewed in nursing homes. Furthermore, we limited the sample to individuals aged 50 years and older, meaning that partners of respondents younger than 50 were excluded. Similar restrictions were applied to the SCS1 and SCS2 samples, with the additional criterion of excluding interviews conducted entirely by proxy respondents. Upon merging these three samples, retaining only those who participated in all mentioned waves and eliminating any missing values for all explanatory variables (around three percent), our final working sample comprised 37,225 observations from 27 European countries and Israel.

3.2 VARIABLES
3.2.1 Outcome variable
In order to present unmet healthcare needs in the aftermath of the pandemic – mainly during 2022 – we have constructed the outcome binary variable, which indicates whether respondents encountered limited access to healthcare due to unavailability or cost. The questions contributing to the construction of this outcome variable were asked during SHARE Wave 9. The outcome variable encompasses various aspects of healthcare for which respondents encountered limited access. These include general practitioner or specialist physician appointments, access to medication, dental or optical care, home care or paid home assistance, and other healthcare services. It should be noted that home care or paid assistance can also be regarded as a form of social care service.

3.2.2 Explanatory variables
To closely investigate the factors contributing to unmet healthcare needs, we employ a range of factors, for example, *predisposing factors* (gender, age, living arrangement, level of education), and *enabling factors* (area of residence, and financial situation of the household). We also incorporate *need factors*, e.g. various health-related variables such as self-reported health status (SRH), chronic or long-term illnesses, remote healthcare utilization, unmet healthcare needs during the pandemic, and the impact of COVID-19 on an individual.

Age categories for respondents are divided into three groups: those who are occupationally active (ages 50-64), young retirees (ages 65-79), and the oldest individuals (age 80+). Education levels are categorized as low, medium, or high based on the ISCED 2011 classification, derived from data in the regular SHARE waves.

Respondents' living arrangements are presented as "living alone" or "living with others". The area of residence is classified as either rural (rural areas or villages) or urban. Financial situations are self-reported by respondents as either satisfactory or unsatisfactory (making ends meet with or without difficulties).

In terms of health-related variables, we apply a binary variable for self-reported health (SRH) in Wave 9, categorized as "fair or poor" and "good and better", but we also control for the SRH of respondents before the pandemic. Additionally, we include an objective health status variable indicating whether respondents suffer from chronic or long-term illnesses. We also incorporate a binary variable denoting the utilization of remote medical consultations since the onset of the COVID-19 pandemic, extracted from SCS2. Three dummy variables are employed to determine if respondents: a) forwent medical treatment due to fear of COVID-19 infection, b) had scheduled medical treatment postponed by a doctor or medical facility, or c) had been denied after asking for an appointment for medical treatment during the pandemic. Furthermore, we construct a variable reflecting the impact of COVID-19, categorized into three groups: respondents who were not exposed (with no personal knowledge of anyone experiencing symptoms, testing positive, hospitalization, or death due to COVID-19, including respondent), those partially exposed (personally knowing someone with symptoms or a positive test, including respondent), and those severely exposed (personally knowing someone hospitalized including respondent, or deceased due to COVID-19). Finally, we introduce country controls using a set of country-specific dummy variables and healthcare system features (dominant model of healthcare system organisation, financing and regulatory framework for TM).

3.3 DATA ANALYSES

We performed descriptive analyses to gain more insight into the healthcare access constraints older adults experienced during and after the COVID-19 pandemic. Additionally, we investigated the utilization of TM (remote healthcare) during the pandemic and explored its potential role in addressing unmet healthcare needs. We then explored the differences between older adults who utilized TM and those who did not. Following the descriptive analyses, we developed a multivariable logistic regression model to assess our outcome variable. We use odds ratios to interpret our findings. In our study, the odds ratios indicate how the likelihood of experiencing limited access to healthcare changes with a one-unit increase in the explanatory variable while all other variables are kept constant.

4 RESULTS

Figure 1 shows the weighted percentages of older adults who encountered barriers to accessing healthcare during (in SCS1 and SCS2) and after the COVID-19 pandemic (SHARE Wave 9). The reported percentages exhibited a wide range, from 3.4% (0.4%) of older adults who have forgone healthcare due to fear of infection in Spain to 24.5% (16.5%) of those in Luxembourg in SCS1 (SCS2). In SCS1, the figures for healthcare postponed ranged from 1.7% in Bulgaria to 55.6% in Luxembourg, and in SCS2, from 2.1% in Romania to 26.1% in Portugal.

Conversely, the average figures for denied healthcare in SCS1 and SCS2 remained almost unchanged, i.e. 5.6% of older adults asked for an appointment for medical treatment but did not get it. In SHARE Wave 9, almost 15% of older adults reported unmet healthcare needs, ranging from 3.5% in Cyprus to 20.8% in Greece.

As demonstrated, there was a general decrease in unmet healthcare needs across most countries during the pandemic. Nevertheless, a few notable exceptions warrant attention. For example, although respondents from most countries generally indicated fewer obstacles to accessing healthcare in SCS2 compared to SCS1, Bulgaria and Slovakia experienced an increase in the percentage of older adults whose scheduled medical appointments were postponed by a doctor or medical facility.

FIGURE 1

Percentages of older adults with unmet healthcare needs in SCS1, SCS2 and SHARE Wave 9 (horizontal axis) with 95% confidence intervals
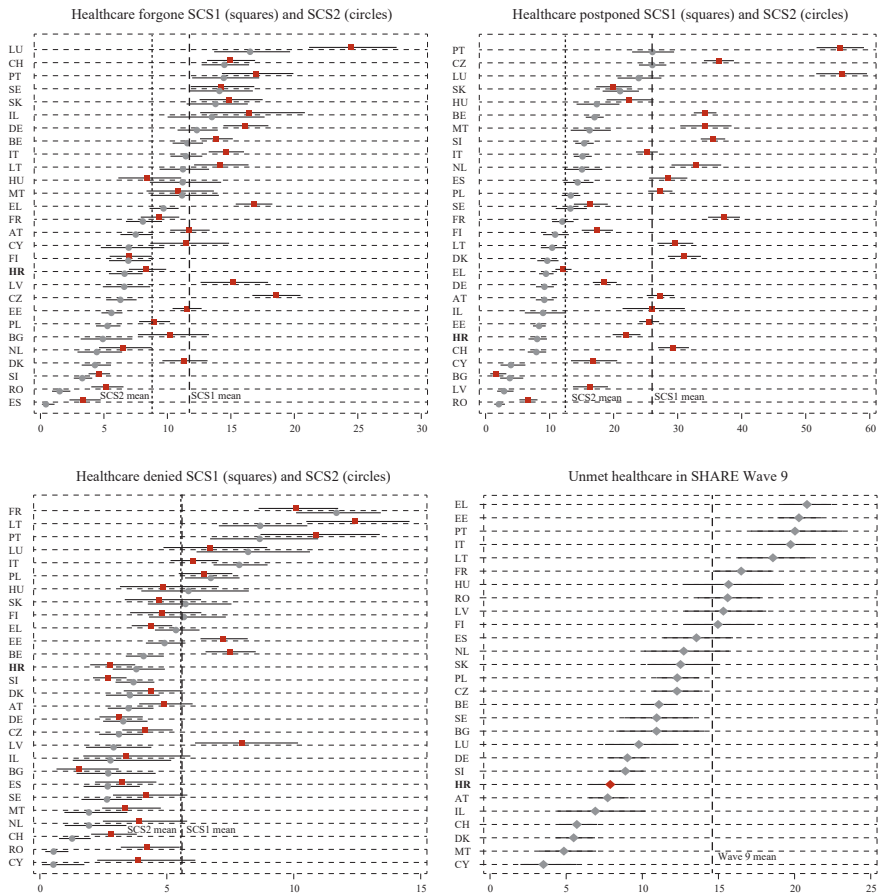
Note: Weighted data using calibrated cross-sectional individual weights. Dashed lines represent the average of the samples.

Source: Authors' calculations based on SHARE Wave 8 COVID-19 Survey release 8.0.0., SHARE Wave 9 COVID-19 Survey release 8.0.0., Preliminary Wave 9 Release version 0.

We further examined the utilization of TM as one of the methods used to reduce barriers to healthcare access, particularly during times like the COVID-19 pandemic. Figure 2 shows the percentages of older Europeans who reported using remote medical care as an alternative to traditional healthcare during the pandemic. On average, approximately one out of every three older adults utilized remote consultations during the pandemic. The utilization rates varied significantly, from around 5% in Germany to slightly over 71% in Latvia. Respondents from Eastern and Southern Europe and Israel embraced TM to a greater extent during the pandemic compared with the pre-pandemic period. The percentage of older adults who increased their use of TM ranged from 2.4% in Switzerland to 35.9% in Lithuania (right panel of figure 2).

FIGURE 2

Percentages of older adults who reported using TM in the COVID-19 pandemic (left) and who increased TM use compared with the period before the pandemic (right)
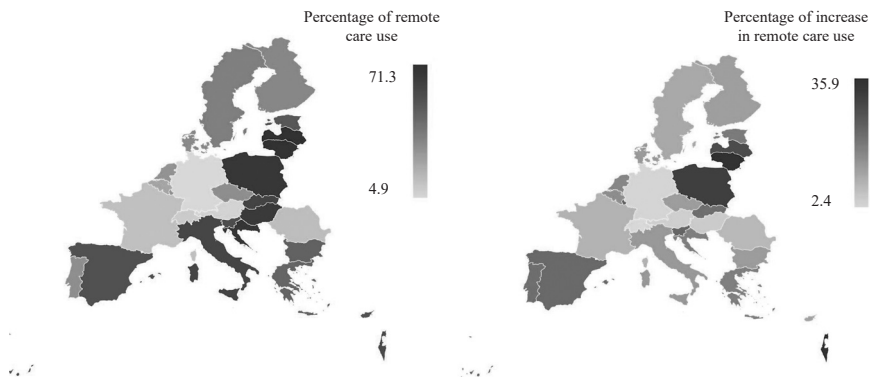
Note: Weighted data using calibrated cross-sectional individual weights.
Source: Authors' calculations based on SHARE Wave 9 COVID-19 Survey release 8.0.0.

Before outlining the factors contributing to unmet healthcare needs in the post-pandemic period, we provide descriptive statistics for our working data set in table 1, categorized by the utilization of remote consultations. During the pandemic, fewer older adults had remote consultations, and those who had remote consultations were, on average, younger. Factors such as female sex, living with others, the lowest educational attainment, reported economic difficulties and urban residence were associated with a higher likelihood of utilizing remote consultations during the pandemic. Furthermore, older individuals who used remote consultations were less prone to indicate good and better SRH, both before and after the onset of the pandemic, and those who engaged with remote medical consultations were nearly 50% more inclined to report fair and poor SRH. Older adults with chronic illnesses and those reporting unmet healthcare needs exhibited a significantly heightened likelihood of utilizing remote consultations during the pandemic. Lastly, individuals who experienced hospitalization or had personal connections with individuals who were hospitalized or who died due to COVID-19, indicating severe repercussions of the pandemic, were significantly more likely to have had remote consultations during this period.

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TABLE 1
Sample descriptive statistics

	No remote consultations		Had remote consultations	
	N	Mean (%)	N	Mean (%)
Women	12,772	57.3	9,205	61.7***
Age (*in years*)	22,298	71.2	14,927	70.6***
Lives alone	6,042	27.1	3,701	24.8***
Education level				
Low	6,827	30.6	4,849	32.5***
Medium	9,885	44.3	6,709	45.0
High	5,586	25.1	3,369	22.6***
Had economic difficulties	6,851	30.7	6,697	44.9***
Lives in the urban area	14,235	63.8	10,252	68.7***
SRH (Wave 9) Good and better	14,722	66.0	7,891	52.9***
SRH before Corona				
Poor	866	3.9	948	6.4***
Fair	4,519	20.3	4,589	30.7***
Good	10,434	46.8	6,773	45.4***
Very good	4,490	20.1	1,979	13.3***
Excellent	1,989	8.9	638	4.3***
Suffering from chronic illness	11,326	50.8	9,367	62.8***
Had healthcare forgone	3,603	16.2	3,064	20.5***
Had healthcare postponed	6,575	29.5	5,705	38.2***
Had healthcare denied	1,519	6.8	1,818	12.2***
Affectedness by COVID-19				
No	12,170	54.6	7,205	48.3***
Mildly	6,850	30.7	5,209	34.9***
Severely	3,278	14.7	2,513	16.8***
Total SHARE sample (SCS1, SCS2 and Wave 9)	22,298	59.9	14,927	40.1

Note: Unweighted figures. *** p < 0.01.

Source: Authors' calculations based on combined data from SHARE Wave 8 COVID-19 Survey release 8.0.0., Wave 9 COVID-19 Survey release 8.0.0., Preliminary Wave 9 Release version: 0.

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Table 2 displays the sample sizes of participants aged 50 and above across different countries, ranging from 332 in Israel to 3081 in Estonia.

TABLE 2
Sample sizes by country

Country identifier	N	%
Austria	1,707	4.59
Germany	1,713	4.60
Sweden	786	2.11
Netherlands	585	1.57
Spain	910	2.44
Italy	2,551	6.85
France	1,483	3.98
Denmark	1,273	3.42
Greece	2,646	7.11
Switzerland	1,415	3.80
Belgium	2,820	7.58
Israel	332	0.89
Czechia	1,661	4.46
Poland	2,182	5.86
Luxembourg	624	1.68
Hungary	520	1.40
Portugal	717	1.93
Slovenia	2,464	6.62
Estonia	3,081	8.28
Croatia	1,433	3.85
Lithuania	1,059	2.84
Bulgaria	484	1.30
Cyprus	439	1.18
Finland	967	2.60
Latvia	734	1.97
Malta	563	1.51
Romania	1,249	3.36
Slovakia	827	2.22
Total	37,225	100.00

Note: Unweighted figures.

Source: Authors' calculations based on combined data from SHARE Wave 8 COVID-19 Survey release 8.0.0., Wave 9 COVID-19 Survey release 8.0.0., Preliminary Wave 9 Release version 0.

To explore the determinants of unmet healthcare needs after the pandemic, we present the logistic regression model estimated odds ratios in table 3. These odds ratios indicate the likelihood of experiencing (reporting) unmet healthcare needs, as determined by our pooled logistic regression model with country controls. Our analysis reveals several significant findings. We found that women [OR = 1.12, 95% CI (1.04–1.19)] and those living alone [OR = 1.22, 95% CI (1.13–1.31)] were significantly more likely to report unmet healthcare needs. On the other hand, individuals aged 80 and above [OR = 0.69, 95% CI (0.62–0.77)] were significantly less likely to report barriers to accessing healthcare in the aftermath of the

pandemic. Interestingly, educational levels did not significantly affect the odds of reporting unmet healthcare needs in the post-pandemic period. Conversely, residing in urban areas [OR = 1.06, 95% CI (0.99–1.14)] and facing financial difficulties [OR = 2.03, 95% CI (1.89–2.18)] were associated with significantly higher odds of reporting unmet healthcare needs.

TABLE 3

Determinants of unmet healthcare needs in 27 European countries and Israel in the aftermath of the COVID-19 pandemic

	Odds ratios
Gender *(ref. Men)*	
Women	1.116***
Age *(ref. 50-64)*	
65-79	0.832***
80+	0.689***
Living arrangement *(ref. Living with others)*	
Living alone	1.217***
Education level *(ref. Low)*	
Medium	1.043
High	0.964
Financial situation of household *(ref. No econ. difficulties)*	
With econ. difficulties	2.029***
Area of residence *(ref. Rural)*	
Urban	1.062*
SRH (Wave 9) *(ref. Good and better)*	
Fair or poor	1.338***
SRH before Corona *(ref. Poor)*	
Fair	0.870**
Good	0.763***
Very good	0.648***
Excellent	0.543***
Suffering from chronic illnesses *(ref. No)*	
Yes	1.376***
Remote healthcare use *(ref. No)*	
Yes	1.230***
Healthcare forgone *(ref. No)*	
Yes	1.466***
Healthcare postponed *(ref. No)*	
Yes	1.217***
Healthcare denied *(ref. No)*	
Yes	1.789***
Affectedness by COVID-19 *(ref. No)*	
Mildly	1.140***
Severely	1.253***

Note: *p < 0.1, **p < 0.05, ***p < 0.01. How to read the results in the table? For example, women aged 50 and older in 27 European countries and Israel had nearly 1.12 times (or 12 percentage points) higher odds of reporting unmet healthcare needs after the pandemic compared to men aged 50 and older in 27 European countries and Israel, ceteris paribus.

Source: Authors' calculations based on SHARE Wave 8 COVID-19 Survey release 8.0.0., Wave 9 COVID-19 Survey release 8.0.0., Preliminary Wave 9 Release version 0.

Furthermore, various health-related factors emerged as significant predictors of limited access to healthcare following the pandemic. Older adults reporting fair or poor SRH [OR = 1.34, 95% CI (1.24–1.45)] and those grappling with at least one chronic or long-term illness [OR = 1.38, 95% CI (1.27–1.49)] were significantly more prone to reporting unmet healthcare needs in the post-pandemic times. On the other hand, individuals reporting better SRH before Corona (e.g., excellent, very good, good and fair compared with poor SRH) were considerably less likely to report barriers to accessing healthcare.

Concerning the variables of particular significance in this paper, remote care utilization played an important role, with an odds ratio of 1.23 and a 95% confidence interval of (1.15–1.32), indicating that odds of reporting unmet healthcare needs after the pandemic were 23% higher if the person had had remote medical consultations during the pandemic. Subsequently, individuals who had forgone healthcare in the pandemic exhibited an odds ratio of 1.47 [95% CI (1.36–1.58)], and those indicating postponed healthcare showed an odds ratio of 1.22 [95% CI (1.13–1.31)] for reporting unmet healthcare needs in Wave 9. These findings were statistically significant as well. Additionally, older adults with denied healthcare during the pandemic had 79% higher odds of reporting unmet healthcare needs in the post-pandemic period. Lastly, older adults who had or personally knew someone with COVID-19 symptoms, who had or personally knew someone with a positive COVID-19 test result [OR = 1.14, 95% CI (1.06–1.23)] or who were or personally knew someone who died or was hospitalized due to the COVID-19 disease [OR = 1.25, 95% CI (1.15–1.37)] had significantly higher odds of reporting unmet healthcare needs in SHARE Wave 9.

To enhance our analyses, we computed the average marginal effects of the predictors "healthcare forgone", "healthcare postponed", "healthcare denied" and "remote healthcare use", at the level of countries using the observed values for the other predictors (see the appendix for more details). We conclude that respondents who avoided healthcare due to fear of COVID-19 infection had a probability of reporting unmet healthcare needs that is about 3.4–5.2 percentage points higher (on average 4.3 percentage points) than those who did not avoid healthcare. Next, on average, the probability that an individual will report unmet healthcare needs in the aftermath of the pandemic was 2.1 percentage points (range 1.3–2.9) higher for those who had their scheduled medical treatments postponed, 7 percentage points (range 5.7–8.3) if healthcare was denied and by 2.2 percentage points (range 1.4–2.9) if the individual had a remote consultation during the COVID-19 pandemic. If we observe the marginal effects for different countries, we see that the effects of healthcare forgone, postponed and denied, and remote healthcare use differ by country. For example, the probability of reporting unmet healthcare needs after the pandemic is almost 6 percentage points higher for those who forwent healthcare in Italy, and 1.5 percentage points in Cyprus (see figure A1 and table A1 in the appendix). It is evident that, in all the countries included in the sample, older adults who reported unmet healthcare needs during the COVID-19 pandemic had a greater

probability of continuing to experience unmet healthcare needs in the post-pandemic period. Similar findings hold for those who have had remote medical consultations during the pandemic. However, there is significant variation in the probability of unmet healthcare needs across countries after the pandemic.

We have implemented several robustness checks to assess the performance and reliability of our main model.[2] We examined the effects of including several control variables that describe the specific characteristics of a healthcare system in terms of financing and organization (Beveridge vs. Bismarck) and the institutional settings for TM deployment during the pandemic. Additionally, we examined the effects of using a continuous measure of remote healthcare use (number of remote consultations) during the pandemic. The results derived from these specifications align with the empirical findings in the first model, particularly regarding the factors associated with unmet healthcare needs amid the pandemic – healthcare forgone, postponed, and denied – as well as the utilization of remote healthcare such as participation in virtual medical consultations. Furthermore, the empirical findings corroborate the results observed in the main model results when considering the continuous variable for remote healthcare utilization.

5 DISCUSSION

This paper aimed to investigate the determinants of unmet healthcare needs for older Europeans in the aftermath of the pandemic and the extent and changes in TM utilization during the COVID-19 pandemic. To our knowledge, this is the first multinational study to assess the association of TM utilization, unmet healthcare needs experienced during the pandemic and unmet healthcare needs after the COVID-19 pandemic among Europeans aged 50 and above. Concurrently, our research constitutes a significant contribution to comprehending the diverse repercussions of the COVID-19 pandemic on the quality of healthcare for older adults across Europe.

Our analyses revealed that women and those living alone were more likely to report unmet healthcare needs following the pandemic. Like other studies (Eberly et al., 2020; Rodrigues, Block and Sood, 2022), we showed that older age was associated with less frequent utilization of remote healthcare. At the same time, education did not seem to play a significant role in this regard. On the other side, poorer SRH, the presence of chronic illness(es) and economic hardship were significant predictors of unmet healthcare needs after the pandemic. These findings are backed by previous research on unmet healthcare needs among older adults during the pandemic. For instance, a study by Tavares (2022) showed that women, occupationally active adults aged 50-64, individuals in poor health, and those facing financial difficulties were more likely to report unmet healthcare needs. Similar determinants of unmet healthcare needs among older Europeans were identified in studies such as those conducted by Arnault, Jusot and Renaud (2022), and Smolić, Čipin and Međimurec (2022) with

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[2] Available upon request from the authors.

the SCS1 data. While those who lived in urban areas had higher odds of reporting unmet healthcare needs after the pandemic, it is interesting to note that they were more likely to utilize TM. Overall, there is an assertion that discrepancies in TM utilization were present throughout the COVID-19 pandemic, with the utilization patterns notably affected by urbanicity (Cantor et al., 2021; Frydman et al., 2022). Additionally, studies conducted outside of Europe, in settings like Korea (Kim, You and Shon, 2021; Kim and Hwang, 2023) and the US (Zhong, Huisingh-Scheetz and Huang, 2022), have detected poor economic status, i.e. lower income, or urban area of residence (Cantor et al., 2021) as significant factors contributing to unmet healthcare needs among older adults.

Regarding our explanatory variables of interest, we showed that older adults who utilized remote healthcare during the pandemic had higher odds of reporting unmet healthcare needs after the pandemic. This could suggest that although TM expanded during the pandemic, it may not have entirely resolved the healthcare access challenges for some vulnerable population groups as a result of the pandemic. Research conducted by Smith and Balvin (2021) illustrated that despite the increased adoption of TM in the initial months of the pandemic, unmet healthcare needs continued to persist. Before the pandemic, research also demonstrated a strong association between unmet healthcare needs and the various types of TM networks (Kim et al., 2018). An alternative interpretation of this finding is that individuals who were more likely to report unmet healthcare needs after the pandemic – even though they utilized TM during the pandemic – were also those with poorer SRH and probably with greater healthcare needs. For most of them, TM represented merely an additional avenue for access to healthcare. Therefore, TM did not completely compensate for the absence or limited access to healthcare during the pandemic, but it mitigated the adverse effects to some extent. Our findings support this notion (see table 1). For instance, significantly higher odds of utilizing remote consultations during the pandemic were observed for older adults with chronic illness(es).

Our findings on the association of past and current unmet healthcare needs also indicate that some individuals may persistently encounter unmet healthcare needs over an extended duration. We demonstrated that the unmet healthcare needs experienced in the past, particularly during the pandemic, play a significant role in determining the occurrence of unmet healthcare needs among older adults after the pandemic. This finding deserves special attention considering the well-documented findings that having unmet healthcare in the past is associated with a higher risk of mortality (Alonso et al., 1997; Lindström, Rosvall and Lindström, 2020). Additionally, we presented evidence to show that respondents' exposure to COVID-19, either personally or by having someone close who had symptoms, tested positive, was hospitalized or died due to COVID-19, is also an important determinant of unmet healthcare needs among older adults. This association can be explained in two different ways. Firstly, exposure to COVID-19 infection may have adverse effects on individuals' health, leading to long-term negative health consequences (Ma et al., 2022; del Rio, Collins and Malani, 2020). This, in turn, could lead to increased demand for healthcare after the pandemic, particularly

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considering health treatments that were deferred or denied at the onset of the pandemic to curb the spread of the virus. Secondly, exposure to COVID-19 could have prompted some individuals to forgo medical appointments to avoid getting infected. Given that COVID-19 infection is still possible even today, the fear of infection constitutes one of the personal choices related to unmet healthcare (Smolić, Fabijančić and Blaževski, 2023).

6 CONCLUSION

Despite the accelerated adoption of TM during the COVID-19 pandemic, the lack of fully developed telehealth infrastructure may have introduced or exacerbated challenges, particularly in terms of human resource availability (Alami et al., 2021). While TM is recognized as a valuable tool for improving healthcare access, its reach has been somewhat limited due to factors such as low digital literacy among potential users, inadequate infrastructure, and the lack of clear reimbursement policies. In early 2020, as the pandemic disrupted traditional in-person care, governments swiftly embraced TM to maintain healthcare access (OECD, 2023). However, the uneven uptake of TM across health systems, due to the lack of a pre-existing TM network, raised challenges in terms of human resources and organization (Alami et al., 2021). Although TM accessibility and utilization increased during the pandemic, disparities persist, particularly among older adults. The recent health crisis has significantly raised awareness of TM among healthcare providers, patients, and society as a whole. As we move beyond the pandemic, it is crucial to consider the role of TM in the post-pandemic era (Thomas et al., 2022). However, future considerations regarding TM may present a challenge as scientific advice takes a backseat to economic and political considerations, and public support for restrictions diminishes with improving epidemiological conditions (Sagan et al., 2022). Nevertheless, we should be aware again that the COVID-19 crisis exposed weaknesses in healthcare infrastructure and exacerbated health inequalities (Alami et al., 2021).

Europe exhibits significant diversity in the regulation of TM and the provision of remote healthcare and the COVID-19 pandemic had contrasting effects on the expansion of TM across European healthcare systems. It accelerated the TM expansion in EU member states like Finland, the Netherlands, or Sweden, which already had established remote healthcare systems and corresponding payment mechanisms. Moreover, it encouraged the implementation and development of TM in countries such as Italy, Belgium, Denmark, Czechia, Slovenia, etc., which lacked an institutional framework for remote healthcare before the pandemic. Despite the pandemic, certain countries, including Austria, Spain, Greece, or Cyprus, have not yet established a more comprehensive system for continuous remote healthcare, limiting their offerings to e-prescriptions or telephone-based mental healthcare options (Waitzberg et al., 2022; HSRM, 2023).

In conclusion, this study offers valuable insights into the factors influencing healthcare access in the post-pandemic period. Policymakers should take note of the significance of previous unmet healthcare needs in understanding current

healthcare access challenges. It is essential to identify the components that contribute to policy-practice gaps when discussing any broader TM adoption among older adults. These components typically encompass the lower digital skills of older adults, the negative perception of TM, and the inadequate responses from key healthcare system stakeholders due to resource constraints, clear reimbursement policies, compliance and standards. Despite the inequalities in TM access, it offers a promising avenue for addressing health disparities, as it has the potential to benefit vulnerable populations. This includes older adults with poorer health and socioeconomic status, those significantly affected by the COVID-19 pandemic, or those who live alone.

7 STUDY LIMITATIONS

We acknowledge several limitations in our study. We employed a non-standard set of predictors to examine the unmet healthcare needs of individuals aged 50 and above during the pandemic, all of which were self-reported. Additionally, our study lacks the ability to distinguish between various types of remote healthcare services utilized. Our estimates of remote healthcare use may be biased upwards, as we may have included TM services that cannot be attributed explicitly to telehealth. Furthermore, we recognize that differences in TM settings across European countries, particularly in terms of regulations and payment structures, may have affected the availability (supply) of TM services. Despite these limitations, we believe our findings remain valuable in uncovering important determinants of unmet healthcare needs in the post-pandemic period. They could also serve in fostering more in-depth discussions on the significance of TM in ensuring ongoing healthcare access for vulnerable populations.

Disclosure statement
None of the authors have any conflict of interest to declare.

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FIGURE A1

Effects on the probability of unmet healthcare in SHARE Wave 9 at country level with 95% confidence intervals
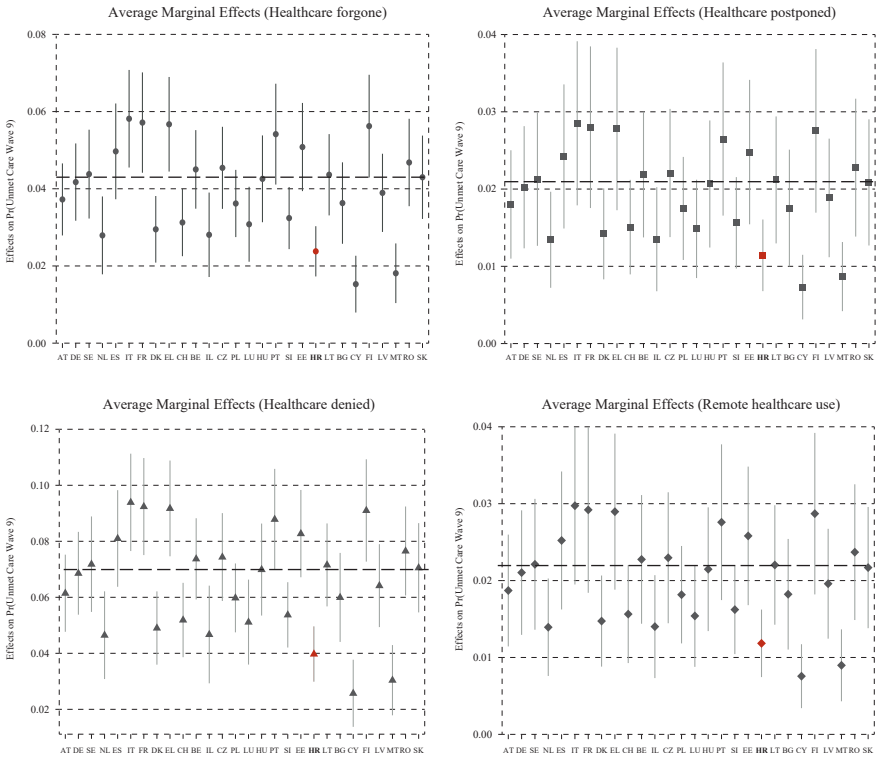
Note: Average marginal effects for healthcare forgone 4.3 percentage points, healthcare postponed 2.1 percentage points, healthcare denied 7 percentage points and remote healthcare use 2.2 percentage points (dashed lines).

Source: Authors' calculations based on SHARE Wave 8 COVID-19 Survey release 8.0.0., Wave 9 COVID-19 Survey release 8.0.0., Preliminary Wave 9 Release version 0.

TABLE A1

Average marginal effects for selected predictors at country level

Country	(1) Healthcare forgone	(2) Healthcare postponed	(3) Healthcare denied	(4) Remote healthcare use
Austria	0.0372***	0.0180***	0.0615***	0.0187***
	(0.00476)	(0.00358)	(0.00703)	(0.00371)
Germany	0.0417***	0.0202***	0.0686***	0.0210***
	(0.00511)	(0.00403)	(0.00754)	(0.00413)
Sweden	0.0438***	0.0213***	0.0718***	0.0221***
	(0.00587)	(0.00439)	(0.00870)	(0.00434)
Netherlands	0.0279***	0.0134***	0.0465***	0.0139***
	(0.00515)	(0.00317)	(0.00799)	(0.00323)
Spain	0.0497***	0.0242***	0.0810***	0.0252***
	(0.00633)	(0.00476)	(0.00880)	(0.00458)
Italy	0.0581***	0.0285***	0.0939***	0.0297***
	(0.00645)	(0.00542)	(0.00887)	(0.00523)
France	0.0572***	0.0280***	0.0924***	0.0292***
	(0.00663)	(0.00534)	(0.00884)	(0.00550)
Denmark	0.0295***	0.0142***	0.0490***	0.0147***
	(0.00440)	(0.00300)	(0.00668)	(0.00302)
Greece	0.0567***	0.0278***	0.0917***	0.0290***
	(0.00625)	(0.00537)	(0.00872)	(0.00518)
Switzerland	0.0313***	0.0151***	0.0519***	0.0156***
	(0.00446)	(0.00312)	(0.00677)	(0.00325)
Belgium	0.0450***	0.0219***	0.0737***	0.0228***
	(0.00519)	(0.00415)	(0.00739)	(0.00427)
Israel	0.0281***	0.0135***	0.0467***	0.0140***
	(0.00558)	(0.00344)	(0.00890)	(0.00341)
Czechia	0.0454***	0.0221***	0.0744***	0.0230***
	(0.00542)	(0.00423)	(0.00800)	(0.00434)
Poland	0.0362***	0.0175***	0.0598***	0.0182***
	(0.00444)	(0.00340)	(0.00627)	(0.00323)
Luxembourg	0.0308***	0.0148***	0.0511***	0.0154***
	(0.00495)	(0.00325)	(0.00774)	(0.00338)
Hungary	0.0426***	0.0207***	0.0699***	0.0215***
	(0.00574)	(0.00420)	(0.00838)	(0.00411)
Portugal	0.0542***	0.0265***	0.0879***	0.0276***
	(0.00667)	(0.00506)	(0.00918)	(0.00517)
Slovenia	0.0324***	0.0156***	0.0537***	0.0162***
	(0.00411)	(0.00302)	(0.00595)	(0.00295)
Estonia	0.0508***	0.0248***	0.0827***	0.0258***
	(0.00583)	(0.00477)	(0.00795)	(0.00460)
Croatia	0.0238***	0.0114***	0.0397***	0.0118***
	(0.00332)	(0.00236)	(0.00504)	(0.00224)
Lithuania	0.0436***	0.0212***	0.0716***	0.0220***
	(0.00537)	(0.00419)	(0.00756)	(0.00396)

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ŠIME SMOLIĆ, NIKOLA BLAŽEVSKI AND MARGARETA FABIJANČIĆ: PERCEIVED UNMET HEALTHCARE NEEDS AMONG OLDER EUROPEANS IN THE COVID-19 PANDEMIC AND BEYOND: THE TELEMEDICINE SOLUTION

Country	(1) Healthcare forgone	(2) Healthcare postponed	(3) Healthcare denied	(4) Remote healthcare use
Bulgaria	0.0363***	0.0175***	0.0600***	0.0182***
	(0.00538)	(0.00385)	(0.00811)	(0.00367)
Cyprus	0.0153***	0.00731***	0.0257***	0.00757***
	(0.00375)	(0.00213)	(0.00612)	(0.00212)
Finland	0.0562***	0.0275***	0.0910***	0.0287***
	(0.00679)	(0.00540)	(0.00932)	(0.00536)
Latvia	0.0389***	0.0189***	0.0642***	0.0196***
	(0.00517)	(0.00391)	(0.00755)	(0.00364)
Malta	0.0181***	0.00867***	0.0304***	0.00898***
	(0.00394)	(0.00228)	(0.00640)	(0.00239)
Romania	0.0468***	0.0228***	0.0765***	0.0237***
	(0.00578)	(0.00455)	(0.00810)	(0.00450)
Slovakia	0.0430***	0.0209***	0.0705***	0.0217***
	(0.00551)	(0.00417)	(0.00813)	(0.00402)
Observations	37,225	37,225	37,225	37,225

Note: Standard errors in parentheses: *** p<0.01. How to read the results in the table? For example, persons aged 50 and older in Austria who have forgone healthcare due to fear of COVID-19 infection had, on average, a 3.7 percentage points higher probability of reporting unmet healthcare needs after the pandemic compared to those who did not forgo their medical treatments due to fear.

Source: Authors' calculations based on SHARE Wave 8 COVID-19 Survey release 8.0.0., Wave 9 COVID-19 Survey release 8.0.0., Preliminary Wave 9 Release version 0.

How can the preferences of policy makers be operationalised in optimum control problems with macroeconometric models? A case study for Slovenian fiscal policies

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Abstract

In this paper, we use the results of a survey among Slovenian politicians in order to design an objective function for an optimal control problem with a macroeconometric model for fiscal policy in Slovenia that takes account of policy makers' preferences. The paper discusses three different scenarios in which the policy preferences revealed in interviews can be included in the objective functions of the control problems. These objective functions are then used to calculate optimal fiscal policies for the Slovenian economy until 2030. For this purpose, we utilise the macroeconometric model SLOPOL10 and the OPTCON2 algorithm. The results indicate qualitatively similar behaviour of the optimised dynamic system and a better performance (lower values of the loss due to deviation from "ideal" paths) from a ranking-based approach than from an ad-hoc assumption of policy makers' preferences. We sketch how to integrate the approach in a decision-support system for macroeconomic policy design.

Keywords: policy preferences, macroeconomics, fiscal policy, Slovenia, optimum control

1 INTRODUCTION

The optimal control framework allows the calculation of optimal policies according to predefined targets of the decision maker, usually the government of the country under consideration. This approach originates in the work of Chow (1975; 1981) and Kendrick (1981; 1988), among others. Blueschke, Weyerstrass and Neck (2016) and Neck, Blueschke and Weyerstrass (2011) are examples of such studies for the Slovenian economy. Due to a series of international (global or EU-wide) shocks as well as structural problems, especially in the banking sector (IMF, 2017), the Slovenian economy experienced a rapid increase of public debt, giving rise to an urgent need for budget stabilisation policies. However, stabilising public debt is not the single aim of policy makers in Slovenia. There are many different objectives such as growth, employment and price stability, that need to be taken care of at the same time. The optimal control framework helps the main trade-offs in an economy to be identified and enables recommendations for policy makers on how to design fiscal (and/or monetary) policies in order to approximate the given targets in the best way to be derived.

The common way of defining the objective function is to use well known and well justified setups from the literature. Often, an intertemporal objective function is formulated and optimised, subject to an empirical (econometric or other) model of the economy using optimum control techniques. In this study we go one step further and include the results of a survey of policy makers in the Slovenian government. The aim is to be able to design an objective function that is closer to the policy makers' opinions as to the importance of different targets. The final process of deriving optimal policy reactions is rather standard and similar to the methodologies presented in Neck, Blueschke and Weyerstrass (2013) and Blueschke, Weyerstrass and Neck (2016). In this paper we concentrate on the problem of how

to include the policy preferences of the policy makers in the objective function. This is a problem because of the different scales of the considered targets and from non-unique ways of operationalising them.

The structure of the paper is as follows: section 2 gives a brief overview of approaches to and applications of empirically obtained objective functions for optimising policy studies. Section 3 describes the econometric model, while the optimal control framework of the study on budgetary policy is presented in section 4. In section 5, we report on the survey of policy priorities we conducted among Slovenian policy makers. Section 6 describes how we transformed the ordinal results of the survey into possible cardinal specifications of the weights of the quadratic objective function, providing some results for our policy problem. Section 7 concludes.

2 PREVIOUS WORK ON THE SPECIFICATION OF AN OBJECTIVE FUNCTION

The optimal control approach and, more generally, the optimisation approach to quantitative economic policy design consists of two elements: an empirically relevant model and an objective function to be optimised. While a large body of literature exists on modelling building and estimating economic models from empirical data, in particular, for econometric models and, more recently, on the calibration of dynamic stochastic general equilibrium and related macroeconomic models, the literature on the specification of the objective function is rather meagre. If the objective function is interpreted as a social welfare function, there is plenty of literature on social choice. However, in addition to the problem of aggregating individual preferences into an expression such as "social welfare", this kind of interpretation might only be useful for normative analyses at best and would not be very relevant for actual policy making by real politicians, particularly as they have their own ideas about "social welfare" and may also have their own preferences that are not necessarily the same as those covered by "social welfare" (however defined). For practical purposes of policy analysis and design, it is much more appropriate to interpret the objective function as an expression of the preferences of those responsible for actual policy making, as we do in this study, that is, of real politicians, whether they are acting (in their view) in society's best interests or also have partly or entirely selfish motivations.

The investigation of policy makers' preferences started in the early years of quantitative economic policy analysis and was carried out by the first Nobel laureates in economic sciences, Frisch (see Bjerkholt, 1995) and Tinbergen (1952), the fathers of the theory of quantitative economic policy. Ragnar Frisch proposed using interview techniques to quantify the preferences of decision makers and applied them so as to include the results of an interview with leading Norwegian politician (and later prime minister) Trygve Bratteli (see Bjerkholt, 1995) in his analyses using his Oslo Median Model of the Norwegian economy. Frisch (1976) contains a methodological discussion of his approach.

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DMITRI BLUESCHKE, KLAUS WEYERSTRASS, REINHARD NECK AND MIROSLAV VERBIČ:
HOW CAN THE PREFERENCES OF POLICY MAKERS BE OPERATIONALISED IN OPTIMUM CONTROL
PROBLEMS WITH MACROECONOMETRIC MODELS? A CASE STUDY FOR SLOVENIAN FISCAL POLICIES

The tradition founded by Frisch did not find many followers. Johansen (1974) was one of them; other work in this direction, combining Frisch's approach with that of Tinbergen, was done with Dutch political parties in the Netherlands in the 1980s (Merkies, 2002) and for the USA in Swank's (1990) PhD dissertation, which was closer to the revealed-preferences approach of Friedlaender (1973). More recent work in this direction includes Krause and Méndez (2005), Aguiar and Martins (2005) and Best (2017). Methodological contributions to various ways of constructing objective functions for macroeconomic policy making are covered in the volumes edited by Tangian and Gruber (1997; 2002). In this paper, we want to contribute to the literature initiated by Ragnar Frisch and combine his idea of using interviews with the optimal control approach to economic policy design by means of a real-world example from Slovenia.

3 THE ECONOMETRIC MODEL

In this study we use the SLOPOL10 model, a medium-sized macroeconometric model of the small open economy of Slovenia. In the version used here, SLOPOL10 (SLOvenian economic POLicy model, version no. 10) consists of 75 equations, 23 of which are behavioural equations and 52 identities. In addition to the 75 endogenous variables, the model contains 41 exogenous variables. The estimation of the behavioural equations used the software program EViews, with quarterly data for the periods 1995Q1 to 2015Q4. Almost all behavioural equations are specified in error correction form. The model should allow for forecasts and policy simulations for the near future. Statistical tests performed for the past showed that the model exhibits acceptable quality for policy makers to use it for determining optimal policies. Improvements in the light of new data were made later when updating the model for these purposes due to the COVID-19 pandemic (which could not be foreseen when this study started in 2017, of course); see Weyerstrass et al. (2023).

The model contains behavioural equations and identities for the goods market, the labour market, the foreign exchange market, the money market and the government sector. The model combines Keynesian (with rigidities of wages and prices) and neoclassical elements, the former determining the short and medium-run solutions in the sense that the model is demand-driven and persistent disequilibria in the goods and labour markets are possible. In the following, we describe the key model equations verbally. Graph 1 is a diagram of the building blocks of the model. A detailed description of the version used here can be found in Weyerstrass et al. (2018).

The supply side incorporates neoclassical features. Potential output is determined by a Cobb-Douglas production function with constant returns to scale. It depends on trend employment, capital stock and autonomous technical progress. Trend employment is defined as the labour force minus natural unemployment, the latter being defined via the non-accelerating inflation rate of unemployment (NAIRU). NAIRU, which approximates structural unemployment, is estimated by applying the Hodrick-Prescott (HP) filter to the actual unemployment rate. For forecasts and simulations, the structural unemployment rate is then extrapolated with an autoregressive (AR) process. Capital stock enters the determination of potential

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GDP not with its trend but with its actual level. Technical progress is determined as follows: Firstly, ex-post total factor productivity (TFP) is calculated as the Solow residual. Secondly, the trend of technical progress is determined by applying the HP filter in a procedure similar to NAIRU. The trend of the TFP is explained in a behavioural equation with the share of people with tertiary education in the labour force, the real investment ratio and lagged real government spending on research and development (R&D) as explanatory variables.

GRAPH 1

SLOPOL10 building blocks

On the demand side, the consumption of private households depends on current disposable income and on the long-term real interest rate. Real gross fixed capital formation is influenced by the change in real disposable income and by the user cost of capital, the latter being equal to the real interest rate plus the depreciation rate of capital stock. Changes in inventories are exogenous. Real exports of goods and services are a function of the real exchange rate and foreign demand for Slovenian goods and services, with foreign demand being approximated by the volume of world trade. Real imports of goods and services depend on domestic final demand and on the real exchange rate.

On the labour market, the labour demand of companies (actual employment) is modelled via the employment rates of two age groups (15 to 64 years, 65 years and above), i.e. employment as a share of the relevant age group in the total population. Both employment rates depend positively on real GDP and negatively on the real net wage and the wedge between the gross and the net wage. Labour supply is modelled via the share of the labour force of the two age groups in the total population. Labour supply depends positively on the real net wage and, like employment, negatively on the wedge between the gross and the net wage.

In the wage-price system, gross wages, the harmonised index of consumer prices (HICP) for Slovenia and various deflators are the endogenous variables. The gross wage rate depends on the price level, labour productivity and the unemployment rate. The consumer price index depends, via the consumption deflator, on domestic (unit labour costs and the capacity utilisation rate) and international (approximated by the import deflator) factors. The investment and the export deflators are influenced by domestic (approximated by unit labour costs) and imported (the import deflator) cost elements. The import deflator depends on the oil price in euro as a proxy for international raw material prices.

On the money market, the short-term interest rate has a link to its euro area counterpart to capture Slovenia's euro area membership. The long-term euro area interest rate is a regressor in the equation determining the long-term interest rate in Slovenia, which is also linked to the short-term rate and contains the debt-to-GDP ratio. The foreign exchange market is modelled by the real effective exchange rate against a group of 41 countries. As Slovenia has only been a euro area member state since 2007, for the period before that, the bilateral exchange rate between the Slovenian tolar and the euro is the explanatory variable in the real effective exchange rate equation; furthermore, the exchange rate between the euro and the US dollar and the domestic inflation rate are regressors.

In the government sector of the model, the most important expenditure and revenue items of the Slovenian budget in the model are: social security contributions by employees and by companies, income and profit tax payments, value added tax revenues and other direct and indirect taxes; all of them depend on institutional factors as well as on GDP and its components. Interest payments on public debt depend on the lagged debt level and on the long-term interest rate. Public consumption and transfer payments to private households as well as the remaining public expenditures and revenues are exogenous. By definition, the budget balance is the difference between total government revenues and expenditures. The public debt level is extrapolated using the budget balance equation. The model is closed by a number of identities and definition equations.

As can be seen from graph 1, the fiscal policy instruments directly affect the goods market, i.e. GDP and its components (both real and nominal). The primary effect is on the demand side as in most Keynesian models. Indirect effects also come from the

supply side via real GDP, capital stock, the labour market and the wage-price system. Simulations showed that government expenditures have a strong effect on GDP while government revenues (through tax rates) affect the labour market and employment strongly. The side effects on public debt originate directly from the policy variables and indirectly from nominal GDP. Long-run effects lead to convergence of the model to a balanced growth path, with real GDP and its components growing at approximately the same rate and nominal GDP and its components at the same rate plus an inflation rate of 2%, with only limited effects on public debt. This long-term path, adapted for the exogenous disturbances that actually occurred, is calculated for the period under consideration. We regard it as an "ideal" path from the viewpoint of the policy makers because it shows the growth performance of the Slovenian economy under actual exogenous shocks without strong oscillations of target variables that is attainable by prudent choice of fiscal policy according to the model.

4 AN OPTIMAL CONTROL FRAMEWORK FOR BUDGET STABILISATION POLICY IN SLOVENIA

In order to obtain optimal trajectories of the fiscal policy instruments, we run several optimal control exercises using the OPTCON2 algorithm (Blueschke-Nikolaeva, Blueschke and Neck, 2012; Blueschke, Blueschke-Nikolaeva and Neck, 2021). Solving an optimum control problem implies finding certain paths of control variables which minimise an objective function involving deviations of the values of the politically relevant variables from some pre-specified target paths. As usual in economic policy applications, we assume a quadratic objective function. The problem is described as follows:

$$\min J = \sum_{t=1}^{T} L_t \left(x_t, u_t \right) \tag{1}$$

$$L_t \left(x_t, u_t \right) = \frac{1}{2} \begin{pmatrix} x_t - \tilde{x}_t \\ u_t - \tilde{u}_t \end{pmatrix}' W_t \begin{pmatrix} x_t - \tilde{x}_t \\ u_t - \tilde{u}_t \end{pmatrix} \tag{2}$$

Here x_t is an n-dimensional vector of state variables that describes the state of the economic system at time t; u_t is an m-dimensional vector of control (policy instrument) variables; $\tilde{x}_t \in R^n$ and $\tilde{u}_t \in R^m$ are given "ideal" levels of the state and control variables respectively. W_t is a matrix specifying the relative weights of the state and control variables in the objective function.

The optimisation is restricted by the dynamics of the system given in the form of a system of nonlinear difference equations:

$$x_t = f \left(x_{t-1}, x_t, u_t, \theta, z_t \right) + \varepsilon_t, \qquad t = 1, \ldots, T \tag{3}$$

where θ is a p-dimensional vector of estimated parameters and z_t denotes a vector of exogenous non-controlled variables. In this study, the dynamic system f is the SLOPOL10 model. The dynamic system (3) and the objective function (1) with (2) define a multivariable nonlinear-quadratic optimum control problem to be solved.

The policy maker in this optimal control experiment is the government of Slovenia, which we assume, in 2017, could have calculated the optimal trajectories of fiscal policy instruments for the period 2018 to 2030. As we are not interested in the details of that exercise apart from comparisons of the time paths of the variables, we will denote the time index by 0 (for the initial historical period 2017), 1 …, 13. There are nine control variables (fiscal policy instruments): government consumption, transfers, government investments, public expenditure for research and development, the average personal income tax rate, the proportion of the active working population with tertiary education, the average social security contribution rate, remaining government revenues and the value added tax rate.

The definition of the objective function (2) and the corresponding choice of the weights W is the topic addressed in this study. As it is not possible and not reasonable to include all 75 endogenous (state) variables as target variables in the SLOPOL10 model, we have to choose an appropriate set of objective variables (evaluated control and state variables), taking account of the policy preferences collected from the policy makers.

5 POLICY PREFERENCES SURVEY

We conducted the survey on policy preferences in order to reveal the economic indicators deemed important in the process of policymaking. The main method used was the Delphi method, which has been used for similar forecasting purposes (e.g. Society of Actuaries, 2005; Rowe and Wright, 1999). The Delphi method was reviewed extensively in Hill and Fowles (1975), Linstone and Turoff (1975), Lock (1987), Parente and Anderson-Parente (1987), Stewart (1987) and Rowe, Wright and Bolger (1991). It was developed in the 1950s by workers at the RAND Corporation while involved in a U.S. Air Force sponsored project. More generally, the technique is a procedure to "obtain the most reliable consensus of opinion of a group of experts […] by a series of intensive questionnaires interspersed with controlled opinion feedback" (Dalkey and Helmer, 1963).

The design of our questionnaire drew on previous literature on the importance of macroeconomic aggregates for the Slovenian economy (Žižmond, 1997; Weyerstrass, Haber and Neck, 2001; Kajzer et al., 2006) as well as on the design of the macroeconometric model SLOPOL10 and previous optimisations with the OPTCON2 algorithm. It started with an introduction to the survey, the purpose of the research and instructions for the participants as well as clarifications regarding the handling of the data and the anonymisation of the responses. The main part of the questionnaire was divided into eight sections covering the macroeconomic indicators of interest.

The eight categories included in the questionnaire were GDP growth, unemployment rate, inflation rate, state budget level, trade balance, share of public debt in GDP, private consumption level and share of investment in GDP. We asked all of the participants to estimate the importance of each category for gauging the condition of the Slovenian economy by awarding the most important category 10 points (marks) and less important targets fewer points down to the least important. They

had to provide such estimates separately for 2016, 2017, 2018 and 2021. Each category also had a final open-ended question on the respondents' opinions on and justifications of the importance of the category for the Slovenian economy.

The survey was conducted between 6 June 2017 and 5 July 2017. Our sample consisted of relevant budget experts and political decision makers. For the budget experts, we addressed the six relevant members of staff at the Budget Directorate of the Ministry of Finance of the Republic of Slovenia. For the political decision makers, we approached the eight parliamentary groups in the National Assembly of the Republic of Slovenia at that time representing all of the elected political parties and the two national minorities. Thus, 14 questionnaires were distributed in all. The questionnaire was sent by e-mail, with a follow-up phone call. We received eight filled-in questionnaires by the end of the survey period. The primary data were collected in accordance with the ethical research standards on data collection and anonymisation laid down by the Research Ethics Committee of the School of Economics and Business at the University of Ljubljana.

Our expectations were that more "broad" categories like GDP growth, unemployment rate, state budget level and share of public debt in GDP would be paid more attention than the inflation rate, for example, as they were also the most vulnerable during the financial crisis in Slovenia (see Verbič et al., 2016). The level of GDP dropped significantly during the crisis, in two waves, firstly as a consequence of the crisis and secondly following the adopted austerity measures. The level of unemployment also increased significantly, particularly affecting younger people. Political reasons (changes of government, PR and media activities, policy measures, etc.) were among the main reasons why the spreads of Slovenian government bonds and, consequently, the cost of debt soared.

The results of the survey are summarised in table 1. The marks shown are the mean values of those the respondents gave to the variables. This aggregation of individual marks converts the ordinal ranking into a cardinal one, which is the simplest way of operationalising the importance of each category.

TABLE 1
The revealed policy preferences

Rank	Target	Mark (1-10)
1	GDP growth	9.5
2	Ratio of public debt to GDP	8.8
3	Trade balance	8.6
4	Unemployment rate	8.5
5	Private consumption level	8.5
6	Share of investment in GDP	8.3
7	State budget level	7.0
8	Inflation rate	6.9

Source: Authors' own calculations.

The data on policy preferences were collected in 2017, when Slovenia had a left-wing government. However, the survey targeted all of the parliamentary groups in the National Assembly of the Republic of Slovenia, not only those in the government. In addition, the relevant budget experts were surveyed, representing, in principle, the professional layer of government administration. For future research, we could additionally differentiate between the policy preferences of left-wing and right-wing political parties and then simulate specifically the policies of left-wing and right-wing governments.

6 DEALING WITH THE OBSERVED POLICY PREFERENCES

Based on the results of the survey, we selected eight "major" state variables to enter in the objective function (2), namely the growth rate of GDP (*GRGDPR*), the unemployment rate (*UR*), the inflation rate (*INFL*), the budget balance ratio to GDP (*BAL*), the debt level ratio to GDP (*DEBT*), the current account balance ratio to GDP (*CAGDP*), real private consumption (*CR*) and real private investment (*PRINVR*).

As the model and control variables consider the supply side of the economy as well, it is necessary to include certain corresponding variables in order to allow for an optimal solution for the entire model and to avoid strong oscillations of the time paths of the major target variables. We added three variables from the supply side to enter the objective function (2), namely the level of real GDP (*GDPR*), the growth rate of potential GDP (*GRYPOT*) and the level of potential GDP (*YPOT*). In order to take it into account that these variables were not named by the politicians, they had significantly lower weights and are called "minor" target variables. As a starting point we attach to each of these "minor" variables a weight of 1 in the matrix *W*. The next step is to attach corresponding weights to the major variables based on the observed preferences as given in table 1. To this end we define four different optimisation scenarios as summarised in table 2.

TABLE 2

Scenarios including the revealed policy preferences

	BAL	CAGDP	CR	DEBT	GDPR	GRGDPR	GRYPOT	INFL	INVR	UR	YPOT
sc0	1	1	1	1	1	1	1	1	1	1	1
sc1	2	2	2	2	2	1	2	1	2	2	1
sc2	7	8.6	8.5	8.8	1	9.5	1	6.9	8.3	8.5	1
sc3	3	7	5	8	1	9	1	2	4	6	1

Source: Authors' own calculations.

Scenario 0 (sc0) is regarded as a baseline solution where all targets have the same weight. Of course, all the weights are normalised according to the time-series characteristics of the variables. Scenario sc1 is the simplest way of including the observed information, that is, by defining just two groups: "minor" variables with a weight of 1 and "major" ones with a weight of 2. In this case the ranking of the targets as expressed by the politicians was ignored and simple inclusion in the decision-making process is crucial. In sc2, the numbers from the right column of

table 1 are taken one-to-one and converted into the objective function. Finally, sc3 takes advantage of the rank order in a different form and converts it into a weighting matrix by increasing the weights by one for each target from the bottom to the top of table 1. Thus, *INFL* gets a weight of 2, as it is least in the ranking. The second last variable, *BAL*, gets the weight 3 and so on. The most important target, *GRGDPR*, gets the highest weight 9.

In addition, we assume "ideal" paths for all of the target variables to be reached as closely as possible by the optimal policies in the optimal control framework. The "ideal" paths imply smooth growth in the income variables and low values for the rates of unemployment and inflation, as sketched in section 3 above.

Using the specified targets and weights, we are able to carry out the optimal control exercise and to calculate optimal fiscal policies. In this study we are not interested in the optimal paths themselves; instead, the focus is on the effects caused by the different ways of including observed policy preferences. Table 3 summarises the objective function values for each path of the considered state variables. In order to make the objective values comparable, the weighting matrix from the baseline scenario is used to evaluate the optimal paths. In addition to these individual targets, table 4 includes the sums of the objective function values over all states (sum_*J*_states), all controls (sum_*J*_controls) and the total sum of the objective function (sum_*J*_all). These show the contributions of the aggregated deviations of the states, the controls and the two combined from the "ideal" paths to the total loss in the scenario concerned.

TABLE 3
Objective function values for individual target state variables*

	BAL	CAGDP	CR	DEBT	GDPR	GRGDPR	GRYPOT	INFL	INVR	UR	YPOT
sc0	6.7	13.7	1.7	1.9	2.8	11.2	12.6	22.8	1.6	9.7	2.3
sc1	5.4	12.9	1.6	1.5	2.7	10.2	10.5	21.4	1.4	7.9	1.9
sc2	3.2	10.3	1.3	0.7	2.2	7.1	7.2	18.3	0.9	4.1	0.8
sc3	5.7	11.3	1.3	0.6	2.2	6.5	10.6	22.2	1.3	4.4	1.7

* A lower value means less deviation from the "ideal" path.
Source: Authors' own calculations.

TABLE 4
Aggregated objective function values*

	sum_*J*_states	sum_*J*_controls	sum_*J*_all
sc0	87.0	54.7	141.7
sc1	77.4	67.4	144.8
sc2	56.2	144.8	201.1
sc3	67.8	107.7	175.4

* With weights from sc0, thus, sc0 produces the best results.
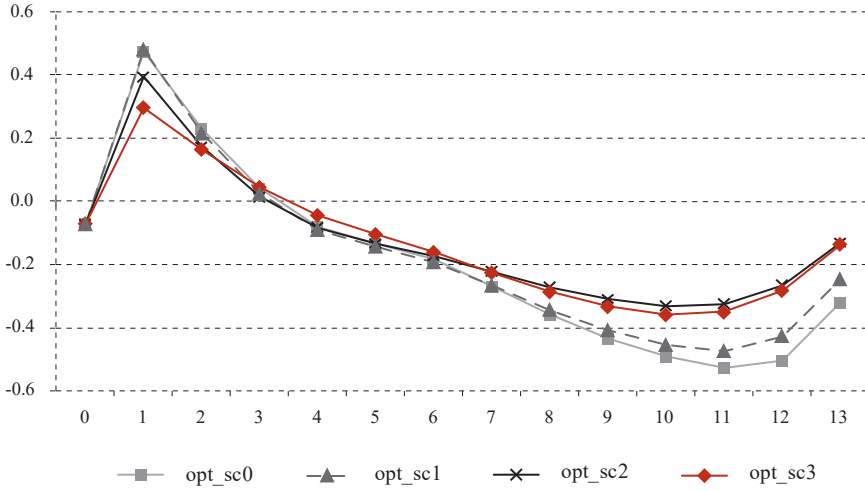*Source: Authors' own calculations.*

We can conclude from tables 3 and 4 that scenarios with weights derived from the revealed preferences (sc2 and sc3) lead to a better performance (lower values of sum_J_states) of the most important state variables than in sc1. This is only possible at the cost of a more active use of the control variables, however, leading to higher overall objective function values. Scenario 2 is the one with the largest deviations of the controls from the baseline as it accords the highest importance to the selected major target variables. However, taking the large losses by the controls (summarised by sum_J_controls) into account and the fact that the choice of the weights is rather ad hoc, taken directly from the data collection process, it is questionable whether sc2 is a good strategy. Furthermore, scenario 1 seems to be too similar to the baseline solution, which may mean that the revealed preferences are not taken into account properly. In contrast, scenario 3 seems to be a good compromise between paying enough attention to the observed preferences and not requiring too much action, which is quite often considered to be undesirable. In this scenario, the summarised objective function value (sum_J_all) increases "only" by less than 25% above its baseline value (sc0).

More information can be obtained from a detailed inspection of the results. Graphs 2-7 show the time paths of the deviations of some key target variables (graphs 2-6) and one instrument variable (graph 7) from their assumed "ideal" paths (which were not changed in the optimisation experiments). They show that the paths of the (endogenous) target variables are mostly close to their "ideal" paths while the reverse is true for the instrument variables (graph 7; similar for the other instruments) resulting from the optimisation runs. In particular, the public-debt-to-GDP ratio (graph 4) is always closer to its "ideal" path in the scenarios using the policy preferences from our procedure (scenarios 1-3), although the budget balance is further away from its "ideal" path. These results show that a more active (counter-cyclical) use of fiscal policy instruments can lead to improvements in terms of the revealed objectives of the policy makers without intolerable side effects on public deficit and debt. In addition, other simulations have shown that a better combination of the instruments with a more active use of government investment and a more restrictive use of government consumption leads to a more favourable outcome in terms of the trade-off between GDP growth and fiscal stability (see Weyerstrass et al., 2020; Neck et al., 2021).

The results in graphs 2-7 support the insights from the objective function values. In all scenarios we can observe qualitatively similar paths to the optimal results from the baseline scenario. The impact of the inclusion procedure is rather restricted to the level of activity of using the policy instruments. The additional losses for the control variables in scenarios 2 and 3 are due to the larger deviations from their given "ideal" values than in the baseline scenario.

GRAPH 2

Growth rate of GDP, %

Source: Authors' own calculations.

GRAPH 3

Budget balance ratio to GDP, % of GDP
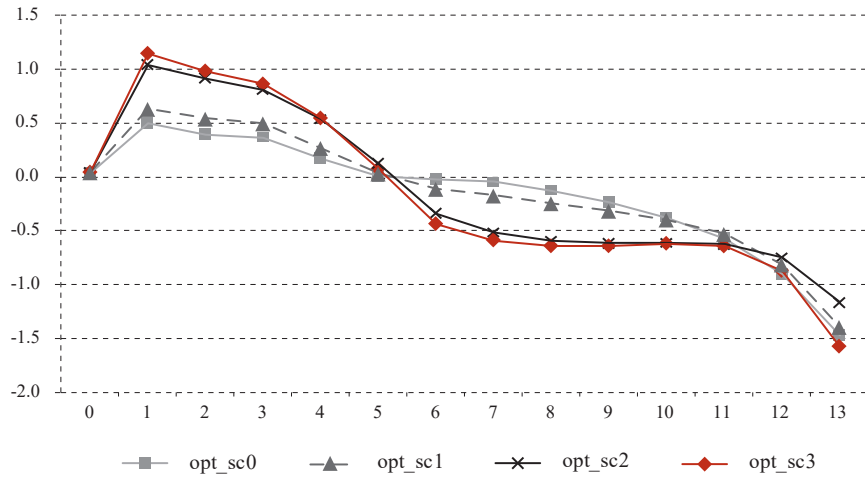
Source: Authors' own calculations.

GRAPH 4

Public debt, % of GDP
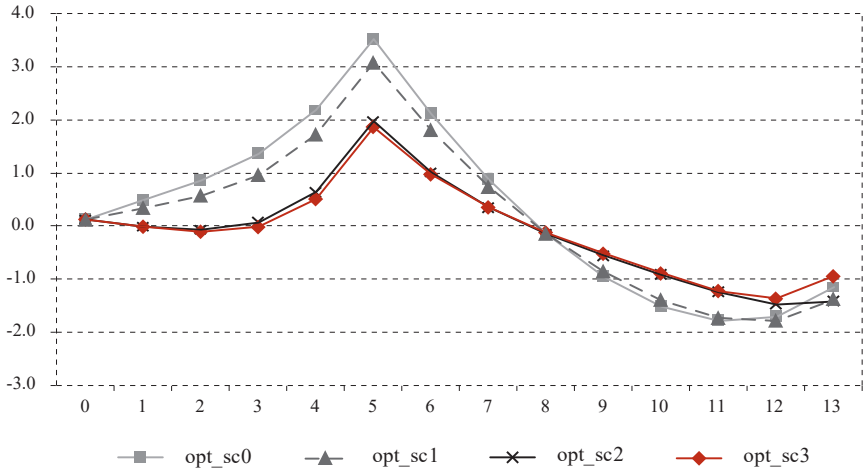
Source: Authors' own calculations.

GRAPH 5

Inflation rate, %

Source: Authors' own calculations.

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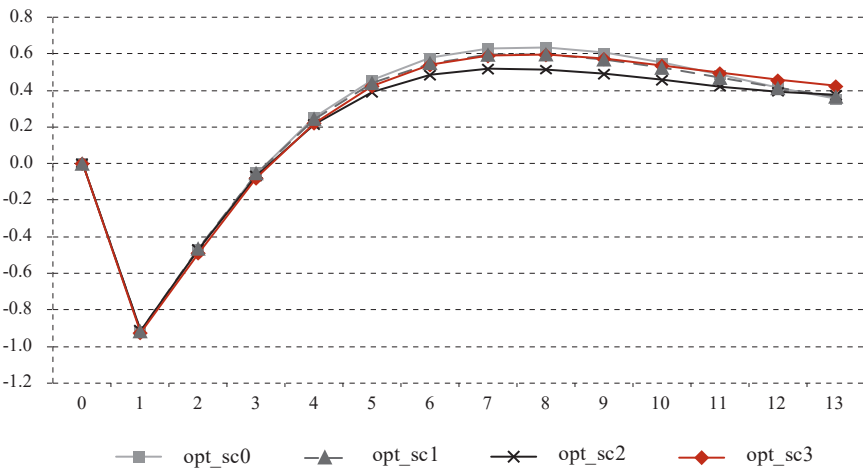
DMITRI BLUESCHKE, KLAUS WEYERSTRASS, REINHARD NECK AND MIROSLAV VERBIČ:
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GRAPH 6

Government investment, mn. euro
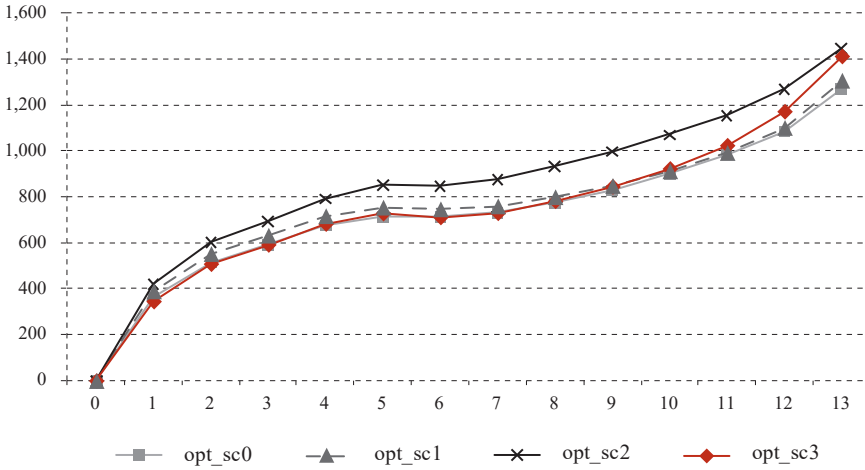
Source: Authors' own calculations.

GRAPH 7

Government consumption, mn. euro
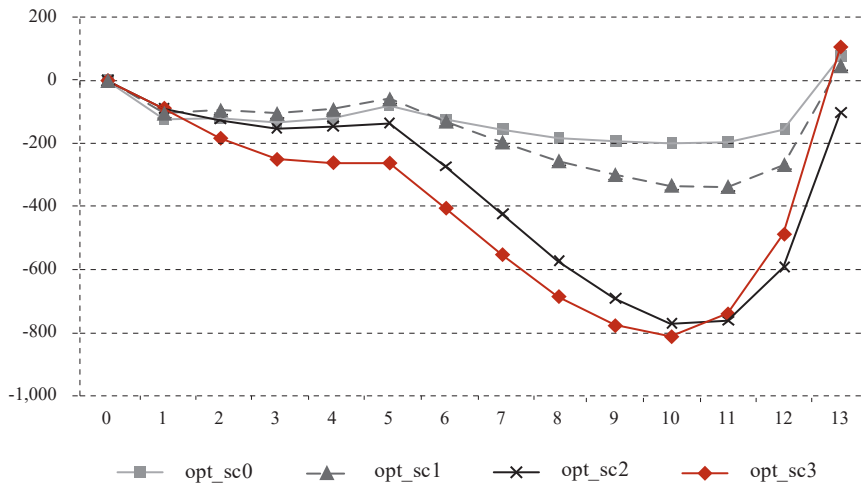
Source: Authors' own calculations.

A more comprehensive analysis would also consider variations in the assumed "ideal" paths of the objective variables and other parameters of the objective function. Previous work in this direction was done for Austria by Neck and Karbuz (1997) and Weyerstrass and Neck (2002). It showed that the variation most relevant for the results was the weights and not the planning horizon or the discount factor; hence we did not consider these elements of the objective function here. Changing the "ideal" paths of the objective variables was not investigated here either because demanding evaluations of such alternatives would have asked too

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much of the policy makers in view of their time constraints. In a more comprehensive analysis, this exercise would have to be included, although for this purpose, not only actual policy makers but also their advisors and other experts (and possibly a representative sample of voters) would have to participate in an interactive process in which they would be shown the results of their stated preferences and the simulations would be adapted accordingly.

The next step would be to do a systematic analysis of all of these variations and their results and to present them to the policy makers in second and further rounds to obtain their views on the different scenarios. The ultimate aim of such an iterated interaction between the modellers and the policy makers is a decision-support system for actual policy decisions relating to current or future fiscal policy. This will be a task for future research, requiring a much larger project, ideally over a longer time horizon.

7 CONCLUSIONS

In this paper, we use the results of a survey among politicians in Slovenia to find an objective function for an optimal policy problem that is closer to what policy makers in this country really want. We show different ways of incorporating the observed data in an objective function and revealing the impact of these procedures on the minimal losses resulting from optimum control scenarios for fiscal policy design. The results indicate qualitatively similar behaviour for the optimal trajectories. A slightly better performance of a ranking procedure incorporating policy preferences can be observed, in particular with respect to the trade-off between economic growth and the sustainability of budgetary policy. The main contribution of this paper is a modest step towards developing a tool supporting policy makers in their decisions about how to design fiscal policy with respect to macroeconomic targets. The preferences of policy makers are often not very explicit and asking them to reveal them at least in an ordinal manner may be the only way to extract some information from them. We showed that there are several possibilities by which such incomplete information can be converted into input for use in an optimisation procedure with optimum control techniques. For this purpose, we concentrated on the weights of the instruments and the targets in the objective function of the policy makers and gave only a few hints on other elements of such an optimisation problem. Further research will have to extend the analysis in the direction of creating a comprehensive decision-support system for macroeconomic policy decisions.

Disclosure statement
All authors declare that they have no conflicts of interest.

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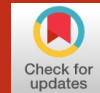
Taxpayers' attitudes toward tax compliance in the Slovenian tax system: differences according to gender, income level and size of settlement

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Abstract

This study investigates the relationship between certain economic and psychological factors and demographic characteristics of Slovene taxpayers, such as gender, income level and size of settlement as it is becoming important for a country's tax compliance framework to align with the tax recommendations of global institutions. The results show some gender differences, with males being less likely to feel guilty or bad if taxes are not paid in full than females, whereas females tend to have the opinion that working for cash-in-hand payment without paying tax is not a trivial offence. Taxpayers with low incomes tend to agree that tax evasion is morally acceptable if tax rates are too high. Taxpayers from rural settlements exhibit a higher tendency to feel morally obligated to pay their taxes than taxpayers from urban settlements. The findings indicate that the vast majority of taxpayers feel morally obligated to pay their taxes.

Keywords: tax system, tax compliance, economic and psychological factors, gender, settlement size, income level

1 INTRODUCTION

Global institutions (UN, 2015; OECD, 2016; WTO, 2023) are exerting significant pressure on governments to achieve the sustainable development goals, enhance revenues, and strengthen tax compliance, which is why gaining a better understanding of taxpayers' behaviour has become increasingly important for alignment with the recommendations of global institutions. One way to improve a country's tax compliance framework is by analysing it from various perspectives. Individual taxpayers exhibit diverse motives, influenced by economic and psychological factors, for either complying with the rules or else engaging in tax evasion. This behaviour is also impacted by gender, income level, settlement size, age, religion, education, employment status, sector of work and other factors. The research question in this paper pertains to understanding whether taxpayers' attitudes towards the economic and psychological factors of tax compliance in Slovene tax system differ according to their gender, and whether income level and size of settlement impact compliance factors.

In the context of its Tax and Gender Equality Policy, OECD (2022) urged countries to take steps to analyse the impact of gender on tax compliance measures as 70% of the countries in their research stated that they do not collect gender-disaggregated data. Slovenia belongs among those countries in which gender-disaggregated data are available from tax returns for use in policy analysis, but it does not practice gender budgeting and has no access to gender disaggregated non-tax data available for policy analysis or detailed micro data on male and female incomes (OECD, 2022). Gender equality constitutes a core value within the European Union (Stanimirović and Klun, 2021). This fundamental value should be reflected in taxation. Countries' public policies should be designed in such a way as to take into account gender equality (Stanimirović and Klun, 2021). Taking this argument into consideration, it is not clear whether the proposed OECD measures in the 2022

report on gender equality would enhance the efficiency and effectiveness of a country's tax system, especially if the system is already gender tax neutral as per existing tax laws in Slovenia. Still, there is some empirical evidence confirming that the country has taken the first steps in gender-responsive budgeting via guidelines and recommendations (Stanimirović and Klun, 2021). However, the impact of gender on tax compliance measures has been confirmed in various studies and reports. Some studies confirm higher female levels of tax compliance globally (Hofmann et al., 2017; OECD, 2019a; D'Attoma, Volintiru and Steinmo, 2017; D'Attoma, Volintiru and Malézieux, 2020; Kangave, Waiswa and Sebaggala, 2021), while others highlighted higher male tax compliance (Grosh and Rau, 2017; Alm and Malezieux, 2021). There are also studies that have not identified any significant gender impact (Vincent, Stevenson and Owolabi, 2023; Nichita et al., 2019).

Next to gender, previous research proposed income level as a significant determinant influencing tax evasion and therefore a robust predictor of tax compliance, occasionally contingent on the geographic region (McGee, 2012; Hoffman et al., 2017; Khalil and Yusuf, 2022). Psychological research found that not just level but also the origin of income (earned or endowed) affects taxpayers' decision making and produces different behaviour (Durham, Manly and Ritsema, 2014). Higher-income taxpayers can exhibit attitudes toward the probability of audits and punishments, fairness, trust in the tax system, tax evasion, and public services that are different from those of low-income taxpayers. Elderly taxpayers and those with low income disproportionately engage in undeclared work (Levenko and Staehr, 2021). Low-income taxpayers tend to exhibit lower tax compliance than high-income taxpayers, and taxpayers with higher incomes are considered more prone to tax evasion than those with lower incomes (Hofmann et al., 2017). The investigations of income level impact on tax compliance in previous studies showed mixed results, with both a positive (Kirchler, 2007; Kirchler et al., 2007) and a negative relationship (Alm and McKee, 2006) being adduced.

Even though there has been some empirical research measuring the impact of urban or rural business location on tax compliance (Dissanayake and Premaratna, 2020; Williams, 2020), there is not sufficient research in measuring the impact of settlement on individual taxpayers with respect to tax compliance. Settlement in rural area can provide stronger social bonds and communal pressure might contribute to increased tax compliance, while in urban areas, settlements with enhanced access to tax-related information and resources, can foster a better understanding of tax regulations and consequently encourage tax compliance. The importance of this demographic factor is still not clear, but some argue (Devos, 2008) that taxpayer location has no impact on compliance.

Our study discusses the impact of three factors (gender, income level, and settlement size) that have already been addressed in previous studies. However, their combined effect on tax compliance decisions has not been examined, especially not among Slovenian taxpayers. Thus, the aim of this research is to examine the impact

of taxpayers' attitudes as the relationships between socio-demographic factors such as gender, income level, settlement size, and tax compliance. The results can provide support for policymakers when enhancing tax compliance policies and adjusting tools based on the impact of these three factors. Furthermore, they can be beneficial as support for the governments' regulatory impact assessment (RIA) of regulations and non-regulatory alternatives. If tax authorities understand the motives behind tax compliance, they will also understand and easier predict the reasons for evasion. This article makes a valuable contribution to the tax compliance literature by analysing the attitudes and influences of gender, income level, and settlement size on both the economic and psychological factors affecting taxpayers. This way a better understanding of taxpayer motivation and reasoning can be achieved.

This paper consists of six parts. After the introduction is the second section, which summarizes the theoretical literature about tax compliance factors. The third section presents an overview of empirical research, detailing the methodological aspects used in this paper and variable descriptions. In the fourth part, discussion of the main results is presented. The last section contains concluding remarks along with the potential for future research.

2 THEORETICAL BACKGROUND AND RESEARCH HYPOTHESES
2.1 TAX COMPLINACE THEORIES

Tax compliance means that taxpayers fully disclose their income and meet all tax obligations by paying the required taxes as required by law (Alm, 1991). There are two basic approaches to tax compliance; economic approach also called the Allingham and Sandmo model, the deterrence model, the expected utility theory, or the rational choice theory and the behavioural approach also called the moral sentiments theory. The behavioural approach states that taxpayers' tax compliance behaviour is influenced not only by financial factors but also by non-economic variables such as trust in government, tax morality, perception of tax justice and even by religiousness. Tax compliance is a multifaceted topic, and researchers often define it differently according to the specific nature and scope of their studies.

The basic theoretical model used in much research on tax compliance originates from Becker's work in 1968, particularly his economics-of-crime model. The conventional conclusion drawn from this model is that individuals fulfil their tax obligations primarily out of fear of being detected and penalized if they fail to report all their income (Alm, 2019). In the economic approach developed by Allingham and Sandmo (1972), taxpayers tend to engage in tax evasion and tax avoidance. Taxpayers typically conduct a cost-benefit analysis, weighing the potential penalties for irregularities and the tax loss they might incur if their tax evasion is discovered during inspections or audits against the amount of tax they would owe if they fully declared their income. If the penalty for tax evasion and detected tax loss exceeds the tax they would pay when declaring their income honestly, they are more likely to opt for full disclosure; otherwise, they may choose not to do so (Güzel, Özer and Özcan, 2019).

This approach consequently provides a logical and effective outcome, indicating that tax compliance is dependent on the possibility of audit (detection) and penalty rates. According to this, it can be concluded that tax compliance depends on enforcement elements whereas government can achieve higher tax compliance by increasing audit and penalty rates. Alm (2019) pointed that there are some problems related to the conventional expected utility approach to tax compliance since certain key predictions of this approach are not strongly corroborated by empirical evidence. For example, one prediction of the standard theory is that a higher tax rate increases compliance. Conventional approaches to improving tax compliance encompass deterrent measures such as regular audits, diverse penalty structures, and potential criminal charges (Shim, Shim and Shim, 2023). In traditional tax compliance literature, deterrence is regarded as a crucial element in the decision-making process related to tax compliance (Kogler et al., 2013). In accordance with the economic model proposed by Allingham and Sandmo in 1972, robust enforcement through rigorous audits and substantial fines stands as the foremost factor influencing tax compliance. Prior research suggests that deterrence, while important, is not the sole determinant of tax compliance and sometimes may result in negative rather than positive influences on compliance (Shim, Shim and Shim, 2023). According to this perspective, social and psychological factors, including social norms, considerations of fairness, and trust in authorities, are likely to lead to voluntary tax compliance. The slippery slope framework, proposed by Kirchler, Hoelzl and Wahl (2008), which represents the development of the economic theory of tax evasion developed by Allingham and Sandmo (1972), recognizes the interconnectedness deterrent factors that increase enforced tax compliance and social psychological factors that lead to voluntary compliance. This framework examines two dimensions: trust in the tax authority and the authority's power, and their impact on tax compliance. As a result, numerous subsequent studies drew inspiration from and were built upon this framework (Gangl et al., 2012; Batrancea et al., 2019).

Extension of the economics-of-crime model incorporated specific behavioural elements that have been explicitly addressed in other social sciences. Behavioural economics can be broadly described as an approach that utilizes techniques and insights from various fields, particularly psychology, to enhance the understanding of individual and collective decision-making processes. Behavioural economics has been employed in two overarching and interrelated dimensions. One-dimension concentrates on individual factors, while the other on group considerations. Frame dependence is often associated with an individual's psychological tendencies or cognitive limitations. Individuals are driven by diverse motivations, encompassing not only self-interest in a narrow sense but also factors stemming from collective considerations. These include concepts such as fairness, altruism, reciprocity, empathy, sympathy, trust, guilt, shame, morality, alienation, patriotism, social norms, social customs, social capital, tax morale, intrinsic motivation, and numerous other objectives (Alm, 2019). Numerous factors have the potential to influence individual decisions regarding compliance. In accordance with gender socialization theory, distinct roles and values are assigned to men and women,

leading to variations in their interests, decisions, and practices (Helmy, Dwita and Cheisviyanny, 2020). According to gender socialization theory, men are twice as likely as women to participate in unethical behaviour (Tjondoro, Widuri and Manoy, 2019). Women taxpayers have been shown to exhibit an elevated tax morality (Hartmann, Mueller and Kirchler, 2019).

The theory of planned behaviour (planned behaviour theory), a theory in social psychology, explains human behaviour by considering behavioural intentions influenced by attitudes towards three components (the behaviour, subjective norms, and perceived behavioural control) (Ajzen, 1991). According to the theory of planned behaviour (TPB), taxpayers are expected to engage in conscious decision-making, considering all the available information, they will analyse the potential consequences of their actions, resulting in their decision being influenced by a careful weighing of advantages and disadvantages, as well as the anticipated reciprocity (Sundari, Chariri and Utomo, 2022). The study by Taing and Chang (2021) uses the TPB as a conceptual framework to explore the factors influencing the compliance intentions of Cambodian taxpayers.

2.2 ECONOMIC AND PSYCOLOGICAL FACTORS OF TAX COMPLINACE
Tax compliance factors can be grouped into three categories based on the level of control power they possess. The first group of factors includes those that are under the control of tax authorities and include penalty, audit probability and tax rate (Alm, 2012; Ritsatos, 2014). Factors in group two are affected government and include trust in government and the tax service (Ritsatos, 2014). The third group of factors includes factors such as personal norms, social norms, and religiosity, all influenced by the taxpayers and by the community they belong to. There are two different paradigms that can be used to increase tax compliance, one using enforcement (Alm, 2012), known as the deterrence approach, and another approach, known as the non-deterrence approach, which includes trust and the service paradigm (Nurkholis, Dularif and Rustiarini, 2020), as well as the fiscal psychological paradigm (Schmolders, 1959).

Fines or tax penalties and tax audits are two instruments that necessarily exist in a country's tax system (Kirchler, Hoelzl and Wahl, 2008). The presence of these two tools is consistent with the constructivist rationality, a top-down mechanism in which formal institutions create instruments to encourage tax compliance (Górecki and Letki, 2020). Tax penalties are regulatory measures in taxation designed to encourage tax compliance. Tax audit includes controlling taxpayers' compliance with the tax reporting system by completing, calculating, collecting, and deducting all taxes in accordance with applicable laws, ensuring compliance (Rahmayanti, Sutrisno and Prihatiningtias, 2020). Individuals make decisions about whether to adhere to tax regulations or not based on an evaluation of the potential benefits and costs (Allingham and Sandmo, 1972). Taxpayer awareness refers to the recognition, respect, and adherence to applicable tax regulations, accompanied by a sense of seriousness or willingness to fulfil their tax obligations

(Nurkhin et al., 2018). Non-compliant behaviour with tax regulations may be result of a taxpayer's limited knowledge of and the skills required to adhere to them (OECD, 2019b). Previous research showed diverse findings related to correlation between tax knowledge and the degree of tax compliance (Wadesango et al., 2018). Loo, McKerchar and Hansford (2014) stated that within a self-assessment system, taxation knowledge emerges as the most influential factor in shaping taxpayer compliance behaviour. Timothy and Abbas (2021) identified a noteworthy positive connection between tax knowledge and tax compliance, reinforcing the idea that taxpayers' inherent motivation should be complemented by sufficient tax knowledge. The findings of Rahmayanti, Sutrisno and Prihatiningtias (2020) indicate that tax penalties, tax audits, and the awareness of taxpayers have a positive impact on corporate taxpayer compliance. From a taxation point of view, non-compliant behaviour of taxpayers refers to actions taken to reduce tax obligations, which may occur unintentionally due to ambiguities in tax laws and are commonly recognized as tax avoidance and tax evasion. The decision for individuals on whether to engage in tax evasion is clearly constrained by the available opportunities for doing so. The final choice on tax evasion will depend on the possibility of tax evasion and the personal desire to engage in it. The decision can be influenced by economic or psychological factors, with psychological factors implying that an individual's well-being may be affected even in the absence of direct economic consequences (Levenko and Staehr, 2022). Economic factors regarding tax compliance include the possibility of evasion, rational individualistic choice, and behavioural individualistic choice (Levenko and Staehr, 2022). In the context of discussing psychological factors for tax compliance, it is possible to differentiate personal norms, social norms, and norms related to interactions with the government (reciprocity) (Levenko and Staehr, 2022).

Dularif and Rustiarini (2022) propose that enhancing tax services and fostering trust in the government are more efficient and simpler to implement than developing positive taxpayer behaviours. Taxpayers' perception of equitable treatment by tax authorities can have a positive impact on their willingness to comply with tax obligations (Taing and Chang, 2020). The government should understand how to create a sense of fairness in the taxpayer-government relationship (Kim, 2002). When taxpayers believe that the tax burden is equitably distributed among their peers, they are more inclined to adhere to tax regulations (Taing and Chang, 2020). The quality of tax services can be enhanced through improving tax administration services through cooperation and socialization, and by enhancing the efficiency of the tax system (Alm et al., 2010).

The government should take all possible actions to serve the common good since citizens have to give some portions of their revenue or assets to the government in the form of tax. Effective collaboration between the government and its citizens plays a crucial role in fostering trust and shaping tax compliance. Building trust in government is based on three key factors: enhancing public engagement in the political process, provision of sufficient public goods, and upholding government

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credibility (Piryaei, Akhlaghi and Saeed, 2015). Most research findings (Cahyonowati, Ratmono and Juliarto, 2023; Nurkholis, Dularif and Rustiarini, 2020) endorse the idea that higher levels of trust in government tend to result in greater tax compliance. Dularif and Rustiarini (2022) conducted a comprehensive study and identified trust in government and tax services as the most important factors in achieving tax compliance while social norms, personal norms, and religiousness were found to contribute to tax compliance, but with lesser impact than initially anticipated. Hartmann et al. (2022) discovered that building trust in government and encouragement of a positive attitude towards taxes have a beneficial effect on compliance.

The behaviour of taxpayers is not only affected by the risks of formal punishment by state authorities but is also determined by psychological factors. Ethical or normative factors are recognized as factors with a significant influence on tax compliance (OECD, 2010; Dularif and Rustiarini, 2022). These factors are also called psychological factors and include personal norms and social norms. Personal norms can be described as deeply ingrained beliefs regarding what is right or wrong to do. Moreover, personal norms can be defined as the conviction that there exists a moral obligation to adhere to certain standards (Wenzel, 2005). Personal norms can be subdivided into two components: attitude (Ajzen, 1991) and intrapersonal norms (Hur, Roese and Namkoong, 2009). Individual personal norms develop over years and cannot be easily influenced. Social norms refer to the behaviour, ideas, and convictions prevalent within social groups, and the norms of a specific social group have a substantial impact on the actions of individuals who identify with that group (OECD, 2010). Regarding these social norms, a differentiation can be made between descriptive social norms and prescriptive social norms (OECD, 2010). Descriptive social norms reflect what others do or what we think they do while prescriptive social norms reflect what others think about certain behaviour or our perceptions of what others believe (OECD, 2010). Bobek, Hageman and Radtke (2015) have classified social norms in four categories: subjective norm, personal norm, injunctive norm, and descriptive norm. Subjective norm pertains to a taxpayer's perception of their friends' or family's opinions or actions, injunctive norm is connected to a taxpayer's viewpoint regarding the actions of individuals in a comparable situation or within the same group while the descriptive norm refers to a taxpayer's perception of tax evasion based on prevailing public opinions (Dularif and Rustiarini, 2021). The behavioural approach acknowledges that individuals' behaviour is significantly shaped by the collective behaviour of the group (Alm, 2019).

2.3 HYPOTHESIS
The Helmy, Dwita and Cheisviyanny (2020) gender socialization theory argues that the socialization of individuals of different genders differs. This results in the formation of unique values, roles, and beliefs that further impact their interests, decisions, and norms (Helmy, Dwita and Cheisviyanny, 2020). Gender can influence the attitude and perception of taxpayers on tax compliance, as indicated in

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previous research, depending on context. Interaction between gender and economic or psychological determinants have confirmed that, in some cases, females are more moral than male (Kastlunger et al., 2010; Hofmann et al., 2017). This is because females do not break the laws, females' personal and social norms have a stronger focus on tax compliance than male norms (Hofmann et al., 2017). Females are also less risk-seeking, more engaged in social and societal activities, and perceive sanctions as more threatening than males (Croson and Gneezy, 2009; Prasetyo, Adi and WoroDamayanti, 2020). To avoid tax audits, females tend to comply with the tax laws meticulously (Hai and See, 2011). However, according to the Filippin and Crosetto (2014) meta-analyses, 90 per cent of the published papers either found no differences between the female and male tax compliance behaviour, or only insignificant variations (Kangave, Waiswa and Sebaggala, 2021). Building on the presumption of the previous research, we propose the following hypothesis:

H1: There are no statistical differences in attitudes toward the economic and psychological factors of tax compliance among taxpayers of different genders.

In different geographic regions, income exhibited varying degrees of influence on tax compliance, with some northern hemisphere countries (Western and Eastern Europe, North America, Central Asia) showing a stronger predictive relationship between income and tax compliance, while certain southern hemisphere countries (East Asia and Pacific, Latin America and Caribbean, Sub-Saharan Africa) displayed a weaker predictive association (Hofmann et al., 2017). Dissanayake and Premaratna (2020) proved that the taxpayer's level of income is positively correlated with voluntary tax compliance, while enforced compliance shows a negative association, whereby power and perceived trust in tax administration are important. The findings of Durham, Manly and Ritsema (2014) suggest that the interaction between income source and context does not have a significant impact on overall compliance, but this combined influence does shape the connection between income level and compliance, as well as the evolution of compliance behaviour over time. Income level positively correlates with compliance in the estimation. Earned income interacts with the tax context to contribute to a stabilizing influence on compliance behaviour as time progresses (Durham, Manly and Ritsema, 2014). Income level significantly influences tax compliance as individuals with high incomes are more likely to engage in non-compliance behaviour, while low-income individuals are less prone to it (McGee, 2012). Prior research on the income level's effects on tax compliance has identified contrasting views, positive (Durham, Manly and Ritsema, 2014; McGee, 2012) and negative (Alm and McKee, 2006; Trivedi and Chung, 2006). Based on the facts presented and the circumstances that Slovenia belongs geographically to the European countries, it could be assumed that a relationship exists between gross income and tax compliance. However, due to the fact that the Slovene tax system is one of the smallest within the European Union according to number of resident taxpayers, we tested the following hypothesis:

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H2: Taxpayers with different income levels do not have statistically significantly different attitudes as far as concerns the economic and psychological factors of tax compliance.

Research concerning the connection between the settlement size (location, rural and urban area) variable of the individual taxpayer and taxpayer compliance is notable while there is some empirical evidences for the location (area) variable of businesses and tax compliance (Dissanayake and Premaratna, 2020; Williams, 2020). According to that research, rural and urban locations are in correlation with trust and voluntary compliance, and among the rural business community, the power of authority reduces tax compliance (Dissanayake and Premaratna, 2020). Williams (2020) even argues that at the European level, those in urban areas were significantly more compliant than those in rural areas. Due to the geographic specifics of the Republic of Slovenia and the size of its population, around two million, we assume, that settlement size has no impact on compliance factors. Therefore, we frame the last hypothesis as:

H3: Taxpayers residing in different settlements size (urban/rural) do not have statistically different attitudes toward the economic and psychological factors of tax compliance.

3 DATA AND METHODOLOGY

3.1 SAMPLE AND DATA COLLECTION

Survey data about Slovene taxpayers' attitudes toward tax compliance were collected based on a written questionnaire that was administered. Due to the sensitive nature of the topic and individuals' reluctance to participate in studies involving taxes and income, the snowball sampling approach was chosen for selecting respondents. The snowball sampling technique is suitable for research when the population is challenging to reach, as is the case when the general population rarely chooses to participate in surveys about their tax payments and income. The process begins by identifying a set of initial respondents for interviews. These respondents then recommend others to be contacted and interviewed. This cycle continues until a sufficient number of respondents is reached (Dragan and Isaic-Maniu, 2013). The target population was individual taxpayers in Slovenia. The sampling process relied on participants' willingness and their availability to complete the questionnaires. The survey was conducted in the period from March to May 2023. In that period overall 390 respondents participated in the survey and filled out the questionnaire.

In the empirical study three research hypotheses were tested; as explained previously, we used only the segments out of the questionnaire that are presented in table 1. The questionnaire was designed based on the previous relevant research conducted by Hasseldine and Hite (2002), Gangl et al. (2013), Braithwaite (2001), Mohamed et al. (2013), Filippin, Fiorio and Viviano (2013), Palil (2010), McGee and Linge (2008). For the purpose of this paper, in addition to the selected demographic variables, overall, 17 questions were observed.

TABLE 1

List of observed questions and variables

Code	Questionnaire variables	Theoretical dimension
TC	I feel a moral obligation to pay my taxes.	Tax compliance
EF1	To my knowledge, I can deduct all personal expenses in calculating my tax liability.	Knowledge of paying taxes
EF2	Taxpayers cannot object or make appeal against Tax Authority assessments.	Knowledge of the tax system
EF3	If tax rates are too high tax evasion is morally acceptable.	Tax evasion attitude
EF4	I pay taxes because the risk of being audited is too high.	Probability of audit
EF5	Serious enforcement and penalty by the FURS may result if I do not comply.	Probability of punishment
PF1	I would feel guilty-bad if I did not pay my full share of taxes.	Feeling bad if evade
PF2	Working for cash-in-hand payment without paying tax is a trivial offence.	Disapprove of shadow purchases
PF3	Paying taxes is one of the basic duties of citizenship.	Important obligation
PF4	Not paying taxes is one of the worst crimes a person can commit because it harms the whole community.	Disapprove of shadow work
PF5	Tax Authority in Slovenia can be trusted to administer the tax system fairly.	Trust in the government / Tax Authority
PF6	It is fair that individuals who deliberately evade their taxes should be penalized with the same amount of penalty regardless of the amount of tax evaded.	Fairness of punishment
PF7	The government ensures services, facilities, and infrastructure for which I am very thankful.	Satisfaction with public services
PF8	I personally believe that the tax system in Slovenia is fair.	Fairness of the tax system
PF9	I would pay taxes even if there were no tax audits.	General tax compliance
PF10	People in my environment would strongly disapprove if I did not meet my tax obligations.	Normative expectations
PF11	My relatives do not comply, and they have never been penalized.	Empirical expectations

All 17 questions belong to the 5-point Likert scale type of question. Therefore, the respondents could give an answer in the range from 1 (strong disagreement) to 5 (strong agreement). Answer 3 represents the neutral answer by which respondent points out that he does not disagree or agree with the presented statements in the survey questions. The main variable under the study is the variable related to the tax compliance of the respondents (variable TC). This variable shows how much the respondents feel morally obligated to pay their taxes. The other 16 questions can be separated into two groups: economic (EF) and psychological (PF) variables (factors). Included in the first group are the variables which cover the economic motives of tax compliance whereas the second group includes variables that cover the psychological aspects of tax compliance. In that way, the first, economic group includes five (EF1–5) questions whereas the second, psychological group is composed of 11 questions (PF1–11). To analyse the data, Microsoft Excel, R 4.3.0 and RStudio 2023.06.1+524 were utilized. Microsoft Excel was primarily used for data editing, while RStudio was used for statistical analyses.

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3.2 DATA ANALYSIS

The respondents' structure according to main demographic characteristics is shown in table 2.

TABLE 2

Respondents' structure, main demographic characteristics

Variable	Categories	No. of respondents	Share of respondents, %
Gender	Male	187	48
	Female	203	52
Gross income	Low income	47	12
	Medium income	196	50
	High income	67	17
	I prefer not to answer	80	21
Settlement	Urban settlement	157	40
	Rural settlement	233	60

In the survey, 187 males (48%) and 203 females (52%) participated. The median age of the respondents was 42 years, which means that 50% of the respondents were 42 years old or younger, while the remaining 50% were 42 years old or older.

Slightly over 50% of the participants reported a monthly gross income ranging between 1,001 and 2,000 euros. This specific range is categorized as a medium income level. 12% of respondents fell into the low-income bracket, indicating an income below 1,001 euros, while approximately 17% of respondents belonged to the high-income category, signifying an income exceeding 2,000 euros. Out of all respondents, 21% respondents opted not to disclose their gross income information. Consequently, those respondents, who did not share their gross income information, will be excluded from subsequent analyses involving the gross income variable.

Forty per cent of the respondents lived in an urban settlement, and 60% in a rural settlement. An urban settlement is considered to be a settlement with more than 3,000 inhabitants. On the other hand, a rural settlement is a settlement with fewer than 3,000 inhabitants.

To answer the research question, the results of the survey data were further analysed as follows. In the first step, the structure of responses to the 17 observed questions was analysed. For a better understanding of the structure of responses, in addition, main descriptive statistics indicators were calculated as well. To measure the relationship between the variables, polychoric correlations were calculated. Polychoric correlation is used to calculate the correlation between two ordinal variables. The 17 observed questions have only five levels and therefore it is more appropriate in this case to use the polychoric correlation instead of the usually used Pearson linear correlation. However, the interpretation of polychoric correlation corresponds to the interpretation of Pearson's linear correlation. If the polychoric correlation indicator is equal to -1, a perfect negative correlation is present between the observed variables. On the other hand, a polychoric

correlation indicator value of 1 indicates a perfect positive correlation. In the absence of any correlation, the polychoric correlation indicator is equal to 0.

In the second step, the Chi-square tests of independence were conducted (see McHugh, 2013). The Chi-square test of independence is used to inspect whether two categorical variables are likely to be related or not. In this paper, the relationship between disagreements and agreements on the observed 17 survey questions with respondents' gender, gross income, and settlement were tested. To conduct the Chi-square test of independence, answers to the observed survey questions were grouped as follows. Answers 1 and 2 in a category 1 and 2 were treated as disagreement whereas answers 4 and 5 were considered as agreement. For all 17 questions, category 3, the neutral category, was not observed and was omitted in the Chi-square test of independence. The null hypothesis of the Chi-square test of independence is that the two observed variables are not related, not associated, and independent. If the null hypothesis of the Chi-square test of independence is rejected it can be concluded that the two observed variables are related, associated, and dependent. The test statistic used in the Chi-square test of independence is as follows (McHugh, 2013):

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{\left(o_{ij} - e_{ij}\right)^2}{e_{ij}} \tag{1}$$

where o_{ij} is the observed cell count in the i-th row and j-th column of the contingency table, e_{ij} is the observed cell count in the i-th row and j-th column of the contingency table (McHugh, 2013). The calculated χ^2 value is compared to the χ^2 critical value for (r-1)(c-1) degrees of freedom and chosen significance level. The decisions for the Chi-square test of independence will be brought by considering a significance level of 0.05.

4 RESULTS
4.1 DESCRIPTIVE STATISTICS
In this chapter, the collected attitudes on tax-related questions were analysed. In table 3 the structure of responses on the observed 17 questions is shown.

According to the results provided in table 3, it can be concluded that only 9% of respondents do not feel morally obligated to pay their taxes (variable TC). On the other hand, 27% of respondents agree and 42% of respondents completely agree that they feel morally obligated to pay their taxes. This results in the highest mean value among the observed variables. According to this, it can be concluded that the vast majority of respondents do comply with tax regulations.

However, if the economic variables related to taxes are observed, in general, it can be concluded that the majority of respondents disagree with the economic dimension of compliance. The only economic variable at which the majority of respondents agreed is variable EF4 (mean = 3.74).

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TABLE 3

Structure and main descriptive statistics of responses on tax-related questions, n = 390

Code	Responses (%)					Mean	St. dev.	Min.	Median	Max.	Skewness
	1	2	3	4	5						
TC	2	7	22	27	42	4.00	1.06	1	4	5	-0.82
EF1	21	18	41	13	7	2.65	1.15	1	3	5	0.12
EF2	25	26	27	16	6	2.53	1.21	1	2	5	0.33
EF3	31	26	24	13	5	2.34	1.19	1	2	5	0.50
EF4	8	8	24	23	37	3.74	1.26	1	4	5	-0.69
EF5	22	41	28	8	2	2.26	0.94	1	2	5	0.48
PF1	4	8	29	24	35	3.79	1.12	1	4	5	-0.57
PF2	20	21	31	20	7	2.74	1.20	1	3	5	0.07
PF3	10	23	43	16	8	2.90	1.06	1	3	5	0.11
PF4	10	20	28	28	14	3.15	1.19	1	3	5	-0.16
PF5	9	17	45	24	5	3.01	0.98	1	3	5	-0.24
PF6	27	15	26	17	14	2.76	1.39	1	3	5	0.14
PF7	9	40	37	10	4	2.60	0.92	1	3	5	0.49
PF8	12	36	32	15	5	2.64	1.02	1	3	5	0.36
PF9	9	12	28	25	26	3.46	1.24	1	4	5	-0.39
PF10	7	12	43	24	14	3.27	1.06	1	3	5	-0.18
PF11	2	9	22	27	39	3.92	1.08	1	4	5	-0.69

If the psychological variables are observed it can be noticed that the highest average agreement is achieved at variables PF11 (mean = 3.92), PF1 (mean = 3.79) and at variable PF9 (mean = 3.46). The most disagreement level respondents have shown at variables PF7 (mean = 2.60) and PF8 (mean = 2.64).

In graph 1 the mean response values between the tax compliance variable and economic and psychological variables are presented. The economic factor (EF) mean value was calculated by taking into account all answers on five economic variables. To calculate the psychological factor (PF) mean, all respondents' answers on the 11 psychological variables were observed.

GRAPH 1

Comparison of mean response values on the tax compliance variable and on economic and psychological variables, n = 390
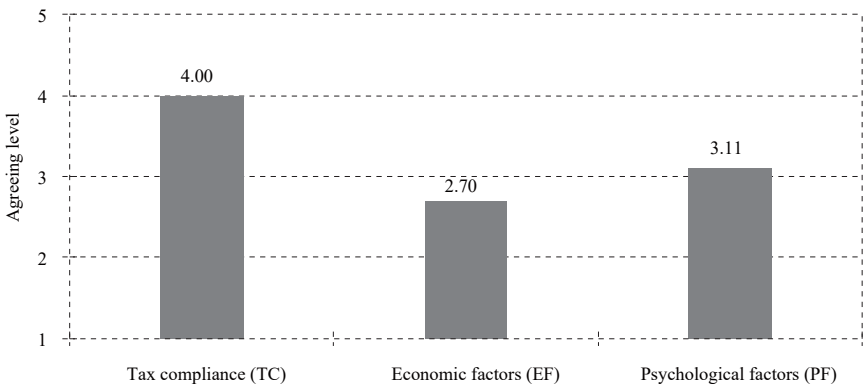
According to graph 1, it is noticeable that the highest average agreement level is present at the tax compliance (TC) variable. On the other hand, the respondents have shown the lowest average agreement level with the economic variables.

In table 4 polychoric correlations among the tax-related questions are shown.

Strong correlations exist where the polychoric correlations are under -0.50 or above 0.50 or are present only in four cases. Variable TC has a strong positive correlation with variable PF1 (polychoric correlation = 0.72) and with variable PF9 (polychoric correlation = 0.68), respectively. Also, there is a strong positive correlation between variables PF1 and PF9 (polychoric correlation = 0.59). In the fourth case, the strong positive correlation is between variables PF3 and PF4 (polychoric correlation = 0.52).

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TABLE 4
Correlation matrix, polychoric correlation, tax-related questions, n = 390 respondents

Variable	TC	EF1	EF2	EF3	EF4	EF5	PF1	PF2	PF3	PF4	PF5	PF6	PF7	PF8	PF9	PF10
EF1	-0.05															
EF2	-0.10	0.34														
EF3	-0.29	0.11	0.18													
EF4	0.16	0.09	0.10	-0.14												
EF5	-0.17	0.11	0.10	0.10	-0.27											
PF1	**0.72**	-0.04	-0.08	-0.29	0.32	-0.21										
PF2	-0.18	0.34	0.25	0.16	0.15	0.04	-0.26									
PF3	0.30	0.02	-0.05	-0.17	0.16	0.01	0.41	-0.12								
PF4	0.33	-0.09	-0.10	-0.28	0.00	-0.12	0.38	-0.19	**0.52**							
PF5	0.18	0.14	0.00	-0.15	-0.06	-0.02	0.06	-0.01	0.09	0.10						
PF6	-0.11	0.41	0.29	0.09	0.13	0.08	-0.09	0.21	-0.05	-0.01	0.06					
PF7	-0.11	-0.07	0.16	0.08	0.09	0.10	-0.05	0.04	0.04	-0.10	-0.32	0.07				
PF8	0.15	0.01	-0.18	-0.13	0.00	-0.03	0.16	-0.12	0.06	0.13	0.30	0.08	-0.22			
PF9	**0.68**	-0.04	-0.09	-0.34	0.04	0.04	**0.59**	-0.19	0.34	0.30	0.20	-0.09	-0.07	0.13		
PF10	0.34	0.07	0.12	-0.10	0.13	-0.13	0.25	0.06	0.12	0.13	0.25	0.16	-0.13	0.04	0.37	
PF11	0.18	-0.33	-0.27	-0.23	0.10	-0.31	0.21	-0.24	-0.03	-0.04	-0.07	-0.23	0.02	0.13	0.11	-0.07

Note: Polychoric correlation values higher than 0.50 are in bold.

4.2 CHI-SQUARE TEST OF INDEPENDENCE

In this chapter, the Chi-square tests of independence between the observed tax-related questions and selected demographic variables were conducted. The socio-demographic variables taken into account were respondents' gender, gross income, and settlement type. In that way, it was possible to inspect whether the respondents' tax compliance attitudes towards related questions were different according to their socio-demographic characteristics. The relationship between the tax compliance attitudes on observed questions and respondents' gender is observed in table 5.

TABLE 5

Chi-square test of independence, attitude on tax-related questions vs. gender

Code	Number of disagreements		Number of agreements		Sample size	Emp. Chi-square	p-value	H₀
	Male	Female	Male	Female				
TC	21	14	116	154	305	3.63	0.0566	Not rejected
EF1	68	87	39	37	231	1.14	0.2863	Not rejected
EF2	91	107	48	38	284	2.33	0.1269	Not rejected
EF3	100	125	38	32	295	2.08	0.1495	Not rejected
EF4	32	31	113	121	297	0.12	0.7242	Not rejected
EF5	114	131	19	17	281	0.49	0.4833	Not rejected
PF1	29	17	100	132	278	6.14	0.0132	Rejected
PF2	67	93	60	48	268	4.84	0.0278	Rejected
PF3	61	67	41	55	224	0.54	0.4618	Not rejected
PF4	61	57	71	91	280	1.70	0.1928	Not rejected
PF5	49	50	55	60	214	0.06	0.8076	Not rejected
PF6	88	78	58	65	289	0.97	0.3247	Not rejected
PF7	92	98	28	26	244	0.20	0.6563	Not rejected
PF8	96	93	37	39	265	0.10	0.7561	Not rejected
PF9	45	38	86	110	279	2.50	0.1137	Not rejected
PF10	38	34	64	85	221	1.89	0.1697	Not rejected
PF11	25	20	119	141	305	1.47	0.2247	Not rejected

Note: Decision made based on significance level of 0.05; df = 1.

According to the results in table 5, the null hypothesis of the Chi-square test of independence was rejected in only two cases at a significance level of 0.05. This occurred with variables PF1 and PF2. Therefore, it appears that there is a relationship between variables PF1 and gender, as well as variables PF2 and gender. To better understand these relationships, mosaic plots for these two cases are presented in graph 2.

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GRAPH 2

Mosaic plots, attitude on tax-related questions vs. gender
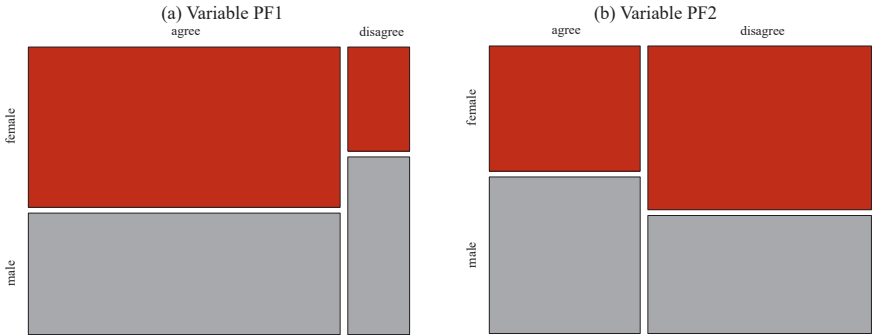
According to graph 2, males tend to disagree more with PF1 (I would feel guilty-bad if I did not pay my full share of taxes) than females. That would, at the same time, mean that females tend more to agree with PF1 than males. So, females tend more to feel guilty if the taxes are not paid in full than males. Additionally, females tend to disagree more with PF2 (Working for cash-in-hand payment without paying tax is a trivial offence) than males. Due to the fact that the Chi-square tests of independence conducted have shown no statistically different attitudes toward the economic factors of tax compliance but they have shown statistically different attitudes toward two psychological factors, the first research hypothesis H1, that there are no statistical differences in attitudes toward the economic and psychological factors of tax compliance between taxpayers of different genders, can be only partially accepted.

In table 6 the relationship between observed tax-related questions and respondents' gross income is inspected.

In two cases the null hypothesis of the Chi-square test of independence, at a significance level of 0.05, was rejected. The first case appeared at variable EF3 whereas the second case appeared at variable PF9.

Mosaic plots for cases when the null hypothesis of the conducted Chi-square test of independence was rejected, when attitudes on tax-related questions and gross income were compared, are shown in graph 3.

TABLE 6

Chi-square test of independence, attitude on tax-related questions vs. gross income

Code	No. of disagreements			No. of agreements			Sample size	Emp. Chi-square	p-value	H₀
	Low income	Medium income	High income	Low income	Medium income	High income				
TC	5	15	8	32	131	50	241	0.65	0.7213	Not rejected
EF1	12	75	31	10	28	18	174	3.42	0.1809	Not rejected
EF2	31	99	38	8	38	15	229	0.91	0.6349	Not rejected
EF3	24	116	39	16	31	12	238	6.09	0.0477	Rejected
EF4	4	33	14	31	122	34	238	3.79	0.1505	Not rejected
EF5	26	130	36	6	12	8	218	4.69	0.0958	Not rejected
PF1	6	19	10	30	118	39	222	1.19	0.5520	Not rejected
PF2	21	79	33	15	59	13	220	3.11	0.2110	Not rejected
PF3	15	63	21	19	44	12	174	3.05	0.2180	Not rejected
PF4	19	55	20	20	77	30	221	0.78	0.6763	Not rejected
PF5	18	44	18	11	59	20	170	3.40	0.1824	Not rejected
PF6	22	73	37	14	66	16	228	4.89	0.0868	Not rejected
PF7	20	89	43	9	21	9	191	2.44	0.2952	Not rejected
PF8	21	91	31	9	35	20	207	2.24	0.3267	Not rejected
PF9	14	46	10	17	91	41	219	6.23	0.0444	Rejected
PF10	14	33	12	13	65	32	169	4.61	0.1000	Not rejected
PF11	3	21	9	33	134	46	246	1.21	0.5449	Not rejected

Note: Decision made based on significance level of 0.05; df = 2.

GRAPH 3

Mosaic plots, attitude on tax-related questions vs. gross income
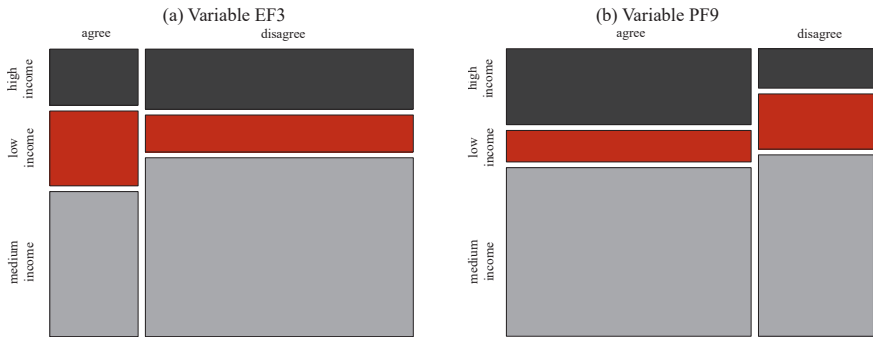
According to the mosaic plot, given in graph 3, it seems that respondents with medium gross income tend more to disagree with EF3 (If tax rates are too high tax evasion is morally acceptable). On the other hand, the respondents with low gross income tend more to agree with EF3. If a relationship between variable PF9 (I would pay taxes even if there were no tax audits) and the gross income is observed, based on the mosaic plot in graph 4, it can be concluded that respondents with low gross income tend more to disagree with PF9 whereas respondents with high gross income tend to agree with PF9. In that way, the second research hypothesis H2 that taxpayers with different income levels do not have statistically different attitudes toward the economic and psychological factors of tax compliance, should be rejected. Namely, variable EF3 is a part of economic factors whereas variable PF9 belongs to psychological factors. At these two variables, it has been shown that taxpayers with different income levels do have statistically different attitudes toward tax compliance.

In table 7 results of the Chi-square test of independence between tax-related questions and respondents' settlement type are provided.

In two cases the null hypothesis of the Chi-square test of independence, at a significance level of 0.05, was rejected. In that way, it was pointed out that some statistically significant relationship exists between variables TC and settlement type, and between variables PF6 and settlement type. For a better understanding of the relations in those two cases, the corresponding mosaic plots were plotted, and they are shown in graph 4.

TABLE 7

Chi-square test of independence, attitude on tax-related questions vs. settlement type

Code	Number of disagreements		Number of agreements		Sample size	Emp. Chi-square	p-value	H_0
	Urban	Rural	Urban	Rural				
TC	21	14	101	169	305	6.59	0.0103	Rejected
EF1	60	95	33	43	231	0.47	0.4927	Not rejected
EF2	79	119	40	46	284	1.08	0.2994	Not rejected
EF3	88	137	35	35	295	2.60	0.1066	Not rejected
EF4	28	35	92	142	297	0.54	0.4616	Not rejected
EF5	89	156	15	21	281	0.38	0.5355	Not rejected
PF1	23	23	89	143	278	2.16	0.1415	Not rejected
PF2	69	91	41	67	268	0.71	0.3994	Not rejected
PF3	49	79	35	61	224	0.08	0.7803	Not rejected
PF4	46	72	68	94	280	0.25	0.6148	Not rejected
PF5	40	59	48	67	214	0.04	0.8431	Not rejected
PF6	55	111	66	57	289	12.23	0.0004	Rejected
PF7	77	113	26	28	244	1.00	0.3170	Not rejected
PF8	68	121	36	40	265	2.95	0.0859	Not rejected
PF9	37	46	84	112	279	0.07	0.7909	Not rejected
PF10	36	36	65	84	221	0.80	0.3725	Not rejected
PF11	21	24	101	159	305	0.98	0.3228	Not rejected

Note: Decision made based on significance level of 0.05; df = 1.

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GRAPH 4
Mosaic plots, attitude on tax-related questions vs. settlement type
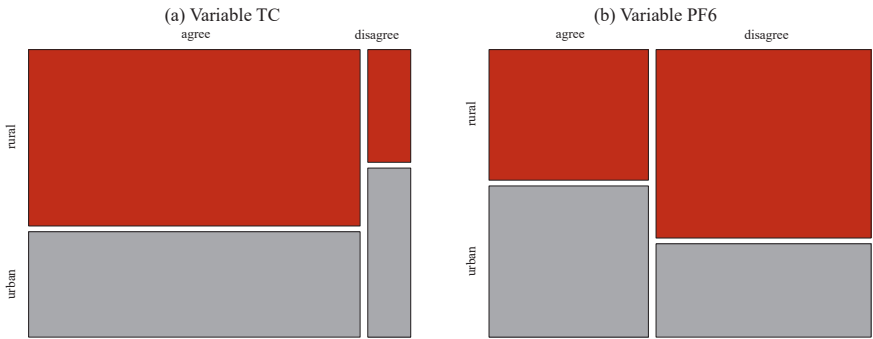
The mosaic plot presented in graph 4 reveals that respondents from rural settlements tend more to agree with variable TC (I feel morally obligated to pay my taxes) whereas respondents from urban settlements tend more to disagree with variable TC. The relationship at variable PF6 (It is fair that individuals who deliberately evade their taxes should be penalized with the same amount of penalty regardless of the amount of tax evaded) is the opposite. In this case, respondents from rural settlements tend more to disagree with variable PF6 whereas respondents from urban settlements tend more to agree with variable PF6. That would mean that respondents from rural settlements tend not to support penalties being of the same size regardless of the amount of tax evaded by individuals as opposed to the respondents from urban settlements.

The Chi-square tests of independence have shown no statistically different attitudes toward the economic factors of tax compliance, but they have shown statistically different attitudes toward one psychological factor. Therefore, the third research hypothesis H3 that taxpayers residing in different settlement sizes do not have statistically different attitudes toward the economic and psychological factors of tax compliance, can be partially accepted.

5 DISCUSSION
The regulatory impact assessment (RIA) framework assumes that the policy challenges encompass behavioural and structural (economic, legal, incentives, etc.) factors (OECD, 2020). RIA is thus one of the most common and essential tools for analysing the quality of legislation and/or evaluating the impact of regulations (Jovanović and Klun, 2017).

Still, neglecting behavioural analysis when addressing a policy issue can result in a flawed understanding of the problem, overlooking the chance to integrate behaviourally-informed solutions that could enhance the effectiveness of policy outcomes (OECD, 2020). To promote equality and social justice, specific impacts arising from tax policies should consider factors such as gender, income and settlement size in the assessment process. According to Jovanović and Klun (2017)

the Slovenian Regulatory Impact Assessment lacks the sophistication needed to evaluate complex tax policies and instruments considering some of these factors.

This study investigated the relationship between the taxpayers' attitudes towards economic and psychological factors of tax compliance on one hand, and gender, income level and settlement size on the other. The results of this study can support decision makers with specific information regarding improvement of regulations in order to better design and implement systems and strategies.

The results of our study indicate that self-reported general tax compliance among Slovene taxpayers could be higher, as only 69 per cent of the respondents feel morally obligated to pay taxes; a small percentage express non-compliance (9 per cent) while only 42 per cent see themselves as fully tax compliant. When we examine the economic factors influencing tax compliance, it appears that the probability of being audited is the most significant variable affecting tax compliance behaviour. The mean of knowledge about paying taxes (2.65) as well as about the tax system (2.53) is under the average, which shows that compliance behaviour could be enhanced through education. Within psychological factors, taxpayers' perception is influenced by empirical expectations. They may perceive that the other taxpayers are not highly tax-compliant (for example, their relatives may not comply and have never been penalized), view tax evasion or non-payment of taxes as morally unacceptable (feeling guilty or bad if they were to evade taxes or not pay their full share), and express a willingness to pay taxes even in the absence of tax audits (stating that they would still pay taxes even if there were no tax audits). The results of taxpayers' perception regarding their satisfaction with public services, infrastructure, and facilities (expressing gratitude for various government services, facilities, and infrastructure) indicate dissatisfaction. In their opinion, the Slovenian tax system is perceived as unfair, but trust in government is, on average, slightly higher (3.01) than the perception of tax system fairness (2.64). It can be concluded, that due to the strong polychoric positive correlations in the results between the moral obligation to pay taxes, feelings of guilt about not paying, and willingness to pay taxes even in the absence of audits, Slovene taxpayers perceive paying taxes as one of the basic duties of citizenship. In their perception, not paying taxes signifies a failure to contribute to the community, which they find ethically unacceptable (polychoric correlation = 0.52). Comparison of general tax compliance with the Leveko and Staehr (2022) study show a much lower tax compliance attitude of Slovene taxpayers compared to taxpayers in Estonia (mean = 3.65), where 65 per cent declare themselves fully tax compliant as against the only 42 per cent of Slovenia. The taxpayers in Estonia reported much higher satisfaction with public services (mean = 3.50) than Slovene taxpayers (mean = 2.60), whereas the Estonian taxpayers report on average lower trust in government (2.91) than Slovene taxpayers and higher tax system fairness (2.94).

Based on the results of further examination of taxpayers' tax compliance attitudes towards related questions to their socio-demographic characteristic gender, we can

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conclude that there are no statistically significant differences in attitudes toward the economic factors of tax compliance. However, statistically significant differences have been observed in attitudes toward two psychological factors. Firstly, females tend to agree more than males with the attitude of paying their full share of taxes as an obligation, and they feel guilty or bad if they do not (feeling bad if evade). Secondly, they also disapprove of shadow working for cash-in-hand payment without paying taxes, more than males. The first research hypothesis (H1) was therefore only partially accepted. These results are consistent with the research of Kastlunger et al. (2010) and Hofmann et al. (2017), suggesting that females tend to be more tax compliant than males in certain cases. Agreement regarding paying full share of taxes aligns with the Hofmann et al. (2017) explanation, which posits that females have stronger personal and social norms focused on tax compliance than males. This difference can also be observed in our results in terms of females' awareness that tax non-compliance harms the tax community; females have strong normative expectations compared to males. However, when we compare our results with the meta-analyses conducted by Filippin and Crosetto (2014), which found no differences in tax compliance behaviour between females and males, it can be concluded that our research revealed partial differences in psychological factors (PF1, PF2).

The next variable considered for tax compliance attitude was gross income. The results show that taxpayers with low gross incomes perceive tax evasion as morally acceptable in circumstances where tax rates are too high and are less tax-compliant than taxpayers with medium gross incomes. Taxpayers with medium gross incomes tend to disagree more with tax evasion due to high tax rates. The possible explanation of this result could be fear that the high taxes would reduce the receipts of low-income taxpayers to the point at which they would not have enough income for basic living needs. Taxpayers with low gross incomes tend to be less tax compliant as they disagree with paying taxes even in the absence of tax audits. In contrast, taxpayers with high gross incomes are more inclined to agree to pay taxes in such circumstances. Since taxpayers with different income levels do have statistically different attitudes toward tax compliance in economic variable (EF3) and psychological variable (PF9), the second research hypothesis (H2) was rejected. Our research results are in line with the Durham, Manly and Ritsema (2014) and the McGee (2012) research that confirm the effect of income level on tax compliance. The conclusions of Hofmann et al. (2017) predicted strong relationship between income and tax compliance in northern hemisphere countries (Western and Eastern Europe). In our study, it cannot be argued that the relationship is as strong as in Hofmann et al. (2017); still, Slovene taxpayers with different incomes have shown different attitudes towards some economic and psychological variables.

Some statistically significant relationship was also found between settlement type, and two compliance variables (TC, PF6) showing, that taxpayers from rural settlements tend to agree more with the moral obligation to pay taxes than taxpayers from urban settlements. The results also indicated that the taxpayers have different perceptions regarding the fairness of punishment. While taxpayers in rural

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settlements believe that different amounts of deliberate tax evasion should not be penalized equally, as it would not be fair, taxpayers in urban settlements have a different attitude. They see equal penalization for deliberate tax evasion, regardless of the amount evaded, as fair. As the tests of independence have shown no statistically significant different attitudes toward the economic factors of tax compliance but they have shown statistically different attitudes toward one psychological factor, the third research hypothesis (H3) was partially accepted. Our results do not support the Dissanayake and Premaratna (2020) findings according to which voluntary compliance has a positive relationship to either a rural setting or an urban environment. They are also not in line with the Williams (2020) results arguing that taxpayers in urban areas are significantly more compliant than those in rural areas. Quite the opposite, Slovene taxpayers from rural area show higher voluntary tax compliance. An explanation could be found in the different personal norms; while taxpayers in rural area are traditionally conservative, this is not the case with taxpayers in urban area.

6 CONCLUSIONS

The study aims to inspect the socio-demographic variables gender, income level and settlement size on the economic and psychological factors of tax compliance. The research findings indicate that there are some statistically significant relationships found between gender, settlement type and the economic and psychological factors of tax compliance. The results confirmed that taxpayers with different income levels have different attitudes toward the economic and psychological factors of tax compliance. The significant fact noted in the study was the prevalence of voluntary compliance among taxpayers in a rural area compared to taxpayers in urban area and different gender attitude seeing tax payment as obligation and disapproval of shadow purchase from females' side.

Policymakers should consider reviewing existing legislation and promoting a more positive tax culture among taxpayers in urban areas and within the male population, as suggested by our results. Given that taxpayers with low incomes tend to agree that tax evasion is morally acceptable when tax rates are excessively high, policymakers should carefully reassess and establish tax laws with tax rates that do not result in non-compliance due to high tax rates. Tax authorities should work on promoting a better tax culture among male taxpayers and those with lower incomes to cultivate an environment that encourages voluntary compliance. Additionally, further research could assess the impact of enforced tax compliance measures, with a specific focus on the male population and low-income taxpayers. In future research, a probability sampling approach should be employed instead of a non-probability sampling approach, as snowball sampling may not allow for the making of inferences relevant to the entire target population.

Disclosure statement
The authors have no potential conflict of interest to report.

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LIDIJA HAUPTMAN, BERISLAV ŽMUK AND IVANA PAVIĆ: TAXPAYERS' ATTITUDES
TOWARD TAX COMPLIANCE IN THE SLOVENIAN TAX SYSTEM: DIFFERENCES
ACCORDING TO GENDER, INCOME LEVEL AND SIZE OF SETTLEMENT

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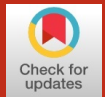
Fiscal decentralization and gender equality: empirical evidence across countries

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Abstract

Globally, over the last few decades, countries have become increasingly decentralized but only recently did they recognize the need for incorporating a gender dimension into such policies. As a result, the relationship between fiscal decentralization, which implies delegating fiscal powers from national to subnational governments, and gender equality remains elusive. In this paper, I study the impact of expenditure decentralization on gender equality using panel data from the Organisation for Economic Co-operation and Development – OECD countries between 2006 and 2021. I find that decentralization of expenditure increases gender equality in these countries. My results also demonstrate that unionization, the extent of a country's integration with the rest of the world, urbanization, population growth, and the state of democracy also matter for gender equality. This suggests that these factors should also accompany expenditure decentralization if the governments of these countries want to further promote gender equality through such public policies.

Keywords: fiscal decentralization, gender equality, public expenditure

1 INTRODUCTION

In Forster's view, "Gender inequality is perhaps the single most significant impediment to achieving a more just, equitable, prosperous, and inclusive world" (Forster, 2020:10). Major world institutions that promote macroeconomic and financial stability globally also emphasize the importance of gender equality for building and maintaining strong economies. The ILO (2000) defines gender equality as a situation free of stereotypes, biases, and discrimination across genders. On average across countries, long-term GDP per capita would be 20% higher if the gender employment gap were closed and there would be 5-6 trillion dollars' worth of economic gains globally if women participated in new businesses at the same rate as men (World Bank, 2023a). One of the major sustainable development goals of the United Nations (UN) is to ensure equal opportunities for women so that they can actively participate in all levels (i.e., political, economic and public) of decision-making in the economy.

The issue of gender equality has relevance not only for developing but also for developed countries. Although gender inequality can often be observed to persist severely in the Global South, Forster (2020) points out that this economic deficiency also characterizes countries in the Global North. That is why one will find pro-gender-equality initiatives like gender budgeting in OECD countries or the Feminist International Assistance Policy (Global Affairs Canada, 2017:3) in Canada. In the OECD countries, despite some progress in recent decades, gender inequalities prevail in areas that include entrepreneurship, compensation, participation in the labor market, education, health, and so on. This reflects not only the difficulty in drafting, implementing, and assessing gendered public policies but also the greater scope for misallocation and misuse of public resources (Downes, Von T. and Nicol, 2017).

Fiscal decentralization, where more authority and autonomy are delegated from national to subnational governments, has become increasingly common in both developed and developing countries over the last few decades (Treisman, 2007). It is generally argued that decentralization improves the overall efficiency of government, although it might not always be the case. Martinez-Vazquez, Lago-Peñas, and Sacchi (2017) suggest that it has become essential to study how fiscal decentralization influences society, politics, and the economy since subnational governments worldwide have become increasingly responsible for providing public goods and services. The available literature has widely explored fiscal decentralization's effect on various socioeconomic variables like economic growth, income inequality, and poverty, as well as the provision of public goods and services. Although gender equality is a potentially desirable outcome of the decentralization process and a major sustainable development goal of countries around the world there are only a few studies on how fiscal decentralization affects gender equality.

Using cross-sectional data Williams (2018) found no empirical evidence of any relationship between a country being federal and the extent of gender inequality; however, several limitations of the analysis can be pointed out. First, the analysis was cross-sectional so it was not possible to control for unobserved heterogeneity between countries and over time. Second, the outcome variable studied was "federalism" a dummy variable indicating whether a country has a unitary or federal constitution. Lessman (2009) asserts that a dummy variable does not adequately represent the decentralization process. Third, the Human Development Index (HDI) was the only control variable used in the regressions and thus estimation was very likely biased due to omitted variables that could also affect gender inequality. Finally, potential endogeneity bias in the relationship was also ignored during empirical analysis.

Naeem and Khan (2021) examined how fiscal decentralization affects gender equality using panel data but its results cannot be generalized since the study was done only for developing countries. Another concern is that the authors used a system-GMM estimator to tackle endogeneity in which lagged values of fiscal decentralization were used as instrumental variables. However, this way of addressing endogeneity is problematic since in the process of using past values as instruments the estimator might end up producing too many instruments resulting in an overestimation of the coefficients of the endogenous variables (Roodman, 2009).

In this study, I investigate how fiscal decentralization affects gender equality in developed countries and to my knowledge, this is a novel study using data on OECD countries. Specifically, panel data on OECD countries during the period 2006-2021 was utilized, with a focus on expenditure decentralization since it has been observed by Sow and Razafimahefa (2018) that unlike other types of decentralization such as revenue, expenditure decentralization directly influences health and education outcomes as well as the efficiency in public goods and services provision. Also, Gemmell, Kneller, and Sanz (2013) point out that in these countries

spending has been decentralized more than revenue in the last few decades. Moreover, expenditure decentralization was found by Cavusoglu and Dincer (2015) to be more effective than revenue decentralization in decreasing income inequality.

In the empirical estimation, endogeneity issues are tackled using instrumental variables, and additional estimation was performed to establish the robustness of the findings. The key result is that expenditure decentralization increases gender equality across the OECD countries. This finding is robust to different measures of outcome and instruments. The results also show that unions, population growth, urbanization, the extent of a country's integration with the rest of the world, and the state of democracy matter for gender equality. Although the level of development and unemployment influence gender equality as well, the finding is not robust.

Next, the related literature on fiscal decentralization and its impact on different socioeconomic variables is reviewed. The data and empirical methodology are then presented and discussed. After that, the empirical results and robustness checks are analyzed before I conclude my paper.

2 RELATED LITERATURE
Theoretical considerations provide no clear-cut direction about the relationship between fiscal decentralization and various socio-economic outcomes. For example, advocates argue that the delivery of public goods and services is more efficient in a decentralized setting since local governments have better access to and thus information about local preferences (Oates, 2005). As public institutions are geographically close to the local population there is also greater accountability that might lead to increased public investment in the key sectors of the economy (such as health and education) and improved public service outcomes (Ahmad, Brosio and Tanzi, 2008; Fredriksen, 2013). On the contrary, critics argue that the benefits of decentralization might not be fully realized since local governments might grow and simply become unmanageable. If they face soft budget constraints then local public officials might end up adopting inefficient public policies. Macroeconomic instability might also result from their failure to attract the investments necessary for innovation and technological progress (Treisman, 2000; Ivanyna and Shah, 2011; Weingast, 2014).

Similar ambiguity is also evident in empirical studies on fiscal decentralization. Baskaran and Feld (2013) found a negative effect of fiscal decentralization on economic growth across 23 OECD countries during 1975-2008. In contrast, Eller (2004) notes a positive effect of fiscal decentralization on economic growth while Thornton (2007) encounters no evidence of such a relationship among the OECD countries. Gemmell, Kneller, and Sanz (2013) using data on 23 OECD countries between 1972-2005 find that expenditure decentralization deters economic growth whereas revenue decentralization facilitates it. However, for a similar sample of OECD countries Bodman (2011) observes that neither spending nor revenue decentralization has any effect on economic growth.

Tselios et al. (2012) for 102 EU regions during 1995-2000 and Lessman (2012) for regions across 54 developed and developing countries during 1980-2009 found that fiscal decentralization decreases income inequality in less developed regions but increases income inequality in high-income regions. On the contrary, Cavusoglu and Dincer (2015) observe that in the U.S., fiscal decentralization decreases income inequality only in the rich states.

Fernandez, Luna and Rambousek (2019) observe that for sustainable development of any economy, achieving gender equality is vital since it allows for the distribution of resources, programs, and decisions without discriminating across genders and thus leads to inclusive growth. However, according to the World Bank (2023b), it is difficult to establish and sustain gender equality even under the most favorable conditions since it involves complex and often controversial issues. In almost every industrialized country women's economic status in terms of employment and earnings falls behind men as a result of having children and Gornick (2004) asserts that such economic outcomes can be transformed through public policies. For instance, across 18 high-income countries in the West gender poverty gap for lone mothers and elderly women was mitigated by social transfers (Brady and Burroway, 2012).

In their systematic review, King et al. (2020) find that generally in high-income countries greater gender equality improves the health outcomes of both men and women. Jimenez-Rubio's (2011) exploratory empirical analysis of Canadian provinces during the period 1979-1995 showed that fiscal decentralization of health services improved the health outcomes of the population.

There is a paucity of research that examines how fiscal decentralization affects gender equality. In theory according to Williams (2018), "federalism" which involves decentralization of power to more local levels is in general neither good nor bad for gender equality. On one hand, decentralization creates more opportunities for women's political participation thus increasing their scope for promoting a gender equality agenda. According to political scientists such effects of decentralization can spill over to neighboring local units consequently increasing competition among them and thus improving policies. On the other hand, decentralization can act as a barrier to gender equality as communities at the local level might be more conservative in terms of gender roles and ideologies than their national counterparts and thus hinder any kind of feminist reforms at the local level. Decentralization could also push women towards less resourced and inferior positions of decision-making for the government. There could be further costs for women if political lobbying results in women's rights and/or benefits (such as access to child care and reproductive health services) being distributed asymmetrically across different local units. The discussion points to ambiguity from a theoretical perspective regarding how decentralization will influence gender equality as it depends on the underlying mechanisms at work (Vickers, 2012; Stockemer and Tremblay, 2015; Williams, 2018).

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Williams (2018) applies linear regression analysis on cross-sectional data for 24 countries in 2016 and controlling for HDI finds no evidence of any statistically significant relationship between a country being federal and its gender inequality index. Stockemer and Tremblay (2015) show that though gender equality is one of the normative principles underlying modern democracy globally women remain marginalized in politics even today. Using descriptive statistics and regression analysis they investigate the impact of federalism on female representation using data on 99 countries from 1995 to 2010. They find that federal countries have between three to four percentage points more female parliamentarians than unitary countries.

The only available study that examines how fiscal decentralization affects gender equality in a cross-country framework is by Naeem and Khan (2021). Their dynamic panel data analysis on 29 developing countries showed that fiscal decentralization worsened gender equality in lower-middle-income countries but to a lesser extent than in upper-middle-income countries in their sample regardless of whether the outcome analysed was the decentralization of revenue or expenditure.

3 DATA

The sample data in this paper covers an unbalanced panel of 27 OECD countries during 2006-2021: Australia, Austria, Belgium, Canada, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, United Kingdom, United States. Table 1 presents the variables and data sources. Figure 1 shows a scatter plot of expenditure decentralization against the gender equality index from which high variation in both these variables can be seen across the OECD countries.

FIGURE 1

Scatter plot of expenditure decentralization on gender equality across OECD countries, 2006-2021, with a linear regression line
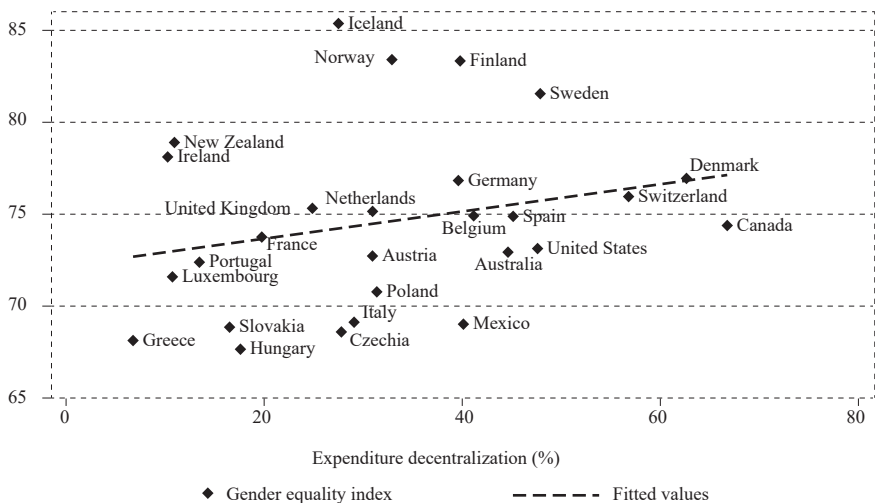
Source: Author's illustration.

The plot also includes the line of best fit which slopes upward indicating that countries with higher levels of expenditure decentralization attain higher equality in terms of gender.

However, at this stage, it will not be possible to make a claim based merely on such a visual inspection that the relationship is causal. The reason is that various factors other than expenditure decentralization will likely impact gender equality across the countries. Another concern would be the issue of endogeneity as a result of potential reverse causality where countries with high gender equality might lobby for higher decentralization of expenditure. Hence, to isolate and estimate the actual effect of expenditure decentralization on gender equality in a reliable manner using the appropriate empirical techniques I resort to regression analysis.

4 EMPIRICAL METHODOLOGY
The basic empirical specification is as follows:

$$Y_{it} = \alpha_i + \beta_1 Dec_{it} + \gamma' X_{it} + \delta_t + \varepsilon_{it} \tag{1}$$

where the i and t denote countries and years, respectively; Y denotes the gender equality index; Dec denotes expenditure decentralization; X represents country-specific characteristics that are included as control variables; α's are country fixed effects; δ's are time fixed effects; ε is a stochastic error term.

The dependent variable, Gender equality, is represented by the gender equality index which captures the size of gender-based disparities and tracks their progress over time by synthesizing the performance of both men and women along four dimensions: educational attainment, health and survival, political empowerment, and economic participation. It is a weighted average of the sub-indices along these dimensions and its value ranges from one (that indicates equality) to zero (that indicates inequality). My measure of decentralization is the ratio of subnational government expenditures expressed as a percentage of general government expenditures. It is not a perfect measure of local autonomy because subnational governments often do not have complete discretion on expenditure decisions. This might happen due to the federal laws, the extent to which a party is centralized, and/or the service standards being determined centrally (Joumard and Kongsrud, 2003; Martinez-Vazquez, Lago-Peñas and Sacchi, 2017). However, because of its strength the expenditure share of subnational government is one of the most widely used indicators in decentralization studies.

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TABLE 1
Variables and data sources

Variables	Description	Sources
Democracy index	A snapshot of the state of democracy	Economist Intelligence Unit
Gender equality index	A summary measure of progress toward gender equality	World Economic Forum
Financial development index	Indicator of depth, access, and efficiency of financial institutions and markets	International Monetary Fund
Government size	An index measuring the size of the public sector in terms of consumption, investment, transfers, etc.	Fraser Institute
Gender inequality index	A summary measure of progress toward gender inequality	United Nations Development Programme
Human development index	A summary measure of average achievement in key dimensions of human development	
Expenditure decentralization	The ratio of sub-central to general government spending	Organisation for Economic Co-operation and Development
Union	The share of wage and salary earners that are trade union members	
Real GDP per capita	GDP per capita in 2015 U.S. dollars	
Urbanization	The ratio of Urban population to Total population	
Population growth	Growth rate value	
Land area (sq. km)	Land area value	
Unemployment rate	The ratio of Unemployed to Total labor force	
Exports	The ratio of Exports to GDP	World Bank
Foreign direct investment	The ratio of Foreign direct investment to GDP	
Population	Population value	
Population density	The ratio of Population to Land Area	
Government effectiveness	Governance indicator capturing the perceptions of government effectiveness	

Source: Author's compilation.

To minimize possible omitted variable bias in estimation, control variables that are expected to affect gender equality are also included. Those variables are urbanization and population growth, to control for demographic changes such as agglomeration; real GDP per capita or HDI, to control for the level of a country's development; unions and financial development, to control for institutional characteristics that might influence gender equality by establishing standardized rates of pay, allowing workers to earn additional benefits such as paid sick and family leaves and/or by providing access to finance without discriminating across gender; unemployment rate, to control for macroeconomic conditions; government size, to control for the size of the public sector in the economy; the level of democracy, to capture the structural characteristics of the political system; exports and foreign

direct investment, to control for a country's openness to the rest of the world. Table 1A reports the descriptive statistics of the variables used in this analysis.

TABLE 1A
Descriptive statistics

Variable	Obs.	Mean	Std. dev.	Min.	Max.
Gender equality index	432	0.75	0.05	0.64	0.91
Gender inequality index	432	0.12	0.08	0.01	0.43
Year	432	n/a	n/a	2006	2021
Expenditure decentralization (%)	431	32.40	16.12	5.60	69.11
Human development index	432	0.90	0.04	0.74	0.96
Log of Real GDP per capita	432	10.48	0.61	9.07	11.63
Government size	405	6.01	0.88	4.32	8.37
Urbanization (%)	432	77.82	10.96	53.73	98.12
Population growth (%)	432	0.64	0.68	-1.85	2.89
Unemployment rate (%)	432	7.39	4.17	2.01	27.47
Union	336	32.12	21.75	8.30	92.20
Exports (%)	432	52.96	34.63	10.20	211.43
Foreign direct investment (%)	432	5.68	16.64	-42.29	138.70
Financial development index	432	0.68	0.18	0.25	1.00
Government effectiveness	432	1.34	0.56	-0.31	2.35
Democracy index	378	8.40	0.89	5.57	9.93
Log of Population	432	16.44	1.49	12.62	19.62
Log of area (km^2)	405	12.23	1.82	7.85	16.03
Log of Population density	405	4.20	1.38	0.98	6.25

Source: Author's calculations.

5 EMPIRICAL RESULTS

Column 1 of table 2 shows that expenditure decentralization positively influences gender equality but the effect is statistically insignificant. When other control variables are added, column 2 shows that real GDP per capita and unemployment negatively influence gender equality while the variables union, exports, and foreign direct investment affect it positively but the other variables including expenditure decentralization remain statistically insignificant. When the Human Development Index-HDI instead of real GDP per capita is also controlled for, the results reported in column 3 hardly change in comparison with those in column 2 except that the unemployment rate and HDI are also statistically insignificant.

TABLE 2

Basic regression results

Variables	Dependent variable: Gender equality index			
	(1)	(2)	(3)	(4)
Expenditure decentralization	0.007	-0.042	-0.0321	0.542**
	(0.079)	(0.062)	(0.068)	(0.233)
Real GDP per capita (log)		-6.826**		
		(2.910)		
Government size		0.221	0.066	0.081
		(0.707)	(0.715)	(0.430)
Urbanization		0.064	0.175	0.424***
		(0.165)	(0.173)	(0.164)
Population growth		-0.107	-0.122	-0.633*
		(0.314)	(0.354)	(0.375)
Unemployment rate		-0.234**	-0.125	-0.0169
		(0.095)	(0.092)	(0.084)
Union		0.325***	0.325***	0.219***
		(0.071)		(0.085)
Exports		0.085**		0.108***
		(0.031)	(0.024)	(0.035)
Foreign direct investment		0.015**	0.017**	0.024**
		(0.006)	(0.007)	(0.012)
Financial development		4.188	5.304	1.810
		(4.344)	(4.333)	(3.270)
Democracy		0.349	0.120	1.289*
		(1.031)	(1.053)	(0.744)
Human development index			-1.688	-10.860
			(25.740)	(21.210)
Constant	71.10***	118.8***	42.09*	
	(2.626)	(33.83)	(23.95)	
No. of observations	431	288	288	288
Countries	27	27	27	27
Country fixed effects	Y	Y	Y	Y
Year effects	Y	Y	Y	Y
KP (F-stat)				10.323
P-value (J-Stat)				0.372

Note: P-values (clustered by country) appear in parentheses below estimates; *p<0.10, **p<0.05, ***p<0.01. Column 4 uses population (in logs) and government effectiveness as instruments for the decentralization measure. The KP (F-stat) refers to the Kleibergen Paap rk Wald F-statistic; the J-stat refers to Hansen's overidentification test.

Source: Author's calculations.

Now expenditure decentralization could be endogenous as a consequence of the political circumstances prevailing in the country. Hence changes in gender equality might influence expenditure decentralization and the extent to which it is implemented. For instance, in Switzerland, female policymakers have been found to have a substantial effect on public expenditure composition (Funk and Gathmann, 2008). Then the fixed effect estimates that I have obtained so far will likely be biased. I tackle the potential endogeneity of expenditure decentralization employing the two-stage-least squares (TSLS) estimation procedure using population as an instrument. Jimenez-Rubio (2011) and Escolano et al. (2012) observe

that when the population of a country is high it becomes difficult for centralized governments to gather sufficient information for adequately meeting the needs of its citizens and hence decentralization is common in larger countries.

Another instrument used for my analysis is government effectiveness since that can trigger the decentralization process. Local governments by being geographically close to the population can gather information about local preferences more easily than centralized governments (Besley and Coate, 2003). This would lead to optimal public goods provision according to Seabright (1996) as then politicians would be able to sufficiently distinguish among groups based on their specific needs. Hence the more effective the governments are in terms of their public goods provision and accountability the more decentralized the countries can be expected to be. However public goods provision might be more costly and inefficient, i.e. local governments might be less effective if scale economies are important. In that case, the effect of government effectiveness on expenditure decentralization will go in the opposite direction. Hence a priori it would be difficult to determine the expected sign of this instrument on the decentralization process as it would depend on the political motives of the government.

Table 3 reports estimation results for the first stage where the endogenous regressor-expenditure decentralization is regressed on the excluded instruments and the included regressors. It can be seen that both instruments influence expenditure decentralization. Specifically, when government effectiveness increases by 1 unit, expenditure decentralization decreases by 2.31 percentage points whereas a 1 percent increase in population increases expenditure decentralization by 0.185 percentage points. Now whether the causal effect of expenditure decentralization on gender equality has been identified depends on the validity of the instrumental variables. That will be inferred from standard tests that assess the strength of the first-stage regression based on the KP (Wald) F-stat as well as the J-stat for the overidentification test. As can be seen at the bottom of column 4 in table 2 the F-stat is greater than 10, which rules out weak instruments. The p-value of 0.372 is significantly larger than 0.01 which indicates that the additional instruments are exogenous.

Column 4 in table 2 reports the estimation results after instrumentation and this is my preferred specification since it takes into account the potential endogeneity of the key explanatory variable while including other relevant controls as well as fixed effects by country and year respectively. It shows that expenditure decentralization positively influences gender equality; if it increases by 1 percentage point then gender equality increases by 0.542 percentage points. As well as unions, exports, and foreign direct investment, now it can be seen that urbanization and democracy also have a statistically significant positive effect on gender equality while population growth's effect is negative.

These findings align with those of Chakraborty (2021) who argues that labor market characteristics influence gender equality, as well as Rocha and Piermartini (2023) who observe that integration of a country with the rest of the world will be necessary

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for gender-inclusive economic progress. Further, my results corroborate Andersen's (2022) finding that democracy causes gender equality as well as Pandey and Kumar's (2021) findings of urbanization being associated with lower fertility levels, increased independence, and more employment opportunities for women.

TABLE 3
First stage estimates

Variables	Dependent variable: Expenditure decentralization
Population (log)	18.53***
	(3.61)
Government effectiveness	-2.310*
	(-2.07)
Human development index	23.17
	(0.99)
Government size	-0.374
	(-0.79)
Urbanization	-0.395**
	(-2.71)
Population growth	0.560
	(1.84)
Unemployment rate	-0.258***
	(-3.53)
Union	0.128
	(1.27)
Exports	-0.0902**
	(-3.11)
Foreign direct investment	-0.013
	(-1.03)
Financial development	5.417
	(1.52)
Democracy	-2.197**
	(-2.71)
No. of observations	288
Country fixed effects	Y
Year effects	Y

*Note: P-values (clustered by country) appear in parentheses below estimates; * p < 0.05, ** p < 0.01, *** p < 0.001. First-stage regression results for the specification estimated in column 4 of table 2 above.*

Source: Author's calculations.

6 ROBUSTNESS CHECKS

The robustness of the results is assessed in various ways starting with repeating the estimation using an alternative measure of gender equality known as the gender inequality index-GII. This measure was developed by the United Nations Development Programme and it measures gender inequality rather than gender equality. While both measures reflect the same fundamental concept their components somewhat differ. The GII is a composite measure of gender inequality along three dimensions: reproductive health, empowerment, and the labor market. A low GII indicates

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low inequality between men and women, and vice versa. Hence, the estimated coefficients of its explanatory variables would be expected to have opposite signs than those that explained gender equality.

The results reported in column 5 of table 4 show that expenditure decentralization has a negative and statistically significant effect on gender inequality. Except for human and financial development, all the other explanatory variables are statistically significant with coefficient estimates having signs as expected a priori.

TABLE 4
Robustness checks

Variables	Gender inequality index	Gender equality index		
	(5)	(6)	(7)	(8)
Expenditure decentralization	-0.354**	0.523**	0.390***	0.310**
	(0.164)	(0.222)	(0.140)	(0.132)
Human development index	11.75	-10.56	-8.428	-7.144
	(14.70)	(20.95)	(19.39)	(18.81)
Government size	-1.379***	0.0803	0.077	0.075
	(0.318)	(0.426)	(0.406)	(0.398)
Urbanization	-0.509***	0.415***	0.358**	0.323**
	(0.146)	(0.161)	(0.139)	(0.138)
Population growth	0.813***	-0.616*	-0.498*	-0.426
	(0.252)	(0.365)	(0.299)	(0.277)
Unemployment rate	-0.180***	-0.021	-0.045	-0.061
	(0.055)	(0.082)	(0.069)	(0.066)
Union	-0.107*	0.223***	0.247***	0.262***
	(0.062)	(0.083)	(0.076)	(0.075)
Exports	-0.057**	0.107***	0.097***	0.091***
	(0.023)	(0.034)	(0.028)	(0.027)
Foreign direct investment	-0.015**	0.024**	0.022**	0.021**
	(0.008)	(0.011)	(0.01)	(0.009)
Financial development	2.096	1.926	2.737	3.226
	(2.444)	(3.234)	(3.115)	(3.133)
Democracy	-2.677***	1.250*	0.979	0.815
	(0.615)	(0.731)	(0.651)	(0.639)
No. of observations	288	288	288	288
Countries	27	27	27	27
Country fixed effects	Y	Y	Y	Y
Year effects	Y	Y	Y	Y
KP (F-stat)	10.323	10.363	12.100	18.61
P-value (J-Stat)	0.919	0.342	0.295	0.440

*Note: P-values (clustered by country) appear in parentheses below estimates; * p<0.10, ** p<0.05, *** p<0.01. Instruments used for the decentralization measure are population (in logs) and government effectiveness in column 5; population density (in logs) and government effectiveness in column 6; population (in logs), area (in logs), and government effectiveness in column 7; population (in logs) and area (in logs) in column 8. The KP (F-stat) refers to the Kleibergen Paap rk Wald F-statistic; the J-stat refers to Hansen's overidentification test.*

Source: Author's calculations.

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Next, population density[1] and government effectiveness are used as instruments and the results are reported in column 6 of table 4. Then in column 7, population, land area, and government effectiveness are employed as instruments for expenditure decentralization. Finally, population and land area are utilized as instruments and the estimation results are reported in column 8. In these last three specifications, the gender equality index is the dependent variable. The KP (Wald) F-stat remains above 10 in all the specifications of table 4 and the reported p-values all indicate the instruments' exogeneity. It can be seen that the results reported in table 4 support the key results of the analysis.

7 CONCLUSION

In this study, I investigate the effect of the decentralization of expenditure on gender equality using panel data from 2006-2021 for 27 OECD countries. In the empirical analysis, potential endogeneity concerns in the relationship were tackled using instrumental variables. The estimation results show that expenditure decentralization increases gender equality. The results remained robust when alternative indicators for the outcome as well as the instruments were employed.

My empirical results are consistent with those of Stockemer and Tremblay (2015) who found that across countries federalism promotes women's political participation. But my findings are in sharp contrast with Naeem and Khan (2021) who found that fiscal decentralization increased gender inequality in developing countries. This likely reflects the fact that developing countries did not have any gender aspect explicitly embedded in their decentralization process as the OECD countries did over the last few decades. Also, in general, fiscal decentralization works more effectively in developed countries according to Tselios et al. (2012).

Although fiscal policy has been increasingly decentralized across the OECD countries over the last few decades the gender aspects of such policies has only recently gained attention. In this paper, I find that expenditure decentralization can serve as an important policy tool to promote gender equality across OECD countries. However, the effectiveness of such policy will depend on whether it is complemented by increased urbanization, trade, foreign direct investment, unionization, and the level of democracy but decreased population growth. Chakraborty (2021) recommends that such decentralization measures tend to be more effective when targeted funds are implemented for the achievement of gender-specific outcomes. More importantly as highlighted by Downes, Von T. and Nicol (2017), rather than ad hoc such a gender budgeting initiative must be adopted in an all-encompassing manner so that it remains consistent with other sustainable development goals. However, it must be borne in mind that the process of establishing gender equality economywide will be time-consuming, which is, after all, characteristic of the accomplishment of all the goals of the government.

Disclosure statement
The author has no conflict of interest to declare.

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[1] Arzaghi and Henderson (2005) find that population and the area of the country are both important determinants of fiscal decentralization.

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Is the use of the investment resources allocated to municipalities in Cameroon efficient?

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SYLVAIN NGÔ NDJANG, SATURNIN BERTRAND NGUENDA ANYA
AND FABRICE NZEPANG: IS THE USE OF THE INVESTMENT
RESOURCES ALLOCATED TO MUNICIPALITIES IN CAMEROON EFFICIENT?

Abstract

The aim of this study is to assess the technical efficiency of the use of investment resources allocated to municipalities in Cameroon. The data used come from the Special Inter-municipal Equipment and Intervention Fund (FEICOM), the National Participatory Development Programme (PNDP) and the Public Investment Budget (BIP), for the period 2010 to 2020, and the Data Envelopment Analysis (DEA) method. The results shows that the BIP counter has the highest efficiency score, at 1 for the whole period, while the scores of the FEICOM and PNDP windows are 0.896 and 0.857 respectively. Secondly, the pooling of resources from the different windows increases the efficiency score obtained, an average of 0.96 for the whole period, even if the new scores remain lower than those of BIP. These results, which highlight the good performance of the BIP window, justified by the significant learning effects from which this window benefits.

Keywords: decentralisation, technical efficiency, municipalities, local development, Cameroon

1 INTRODUCTION

The efficient use of resources allocated to decentralised local authorities for investment projects is at the heart of many concerns about the effectiveness of decentralisation policy (De Calan and Coquart, 2013; Saoudi, 2017). Indeed, it is accepted that decentralisation brings greater economic efficiency by matching people's tastes and preferences to the services offered by local authorities (Tiebout, 1956; Oates, 1972). The existing literature reports numerous previous studies on the efficiency of decentralised local authorities, although only single sources of funding are usually considered (Narbón-Perpiñá and De Witte, 2018a; 2018b; Moreno and Lozano, 2018; Titl and De Witte, 2022; Milán-García, Rueda-López and De Pablo-Valenciano, 2022).

In Cameroon, between 2010 and 2020, as part of the decentralisation process, the State has transferred no fewer than forty-three (43) powers, out of the fifty-six (56) provided for by the legislator since 2004, to the municipalities in various sectors relating to the country's economic and social development. Cameroon's local authorities are, however, experiencing many difficulties in mobilising their own resources. For example, the share of own resources in their total resources was less than 30% in 2020 (Kom Tchuente, 2020). Faced with this weakness in local own resources, the State, within the context of fiscal decentralisation, has provided for other funding measures in the form of grants or tax sharing for the communes. In addition to this system put in place by the central government, which is implemented through the Public Investment Budget (BIP), there are two other structures responsible for funding decentralisation, namely: the Special Inter-municipal Equipment and Intervention Fund (FEICOM), a sort of "local authority bank" whose resources come from the public treasury, and the National Participatory Development Programme (PNDP) which is financed by international donors as part of development aid (World Bank, Agence Française de Développement, etc.). Between 2010 and 2020, these three windows have allocated financial resources estimated at around FCFA 2,280 billion to the communes, primarily for local

investment projects. However, people's limited access to basic amenities such as water (64.7% of the population), electricity (64.1% of the population), and refuse collection (33.0% of the population), as well as the worsening level of monetary poverty among people living in rural areas, where the incidence of poverty stood at 56.8% in 2014 compared with 55.0% in 2007 (INS, 2019), are in contrast with the ever-increasing financial resources allocated by the various funding sources for the implementation of investment projects. The discrepancy between the measures taken by the public authorities and the results achieved on the ground in terms of local development raises questions about the efficient use of the investment resources allocated to the municipalities.

The aim of this study is to assess the technical efficiency (Farell, 1957) of using investment resources allocated to municipalities in Cameroon. The contribution of this paper lies in the fact that, on the one hand, it analyses the efficiency of municipalities by taking account of the origin of funding, which is still rare in the empirical literature. On the other hand, this study evaluates the efficiency resulting from pooling the resources of the various funding windows in the form of a single window in order to estimate the efficiency losses associated with a multiplication of players in the decentralisation funding chain in Cameroon. In order to achieve this objective, the article uses the data envelopment analysis (DEA) method, which analyses data from the annual activity reports of the various funding windows for communal investments in Cameroon, for the period from 2010 to 2020.

This paper is of interest on at least two levels. Firstly, this study is a contribution to the debate on the relevance of the decentralisation policy implemented in Cameroon and in many developing countries, including those in Africa, where the issue of the efficient use of resources allocated to local public administration is becoming increasingly important (De Calan and Coquart, 2013). Secondly, taking into account the origin of resources in the evaluation of the efficiency of local public services makes it possible to improve the contribution of the "fragile" funding windows and to consolidate the contribution of the most efficient windows, which is important for improving the overall use of the resources allocated by the State and the various partners.

The rest of the article is structured as follows: section 2 is devoted to a literature review, section 3 presents the methodology, section 4 comments on the results and section 5 concludes.

2 LITERATURE REVIEW

This literature review presents the concept of efficiency in local public services and the problems associated with its assessment, as well as the approaches used to measure this efficiency.

2.1 THE CONCEPT OF EFFICIENCY IN LOCAL PUBLIC SERVICES AND THE PROBLEMS ASSOCIATED WITH ASSESSING IT

From an economic perspective, efficiency implies a rational use of resources, which implies an absence of waste. On the other hand, municipalities are a type of public service that are developing as a consequence of decentralisation, which implies a

transfer of powers and responsibilities in the management of public affairs from central government to lower levels (Oates, 1993). According to Milán-García, Rueda-López and De Pablo-Valenciano (2022), interest in the study of local government efficiency and its determinants has intensified in recent years (Moreno and Lozano, 2018). Specifically, the various recent economic and financial crises have highlighted the need to improve efficiency and reduce the costs of public service delivery at all levels of public administration, including local (Andrews and Boyne, 2011) and regional (Titl and De Witte, 2022) governments. Therefore, measuring efficiency is essential for assessing the outcomes of local public policies (Lo Storto, 2016). However, estimates of efficiency that do not take into account the variables that condition it are of limited value (De Witte and Kortelainen, 2013). It is therefore equally important, from the point of view of policymakers, to identify the main determinants of local efficiency in order to be able to articulate measures likely to affect them directly or indirectly. A summary of empirical work on municipality efficiency, highlighting trends and determinants, is presented by Milán-García, Rueda-López and De Pablo-Valenciano (2022). According to this summary, it is possible to identify two streams of empirical research. On the one hand, some studies focus on the evaluation of a particular local service, such as refuse collection and street cleaning (Benito-López, del Rocio Moreno-Enguix and Solana-Ibañez, 2011), water services (García-Sánchez, 2006), street lighting (Lorenzo and Sánchez, 2007), local police (Davis and Hayes, 1993), fire services (Jaldell, 2019), libraries (De Witte and Geys, 2013), education services (Ferraro et al., 2021), waste collection and street cleaning (Benito et al., 2021), regional road maintenance (Kalb, 2014) and urban transport (Campos-Alba et al., 2020). A second stream includes studies that assess the efficiency of municipalities from a holistic perspective, for which local governments are complex organisations responsible for providing a wide variety of services (Da Cruz and Marques, 2014).

Since the early 1990s, a great deal of scientific research has focused on the evaluation of the efficiency of local public services (Benito, Bastida and Garcia, 2010; Balaguer-Coll, Prior and Tortosa-Ausina, 2013; Monkam, 2014). However, there are a number of difficulties associated with this evaluation work (Balaguer-Coll, Prior and Tortosa-Ausina, 2013). One of these is the lack of a standardised definition of a unit of public product and of prices that can be evaluated as units of non-market production (Mandl, Dierx and Ilzkovitz, 2008). At municipal level, another difficulty is that it is not always possible to rely on disaggregated information about the number of inputs used to carry out the different services provided (Zafra-Gómez, Antonio and Muñiz, 2010).

Despite these difficulties, Milán-García, Rueda-López and De Pablo-Valenciano (2022) found that other studies have preferred to focus on analysing the technical efficiency at municipal level. For these authors, municipalities are multi-product organisations in which the joint use of inputs generates a variety of products. In addition, citizens often evaluate local government management on the basis of the set of public services they receive (Bosch-Roca, Espasa and Mora, 2012). In this line of analysis, some authors construct a composite indicator of public output by applying identical weights to the partial indicators (Afonso and Venâncio, 2020) or by using differentiated weights according to the relative expenditure of the

public service they represent (Bosch-Roca, Espasa and Mora, 2012) or by using specific weights according to the nature of the service (Nakazawa, 2014).

A clear measure and decomposition of economic efficiency was first proposed by Farrell (1957). However, the concept of efficiency is not new to economic analysis. Until the early 1950s, the possibility that firms might exploit their resources inefficiently was implicitly ruled out in empirical studies. It was assumed that firms allocated their resources efficiently, given the constraints imposed by production technology, market structure and the objectives that motivated entrepreneurs. This omission of the treatment of efficiency has characterised the work of several renowned economists such as Koopmans (1957) and Debreu (1951). Koopmans was the first to propose a measure of the concept of efficiency and Debreu the first to measure it empirically. Debreu proposed the resource utilisation coefficient, which was essentially a measure of the output-input ratio.

2.2 WORK ON MEASURING THE EFFICIENCY OF LOCAL PUBLIC SERVICES

The empirical literature on the efficiency of decentralised municipalities reveals, on the one hand, a diversity of approach methods and, on the other, a complexity in the choice of variables (Narbón-Perpiñá and De Witte, 2018a; 2018b; Milán-García, Rueda-López and De Pablo-Valenciano, 2022; Romano and Molino-Senante, 2020). With regard to the diversity of approach methods, the literature uses different techniques to analyse the efficiency of local governments. On the one hand, the non-parametric tools most commonly used in the literature on local government efficiency are the Data Envelopment Analysis technique (Charnes, Cooper and Rhodes, 1978), and its non-convex version, the Free Disposal Hull (Deprins, Simar and Tulkens, 1984). On the other hand, some studies have used parametric approaches. They determine the frontier from a specific functional form using econometric techniques. Deviations from the best practice frontier derived from parametric methods can be interpreted in two different ways. While deterministic approaches interpret any deviation from the best practice frontier as inefficiency (standard ordinary least squares (OLS) or corrected ordinary least squares (COLS)), the stochastic frontier approach (Aigner, Lovell and Schmidt, 1977; Meeusen and Van den Broeck, 1977), decomposes the deviation from the best practice frontier between the effect of measurement error and inefficiency. Furthermore, environmental variables can easily be treated with a stochastic frontier. They can adopt different cost or production functions, for example Cobb-Douglas or Translog.

With regard to the complexity of the choice of variables, the literature notes a diversity in the choice of inputs used to evaluate the efficiency of municipal resources. The selection of inputs may vary from one country to another because it depends on specific accounting practices and the characteristics of local governments (Narbón-Perpiñá and De Witte, 2018a; 2018b). In addition, it should be noted that most studies have used inputs in terms of costs since data on prices and physical units are not available. Public sector goods and services are often not priced as they are non-market in nature (Kalb, Geys and Heinemann, 2012). Although some authors have

attempted to decompose physical inputs and input prices, most of these input price variables coincide with input variables in terms of costs. Regarding outputs, it is acknowledged that measuring local government outcomes is a complex task, which is explained by the difficulty of collecting data and measuring local services (Balaguer-Coll, Prior and Tortosa-Ausina, 2013). This is because different studies use different outcome measures, even those that analyse efficiency using data from the same country. In addition, the number of outcome variables included in the different studies varies, as some studies aggregate various council services into an overall index, while others assess a set of specific local services.

An important limitation of the different approaches to measuring the efficiency of local public services is that they do not take into account the effects of the funding source and its delivery mechanisms on the efficiency of local public services. So, the contribution of this paper lies in the fact that it assesses the efficiency of local public services by taking into account the variety of funding windows, thus setting itself apart from other previous empirical studies. In particular, the aim is to highlight the specific features of each funding window on the one hand, and to assess the efficiency in the case of pooling all these windows, in the form of a single window, on the other.

3 METHODOLOGY

The methodology is broken down into two points: the data sources, the efficiency assessment tool and the choice and justification of the variables selected.

3.1 DATA

The data used in this study comes from activity reports and various surveys conducted with FEICOM, PNDP and MINEPAT over the period from 2010 to 2020. Data are presented in appendices 1 and 2. The reports were obtained from the websites www.pndp.org and https://feicom.cm. However, there were a number of difficulties in collecting the data, including: (i) the unavailability of the PNDP's 2020 annual report on that organisation's website, (ii) the incomplete nature of some of the information provided by the FEICOM annual reports, which necessitated recourse to additional surveys in order to obtain complete data on the municipalities' own resources, (iii) the unavailability of data relating to the public investment budgets (BIP) for the financial years 2010 and 2011, (iv) the absence of information on the outputs of the various windows by municipalities. This last difficulty explains the decision to use the various years of the period selected as the decision-making units for this study.

3.2 METHOD AND VARIABLES FOR MEASURING THE EFFICIENCY OF RESOURCES ALLOCATED TO INVESTMENT IN MUNICIPALITIES

The data envelopment analysis (DEA) method is used to measure the technical efficiency derived from the use of investment resources allocated to municipalities. There are at least three reasons for choosing this method: (i) it allows multiple inputs and multiple outputs to be taken into account simultaneously, even when they are all expressed in different units of measurement; (ii) it does not require any particular specifications or a priori knowledge of the weights and prices of the inputs or

outputs; and (iii) it does not impose any restrictions on the functional form of the production function (Coelli and Perelman, 1996). This study looks at the technical efficiency, one of the three components of the economic efficiency of organisations proposed by Farrell (1957). It refers to the capacity of a decision-making unit to produce as many outputs as possible with a given amount of inputs, or conversely, its capacity to produce a given level of outputs with a minimum quantity of inputs.

More specifically, the hypothesis adopted is that of variable returns to scale (VRS) rather than constant returns to scale (CRS) since we assume that the size of Cameroon's communes is not optimal and the environment in which they operate is imperfect due to difficulties in accessing information on the direct and indirect costs associated with the production of local public services. In this study, we adopt an output orientation for the calculation of efficiency scores (Huguenin, 2013), since communal decision-makers in Cameroon exercise greater decision-making power over the outputs of their investment activities, because the inputs, which are the financial resources mobilised, are generally beyond their control.

With this in mind, n decision units are evaluated, where each consumes a variable quantity of m different inputs in order to produce s different outputs. More precisely, decision unit j uses x_{ij} of input m and produces a quantity y_{rj} of output s. An intuitive way of introducing the DEA method is to use ratios (Coelli, Rao and Battese, 1998). For each decision unit, a measure of the ratio of all outputs to inputs (R_0) is obtained as follows:

$$R_0 = \frac{u'y_r}{v'x_i} \tag{1}$$

With: u a vector M x l of output weights; v a vector N x l of input weights.

Assume that each decision unit produces s different outputs, $y = (y_1, y_2,\ldots, y_s)$ using m different inputs, $x = (x_1, x_2,\ldots, x_m)$ and that there are n decision units, $N = (1, 2, \ldots, n)$. For each unit i ($i \in N$), the outputs $y_i = (y_1, y_2,\ldots, y_{si})$ are the realisations obtained from the inputs $x_i = (x_1, x_2,\ldots, x_{mi})$ used.

Charnes, Cooper and Rhodes (1978) show that the relative efficiency of a given decision unit i can be obtained by solving the following linear programme

$$\begin{cases} Max \dfrac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \\ \\ s\Big/_c \dfrac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \\ \\ j = 1,\ldots, n;\ u_r, v_i \geq 0;\ i, r \end{cases} \tag{2}$$

Note that the optimal weights (u^*, v^*) are interpreted as the marginal contribution of one unit of each input or output to the R_o efficiency score.

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4 RESULTS AND DISCUSSION

The results of this study comprise the descriptive statistics of the variables selected, as well as the efficiency scores calculated using the DEA method. All of these results are accompanied by comments that provide a better understanding of their significance in the case of Cameroon's councils.

4.1 DESCRIPTIVE STATISTICS

As table 1 shows, the BIP window is the one for which the average values of the various variables between 2010 and 2020 are the highest, i.e. FCFA 56,802,765,947 for the explanatory variable. This makes it the window that has allocated the most resources to the communes over the entire period, while also being the window that has enabled the largest number of investment projects to be carried out at local level over the same period. This situation therefore implies that the BIP window is a priori the one for which technical efficiency should be the highest. The superior efficiency of the BIP window over the other windows can also be seen in the change in the amount of financing mobilised (the explanatory variable), as illustrated in figure 1 below.

FIGURE 1

Evolution of investment resources allocated to the municipalities between 2010 and 2020 (in bn CFA francs)
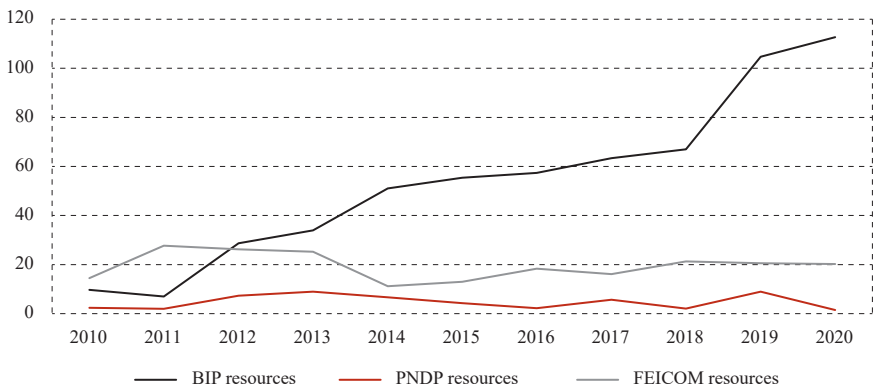
Sources: Based on data from FEICOM, PNDP and MINEPAT, 2010-2020.

For the BIP window, the standard deviation is FCFA 24.99 bn, illustrating the strong increase in resources allocated to communal investments by this window between 2010 and 2020, greater than the FEICOM and PNDP windows, whose standard deviations are FCFA 5.50 bn and FCFA 2.84 bn respectively.

On the other hand, the minimum and maximum values, means and standard deviations of the explanatory and explained variables in the single window are closer to those of the BIP. This implies that the introduction of a one-stop shop could generate results close to those of the BIP in terms of technical efficiency. All of this needs to be verified on the basis of the results of estimating the efficiency scores of the various windows using the DEA method.

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TABLE 1
Descriptive statistics on outputs and inputs for measuring the efficiency between 2010 and 2020

Origin of resources	Statistics	Number of projects financed and amount of financing mobilised						Amounts of funding mobilised (Input) in mn of CFA francs
		Construction or rehabilitation of						
		water infrastructure (Output 1)	electrical infrastructure (Output 2)	transport infrastructure (bridges and roads) (Output 3)	health infrastructure (Output 4)	school infrastructure (Output 5)	Manufacture of bench-tables for schools (Output 6)	
FEICOM	Means	7.364	4.545	1.909	2.545	10.364	1.182	19,501.8
	SD	7.075	3.205	0.832	3.857	6.217	0.603	5,502.4
	[Min-Max]	[1-21]	[1-12]	[1-4]	[1-14]	[1-22]	[1-3]	[11,163.4-27,750.9]
PNDP	Means	283.1	33.7	6.8	20.4	169.1	305.2	5,059.8
	SD	94.189	36.683	1.932	30.241	82.853	202.948	2,840.1
	[Min-Max]	[171-481]	[2-120.5]	[3-10]	[1-88]	[42-331]	[0.5-579.5]	[1,992.5-8,982.5]
BIP	Means	503.667	97.556	487.444	313.667	643.444	762.778	56,802.8
	SD	207.227	91.942	274.833	44.048	251.431	263.071	24,991
	[Min-Max]	[174-806]	[2-250]	[47-809]	[240-388]	[401-1,083]	[183-1,158]	[23,710-98,729.9]
Funders unique	Means	676.818	115	406.909	277.727	690.545	902.727	48,811.3
	SD	329.596	114.128	313.915	143.094	374.826	579.176	22,590.1
	[Min-Max]	[174-1,289]	[6-361.5]	[8-811]	[4-427]	[124-1,375]	[1.5-1,738.5]	[16,826-85,339.4]

SD: Standard deviation.

Source: Based on FEICOM, PNDP and MINEPAT data for 2010-2020.

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4.2 THE RESULTS OF ESTIMATING THE EFFICIENCY SCORES OF THE VARIOUS WINDOWS

Table 2 shows the efficiency scores for the various funding windows determined by the DEA method. Overall, it shows that the BIP window has the highest technical efficiency score, equal to 1, higher than the scores of the FEICOM and PNDP windows, which are 0.896 and 0.857 respectively. This superiority of the BIP window is mainly explained by the considerable experience acquired over time by the ministerial departments involved in transferring powers and resources to the communes as part of the decentralisation process. This experience is reflected in the fact that the resources of this window are managed without waste, as illustrated by the efficiency score under the VRS hypothesis, which is equal to 1 (Huguenin, 2013). Of the three funding windows studied here, BIP is the one that has existed the longest, having been set up in 1962, while FEICOM and PNDP were created in 1974 and 2004 respectively. As Arrow (1962) and Barro and Sala-i-Martin (1995) show, the experience acquired by operational players is a decisive factor in reducing the "waste" associated with the performance of the tasks entrusted to them.

Furthermore, the inefficiency of the PNDP and FEICOM windows is mainly due to the delays in delivery suffered by a large number of projects financed by these windows. For example, the percentage of unfinished projects was 20% for FEICOM in 2020 (FEICOM, 2020), whereas for PNDP, this rate remained at an average of 24% until 2014 (Folléa et al., 2016). Also, projects that are not completed even though the corresponding resources have been mobilised reduce the value of the output/input ratio for each of these windows, which explains their low efficiency of scale scores of 0.898 and 0.614 respectively for FEICOM and PNDP. With regard specifically to the PNDP, whose resources for the financing of communal investments come from development partners (World Bank, Agence Française de Développement, etc.), its technical efficiency under the assumption of variable returns (VRS) of 0.857, which is the lowest score of all the financing windows studied here, shows that this window is the one whose resource management is the most perfectible (Huguenin, 2013). This situation has also rekindled the debate on the effectiveness of development aid, whose ability to promote the economic and social development of beneficiaries has often been contested. Indeed, for many authors, development aid reduces the incentives that should lead beneficiaries to adopt good practices (Bauer, 1976; Monga, 2009).

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TABLE 2
DEA scores for the technical efficiency of the different municipal investment financing sources

| | Technical efficiency scores | | | | | | | | | | | |
| | FEICOM | | | PNDP | | | BIP | | | Funders unique | | |
Years	Constant returns to scale	Variable returns to scale	Scale efficiency	Constant returns to scale	Variable returns to scale	Scale efficiency	Constant returns to scale	Variable returns to scale	Scale efficiency	Constant returns to scale	Variable returns to scale	Scale efficiency
2010	1.000	1.000	1.000	0.517	0.600	0.862	–	–	–	0.818	1.000	0.818
2011	1.000	1.000	1.000	0.722	1.000	0.722	–	–	–	0.513	0.558	0.921
2012	0.503	0.761	0.660	0.234	0.814	0.287	1.000	1.000	1.000	0.998	1.000	0.998
2013	0.572	0.817	0.700	0.190	0.718	0.264	0.920	1.000	0.920	1.000	1.000	1.000
2014	0.953	1.000	0.935	0.247	0.800	0.309	1.000	1.000	1.000	1.000	1.000	1.000
2015	1.000	1.000	1.000	0.487	0.838	0.582	0,998	1.000	0.998	1.000	1.000	1.000
2016	0.987	0.999	0.988	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2017	0.670	0.677	0.991	0.394	0.802	0.491	1.000	1.000	1.000	1.000	1.000	1.000
2018	1.000	1.000	1.000	1.000	1.000	1.000	0.943	1.000	0.943	1.000	1.000	1.000
2019	0.507	0.636	0.796	0.625	1.000	0.625	1.000	1.000	1.000	1.000	1.000	1.000
2020	0.778	0.963	0.808	–	–	–	0.988	1.000	0.988	0.904	1.000	0.904
Means	0.814	0.896	0.898	0.542	0.857	0.614	0.983	1.000	0.983	0.930	0.960	0.967

Source: Based on FEICOM, PNDP and MINEPAT data for 2010-2020.

On the other hand, pooling the resources of the various windows (FEICOM, PNDP and BIP) in the form of a single funding window generates an efficiency score of 0.96, higher than that of FEICOM and PNDP taken separately, but lower than that of BIP. However, the loss of efficiency in relation to BIP is small, at less than 0.04 when variable returns are taken into account and less than 0.02 when the technical efficiency of scale is taken into account; whereas the efficiency gains in relation to the other two windows (PNDP and FEICOM) are respectively 0.064 and 0.103 when variable returns are taken into account, and 0.069 and 0.353 for the technical efficiency of scale. This means that it would be wiser to implement projects financed by FEICOM and PNDP on the BIP model in order to improve the technical efficiency of decentralisation in Cameroon. In other words, extending the procedures applied by the BIP window to all communal investment financing windows would not only make the management of the FEICOM and PNDP windows more efficient, but also improve optimisation of the size of their interventions.

5 CONCLUSION

The aim of this study was to assess the efficiency of using the investment resources allocated to municipalities in Cameroon. The DEA method used produced at least two important results. Firstly, the resources allocated by the BIP window are those whose use shows the best efficiency scores compared with those of the FEICOM and PNDP windows. This situation is justified by the learning effects or phenomena from which the BIP branch benefits because it has been in existence longer than the other two branches. Secondly, pooling the resources of the various windows through a single window produces higher efficiency scores than the FEICOM and PNDP windows on their own, but lower than the BIP window. These results suggest an important economic policy implication, mainly that the use of investment resources allocated to municipalities through BIP mechanisms appears to be the most appropriate way of improving technical efficiency in Cameroon's municipalities. More specifically, it emerges from this study that the PNDP, a window whose resources come from international donors in the context of development aid, is the one whose efficient management is the most perfectible; this brings to mind the debate on the effectiveness of development aid, presented by certain authors as being incapable of promoting the economic and social development of those who benefit from it. For policymakers, the technical efficiency score of the PNDP window, like that of the FEICOM window, suggests a better institutional framework for the use of resources whose management is left to autonomous entities within the framework of fiscal decentralisation, in order to increase the resulting efficiency. However, these results could be further improved if we had, on the one hand, outputs for each of Cameroon's 360 communes and, on the other hand, sectoral data concerning the environment of these communes. In this respect, there are three main avenues to explore in greater depth. Firstly, the study of the efficiency of the communes by highlighting the outputs per commune; secondly, the questioning of the sources of the observed efficiency, and finally the questioning of the levels of efficiency with regard to the operating expenditure of the communes.

Disclosure statement

The authors have no financial or other conflicts of interest to declare that could be interpreted as influencing the results or interpretation of their manuscript.

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APPENDIX

TABLE A1

Evolution of resources mobilised for municipalities between 2010 and 2020 (in mn CFA francs)

Funders	Type of financing granted	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
FEICOM	Investment credit (CIC) FEICOM	14,443.5	27,750.9	26,296.3	25,260.2	11,163.4	12,977.2	18,368.7	16,117.9	21,292.1	20,595.1	20,253.6
PNDP	PNDP grants	2,382.5	1,992.5	7,322.2	8,968.0	6,640.0	4,329.5	2,265.4	5,661.6	2,053.7	8,982.5	1,500.0
BIP	Investment resources transferred as part of the transfer of responsibilities	–	–	21,210.0	23,779.0	38,430.6	44,719.3	46,643.4	51,056.0	56,483.3	55,002.1	61,396.4
	Operating DGD	5,000.0	5,000.0	5,000.0	5,000.0	5,000.0	5,000.0	5,000.0	5,000.0	5,000.0	13,800.0	13,900.0
	One-off investment transfers	–	–	–	2,664.8	2,574.8	626.5	679.6	2,260.9	510.3	800.4	1,333.6

Sources: Based on FEICOM, PNDP and MINEPAT data for 2010-2020.

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TABLE A2
Number of municipalities projects funded between 2010 and 2020

Type of projects	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
PNDP											
Water points built/rehabilitated	171	175	286	284	262	304	337	188	343	481	–
Rural roads built/rehabilitated	6	7	8	6	8	8	5	3	10	7	–
Classrooms built/rehabilitated	124	113	134	147	143	175	214	42	268	331	–
School tables and benches acquired	–	–	–	–	–	–	–	–	–	–	–
Health centres built, renovated or equipped	4	5	8	20	27	9	10	12	59	59	–
Rural markets built	1	5	8	3	7	9	5	13	65	88	–
Storage warehouses built	2	2	9	3	10	11	6	18	32	23	–
BIP											
Construction and rehabilitation of boreholes, wells and water networks	–	–	174	195	493	496	571	638	497	806	663
Construction, rehabilitation of power stations, transport networks and public lighting	–	–	12	13	2	86	101	95	79	240	250
Construction and rehabilitation of roads and bridges	–	–	47	53	444	480	575	650	566	763	809
Construction and rehabilitation of classrooms and latrines in schools	–	–	401	450	465	509	571	585	689	1038	1083
Acquisition of tables and benches for schools	–	–	685	768	183	687	794	854	963	1158	773
Construction, rehabilitation and equipping of health centres	–	–	240	269	339	335	316	314	284	338	388
FEICOM											
Construction and rehabilitation of boreholes, wells and water networks	3	18	3	1	3	6	14	2	21	2	8
Construction, rehabilitation of power stations, transport networks and public lighting	7	12	6	7	2	3	2	3	3	1	4
Construction and rehabilitation of roads and bridges	4	1	2	–	–	1	–	–	1	2	2

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Type of projects	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Construction, rehabilitation and equipping of health centres	3	2	2	1	1	–	–	–	14	–	–
Construction and rehabilitation of classrooms and latrines in schools	7	11	1	–	–	17	14	8	22	6	16
Acquisition of tables and benches for schools	1	1	1	–	–	–	–	–	3	–	–

Sources: Based on FEICOM, PNDP and MINEPAT data for 2010-2020.
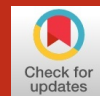
Transforming institutions to achieve the Sustainable Development Goals after the pandemic, World Public Sector Report 2023

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The Department of Economic and Social Affairs (DESA) of the United Nations has issued the 2023 World Public Sector Report as part of their assessment of the progress made towards the implementation of the UN 2030 Agenda for Sustainable Development. This report focuses on changes in national institutions and governance during the COVID-19 pandemic and on three main themes: the relationship between government and society in terms of solidifying public trust through various mechanism and combating elements that undermine it such as fake news and misinformation; identifying and matching policy priorities between national governments and SDGs including how to use the science-policy relation to advance SDG integration processes into national priorities, and the path toward using innovations in governance for the achievement of the SDGs.

The latest World Public Sector Report 2023 is another in a series of assessments of progress towards the implementation of the Sustainable Development Goals (SDGs). In its structure, the Report represents a departure from past reports in that it focuses on a smaller number of topics (three), followed by 23 short contributions from 38 experts from across the globe, ranging from regional contexts, to specific niches, but always related to the main three questions. This volume is specific also because 2023 marks the midpoint in the implementation of the SDGs and while institutions have always been a point of departure on the way to SDG achievement, new developments in the geopolitical arena such as the war in Ukraine have further threatened peace and justice as goals. Social and economic changes that took place during the COVID-19 pandemic have undermined the capacity of national governments to implement policies during periods of crisis and this report addresses some of the challenges as well as possible steps towards handling them by enhancing the capacity of national governments to achieve, and synchronize their policy priorities with, the SDGs. Issues that the pandemic has brought to the surface include risk management and crisis preparedness, communication with the public and the subsequent effect on social and political trust, science-policy interfaces, and transparency and accountability. The report examines the ways in which governments can use their institutional arrangements and innovations in building trust with social actors, in harmonizing their policy priorities with the SDGs, and how to use innovative ways of doing so.

Chapter one is dedicated to the need to strengthen the relationship between government and citizens, given that during the pandemic period there was a decrease in civic culture and an erosion of public trust along with political polarization, all of which had a detrimental effect on the success of governments in the implementation of emergency management in public health. The chapter begins with a review of the lessons learned in the pre-pandemic period about how relationships between public administration and society shape policy and societal outcomes. More specifically, this section restates how positive and cooperative relationships between all levels of government and different societal actors (private and public) have proved to be a key influence in the ability of public institutions to effectively deliver

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their services. This relationship became especially apparent during the pandemic period when, for example, members of the scientific community in collaboration with government authorities were able to promote public health messages in the wake of the campaign of misinformation surrounding vaccine safety, among other services, where a high level of public trust in government was crucial in the successful implementation of immunization and other anti-pandemic measures. The chapter continues with a discussion on the assessment mechanisms of the relationship between government and other actors, trust being the central variable in the relationship. Trust in government institutions is an indicator of how effective people perceive the institutions to be, can be influenced by broader social and economic processes and has been shown to be key for the implementation of emergency management when the public is expected to follow rules to ensure public safety. The chapter gives a summary of existing measurement tools of the relationship between government and societal actors across the globe. It also shows successful examples of public service delivery, and the effect of accountability and transparency in government operations on the level of corruption and ultimately on the level of trust citizens have in their government and how the efficient and targeted utilization of digital technology, in part pushed by the need to keep social distance during the pandemic, has facilitated the implementation of government policies. The third section discusses the effects of false or misleading information which, coupled with the advances in digital communication, had a significant impact during the pandemic. It also describes the different response mechanisms used to combat these damaging effects through regulation, independent audits, and the increase in the salience of media literacy which continues today.

The individual contributions in this chapter are diverse ranging from: a discussion about the effectiveness of social redistribution in diminishing income inequality both within and among countries through fiscal policies such as the taxation of MNEs and high net worth individuals; the effect of the pandemic on gender equality in public administration; communication during emergencies with social actors; harnessing of digital technology in public administration while protecting human rights; e-justice; the effect of the COVID-19 pandemic on civic space; the role of youth in democratic processes; an example of fighting misinformation in Africa, all finalized by expert recommendations to government administrators.

Chapter two uses the midpoint to the 2030 target of achieving the SDGs as a benchmark against which it reflects on the interdependencies and synergies of some SDGs and how these can be harnessed to propel them towards greater achievement. The authors provide six methods of analysing the interdependencies between SDGs and how each of them can be utilized for policymaking and goal advancement by supporting various stages of the policy process including scoping, prioritization, identification and evaluation of alternate solutions, and monitoring. The six methods include: self-assessment, expert judgement, literature-based analysis, statistical analysis, SD modelling, and coupled component modelling. This initiative comes in the wake of acknowledgment that little is known

about the effect of the pandemic on SDG interactions particularly when some SDGs, such as SDG1 (ending poverty in all its forms everywhere) have experienced a fallback.

The question of how goals are prioritized has been addressed by several studies but approaches on which policy goals should take priority need to be placed in the country context and entry points should be identified that will in synergy advance other SDGs as well. According to the authors, although little is known about whether institutional changes have led to greater policy coherence, global, regional and national factors influence which policies are given priority over others. This chapter also makes it clear that global and contextual factors such as the COVID-19 pandemic and the war in Ukraine have conditioned regional and domestic priorities towards security and away from the eradication of poverty; the lack of trust that has come hand in hand with an increase in positive perceptions of autocratic leaders indicates a movement towards illiberal values. The authors thus suggest a need to develop and use tools that will provide further support for the strengthening of policy coherence by using strategic foresight in the evaluation of government policies, among other things. Identifying and mapping the science-policy interface would improve responsiveness to the needs of policymakers and increase efforts to build capacity in identifying needs and priorities and subsequently develop responsive policies. This, too, should be supportive of the process of improving policy coherence to achieve the SDGs. The chapter concludes with two sections: one that addresses the use of public financial management strengthening to increase its efficiency, efficacy and equity in the wake of limited resources by using computational models and simulation modelling in projections to take advantage of local level capacities to achieve goals. Thus, budgeting for sustainable development need not be an unattainable goal or reserved only for wealthy countries. Finally, changes in institutional arrangements along with enhanced long-term planning and investment in capacity building and talent are all needed to increase SDG achievement.

Contributions to this chapter include: an analysis of both national and local level processes, examples of synergy for economic recovery in Sri Lanka; the strengthening of the science-policy interface; operationalizing strategic foresight and the transformative foresight triangle; transnational networks and exchanges, risk management, evidence based resource prioritization, government expenditure and prioritization in sustainable development, and how to build legitimacy to achieve open and transparent government. This chapter, too, concludes with a set of recommendations by the contributing experts.

Chapter three emphasizes the importance of innovations in advancing the working of the government to achieve the SDGs. Given that the picture likelihood of the SDGs being attained is now less optimistic than it was when the SDGs were created, there is a need to harness the experience and knowledge gained through the past few years of challenges. Examples of innovations in procedures have been

witnessed during the COVID-19 crisis when public administrations around the world, faced with a new situation, had to alter their processes to be more flexible in their reaction to the new emergency. These innovations that were the result of the response to the public health and economic crisis also had the effect of improving communication with stakeholders, thus bringing about improvement in governance processes. Here a positive effect is evident not only in the cutting of red tape by public administrations, but also in the utilization of digital tools to advance administrative processes both for citizens and businesses, among others. The authors stress the difference between innovation and transformation so that innovations represent incremental improvements or disruptions due to crises, while transformations change or replace processes including social distributions. Single point innovations may not always be sufficient to create long term transformations in government processes to accelerate achieving the SDGs and goals such as effectiveness and resource optimization and inclusive access to public services are necessary benchmarks for sustainability. Further topics such as innovation in public accountability and multilevel governance at subnational levels of government are discussed in this chapter focusing back on domestic capacity building of public servants which will help with developments in governance beyond crisis periods. One innovation that spurred transformations was the digital transformation forced upon governments during the COVID-19 crisis. The need for successful implementation of emergency policies and procedures has required the government to act in collaboration with other stakeholders which has created a channel of communication and collaboration. One example given is the integration of multiple stakeholders through channels of communication to gather epidemiological information in Poland including lifestyle habits and health for a better understanding of the spread of the disease. Next, co-creation, co-production and advancements in service delivery are discussed as methods that allow equal participation and partnership of all stakeholders in designing public policies acknowledging all along that the actual effects of these are difficult to measure. Finally, the authors conclude that technological advancements should be utilized for improved service delivery so that existing innovations can have a greater developmental effect.

The individual contributions to this final chapter address topics of government reform and public service provisions, co-creation at different levels of government, innovations in health care services, multilevel coordination and preparedness after COVID-19, blended learning in higher medical education in South Africa, models of public sector operation after the pandemic, and a summary of main recommendations of action points by the experts.

The fourth chapter concludes the report by summing up how the pandemic has not only changed the expectations of stakeholders about the forms of governance and participation by increasing engagement at all process and policymaking levels, underlining the need for public administration to keep up with the changing societies to become more inclusive and apt to accept innovation as well as adjusting the relationship between the different levels of government. The chapter concludes

with emphasis on the need to preserve the knowledge we have gathered during the extraordinary period of the pandemic and continue to follow the lessons learned on inclusiveness, change and transformation, flexibility and co-creation, among many other things, into the future.

In summary, the World Public Sector Report 2023 is a departure from the previous reports in that it focuses on its three main themes by looking at the significant and most valuable experiences and lessons learned during the pandemic and post-pandemic period. The structure of the chapters, where an introduction to each chapter is enriched through many short case studies provides for an interesting interlay of theory and practical applications. Finally, the key takeaway points presented as sets of recommendations for public administrators highlight the most important elements to be focused on when creating policies to improve government performance in achieving the SDGs.