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Pension indexation and fiscal dynamics of the Serbian pension and disability insurance fund: a decomposition of price and quantity channels (2015–2025)

Indeksacija penzija i fiskalna dinamika Republičkog fonda za penzijsko i invalidsko osiguranje Srbije: dekompozicija cenovnog i količinskog kanala (2015–2025)

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Abstract

The paper examines the expenditure dynamics of the Serbian public pension system after the COVID-19 pandemic from the perspective of management of public pension expenditure. It distinguishes between the price channel, shaped by indexation rules, inflation, wage dynamics and extraordinary pension increases, and the quantity channel, reflected in changes in the number of beneficiaries. The mortality shock among the population aged 65 and over is treated as a demographic context for fiscal transmission. The analysis combines official mortality data for 2015–2024, administrative data from the Serbian Pension and Disability Insurance Fund for 2018–2025 and a Shapley decomposition of approximated annual pension expenditure. The results show that post-pandemic expenditure growth was driven predominantly by the price channel, a result that is important for medium-term fiscal projections of PAYG pension systems.
Keywords: *pension indexation, pension expenditure, PAYG system, price channel, Serbia*

Sažetak

Rad ispituje dinamiku rashoda javnog penzijskog sistema Srbije nakon pandemije COVID-19 iz perspektive finansijskog upravljanja javnim penzijskim rashodima. Analiza razdvaja cenovni kanal, oblikovan indeksacijom, inflacijom, rastom zarada i vanrednim povećanjima penzija, i količinski kanal, povezan sa promenom broja korisnika. Mortalitetni šok populacije 65+ posmatra se kao demografski kontekst fiskalne transmisije, a ne kao samostalna epidemiološko-statistička tema. Korišćeni su zvanični podaci o mortalitetu za 2015–2024, administrativni podaci RF PIO za 2018–2025 i Shapley dekompozicija aproksimiranih godišnjih rashoda. Rezultati pokazuju da je postpandemijski rast rashoda dominantno vođen cenovnim kanalom, što ima neposredan značaj za srednjoročne fiskalne projekcije PAYG sistema i upravljanje budžetskim rizikom.
Ključne reči: *penzijska indeksacija, penzijski rashodi, PAYG sistem, cenovni kanal, Srbija*

1. Introduction

The Serbian pension system, predominantly based on the pay-as-you-go (PAYG) principle, provides a relevant framework for analysing the relationship between demographic disturbances and the fiscal dynamics of public expenditure. In such a system, current pension payments depend on the number of beneficiaries, the average pension level and institutional indexation rules, while financing largely relies on employee contributions and budget transfers. Therefore, short-term demographic shocks, including increased mortality among older persons during the pandemic, cannot be interpreted separately from indexation rules, inflation, wage growth and discretionary decisions on pension increases.

The COVID-19 pandemic raised an important public finance question: whether increased mortality among older persons could have produced a visible fiscal effect through a reduction in the number of pension payments, or whether the expenditure dynamics of the Serbian Pension and Disability Insurance Fund were predominantly determined by other mechanisms. Intuitively, a strong mortality shock could be expected to temporarily reduce the number of beneficiaries and thereby ease expenditure pressure. However, in nominal

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fiscal terms, this effect may be outweighed by the increase in the average pension, especially under conditions of inflation, wage growth, statutory indexation and extraordinary pension adjustments.

For this reason, the paper does not treat the mortality shock as an independent epidemiological-statistical issue, but as a demographic context for analysing fiscal transmission. The focus is on whether the post-pandemic increase in the expenditure of the Serbian Pension and Disability Insurance Fund resulted from changes in the number of beneficiaries or from changes in the average pension. This approach makes it possible to link the empirical results with broader debates on the sustainability of PAYG pension systems, the design of indexation rules and budget planning in post-crisis conditions.

The study's contribution is empirical rather than methodological. It applies the established Shapley decomposition approach to official Serbian pension data through December 2025 to quantify how changes in beneficiary numbers and average pension amounts contributed to nominal expenditure growth. Interpreting this accounting decomposition alongside evidence on the temporary pandemic mortality shock provides an updated public-finance assessment of the relative importance of the quantity and price channels for pension expenditure planning.

The research objectives are: (1) to describe the scale and duration of the mortality shock among the population aged 65 and over as a demographic context; (2) to update the administrative indicators of the Serbian Pension and Disability Insurance Fund up to December 2025; (3) to decompose the change in approximated expenditure of the Serbian Pension and Disability Insurance Fund into the quantity and price channels; and (4) to assess whether, after the pandemic, fiscal dynamics were primarily determined by indexation and the increase in the average pension rather than by changes in the number of beneficiaries.

In line with these objectives, the study tests three hypotheses: that the pandemic mortality shock among people aged 65 and over in Serbia was pronounced in 2020–2021 but short-lived (H1), that mortality indicators moved back towards their pre-pandemic range after 2021 with no clear evidence of a sustained shift in mortality levels over the observed period (H2), and that the price channel accounted for most of the post-pandemic increase in estimated pension expenditure by the Serbian Pension and Disability Insurance Fund, with the quantity channel making a limited or negative contribution (H3).

2. Institutional framework and indexation rules

The Serbian pension system is based on mandatory public insurance and the dominant role of the Serbian Pension and Disability Insurance Fund. From a public finance perspective, pension expenditure represents one of the most significant components of social transfers, and its dynamics depend on demographic factors, contribution parameters, wage movements, inflation and pension indexation rules. In a PAYG system, the relationship between employment, wages and pension payments is particularly important, since long-term sustainability is determined not only by the number of beneficiaries, but also by the relationship between pensions, wages and the fiscal capacity of the state.

Since 2020, Serbia has reintroduced a pension indexation model that combines changes in consumer prices and wages. However, in the observed post-pandemic period, indexation should not be viewed as a static Swiss formula consisting of 50% inflation and 50% wage growth. According to the current provision of Article 80 of the Law on Pension and Disability Insurance, starting from the pension for December of the current year, pensions are indexed depending on the share of pensions and cash supplements paid with pensions in gross domestic product: when this share is below 10%, indexation follows the change in the average wage net of taxes and contributions; when it is 10% or more, but below 10.5%, a combination of one half of the change in consumer prices and one half of the change in the average wage is applied; and when it is 10.5% or more, indexation follows the change in consumer prices. In addition, extraordinary adjustments of 9% applied to the pension for November 2022 and 5.5% applied to the pension for October 2023 show that the price channel includes a broader set of institutional and macroeconomic factors affecting expenditure per beneficiary (Law on Pension and Disability Insurance).

The pandemic period further complicated this dynamic. Economic measures adopted during 2020 were primarily aimed at preserving liquidity and employment in the private sector, and therefore affected the pension system indirectly, through the contribution base and wage movements (Government of the Republic of Serbia, 2020a, 2020b). At the same time, increased mortality among older persons could have reduced the number of beneficiaries. Thus, two channels operated in opposite directions: the quantity channel, which reduces expenditure through a lower number of beneficiaries, and the price channel, which increases expenditure through the growth of the average pension.

Therefore, nominal expenditure growth must be interpreted through the logic of public financial management: the number of beneficiaries determines the quantity of payments, while indexation, inflation, wage growth and extraordinary adjustments determine the value of the payment per beneficiary. For the financial management of the pension system, it is essential to distinguish between these two sources of expenditure dynamics, as they generate different budgetary risks and require different projection assumptions.

3. Theoretical framework

Economic literature emphasizes that the sustainability of PAYG arrangements is determined by the relationship between demographic trends, productivity, wages, employment and benefit rules (Barr & Diamond, 2006;

Holzmann & Hinz, 2005). In its simplest accounting form, public pension expenditure can be represented as the product of the number of beneficiaries and the average pension. This identity is analytically useful because it allows the quantity and price sources of expenditure dynamics to be separated.

The demographic component is most often analysed through population ageing, increasing life expectancy and changes in the ratio between employees and pensioners. In the long run, ageing increases pressure on PAYG systems because the number of beneficiaries grows relative to the number of contributors (European Commission, 2024; OECD, 2023). The pandemic mortality shock represents a different case: it was sudden, concentrated in time and did not necessarily translate into a permanent demographic trend. For this reason, its fiscal effect must be distinguished from the effects of long-term ageing.

The literature emphasizes that public pension expenditure depends not only on demographic ageing, but also on the level of pension benefits, the retirement age, labour force participation and the institutional design of the system (Bongaarts, 2004). From the perspective of fiscal sustainability, this means that demographic pressure must be analysed together with the rules that determine the level of entitlements and the pace of expenditure growth per beneficiary (Clements et al., 2014).

The second component of expenditure relates to the average pension level. Indexation is an institutional mechanism through which pensions are adjusted to inflation, wages or a combination of the two. In theoretical terms, it balances three objectives: protecting the purchasing power of pensioners, preserving the relative income of older persons and maintaining the fiscal sustainability of the system. The more strongly indexation is linked to price and wage growth, the greater the resilience of pensioners' income to macroeconomic shocks, but also the greater the pressure on the expenditure side of the budget (European Commission, 2021).

Empirical literature on the COVID-19 pandemic has mainly focused on excess mortality, health outcomes and cross-country differences (World Health Organization, 2022). Such studies are important for quantifying the demographic shock, but they do not directly answer the question of fiscal transmission. On the other hand, literature on public finance and pensions predominantly examines the long-term sustainability of pension systems, while short-term mortality disturbances are less frequently introduced as a separate channel of expenditure change. This paper links these two strands of research through a common analytical framework: the mortality shock is used to identify the potential quantity effect, while administrative data from the Pension and Disability Insurance Fund are used to assess actual expenditure dynamics.

In methodological terms, Shapley decomposition enables an order-neutral decomposition of total change into the contributions of individual factors (Shapley, 1953; Shorrocks, 2013). When expenditure is observed as the product of the number of beneficiaries and the average pension, the change between two years can be attributed to the quantity and price channels without an arbitrary decision on which factor changes first. This approach is suitable for public finance analysis because it provides interpretable contribution estimates expressed in monetary units and as percentages of the total change.

3.1. Indexation between pension adequacy and fiscal sustainability

In the analysis of pension systems, it is important to distinguish between adequacy and sustainability. Adequacy refers to the ability of the system to provide an acceptable level of income in old age and to limit the risk of poverty among older persons. Sustainability refers to the ability of the state to finance such payments without permanently undermining fiscal balance. Indexation rules lie at the intersection of these two objectives: they protect beneficiaries from a decline in the real value of pensions, while at the same time transmitting inflationary and wage-related shocks to the expenditure side of the budget.

In systems in which pensions are indexed to prices, expenditure follows inflation, but the relative position of pensioners compared with employees may deteriorate if wages grow faster than prices. In systems in which pensions are indexed to wages, the preservation of relative living standards is stronger, but fiscal pressure is also greater. Combined formulas, including the Swiss formula, represent an attempt at compromise, but their final fiscal effect depends on the macroeconomic environment and discretionary policy decisions.

Indexation is particularly important because it transfers the risk of inflation and wage growth between pension beneficiaries and public finances. If indexation is weaker, a larger part of the risk falls on the purchasing power of pensioners; if it is stronger, a larger part of the risk is transferred to the budget and the long-term sustainability of the system (Whitehouse, 2009). For this reason, the design of pension rules should also be viewed through the principles of actuarial neutrality and fairness, that is, through the relationship between entitlements, contributions and the fiscal cost of the system (Queisser & Whitehouse, 2006).

In the post-pandemic period, this distinction becomes particularly important for expenditure risk management. If the average pension increases under the influence of indexation, inflation, wages and extraordinary adjustments, total expenditure may rise rapidly even if the number of beneficiaries stagnates or declines. For this reason, the theoretical framework of the paper leads to the empirical separation of the quantity and price channels as the first step in assessing the fiscal sustainability and budgetary exposure of the public pension system.

4. Data and methodology

4.1. Data sources and scope

The analysis is based on two related datasets. The first refers to mortality among the population aged 65 and over in Serbia in the period 2015–2024. Official series of the Statistical Office of the Republic of Serbia on deaths by age and sex are used, with the age groups 65–69, 70–74, 75–79, 80–84 and 85+ aggregated into the 65+ population. The period 2015–2019 is used as the pre-pandemic baseline, 2020–2021 as the period of the pandemic mortality shock, and 2022–2024 as the period for assessing the return towards the previous range. The basic series is presented in Table 1, relative ratios for the key pandemic years in Table 2, and cumulative excess mortality in Table 3.

The second dataset refers to administrative December cross-sections of the Serbian Pension and Disability Insurance Fund (RF PIO) on the number of beneficiaries and the average pension. The expenditure part of the analysis covers the period 2018–2025, since comparable December cross-sections are available for that period. The year 2025 is included in the RF PIO/expenditure part of the analysis, but not in the full 65+ mortality series, because detailed data on deaths by age and sex for 2025 are not part of the same comparable series. Data on beneficiaries, the average pension and approximated expenditure are presented in Table 4.

The average pension figures are based on the official Serbian Pension and Disability Insurance Fund statistical bulletins and include old-age, disability and survivor pensions across all insured categories. For December 2025, reported funds for net pensions (RSD 94,488,011,960.28), divided by 1,662,533 beneficiaries, yield an average of RSD 56,833.77, corresponding to the published figure of RSD 56,834 after rounding (Serbian Pension and Disability Insurance Fund, 2026, pp. 3–5). Statutory indexation and extraordinary percentage increases incorporated into pension amounts are reflected in these figures. Cash supplements under Article 207a of the Law on Pension and Disability Insurance are separately disclosed. The expenditure approximation does not add separately reported supplementary payments or other PIO benefits, and the aggregate data do not permit their individual reconciliation within the published average.

The use of December cross-sections has both advantages and limitations. The advantage is the consistent availability of administrative indicators suitable for interannual comparison. The limitation is that the full monthly budgetary series of pension payments is not used; therefore, annual expenditure is approximated as the product of the December number of beneficiaries, the December average pension and twelve months. The resulting amounts are therefore interpreted as approximated values, not as official executed budgetary expenditure. For the purposes of channel decomposition, however, this approximation is methodologically acceptable because the same calculation principle is applied throughout the entire period.

4.2. Measuring the mortality shock

The mortality shock is measured by comparing the observed number of deaths among persons aged 65 and over with the expected level based on the pre-pandemic average for 2015–2019. For each year, the observed-to-expected relative ratio (RR) is calculated. An RR value above 1 indicates that the observed number of deaths is higher than expected, while a value around 1 indicates a return towards the pre-pandemic pattern. In addition to the relative ratio, absolute excess mortality is calculated as the difference between the observed and expected number of deaths.

The full epidemiological-statistical apparatus is presented in a concise form, because the central research question is not the assessment of the health shock itself, but its fiscal transmission. This approach preserves the readability of the paper for an economic audience, while at the same time providing sufficiently precise quantification of the demographic context for the analysis of expenditure.

4.3. Expenditure approximation and shapley decomposition

For the expenditure part of the analysis, an approximation of the annual expenditure of the Pension and Disability Insurance Fund is used:

$$R_t \approx 12 \times U_t \times \bar{P}_t \qquad (1)$$

where R_t denotes approximated annual expenditure in year t, U_t denotes the number of pension beneficiaries in December, and $\bar{P}_t$ denotes the average pension in December.

The change in expenditure between two years may result from a change in the number of beneficiaries, a change in the average pension, or the simultaneous effect of both factors. In order to avoid an arbitrary allocation of the interaction effect, a symmetric Shapley decomposition is applied.

$$\Delta R_U = 12 \times (U_B - U_A) \times \left[\frac{(\bar{P}_A + \bar{P}_B)}{2}\right] \qquad (2)$$

$$\Delta R_P = 12 \times \left[\frac{(U_A + U_B)}{2}\right] \times (\bar{P}_B - \bar{P}_A) \qquad (3)$$

Expression (2) measures the quantity contribution, that is, the change in expenditure arising from the change in the number of beneficiaries, evaluated at the average pension level between the two observed years. Expression (3) measures the price contribution, that is, the change in expenditure arising from the change in the average pension, evaluated at the average number of beneficiaries. The sum of these two contributions equals the total change in approximated expenditure, and the decomposition results are presented in Table 5.

4.4. Interpretation strategy and limits of the empirical approach

The empirical approach is diagnostic rather than strictly causal. The aim is not to estimate a structural model of the behaviour of the pension system, but to separate the immediate sources of expenditure change. This is appropriate for the research question, since it is first necessary to establish whether expenditure growth, in accounting terms, originated from changes in the number of beneficiaries or from changes in the average pension.

Shapley decomposition does not replace econometric modelling, but it provides a transparent instrument for financial-management analysis of expenditure. Its advantage lies in the fact that it decomposes the entire change in expenditure without a residual and without an arbitrary allocation of the interaction between quantity and price. The results are therefore directly useful for budget planning: each contribution is expressed in billions of dinars and as a share of the total change.

The price channel in this paper includes all factors that increase the average pension: statutory indexation, inflation, wage growth and extraordinary increases. It is therefore not interpreted as a market price, but as an institutional-macroeconomic channel of expenditure per beneficiary. The quantity channel does not include only mortality, but the net change in the number of beneficiaries, which also depends on new retirements, exits from the system and the structure of beneficiaries.

5. Results

5.1. Mortality among the 65+ population as a demographic context of fiscal analysis

Annual series confirm that the mortality shock was concentrated in 2020–2021, followed by a return towards the previous range in the period 2022–2024. In this paper, the mortality finding serves as a demographic context: it shows that a potential quantity channel existed in the observed period, but it does not prove that this channel was dominant in fiscal dynamics.

Table 1. Deaths among the 65+ population by sex and total, Serbia (2015–2024)

Year	Men 65+	Women 65+	Total 65+
2015	37.930	44.059	81.989
2016	37.275	42.968	80.243
2017	38.521	44.709	83.230
2018	38.402	43.844	82.246
2019	38.546	43.608	82.154
2020	45.994	49.076	95.070
2021	54.036	58.296	112.332
2022	42.632	47.679	90.311
2023	37.156	42.513	79.669
2024	37.674	43.499	81.173

Source: Authors' calculations based on data from the Statistical Office of the Republic of Serbia

Table 1 clearly identifies the peak values in 2020–2021 relative to the stable pre-pandemic path. The total number of deaths among persons aged 65 and over increased from approximately 82 thousand in the pre-pandemic period to 95,070 in 2020 and 112,332 in 2021. This was followed by a decline: in 2022, the value remained elevated but was considerably below the 2021 peak, while in 2023–2024 it returned to a range closer to pre-pandemic fluctuations.

Relative to expectations defined by the 2015–2019 baseline, the observed-to-expected relative ratio confirms that 2020 and 2021 were significantly above the baseline. The deviation was relatively more pronounced among men, which is consistent with broader findings in the literature on higher pandemic risk in older male cohorts. For fiscal analysis, the key point is that the shock did not continue with the same intensity after 2021.

Table 2 supports H1: RR indicators for the 65+ population significantly exceed 1 in both pandemic years, with a stronger relative increase among men than among women.

Table 2. Annual RR with 95% confidence intervals (2020–2021): total, men and women aged 65+

Series	2020 RR (95% CI)	2021 RR (95% CI)
Total 65+	1.160 (1.152–1.168)	1.370 (1.361–1.379)
Men 65+	1.206 (1.194–1.218)	1.417 (1.404–1.431)
Women 65+	1.119 (1.109–1.131)	1.330 (1.318–1.342)

Note: Confidence intervals are calculated on the log scale; baseline 2015–2019.

Source: Authors' calculations based on data from the Statistical Office of the Republic of Serbia

Table 3. Cumulative absolute excess mortality, 2020–2021

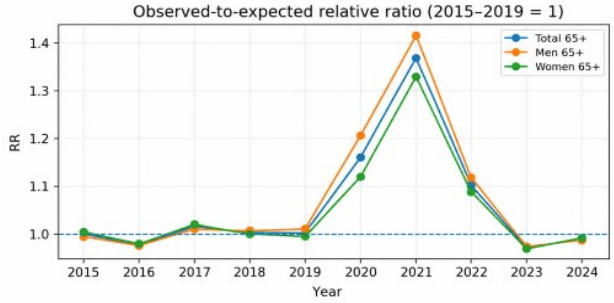
Indicator	Value
Total excess mortality 2020–2021 (65+)	43.458
Contribution of men	23.760
Contribution of women	19.696

Note: A small difference may arise from independent rounding of the total and sex-specific baselines.

Source: Authors' calculations based on data from the Statistical Office of the Republic of Serbia

Table 3 summarizes the cumulative mortality burden in the peak pandemic years. Total excess mortality of 43,458 deaths among the 65+ population provides the starting point for the question of whether the demographic shock was transmitted to expenditure through the quantity channel.

Figure 1. Observed-to-expected relative ratio (RR) relative to the 2015–2019 baseline: 65+ population



Source: Authors' illustration based on data from the Statistical Office of the Republic of Serbia

Figure 1 additionally shows the two-year peak in 2020–2021 and the return towards values around 1 in the period 2022–2024. This supports H2: the mortality shock was pronounced, but in the observed series it did not turn into a permanently elevated level of mortality. The analysis therefore proceeds to administrative data on beneficiaries and the average pension.

5.2. Beneficiaries, average pension and approximated expenditure of the pension and disability insurance

Fund Administrative series of the RF PIO show a different dynamic from mortality data. The number of beneficiaries declined after 2019 and then stabilized, while the average pension increased strongly and almost continuously. If only the number of beneficiaries were observed, strong expenditure pressure would not be expected. However, once the average pension is included, it becomes clear that nominal expenditure dynamics were primarily shaped by the price channel.

In December 2025, the total number of beneficiaries was 1,662,533, while the average pension amounted to RSD 56,834. Compared with December 2019, the number of beneficiaries was lower by 45,760, while the average pension more than doubled. This divergence between quantity and price represents the central empirical pattern of the paper.

Table 4. Number of beneficiaries, average pension and approximated annual expenditure, December cross-sections (2018–2025)

Year	Number of beneficiaries	Average pension (RSD)	$R \approx 12 \times U \times \bar{P}$ (RSD billion)
2018	1.715.152	26.324	541.796
2019	1.708.293	26.336	539.875
2020	1.692.282	27.744	563.408
2021	1.660.460	29.365	585.113
2022	1.651.890	33.731	668.639
2023	1.651.315	39.850	789.659
2024	1.657.549	50.683	1.008.115
2025	1.662.533	56.834	1.133.861

Note: The reported average covers old-age, disability and survivor pensions across all insured categories and reflects statutory and extraordinary increases incorporated into pension amounts. Separately reported cash supplements, one-off assistance and other benefits were not added as independent expenditure items. The resulting annualised estimate represents an approximation of pension expenditure, not the Fund's total executed expenditure.

Source: Authors' calculations based on the statistical monthly bulletins of the Serbian Pension and Disability Insurance Fund

Table 4 shows that approximated annual expenditure increased from RSD 539.9 billion in 2019 to RSD 1,133.9 billion in 2025, although the number of beneficiaries in 2025 was lower than in 2019. The quantity channel alone therefore cannot explain expenditure growth; the explanation lies in the increase in the average pension.

It is important to distinguish between nominal and real interpretation. Part of the nominal increase in the average pension reflects the preservation of purchasing power in an inflationary environment. Nevertheless, for public finances, nominal amounts remain decisive because they directly affect budgetary needs and medium-term projections.

5.3. Shapley decomposition: price and quantity channels

Based on the data from Table 4, the following section quantifies the contribution of changes in the number of beneficiaries and the average pension to the total change in approximated expenditure. Table 5 presents the results of the Shapley decomposition for selected intervals and serves as the basis for separating the quantity and price channels.

In the period 2019–2021, total approximated expenditure increased by about RSD 45.2 billion, while the quantity contribution was negative (-RSD 16.0 billion). This means that the change in the number of beneficiaries acted in the direction of reducing expenditure. By contrast, the price contribution amounted to RSD 61.2 billion and exceeded the total change because it compensated for the negative quantity effect.

The pattern remains stable over longer intervals. In the period 2019–2024, the total increase in approximated expenditure amounted to about RSD 468.2 billion, with the quantity channel remaining negative (-RSD 23.5 billion), while the price channel amounted to RSD 491.7 billion. In the period 2019–2025, total growth amounted to about RSD 594.0 billion, while the price channel reached RSD 616.8 billion and the quantity channel remained negative (-RSD 22.8 billion).

The short interval 2024–2025 shows that even when the quantity channel changes sign, its significance remains limited. The number of beneficiaries increased slightly, but the quantity contribution amounted to only RSD 3.2 billion, or 2.6% of the total change. The price contribution amounted to RSD 122.5 billion, or 97.4% of total growth.

Table 5. Shapley decomposition of the change in approximated expenditure of the Pension and Disability Insurance Fund

Interval	R_A	R_B	ΔR	Quantity contribution	Share of quantity contribution	Price contribution	Share of price contribution
2019 → 2021	539.875	585.113	45.238	-15.986	-35.3%	61.224	135.3%
2021 → 2023	585.113	789.659	204.546	-3.798	-1.9%	208.344	101.9%
2019 → 2024	539.875	1.008.115	468.239	-23.450	-5.0%	491.689	105.0%
2024 → 2025	1.008.115	1.133.861	125.746	3.215	2.6%	122.531	97.4%
2019 → 2025	539.875	1.133.861	593.986	-22.835	-3.8%	616.821	103.8%

Note: Values are expressed in RSD billion; R ≈ 12 × number of beneficiaries × average pension.

Source: Authors' calculations based on the statistical monthly bulletins of the Serbian Pension and Disability Insurance Fund

From a public finance perspective, the decomposition shows that expenditure growth was not the result of the demographic event itself, but primarily of the institutionally and macroeconomically driven increase in expenditure per beneficiary. This establishes an empirical link between the results in Table 5 and the hypothesis on the dominance of the price channel.

5.4. Summary assessment of the hypotheses and robustness of the findings

Based on the preceding results, H1 is supported by the relative mortality indicators in Table 2, while H2 follows from the return of mortality indicators towards the pre-pandemic range shown in Table 1 and Figure 1. H3 is confirmed by the Shapley decomposition in Table 5, since the price channel accounts for almost the entire increase in approximated expenditure in the key intervals. The robustness of the findings stems from the fact that the same direction of the relationship between the price and quantity channels remains present in the pandemic, post-pandemic and full 2019–2025 intervals.

6. Discussion

From the perspective of financial management of public pension expenditure, the results show that the fiscal effect of the crisis period cannot be directly derived from the mortality shock itself. For the Pension and Disability Insurance Fund, the relevant factor is the net change in the number of beneficiaries, while in the analysed period the decisive expenditure pressure arose through the increase in the average pension, that is, expenditure per beneficiary.

The main interpretative value of the paper lies in the finding that, in the short and medium term, expenditure pressure in a PAYG system may emerge even without an increase in the number of beneficiaries. Demographic projections therefore represent only one segment of financial planning, while indexation rules, inflation, wage movements and extraordinary adjustments determine the pace of growth in obligations per beneficiary.

The finding does not imply that indexation is economically unjustified. It has an important social function, as it protects the purchasing power of pensioners and contributes to the adequacy of pension income. However, the same mechanism simultaneously produces an automatic expenditure effect. From the perspective of public finance, it is therefore not sufficient to assess only the social justification of indexation; it is also necessary to assess its medium-term impact on budgetary exposure and fiscal space.

The nominal expenditure increase documented here should not be interpreted as an equivalent increase in the real fiscal burden. Part of the rise in average pensions compensates for inflation and helps preserve beneficiaries' purchasing power; consequently, nominal expenditure growth need not imply proportional growth in real pension expenditure. Assessing changes in the real fiscal burden would require adjusting expenditure for inflation and considering it relative to GDP or public revenues. These comparisons are outside the scope of the present nominal decomposition.

In the broader European context, the result should not be interpreted as an exclusively national specificity of Serbia. It fits into the contemporary debate on PAYG systems, in which fiscal sustainability is determined not only by demographic ageing, but also by indexation formulas, macroeconomic shocks and discretionary adjustments of entitlements. The Serbian case therefore has analytical value for small open and demographically ageing economies in Europe and the Western Balkans: it shows that a short-term demographic disturbance may be fiscally secondary if expenditure growth per beneficiary is strong and institutionally embedded in indexation rules (European Commission, 2024; OECD, 2023).

The limitations of the analysis clearly define the scope for interpreting the results. First, the year 2025 is included in the expenditure part, but not in the full 65+ mortality series, because comparable detailed data by age and sex were not available. Second, expenditure is approximated on the basis of December cross-sections, which enables consistent decomposition but does not replace an analysis of full monthly budgetary payment series. Third, the price

channel is observed in aggregate terms; future research may decompose it into inflationary, wage-related and discretionary components. These limitations do not call into question the main finding, but rather specify the scope and boundaries of its application.

6. Conclusion

The paper shows that the fiscal effects of the pandemic period in the public pension system must be interpreted through the structure of expenditure dynamics, and not only through the demographic shock. The mortality shock among the population aged 65 and over in Serbia was pronounced in 2020–2021, but time-limited, confirming the existence of a potential quantity channel, but not its dominance in explaining the increase in pension expenditure.

The key empirical finding is that the post-pandemic increase in approximated expenditure of the Pension and Disability Insurance Fund almost entirely resulted from the price channel. In the period 2019–2025, the number of beneficiaries remained lower than in the initial year, while the average pension more than doubled. Shapley decomposition shows that the price contribution not only explained total expenditure growth, but also compensated for the negative quantity effect. This result confirms that the nominal dynamics of public pension expenditure cannot be reliably interpreted without explicitly including indexation and macroeconomic parameters.

The scientific contribution lies in providing country-specific empirical evidence, rather than a new decomposition method. Applying the established Shapley framework to recent administrative pension data makes it possible to quantify the respective contributions of beneficiary numbers and average pensions to nominal expenditure growth in Serbia. Placing these results alongside the mortality evidence distinguishes the temporary demographic shock from the observed change in the number of pension beneficiaries and provides a transparent basis for public-finance planning.

The practical implication is direct: medium-term projections of pension expenditure should be based not only on demographic assumptions, but also on modelling indexation rules, inflation, wage growth and extraordinary pension increases. Stabilisation or decline in the number of beneficiaries does not guarantee expenditure stabilisation if the price channel remains strong. For this reason, the indexation mechanism should be treated as a central instrument and a potential source of budgetary risk in the financial management of the public pension system.

Future research may improve the analysis by including the detailed mortality structure for 2025, using full monthly series of pension payments and decomposing the price channel into inflationary, wage-related and discretionary components. Nevertheless, the main conclusion of the paper remains empirically stable: in the analysed post-pandemic period, the increase in pension expenditure in Serbia was primarily the result of an institutionally and macroeconomically driven increase in the average pension, while the demographic-quantity channel had a secondary role.

Declaration of generative AI in the writing process

During the preparation of this manuscript, the author(s) did not use generative AI or AI-assisted technologies in the writing process.

References

Barr, N., & Diamond, P. (2006). The economics of pensions. *Oxford Review of Economic Policy, 22*(1), 15–39. https://doi.org/10.1093/oxrep/grj002

Bongaarts, J. (2004). Population aging and the rising cost of public pensions. *Population and Development Review, 30*(1), 1–23. https://doi.org/10.1111/j.1728-4457.2004.00001.x

Clements, B., Eich, F., & Gupta, S. (Eds.). (2014). *Equitable and sustainable pensions: Challenges and experience*. International Monetary Fund.

European Commission. (2021). *Pension adequacy report 2021: Current and future income adequacy in old age in the EU* (Vol. 1). Publications Office of the European Union. https://doi.org/10.2767/013455

European Commission. (2024). *The 2024 ageing report: Economic and budgetary projections for the EU Member States (2022–2070)*. Publications Office of the European Union. https://economy-finance.ec.europa.eu/publications/2024-ageing-report-economic-and-budgetary-projections-eu-member-states-2022-2070_en

Government of the Republic of Serbia. (2020a). *Uredba o fiskalnim pogodnostima i direktnim davanjima privrednim subjektima radi ublažavanja ekonomskih posledica bolesti COVID-19* [Regulation on fiscal benefits and direct payments to business entities for mitigating the economic consequences of COVID-19]. *Službeni glasnik Republike Srbije*, br. 54/2020.

Government of the Republic of Serbia. (2020b). *Uredba o dopunama Uredbe o fiskalnim pogodnostima i direktnim davanjima privrednim subjektima radi ublažavanja ekonomskih posledica bolesti COVID-19* [Regulation on amendments to the Regulation on fiscal benefits and direct payments to business entities for mitigating the economic consequences of COVID-19]. *Službeni glasnik Republike Srbije*, br. 60/2020.

Holzmann, R., & Hinz, R. (2005). *Old-age income support in the 21st century: An international perspective on pension systems and reform*. World Bank.

Law on Pension and Disability Insurance. (2003/2024). *Službeni glasnik Republike Srbije* [Official Gazette of the Republic of Serbia], br. 34/2003, sa kasnijim izmenama i dopunama, zaključno sa br. 94/2024.

OECD. (2023). *Pensions at a glance 2023: OECD and G20 indicators*. OECD Publishing.

Queisser, M., & Whitehouse, E. (2006). *Neutral or fair? Actuarial concepts and pension-system design* (OECD Social, Employment and Migration Working Papers, No. 40). OECD Publishing. https://doi.org/10.1787/351382456457

Serbian Pension and Disability Insurance Fund. (n.d.). *Statističke publikacije: Decembarski preseci broja korisnika i prosečne penzije* [Statistical publications: December cross-sections of the number of beneficiaries and the average pension]. Retrieved June 4, 2026, from https://www.pio.rs/sr/mesechni-bilten

Serbian Pension and Disability Insurance Fund. (2026). *Statistički mesečni bilten XII/2025* [Statistical monthly bulletin XII/2025]. RF PIO.

Shapley, L. S. (1953). A value for n-person games. In H. W. Kuhn & A. W. Tucker (Eds.), *Contributions to the theory of games II*. Princeton University Press.

Shorrocks, A. F. (2013). Decomposition procedures for distributional analysis: A unified framework based on the Shapley value. *The Journal of Economic Inequality, 11*(1), 99–126. https://doi.org/10.1007/s10888-011-9214-z

Statistical Office of the Republic of Serbia. (n.d.). *Diseminaciona baza: Umrli po starosti i polu, Srbija, 2015–2024* [Dissemination database: Deaths by age and sex, Serbia, 2015–2024]. Retrieved June 4, 2026, from https://data.stat.gov.rs/

Whitehouse, E. (2009). *Pensions, purchasing-power risk, inflation and indexation* (OECD Social, Employment and Migration Working Papers, No. 77). OECD Publishing. https://doi.org/10.1787/227182142567

World Health Organization. (2022). *Global excess deaths associated with COVID-19, January 2020–December 2021*. https://www.who.int/data/sets/global-excess-deaths-associated-with-covid-19-modelled-estimates