Bank i Kredyt 57(1), 2026, 93-104
DOI: 10.5604/01.3001.0055.5930

BANK I KREDYT
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A note on the indirect impact of emigration on population age structure and macroeconomic outcomes

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Submitted: 21 October 2025. Accepted: 4 November 2025.

Suggested citation: Walerych M. (2026), A note on the indirect impact of emigration on population age structure and macroeconomic outcomes, *Bank i Kredyt*, 57(1), 93–104, DOI: 10.5604/01.3001.0055.5930.

Abstract

Assessing the impact of population outflows on the age structure of sending countries is difficult, since the effects are not only direct – through instantaneous changes in the size of specific age cohorts – but also indirect, extending to childbearing trends within the economy. In this paper I use the overlapping generation model with endogenous migration choice to examine the significance of the indirect 'missing births' channel. The results confirm the key role of the indirect channel in shaping the population age structure and the long-term effects of emigration flows on macroeconomic aggregates.

Keywords: emigration, population ageing, births, OLG models

JEL: F22, J61, D31, D58

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1. Introduction

Emigration, alongside fertility, mortality, and immigration, constitutes one of the key determinants of demographic change in a country. While the effects of the other three determinants on population ageing are relatively well studied, the literature on how emigration affects future ageing remains rather scarce (Tønnessen, Syse 2023). Assessing the impact of population outflows on the age structure of sending countries is both difficult and complex, since the effects are not only direct and immediately visible – through instantaneous changes in the size of specific age cohorts – but also indirect, extending to childbearing trends within the economy (Sobotka 2008). Emigrants, who are often young and in their reproductive years, reduce the number of births in their countries of origin, thereby intensifying the demographic challenges faced by many sending countries. As argued by Fihel, Janicka, and Kloc-Nowak (2018), this indirect channel of 'missing births' plays an even greater role in shaping population ageing than the direct effect, suggesting that it should occupy a central place in analyses of international migration in the context of demographic processes.

In this paper, I employ a small open economy general equilibrium model with idiosyncratic risk and endogenous migration choice proposed by Walerych (2024) to examine the importance of the indirect channel of migrants' descendants. To this end, I compare the results of a model that incorporates both the direct and indirect effects of emigration, exactly the same as in Walerych (2024), with those of a model in which the indirect channel is switched off, i.e. emigration is not assumed to affect the number of future births within the sending economy. The model is calibrated to Polish data from the period following EU accession, when the country experienced a substantial outflow of young people. However, the conclusions regarding the importance of the indirect channel of emigration can be generalized to other countries facing significant emigration of individuals in reproductive age.

I find that omitting the indirect effect of emigration can lead to misleading conclusions regarding the long-run effects of population outflows. In the model where future births are not linked to population outflows, the population becomes younger than in the non-migration scenario, rather than ageing, as observed in the model that incorporates both the direct and indirect effects of emigration. Importantly, unlike purely demographic models, the presented framework also allows for a consistent analysis of the implications of such differences in age structure for macroeconomic variables. My results further indicate that omitting the indirect effect of emigration and neglecting the resulting changes in population age structure alters not only the quantitative, but also the qualitative conclusions regarding the long-term impact of emigration on various macroeconomic aggregates, including capital and labour supplies and output *per capita*. Although there is a considerable literature on the impact of changes in age structure on macroeconomic outcomes (see, e.g. Börsch-Supan 2003; Feyrer 2007; Sheiner, Sichel, Slifman 2007; Ludwig, Schelkle, Vogel 2012; Sheiner 2014; Acemoglu, Restrepo 2017; Kolasa 2020; Gagnon, Johannsen, López-Salido 2021; Maestas, Mullen, Powell 2023), none of the existing studies focus on the effects of age-structure changes induced by emigration, and in particular on the separate contributions of the direct and indirect effects of population outflows.

The remainder of this paper is organized as follows. Section 2 summarizes the model and its calibration. Section 3 presents the findings. Section 4 concludes.

2. Model and calibration

The analysis is based on a small open economy general equilibrium model with idiosyncratic uncertainty and endogenous migration choice, proposed and applied by Walerych (2024) to study the aggregate and redistributive consequences of changes in the size, age structure, and skill composition of emigration from Poland following the country's accession to the EU. Since the model and its calibration are detailed in her paper, I only summarize its key features here and refer the reader to the original work for full equations and calibration data.

From a demographic perspective, the key feature of the model is its overlapping-generations (OLG) structure, with finitely lived agents heterogeneous in age, skills, productivity, and cost of changing their country of residence. In the model, labour is imperfectly mobile: individuals may relocate, but migration is costly. First, individuals residing abroad face a migration utility cost, introduced to capture their attachment to the home country. Second, to reflect the empirical evidence that immigrants' economic performance tends to be lower than that of natives (see, e.g. Büchel, Frick 2005; Clark, Drinkwater 2008), migration entails a loss of individual productivity. In this setting, population flows arise solely from economic motives, namely wage differentials driven by differences in TFP levels between the home and foreign country. Finally, only permanent relocation is allowed, ruling out the possibility of return migration. Moreover, the framework incorporates age-specific fertility rates and a stochastic lifespan, with survival probabilities depending on age, skills and country of residence.

In her study, Walerych (2024) first computes the non-migration stationary equilibrium – that is, the stationary equilibrium in which agents are not allowed to change their country of residence. Subsequently, she solves for the migration equilibrium, which reproduces both the size and the skill composition of post-accession emigration from Poland, and calculates the transition path between both steady states. In this paper, I follow the same approach but introduce one modification to Walerych's (2024) model. Unlike in her framework – where migration affects the age structure of the sending country both directly, through the immediate loss of emigrants, and indirectly, through fewer future births as women of reproductive age who emigrate give birth abroad rather than in their country of origin – I assume that the growth rate of the initial cohort is exogenous and fixed at the level implied by the non-migration stationary equilibrium, rather than determined endogenously. In other words, the indirect channel of 'missing births' is switched off. I will refer to the model developed in Walerych (2024) as the baseline model, and to the modified version as the no-indirect-effect scenario.

To ensure that the results from the modified model are fully comparable with those presented in Walerych's (2024) study, and that the impact of the indirect emigration channel is properly captured, I calibrate the model in exactly the same way as in her work. The only difference lies in the values of the parameters governing the distribution of migration utility costs. As in her work, I assume that these costs follow uniform distributions on the interval $[0, \mu_S]$, where the upper bounds μ_S are skill-specific. In the no-indirect-effect scenario, these upper bounds are recalibrated so that the emigration flow-to-population ratio and the share of skilled emigrants in the total emigrant stock match the targets reported in Walerych (2024) and derived from data provided by Statistics Poland on the size and directions of temporary emigration from Poland, as well as from the 2002 and 2011 Poland's National Censuses. This recalibration ensures that any differences between the two migration equilibria arise solely from the inclusion or exclusion of the indirect effect of emigration, rather than from differences in the observed scale or skill composition of emigration.

Similarly to the baseline model, in my newly considered scenario, I do not directly target the age structure of population flows. Nevertheless, it closely replicates the structure of outflows observed in the data, see Figure 1.

3. Results

To analyse the importance of the indirect channel of emigration, I compare the non-migration stationary equilibrium with two variants of the migration steady state: one from the baseline model and one from the model with a fixed growth rate of the initial cohort. In both migration equilibria, a significant share of the population of the sending country resides abroad, see Table 1. However, although the scale of emigration in both cases is very similar, the changes in the age structure of the population caused by the outflow of people differ significantly in each case and lead to distinct long--run responses of various macroeconomic variables.

In the baseline model, emigration leads to population ageing. While fertility rates remain unchanged between the migration and non-migration steady states, the outflow of young, fertile individuals leads to a reduced growth rate of the first generation. Consequently, the long-run age structure of the population remaining in the home country becomes more skewed toward older, unproductive cohorts (Figure 2A). In contrast, the age distribution of individuals residing in the home economy in the migration steady state from the no-indirect effect scenario is younger than initially. Moreover, the share of the working-age population in the total population of the home country increases, rather than decreases as observed in the baseline migration scenario (Figure 3B).

To understand these differences in the population age structure, note that once agents decide to emigrate, they remain in the foreign country for the rest of their lives (as return migration is not allowed in the model). As a result, in the long-run migration steady state, the current outflow of young individuals accounts for only a small share of the total emigrant stock. Most emigrants are those who left when they were young in earlier periods and have since grown older while living abroad. Combined with the absence of a negative impact of emigration on the number of new agents entering the economy, this automatically shifts the age structure of the population residing in the home country toward younger cohorts.

Fixing the growth rate of the first generation reverses many of the long-run outcomes that, in the baseline model, were driven by population aging and the increasing share of individuals in retirement. As a result, capital stock, output, and labour supply, expressed in *per capita* terms, respond in the opposite direction compared to the baseline case; that is, they increase in the long run. Similarly, the long-run response of the net foreign assets-to-output ratio also differs: unlike in the model accounting for both the direct and indirect effects of emigration, in the no-indirect-effect scenario this ratio is lower than in the non-migration equilibrium because there are fewer elderly individuals, who typically hold higher levels of assets.

The long-term responses of wages and average labour incomes are quite similar to those in the baseline scenario, and in both versions of the model they stem primarily from shifts in the educational structure of the population, driven by the disproportionately high outflow of educated individuals (as observed in the data for the period following the country's accession to the EU; see, e.g. Fihel, Kaczmarczyk, Okólski 2006; Kaczmarczyk, Okólski 2008). Specifically, we observe an increase in the

skill premium, resulting from a rise in the wage per efficiency unit of skilled labour and a decline in the wage per efficiency unit of unskilled labour. The increase in average labour income for skilled workers is slightly smaller than in the baseline migration steady state, while the labour income of unskilled workers declines slightly, rather than increasing as it did in the baseline case. This difference in outcomes between the two scenarios stems from a higher share of younger cohorts, whose earnings are, on average, lower.

Figure 3 shows the evolution of key model variables over the transition path. In each subfigure, the first data point (transition period = 0) corresponds to the non-migration equilibrium. Transition period 1 marks the point at which agents are permanently allowed to relocate.

Again, in the model where the effects of emigration on the number of births are switched off, wages per efficiency unit of labour behave similarly to those in the baseline scenario. More interesting dynamics, however, are observed in the case of output, capital, and labour supply *per capita*. In the initial years following the opening of the borders, the age structure of the emigrant stock closely mirrors that of the migration outflows.[1] During this period, the share of retirees increases at the expense of the working-age population, leading to a decline in *per capita* aggregates – similar to what is observed in the baseline scenario. As emigrants age, however, the share of retirees in the total population of the sending country declines in favour of younger, working-age cohorts, which in turn drives an increase in the macroeconomic variables under consideration.

4. Conclusions

In this paper, I examine the significance of the indirect channel of emigration, i.e. the impact of migration on the future number of births in the economy, on the population age structure, and on macroeconomic aggregates. To this end, I employ an OLG model with idiosyncratic risk and endogenous migration decisions developed in Walerych (2024), and compare the results of its two versions: a baseline model that incorporates both the direct and indirect effects of emigration, and an alternative in which the indirect channel is switched off, i.e. emigration is not assumed to affect the number of future births within the sending economy.

In the baseline model, where emigration reduces the number of agents born in the home economy, the population in the migration steady state becomes older than in the non-migration stationary equilibrium, contributing to a decline in output, capital, and labour supply *per capita*. By contrast, the outcomes look entirely different in the model that omits the indirect channel: in this case, the population in the long run becomes younger than in the non-migration scenario, and the reactions of most macroeconomic aggregates are reversed.

The outflow of young adults, combined with the absence of significant return migration, deepens the decline in the number of births by reducing the size of cohorts in their reproductive years. This effect has been particularly evident in Central, Eastern, and Southeastern Europe, where the massive emigration of young people has intensified adverse demographic trends (Atoyan et al. 2016). However, empirical studies (Anelli, Balbo 2021) indicate that migrants are often disproportionately

[1] Figure 2B presents the population age structure 10 years after the borders opened. It clearly shows that in both model variants – whether accounting for or abstracting from the impact of emigration on the number of births – the population is older compared to the scenario without migration flows.

drawn from groups with lower propensities to have children, which may, in turn, lead to an increase in the total fertility rate in the sending country, thereby mitigating the negative impact of emigration on birth rates. Incorporating the selectivity of migrants with respect to fertility preferences into an OLG framework, such as the one used in this study, could provide an interesting avenue for future research.

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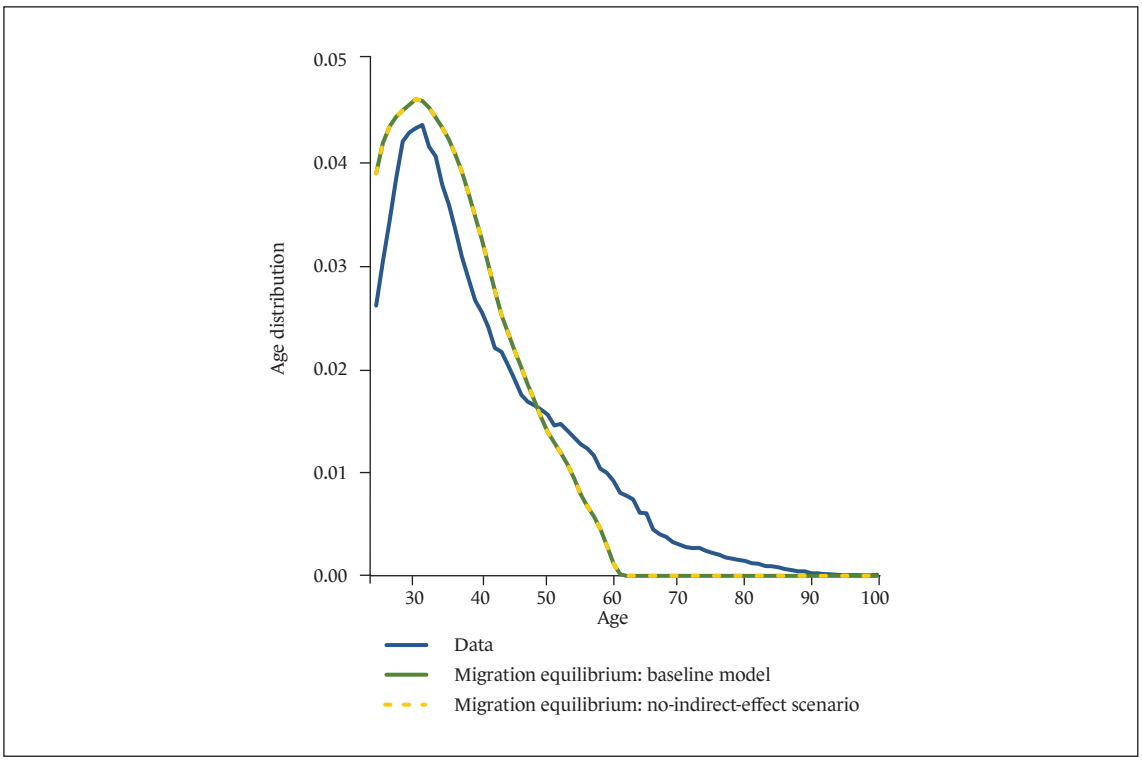
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Appendix

Figure 1
Age structure of emigration flows



Source: Eurostat – age structure of migration flows from Poland averaged over the period 2009–2016.

Figure 2
Population age structure

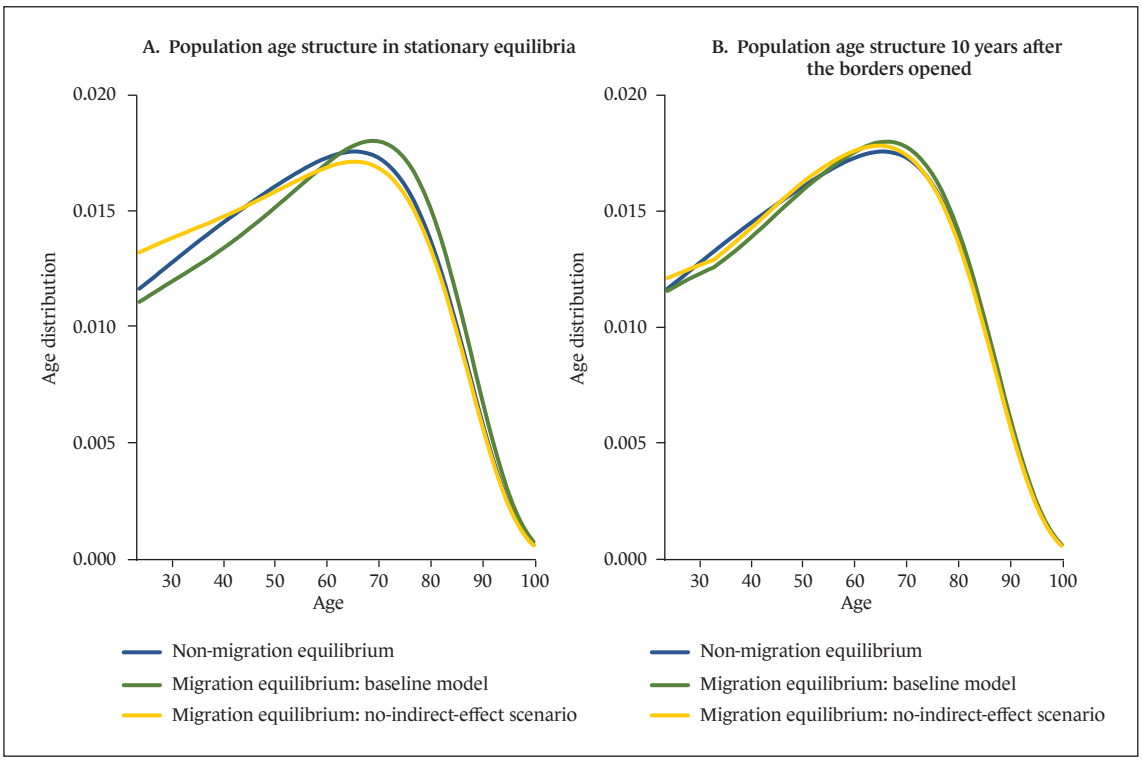
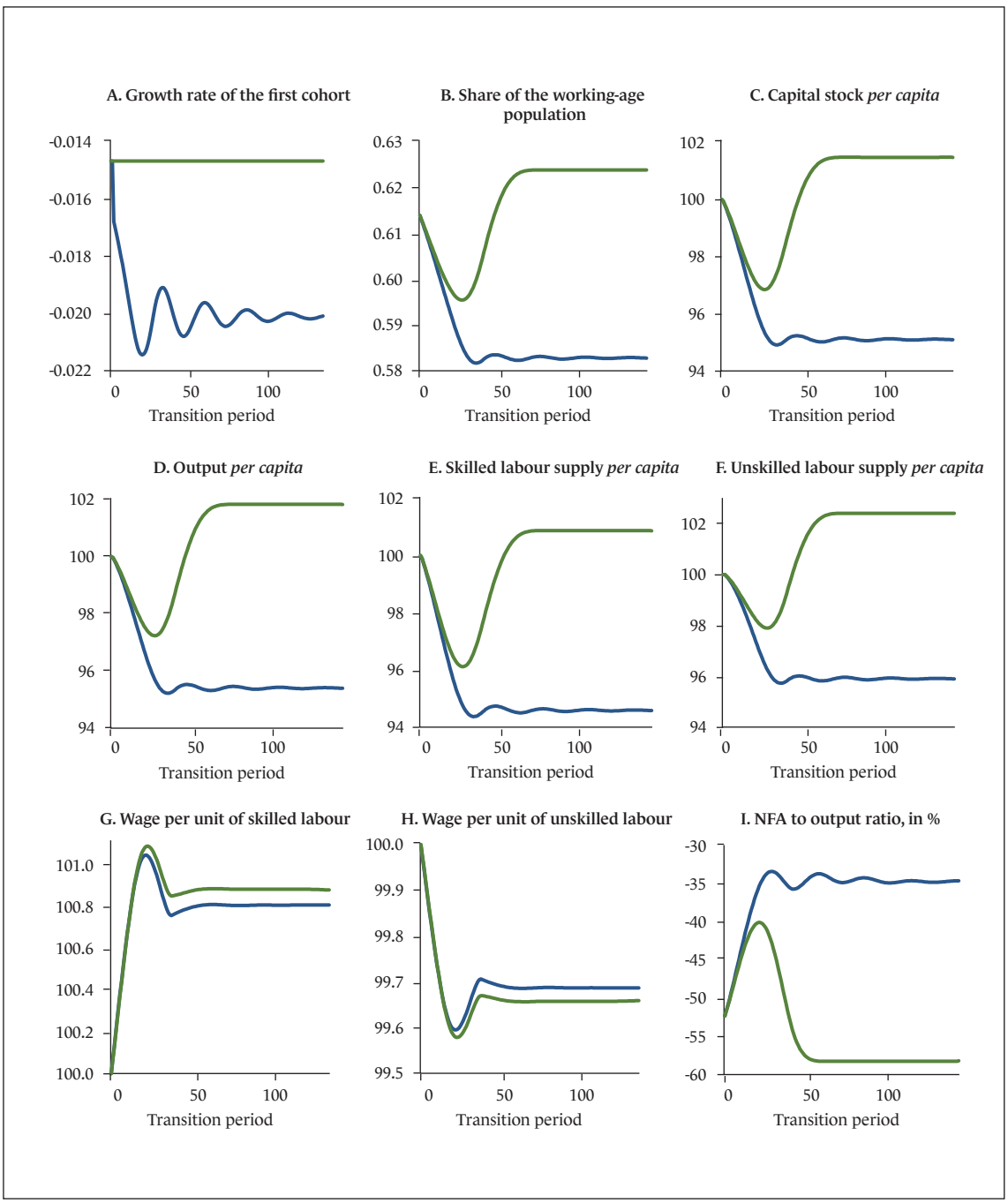


Figure 3
Macro variables along the transition



Notes:
The blue line represents the transition path from the baseline model, while the green line represents the transition path from the no-indirect-effect scenario. In Figures C–H, values in the non-migration equilibrium are normalized to 100.

Table 1
Comparison of stationary equilibria

	Change	
	baseline model	**no-indirect-effect scenario**
Ratio of emigrants to agents born in the country (p.p.)	14.75	13.21
Growth rate of the first generation (p.p.)	-0.54	no change
Wage per efficiency unit of skilled labour (%)	0.81	0.90
Wage per efficiency unit of unskilled labour (%)	-0.31	-0.35
Average labour income of skilled worker (%)	3.03	2.78
Average labour income of unskilled worker (%)	0.13	-0.16
Capital stock *per capita* (%)	-4.90	1.47
High skill labour *per capita* (%)	-5.41	0.87
Low skill labour *per capita* (%)	-4.09	2.42
Output *per capita* (%)	-4.60	1.83
NFA to output ratio (p.p.)	17.70	-5.88

Note: table presents changes in migration equilibria with respect to the non-migration equilibrium.

O pośrednim wpływie emigracji na strukturę wiekową populacji i zmienne makroekonomiczne

Streszczenie

Ocena oddziaływania odpływów migracyjnych na strukturę wiekową ludności w krajach wysyłających stanowi istotne wyzwanie badawcze. Skutki migracji nie przejawiają się bowiem wyłącznie przez bezpośrednie, natychmiastowe zmiany liczebności określonych kohort wiekowych, lecz również pośrednio, wpływając na długofalowe tendencje dzietności w gospodarce. W niniejszym artykule wykorzystano model nakładających się pokoleń z heterogenicznymi agentami i endogenicznym wyborem migracyjnym w celu zbadania znaczenia pośredniego kanału tzw. utraconych urodzeń.

Uzyskane wyniki wskazują na istotną rolę pośredniego kanału oddziaływania emigracji w kształtowaniu struktury wiekowej ludności oraz długookresowych skutków odpływów migracyjnych dla wielu zmiennych makroekonomicznych. W wariancie modelu, w którym liczba przyszłych urodzeń nie jest powiązana z wielkością odpływów ludności (a zatem kanał pośredni pozostaje wyłączony), struktura demograficzna populacji w długim okresie wykazuje tendencję do odmładzania się. Jest to efekt przeciwny do tego, który obserwujemy w modelu uwzględniającym zarówno bezpośrednie, jak i pośrednie skutki emigracji, gdy populacja stopniowo się starzeje. Różnica ta prowadzi do odmiennych reakcji wielu kluczowych zmiennych makroekonomicznych i tym samym wpływa na ocenę długookresowych konsekwencji emigracji.

Słowa kluczowe: emigracja, starzenie się ludności, urodzenia, modele OLG