

Demographic Substitution and Family Firm Succession in the EU: Panel Evidence from Eurostat 2012-2023

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Abstract

Family-run businesses in Southern and Eastern Europe faced succession pressures from declining cohort sizes and continuing out-migration. Whether population decline led to replacement migration, or whether economic conditions mediated the relationship, remained an open empirical question. EU-27 total fertility rates (TFR) have been persistently below the replacement level of 2.1 for more than four decades now, net migration becoming the key source of population growth in the overwhelming majority of EU-27 members. Whether lower fertility served as a fundamental pull factor for immigration independently of the concurrent economic determinants driving migration remained an empirical question lacking evidence within the EU-27 context. The aim of this study was to test the demographic substitution hypothesis by estimating pooled OLS regressions on Eurostat panel data of all 27 EU countries during the period of 2012-2023. Three different models were estimated in the study. TFR turned out to be a strong and highly significant determinant of net immigration in all three cases, GDP per capita, unemployment rate, women's employment rate, and social protection measures were accounted in the models, results suggesting that raw correlation does not capture the pure effect. GDP per capita and unemployment turned out to be significant and jointly determined factors influencing net immigration flow. In sum, this paper offered, for the first time, pooled OLS analysis for all 27 EU members across 12 years of harmonized Eurostat data, addressing an identification challenge that purely cross-sectional analysis could not resolve. It provided a link between macro-level demographic substitution effect and firm succession constraints of economies dependent on family enterprises. Immigration partially substituted for low fertility, but the substitution was conditional on economic attractiveness and was attenuated where labour markets were weak.

Keywords

Fertility rate, immigration, demographic substitution, EU-27, population sustainability, family business succession, regional workforce

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Introduction

Total fertility rates (TFR) in the European Union (EU-27) have been below the replacement level of 2.1 throughout the last four decades. According to Eurostat (2024a), the average TFR in the EU-27 stood at 1.46 in 2022, ranging from 1.08 in Malta to 1.79 in France. In 2023, deaths exceeded births in eighteen member states. As a result, immigration had become the main determinant of EU-27 aggregate population growth, and, in its absence, the absolute population decline would occur in several member states. Several countries have experienced relatively high levels of net immigration considering the size of their populations. For instance, between 2010 and 2023, the number of net immigrants was on average 20.55 per 1,000 people in Malta and 16.58 in Luxembourg (Eurostat, 2024b). Conversely, member states from Eastern Europe have largely served as sources of emigration since accession.

Whether these two phenomena were causally related, and whether the former acted as a pulling factor for the latter, was less straightforward. Countries that were economically developed and had low fertility rates, such as Germany and the Netherlands, mainly used wage differential and well-developed labor markets to

attract foreigners and not demographics. Indeed, the EU member states with the lowest TFRs tended to belong to Eastern Europe and have acted as net emigrants, not as migrant destinations. Hence, analyzing a bivariate relationship between TFR and net immigration would have been misleading, as it would have conflated economic and demographic factors and risked reversing the underlying relationship in subsamples. To show a demographic substitution effect, it was necessary to control simultaneously for GDP per capita, labour market conditions, and the size of the welfare state. These issues were essential, not only due to the economic implications regarding sustainability of the welfare system but also because of the role of family-firms' ecosystems in the relevant member states.

Prior empirical work on the demographic substitution hypothesis remained either cross-sectional or restricted to subsamples of OECD countries. Wilson (2019) tested the hypothesis on 27 OECD countries and concluded that immigration slowed but did not arrest ageing. Parr (2025) showed for 22 European countries that the fertility level consistent with zero long-run population growth depended jointly on TFR and migration volumes, with most member states failing to meet the combined threshold. Coleman (2008) documented migration's growing role in Western and Northern EU population change, leaving the substitution mechanism untested on harmonised EU-27 panel data. No study, however, tested the demographic substitution hypothesis across all 27 EU member states using harmonised Eurostat panel data covering more than a decade. The present paper addressed that gap. The research question was whether low fertility independently attracted net immigration in the EU-27 after controlling for economic conditions. The objective was to estimate the magnitude of any such substitution effect using pooled OLS on a balanced 2012–2023 panel of all 27 EU member states and to assess its robustness to structural outliers and to the inclusion of economic controls.

Pooled OLS regression was used to test the substitution effect in the EU-27 using Eurostat panel data on all 27 member countries from 2012 to 2023 (N=324 observations). Three models were estimated: bivariate, full controls, and one model that excludes Luxembourg due to its status as an influential case.

1. Review of Scientific Literature

The concept of demographic substitution through immigration has become well defined with the United Nations Population Division's work in 2001, in which it was argued that the maintenance of stable working-age populations in EU member countries would require significantly higher levels of migration than before. In his study, Coleman (2006) introduced the idea of the "third demographic transition" where he argued that constant migration coupled with below-replacement fertility rates led to constant changes in the composition of European populations, thus making it impossible to view fertility and migration independently in terms of demography. Further, Coleman (2008) proved that migration was a major component of change in Western and Northern EU member countries.

The hypothesis was directly tested quantitatively by Wilson (2019). In the study the data consisted of 27 OECD countries that showed that an increased rate of immigration could have slowed down population ageing in countries with lower fertility rates, but it was not enough to stop population ageing even in optimistic immigration situations. Increasing the rate of immigration by twofold in the group of OECD countries with the lowest total fertility rates slowed down the increase in the median age by just five to eight years.

Eastern Europe's fertility path brought additional dimensions to the substitution hypothesis that could not be addressed via purely cross-sectional analysis. For instance, Goldstein et al. (2009) reported a partial revival of total fertility rate (TFR) in Southern and Eastern European member states following post-transition low levels of fertility, indicating that the EU's lowest TFR members happened to fall in the subregion that had been experiencing net population loss since joining the Union. This pattern produced a positive bivariate TFR–immigration correlation in that subregion alone. Frejka and Gietel-Basten (2016) documented the non-linear path of fertility decline and partial revival in Central and Eastern Europe after 1990, introducing within-region variability that cross-sectional time averaging obscured. In their sub-national Eurostat-based study on 16 EU member states, Matysiak et al. (2021) found the Great Recession to lower TFR in Southern and Eastern European regions with high levels of unemployment, which confirmed the impact of economic factors on TFR differences irrespective of migration effects. Taken together, this line of research suggested that any pooled EU-27 test of the substitution hypothesis needed to factor in economic considerations to prevent false attribution of economically induced TFR differences to demographic pull dynamics.

Two recent studies tested the substitution mechanism on EU-specific data. Parr (2025), in a peer-reviewed study covering 22 European countries, demonstrated that the fertility level consistent with zero long-run

population growth varied widely with national immigration and emigration patterns, ranging from 0.86 in Spain to 2.44 in Croatia; Eastern European countries with negative net migration required above-replacement fertility to avoid long-run depopulation, whereas high-immigration countries could sustain population size with very low TFRs. Lukács Gellérné, Mészáros and Pári (2025) extended this analysis to Central and Eastern European member states, arguing that crises had a disproportionately larger impact on CEE demographics and labour markets than on Western Europe, and that labour-market inflexibility limited the effectiveness of family-supporting policies in the region. These results suggested the substitution effect depended on national economic and institutional conditions.

The causal arrow also ran from immigration to host-country fertility, not only the reverse. As estimated by Sobotka (2008), the presence of immigrant females increased the total fertility rate (TFR) of the host society by 0.05-0.10 points via a higher period fertility among recently arrived migrants, leading to reverse causation that reduces the OLS estimate of the TFR-immigration relationship. According to Impicciatore et al. (2020), based on Italian registers, the TFR-increasing impact strongly depended on the composition of origin countries among the migrant arrivals and quickly diminishes due to immigrants' cultural assimilation. Furthermore, according to Kulu et al. (2019), a systematic review of life course studies showed that the convergence toward native fertility norms occurs very fast, taking only one generation. Immigration thus provided a transitory and incomplete fertility boost, insufficient for population replacement but enough to introduce downward bias in OLS coefficients that only instrumental-variables identification could fully correct.

Continuously falling fertility below the level of replacement was associated with structural drivers that were independent of short-term migration movements. According to Lesthaeghe (2010), low fertility persisted due to values-based moves towards individuality, more education, and postponed marriage. Thus, Lesthaeghe regarded this development as the "Second Demographic Transition" and did not see it as an effect of cyclical economic circumstances. Low-fertility dynamics were described by the "trap" concept proposed by Lutz, Skirbekk, & Testa (2006): when the TFR fell below approximately 1.5, smaller population cohorts created reinforcing demographic momentum difficult to reverse through policies. Gauthier and Gietel-Basten (2025) surveyed family policies across Europe and documented that expansion of childcare facilities and parental leave produced positive effects on the TFR especially in welfare states of Northern and Continental Europe. Guner, Kaya and Sánchez-Marcos (2024) corroborated this institutional finding using a panel of OECD countries, showing that high unemployment and unstable employment contracts depressed fertility, particularly among younger women, whereas stable public-sector employment and generous employment-linked maternity benefits raised fertility in the prime childbearing age groups. Such structural trends suggested that variables such as per capita GDP, unemployment, and spending on social programs had to be taken into account as control variables because they not only affected TFR independently but were the main economic attractors of migration according to Brewster & Rindfuss (2000), Zaiceva & Zimmermann (2008).

The substitution hypothesis was consistent with Coleman's (2006, 2008) macro framework and bounded by Wilson's (2019) quantitative estimates, but reverse causality, the Eastern European emigration paradox, and the entanglement of demographic and economic determinants left the EU-27 effect empirically underspecified.

These demographic and migratory factors had clear firm-level consequences via two main mechanisms, family business succession and regional labor supply issues. In the most recent systematic review of family business succession, Reif et al. (2025) found the pool of potential successors to be the principal structural antecedent of succession outcomes in family businesses, a pool that was directly defined by demographic processes such as population growth rates, cohort sizes, and influenced by fertility and migration trends similar to those investigated empirically in this paper. Thus, when the total fertility rate consistently remained below the replacement level, subsequent cohorts produced less potential successors; when net migration out of a country further reduced the availability of candidates on the labor market, even the alternative strategy of professionalized succession became structurally limited. Amato et al. (2022) showed that family-business outcomes, though firm-level on the surface, were embedded in the demographic context of the surrounding territory: regions with favourable demographic and economic conditions produced different succession and staffing outcomes than economically prosperous regions with weaker demographic dynamics. Baù et al. (2019) found that family-firm embeddedness was particularly strong in peripheral and rural regions, precisely the Eastern and Southern European regions identified in the Eurostat dataset as facing a substitution trap, where low TFR coincided with high net out-migration and weak labour markets. Demographic substitution through immigration was therefore not just a fiscal-welfare concern but a constraint on succession and staffing in the family-firm ecosystem. The member states worst equipped to attract replacement immigrants were those facing the most acute demographic challenges. Korang Adjei, Amato,

Basco and Suwala (2025) showed that local embeddedness, regional labour markets, and spatial demographic dynamics jointly conditioned family-firm performance and succession outcomes, implying that the substitution trap operated not only at the macro level but also at the firm level, particularly in peripheral regions.

The analysis tested three hypotheses: (H1) that low-fertility EU countries received higher net immigration in bivariate form; (H2) that this relationship survived the inclusion of economic and welfare-state controls (per capita GDP, unemployment, female employment, and social-protection spending); and (H3) that it was not driven by Luxembourg as an influential outlier.

2. Research methodology

The model used a balanced panel that covers all 27 EU member countries for the period 2012-2023, provided N=324 country-year observations. The period under consideration was limited by the existence of data on social protection spending (Eurostat TPS00098), which begun in 2012. An OLS estimator was used as opposed to a fixed-effects model since the substitution effect was derived based on the level differences of total fertility rate (TFR) among the member countries. Using a fixed-effect estimator would eliminate one of the major sources of identification by demeaning the countries (Angrist & Pischke, 2009; Wooldridge, 2010). Thus, the model exploited not only changes in TFR within each country over time but also differences in the fertility rates of the countries included in the model, which comprised all 27 members of the EU. A first-differences estimator would similarly discard the level information that identifies the substitution hypothesis and would amplify measurement error in slowly-varying demographic series. A random-effects estimator would require the additional assumption that country-level unobservables were not correlated with the regressors, an assumption unlikely to hold given that institutional and geographic features jointly shaped both fertility and immigration in the EU-27. The pooled specification therefore retained both within- and between-country variation, exploited all 324 country-year observations, and yielded substitution coefficients in the original units of TFR. The cost of this choice, that unobserved time-invariant country heterogeneity remained in the residual, was addressed through HC3 robust standard errors and through the Luxembourg-exclusion robustness check reported in Model 3. Data came from Eurostat open-access database and were processed with the use of Python programming language.

The dependent variable was the net immigration rate per 1,000 people, which was determined by the absolute number of net migration (Eurostat demo_gind, indicator NETMIG) divided by the mid-year population (demo_pjan) and multiplied by 1,000. The independent variable was the total fertility rate (TFR) that represented the average number of children per woman during her reproductive life time (Eurostat demo_find, indicator TOTFERRT). There were four additional variables used as controls: GDP per capita in PPS (nama_10_pc, CP_PPS_EU27_2020_HAB), female labor force participation rate (lfsa_egan, PC_POP), expenditure on social protection (% of GDP) (TPS00098), and the unemployment rate (une_rt_a).

Descriptive statistics are reported in Table 1. The dependent variable ranged from -20.3‰ to 42.1‰, reflecting the structural gap between high-immigration countries (Malta, Luxembourg, Cyprus) and Eastern European countries with net emigration, and motivating the inclusion of economic controls. The TFR variable had a mean value of 1.52 (SD = 0.19), and it showed a decreasing trend across time. The GDP per capita was between 12,125 and 95,125 PPS, where Luxembourg had the maximum GDP per capita.

Table no. 1. Descriptive Statistics, EU-27 Panel, 2012-2023 (N = 324 country-year observations)

Variable	Mean	Std. Dev.	Min	Max
Net immigration rate (‰)	3.89	7.88	-20.30	42.10
Total fertility rate (children/woman)	1.52	0.19	1.06	2.01
GDP per capita (PPS)	30,909	13,987	12,125	95,125
Female employment rate (% of pop.)	67.10	7.90	43.30	80.90
Social protection exp. (% GDP)	23.38	6.12	11.57	38.05
Unemployment rate (%)	8.22	4.54	2.00	27.80

Source: Authors' calculations based on Eurostat (2024a, 2024b, 2024c, 2024d).

The pooled OLS model was specified as:

$$\text{Net Immigration Rate}_{it} = \beta_0 + \beta_1 \cdot \text{TFR}_{it} + \beta_2 \cdot \text{GDPpc}_{it} + \beta_3 \cdot \text{FemEmpl}_{it} + \beta_4 \cdot \text{SocProt}_{it} + \beta_5 \cdot \text{UNEMP}_{it} + \varepsilon_{it} \quad (1)$$

Where:

Net Immigration Rate_{it} = net migrants per 1,000 inhabitants in country i in year t

TFR_{it} = total fertility rate (live births per woman) in country i in year t

$GDPpc_{it}$ = GDP per capita in purchasing power standards in country i in year t

$FemEmpl_{it}$ = female employment rate as a percentage of working-age population in country i in year t

$SocProt_{it}$ = social protection expenditure as a percentage of GDP in country i in year t

$UNEMP_{it}$ = unemployment rate in country i in year t

ε_{it} = disturbance term, assumed i.i.d. with mean zero

β_0 = intercept

β_1 – β_5 = coefficients to be estimated

i = country index, EU-27 member states

t = time index, years 2012–2023

Three specifications were estimated: Model 1 (bivariate: TFR only, $N = 324$), Model 2 (full controls, $N = 324$), and Model 3 (full controls, Luxembourg excluded, $N = 312$).

The model assumptions were verified through four diagnostic tests. The Breusch-Pagan (1979) LM test rejected the assumption of homoscedasticity, indicating the use of heteroscedasticity-robust standard errors such as HC3 (White, 1980). Among different types of HC estimators, HC3 was preferred over HC1 and HC2 due to the latter's more accurate inference when there were differences in leverage, which was evident in this case due to Luxembourg's extreme value in GDP (MacKinnon & White, 1985). Variance inflation factors did not exceed 3.5 for all independent variables in the full model and showed no effect of multicollinearity on coefficients (Wooldridge, 2010). Cook's (1977) distance found Luxembourg as the only influential point with Cook's $D > 4/N = 4/324 = 0.012$, thus leading to Model 3. No discernible pattern could be seen in scatter plots between residuals and fitted values.

3. Results and discussion

Pooled OLS estimations of the models are shown in Table no. 2. The gross domestic product per capita was measured in terms of purchasing power parity (PPS) 2011; hence, the point estimate was quite small, being around 0.0003 per PPS. However, the estimate carried economic significance since an increase of 10,000 PPS in GDP per capita corresponded to about 3.0 more net migrants per 1,000 population.

Table no. 2. Pooled OLS Regression Results: Net Immigration Rate (%) as Dependent Variable

Variable	Model 1 (Bivariate)	Model 2 (Full)	Model 3 (excl. LUX)
Total fertility rate (TFR)	−9.905*** (2.931)	−13.160*** (2.703)	−13.840*** (2.724)
GDP per capita (PPS)		0.000*** (0.000)	0.000*** (0.000)
Female employment rate (%)		0.036 (0.069)	0.021 (0.071)
Social protection (% GDP)		−0.069 (0.053)	−0.100 (0.068)
Unemployment rate (%)		−0.515*** (0.125)	−0.490*** (0.122)
Constant	18.959*** (4.713)	19.715** (7.653)	20.383*** (7.735)
Observations	324	324	312
R ²	0.055	0.442	0.400
Adj. R ²	0.052	0.434	0.391

Note: HC3 robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: Authors' calculations based on Eurostat data.

In Model 1, the bivariate regression, TFR emerged as a negative and statistically significant variable in explaining net migration ($\beta = -9.905$, $SE = 2.931$, $p = 0.001$). Every unit decline in TFR implied that there was an estimated increase of 9.9 net migrants per 1,000 individuals, which was equivalent to an extra 1.0 net migrant for every 0.1-unit drop in TFR. The value of pooled R^2 of 0.055 was small but reasonable in

the context of a diverse panel of 27 countries. The coefficient was accurately measured based on $N = 324$ observations. As such, decreased fertility was linked to increased net migration in the EU-27, as postulated by the macro-level substitution theory developed by Coleman (2006, 2008) and demonstrated by Wilson (2019) at the OECD level.

For Model 2, which included five control variables, the coefficient of TFR became -13.160 ($SE = 2.703$, $p < 0.001$). The increase from -9.905 in the bivariate model is consistent with suppression: the bivariate coefficient was biased toward zero because economic conditions were positively correlated both with TFR and with net migration. Once those conditions were controlled for, the TFR effect emerged more strongly. Every 0.1 unit of decrease in the fertility rate implied an increase in the number of net immigrants by 1.3 per 1,000, other factors held constant.

GDP per capita remained statistically significant ($p < 0.001$), thus supported the wage differential model proposed by Zaiceva & Zimmermann (2008). The variable unemployment was negative and statistically significant ($\beta = -0.515$, $SE = 0.125$, $p < 0.001$): every percentage point rise in the share of unemployed people implied a reduction in the number of net immigrants by 0.5 per 1,000, suggesting that migrants tended to avoid destinations with surplus labour. In addition, controlling for GDP and unemployment made female employment rate ($p = 0.598$) and social protection expenditure ($p = 0.194$) statistically insignificant. The $R^2 = 0.434$ showed adequate model fit.

Together, TFR, GDP per capita, and unemployment were jointly significant, implying that migration was determined by demographic as well as economic conditions.

When Luxembourg was removed from the sample (Model 3, $N = 312$), there was a small improvement in the TFR coefficient, which rose to -13.840 ($SE = 2.724$, $p < 0.001$). This implied that Luxembourg acted as an anomaly because the country's moderate total fertility rate and extremely high level of immigration helped to reduce the substitution effect estimated in Model 2. GDP per capita and the unemployment rate retained their signs, values, and statistical significance. There was also only a modest decrease in the adjusted R^2 value, to 0.391. Hence, the substitution effect was not unique to Luxembourg but rather a general pattern within the EU.

The TFR coefficient was negative and statistically significant in all three models. The growth of the coefficient from Model 1 to Models 2 and 3 matched the confounding pattern outlined in the literature: economic conditions both attracted migrants and correlated with TFR. This led to attenuation in the two-variable model that was fully corrected by controls. In finding female employment and social protection non-significant when GDP and unemployment were included, led us to the conclusion that the welfare state and women's role in the economy were driven by economic development and did not necessarily represent independent influences on migration, but should be seen as mediating factors. The clustering of the substitution trap among the member countries of Eastern and Southern Europe, where the TFR was low, net migration outflows were high, and the labor market was weak, captured exactly the economies in which family businesses faced demographic pressures in both potential successors and external labor supply (Amato et al., 2022; Reif et al., 2025).

Conclusions

In all three models, the total fertility rate (TFR) was found to be a negative and statistically significant predictor of net immigration into the EU-27 countries. According to the bivariate model, a unit reduction in the TFR translated into an extra 9.9 immigrants per 1,000 population ($\beta = -9.905$, $p = 0.001$). If additional explanatory variables similar to per capita income, unemployment rate, female participation in the labor market, and level of social protection were considered, the effect increased and did not weaken ($\beta = -13.160$, $p < 0.001$). The evidence indicates that a low total fertility rate is a genuine demographic pull factor, and not simply a proxy for a rich country's welfare state. This result was not affected by the outlier of Luxembourg: excluding Luxembourg from the sample left the coefficient unchanged at $\beta = -13.840$ ($p < 0.001$, $N = 312$), while all other estimates remained similar. Hence, the effect was real but conditional: immigration depended on the demographic demand, but this was stimulated by economic attraction and hindered by poor labor markets with implications far beyond welfare-state accounting.

From a policy perspective, relying on migration to offset demographic decline is not sufficient on its own. Those EU member states that combine a low total fertility rate with high unemployment, especially those in the South and East, cannot count on immigration as a demographic lever unless economic conditions are first addressed. Economic reforms and labour market improvements need to precede or accompany migration policy for immigration to function as a meaningful demographic solution. Gauthier & Gietel-Basten (2025) demonstrate that family policies, such as expanding access to affordable childcare, paid parental

leave, and affordable housing, can produce meaningful increases in fertility, particularly in Northern and Continental welfare states. Both demographic and economic policy levers need to work together; neither is sufficient alone. The implications for business are direct. Eastern European countries caught in the substitution trap are dominated by family firms as the prevalent business model (European Commission, 2009). Amato et al. (2022), Baù et al. (2019) show that these firms rely more heavily on local labour than non-family enterprises. Reif et al. (2025) confirm that the demographic environment shapes the pool of succession candidates, directly affecting generational continuity of family businesses. Workforce policy and migration policy are therefore inseparable from family business policy in these regions.

Nevertheless, pooled OLS does not control for time-invariant country characteristics, institutions, geography, diaspora networks, that may jointly affect TFR and immigration flows, and the between-country variation driving the substitution effect may partly reflect such omitted factors. Future research should explore fixed-effects and first-difference estimators to disentangle the within-country from the between-country components of the TFR effect. Reverse causality also remains a concern: immigrants raise host-country TFR through their own reproduction, introducing downward bias into the OLS coefficient that would need to be addressed through instrumental variables, lagged TFR, or shift-share migration instruments. What this analysis establishes is a baseline: the countries most in need of replacement immigration, those with the lowest fertility, oldest populations, and weakest labour markets, are also the least able to attract it.

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