

Does Immigration Mitigate Aging-Led Ineffectiveness of Monetary Policy for Economic Growth in OECD Countries?

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Abstract

The OECD countries are revising their immigration policies by taking in foreign workers to combat labor shortage caused by declining fertility and a rapidly aging population. This is the first scholarly attempt to test the hypothesis that inflows of foreign workers would mitigate the ineffectiveness of monetary policies in 10 OECD economies that are experiencing a declining demographic dividend. The first set of results reinforce the findings in the extant literature that population aging weakens the effectiveness of monetary policies for economic growth. Two new results emerge which enhance the novelty of this study. One, the higher-aged OECD economies experience a more declining effectiveness of monetary policy for economic growth. Two, an increase in net migration mitigates the ineffectiveness of monetary policy for economic growth. The results underscore the importance of immigration policies in strengthening monetary policy effectiveness for economic growth in the aging OECD economies.

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JEL Classification Codes: E52, E58, J11.

I. Introduction

Advanced economies, especially the OECD member countries, are currently facing the problems of population aging and rising budget deficits. Population aging means an increase in the proportion of elderly individuals in total population. Population aging arises due to a decline in fertility rate and an increase in life expectancy. According to the historical time series data released by the World Development Indicators of the World Bank Group, the adolescent fertility rate (births per 1,000 women ages 15-19) in the OECD countries declined from 53.37 in 1960 to just 18.06 in 2022. On the other hand, life expectancy at birth in the OECD countries increased from 67.29 years in 1960 to 79.63 years in 2022. The declining fertility rates and rising life expectancies have led to the problem of population aging. The proportion of individuals who are 65 years and above in total population in the OECD member countries increased from 8.22% in 1960 to 17.89% in 2022 and then to 18.25% in 2023. Japan is now the world's oldest country with about 30% of its total population aged 65 years and above. In the year 2022, Japan's adolescent fertility rate stood at 1.82, which was well below the OECD estimate of 18.06. On the other hand, Japan's life expectancy at birth in the same year stood at 83.99 years, which was well above the OECD estimate of 79.63 years.

According to Yoshino and Miyamoto (2019), based on the projections of the United Nations, the old-age dependency ratio, which is the proportion of individuals aged 65 years and above in working-age population, is expected to double in aging economies by the year 2050. Population aging is a major concern for the national governments of the OECD countries because of increases in social security and healthcare payments which lead to an increase in budget deficit. The persistent budget deficit is making it increasingly difficult for the OECD countries to increase spending on infrastructure, human capital, and welfare in general. The OECD countries are revising their immigration policies by taking in foreign workers to combat labor shortage caused by population aging. An increase in immigration, that includes a large fraction of migrant workers, is expected to not only lead to an increase in the size of the labor force but also result in "an overall shift towards a more educated labor force" (Spielvogel and Meghnagi, 2018). Additionally, an increase in immigration due to increases in the inflows of migrant workers and their families, along with refugees and asylum seekers, would lead to an increase in domestic consumer demand and investment spending and boost economic growth.

Money Supply and Economic Growth: According to both Classical and Monetarist schools, money supply is an important determinant of economic growth, and labor supply is one of the main channels through which money supply affects economic growth. An increase in money supply would be associated with a decrease in interest rate. Lower interest rates would stimulate investment spending by firms. An increase in the demand for labor by firms would raise wages. Higher wages would lead to increases in labor force participation rate, consumer demand, and economic growth. While it is true that an increase in money supply is expected to result in increases in productivity and production, if the demand for goods and services increases relative to production, then there could be an inflationary effect. Therefore, money supply must be controlled in order to achieve economic stability.

Population Aging and Monetary Policy: Although the direct relationship between money supply and output proposed by both Classical and Monetarist schools is well documented in the

macroeconomic literature, the results of empirical research reveal that the impact of money supply on economic growth, positive or negative, depends on macroeconomic factors such as inflation, the level of financial development, the quality of institutions, trade openness, amongst other factors. Recent strands of literature have also argued that a demographic shift such as population aging diminishes the effectiveness of monetary policies through the interest rate channel and labor market dynamics. A decrease in the proportion of workers decreases labor supply and results in a shortage of workers in industries; consequently, aggregate output, consumption, and investment would decrease. Acemoglu and Restrepo (2017) noted that economic growth in the developed countries may slow down because of a reduction in the labor force participation rate and productivity due to population aging. An aging population would lead to decreases in aggregate demand for goods and aggregate supply of goods. If aggregate demand is less than aggregate supply, then excess supply would give rise to a deflationary effect and interest rate would fall. Since the elderly accumulate savings before retirement, an aging population may result in an increase in savings relative to investment (see Hansen, 1939; Summers, 2013; Acemoglu and Restrepo, 2017). If savings increase relative to investment due to an increase in the number of older individuals, then an increase in net savings would put a downward pressure on interest rates. Once interest rates approach the zero-lower bound, there would be limited space for monetary easing in a low-interest environment in the event of an economic downturn. The countries may be caught in a low-output liquidity trap. In such a case, conventional monetary policies would be ineffective in stimulating spending and output in aging economies.

Population aging may diminish the effectiveness of monetary policies through the credit channel and the wealth effect channel also. In case of the credit channel effect, a decrease in aggregate demand due to low demand from the elderly would result in a decrease in credit demand; consequently, the central banks' policies to stabilize output through credit adjustments would diminish. In case of the wealth effect channel, an expansionary monetary policy is expected to result in increases in asset prices, such as stock prices and housing prices, and financial wealth of the households. However, since the elderly have low marginal propensities to consume, an expansionary monetary policy would be ineffective in stimulating household consumption and boosting economic growth despite an increase in financial wealth of the elderly.

Research Objectives: Since population aging is found to reduce the effectiveness of monetary policies for economic growth, the scientific question that this study seeks to answer is: can increase in net migration in aggregate, which includes inflows of migrant workers and their families, refugees and asylum seekers, mitigate the ineffectiveness of monetary policies in aging OECD economies through increases in labor supply, consumer demand, and domestic investment? Net migration would mitigate the ineffectiveness of monetary policies through the labor supply channel if a large fraction of the immigrants belongs to the working age group. And increases in the inflows of migrant workers, their families, refugees and asylum seekers would increase domestic consumer demand and investment spending and boost long-run economic growth. The OECD countries are revising their immigration policies by taking in foreign workers. The fact that immigration could play a significant role in mitigating the ineffectiveness of monetary and fiscal policies has been recognized. Papapetrou and Tsalaporta (2020), when studying the inability of monetary policies to respond to deflationary forces that are triggered by demographic trends because of the zero lower bound, noted that "recourse to appropriate policy reforms (such as immigration) and institutional structures is warranted". However, no scholarly attempt has yet been

made to examine the role of immigration in mitigating the ineffectiveness of monetary policies through the labor dynamics channel by increasing output. This study fills the gap in the literature.

Importance of the Research Question: The importance of the research question stems from the fact that lack of monetary policy intervention space due to a decrease in domestic labor supply would amplify the impact of a financial crisis. Ineffective monetary policies would result in low output liquidity trap and prolonged recessionary periods. Economic recovery would be slow. Therefore, in countries that are experiencing population aging and weak domestic aggregate demand, it is of vital importance from a monetary policy standpoint to examine if increases in labor supply and consumer demand due to immigration would result in an increase in output and boost economic growth. With a fixed amount of pension benefit per retiree, immigration would result in a lower tax burden for each worker. That would result in increases in disposable income and consumption of the workers. An increase in aggregate demand would lead to an increase in aggregate investment and output. Inflationary effect due to an increase in aggregate spending by the households and businesses would lead to an increase in interest rates, which would widen the space for monetary policy intervention.

II. Literature Review

Numerous studies have examined the ineffectiveness of monetary policies due to population aging. Imam (2013) using the Bayesian estimation technique found that population aging weakens the effectiveness of monetary policy with regards to unemployment and inflation in the United States, Canada, Japan, the United Kingdom, and Germany. Aksoy et al. (2019) estimated a panel vector autoregressive model for 21 OECD countries and provided evidence of a negative effect of population aging on real interest rates across the OECD countries. Kara and Thadden (2016) developed a New Keynesian DSGE model and using the calibration method, found evidence of a decline in equilibrium interest rate with population aging in the euro area. Yoshino and Miyamoto (2017) developed a New Keynesian DSGE model to account for the complex interplay between heterogeneous households and firms and examined the declined effectiveness of monetary policy for Japan using the calibration method. The results indicate that aggregate output declines and the effectiveness of monetary policies becomes weaker when the proportion of retirees in total population increases. Wong (2019) using household consumption and mortgage data for the United States estimated a vector autoregression model and found that consumption of the elderly is less responsive to a monetary policy shock compared to consumption of the younger people. Although Hamman et al. (2021) developed a small open economy model to study the response of a monetary policy shock to a migration shock in Columbia, their study did not account for population aging. Vlieghe (2022) using data for the United Kingdom provided evidence of a demographic transition putting downward pressure on interest rates. Lee et al. (2025) developed an open-economy life-cycle model and examined how population aging affects the monetary policy environment in the Republic of Korea. The results of calibration analysis show that population aging lowers potential growth through reduced labor supply and reduced investment.

The studies have suggested structural reform measures such as postponing the retirement age and introducing productivity-based wage rate rather than seniority-based wage rate in order to increase labor force as plausible solutions to the problem (see Yoshino and Miyamoto, 2017). Although Acemoglu and Restrepo (2017) have shown that the negative effects of labor scarcity on economic

growth due to population aging could be neutralized or reversed through the adoption of new automation technologies, they have not examined the impact of automation on the effectiveness of monetary policies in aging economies.

A review of the literature reveals that none of the studies has considered immigration as a means to counteract the ineffectiveness of monetary policies for economic growth in aging economies. Therein lies the importance and the novelty of our contribution.

III. Immigration and Monetary Policy in Aging Economies: The Theoretical Framework

An increase in net migration would counteract the negative effects of population aging on the effectiveness of monetary policies for economic growth through the labor supply, interest rate, consumer demand, credit demand, and wealth effect channels. An increase in net migration would result in increases in the labor force participation rate and production. Aggregate consumption would increase due to an influx of foreign workers. An increase in investment spending by the firms in an attempt to boost production would lead to increases in employment and wages. If aggregate demand exceeds aggregate supply, then excess demand would give rise to an inflationary effect. With inflationary effect and a rise in the real interest rate, the monetary policy intervention space would widen. Therefore, in this case, an increase in net migration would result in increases in household consumption, investment, and output through the interest rate channel and the labor supply channel. Furthermore, an increase in aggregate demand due to an influx of foreign workers would result in an increase in the demand for credit. That would strengthen the transmission mechanism of monetary policy and enhance the central banks' ability to stabilize output through credit adjustments. For instance, when the demand for credit is low due to weak domestic demand, investment and household consumption spending would be less sensitive to changes in interest rates. But when the demand for credit is high, changes in interest rates would have direct and significant effects on borrowing, investment, and consumption decisions. The central bank's actions would be more effective in managing economic activity, controlling inflation, and preventing financial crises. Increases in asset prices such as stock prices and housing prices and financial wealth of immigrants following the implementation of an expansionary monetary policy could stimulate household consumption and boost economic growth.

In short, immigration is believed to have the potential to significantly increase the monetary policy intervention space by increasing labor supply and consumer demand. Increases in labor supply and consumer demand would boost economic growth and create inflationary pressure. At the same time, an increase in labor force participation rate due to an increase in immigration would ease labor shortages and act as a disinflationary force by increasing production. A sudden halt in immigration, on the other hand, would tighten the labor market. A decrease in labor supply and production would create inflationary pressure while decreases in labor supply and consumer demand would slowdown economic growth. Immigration could act as a disinflationary force by increase labor supply and production. From a policy standpoint, therefore, it is of utmost importance to account for immigration policies when setting interest rates in aging economies.

Hypotheses and Main Results: The initial results provide support for the hypothesis and reinforce the findings in the extant empirical literature that population aging reduces the effectiveness of monetary policies in aging OECD economies. The novelty of our study is enhanced by two new

results. One, monetary policy is weaker in the higher-aged OECD economies. Two, an increase in net migration mitigates the ineffectiveness of monetary policy for economic growth. The results underscore the importance of immigration in strengthening monetary policy effectiveness for economic growth through the labor supply channel in the aging OECD economies.

IV. Data, Model Specifications, and Estimation Method

Data: Due to restrictions on the availability of time series data, annual data are obtained from the World Development Indicators of the World Bank Group on 10 OECD member countries only. The countries are Australia, Denmark, Israel, Japan, the Republic of Korea, New Zealand, Norway, Sweden, the United Kingdom, and the United States. The study period is 2001-2021.

The dependent variable in the model is per capita real GDP, indexed $PGDP$ in the model. The three explanatory variables of interest are (1) old age dependency ratio (indexed DEP), which is the ratio of the number of individuals 65 years and above to the number of individuals between 15-64 years of age, (2) broad money as a percentage of GDP for quantitative monetary policy (indexed LBM), and (3) net migration (indexed NM), which is the ratio of the difference between the number of people entering and leaving a country in a given year to total population.

The control variables are (1) domestic investment (indexed DIV), which is gross fixed capital formation in proportion to GDP, (2) trade openness (indexed OPN), which is the sum of exports and imports in proportion to GDP, (3) total consumption (indexed CON), which is total retail sales of consumer goods in proportion to GDP, (4) total government expenditure (indexed GOV), which is government expenditure in proportion to GDP, (5) labor force participation rate (indexed LFP) for ages 15-64 which is the proportion of the population ages 15-64 that supplies labor, (6) life expectancy at birth (indexed $LIFE$), which is the number of years a newborn is expected to live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life, and (7) consumer price index (indexed CPI) which is the index of the prices of consumer goods and services as a measure of inflation, and (8) real house price index (indexed RHP) with 2015 as the base year, and (9) the real effective exchange rate index (indexed RER) with 2010 as the base year. Due to lack of availability of time series data, human capital could not be included in the model.

Model 1: In order to test the hypothesis that population aging weakens the effectiveness of monetary policy, for short-run and long-run effects, we specify the short-run and long-run panel regressions of the following forms

$$(1) \Delta \ln PGDP_{it} = \theta_0 + \theta_1 \Delta \ln CPW_{it} + \theta_2 \Delta \ln OPN_{it} + \theta_3 \Delta \ln CON_{it} + \theta_4 \Delta \ln GOV_{it} +$$

$$\theta_5 \Delta \ln LFP_{it} + \theta_6 \Delta \ln LIFE_{it} + \theta_7 \Delta \ln DEP_{it} + \theta_8 \Delta \ln CPI_{it} + \theta_9 \Delta \ln BM_{it} +$$

$$\theta_{10} \Delta (\ln BM \times \ln DEP)_{it} + \sum_{i=1}^{31} \delta_{2i} + \gamma ECT_{i,t-1} + \epsilon_{it}$$

$$(2) \ln PGDP_{it} = \theta_0 + \theta_1 \ln CPW_{it} + \theta_2 \ln OPN_{it} + \theta_3 \ln CON_{it} + \theta_4 \ln GOV_{it} + \theta_5 \ln LFP_{it} +$$

$$\theta_6 \ln LIFE_{it} + \theta_7 \ln DEP_{it} + \theta_8 \ln CPI_{it} + \theta_9 \ln BM_{it} + \theta_{10} (\ln BM \times \ln DEP)_{it} +$$

$$\sum_{i=1}^{16} \delta_{1i} + \sum_{i=1}^{32} \delta_{2i} + \epsilon_{it}$$

Equation (1) is the short-run model, and equation (2) is the long-run model. If the coefficient θ_9 is positive, then money supply is negatively correlated with economic growth. If the coefficient θ_{10} is negative, then population aging would weaken the regulatory effect of monetary policy.

Model 2: To test the hypothesis that population aging contributes to the heterogeneity in the ineffectiveness of monetary policy, we specify the short-run and long-run panel regressions as

$$(3) \Delta \ln PGDP_{it} = \theta_0 + \theta_1 \Delta \ln CPW_{it} + \theta_2 \Delta \ln OPN_{it} + \theta_3 \Delta \ln CON_{it} + \theta_4 \Delta \ln GOV_{it} +$$

$$\theta_5 \Delta \ln LFP_{it} + \theta_6 \Delta \ln LIFE_{it} + \theta_7 HDEP_i + \theta_8 \Delta \ln CPI_{it} + \theta_9 \Delta \ln BM_{it} +$$

$$\theta_{10} HDEP_i \times \Delta \ln BM_{it} + \sum_{i=1}^{31} \delta_{2i} + \gamma ECT_{i,t-1} + \epsilon_{it}$$

$$(4) \ln PGDP_{it} = \theta_0 + \theta_1 \ln CPW_{it} + \theta_2 \ln OPN_{it} + \theta_3 \ln CON_{it} + \theta_4 \ln GOV_{it} + \theta_5 \ln LFP_{it} +$$

$$\theta_6 \ln LIFE_{it} + \theta_7 HDEP_i + \theta_8 \ln BM_{it} + \theta_9 \ln CPI_{it} +$$

$$\theta_{10} HDEP_i \times \ln BM_{it} + \sum_{i=1}^{16} \delta_{1i} + \sum_{i=1}^{32} \delta_{2i} + \epsilon_{it}$$

Equation (3) is the short-run model and equation (4) is the long-run model. We first calculate the average of the dependency ratios for all the countries in the sample. A dependency ratio above the sample average would be classified as ‘HIGH’ meaning higher aging population. A dependency ratio below the sample average would be classified as ‘LOW’ meaning a lower aging population. The dummy variable $HDEP_i$ will take the value 1 (or 0) if the dependency ratio for country i at time t is greater than one (or 0). A statistically significant dummy variable coefficient would mean that population aging contributes significantly to the heterogeneity in the ineffectiveness of monetary policy across the countries. If the coefficient θ_{10} is negative, then the regulatory effect of quantitative monetary policy will be weaker in countries with higher aging population.

Model 3: To test the hypothesis that immigration would mitigate the ineffectiveness of monetary policy for economic growth when the number of individuals 65 years and above as a percentage of working-age population increases, we specify the short-run and long-run panel regressions as

$$(5) \Delta \ln PGDP_{it} = \theta_0 + \theta_1 \Delta \ln CPW_{it} + \theta_2 \Delta \ln OPN_{it} + \theta_3 \Delta \ln CON_{it} + \theta_4 \Delta \ln GOV_{it} +$$

$$\theta_5 \Delta \ln LFP_{it} + \theta_6 \Delta \ln LIFE_{it} + \theta_7 \Delta \ln DEP_{it} + \theta_8 \Delta \ln CPI_{it} + \theta_9 \Delta \ln BM_{it} + \\ \theta_{10} \Delta NM_{it} + \theta_{11} \Delta (\ln BM \times \ln DEP \times NM)_{it} + \sum_{i=1}^{31} \delta_{2i} + \gamma ECT_{i,t-1} + \epsilon_{it}$$

$$(6) \ln PGDP_{it} = \theta_0 + \theta_1 \ln CPW_{it} + \theta_2 \ln OPN_{it} + \theta_3 \ln CON_{it} + \theta_4 \ln GOV_{it} + \theta_5 \ln LFP_{it} +$$

$$\theta_6 \ln LIFE_{it} + \theta_7 \ln DEP_{it} + \theta_8 \ln BM_{it} + \theta_9 \ln CPI_{it} + \theta_{10} NM_{it} +$$

$$\theta_{11} (\ln BM \times \ln DEP \times NM)_{it} + \sum_{i=1}^{16} \delta_{1i} + \sum_{i=1}^{32} \delta_{2i} + \epsilon_{it}$$

Equation (5) is the short-run model and equation (6) is the long-run model. If the coefficient θ_{10} is positive, then an increase in net migration would be associated with an increase in economic growth. If the coefficient θ_{11} is positive, then an increase in net migration would offset and mitigate the ineffectiveness of monetary policy in aging economies.

In Model 1, Model 2, and Model 3, the parameters δ_{1i} and δ_{2i} are the country fixed effects and time fixed effects, respectively. The errors ϵ_{it} are independently and identically distributed.

Analytical Technique: Since panel data could be subject to cross-sectional dependence which would produce inconsistent results, in the first step, we perform the cross-sectional dependence test before estimating the panel data models. We perform the tests proposed by Pesaran (2004) which are appropriate for small samples and have both the correct size and satisfactory power in small samples. The tests proposed by Pesaran (2004) are robust to the presence of unit roots and single or multiple structural breaks in time series data of an individual country. The null hypothesis that there is no cross-sectional dependence is tested against the alternative hypothesis that the errors are correlated across the cross-sections. In the second step, we perform cross-sectional dependent unit root test proposed by Pesaran (2006) in order to examine for stationarity in time series data. The null hypothesis of a unit root is tested against the alternative of trend stationarity. In the third step, the panel cointegration test (Kao, 1999) is performed. Here, we apply a residual-based panel cointegration test in order to identify a common long-run relationship among the non-stationary panel variables under the assumption that there exists a homogeneous cointegrating vector across cross-sections. In the final step, we examine the short-run and long-run effects. For the short-run and long-run dynamics, we first apply the ordinary least squares (OLS) method to estimate all the equations by controlling all the year and country fixed effects. Considering fixed effects in estimating equations also addresses cross-sectional dependence to some extent except the global shocks. In order to control cross-sectional dependence arising from global shocks, we estimate all the equations by panel corrected standard error (PCSE) ordinary least square (OLS) method. PCSE OLS does not remove cross-sectional dependence. The PCSE-OLS method adjusts the standard errors of the estimate to represent the true value free from cross-sectional dependence.

We report the results of the cross-sectional dependence test under the estimated results in OLS (Pesaran and Xie, 2021).

As macroeconomic variables are usually subject to endogeneity concerns, for robustness and endogeneity concerns, we adopt the instrumental variable two stage least square (IV-2SLS) approach. Due to plausible endogeneity, the estimated coefficients become inconsistent. It is well-known that endogeneity comes from omitted variable bias, reverse causality, and measurement errors. In our model, there is no measurement error. We also consider relevant fixed effects to control omitted variable bias. For example, the country fixed effects addressed factors that vary across countries but not across time. Time fixed effects addresses factors that vary across time but not across countries. Still, there are some other relevant macroeconomic variables affecting economic growth. Also, economic growth may affect the independent variables in our proposed models. We apply the IV-2SLS method based on three restrictions - (1) relevance, (2) validity, and (3) exclusion. Relevance restrictions assert that, in the first stage, endogenous variables are instrumented with those variables that strongly cause the endogenous variables. Validity restriction asserts that instruments do not correlate with the error terms. Exclusion restriction asserts that instruments do not directly affect the dependent variables; rather the effects should be through the endogenous variables. In this approach, a particular endogenous variable is instrumented with the first lags of macroeconomic variables in the first stage. It is mainly due to the fact that we do not have the data of other variables. We, therefore, based on the relevance restriction, find that only the first lags significantly affect the endogenous variables. We highlight the relevance of the instruments in the first stage by the significance of a particular statistic ($F_{Relevanc}$ statistic). Hence, the first lags of the endogenous variables are used to instrument a particular endogenous variable. Even if this is not the single ideal process, following this approach successfully eliminates the endogeneity. In the IV-2SLS approach, we also use robust clustered standard errors in order to control heteroscedasticity and auto-correlation. In order to adopt the instrumental variable two stage least square (IV-2SLS) approach, we first test whether there exist endogenous variables in the regression equations. For this, we adopt an augmented version of Durbin-Wu-Hausman test (Davidson and MacKinnon, 1993). In order to control for cross-sectional dependence, we consider all the fixed effects in estimating the regression equations. We check the validity of the instruments by a test of over-identifying restrictions where the null hypothesis is accepted (χ^2_{Overid} statistic).

V. Main Results and Discussions

Cross-Sectional Dependence Test: The results of the cross-sectional dependence test are reported in Table 3. Except for $HDEP_i$, the null hypothesis of no cross-sectional dependence is rejected at the 1% significance level; thus, the countries are dependent as far as $HDEP_i$ is concerned.

Table 3. Cross-Sectional Dependence Test

Variables	Test Statistic
<i>lnPGDP</i>	62.04*** (0.00)
<i>lnCPW</i>	22.54*** (0.00)
<i>lnLIFE</i>	61.24*** (0.00)
<i>lnOPN</i>	29.21*** (0.00)
<i>lnDEP</i>	58.45*** (0.00)
<i>lnBM</i>	46.06*** (0.00)
<i>lnCPI</i>	60.38*** (0.00)
<i>NM</i>	12.29*** (0.00)
<i>lnLFP</i>	18.26*** (0.00)
<i>lnCON</i>	11.27*** (0.00)
<i>lnGOV</i>	12.17*** (0.00)
<i>HDEP</i>	0.27 (0.78)
<i>HDEP × lnBM</i>	2.82*** (0.00)
<i>lnBM × lnDEP</i>	57.19*** (0.00)
<i>lnBM × lnDEP × NM</i>	14.43*** (0.00)

*** indicates significant at the 1% significance level.

Cross-Sectional Dependence Unit Root Test: The results of the cross-sectional dependent unit root test are reported in Table 4. The variables are first-difference stationary.

Table 4. Cross-Sectional Dependent Unit Root Test

Level		First Difference	
Variable	Test Statistic	Variable	Test Statistic
<i>lnPGDP</i>	-2.40	$\Delta \ln PGDP$	-4.52***
<i>lnCPW</i>	-2.23	$\Delta \ln CPW$	-4.81***
<i>lnLIFE</i>	-1.12	$\Delta \ln LIFE$	-5.70***
<i>lnOPN</i>	-2.31	$\Delta \ln OPN$	-4.74***
<i>lnDEP</i>	-2.56	$\Delta \ln DEP$	-4.96***
<i>lnBM</i>	-1.78	$\Delta \ln BM$	-5.13***
<i>NM</i>	-1.86	ΔNM	-4.48***
<i>lnLFP</i>	-2.47	$\Delta \ln LFP$	-4.43***
<i>lnCPI</i>	-2.26	$\Delta \ln CPI$	-4.78***
<i>lnCON</i>	-2.11	$\Delta \ln CON$	-4.72***
<i>lnGOV</i>	-1.66	$\Delta \ln GOV$	-4.29***
<i>lnBM × lnDEP</i>	-1.48	$\Delta (\ln BM \times \ln DEP)$	-5.03***
<i>lnBM × lnDEP × NM</i>	-1.88	$\Delta (\ln BM \times \ln DEP \times NM)$	-4.24***

The critical values at 10%, 5%, and 1% levels of significance are -2.66, -2.71 and -2.85 respectively. ***, **, and * indicate significant at 1%, 5%, and 10% significance level, respectively.

Panel Cointegration Test: The results of the panel cointegration test are reported in Table 5. The results provide evidence of a long-run relationship between the variables.

Table 5. Panel Cointegration Test

Model	Test Statistic
Model 1	-4.49*** (0.00)
Model 2	-4.98*** (0.00)
Model 3	-4.71*** (0.00)

*** indicates significant at the 1% significance level.

Short-Run and Long-Run Effects: The estimates of Model 1 reported in Table 6 and Table 7 show that the coefficients of $\Delta \ln BM$ and $\ln BM$ are both positive and significant; therefore, money supply is positively correlated with economic growth in both short-run and long-run. However, the coefficients of $\Delta(\ln BM \times \ln DEP)$ and $\ln BM \times \ln DEP$ are negative and significant; therefore, population aging weakens the effects of monetary policy in both short-run and long-run.

Table 6. Long-Run Effects: Model 1

Variables	OLS	PCSE OLS	IV-2SLS
$\ln CPW$	0.11*** (0.00)	0.15*** (0.00)	0.10*** (0.00)
$\ln OPN$	-0.12*** (0.00)	-0.08*** (0.00)	-0.13*** (0.00)
$\ln CON$	-0.29*** (0.00)	-0.11** (0.02)	-0.25*** (0.00)
$\ln GOV$	-0.14*** (0.00)	-0.10*** (0.00)	-0.12*** (0.00)
$\ln LFP$	0.87*** (0.00)	0.32*** (0.00)	0.94*** (0.00)
$\ln LIFE$	1.94*** (0.00)	0.65*** (0.00)	1.89*** (0.00)
$\ln DEP$	-0.71*** (0.00)	-0.80*** (0.00)	-0.66*** (0.00)
$\ln CPI$	0.02*** (0.00)	0.02 (0.12)	0.04*** (0.00)
$\ln BM$	0.46*** (0.00)	0.30*** (0.00)	0.40*** (0.00)
$\ln BM \times \ln DEP$	-0.11*** (0.00)	-0.10*** (0.00)	-0.09*** (0.00)
Time Effects	✓	✓	✓
Country Effects	✓	✓	✓
Robust Clustered SE	✓	-	✓
$\rho_{AR(1)}$	-	0.83	-
χ^2_{CD}	-3.86*** (0.00)	-	-
$\chi^2_{Exogeneity}$	-	-	0.01 (0.93)
$F_{Relevance}$	-	-	178.85*** (0.00)
χ^2_{Overid}	-	-	0.01 (0.91)

*** indicates significant at the 1% significance level.

Table 7. Short-Run Dynamics: Model 1

Variables	OLS	PCSE OLS	IV-2SLS
$\Delta \ln CPW$	0.14*** (0.00)	0.14*** (0.00)	0.38*** (0.00)
$\Delta \ln OPN$	-0.05** (0.02)	-0.03** (0.01)	-0.02** (0.03)
$\Delta \ln CON$	-0.05 (0.31)	-0.02 (0.49)	-0.20*** (0.33)
$\Delta \ln GOV$	-0.08** (0.03)	-0.09*** (0.00)	-0.01*** (0.00)
$\Delta \ln LFP$	0.19** (0.02)	0.09*** (0.00)	0.10*** (0.00)
$\Delta \ln LIFE$	0.37** (0.04)	0.22** (0.02)	0.27*** (0.00)
$\Delta \ln DEP$	-0.45*** (0.00)	-0.40*** (0.00)	-0.61*** (0.00)
$\Delta \ln CPI$	-0.01 (0.67)	0.02** (0.04)	0.01*** (0.00)
$\Delta \ln BM$	0.12** (0.02)	0.06** (0.03)	0.23*** (0.00)
$\Delta(\ln BM \times \ln DEP)$	-0.05** (0.02)	-0.03** (0.04)	-0.09*** (0.00)
$ECM(-1)$	-0.08*** (0.00)	-0.09*** (0.00)	-0.04*** (0.00)
Time Effects	✓	✓	✓
Robust Clustered SE	✓	-	✓
$\rho_{AR(1)}$	-	0.30	-
χ^2_{CD}	-3.69*** (0.00)	-	-
$\chi^2_{Exogeneity}$	-	-	1.94 (0.17)
$F_{Relevance}$	-	-	14.49*** (0.00)
χ^2_{Overid}	-	-	1.01 (0.33)

*** and ** indicate significance at 1% and 5% significance level, respectively.

The results in Table 8 and Table 9 show that the short-run and long-run coefficients of $HDEP$ are negative and significant; thus, higher dependence ratio is associated with lower economic growth in both short-run and long-run. The coefficients of $\Delta(\ln BM \times HDEP)$ and $\ln BM \times HDEP$ are negative and significant; thus, population aging weakens the regulatory effect of monetary policy in both short-run and long-run. The results provide support for the hypothesis that the higher-aged OECD economies experience a more declining effectiveness of monetary policy for economic growth. The statistically significant dummy variable coefficient shows that population aging contributes significantly to the heterogeneity in the ineffectiveness of monetary policy.

Table 8. Long-Run Effects: Model 2

Variables	OLS	PCSE OLS	IV-2SLS
$\ln CPW$	0.11*** (0.00)	0.14*** (0.00)	0.08*** (0.00)
$\ln OPN$	-0.11*** (0.00)	-0.07*** (0.00)	-0.11*** (0.00)
$\ln CON$	-0.18** (0.02)	-0.07 (0.19)	-0.13* (0.09)
$\ln GOV$	-0.11*** (0.00)	-0.06** (0.04)	-0.09*** (0.00)
$\ln LFP$	0.93*** (0.00)	0.41*** (0.00)	0.99*** (0.00)
$\ln LIFE$	2.20*** (0.00)	0.86*** (0.00)	2.24*** (0.00)
$HDEP$	-0.80*** (0.00)	-0.57*** (0.00)	-0.71*** (0.00)
$\ln BM$	0.26*** (0.00)	0.08*** (0.00)	0.22*** (0.00)
$\ln CPI$	0.03*** (0.00)	0.03*** (0.00)	0.04*** (0.00)
$\ln BM \times HDEP$	-0.19*** (0.00)	-0.13*** (0.00)	-0.17*** (0.00)
Time Effects	✓	✓	✓
Country Effects	✓	✓	✓
Robust Clustered SE	✓	-	✓
$\rho_{AR(1)}$	-	0.82	-
χ^2_{CD}	-3.84*** (0.00)	-	-
$\chi^2_{Exogeneity}$	-	-	0.12 (0.72)
$F_{Relevance}$	-	-	148.17*** (0.00)
χ^2_{Overid}	-	-	0.28 (0.59)

***, **, and * indicate significant at 1%, 5%, and 10% significance level, respectively.

Table 9. Short-Run Dynamics: Model 2

Variables	OLS	PCSE OLS	IV-2SLS
$\Delta \ln CPW$	0.15*** (0.00)	0.14*** (0.00)	0.38*** (0.00)
$\Delta \ln OPN$	-0.03* (0.06)	-0.02* (0.08)	-0.01* (0.08)
$\Delta \ln CON$	-0.07** (0.02)	-0.04** (0.04)	-0.23* (0.07)
$\Delta \ln GOV$	-0.07* (0.08)	-0.08*** (0.00)	-0.02*** (0.00)
$\Delta \ln LFP$	0.17** (0.03)	0.08** (0.02)	0.07** (0.03)
$\Delta \ln LIFE$	0.38* (0.06)	0.25* (0.07)	0.26** (0.03)
$HDEP$	-0.20*** (0.00)	-0.17*** (0.00)	-0.19*** (0.00)
$\Delta \ln BM$	0.02*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
$\Delta \ln CPI$	-0.02 (0.44)	0.04** (0.02)	0.02*** (0.00)
$\Delta (\ln BM \times HDEP)$	-0.01*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)
$ECM(-1)$	-0.07*** (0.00)	-0.07*** (0.00)	-0.04*** (0.00)
Time Effects	✓	✓	✓
Robust Clustered SE	✓	-	✓
$\rho_{AR(1)}$	-	0.25	-
χ^2_{CD}	-3.82*** (0.00)	-	-
$\chi^2_{Exogeneity}$	-	-	1.51 (0.22)
$F_{Relevance}$	-	-	10.28*** (0.00)

***, **, and * indicate significant at 1%, 5%, and 10% significance level, respectively.

The estimates of Model 3 reported in Table 10 and Table 11 show that the coefficients of ΔNM and NM are positive and significant; therefore, an increase in net migration is associated with an increase in economic growth. Since the coefficients of $\Delta (\ln BM \times \ln DEP \times NM)$ and $\ln BM \times \ln DEP \times NM$ are also positive and significant, the results provide support for the hypothesis that an increase in net migration would offset and mitigate the ineffectiveness of monetary policy.

Table 10. Long-Run Effects: Model 3

Variables	OLS	PCSE OLS	IV-2SLS
$\ln CPW$	0.08*** (0.00)	0.14*** (0.00)	0.07*** (0.00)
$\ln OPN$	-0.18*** (0.00)	-0.10*** (0.00)	-0.17*** (0.00)
$\ln CON$	-0.33*** (0.00)	-0.17*** (0.00)	-0.29*** (0.00)
$\ln GOV$	-0.22*** (0.00)	-0.12*** (0.00)	-0.19*** (0.00)
$\ln LFP$	0.93*** (0.00)	0.38*** (0.00)	0.97*** (0.00)
$\ln LIFE$	1.51*** (0.00)	0.65*** (0.00)	1.46*** (0.00)
$\ln DEP$	-0.26*** (0.00)	-0.35*** (0.00)	-0.28*** (0.00)
$\ln BM$	0.19*** (0.00)	0.07*** (0.00)	0.17*** (0.00)
$\ln CPI$	0.04*** (0.00)	0.04*** (0.00)	0.04*** (0.00)
NM	30.33*** (0.00)	10.79*** (0.00)	28.98*** (0.00)
$\ln BM \times \ln DEP \times NM$	2.34*** (0.00)	0.85*** (0.00)	2.21*** (0.00)
Time Effects	✓	✓	✓
Country Effects	✓	✓	✓
Robust Clustered SE	✓	-	✓
$\rho_{AR(1)}$	-	0.78	-
χ^2_{CD}	-3.64*** (0.00)	-	-
$\chi^2_{Exogeneity}$	-	-	0.004 (0.95)
$F_{Relevance}$	-	-	234.15*** (0.00)
χ^2_{Overid}	-	-	0.05 (0.82)

*** indicates significant at the 1% significance level.

Table 11. Short-Run Effects: Model 3

Variables	OLS	PCSE OLS	IV-2SLS
$\Delta \ln CPW$	0.07*** (0.00)	0.14*** (0.00)	0.38*** (0.00)
$\Delta \ln OPN$	-0.17*** (0.00)	-0.03*** (0.00)	-0.03*** (0.00)
$\Delta \ln CON$	-0.33*** (0.00)	-0.04*** (0.00)	-0.23*** (0.00)
$\Delta \ln GOV$	-0.22*** (0.00)	-0.09*** (0.00)	-0.02*** (0.00)
$\Delta \ln LFP$	0.93*** (0.00)	0.08*** (0.00)	0.06*** (0.00)
$\Delta \ln LIFE$	1.51*** (0.00)	0.19*** (0.00)	0.09*** (0.00)
$\Delta \ln DEP$	-0.26*** (0.00)	-0.28*** (0.00)	-0.24*** (0.00)
$\Delta \ln BM$	0.19*** (0.00)	0.20*** (0.00)	0.11*** (0.00)
$\Delta \ln CPI$	0.04*** (0.00)	0.02*** (0.00)	0.01*** (0.00)
ΔNM	30.33*** (0.00)	4.11*** (0.00)	6.22*** (0.00)
$\Delta (\ln BM \times \ln DEP \times NM)$	2.34*** (0.00)	0.33*** (0.00)	0.61*** (0.00)
$ECM(-1)$	-0.09*** (0.00)	-0.09*** (0.00)	-0.04*** (0.00)
Time Effects	✓	✓	✓
Robust Clustered SE	✓	-	✓
$\rho_{AR(1)}$	-	0.31	-
χ^2_{CD}	1.88* (0.07)	-	-
$\chi^2_{Exogeneity}$	-	-	1.27 (0.26)
$F_{Relevance}$	-	-	78.01*** (0.00)
χ^2_{Overid}	-	-	0.80 (0.39)

*** indicates significant at the 1% significance level.

The transmission mechanisms of monetary policies in aging economies and how immigration would mitigate aging-led ineffectiveness of monetary policy for economic growth in OECD countries through the labor supply, interest rate, consumer demand, credit demand, and wealth effect channels have been discussed in the theoretical framework. A high degree of substitutability between domestic and foreign workers, and higher productivity of foreign workers relative to domestic workers would most likely mitigate the ineffectiveness of monetary policy due to population aging.

The results of short-run and long-run analyses reported in Tables 6-11 further indicate that, in all the three models, capital per worker, labor force participation rate, life expectancy at birth, and inflation rate are positively correlated with economic growth in both short-run and long-run. A reason for the positive correlation between inflation rate and per-capita real GDP could be that inflation would lower the real interest rate; consequently, investment spending by the firms would increase and per-capita real GDP would increase. Additionally, higher average prices would induce the firms to increase the production and supply of goods and services, thereby leading to an increase in per-capita real GDP. On the other hand, trade openness, total consumption in proportion to GDP, total government expenditure in proportion to GDP, and old-age dependency ratio are negatively correlated with economic growth in both short-run and long-run. The negative correlation between trade openness and total consumption of goods and services in proportion to GDP would likely arise when a country's consumption of imported goods exceeds its exports in proportion to GDP. Greater participation in international trade and higher consumption of imported goods relative to domestically produced goods and services would have a negative impact on per-capita real GDP. The data, in fact, reveals most of the 17 OECD countries in our sample, such as the United States, have been running trade deficits in recent years. An increase in total government expenditure in proportion to GDP, beyond a certain threshold, may have a negative effect on per

capita real GDP. A reason could be the crowding out of private investment and private sector activity. Second, financing government spending by raising taxes or by selling bonds to the public may reduce the level of economic activity and per-capita real GDP.

VII. Concluding Remarks and Policy Implications

Recent strands of literature have argued that population aging diminishes the effectiveness of monetary policies through labor market dynamics. As the demand for foreign labor in the aging economies continues to increase in order to meet domestic labor shortage, an important question that arises from a policy standpoint is, does immigration mitigate aging-led ineffectiveness of monetary policy for economic growth in the aging OECD economies? Two results enhance the novelty of our study. One, the higher-aged OECD economies experience a more declining effectiveness of monetary policy for economic growth. Two, an increase in net migration mitigates the ineffectiveness of monetary policy for economic growth.

A major concern is identification. Net migration is highly endogenous to economic growth, labor-market conditions, demographic pressures, and policy choices. The paper's conclusion that immigration mitigates the aging-led weakening of monetary policy therefore requires a source of exogenous variation in migration or immigration policy. The use of lagged variables as instruments may not be sufficient. Lags of endogenous macroeconomic variables are unlikely to satisfy the exclusion restriction, especially in annual macro-panel data with persistent variables. While an exogenous variable for migration or immigration policy index may resolve the issue, to the best of our knowledge, continuous time series data on such a variable are not available. We are constrained as far as data availability is concerned. A plausible solution is to construct a migration policy uncertainty index. But that is beyond the scope of this study. Second, from a policy standpoint, it is also necessary to distinguish between the effects of increases in short-term and long-term net migration. Long-term rather than short-term immigration would most likely have a stronger effect. But data on short-term and long-term immigration are also not available. Third, the transmission mechanisms could perhaps be established empirically and more convincingly. These limitations, therefore, provide the basis and scope for future extensions of this study.

This is the first study to establish a direct relation between an increase in net migration and the effectiveness of monetary policies for economic growth in aging economies. To that end, the study meets its objective. Notwithstanding the limitations of the study, the results underscore the importance of immigration policies in strengthening monetary policy effectiveness for economic growth in 10 select OECD economies that are experiencing a declining demographic dividend. In advanced industrialized countries that are experiencing problems of population aging and declining effectiveness of monetary policy for economic growth, an increase in the share of net migration in total population is expected to strengthen monetary policy effectiveness and boost economic growth in both short-run and long-run.

References

- Acemoglu, D. and Restrepo, P. (2017). "Secular Stagnation? The Effect of Aging on Economic Growth in the Age of Automation." *American Economic Review* 107 (5): 174–79. DOI: 10.1257/aer.p20171101.
- Aksoy, Y., Basso, H., Smith, R. and Grasl, T. (2019), "Demographic structure and macroeconomic trends", *American Economic Journal: Macroeconomics*, Vol. 11, No. 1, January, pp. 193-222.
- Davidson, R., and J. G. MacKinnon, *Estimation and Inference in Econometrics*. Oxford University Press, 1993.
- Hamann, F., Anzola, C., Avila-Montealegre, O., Castro-Fernandez, J.C., Grajales-Olarte, A., Guarín, A., Mendez-Vizcaino, J.C., Ospina-Tejeiro, J.J., Ramos-Ve, M.A. (2021). "Monetary Policy Response to a Migration Shock: An Analysis for a Small Open Economy," *Borradores de Economia* 1153, Banco de la Republica de Colombia. DOI: <https://doi.org/10.32468/be.1153>.
- Hansen, A. H. 1939. "Economic Progress and Declining Population Growth." *American Economic Review* 29: 1–15.
- Imam, P. (2013). "Shock from Graying: Is the Demographic Shift Weakening Monetary Policy Effectiveness", IMF Working Paper.
- Kao, C. (1999). Spurious regression and residual-based tests for cointegration in panel data. *Journal of Econometrics*, 90(1), 1–44.
- Kara E, von Thadden L. (2016). "Interest Rate Effects of Demographic Changes in a New Keynesian Life-Cycle Framework", *Macroeconomic Dynamics*. 20(1):120-164. doi:10.1017/S1365100514000273.
- Lee, Jae Won and Hwang, In Do and Hwang, Seolwoong and Jang, Hun and Kwak, Boreum and Lee, Yeil and Kim, Wooseok, Impact of Super-Aging on the Monetary Policy Environment: Implications for Korea (May 29, 2025). Bank of Korea "Chapter 3 in Korea Economic Outlook (May 2025)", <http://dx.doi.org/10.2139/ssrn.5371842>.
- Naoyuki Yoshino, Hiroaki Miyamoto, Declined effectiveness of fiscal and monetary policies faced with aging population in Japan, *Japan and the World Economy*, Volume 42, 2017, Pages 32-44, ISSN 0922-1425, <https://doi.org/10.1016/j.japwor.2017.06.002>.
- Papapetrou, E., and Tsalaporta, P. (2020). "The impact of population aging in rich countries: What's the future?", *Journal of Policy Modeling*, Volume 42, Issue 1, 2020, Pages 77-95, ISSN 0161-8938, <https://doi.org/10.1016/j.jpolmod.2019.12.002>.
- Pesaran, M. H. (2004). General diagnostic tests for cross section dependence in panels (Cambridge Working Papers in Economics No. 0435). Faculty of Economics, University of Cambridge.

Pesaran, M. H. (2006). A simple panel unit root test in the presence of cross section dependence (Cambridge Working Papers in Economics No. 0346). Faculty of Economics, University of Cambridge.

Pesaran, M. H., & Xie, Y. (2021). How to detect network dependence in latent factor models? A bias-corrected CD test (Cambridge Working Papers in Economics No. 2158). Faculty of Economics, University of Cambridge.

Spielvogel, G. and M. Meghnagi (2018), “The contribution of migration to the dynamics of the labour force in OECD countries: 2005-2015”, OECD Social, Employment and Migration Working Papers, No. 203, OECD Publishing, Paris, <https://doi.org/10.1787/a301bef8-en>.

Summers, Lawrence. 2013. “Why Stagnation Might Prove to be the New Normal.” Financial Times. December 15. <https://www.ft.com/content/87cb15ea-5d1a-11e3-a55800144feabdc0>.

Vlieghe, G. (2022). “Demographics and other constraints on future monetary policy”, The Journal of the Economics of Ageing, Volume 23, 100424, ISSN 2212-828X, <https://doi.org/10.1016/j.jeo.2022.100424>.

Wong, A. (2019). “Refinancing and The Transmission of Monetary Policy to Consumption”, Working Paper, Princeton University. United States.

Yoshino, N. and H. Miyamoto. 2017. Declined Effectiveness of Fiscal and Monetary Policies Faced with Aging Population in Japan. Japan and the World Economy 42: 32–44.

Yoshino, N. and H. Miyamoto. 2019. How Does Population Aging Affect the Effectiveness of Monetary and Fiscal Policies? ADBI Working Paper 1064. Tokyo: Asian Development Bank Institute. Available: <https://www.adb.org/publications/how-does-population-aging-affect-effectiveness-monetary-fiscal-policies>.