

Migration and inflation nexus under high and low interest rate environments: Some panel data evidence

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Abstract

This study analyzes the relationship between migration and inflation as well as the intervening role of interest rates in selected OECD countries from 1995 to 2020, covering periods of turbulence and tranquillity. The study finds that migration increases inflation in the short run but lowers it in the long run. In other words, the inflationary effect of migration is a long-run phenomenon. Additionally, we find that the high interest rates help mitigate the inflationary effect of migration in the short run relative to the low interest rates. Moreover, additional analysis using the panel threshold technique further lends credence to the mediating role of interest rates in the nexus, thus making our results robust to alternative estimation techniques. These findings have significant implications for policymakers responsible for managing inflation.

INTRODUCTION

The issue relating to migration and its attendant impact on the economy has been primarily discussed in the literature (see Akgündüz et al., 2015; Asad et al., 2016; de Brauw et al., 2018; Dinbabo & Nyasulu, 2015; Ejaz et al., 2022; Přivara et al., 2023; Takahashi, 2019). While enough evidence suggests that migration is a growth-enhanced strategy for the destination countries, an abundance of evidence equally relates migration to cause a negative impact for both receiving and sourced economies. In essence, the effect of migration on inflation can be explained from two different channels: goods demand and labour supply. When people migrate to other countries,

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it amounts to a higher demand for goods and services in the destination country. The need to respond to such demand may, in the short run, lead to price growth and, by implication, high inflation. Similarly, on the supply side, it has direct implications through higher labour supply from source countries. In other words, the contribution from an increased labour supply force in the destination countries signals higher output growth, which could lead to lower prices of goods and services.

In addition to the above, labour supply through migration directly contributes to output growth while at the same time generating higher prices of goods and services through increased demand, as previously established. However, an increased output growth occasioned by an increasing labour force will give a push to a rise in real wages and marginal costs, which in turn brings about a higher inflation rate. Conversely, in the event of a major shock to the labour supply through migration, workers' real earnings could decline significantly (Peñaloza Pacheco, 2022), particularly when the market is already saturated. In other words, more migrant inflow would result in a decline in the value of the marginal product of labour, thereby reducing the associated wages and, by extension, inflation. As for the sourced countries, migration amounts to brain drains or loss of productive human capital that is necessarily required for output expansion.

Another channel, though still linked to demand, through which migration impacts inflation is remittances. The economic theory of migration suggests that migration is fueled by the tendency to cater for household needs. This suggests having a higher flow of remittances in the countries of origin immediately after migration. Therefore, since the remittance flow is channelled through financial institutions, the tendency for higher investment opportunities is very much assured for the concerned economy. At the same time, the continuous flow of remittances with demand pressure on the local economy can equally generate higher prices of goods and services (Nepal, 2022). This is evidenced when considering how remittances are expended in the country of origin. In a situation whereby the increased flow of remittances is expended on consumption goods, particularly imported products, as against the investment on productive purposes, there is a tendency for inflation to rise. In some prior studies, much of the remittance for the immediate households of the migrants is believed to be channelled to consumption rather than for investment purposes (see Massey & Parrado, 1998). This suggests that migration can constitute either an opportunity or a threat to price and economic growth in both countries.

The dicey influence of migration on inflation further elicits our interest in probing the nexus. However, our intention in this regard is to investigate a possible connection between migration and price growth in countries with low and high interest rates. The motivation for this is underscored by the possible intervening role of some important macroeconomic variables, including interest rates,¹ in this connection. For instance, in an economy where there is a sudden influx of migrants, an appropriate response is expected from the supply side, perhaps through the rising output to meet up with sudden demands or through rising prices. However, in an environment with low interest rates, the possibility of rising output is more assured, as the investment cost is low. In other words, an environment with a low interest rate is expected to have a low cost of living, which might eventually encourage more migration (see Dinbabo & Nyasulu, 2015). However, while the foregoing is possible, the reverse is expected to hold in an environment with a high interest rate. When interest rate is exceedingly high as demand rises, two things are possible: either output is increased at a very high cost of production arising from the higher interest rate or by maintaining the prevailing output level. If output increases, the rising cost manifests in the price level. This is also true when the output level is unchanged at a higher level of demand. By further implication, with a high interest rate, the cost of living is expected to be high. It indicates a possible fall in migration for the concerned economy. This suggests that at any point in time, the nexus between migration and inflation may be influenced by the prevailing interest rate level in either of the countries. Given the foregoing explanations, we test the hypothesis of a positive nexus between migration inflow and inflation. Moreover, we postulate that interest rates may mitigate the elevated influence of migration on inflation.

Essentially, we focus on the inflow of migrants into the OECD countries. Our interest in this group is premised on the fact that most OECD countries are developed countries and are usually popular migration destinations for migrants from developing countries (see International Organization for Migration, 2022).² In addition, the OECD

recognized the significant contribution of talented and highly skilled individuals to economic development and adopted more favourable migration policies to continually make the countries more attractive to such individuals. Consequently, between 2000/2001 and 2015/2016, for instance, the OECD's stock of migrants with tertiary education expanded by 108%. Comparably, among working-age individuals with postsecondary education, the proportion of migrants rose from 11% to 16% (OECD, 2019). However, inflation has been a major concern for the OECD when compared to other groups such as G7, G20, and the Euro in recent times.³ Could this be associated with the inflow of migrants into this organization of countries? There is hardly any study that has paid attention to this connection; hence, we attempt to fill this gap. Overall, consistent with our aforementioned hypothesis, we find evidence of a significantly positive long-term relationship between migration inflows and inflation. This result holds true for both tranquil and turbulent periods, represented by the pre- and post-GFC periods, respectively. More so, the moderating role of high interest rates for the nexus is only prominent in the short run.

The rest of this paper is arranged as follows: Section [Literature review](#) presents the theoretical issues and reviews some related empirical studies. Section [Methodology and data](#) presents the methodology and data, as well as the summary statistics. Section [Results and discussion](#) discusses the results from our findings, while Section [Conclusion](#) provides the concluding remarks.

LITERATURE REVIEW

Theoretical issues

Several theories have been referenced to explain the causes and effects of migration across countries (see Castles, 2010; Crush, 2012; Mayda, 2010; Nwajiuba, 2005; Taylor, 1999). In some instances, migration was viewed as a response to political and economic challenges in the countries of origin (the push factors). In another instance, it was viewed to have resulted from a differential in well-being packages that are obtainable in both origin and receiving countries (the pull factors). Specifically, the push-pull theory of migration maintains that factors such as poverty, unemployment, political instability, and insecurity can force people to leave their countries of origin, while at the same time, the presence of some incentives such as better employment package, political freedom, adequate security, and the overall better life can constitute significant attraction factors in the destination countries (see Dinbabo & Nyasulu, 2015; King, 2012). There are equally a series of models that have described significant factors responsible for the initiation of migration and those responsible for the continuation of migration. While the neoclassical theory holds that wage differential is an essential factor that drives people from the low-wage region to the high-wage region (see Massey et al., 1999), the evidence from the dual labour market theory accounts that migration emanates from demand pressure for labour inputs needed in primary sectors in the developed economies and the response through supply side in the less developed countries (see Piore, 1979).

The issue of migration has equally been linked to remittances in the sourced countries. The argument is that migration flows can be explained by people's desire to ensure continuous income flows to cater to the households' needs. As viewed by the new economics labour migration theory, the foregoing argument has extended implications on the countries of origin. In more particular terms, there is a greater chance of having high inflationary pressure in the economy when remittances flow at a higher level, and further implications are possible for economic growth (see Taylor, 1999). However, while the awareness of wage differential between sending and receiving nations continues, developing countries may have no choice but to depend on richer countries for existence (see Amankwaa, 1995). As people migrate, they continue to have linkage among their network, which implies that the migration of people will continue. This can be further influenced by attractions and offerings such as financial assistance, material, legal, and various international organizations' support.

The belief of neoclassical theory renders no connection between migration and business formation. Rather, the theory holds that households can quickly obtain credit facilities from the financial sector for business purposes.

Hence, the need for migration to secure investible capital could be more helpful. This position could be more robust. According to the explanation offered by the new economics theory, business formation may be linked to business enterprises (see Taylor, 1999). Sometimes, people migrate because of the desire to fend for their immediate family, and such desire is met through the frequent flow of remittances to them in their home countries. By directly investing the amount in a productive business capacity, much pressure on loanable funds is reduced, forcing the prevailing interest rate to fall. If, on the other hand, the money is saved, the availability of more funds in this market may lower interest rates. While this holds for theoretical analysis, some empirical justification has also been offered where the connection between interest rate and economic output is negative. Thus, as interest rate reduces, investment is expected to rise, output equally rises, and prices then fall (Dinbabo & Nyasulu, 2015; Stark & Bloom, 1985; Taylor, 1999).

Related empirical literature

While the literature on the migration–growth nexus is widespread, many relate migration to remittances (see Asad et al., 2016). Many of these studies particularly find evidence that confirms that the flow of remittance significantly or otherwise contributes to the welfare of the households of the migrants, the economic growth of the sourced countries, and the price level (see Akay et al., 2014; Akçay, 2018; de Brauw et al., 2018; Nepal, 2022). Moreover, in his research work, Shin (2021) emphasized the relationship between exchange rate fluctuations and immigration policy. Another strand of literature in this regard paid attention to the possible implication of migration on the economic growth of destination countries through tourism (see Takahashi, 2019) and housing and food prices (see Akgündüz et al., 2015). Further evidence has also been established between migration and unemployment (see Esposito et al., 2020; Latif, 2015).

Evidence also abounds for the connection between migration and earnings/wages (Cardozo Silva et al., 2023; De Silva et al., 2010; Peñaloza Pacheco, 2022; Piyapromdee, 2021). The overarching evidence suggests a negative impact of immigration on wages. For instance, De Silva et al. (2010) estimate the impact of large-scale in-migration on regional earnings by comparing changes in average earnings in the non-traded, low-skill industries to corresponding changes in the high-skill industries in the Houston and Dallas-Fort Worth MSAs prior to and following the migration induced by Hurricane Katrina. They find evidence of a 0.7% decrease in the relative average payroll in the Houston non-traded, low-skill industries compared to the change in the same industry group in Dallas. Notwithstanding the overarching evidence of the influence of migration on macro-fundamentals, there has not been a particular study on the migration–inflation nexus, which constitutes the gap this study attempts to fill. As suggested by the theory, it is expected that some shared connection should play out between migration and inflation. This is expected to be true for migrant-receiving countries and migrant-sending economies, although this study focuses on the former. As an emphasis, we test the hypothesis of a positive nexus between migration inflow and inflation. This is a clear departure from the migration literature as we delve into how the former influences price growth in the destination country.

METHODOLOGY AND DATA

Methodology

We employ the panel autoregressive distributed lag (PARDL) approach to analyse the nexus between migration and inflation in a number of OECD countries. The attraction to this technique is underscored by the underlying salient features of the variables of interest, as shown in Table 2, where there is evidence of mixed order of nonstationarity, which is typically one of the conditions for an ARDL-based regression model. In addition, we also find evidence of cointegration between migration and inflation as well as interest rate, enabling us to capture short- and long-run dynamics in

the estimation process. In achieving the study's objectives, different models are specified. One, we examine the nexus between migration and inflation. Similarly, this nexus is further examined during the tranquil (pre-GFC) and turbulent (post-GFC) periods. Two, given the role of interest in the nexus as previously espoused, the influence of interest rates along low and high interest rates is equally examined. Consequently, the first objective is captured by specifying the panel autoregressive distributed lag model for the nexus between migration and inflation as:

$$\Delta cpi_{it} = \partial_i cpi_{i,t-1} + \theta_i + \delta_i mig_{i,t-1} + \sum_{j=1}^r \pi_{ij} \Delta cpi_{i,t-j} + \sum_{j=0}^s \eta_{ij} \Delta mig_{i,t-j} + \varepsilon_i + v_{it} \tag{1}$$

where cpi_{it} denotes the consumer prices expressed in natural logs for country i over a specified period t ; mig_{it} is the explanatory variable, which denotes migration inflow expressed in natural logs; θ_i is the state-specific intercept; Δ indicates the first difference operator; ε_i is for the state-specific effects; and v_{it} connotes stochastic disturbance term. Furthermore, while the short-run impact of migration inflow on inflation is η_{ij} , $-\delta_i / \partial_i$ measures the long-run effect. A principal feature of cointegrated variables is their responsiveness to any deviation from long-run equilibrium. This feature implies an error correction model in which the short-run dynamics of the variables in the system are influenced by the deviation from equilibrium (Blackburne III & Frank, 2007).

The corresponding error correction form for Equation (1) can be specified as:

$$\Delta cpi_{it} = \partial_i e_{i,t-1} + \sum_{j=1}^r \pi_{ij} \Delta cpi_{i,t-j} + \sum_{j=0}^s \eta_{ij} \Delta mig_{i,t-j} + \varepsilon_i + v_{it} \tag{2}$$

where $e_{i,t-1}$ is the error correction term and the speed of adjustment factor is ∂_i which measures how long it takes the system to revert to the original equilibrium where it is confronted with shocks. In other words, if $\partial_i = 0$, then there would be no evidence for a long-run relationship; however, for long-run equilibrium to exist, the parameter is expected to be significantly negative. The closer the value of this parameter to one in absolute terms, the quicker the adjustment of inflation to long-run equilibrium after a change in the independent variable(s); otherwise, the speed of adjustment to equilibrium will be slow, and therefore, it will take a longer period for the long-run equilibrium to be realized.

To capture more dynamics as enshrined in objective one, Equation (1) is further partitioned to allow for the role of GFC in the nexus, wherein we employ a dummy to distinguish pre-GFC estimates from post-GFC (see Appendix 1 for technical details). Further to the foregoing, and in realizing the second objective of this study, we specify a model that shows the influence of interest rates along low and high interest rates on inflation:

$$\Delta cpi_{it} = \partial_i cpi_{i,t-1} + \theta_i + \delta_i mig_{i,t-1} \cdot d_t^{lowint} + \delta_i mig_{i,t-1} (1 - d_t^{lowint}) + \sum_{j=1}^r \pi_{ij} \Delta cpi_{i,t-j} + \sum_{j=0}^s \eta_{ij} \Delta mig_{i,t-j} \cdot d_t^{lowint} + \sum_{j=0}^s \eta_{ij} \Delta mig_{i,t-1} (1 - d_t^{lowint}) + \varepsilon_i + v_{it} \tag{3}$$

where d_t^{lowint} is the dummy variable for a low interest rate which is derived as any rate below the average for the OECD countries, while the converse (that is, $1 - d_t^{lowint}$) is for the high interest rate.

Finally, we account for an important driver of inflation, which is output (using the Gross Domestic Product as a proxy), whose theoretical foundation hinges on the new Keynesian perspective to output-inflation trade-off where a negative relationship is hypothesized between output and inflation with a plethora of evidence supporting the hypothesis at least in the short run (see, for a review of both the empirical and theoretical literature, Sim, 2021).

In terms of estimation, we adopt the two prominent methods for Panel ARDL analyses, namely the Pooled Mean Group (PMG) (see Pesaran et al., 1997) and the Mean Group (MG) (see Pesaran & Smith, 1995) estimators. The difference between the two estimators lies in how the long-run estimates are treated. While all the parameters, such as the intercepts, slope coefficients, and error variances, are all allowed to differ across groups in the case of the MG estimator, the PMG estimator constrains the long-run coefficients to be equal across groups while

the intercept, short-run coefficients, and error variances are allowed to differ across the groups (as would the MG estimator). In order to choose between the MG and PMG estimators, the familiar Hausman test is performed, where a non-rejection of the null hypothesis implies the adoption of the PMG while a rejection favours the MG estimator (see also Blackburne III & Frank, 2007).

Data

The dataset used in this study consists of OECD migration and inflation. The OECD immigration data used in this study contains two indicators of migration: outflows of foreign population by nationality and inflows of foreign population by nationality. The latter, which is the focus of this study, is taken to proxy migration inflow into the OECD. The foreign population consists of people who still have the nationality of their home country. Therefore, the outflow of the population by nationality implies the departures of foreigners who were staying in the OECD countries on a permanent or temporary basis, while the inflow covers regulated movements of foreigners considered to be settling in the OECD from the perspective of the destination country. The start and end dates of our annual data, as sourced from the international migration database of OECD Migration Statistics via [10.1787/data-00342-en](https://data.oecd.org/migration/), are 1995 and 2020, respectively. More so, the data is adequately available for 21 OECD countries in the case of the outflows and 30 OECD countries in the case of the inflows. Similarly, we source inflation (computed as an annual percentage change in consumer price index) data on 'Prices - Inflation (CPI) - OECD Data' to explore the relationship between migration and inflation in the OECD countries. While inflation is expressed in growth, the unit of measure for migration is in thousands.

Summary statistics

Table 1 illustrates the summary statistics for our choice of variables under examination. The table summarizes the two highlighted variables' mean, standard deviation, median, minimum, and maximum values. The reported mean values represent the average values for each variable represented. On the other hand, the standard deviation shows how clustered/dispersed the series are around their means. While the minimum shows the least value of each variable during the analysis period, the maximum shows the highest value recorded for each variable. The table shows that migration inflow ranges between 4620.96 and 975,839 for Iceland and the USA, respectively. This indicates that the inflow of foreigners into the United States is the highest, on average, compared to other OECD countries. While Japan has the lowest inflation rate, the level of inflation is the highest in Mexico, with 0.16 and 8.37, respectively.

Regarding dispersion of the series around their means, Germany has the highest dispersion for the inflow of migrants. In contrast, the Slovak Republic has the least inflow, with 1739.09. **Table 1** also suggests more price instability in Hungary than in any other OECD country.

Moreover, we present a graphical representation of the relationship between migration and inflation for all the OECD countries examined (see **Appendix 2: Figure A1**). The causal relationship between migration inflow cannot be established at this stage. Hence, the validation is subjected to further empirical analysis.

RESULTS AND DISCUSSION

Some formal tests

One of the justifications for using the Panel ARDL model is that there is a concern about nonstationarity in the model. Consequently, we perform some panel unit root tests to establish this condition. These tests involve those

TABLE 1 Summary statistics.

Country	Migration-inflow					Inflation				
	Mean	Std. dev.	Median	Min.	Max.	Mean	Std. dev.	Median	Min.	Max.
Australia	166962.60	51555.92	168969.5	87,428	244,849	2.44	1.17	2.40	0.22	4.63
Austria	103557.30	36055.08	95,632	56,895	198,658	1.80	0.72	1.84	0.51	3.29
Belgium	89744.73	27553.69	97,470	49,240	133,587	1.82	0.98	1.81	-0.05	4.49
Canada	247754.90	38708.75	249670.5	174,198	341,175	1.82	0.64	1.88	0.30	2.91
Chile	74545.94	81863.43	41,112	8569.3	339,350	3.71	2.05	3.34	0.35	8.72
Czech Rep.	37446.35	25109.80	36503.5	4227	102,511	3.35	2.92	2.49	0.12	10.70
Denmark	32757.54	11830.48	32463.5	18,385	58,695	1.71	0.86	1.88	0.25	3.42
Finland	16344.92	6702.40	17795.5	7345	27,274	1.36	1.09	1.12	-0.21	4.07
France	160018.30	145853.5	145853.5	48,410	255,445	1.35	1.58	1.58	0.04	2.81
Germany	894991.00	400819.5	684,394	558,467	2,016,241	1.38	0.63	1.48	0.14	2.63
Hungary	25328.35	10543.61	22560.5	13,283	55,297	7.06	6.99	4.76	-0.23	28.31
Iceland	4620.96	3306.27	3190	938	11,758	4.12	2.88	3.20	1.63	12.69
Ireland	47042.31	24592.03	42,100	13,600	120,400	1.79	2.23	1.72	-4.48	5.59
Israel	32023.02	18312.22	25044.5	13,701	76,996	2.73	3.31	1.44	-0.61	11.42
Italy	265937.30	129282.3	263,750	27,098	515,201	1.89	1.28	1.97	-0.14	5.24
Japan	340285.00	88955.95	336585.5	209,869	591,961	0.16	0.87	-0.01	-1.34	2.73
Korea	279123.9	107203.0	273399.5	157536.5	495,079	2.73	1.68	2.64	0.38	7.51
Luxembourg	15961.58	5065.92	15200.5	9235	25,150	1.81	0.91	1.81	0.29	3.41
Mexico	20526.12	12542.50	12542.5	3643	62,990	8.37	4.62	4.62	2.72	35.00
Netherlands	112293.30	45003.94	98931.5	63,415	215,228	1.88	0.82	1.94	0.32	4.16
New Zealand	75026.81	25757.10	75,687	27,376	124,742	2.03	1.07	1.98	-0.11	4.03
Norway	42786.15	17528.45	40915.5	16,482	70,759	2.08	0.84	2.18	0.45	3.75
Poland	51442.73	48847.02	39574.5	-8631.67	163,512	5.25	6.76	2.99	-0.93	28.13
Portugal	47745.50	39033.17	36,558	3298	151,433	2.01	1.43	2.35	-0.84	4.37

(Continues)

TABLE 1 (Continued)

Country	Migration-inflow					Inflation				
	Mean	Std. dev.	Median	Min.	Max.	Mean	Std. dev.	Median	Min.	Max.
Slovak Rep.	4734.62	1738.09	4592	2418	7919	4.27	3.45	3.37	-0.52	12.04
Spain	384532.00	358770.5	358770.5	16,686	920,534	2.15	2.38	2.38	-0.50	4.67
Sweden	72302.96	32045.49	77,444	29,318	142,986	1.17	1.06	0.94	-0.49	3.44
Switzerland	118671.70	28524.50	133307.5	72,796	157,271	0.50	0.82	0.64	-1.14	2.43
UK	380863.50	120035.0	432,161	150,000	527,548	2.02	0.78	2.05	0.40	3.80
US	975839.00	173443.0	1,037,195	644,787	1,266,129	2.17	0.99	2.23	-0.36	3.84
Average	170507.00	254447.2	72412.5	-8631.67	2,016,241	2.62	3.32	1.98	-4.48	35.00

Note: Standard deviation, minimum, and maximum are shortened as Std. dev., Min. and Max., respectively.

TABLE 2 Panel unit root tests.

	Migration inflow		Inflation		Interest rate		GDP	
	Level	First diff.	Level	First diff.	Level	First diff.	Level	First diff.
<i>Null hypothesis: Unit root with common process</i>								
Levin, Li, and Chu adjusted t^*	-3.4047***	-8.0327***	-2.7614***	-4.6565***	-2.1672**	-3.8849***	-0.9444	-3.6895***
Harris Tzavalis rho	0.7349	0.1394***	0.8739	0.6044***	0.7320	0.1569***	0.8205	0.2529***
<i>Null hypothesis: Unit root with the individual unit root process</i>								
Im, Pesaran, & Shin W Stat	-4.3388***	-11.7099***	-2.6655***	-5.9320***	-3.2104***	-10.1470***	-1.8850	-11.3698***
ADF Fisher Modified inverse chi-squared	13.4321***	14.0448***	8.8509***	13.6244***	21.7501***	15.9260***	8.2917***	13.5197***
Pesaran CD test	-2.185	-2.841***	-2.272***	-2.693***	-2.389	-3.008***	-1.843	-2.179***
No. of cross-sections	30	30	30	30	30	30	30	30
No. of periods	25	25	25	25	25	25	25	25
Total observations	750	750	750	750	750	750	750	750

Note: Inflation is measured in terms of consumer prices. Except for interest rates, the variables in the table are expressed in natural logs. CD implies cross-sectional dependence. ***, **, and *Statistical significance at 1%, 5%, and 10%, respectively.

with the null hypothesis of unit root with common process (see Harris & Tzavalis, 1999; Levin et al., 2002) and those that assume unit root with individual unit root process in the null hypothesis (see Im et al., 2003; Maddala & Wu, 1999) including the one that also accommodates the presence of cross-sectional dependence in the null (see Pesaran, 2007). We perform the test on the variables of interest, migration, and inflation as well as our control variables, interest rates, and real gross domestic product (GDP). Overall, we are able to establish the problem of stationarity in the Panel ARDL framework where the predictors of interest, that is, migration, interest rates, and GDP, are $I(1)$ series while inflation is an $I(0)$ series, particularly based on the Pesaran (2007) test, which is a more powerful unit root test for panel data as it also accounts for cross-sectional dependence in the test process (see Table 2 for the panel unit root test results). This mixed behaviour of the integration properties of the variables further validates our choice of the Panel ARDL framework.

Further, we test for any possible cointegration in the model based on the error correction terms of the competing estimators used in this study, the PMG and the MG. Given the error correction representation of Equation (1) in the form $\Delta cpi_{it} = \delta_i e_{i,t-1} + \sum_{j=1}^r \pi_{ij} \Delta cpi_{i,t-j} + \sum_{j=0}^s \eta_{ij} \Delta mig_{i,t-j} + \varepsilon_i + \nu_{it}$; the MG tests the following null and alternative hypotheses: $H_0: \delta_i = 0$ and $H_1: \delta_i < 0$ where the null implies no cointegration and the alternative indicates that at least one unit is cointegrated. For the PMG, however, the testable null and alternative hypotheses are $H_0: \delta_i = \delta = 0$ of no cointegration and $H_1: \delta_i < 0$ of panel cointegration, respectively. A non-rejection of the null hypothesis in both cases simply suggests no cointegration, indicating non-causality from migration to inflation rate. This, however, does not preclude causality from inflation to migration. The same intuition can be extended to other alternative models estimated in this paper, including Equation (3) with and without GDP. Our results are presented in Table 3A,B for testable equations with and without the additional predictor of inflation, which is GDP. We find the presence of cointegration for the connection between migration and inflation as well as when the roles of interest rate and GDP are accommodated. All the coefficients are correctly signed and statistically significant at the 1% level. In other words, all the coefficients are negative and statistically significant, as expected for cointegration to exist between the dependent and the independent variables. The formal tests have provided the background for further analyses in terms of determining the long-run and short-run relationships between migration and inflation, as well as the speed of adjustment when the system is confronted with a shock.

TABLE 3 (A) Panel cointegration tests [without additional control] and (B) [with additional control].

	Migration-inflation		Migration-inflation and the mediating role of interest rate	
	MG	PMG	MG	PMG
(A)				
Cointegration test	-0.0783*** (0.0116)	-0.0582*** (0.0100)	-0.182*** (0.0348)	-0.152*** (0.0285)
No. of cross-sections	30	30	30	30
No. of periods	25	25	25	25
Total observations	750	750	750	750
(B)				
Cointegration test	-0.0692*** (0.0124)	-0.0590*** (0.00955)	0.00212*** (0.000358)	-0.130*** (0.0225)
No. of cross-sections	30	30	30	30
No. of periods	25	25	25	25
Total observations	750	750	750	750

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The cointegration test coefficient is derived from the coefficient of the error correction in the Panel ARDL model using alternative estimation methods, namely, the MG and PMG estimators.

Main results: Migration inflow and inflation nexus

We estimate our model equations using the MG and PMG estimators, then identify the more efficient of the two estimators using the Hausman test results. A non-rejection of the null hypothesis implies the adoption of the PMG estimator, whereas a rejection signifies the adoption of the MG estimator. Put differently, the PMG estimator is the efficient estimator under the null, and the MG estimator is the efficient estimator under the alternative hypothesis. Given that the Hausman test statistics are insignificant for all the estimated models, we conclude that the PMG estimator is efficient for the examined nexus. We begin our interpretation with the error correction term, which is the first set of coefficients reported in all the Panel ARDL results tables (see Tables 4–6). As previously noted, for long-run equilibrium to exist, the coefficient of the error correction term is expected to be significantly negative, and the closer the value of this coefficient to one in absolute terms, the quicker the adjustment of the dependent variable to its long-run equilibrium after a change in the independent variable(s); otherwise, it will take a longer period for the equilibrium to be restored. As observed from all our results tables, we find that all the coefficients for the error correction terms in the respective models are significantly negative, indicating the presence of long-run equilibrium. However, the coefficients are small, implying that inflation may take a while to return to long-run equilibrium after a change in migration inflows, among other variables.

The following steps establish an empirical link between migration inflows and inflation for the OECD countries. We examine the relationship between migration and inflation, following the established discussion in Section Introduction (see Table 4). This relationship is examined for calm and turbulent economic periods proxied by pre- and post-GFC, respectively (see Table 5). Similarly, the influence of interest rates along low and high interest rates is also examined for the nexus (see Table 6). As previously noted and represented here for emphasis, high interest rates can help to moderate inflation, at least in the short term, by reducing demand for goods and services. This occurs because investment-oriented consumers may opt to demand less to take advantage of higher returns, reducing prices. An influx of immigrants may increase demand, which can hike prices. Whether this relationship is a short-term or long-term phenomenon or both remains unclear.

Following Equations (1) and (2), our results for the nexus between migration and inflation are shown in Table 4. As previously noted, the PMG estimator is the efficient estimator given the non-rejection of the null hypothesis; hence, our focus is on the corresponding PMG results. Note that Model 1A excludes the output proxy while Model 1B includes it. This approach offers a form of robustness for the analyses and allows us to revisit the

TABLE 4 Migration–inflation nexus for the OECD countries.

Variables	Model 1A		Model 1B	
	MG	PMG	MG	PMG
ec	-0.0783*** (0.0117)	-0.0582*** (0.0100)	-0.0692*** (0.0124)	-0.0590*** (0.00955)
D.Inmig	-0.00270 (0.00370)	0.00343 (0.00351)	-0.00263 (0.00407)	0.00187 (0.00361)
Inmig	0.0633 (0.191)	0.0805*** (0.0120)	0.249* (0.129)	0.0928*** (0.0137)
D.lngdp			-0.0609** (0.0259)	-0.0340** (0.0135)
lngdp			0.254 (2.998)	0.418 (0.281)
Constant	0.230*** (0.0433)	0.230*** (0.0368)	0.210*** (0.0433)	0.224*** (0.0335)
Hausman test		0.01		2.26
Observations	750	750	750	750

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Inmig is the log of migration, and its coefficient denotes the long-run estimate, while the D.Inmig is for the short run where the 'D' is the first difference operator; ec is the error correction term. The Hausman test is performed to choose between the MG and the PMG estimators, where a non-rejection of the null hypothesis implies the adoption of the PMG while a rejection favours the MG estimator.

TABLE 5 The role of GFC in the migration–inflation nexus for the OECD countries.

Variables	Model 2A		Model 2B	
	MG	PMG	MG	PMG
ec	-0.0631*** (0.0178)	-0.0593*** (0.0136)	-0.0604*** (0.0182)	-0.0607*** (0.0122)
D.pregfcmig	-0.000926 (0.00345)	0.00323 (0.00336)	-0.000238 (0.00383)	0.00177 (0.00340)
D.postgfc mig	0.000584 (0.00351)	0.00470 (0.00336)	0.00113 (0.00388)	0.00318 (0.00342)
pregfcmig	1.623 (1.489)	0.0588*** (0.00929)	0.203** (0.0875)	0.0651*** (0.0111)
postgfc mig	1.560 (1.446)	0.0694*** (0.00899)	0.206** (0.0865)	0.0742*** (0.0106)
D.lngdp			-0.0428** (0.0214)	-0.0289** (0.0140)
lngdp			1.241 (1.982)	0.619** (0.250)
Constant	0.222*** (0.0699)	0.242*** (0.0522)	0.230*** (0.0715)	0.243*** (0.0458)
Hausman test		2.60		3.43
Observations	750	750	750	750

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. GFC is the Global Financial Crisis; pregfcmig and postgfc mig measure the long-run effects of migration on inflation under the pre- and post-GFC samples, respectively (see the appendix for technical details), while D.pregfcmig and D.postgfc mig are for the short run. The 'D' is the first difference operator; ec is the error correction term. The Hausman test is performed to choose between the MG and the PMG estimators, where a non-rejection of the null hypothesis implies the adoption of the PMG while a rejection favours the MG estimator.

TABLE 6 The role of interest rates in the migration–inflation nexus for the OECD countries.

Variables	Model 3A		Model 3B	
	MG	PMG	MG	PMG
ec	-0.182*** (0.0348)	-0.152*** (0.0285)	0.00212*** (0.000358)	-0.130*** (0.0225)
D.highint_mig	-0.00158 (0.00136)	-0.00371* (0.00192)	-0.00171* (0.000956)	-0.00345* (0.00192)
D.lowint_mig	-0.000705 (0.00316)	-0.00179 (0.00344)	0.00130 (0.00352)	-0.00290 (0.00337)
highint_mig	-0.00348 (0.00570)	0.0801*** (0.00929)	-0.439 (0.580)	0.104*** (0.0129)
lowint_mig	0.0831** (0.0372)	0.0698*** (0.00866)	7.464 (7.331)	0.0817*** (0.0108)
D.lngdp			-0.0811*** (0.0193)	-0.0394*** (0.0101)
lngdp			-6.935 (34.47)	0.420*** (0.125)
Constant	0.682*** (0.129)	0.545*** (0.0968)	-0.0256 (0.0316)	0.453*** (0.0725)
Hausman test		-117.00		6.20
Observations	750	750	750	750

Note: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. highint_mig and lowint_mig measure the long-run effects of migration on inflation under high and low interest rate environments, respectively (see Equation (2) for technical details), while D.highint_mig and D.lowint_mig are for the short run. The 'D' is the first difference operator; ec is the error correction term. The Hausman test is performed to choose between the MG and the PMG estimators, where a non-rejection of the null hypothesis implies the adoption of the PMG while a rejection favours the MG estimator.

output-inflation tradeoff for the OECD countries. In line with our hypothesis, as indicated above, we find evidence of a significantly positive relationship between migration inflow and inflation; however, this evidence only holds in the long run under Models 1A and 1B in both scenarios. That is, as the population increases due to an increase in the number of migrants in the OECD countries, there exists significant evidence (in the long-run) to support our claim that an increase in the number of migrants exerts pressure on demand for goods and services, thus translating to rise in the prices in this 'region'. This aligns well with the findings by Tanrikulu (2021), who equally finds that Syrian inflow into Turkey spurs demand and consequently increases inflation and unemployment in Turkey. This outcome also corroborates the error correction term, which suggests the presence of a long-run relation between migration and inflation in the OECD countries. It is important to note that migrating to a new country does not immediately affect the overall prices of goods and services. This may be because it takes time for migrants to settle into their new homes and find jobs that pay well, increasing their purchasing power and raising demand for goods and services, ultimately leading to an increase in prices. Regardless of the presence of a control variable, our findings indicate a consistent long-term relationship between migration and inflation, implying our results' reliability under alternative specifications.

Subjecting the analysis to tranquil and crisis periods, our results (see Table 5) for the nexus are upheld in the long run under Models 2A and 2B based on the PMG estimator. One instructive evidence here is that migration drives higher prices, whether during tranquil or turbulent periods, although the impact seems higher in the latter period. Furthermore, we examine the nexus (between migration inflow and inflation) for different interest rate environments—low and high interest rates. The results for these are shown in Table 6, similarly focusing on the PMG estimator given the non-rejection of the null hypothesis. We find that the asymmetric behaviour of high and low interest rates is only evident in the short run, where high interest rates seem to moderate the inflationary tendency of migration inflows. However, the moderating role of interest rates diminishes with time as migration inflows raise prices regardless of the level of interest rates, whether high or low. In other words, interest rates play a dominant role in the nexus in the short run when migration inflows are not observed in the market due to the previously highlighted rigidities. However, as more migrants become employable and visible in the labour and goods markets, the dominant role of interest rates in the nexus wanes.

Our findings have important implications for monetary authorities whose main goal is to control inflation. Based on our research, keeping interest rates high to control the inflation caused by migration inflows can only lead to short-term benefits. To address the long-term inflationary effects of migration inflows, authorities may need to find more innovative solutions beyond traditional approaches, which typically involve interest rates.

Although this study does not focus on the connection between output and inflation, the results are worth noting. There is a negative correlation between output and inflation in the short run, but in the long run, the relationship is positive. This finding is consistent across the various model constructs in Tables 4–6. The reason for this outcome is that an increase in output initially (in the short run) lowers prices. However, as more labour and capital are employed to raise output even further, wages may rise, pushing prices up over time (in the long-run). This can happen in two ways: cost-push inflation, which is caused by rising wages and increased demand for other inputs from producers, and demand-pull inflation, which is caused by increased demand for goods and services due to rising wages. Therefore, a positive relationship between output and inflation may not be farfetched, particularly for emerging and developed economies such as those in the OECD countries.

Additional analysis: Panel threshold analysis for migration–inflation nexus using interest rate as an intervening variable

As an additional analysis and to further establish non-linearity in the nexus between migration and inflation for the OECD countries, we construct panel threshold regression models to determine the threshold effect (where

the interest rate is used as the intervening variable) endogenously and test its significance. The estimated panel threshold regression model takes the form (see Hansen, 1999; Wang, 2015):

$$\text{inf}_{it} = \beta_0 + \theta_1 \text{mig}_{it}(p_{it} < \varphi) + \theta_2 \text{mig}_{it}(p_{it} \geq \varphi) + \mu_i + e_{it} \quad (4)$$

$$i = 1, 2, 3, \dots, N; t = 1, 2, 3, \dots, T.$$

where *inf* is annual inflation; *mig* is the natural log of migration inflow; *p* is the threshold variable (interest rate); φ is the threshold parameter that divides the equation into two regimes with coefficients θ_1 and θ_2 ; μ_i is the individual effect while *e* is the disturbance. The null hypothesis of no threshold effect (i.e., $H_0: \theta_1 = \theta_2$ implying a linear model) is tested against the alternative hypothesis (i.e., $H_1: \theta_1 \neq \theta_2$ which implies the presence of both non-linearity and threshold effect). We generate the *F* statistic needed to assess the significance of the threshold effect using Hansen's (1999) bootstrap design (see also, Wang, 2015).⁴

The estimated results of the interest rate threshold values across different samples, including pre- and post-GFC sample periods, are shown in Table 7. These are in addition to the results offered for the full sample period. The interest rate threshold values across the several samples are estimated to be significant at 16.41%, 19.91% and 3.43% for full, pre- and post-GFC sample periods, respectively, wherein the threshold test confirms the same. The impact of policy responses anchored on interest rates throughout the crisis can be seen by looking deeper at the threshold levels before and after the GFC. To lessen the crisis' effects, central banks quickly lowered interest rates to extremely low levels. To examine the intervening role of interest rates in the relationship between migration and inflation for OECD countries, the lower and upper-interest rate regimes are activated. The results show that when the interest rate is below the threshold values of various samples considered, an increase in migration (up to the threshold level) is associated with a significant reduction in inflation across these samples, barring post-GFC (which is not significant). On the contrary, as the interest rate is raised beyond these thresholds, the implication of migration for inflation becomes significantly positive. Consequently, the higher interest rates when the inflow of migrants becomes massive create additional pressure on the prices of goods and services in the OECD countries. These mixed results across different regimes further lend credence to the plausible non-linearity in the role of interest rates in the nexus between migration and inflation. These results provide additional

TABLE 7 Panel threshold results for migration–inflation nexus with interest rate as an intervening variable.

Regime dependent variable	Full sample	Pre-GFC	Post-GFC
Inf_mig_0	-0.520*** (0.130)	-0.366* (0.198)	-0.0694 (0.210)
Inf_mig_1	1.226*** (0.166)	1.609*** (0.238)	0.132 (0.213)
Constant	8.056*** (1.448)	6.857*** (2.148)	2.193 (2.400)
Threshold value	16.4121	19.9050	3.4342
Threshold test [debtgdp_0 vs. debtgdp_1]	625.57***	500.83***	110.50***
Observations	780	390	390
R-squared	0.511	0.599	0.231
Number of country_id	30	30	30

Note: While the dependent variable is inflation, the regime-dependent variable is migration, and the threshold variable is interest rate. Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Inf_mig_0 and Inf_Mig_1 denote the variables above and below the threshold, respectively; the threshold effect test is *F*-test-based and the critical values are given as 80.6649, 89.6663, and 109.9936, for full sample; 26.8377, 31.2176, and 48.1428, for pre-GFC; and 41.5025, 45.4672, and 55.7044, for post-GFC, for 10%, 5% and 1%, respectively. The *F* test involves the null hypothesis of no threshold (implying a linear relationship) against the alternative hypothesis of the presence of threshold effect (implying a nonlinear relationship).

evidence in support of the panel's ARDL technique's findings regarding the mediating role of low interest rates in the migration–inflation nexus.

CONCLUSION

In this paper, we have examined the nexus between migration inflow and inflation in 30 different OECD countries using a panel ARDL approach that allows us to capture various short- and long-run dynamics in estimating the nexus between our variables of interest. This technique is essential as it accounts for individual country characteristics in the estimation process and accommodates a large number of cross-sections and time dimensions, as is the case in this study. Importantly, our analysis is rendered for tranquil and turbulent economic periods proxied by the periods before and after the global financial crisis, respectively. Afterwards, the OECD countries are divided into low- and high interest rate environments. This is done to examine the intervening role of interest rate in the relationship (between migration and interest rate). Given the demand pressure the former imposes on the goods and services market, we hypothesize a positive relationship between migration inflow and inflation. True to this hypothesis, our results show a positive relationship between migration inflow and inflation in the long-run, while it is non-existent in the short run. We maintain that migration does not have an immediate impact on the overall prices of goods and services due to various challenges that migrants face when settling in their destination countries. Typically, it takes time for migrants to establish themselves in their new homes and secure employment that pays well.

After subjecting the analysis to calm and crisis periods, our results confirm a positive relationship between migration and inflation in the long run. However, there is a tendency for the crisis period to have a greater impact on the nexus. When we divide countries into low- and high interest rate environments, we observe that interest rates have a significant impact in the short term. High interest rates help to control the inflationary impact of migration inflows. However, this effect diminishes over time due to the increasing presence of immigrants in the labour and goods markets. This increased visibility could lead to some price effects. Therefore, to control this inflationary impact of migration inflows in the long run, monetary authorities may need to come up with innovative solutions beyond using interest rates. Nonetheless, the complementary threshold analyses rendered in this study suggest some threshold levels for interest rates for this policy variable to be effective in moderating the inflationary tendency of migration inflows. We hope the monetary authorities in the OECD countries will find this outcome useful in their conduct of monetary policy actions. Nonetheless, we acknowledge the limiting our research to the OECD countries may impede the generalization of the results. Therefore, we suggest that future research extend these analyses to include various economic classifications, including the developing and emerging markets, as well as the industrialized economies. Furthermore, rather than focusing on the destination countries, the migration–inflation nexus could also be examined for the countries of origin.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ENDNOTES

¹When economies are affected by unanticipated shocks, central banks worldwide usually react to restore stability and mitigate the impact of the shock (Aslam et al., 2023). Thus, conventional monetary policies are usually complemented by unconventional ones owing to the limited scope to cut further or lower the conventional rate (monetary policy trap/conventional monetary policy ineffectiveness). This is best captured under shadow interest rates, which measure an

unobserved short-term interest rate consistent with longer-term rates that would have prevailed had the interest rate lower bound not been binding (Krippner, 2014; Wu & Xia, 2016). Therefore, since migration inflow could also constitute a shock – through the labour market – to an economy, various interest rate dynamics, including low- and high interest rates, have been considered in examining the nexus between migration inflow and inflation.

²<https://www.statista.com/chart/30815/top-destination-countries-for-international-migrants/#>.

³<https://www.oecd.org/newsroom/consumer-prices-oecd-updated-5-september-2023.htm#>.

⁴The dynamic version of Kremer et al. (2013) is an extension of the panel threshold model utilized here, and in theory, it entails adding the initial lag of the dependent variable as an additional regression to the model. However, as this model relies on the IV GMM technique and requires small T, it is not taken into account because large time series observations could result in an overabundance of instruments.

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APPENDIX 1

EQUATION DEMONSTRATING THE ROLE OF GFC IN THE MIGRATION-INFLATION

$$\Delta \text{inf}_{it} = \delta_i \text{inf}_{i,t-1} + \theta_i + \delta_i^{\text{pregfc}} \text{mig}_{i,t-1} * d_t^{\text{pregfc}} + \delta_i^{\text{postgfc}} \text{mig}_{i,t-1} (1 - d_t^{\text{pregfc}}) + \sum_{j=1}^r \pi_{ij} \Delta \text{inf}_{i,t-j} + \sum_{j=0}^s \eta_{ij}^{\text{pregfc}} \Delta \text{mig}_{i,t-j} * d_t^{\text{pregfc}} + \sum_{j=0}^s \eta_{ij}^{\text{postgfc}} \Delta \text{mig}_{i,t-j} * (1 - d_t^{\text{pregfc}}) + \varepsilon_i + v_{it} \tag{A1}$$

In order to capture more dynamics in the nexus, a dummy is employed to distinguish pre-GFC from post-GFC such that d_t^{pregfc} and $1 - d_t^{\text{pregfc}}$ are their respective associated dummy variables.

APPENDIX 2

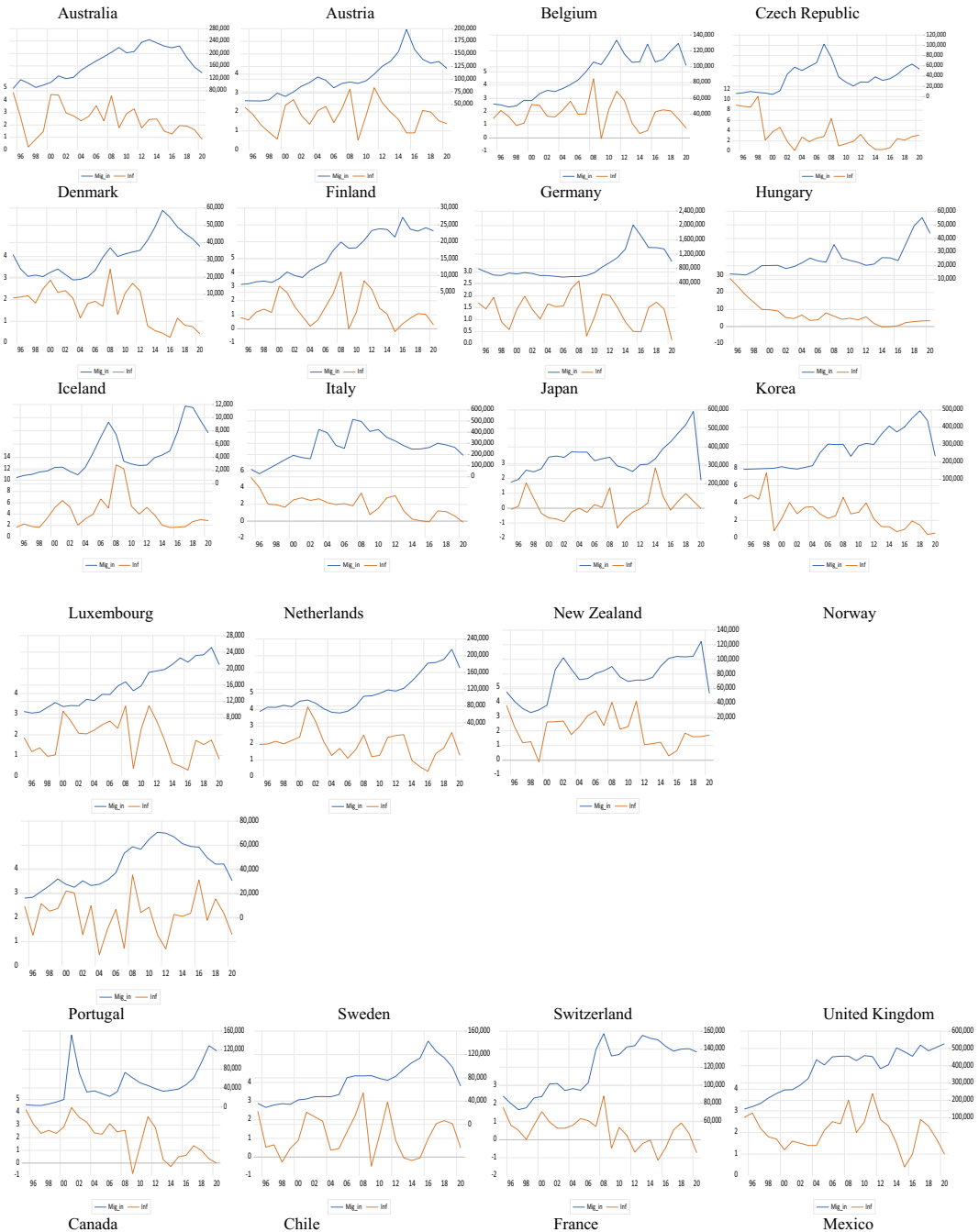


FIGURE A1 Graphs showing the relationship between migration inflow and inflation in the OECD countries.

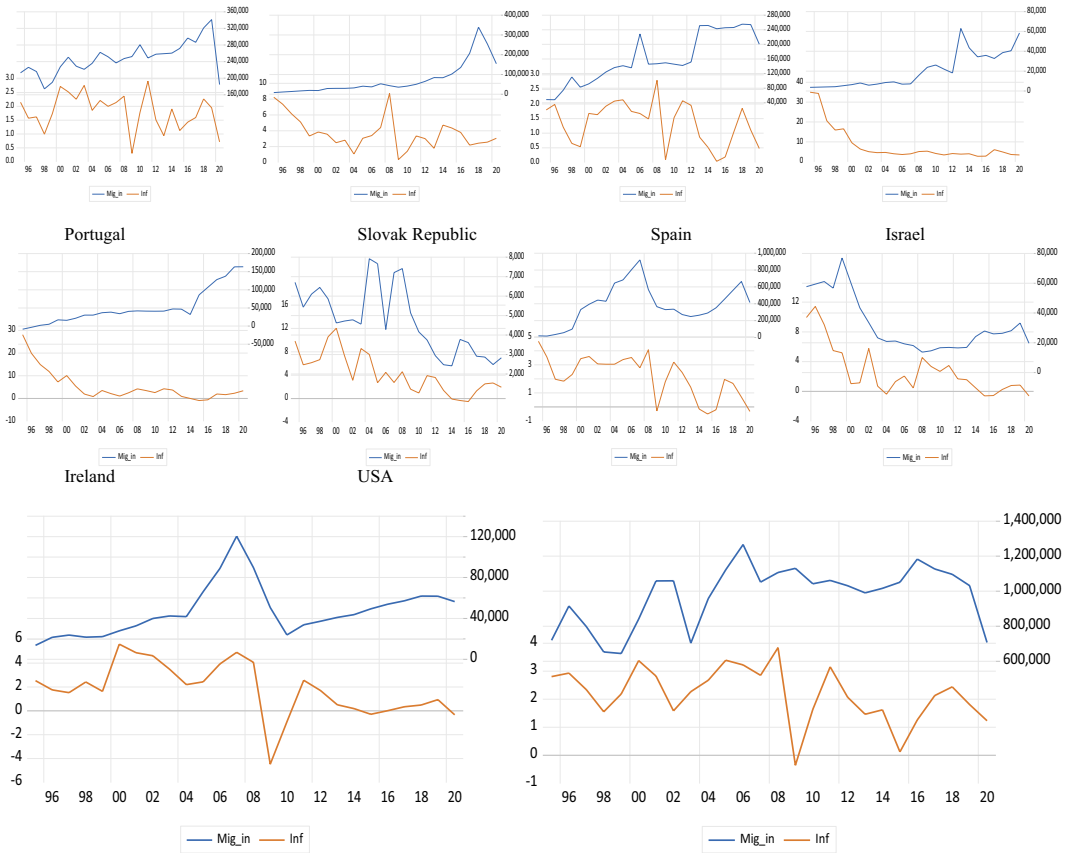


FIGURE A1 (Continued)