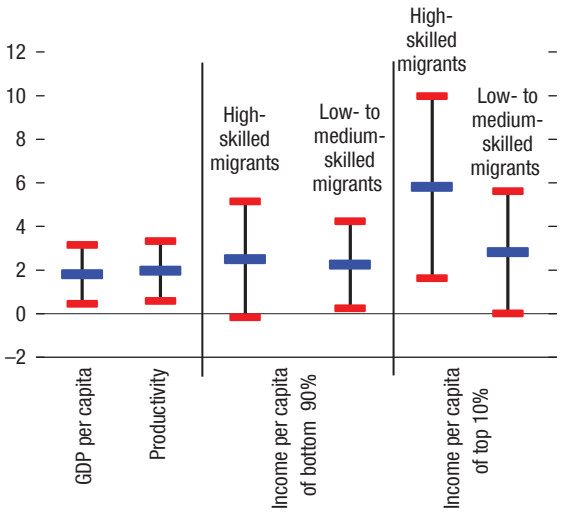
ciently or natives feel displaced, our results suggest that there are long-term benefits to immigration in terms of higher GDP per capita for recipient countries. The benefits seem to be broadly shared across the population, even though high-skilled migration contributes to increase the income share of the top 10 percent earners. Moreover, both high- and low-skilled migrants can contribute to increase GDP per capita. For lower-skilled migrants, this is particularly the case if there is a complementarity with the skills of natives. Such complementarities are more likely in fast-aging societies with rising education levels, where shortages are bound to occur in certain parts of the economy, in particular in non-tradable low-skilled services, for which imports cannot substitute. Our estimates of a sizable impact of immigration on GDP per capita also suggest that the fiscal benefits from immigration could be larger than typically estimated, since static estimates of net fiscal gains, which calculate the difference between immigrants' tax and social security contributions and their receipt of social security benefits and government services, typically do not take into consideration the indirect effects of immigration on the aggregate productivity of the economy.

The labor market integration of migrants is critical to secure GDP per capita gains and benefits for public finances. This note examines the medium- to long-run impact of migration. However, the transition/assimilation process may be difficult and slow, for instance if migrants struggle to integrate in the labor market. A number of policies can help, including language training and active labor market policies targeted to the needs of migrants; a better recognition of the skills of immigrants, through certification equivalence, so that they can be employed effectively and the still-sizable share of high-skilled migrants employed in lower-skilled occupations can be reduced; and product market reforms and other measures that lower barriers to entrepreneurship (Aiyar and others, 2016).

Finally, while the benefits from migration seem to be broadly shared, mitigating policies can help the adjustment. In addition to measures fostering the fast integration of migrants into the labor market, these include, for example, steps to help natives upgrade their skills or reduce possible congestion in the use of public services (for example, health and education). While these policies may require additional public spending, they also aid the long-term increase in GDP per capita and, thereby, help migrants increasingly contribute to the fiscal accounts.

Figure 9. Summary of Estimated Effects of Migrants' Share: Effect of Increase in Share of Migrants in Total Adult Population
(Percent change per 1 percentage point increase)



Source: IMF staff calculations.
Note: Red bands denote 95 percent confidence intervals.

Annex 1. Gravity-Based Instrumental Variables Approach

To construct an instrument for the migration share, we build on the approach of Ortega and Peri (2014), Alesina, Harnoss, and Rapoport (2016), and others,[15] which uses a gravity model for bilateral migration stocks and exploit variation in migration based on migration costs, captured by bilateral geographic and cultural characteristics. This approach assumes that such costs affect GDP per capita only by affecting migration, but not directly.

A good instrument for the migration share should be strongly correlated with the endogenous regressor and uncorrelated with error term in the second-stage equation. Ortega and Peri (2014) and Alesina, Harnoss, and Rapoport (2016) mostly use cross-sectional variation of the migration share across countries to identify the impact on GDP per capita, while we exploit time variation of the migration share within each country, which is somewhat more demanding on the instrument. Therefore, we augment the Ortega and Peri (2014) specification with a number of "push" factors, which are specific to the origin country and vary

[15] Based on the approach by Frankel and Romer (1999) for trade.

over time, and interactions between the push factors and migration costs (specific to each origin–destination pair), which creates variation by destination country over time. We do not include any "pull" factors, specific to the destination country, because they could be correlated with GDP per capita at the destination and therefore could invalidate our instruments.

We estimate the following equation, which relates the bilateral migration share between origin country o and destination country d at time t to migration costs and push factors:

$$\begin{aligned}\ln MSH_{odt} = {} & \gamma_0 + \gamma_1 \ln pop_{d1980} + \gamma_2 \ln pop_{o1980} \\ & + \gamma_3 \ln MSH_{od1980} + \gamma_4 X_{ot} + \gamma_5 Z_{od} \\ & + \gamma_6 X_{ot} Z_{od} + \delta_t + u_{odt}, \end{aligned} \quad \text{(A1.1)}$$

where pop_{d1980} and pop_{o1980} are the initial population size at destination and origin, respectively; MSH_{od1980} is the initial stock of migrants from a given origin at a given destination and captures network effects; X_{ot} is the vector of push factors; Z_{od} is the vector of geography- and culture-based migration costs; δ_t is the time fixed effects; and u_{odt} is the error term. Following Ortega and Peri (2014), in one of the specifications we include destination country fixed effects to reduce the possible omitted variable bias in the gravity equation (since we do not include any pull factors). However, these fixed effects are not included in the prediction as they can be correlated with income in the destination country.

The vector of push variables includes origin country growth, dummies for currency crises and civil wars, the share of the young population (25–34 years old), the shares of population with tertiary and high school education,[16] and a dummy variable for being an EU member. The migration costs include distance between the countries, dummies for contiguity, speaking a common official or ethnic minority[17] language, shared past colonial ties, and membership in the EU.

We aggregate the gravity-based predictors for bilateral migration shares over the origin countries:

$$\widehat{MSH}_{dt} = \Sigma_{0 \neq d} \exp(\widehat{\gamma_M} M_{odt}), \quad \text{(A1.2)}$$

where M_{odt} is the vector of explanatory variables in equation (A1.1) (excluding time and destination fixed effects) and $\widehat{\gamma_M}$ is the vector of estimated coefficients.

[16] Growth level, share of the young population, and share of the educated population are lagged by five years to avoid reverse causality.

[17] More than 9 percent of population.

More adverse socio-economic conditions at the origin and lower migration costs increase the share of migrants. Annex Table 1.1 reports estimates for the gravity model based on bilateral migration shares. For parsimony, the estimated coefficients on the interaction terms are not presented, but they are available on demand. Columns (1)–(3) present estimates for the total migration share from the log-linear ordinary least squares regression, the Poisson pseudo-maximum likelihood regression, and the Poisson pseudo-maximum likelihood regression with destination country fixed effects. Qualitatively the estimates are consistent between the three columns. The number of observations is quite similar in the log-linear and Poisson pseudo-maximum likelihood regressions, meaning that there are few zero observations in our sample, and therefore the main differences between the ordinary least squares and Poisson pseudo-maximum likelihood estimates must come from heteroscedasticity bias. The coefficient signs are mostly as expected: push factors associated with worse economic, political, or demographic conditions at the origin increase the migration share, as do lower geography- and culture-based migration costs. The Poisson pseudo-maximum likelihood estimates with and without destination country fixed effects are quite similar, indicating that the bias coming from misspecification of the gravity model due to omitted pull factors is not strong.

The relative importance of various push factors and migration costs differs between high-skilled and low- and medium-skilled migrants. Columns (4)–(6) present estimates of the bilateral migration share by skill for high-, medium-, and low-skilled separately. Some coefficients are similar across different skill levels of migrants, like the migration share in 1980 (network effect), distance, and the share of the young population. Other coefficients, however, vary across different skill levels, suggesting that the relative importance of various push factors and migration costs varies by skill. For example, per capita income in 1980 reduces significantly medium- and low-skilled migration, but is not important in predicting high-skilled migration. In a similar manner, common border (contiguity), colonial ties, EU membership, and the share of the population with high education at the origin seem to have a stronger impact on low- and medium-skilled migration, while for high-skilled, common language matters more. Based on the similarity of low- and medium-skilled coefficients, we aggregate the low- and

Annex Table 1.1. Gravity Model for Bilateral Migration Share

	(1) Total MSH	(2) Total MSH	(3) Total MSH	(4) High skilled MSH	(5) Medium skilled MSH	(6) Low skilled MSH
	OLS	PPML	PPML FE	PPML	PPML	PPML
Ln pop at dest 1980	–0.52***	–0.55***	–0.16	–0.56***	–1.03***	–0.27
	(–4.967)	(–4.301)	(–1.095)	(–3.753)	(–6.392)	(–1.580)
Ln pop at origin 1980	–0.08	–0.78***	–0.63***	–0.67***	–1.22***	–0.38**
	(–0.926)	(–6.155)	(–4.483)	(–4.584)	(–6.868)	(–2.015)
Ln income pc at origin 1980	–0.60**	–1.51***	–1.48***	–0.59	–2.64***	–2.30***
	(–2.335)	(–3.544)	(–3.999)	(–1.579)	(–4.686)	(–5.585)
Ln MSH in 1980	0.75***	0.77***	0.80***	0.72***	0.74***	0.85***
	(89.874)	(74.864)	(66.451)	(62.873)	(37.121)	(69.432)
Contiguity	1.44***	0.66	0.47	–0.12	0.63	1.17***
	(4.407)	(1.572)	(1.444)	(–0.367)	(1.145)	(2.901)
Ln distance	–0.33***	–0.36***	–0.35***	–0.33***	–0.62***	–0.25***
	(–11.930)	(–7.950)	(–7.289)	(–7.135)	(–9.316)	(–4.924)
Common ethnic language	0.43***	0.15**	0.08	0.21***	0.16	–0.02
	(11.513)	(2.080)	(1.119)	(2.985)	(1.358)	(–0.232)
Colony	0.24***	–0.12	0.01	0.15*	–0.43***	–0.10
	(4.282)	(–1.383)	(0.110)	(1.951)	(–2.808)	(–0.870)
EU origin	–0.11***	–0.26***	–0.40***	–0.16***	–0.09	–0.32***
	(–2.781)	(–4.878)	(–7.031)	(–2.817)	(–1.264)	(–4.318)
EU origin&destination	–0.00	–0.22	0.08	–0.77***	–0.83**	0.14
	(–0.015)	(–0.974)	(0.381)	(–3.338)	(–2.356)	(0.624)
Cumul 5-year growth (lag)	0.11	0.09	0.11	0.04	0.17	0.16
	(1.169)	(0.539)	(0.699)	(0.276)	(0.896)	(0.845)
Share of young pop (lag)	0.05***	0.03***	0.03***	0.03***	0.03***	0.04***
	(8.299)	(3.133)	(3.591)	(2.990)	(2.898)	(4.238)
Currency crisis	–0.01	–0.09	–0.11	0.01	0.02	–0.13
	(–0.108)	(–1.258)	(–1.553)	(0.172)	(0.253)	(–1.234)
Civil war	0.45***	0.12	0.23**	–0.21*	0.11	0.16
	(6.709)	(1.276)	(2.427)	(–1.708)	(0.820)	(1.320)
Ln of high skilled sh (lag)	0.04*	–0.12**	–0.10*	–0.09*	–0.20**	–0.32***
	(1.681)	(–2.153)	(–1.744)	(–1.673)	(–2.428)	(–4.903)
Ln of med skilled sh (lag)	0.13***	–0.00	–0.01	0.08**	0.02	–0.12***
	(4.979)	(–0.044)	(–0.366)	(2.188)	(0.361)	(–3.012)
Interaction terms: "push" factors*migr costs	Yes	Yes	Yes	Yes	Yes	Yes
Destination fixed effects	No	No	Yes	No	No	No
Number of observations	5,640	5,689	5,689	5,401	5,382	5,502
R-squared	0.887					

Source: IMF staff estimates.
Note: Robust t-statistics are reported in parentheses. All models include a constant term and a full set of interactions between the "push" factors and migration costs (reported in the annex text). The migration share (MSH) is defined as the number of adult foreign born in the country over the total population over 25 years old. The fixed-effects specification includes destination country fixed effects (not reported), which are not used, however, in building the predicted MSH.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

medium-skilled migration shares into one variable when constructing predicted migration shares by destination.

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