Review of Economic Analysis 16 (2024) 469-498 1973-3909/2024469

Corruption, Exchange Rates, and Migration Flows

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It is often argued that immigration flows depend positively upon the GDP (a migratory pull factor) and negatively upon the exchange rate depreciations (a migratory push factor) in the destination country. However, we show that both effects depend crucially on the corruption level, and, to the best of our knowledge, this is the first time that the impact of migration's determinants depends on the level of corruption and therefore, migratory flows are found to be corruption dependent. In fact, we show that high corruption in the destination country could lead to a decoupling of the net migration flows from both effects (GDP and PPP exchange rate). The policy implications of our findings suggest that corruption, and its interactions with other migration factors, should in principle be examined in migration studies. We employ net migration flows, defined as immigrants minus emigrants, for the case of Greece as destination country where migration-flows direction has changed sign two times in the post-war era. The data are obtained from the World Bank. Our findings remain robust [1] to a series of alternative specifications with the world governance indicators (WGIs) and, [2] to the use of several estimators.

Keywords: corruption; exchange rates; migration flows; GDP; Greece

JEL codes: D73; F22; F31; O52

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1 Introduction – Motivation and links to the existing literature

We re-visit the empirical literature on migration flows emphasizing corruption, exchange rates and GDP, and focusing on the case of Greece for the period 1996-2021 as a destination country – one of the countries with affluent migration flows in the last 30 years.

Recent contributions include Kuhnt (2019) who offers a literature review on determinants of migration flows and argues that migration decision is a complex process depending on many factors. Similarly, Wheatland (2015) reviews migration literature indicating that corruption is a main driver of migration flows as well as a facilitator of illegal migration. Next, Poprawe (2015) supports that corruption acts as a push factor for migration as it encourages emigration and discourages immigration, and Dimant et al. (2013) show that corruption intensifies migration outflows, especially for high-skilled workers. In the same vein, Ariu et al. (2016) argue that corruption leads to a net loss of highly skilled workers as it pushes them to "virtuous" countries with job finding based on meritocratic criteria. Moreover, Cooray and Schneider (2016), studying emigration and corruption by educational attainments, conclude that increased corruption is linked to greater emigration for high educational levels and support an inverse U-shaped response of emigration to corruption for low and medium education levels. Finally, Bergh et al. (2015) suggest that institutional quality triggers migration flows as high-quality governance encompasses an intrinsic value for people and poor governance acts as a push factor, while Bertocchi and Strozzi (2008) find that institutional quality, besides economic and demographic characteristics, matters for migration.

Bernini et al. (2024) employ a gravity model and provide strong evidence that corruption acts both as a pull and push factor on migration flows. Specifically, emigration positively responds to corruption in the origin country, whilst corruption in the destination country negatively affects immigration. Such results are in line with Poprawe (2015). Li et al. (2023) explore the effect of corruption and other governance indicators on migration flows, using machine-learning techniques and finding that brain drain is primarily driven by corruption. As a result, the authors argue that anti-corruption measures and initiatives, as well as enhanced governance practices, should be enacted to reverse brain drain into brain gain. This is consistent with Cooray and Schneider (2016), suggesting government actions to control corruption and prevent brain drain. Next, Giang et al. (2020) examine the role of income and corruption in pushing and pulling migrants, supporting that higher income tends to attract immigrants, low public services appear to increase emigration and low corruption seems to pull immigrants. Finally, Arif (2022) finds evidence that low corruption could attract more educated migrants than less educated migrants.

For the relation between exchange rates and migration flows, there is rather limited macroeconomic literature. See for example, Agiomirgianakis and Zervoyianni (2001a, 2001b), and Agiomirgianakis (1999, 1996) for a theoretical approach claiming that appreciation of home currency is a pull factor for immigration, whilst depreciation is a push factor for emigration. For an analogous empirical finding on exchange rates, see also Yang (2006) for the case of the Philippines. Also, more recent research on exchange rates and migration flows by Keita (2016) shows that, for a dataset of 30 OECD destination countries, migration flows are positively responsive to favorable bilateral real exchange rates of the home country.

However, none of the above papers has examined how corruption interacts with other determinants of migration flows and how crucially alters the impact of other determining factors.

In this paper we focus on Greece, where migration flows show an idiosyncratic pattern: In the first decades of the post-war era, Greece was a net-emigration country along with other Mediterranean countries, i.e. Italy, Spain, and Turkey. After 1974 Greece switched to a net-immigration country. Especially after the collapse of the ex-socialist countries, Greece experienced a huge inflow of immigrants from Eastern European countries. Thirdly, Greece switched again to a net-emigration country in 2004, and the peak of net emigration flows occurred in 2013 largely due to the debt crisis. That peak was due to a historic depression in the Greek economy with a fall in real GDP by more than 25% up to 2014. Thus, the increasing GDP gap between Greece and EU27 (see Figure 1) led to not only to a fall in the stock of immigrants in Greece but also induced Greek citizens to emigrate abroad. In fact, it is well documented that there was a brain drain from Greece of about half a million people leaving the country (Pratsinakis, 2022).[1] Comparing to the other Mediterranean countries, Greece in the post-war era has switched sign of migration flows twice: from a net-emigration country (1960-1973) became a net-immigration country (1974-2003), and thereafter persistently becomes a net-emigration country (2003-2021). This is an idiosyncratic pattern justifying the choice of Greece as a case study worth investigating on its own.

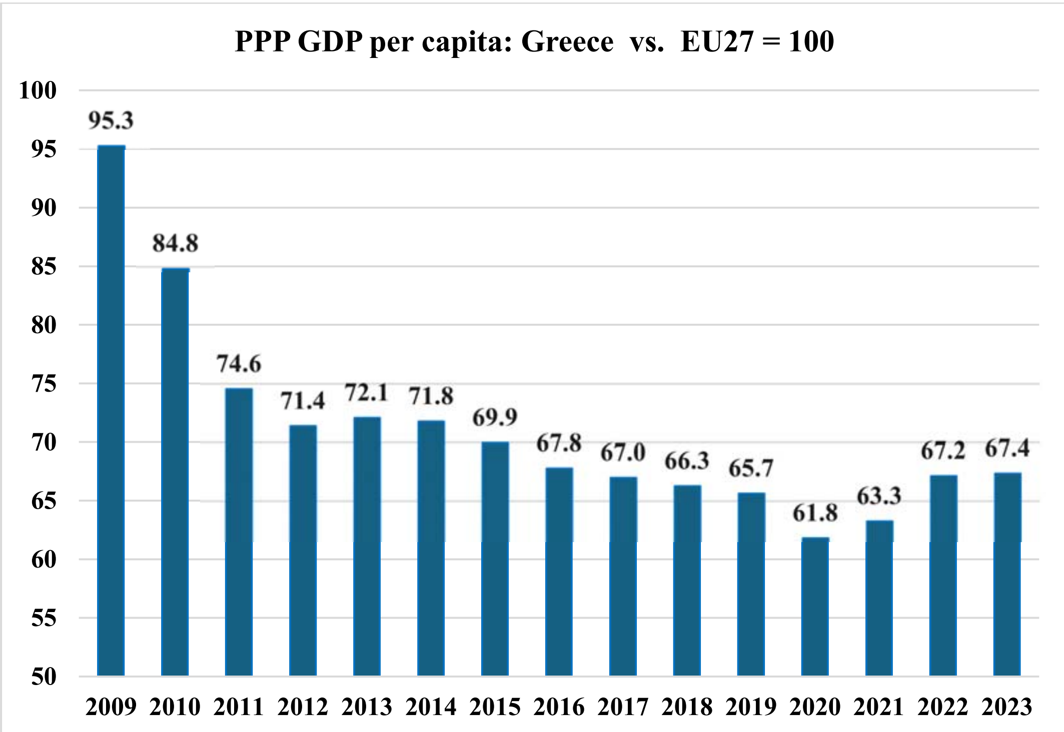
Briefly, our findings are the following: Firstly, we confirm the well-established negative effect of corruption on migration, i.e. increased (decreased) corruption in home country leads to emigration (immigration). Secondly, we enrich the migration-corruption literature by

[1] Such brain drain seems to have created shortages in the Greek labor market. For example, in the tourism sector there are about 60,000 vacancies [source: Research Institute for Tourism, November 2022, https://www.itep.gr/wp-content/uploads/2022/12/Hotel-Employment_2022-11-15_v01_public.pdf] creating serious problem to the primary workforce of the Greek economy. As a result, Greek authorities facilitate the seasonal needs of the domestic economy with an influx of migrant workers from Africa and Asia, or by granting three-year stay and work permits to illegal migrants from non-EU area.

showing PPP exchange rates as a decisive factor of migration flows. Thirdly, we show that the working of push and pull factors of migration flows, such as exchange rates and GDP, depend crucially upon the level of corruption. This is so, since a depreciation at home in PPP terms acts as a push factor for emigration, while an appreciation as a pull factor for immigration. Furthermore, improvement (deterioration) of home relative GDP is a pull (push) factor for migration. However, it empirically appears that public sector corruption at home (Greece) distorts these channels as [1] these effects hold up to median values of corruption and [2] there is a decoupling of these effects for high levels of corruption.

The study continues as follows: Section 2 involves data description as well as, results' presentation and analysis. Next, we briefly describe robustness checks. Section 3 concludes and provides direction for future work. Finally, there is an Appendix with supplementary material related to this paper.

Figure 1: GDP per capita of Greece



Notes: Figure 1 shows the GDP per capita of Greece in purchasing power standards (PPS) and in deviation from the 27 European countries (EU27 = 100). Source: Eurostat, "main GDP aggregates per capita" (code: nama_10_pc), accessed May 2024.

2 Data and results

We obtain net migration flows (NMF) data for Greece from the World Bank. *NMF* is defined as immigrants minus emigrants and constitutes the dependent variable. Positive values denote net inflows and negative values net outflows. Data are annual covering the years 1960 to 2021.

We also download data for the purchasing power parity (PPP) GDP conversion factor (local currency per international USD) to capture PPP exchange rates. A decrease and an increase in this variable denote, respectively, an appreciation and a depreciation of the home currency in PPP terms. The anticipated sign of the exchange rate's coefficient is negative, since appreciations (depreciations) at home act as a pull (push) factor for migration flows, following e.g. Keita (2016), Yang (2006), and Agiomirgianakis and Zervoyianni (2001a, 2001b). Furthermore, GDP values in PPP terms (current international USD) for Greece and the world are obtained to construct the quotient of Greece's GDP to the world's GDP. The expected effect of standardized home GDP is positive as a relative improvement (fall) of the destination country's GDP is a pull (push) factor for migration. Data for both variables cover the 1990 to 2021 period and come from the World Bank.

PPP exchange rates blend relative prices with the nominal exchange rates (home per foreign currency) such that a higher general cost of living at home country, relative to a foreign country, denotes that home currency depreciates. Nominal depreciations of home currency relative to a foreign currency and/or higher cost of living at home country relative to a foreign country is a sufficient monetary condition for local individuals to migrate into that foreign country. So, if home currency becomes weaker in PPP terms, then wage differentials will increase in favor of abroad motivating an individual to emigrate. Moreover, if home currency becomes weaker in PPP terms, then a native will require lower earnings in the foreign country to migrate into that country. Conversely, a stronger home currency, in PPP terms, could motivate foreign individuals to migrate into the home country.

Data for control of corruption (COC) are collected from the World Bank. *COC* is one the six world governance indicators (WGIs) that range between -2.5 to 2.5 with higher values denoting strong governance performance.[2, 3] We transform *COC* to take values between 0 and 5, i.e. $COC' = COC + 2.5$, and employ a log transform such that the new variable becomes normalized and symmetric around zero (see Bertsatos et al., 2023). The new variable, COR, is increasing in corruption as higher values indicate greater levels of perceived corruption in the public sector.

[2] See Kaufmann et al. (2010) for more details about WGIs.

[3] WGI data are available from 1996 and is reported on annual frequency. As for years 1997, 1999 and 2001 there are missing values, we fill them by taking the average of previous and next year.

$$COR = ln\left[\frac{5.1-(COC+2.5)}{0.1+(COC+2.5)}\right] = ln\left[\frac{5.1-COC'}{0.1+COC'}\right] = ln(Z) \quad (1)$$

where *COR* is the natural logarithm of the transformed corruption variable *Z*. Literature suggests that the anticipated effect of home corruption on *NMF* is negative, i.e. it acts as a push factor for migration.

Equation (2) describes the specification of the main model:

$$NMF_t = c + a_1 \cdot X_{1,t} + a_2 \cdot X_{2,t} + \left(a_3 + \beta_1 \cdot X_{1,t} + \beta_2 \cdot X_{2,t}\right) \cdot COR_t + u \quad (2)$$

where *NMF* is net migration flows, X_1 is the natural logarithm of PPP exchange rates, X_2 is the natural logarithm of GDP ratio, *COR* is the natural logarithm of the transformed corruption variable, and u is the error term. X_1 and X_2 account for monetary factors and *COR* for the institutional part of the decision for migrating.

Performing unit-root tests we find evidence that the examined $Z_t = (NMF_t, X_{1,t}, X_{2,t}, COR_t)$ four variables are integrated of order $d = 2$, or *I*(2).[4] Therefore, we estimate long-run effects of Equation (2) using OLS, fully modified OLS (FMOLS) of Phillips and Hansen (1990), and canonical co-integrating regression (CCR) of Park (1992). At the same time, we allow for corruption-varying coefficients (see also Bertsatos et al., 2023). Moreover, should residuals be of a lower order of integration $d - b$ with $b > 0$, $\hat{u} \sim I(d - b)$ then, there is evidence of co-integration according to Engle and Granger (1987). Specifically, vector Z is co-integrated of order d, b and denoted as $Z \sim CI(d, b)$. Table 1 presents the long-run estimates of Equation (2).

We notice that in models without corruption interactions, the coefficients of PPP exchange rates and standardized home GDP are statistically equal to zero with OLS and FMOLS. Also, corruption impacts *NMF* at 10% size. Next, in the other set of models, we observe that the interaction terms with corruption are statistically significant with all three estimators, as well as the coefficients of PPP exchange rates and standardized home GDP. One could claim that such findings point to potential misspecification bias due to omission of the corruption's interactions. As a result, it appears that there is no practical implication in focusing on models without corruption-dependent responses of *NMF*, but on full models with corruption-varying effects.[5]

[4] Details about the results of unit-root tests are in the Appendix.

[5] See the Appendix for a more detailed analysis.

Table 1: Estimation results

	OLS		FMOLS		CCR	
PPP exchange rates	-119,007.8 [0.0217]	-186,017.3 [0.1519]	-113,814.2 [<0.01]	-160,309.5 [0.1103]	-116,985.6 [<0.01]	-178,204.9 [0.0236]
GDP ratio	54,306.7 [0.0824]	76,019.1 [0.1968]	47,974.5 [0.0105]	70,820.5 [0.1634]	49,520.3 [<0.01]	85,814.9 [0.0422]
COR	-1,322,571.1 [<0.01]	-68,450.9 [0.0612]	-1,416,314.9 [<0.01]	-73,419.1 [0.0755]	-1,484,769.2 [<0.01]	-63,539.2 [0.0668]
PPP exchange rates · COR	1,005,677.9 [<0.01]	-	1,042,453.6 [<0.01]	-	1,045,326.7 [<0.01]	-
GDP ratio · COR	-302,184.1 [<0.01]	-	-321,323.5 [<0.01]	-	-334,181.1 [<0.01]	-
Intercept	236,835.3 [0.1360]	335,973.9 [0.2411]	201,332.3 [0.0314]	313,885.6 [0.2183]	208,779.2 [<0.01]	392,482.6 [0.0693]
R^2 / Adj. R^2	0.9488 / 0.9360	0.8109 / 0.7851	0.9482 / 0.9345	0.8170 / 0.7909	0.9472 / 0.9333	0.7984 / 0.7696
Residuals	$I(0)$	$I(0)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$
JB test for residuals	0.7706	0.3627	0.8313	0.7338	0.8456	0.7958

Notes: *p*-values of estimated coefficients are in brackets. HAC standard errors are employed for the OLS estimator. FMOLS denotes the fully modified OLS estimator of Phillips and Hansen (1990), and CCR denotes the canonical co-integrating regression of Park (1992). Testing for co-integration, according to Engle and Granger (1987), with the augmented Dickey-Fuller and the Phillips-Perron unit-root tests on the estimated residuals, we find evidence of co-integration (more details are available in the Appendix). *JB* stands for the Jarque-Bera normality test and its *p*-value is shown.

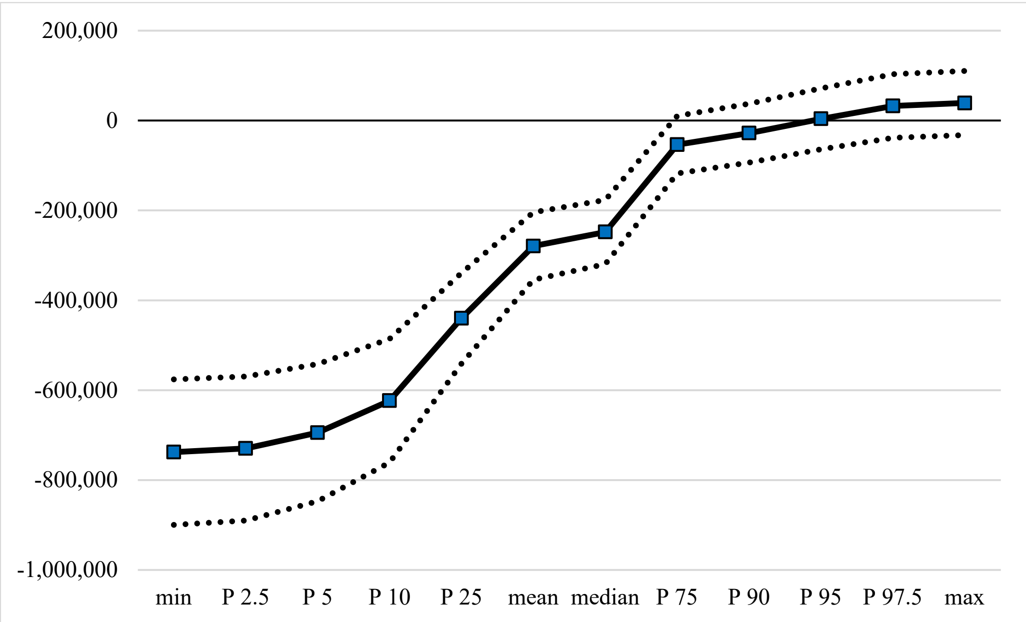
In such models with corruption-varying effects, one can observe that the coefficients of PPP exchange rates and GDP ratio have a negative and positive sign, respectively, as well as that corruption faces a negative coefficient regardless of the estimation method (OLS, fully modified OLS of Phillips and Hansen, 1990, canonical co-integrating regression of Park, 1992). Similar results are obtained should we employ the robust OLS (M-estimation with Cauchy and Welsch functions) and the conditional quantile regressions of Koenker and Bassett (1978) at the median (more details are given in the Appendix). To economize on space in the current analysis, we continue based on the FMOLS results.

Next, we extract the marginal effects of PPP exchange rates and GDP ratio at different points of the empirical distribution of corruption: $\partial NMF/\partial X_j = a_j + \beta_j \cdot COR$ for $j = \{1,2\}$.

Specifically, for corruption values equal to the minimum value, 2.5th, 5th, 10th and 25th percentiles, mean value, median value, 75th, 90th, 95th and 97.5th percentiles, and maximum value. Figures 2 and 3 below depict the average marginal effects and the associated 2-standard-error confidence intervals.

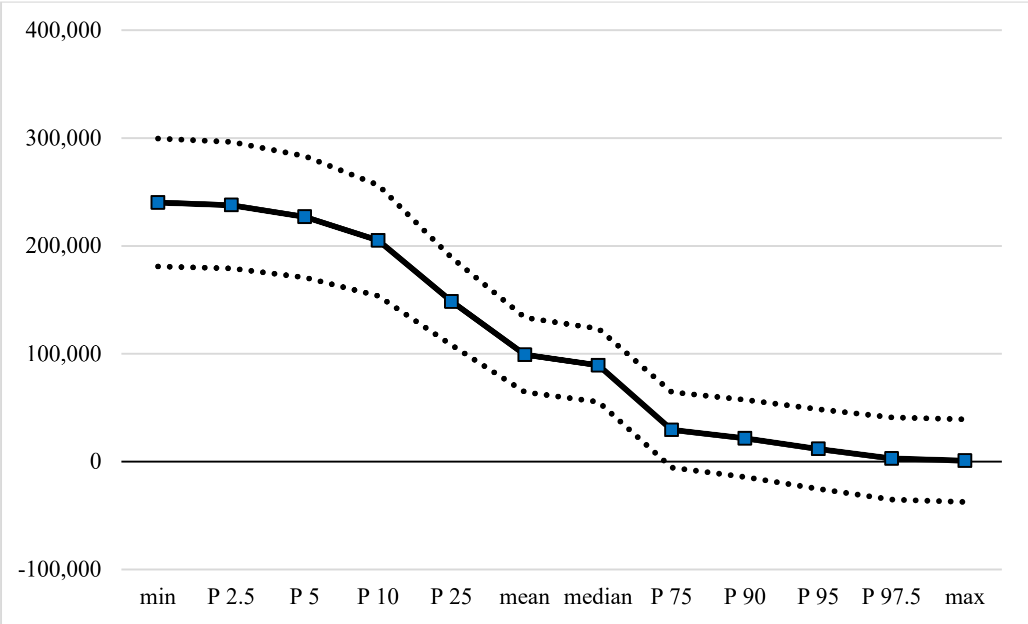
In Figure 2 we notice that the marginal effect of PPP exchange rates is negative and increasing in corruption and remains statistically significant up to median values of corruption. Additionally, the marginal effect at mean corruption is -279,319.0 implying that a 1% depreciation of home currency in PPP terms is linked to a net outflow of about 2,793 emigrants. Namely, there are more emigrants leaving Greece than immigrants coming to Greece. Therefore, according to the specification allowing for corruption-dependent responses of net migration flows, PPP exchange rates exert a negative effect up to median values of corruption and lead to net emigration. On the other hand, in the models without corruption interaction terms, PPP exchange rates exert either a negative effect (see Table 1, CCR results) on migration flows or no effect at all (see Table 1, OLS and FMOLS results).

Figure 2: Marginal effect of PPP exchange rates



Notes: Figure 2 shows the marginal effects of the natural logarithm of PPP exchange rates at different points of empirical distribution: $\partial NMF/\partial X_1 = a_1 + \beta_1 \cdot COR$.

Figure 3: Marginal effect of standardized home GDP



Notes: Figure 3 displays the marginal effects of the natural logarithm of GDP ratio at different points of the empirical distribution of corruption: $\partial NMF/\partial X_2 = a_2 + \beta_2 \cdot COR$.

Figure 3 shows that the marginal effect of the GDP ratio is positive and decreases as corruption deteriorates. Likewise with that of PPP exchange rates, it is statistically significant up to median values of corruption. Furthermore, the marginal effect of the GDP ratio at the mean corruption level equals 98,989.3 denoting that a 1% increase in standardized home GDP is associated, on average, with a net inflow of almost 990 immigrants. Namely, there are more immigrants coming to Greece than emigrants leaving Greece. Consequently, based on the specification with corruption-dependent coefficients, GDP ratio tends to boost net migration flows up to the median values of corruption and leads to net immigration. However, in the models without corruption interaction terms, GDP ratio has either a positive effect (see Table 1, CCR results) on migration flows or no effect at all (see Table 1, OLS and FMOLS results).

To sum up for the home county Greece and for low or medium levels of corruption, it appears that a depreciation at home or a relative fall in home GDP indicates less immigrants coming in Greece than emigrants leaving Greece (net emigration). On the other hand, for high corruption levels, net migration remains unaffected after a depreciation at home or a relative fall in home GDP, denoting empirically that the number of immigrants coming in Greece is about equal to the number of migrants leaving Greece. Moreover, for low or medium corruption levels, it turns out that an appreciation at home or a relative increase in home GDP suggests more immigrants coming in Greece than emigrants leaving Greece (net immigration). However, for high levels of public sector corruption after an appreciation at home or a relative increase in home GDP, net migration flows are constant, indicating empirically that the number of migrants leaving Greece approximately equals the number of immigrants coming in Greece.

Finally, we estimate the corruption effect on net migration flows; however, this is not straightforward to obtain due to the existence of interaction terms. Emphasizing on the mean values of PPP exchange rates and the standardized home GDP, it appears that the average marginal effect of public sector corruption is -135,904.9 with the 2-standard-error confidence interval ranging from -164,797.0 to -107,012.8. Namely, a 1% increase of the transformed corruption variable *Z* denotes a net outflow of about 1,359 emigrants. Using several points of the empirical distributions of PPP exchange rates and GDP ratio (instead of the mean), we find that for their greatest part of empirical distribution, corruption exerts a negative effect on *NMF*. Corruption matters for migration and acts as a migratory push factor. Such a finding for corruption – acting as a push factor – is also well documented in the related literature (see e.g. Arif, 2022, Bernini et al. 2024, Li et al. 2023, Giang et al., 2020).

3 Robustness checks

Estimating a series of specifications with alternative WGIs and estimators, as well as with the corruption perceptions index (CPI) of Transparency International, we find that results exhibit robustness, especially with respect to the marginal effects of PPP exchange rates and standardized home GDP. More details are presented in the Appendix.

4 Conclusions and direction for future work

This paper focuses on net migration flows (immigrants net of emigrants, NMF), involving interactions with public sector corruption, for the home country Greece: a country with net emigration from early 60s until 1973 and with immigrants' surplus after the fall of the "Colonels' Regime" in 1974 up to 2003, before switching again to net emigration from 2004 onwards. Calculating the marginal effects of covariates, a series of fruitful results arises. We find evidence that a depreciation (appreciation) of home currency, and a decrease (increase) of home GDP relative to world GDP, seem to reduce (boost) *NMF*. Alternatively, depreciation at home in PPP terms acts as a push factor for emigration, whilst improvement of standardized home GDP is a pull factor for immigration. Also, appreciation at home in PPP terms acts as a pull factor for immigration, whilst relative deterioration of home GDP is a push factor for emigration. These effects hold up to median values of public sector corruption as for higher corruption values, we observe a decoupling of *NMF* from exchange rates and GDP ratio. In fact, corruption turns out to erode both the positive effect of the GDP ratio and the negative effect of exchange rates on net migration flows, respectively.

Moreover, corruption tends to exert a negative effect on *NMF* for the greatest part of exchange-rate and standardized-GDP empirical distributions. Namely, our results convey the message that corruption has a two-fold role in migration flows for Greece: first it acts as a migratory push factor and second, it distorts the transmission channels of monetary factors (PPP exchange rates and standardized GDP). Furthermore, given that the economic consequences of migration can be either salutary or worrisome (see e.g. Katseli et al., 2006), in research studies it would be advisable to link migration and development policies to corruption levels.

However, there are limitations in this paper. Future research could expand the proposed in this paper's framework as follows. First, by examining larger samples and more countries. Results presented in the current analysis could be exclusively country-specific since Greece is an idiosyncratic country in terms of migration flows, as we have argued above, experiencing positive net inflows in the beginning of the examined sample (1996-2003) and persistent positive net outflows (2004-2021) thereafter. Therefore, the empirically established corruption-driven findings, in this analysis, for the exchange rates and GDP should be explored in larger datasets. Secondly, by employing either cross-sectional or time-series or panel-data framework. Thirdly, with the use of a richer set of controls (e.g. quality-of-life indicators) and estimation of specifications taking into account potential nonlinear responses of migration flows (see Vogler and Rotte, 2000; Cooray and Schneider, 2016; and Ghelli et al., 2022). Fourthly, endogeneity issues may be present in the current analysis, even if the employed CCR estimation technique asymptotically eliminates the endogeneity triggered by the long-run correlation between the cointegrating equation errors and the stochastic regressors innovations. As a result, addressing potential endogeneity between corruption and migration could be examined with alternative techniques such as, 2SLS or 3SLS estimators, as suggested by Baudassé et al. (2018), who examine a two-way relationship between migration and institutions, and Ivlevs and King (2017), who examine reverse causality between emigration and corruption.

Conflict of interests

We declare that there are no conflicts of interest. The views expressed here are our own and do not necessarily represent the position of the institutions we are affiliated with.

Appendix: Further analysis of main results

In this section of the Appendix, we discuss further the results of Table 1 in the main text.

We notice that in models without corruption interactions, the coefficients of PPP exchange rates and standardized home GDP are statistically equal to zero with OLS and FMOLS. Also, corruption impacts *NMF* only at 10% significance level. As a result, we put emphasis on full models with corruption-varying effects. In such models, one can observe that PPP exchange rates and GDP ratio have a negative and positive sign, respectively, as well as that corruption faces a negative coefficient regardless of the estimation method (OLS, fully modified OLS of Phillips and Hansen, 1990, canonical co-integrating regression of Park, 1992). Similar results obtain should we employ robust OLS (M-estimation with Cauchy and Welsch functions) and conditional quantile regressions of Koenker and Bassett (1978) at the median (more details are given in the next section).

We test for co-integration using unit-root tests on the estimated residuals of the models of Table 1. Specifically, we employ the augmented Dickey-Fuller (1979, ADF) and the Phillips-Perron (1988) unit-root tests. Specifications with an intercept, and with intercept and linear trend are estimated. Lag structure, up to max 5 lags, is chosen by the Schwarz information criterion (1978). If residuals are lower than second order of integration, i.e. $\hat{u} \sim I(d-b)$ with $d = 2$ and $b > 0$, there is co-integration – according to Engle and Granger (1987) – in the estimated specification of Equation (2) in main text. Performing unit-root tests on residuals, we find that that they are stationary for all estimated specifications – indicating evidence of co-integration between *NMF*, PPP exchange rates, GDP ratio and the corruption variable – except for the FMOLS and CCR models without corruption interactions where the associated residuals are found to be nonstationary.

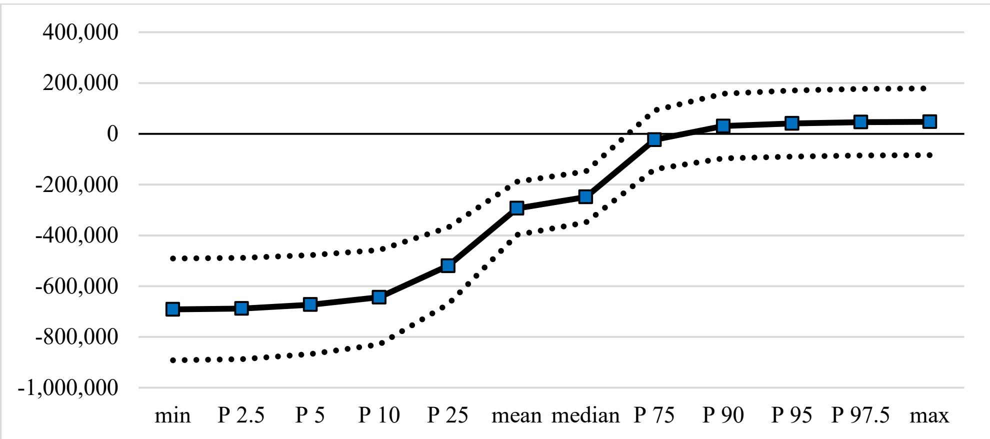
The response of net migration flows (NMF) to corruption is not straightforward to obtain due to the existence of interaction terms with PPP exchange rates and standardized home GDP. As proof, the indirect effect of corruption on *NMF* is negative $\left(\frac{\partial^2 NMF}{\partial X \partial COR} < 0\right)$ with respect to GDP ratio and positive $\left(\frac{\partial^2 NMF}{\partial X \partial COR} > 0\right)$ with respect to PPP exchange rates. Therefore, we extract the marginal effect of corruption at several points of the empirical distribution of PPP exchange rates and standardized home GDP (minimum, 2.5th, 5th, 10th and 25th percentiles, mean value, median value, 75th, 90th, 95th and 97.5th percentiles, and maximum). It turns out for their greatest part of empirical distribution that corruption exerts a negative effect on *NMF*. Namely, corruption matters for migration and is a migratory push factor.

Robustness checks

We repeat the analysis in main text with FMOLS of Phillips and Hansen (1990) by replacing control of corruption (*COC*) each time with one of the rest world governance indicators (WGIs) in Equation (1) in main text, i.e. political stability and absence of violence/terrorism, voice and accountability, rule of law, government effectiveness, and regulatory quality. For extra robustness, we employ the average value of the six WGIs as well as, the median value. Finally, we perform principal component analysis (PCA) on the dataset of the WGIs and according to the associated scree plot, the first principal component explains 82.05% of variance. As a result, we use the first principal component of the WGIs instead of *COC* in the analysis.[6]

The marginal effects of PPP exchange rates and standardized home GDP preserve their sign, with an exception for GDP ratio when regulatory quality is employed as the governance indicator (see Figures A.1 to A.16 below).[7] Furthermore, the negative marginal effect of corruption on NMF holds also for the alternative WGI variables, especially with political stability, voice and accountability, average WGIs, and the first principal component of WGIs. To sum up, we find ample evidence indicating results' stability.

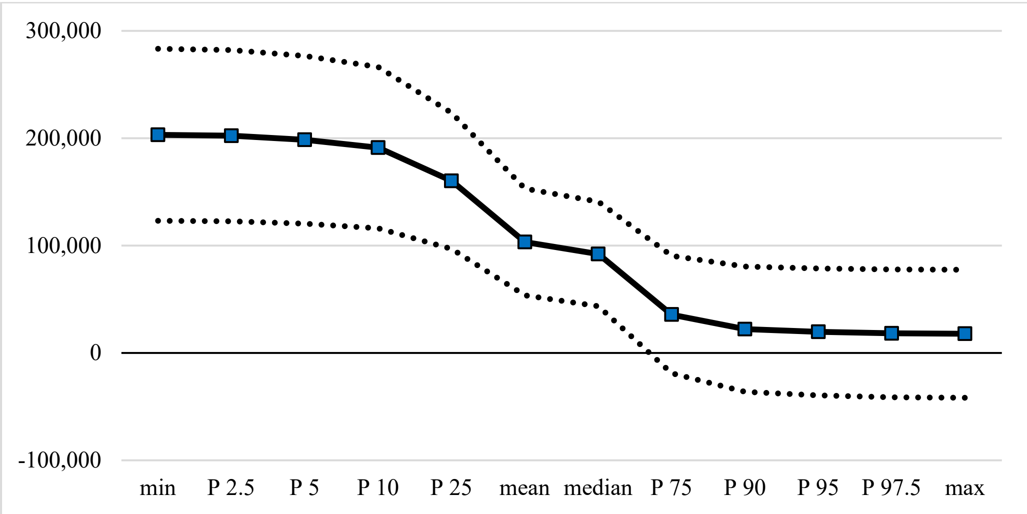
Figure A.1: Marginal effect of PPP exchange rates. Specification with political stability and absence of violence/terrorism



[6] PCA of WGIs has also been used in several papers. For example, Ariu et al. (2016) and Anastasiou et al. (2019) explore the effect of governance quality, respectively, on net migration flows and non-performing loans.

[7] *COC* faces correlation coefficients higher than 75% with all WGIs, except for regulatory quality that shares a correlation coefficient 52% with *COC*.

Figure A.2: Marginal effect of standardized home GDP. Specification with political stability and absence of violence/terrorism



The average marginal effect of transformed political stability WGI, estimated at the mean values of PPP exchange rates and standardized home GDP, is equal to -101,763.9 and the associated 2-standard-error confidence interval ranges from -141,957.1 to -61,570.7.

Figure A.3: Marginal effect of PPP exchange rates. Specification with voice and accountability

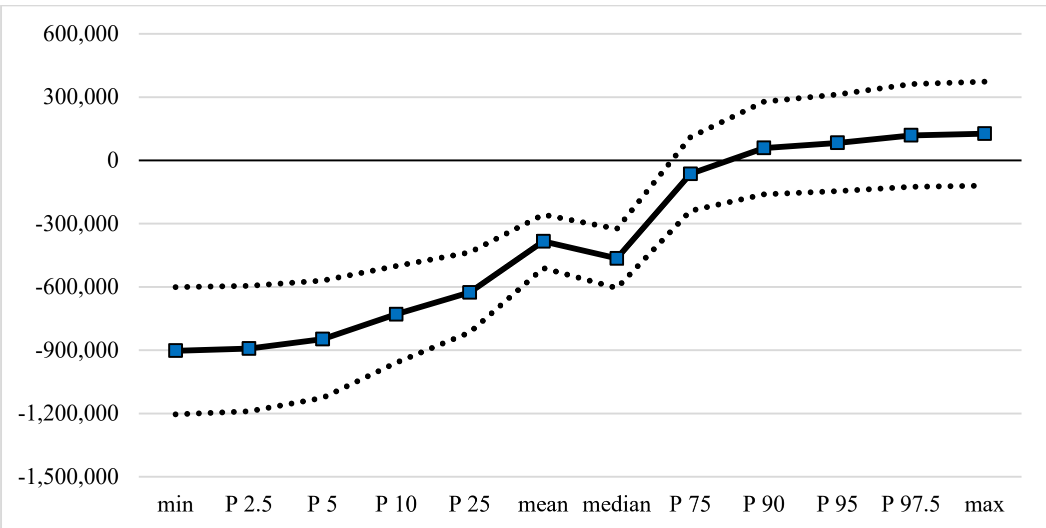
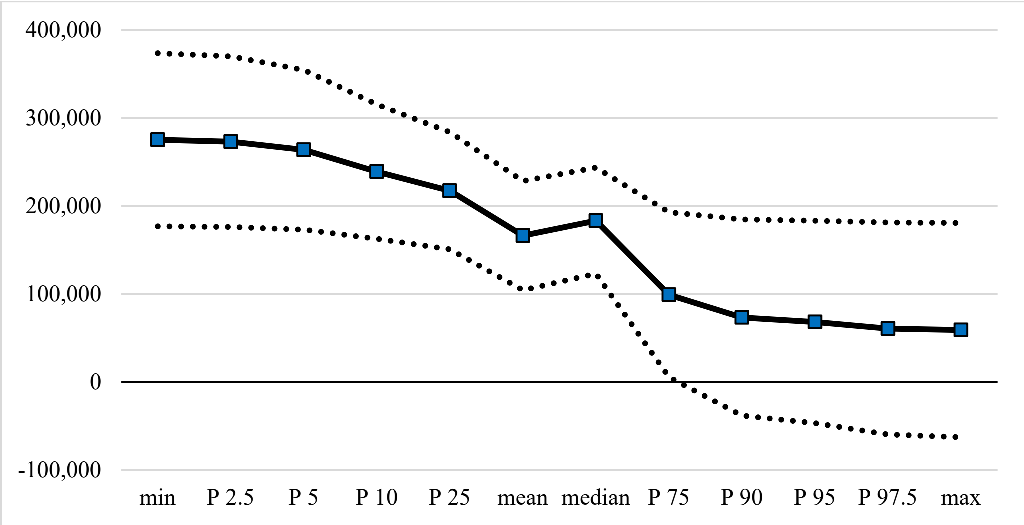


Figure A.4: Marginal effect of standardized home GDP. Specification with voice and accountability



The average marginal effect of transformed voice and accountability, estimated at the mean values of PPP exchange rates and standardized home GDP, is equal to -141,097.9 and the associated 2-standard-error confidence interval ranges from -256,965.2 to -25,230.6.

Figure A.5: Marginal effect of PPP exchange rates. Specification with rule of law

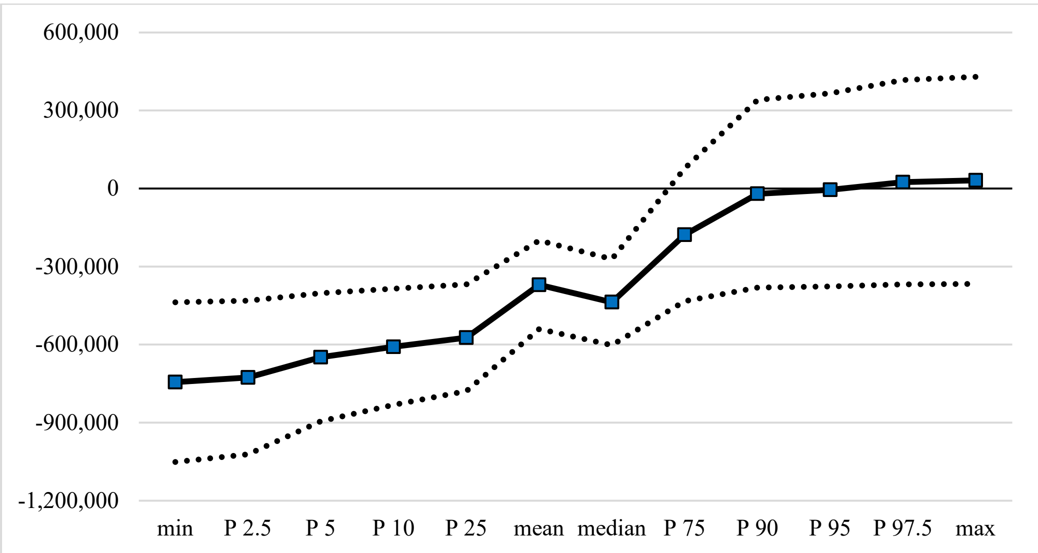
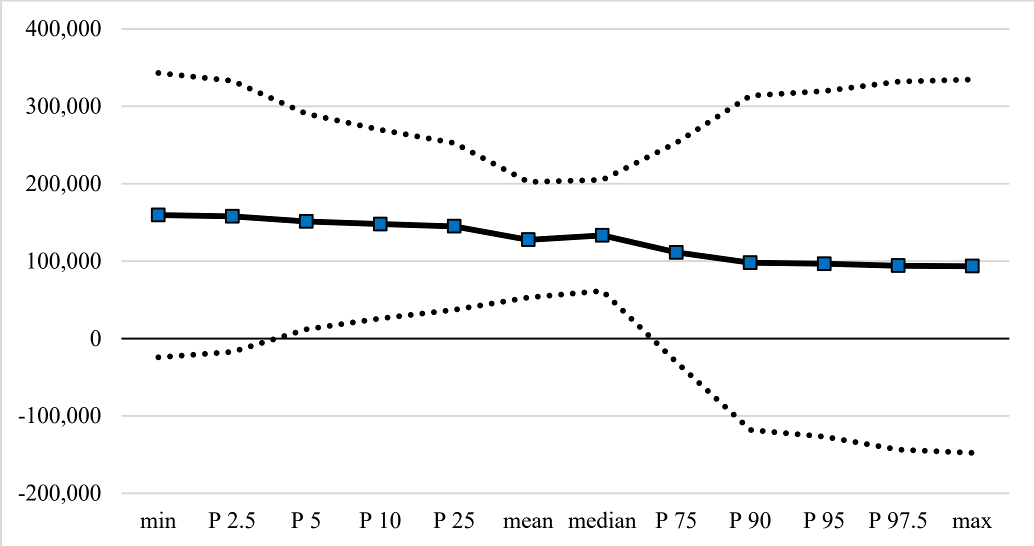


Figure A.6: Marginal effect of standardized home GDP. Specification with rule of law



The average marginal effect of transformed rule of law, estimated at the mean values of PPP exchange rates and standardized home GDP, is -73,281.9 and statistically insignificant as the associated 2-standard-error confidence interval includes zero.

Figure A.7: Marginal effect of PPP exchange rates. Specification with government effectiveness

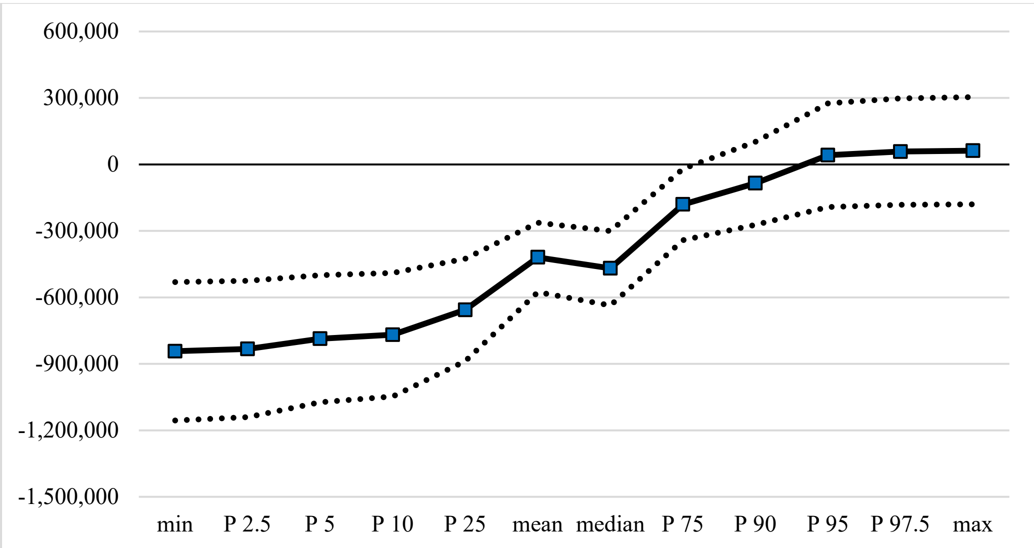
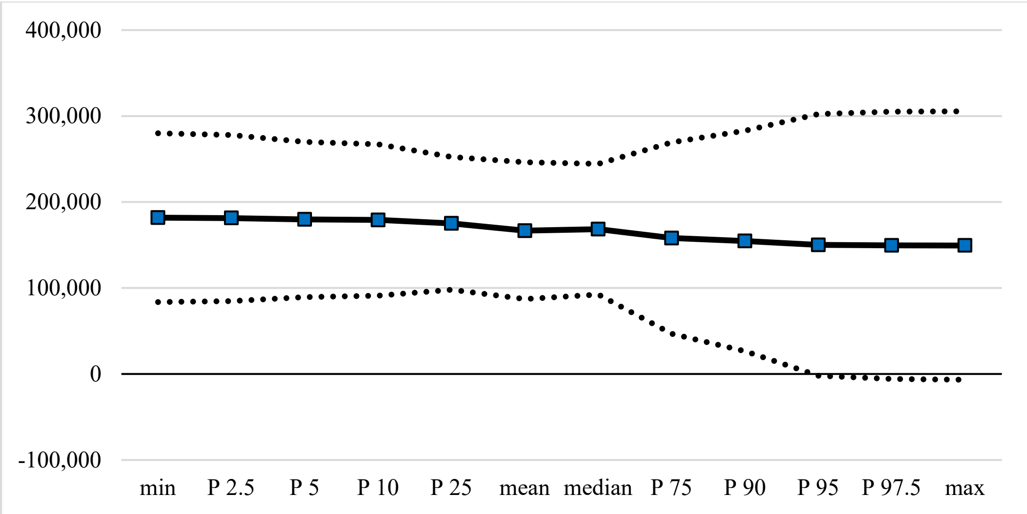


Figure A.8: Marginal effect of standardized home GDP. Specification with government effectiveness



The average marginal effect of transformed government effectiveness, estimated at the mean values of PPP exchange rates and standardized home GDP, is -76,227.8 and statistically insignificant as the associated 2-standard-error confidence interval includes zero.

Figure A.9: Marginal effect of PPP exchange rates. Specification with regulatory quality

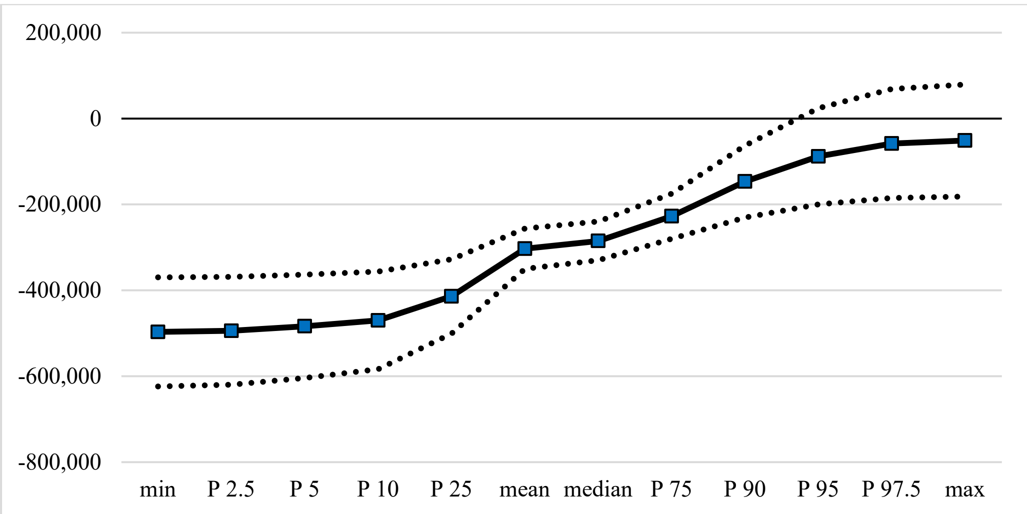
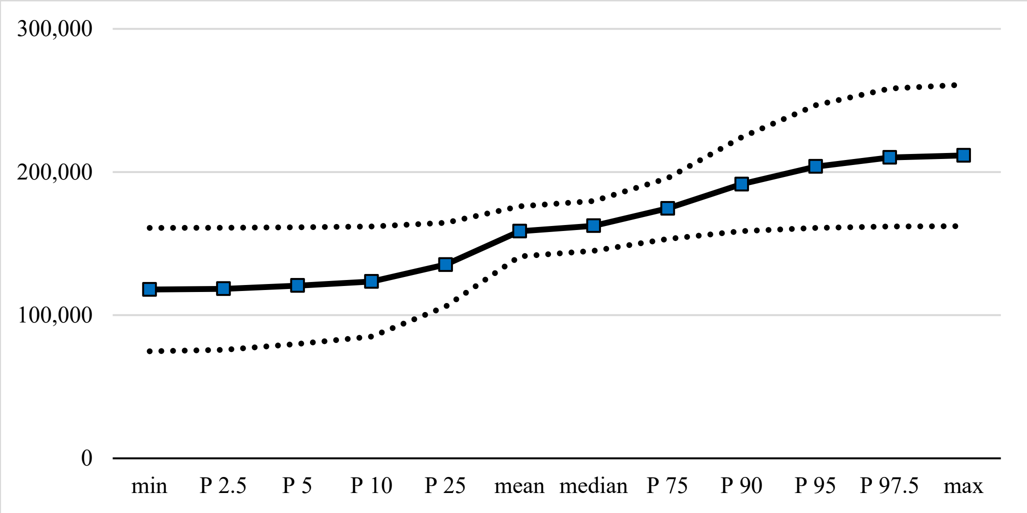


Figure A.10: Marginal effect of standardized home GDP. Specification with regulatory quality



The average marginal effect of transformed regulatory quality, estimated at the mean values of PPP exchange rates and standardized home GDP, is 11,619.2 and statistically insignificant as the associated 2-standard-error confidence interval includes zero.

Figure A.11: Marginal effect of PPP exchange rates. Specification with mean WGI

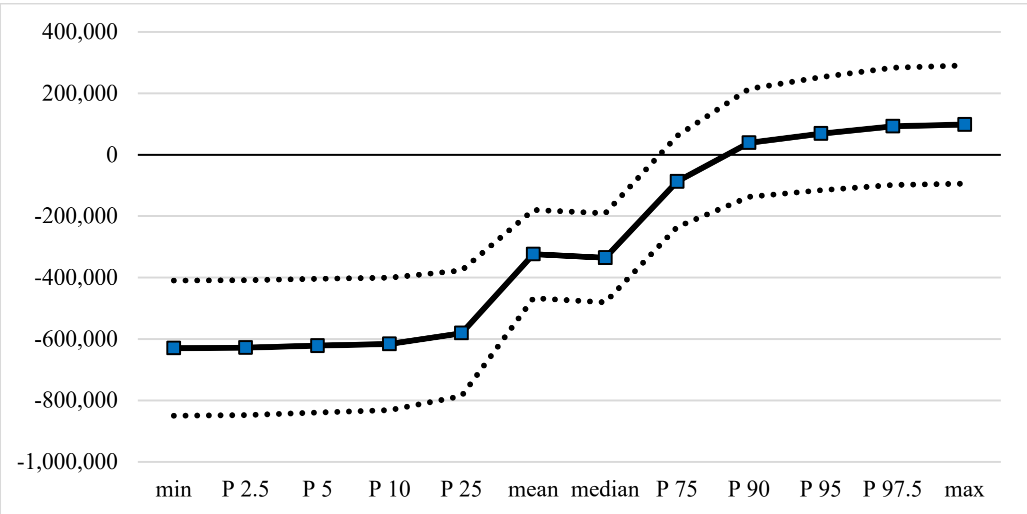
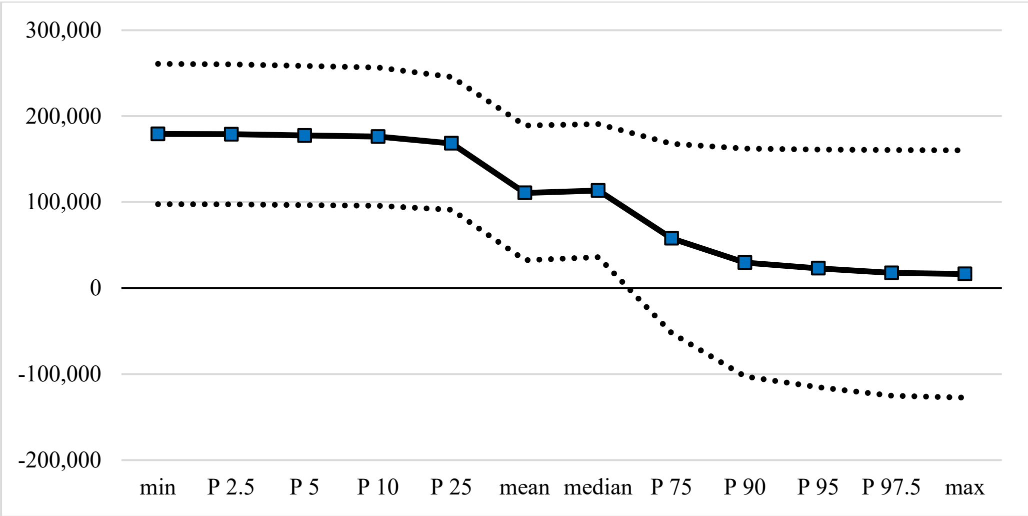


Figure A.12: Marginal effect of standardized home GDP. Specification with mean WGI



The average marginal effect of transformed mean WGI, estimated at the mean values of PPP exchange rates and standardized home GDP, is equal to -150,631.6 and the associated 2-standard-error confidence interval ranges from -248,991.8 to -52,271.4.

Figure A.13: Marginal effect of PPP exchange rates. Specification with median WGI

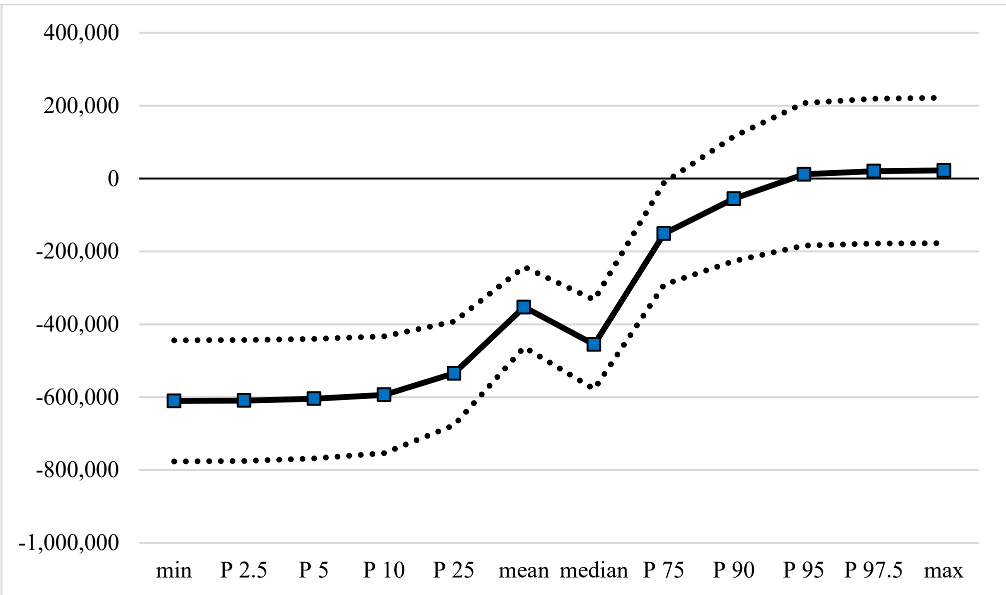
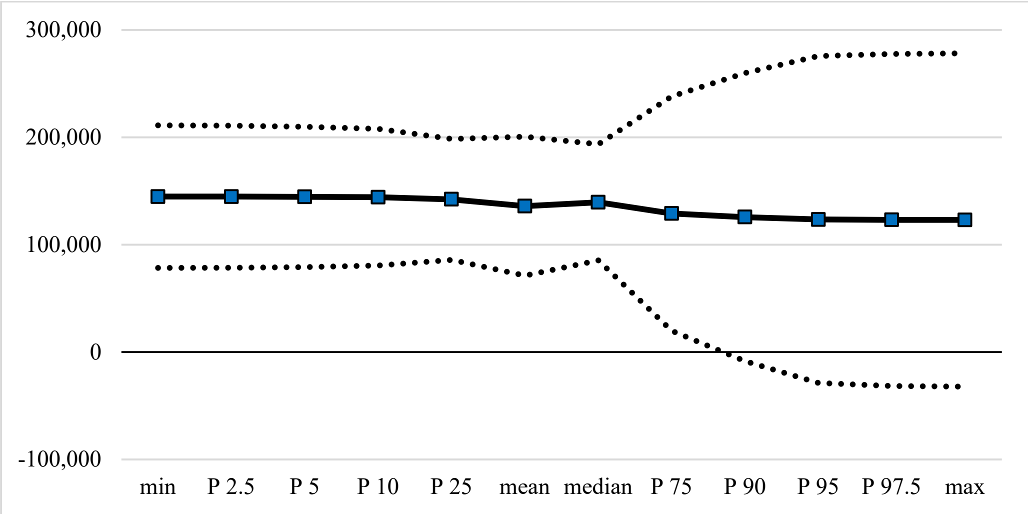


Figure A.14: Marginal effect of standardized home GDP. Specification with median WGI



The average marginal effect of transformed median WGI, estimated at the mean values of PPP exchange rates and standardized home GDP, is -73,392.5 and statistically insignificant as the associated 2-standard-error confidence interval includes zero.

Figure A.15: Marginal effect of PPP exchange rates. Specification with first principal component of WGIs

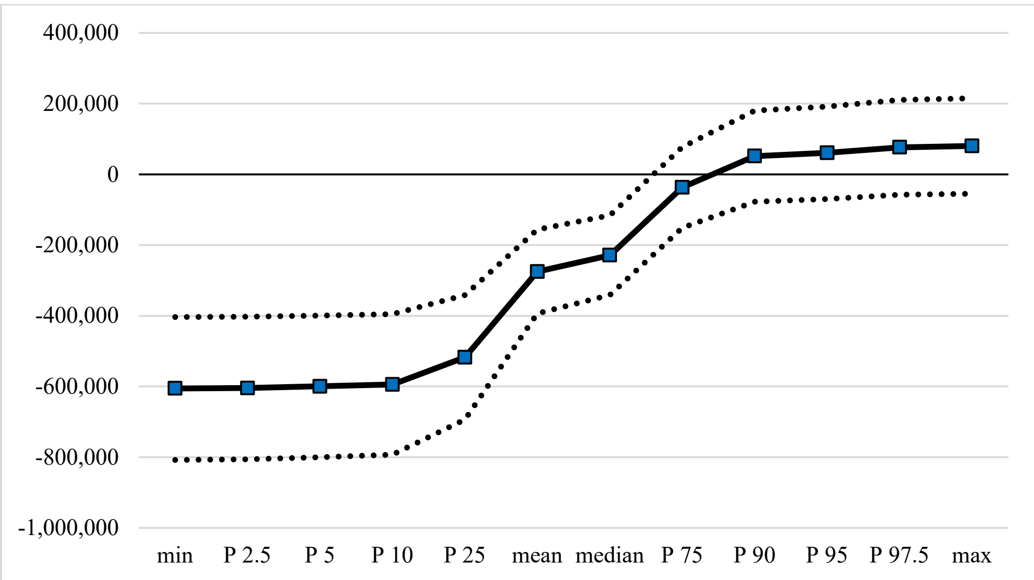
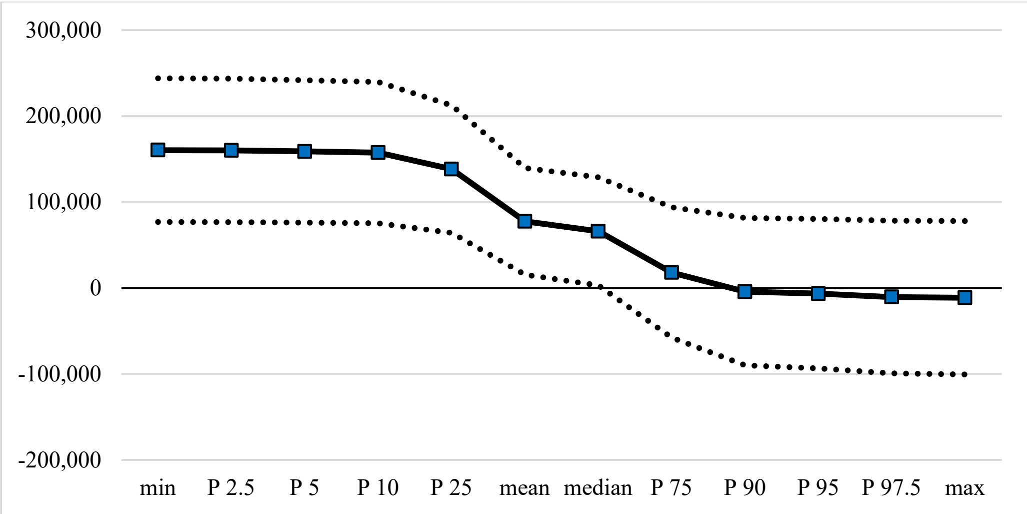


Figure A.16: Marginal effect of standardized home GDP. Specification with first principal component of WGIs



The average marginal effect of transformed first principal component of WGIs, estimated at the mean values of PPP exchange rates and standardized home GDP, is equal to -58,765.3 and the associated 2-standard-error confidence interval ranges from -81,845.6 to -35,685.1.

We also replace *COC* with the widely used variable of corruption perceptions index (CPI) of Transparency International (TI). CPI is a measure of cleanness and ranges from 0 to 100 with higher values denoting a clean public sector. Data are annual and start from 1996. Equation (A.1) shows the log transformation of *CPI* such that the new variable becomes normalized and symmetric around zero (see Bertsatos et al., 2023). Also, the new variable COR' increases in corruption as high values of corruption imply a deterioration of public sector corruption.

$$COR' = ln\left(\frac{101-CPI}{1+CPI}\right) = ln(Z') \tag{A1}$$

where COR' is the transformed corruption variable Z' in natural logarithm.

Even if *CPI* values are comparable year over year since 2012 due to the construction of the variable (see CPI methodology *here* for more details), the marginal effects of PPP exchange rates and GDP ratio preserve their sign across different values of the new corruption variable. Specifically, PPP exchange rates exert a negative effect on *NMF* for every corruption value and such effect is increasing in corruption. On the other hand, *NMF* responds positively to standardized home GDP up to the 90th percentile of corruption and such responses are decreasing in corruption.

Figure A.17: Marginal effect of PPP exchange rates. Specification with CPI

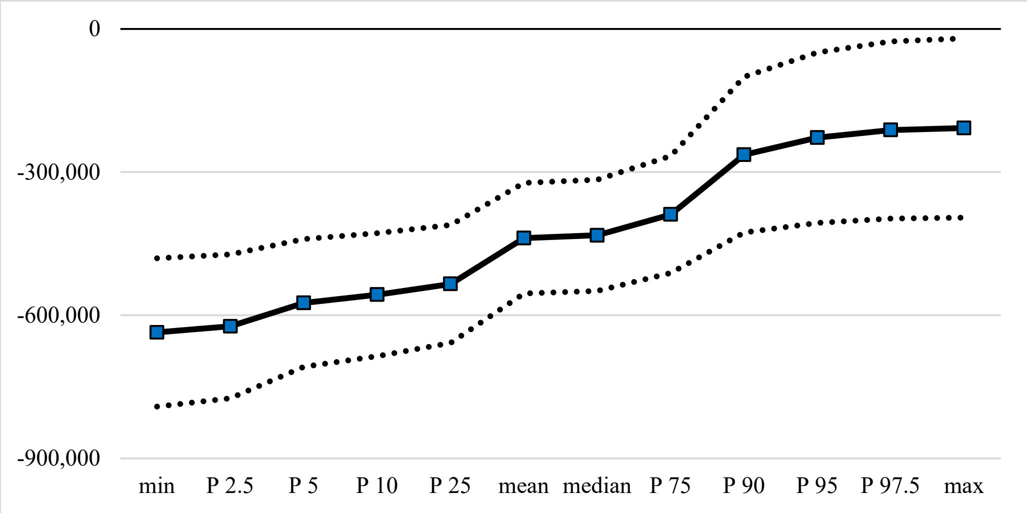
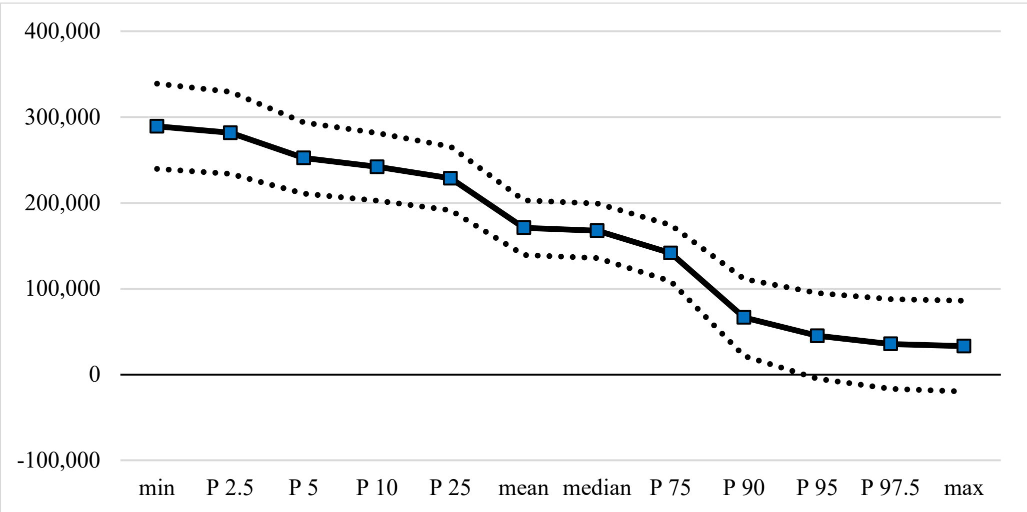


Figure A.18: Marginal effect of standardized home GDP. Specification with CPI



The average marginal effect of transformed CPI, estimated at the mean values of PPP exchange rates and standardized home GDP, is -44,972.4 and statistically insignificant as the associated 2-standard-error confidence interval includes zero.

We also use *NMF* standardized with population of Greece (downloaded from the World Bank as well) and the correlation of this variable with *NMF* is almost 100%, signaling for results robustness. As proof, marginal effects for the specification with *COR* and standardized *NMF* are qualitatively the same with those results with *NMF* and *COR*.[8]

Figure A.19: Marginal effect of PPP exchange rates

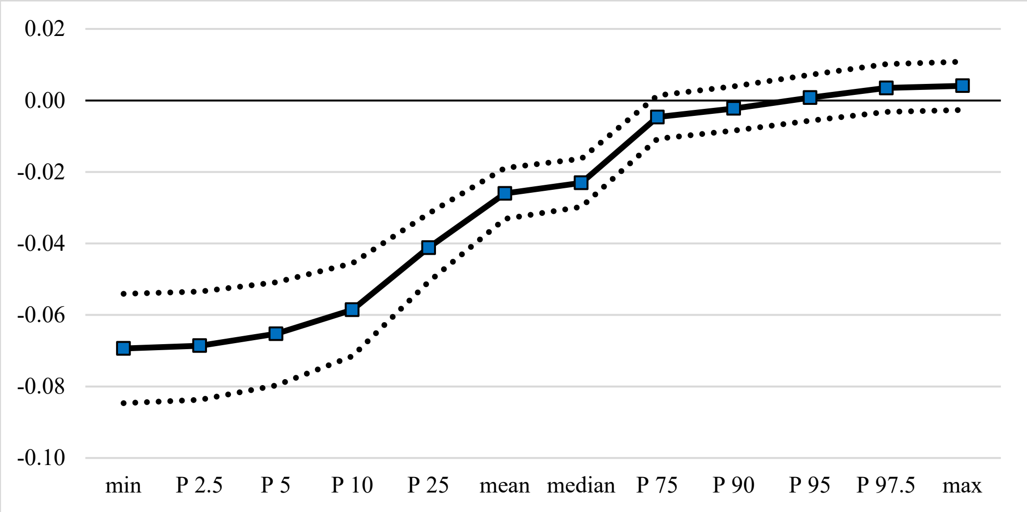
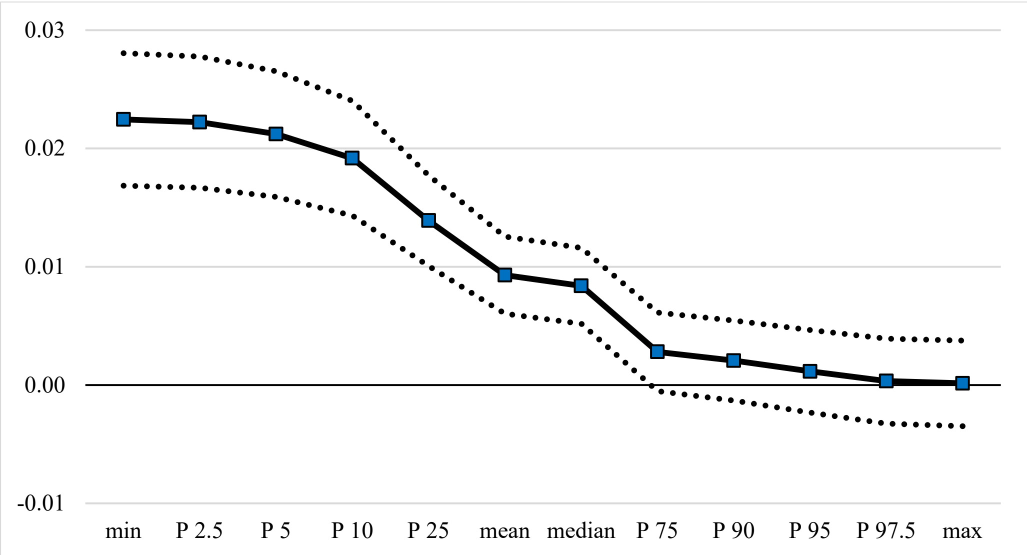


Figure A.20: Marginal effect of standardized home GDP



[8] The magnitude of marginal effects with standardized *NMF* is smaller relative to that from *NMF* specifications due to standardization.

The average marginal effect of transformed control of corruption [see COR in Equation (1) in main text], estimated at the mean values of PPP exchange rates and standardized home GDP, is equal to -0.013 and the associated 2-standard-error confidence interval includes values from -0.015 to -0.010.

Finally, we replace PPP GDP in current international USD with PPP GDP in constant 2017 international USD (they share a 99.5% correlation coefficient) and estimate a specification with *COR*. Results concerning the marginal effects preserve robustness as previously.

The average marginal effect of transformed control of corruption [see COR in Equation (1) in main text], estimated at the mean values of PPP exchange rates and standardized home GDP, is equal to -138,401.3 and the associated 2-standard-error confidence interval includes values from -168,310.3 to -108,492.3.

Similar results to those of the above specification with PPP GDP in constant 2017 international USD are obtained if we replace PPP GDP in current international USD with PPP GDP per capita in current international USD (they share a 96.3% correlation coefficient).

Regarding the marginal effect of corruption in the specification with *COC* (control of corruption) in the main text, we also perform counterfactual analysis, in line with Bertsatos et al. (2023), employing the estimation-sample data points to estimate the overall effect of corruption. To be more specific, it is calculated as the average of the in-sample fitted values allowing for a corruption deterioration, while keeping PPP exchange rates and GDP ratio constant.

Figure A.21: Marginal effect of PPP exchange rates

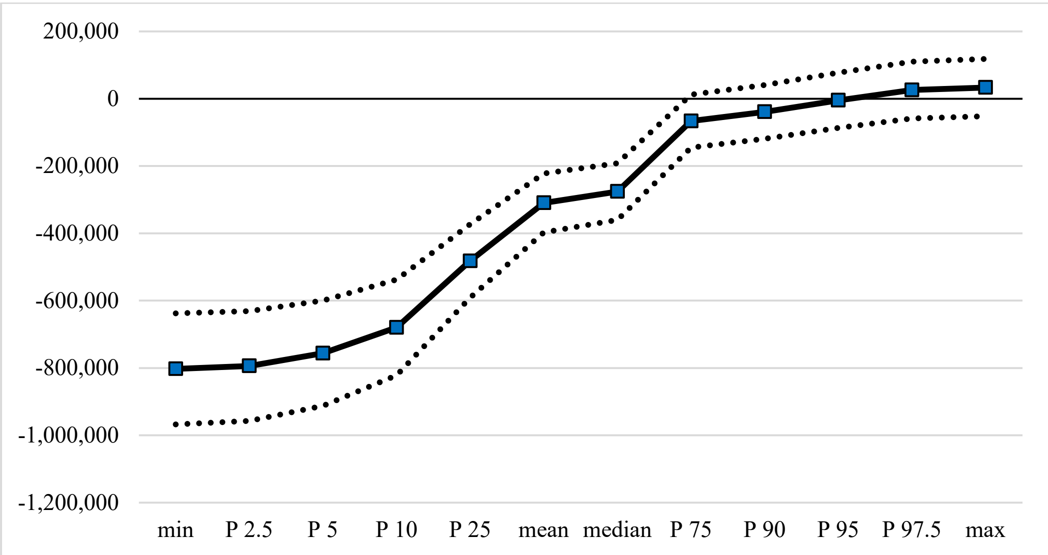
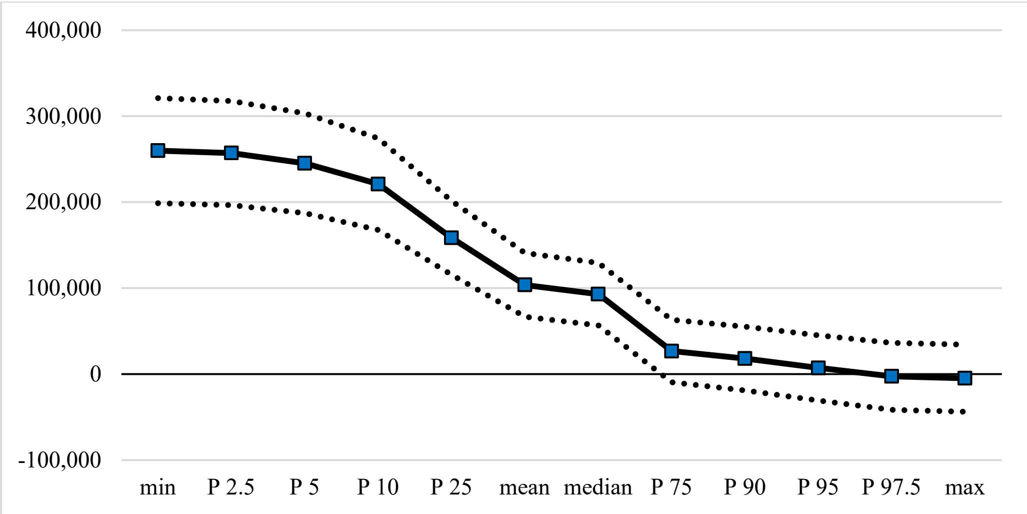


Figure A.22: Marginal effect of standardized home GDP



Considering an increase in corruption equal to a standard deviation (0.2239), the overall corruption effect on *NMF* is, on average, -9.837,1 and the ±2 standard-error confidence interval ranges from -15.460,8 to -4.213.4. Similarly, employing the interquartile range of corruption (0.3704), the corresponding numbers are -16,278.5, -25.584.6, -6.972.4. Such differences in overall corruption effect are justified because the interquartile range of corruption is 1.65 times corruption's standard deviation. To sum up, one can notice that corruption exerts, on average, a negative effect on net migration flow confirming that is a migratory push factor and destroys intrinsic value for people (see Bergh et al. 2015).

Finally, Table A1 presents results based on robust OLS (with Cauchy and Welsch objective functions) and conditional quantile regression of Koenker and Bassett (1978) at the median. One can notice results' robustness relative to results of main specifications presented in the main text. Additionally, the full model with corruption-varying responses of *NMF* is preferred to the model without corruption-dependent effects. As proof, interaction terms with corruption are found to be statistically significant as in the main text, implying misspecification of the model without interaction terms. To be more specific based on that model, PPP exchange rates and standardized home GDP act as push and pull factors, respectively, regardless of the levels of perceived corruption in public sector. This is not the case with the full model, where we have seen that *NMF* responds to PPP exchange rates and GDP ratio up to median levels of corruption since after this cutoff, the associated transmission channels are neutralized by corruption.

Table A.1: Alternative estimation results

	Robust OLS (Cauchy)		Robust OLS (Welsch)		CQREG (median)	
PPP exchange rates	-90,162.2 [<0.01]	-86,048.6 [<0.01]	-103,763.2 [<0.01]	-130,261.5 [<0.01]	-81,176.3 [0.0116]	-93,794.7 [0.0916]
GDP ratio	37,657.7 [<0.01]	27,349.5 [<0.01]	45,746.6 [<0.01]	48,389.7 [<0.01]	27,661.9 [0.0718]	18,575.5 [0.4977]
COR	-1.365,559.4 [<0.01]	-99,803.8 [<0.01]	-1.337,829.5 [<0.01]	-86,836.0 [<0.01]	-1,218,644.1 [<0.01]	-113,686.3 [<0.01]
PPP exchange rates · *COR*	921,900.3 [<0.01]	-	962,414.0 [<0.01]	-	684,783.5 [<0.01]	-
GDP ratio · *COR*	-301,578.1 [<0.01]	-	-300,745.7 [<0.01]	-	-255,492.3 [<0.01]	-
Intercept	152,647.4 [<0.01]	96,898.3 [<0.01]	193,732.9 [<0.01]	199,606.5 [<0.01]	98,097.6 [0.2007]	41,740.1 [0.7629]
Goodness of fit	0.8105 / 0.9594	0.6656 / 0.8548	0.6682 / 0.9541	0.5789 / 0.8295	0.7794 / 0.7243	0.5789 / 0.5181
Residuals	$I(0)$	$I(0)$, $I(1)$	$I(0)$	$I(0)$, $I(1)$	$I(0)$	$I(0)$, $I(1)$

Notes: *p*-values are shown in brackets. The first reported goodness-of-fit statistic for robust OLS is the robust R^2 of Maronna et al. (2006) and the second statistic of Renaud and Victoria-Feser (2010). Moreover, the first reported goodness-of-fit statistic for CQREG is the pseudo R^2 (analogous to typical R^2 from OLS-based regression) according to Koenker and Machado (1999) and the second is its adjusted form. Bootstrapped standard errors, based on resampling residuals with replacement, are used for the conditional quantile regression of Koenker and Bassett (1978) at the median. Augmented Dickey-Fuller (1979) and Phillips-Perron (1988) unit-root tests (with intercept, and with intercept and linear trend) are employed to extract residuals' order of integration from the estimated specifications. Regarding the residuals from the specifications without corruption interactions: Residuals from robust OLS (M-estimation with Cauchy objective function) are found to be stationary at any conventional significance level according to unit-root tests specification with intercept and at 10% size according to specification with intercept and linear trend (at 5% and 1% there is evidence of existence of a unit root). Residuals from robust OLS (M-estimation with Welsch objective function) are $I(0)$ at any conventional level based on specification with a constant term and contain a unit root according to specification with intercept and linear trend. Finally, evidence for residuals' order of integration from CQREG at the median is mixed; specifically, intercept specification denotes stationarity of residuals at 5% level, whilst specification with intercept and linear trend signifies a unit root at 5% size.

Unit-root results and descriptive statistics of main variables

Table A.2: Results from unit-root testing of the examined variables in main text

	ADF		PP	
	C.I	C.II	C.I	C.II
Net migration flows	<0.01	0.7997	0.0459	0.9995
Δ (Net migration flows)	0.9224	0.1149	0.8914	0.1032
$\Delta^{(2)}$ (Net migration flows)	0.0124	0.0284	0.0130	0.0291
PPP exchange rates	0.9582	0.5766	0.8954	0.5928
Δ (PPP exchange rates)	0.0295	0.0304	0.0295	0.0304
$\Delta^{(2)}$ (PPP exchange rates)	<0.01	<0.01	<0.01	<0.01
GDP ratio	0.8983	0.4289	0.9674	0.5363
Δ (GDP ratio)	0.0567	0.1960	0.0567	0.1960
$\Delta^{(2)}$ (GDP ratio)	<0.01	<0.01	<0.01	<0.01
COR	0.7655	0.9265	0.6969	0.7671
Δ (COR)	0.0191	0.0410	0.0139	0.0406
$\Delta^{(2)}$ (COR)	<0.01	0.0180	<0.01	<0.01

Notes: *p*-values are shown. ADF and PP denote augmented Dickey-Fuller (1979, ADF) and Phillips-Perron (1988, PP) unit-root tests. C.I denotes specification with an intercept and C.II with intercept and linear trend. Lag structure, up to max 5 lags, is chosen by the Schwarz information criterion (1978). Sample covers years 1996 to 2021. PPP exchange rates and GDP ratio are in natural logarithm. *COR* is the transformed control of corruption variable in natural logarithm [see equation (1) in main text]. Δ and $\Delta^{(2)}$ denote first- and second-differencing, respectively.

Table A.3: Descriptive statistics of the examined variables in main text

	NMF	***PPP exchange rates***	***GDP ratio***	***COR***
Min	-31,535	0.5478	0.0022	-0.5984
25th percentile	-25,061	0.6016	0.0026	-0.3127
Average	-3,073	0.6472	0.0035	-0.1588
Median	-18,275	0.6658	0.0040	-0.1286
75th percentile	15,717	0.6945	0.0043	0.0578
Max	65,364	0.7220	0.0046	0.1467
St. Dev.	31,307	0.0571	0.0009	0.2239

Notes: Common sample is used, i.e. years 1996 to 2021. Variables of PPP exchange rates and GDP ratio are in levels. *COR* is the transformed corruption variable in natural logarithm based on Equation (2) in main text.

NMF seems to be a *I*(2) variable as the first differences contain a unit root and the second differences are stationary at 5% and 10% nominal size. Next, PPP exchange rates are found to be also a $I(2)$ variable. As proof, there is evidence of a unit root in first differences of PPP exchange rates at 1% level as well as, evidence that the second differences are stationary. Similarly, first differences of standardized home GDP have a unit root at least at 5% nominal size and second differences are stationary. As a result, GDP ratio appears to be a $I(2)$ variable too. Finally, the corruption variable *COR* is nonstationary in first differences at 1% level and stationary in second differences, indicating that COR is a $I(2)$ variable as well.

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