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Trends in International Migration Flows: An Extended Gravity Model Approach over 1960-2010

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Abstract

The paper develops an extended gravity model of migration using a Zero-Inflated Negative Binomial specification. Estimation results based on data concerning the total number of immigrants over the period (1960-2010) for 202 countries confirm the positive and almost constant effect of income. This result contrasts with the relatively rising impact of host countries' labor markets size and requested skills as measured by the level of human capital. Contrary to common language, contiguity and ex-colonizer's impact loosened over the estimation period. Socio-economic conditions in host countries' impact were stronger than the political regime. Also integration policies account more than immigration restrictions in explaining migration flows.

اتجاهات تدفقات الهجرة الدولية: نموذج جاذبية مُوسّع للفترة 1960 – 2010

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بلقاسم العباس

ملخص

تطور الورقة تدفقات الهجرة الدولية باستخدام نُموذج جاذبية مُوسّع وتوزيع ثنائي سلبي ويأخذ بعين الاعتبار حالات انعدام التدفقات ما بين الدول. تُشير نتائج التقدير القائمة على إجمالي التدفقات ما بين 202 دولة وللفترة ما بين 1960 و2010 أن الدخل له أثر مُوجب وثابت. كما أن النتائج تُشير إلى الأثر المتعاظم لدور سُوق العمل في الدول المستقبلة وما يصحبه من ارتفاع في مُستوى المهارات المطلوبة كما يعكسه ارتفاع مُستوى رأس المال البشري. وبالرغم من الأثر الإيجابي لعامل اللغة المشتركة فإن دور عوامل الجوار وأثر الدولة المستعمرة يتناقص عبر الزمن. وتشير نتائج الدراسة أن العوامل السياسية والاجتماعية في الدول المستقبلة لها أثر معنوي وأقوى من أثر طبيعة النظام السياسي. كما أن سياسات دمج المهاجرين لها أثر تأثيري أكثر من سياسات تقييد الهجرة.

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1. Introduction

Recent empirical research on international migration is striving to unveil the deep root causes beyond the impact of relative wages, long mentioned in the literature as the main driver of migration decisions ⟨Sjaastad 1962, Borjas, 1989, 2003, Friedberg and Hunt, 1995 and Card, 2001⟩. Elements of selectivity in immigration decision, like skills and other non-economic factors such as friends and relatives have recently been explored ⟨Portes and Rumbaut 1996, Deborah and Cobb 1993, Kanbur and Rapoport 2005 and Feliciano 2005⟩. Kamemera et al. ⟨2000⟩ tested a gravity model using panel data of migration flows to North America over the decade 1976–86. They showed that population of sender countries and the level of income in host countries are the main determinants. However, they found that migration was also related to political rights and individual freedoms. Lewer and Van den Berg ⟨2007⟩ used a panel data gravity model of migration for 16 OECD countries over 1991–2000 period and showed that migration responded to gravitational forces, distance and others variables such as contiguity and language just like international trade flows. More recently, Orefice ⟨2012⟩ highlighted the role of Preferential Trade Agreements ⟨PTA⟩ on bilateral migration flows by estimating a gravity model and using migrant flows to 29 OECD countries over the 1998–2008 period . Orefice ⟨2012⟩ showed that PTAs stimulated bilateral migration flows more than trade in final goods. This finding questioned the validity of traditional conventional wisdom of trade theories which stipulate that PTAs are expected to favor convergence in factor prices among countries and thus reducing the incentive to migrate. On the contrary, it seems that PTAs reduce information cost of migration between member countries and hence further strengthen labor market linkages.

This paper contributes to the literature on migration in three different directions; first, by using a more comprehensive database which covers almost the global number of international migrants over the years 1960 and 2010 of 202 countries. Second, by using the multiplicative form of Zero-Inflated Negative Binomial specification of the gravity equation instead of its log-linear form, as in Kamemera et al. ⟨2000⟩ and Lewer and Van den Berg ⟨2007⟩, in order to address model's vulnerability against problems of over-dispersion and excess zero flows Third, using a wide array of potential determinants of migration. In all, twelve variables were tested covering economic, distance, linguistic, contiguity, colonial history, human capital level, institutional and socio-economic conditions as well as VISA restrictions and integration policies in host countries. In order to address the different issues of migration flows the paper is organized as follows.

Gravity model and data are presented in section 2. Results are presented and discussed in section 3. Section 4 concludes.

2. Gravity migration model and data

Gravity model was pioneered by Tinbergen (1962), Poyhonen (1963) and Linnemann (1966). The model was found to be very handy in empirically testing of international trade flows. It quickly became the workhorse of empirical international trade and was grounded in trade theory by Anderson (1979), Helpman and Krugman (1985), Helpman (1987), Evenett and Keller (2002), Eaton and kortum (2002) and Haveman and Hummels (2004), among others. The basic gravity model was expressed in its multiplicative form as:

$$F_{ij} = \alpha_0 Y_i^{\alpha_1} Y_j^{\alpha_2} Dist_{ij}^{\alpha_3} \varepsilon_{ij} \qquad (1)$$

where F_{ij} are flows between country i and j. Y_i and Y_j are the economic size of country i and j and $Dist_{ij}$ is the distance between them. The model was commonly log–linearized in order to simplify the estimation of its parameters. The log–linearised form of the gravity model was recently questioned by researchers mainly due to over–dispersion and excess of zero flow data (Polak, 1996; Matyas, 1997, 1998; Cheng and Wall, 2002; Fik and Mulligan, 1998; Pirotte, 1999; Egger, 2002). Santos Silva and Tenreyro (2006) explained that Jenson's inequality, i.e., $E(\ln y) \neq \ln E(y)$, leads to inconsistent and biased estimates in the presence of heteroscedasticity and zero bilateral trade flows which are common in trade flows data. They suggested estimating the gravity equation in its multiplicative form by using a Poisson specification which allows addressing straightforwardly the zero trade flows problems. This solution is thought to be far superior than omitting them or adding a constant or using the inverse hyperbolic sine transformation as commonly done in empirical literature. More recently, Burger and Linders (2009), Martin and Pham (2008), Liu and Cela (2008) added that Poisson specification should be replaced by Zero–Inflated Negative Binomial specification to address its vulnerability for problems of over–dispersion and excess zero flows. These innovative developments revitalized empirical research on trade and led to contrasting new evidence that emanated from augmented multiplicative gravity specification when compared to existing findings. A full discussion of these developments are found in Abdmoulah (2011a, 2011b), Xiong and Beghin (2012) and Tran et al. (2012).

Gravity model, can explain bilateral migration flows just as in the case of international trade by assuming that flows are positively related to the attractive mass of two countries and negatively by the distance between them, in addition to other variables that capture linguistic, contiguity, colonial history, economic or institutional conditions. Since people are expected to respond to differences in relative incomes GDP per capita difference between origin and destination countries is used instead of their absolute economic sizes, which is expressed by their GDPs as in the trade gravity models. Also, population size of origin and destination countries is assumed to affect migration as it reflects a lack of opportunity at home or by larger labor markets at the destination country. Accordingly the model specification is as follows:

$$F_{ij} = \alpha_0 GDP_{\text{pcdiff}_{ij}}^{\alpha_1} Pop_i^{\alpha_2} Pop_j^{\alpha_3} Dist_{ij}^{\alpha_4} \prod_{k=1}^{n} X^{\alpha_k} \varepsilon_{ij} \qquad (2)$$

where F_{ij} are migrants stock between origin country i and destination country j, $GDPpcdiff_{ij}$ is GDP per capita difference between origin and destination countries, Pop_i, Pop_j are origin and destination populations, $Dist_{ij}$ is the distance between origin and destination countries and $\prod_{k=1}^{n} X^{\alpha_k}$ is a matrix of explanatory variables influencing migration, including contiguity, common language, colonizer as well as institutions' differences. These factors were proxied by using indexes of human capital, polity2, socioeconomic conditions, Visa restrictions and MIPEX integration policies. For example, Polity 2 scores go from −10 for Autocracy to +10 for full democracy, whereby their difference goes from −20 to +20 as reported in Table2.

Data on migration were compiled from the World Bank International Migration Database which span the period from 1960 to 2010. Data on explanatory variables were compiled from different sources as detailed in Table (1).

Table (1): Data sources

Total stock of migrants	World Bank: Global Bilateral Migration database 1960 and DICE Database for 2010
Population	WDI, World Bank
GDP per capita	WDI, World Bank
Population weighted distance	CEPII
Colony	CEPII
Common language	CEPII
Contiguity	CEPII
Human Capital Index	Barro & Lee, 2010
Polity2 Index	Center for Systemic Peace: P4 V2010
Socioeconomic Index	ICRG, World Bank
Visa Restrictions Index	Henley & Partners 2010
Integration Policies Index	MIPEX Europe 2010

Summary statistics are reported in Table 2. Data show that total number of migrants has more than doubled from 92.7 million in 1960 to 194 million in 2010. Relative GDP per capita widened between poor and rich countries from 20742$ in 1960 to 136071$, in 2010. Human capital and polity2 are shown to vary in the same range over the period. Other variables being dummy variables their range is confined between 0 and 1. Socioeconomic conditions, Visa restrictions and MIPEX integration policies are unfortunately available only for the year 2010.

Table 〈2〉: Summary statistics

	〈Total migrant = 92.7 million〉 1960					〈Total migrants = 194 million〉 2010				
	Obs	Mean	.St. Dev	Min	Max	Obs	Mean	.St. Dev	Min	Max
Total stock of migrants	41006	2260	64889.19	0	8662538	36200	5350	87371.93	0	11600000
Pop origin	39996	1.50E+07	5.97E+07	5724	6.60E+07	39606	3.40E+07	1.32E+08	9827	1.34E+09
Pop destination	39798	1.50E+07	5.98E+07	5724	6.60E+08	39606	3.40E+07	1.33E+08	9827	1.34E+09
GDPpc PPP difference	11990	0	6553.75	−20742	20742	33672	0	23731	−136071	136071
Distw	41006	8002	4580.02	0	19781	40200	8004	4579.771	0	19735
Colony	41006	0	0.1	0	1	40200	0	0.1011999	0	1
Comlang ethno	41006	0	0.36	0	1	40200	0	0.3605044	0	1
Contig	41006	0	0.12	0	1	40200	0	0.1202563	0	1
Human Capital difference	20022	0	3.49	−10	10	19740	0	3.685137	−11	11
Polity2 difference	10712	0	10.6	−20	20	24806	0	8.825706	−20	20
Socioeconomic difference						19182	0	3.948491	−11	11
Visa index						36200	83.8	43.77819	26	166
Immigration policy						6600	52.8	13.31544	31	83

3. Estimation results and discussion

The estimation results of different gravity regressions are summarized in Table 3. Different models are presented according to different model specifications and independent variables' correlations. Total migrant stocks are used as dependant variable. Explanatory variables include origin and destination populations, GDP per capita differences, population weighted distance, common language, contiguity, colonizer in addition to Visa restrictions and Integration policies and human capital, socioeconomic and polity 2 differences between origin and host countries. Model coefficients are estimated using Zero-inflated Negative Binomial specification using Stata software. Vuong 〈1989〉 test reported in all regressions show that zero-inflated negative binomial model is a better fit than the standard negative binomial model. The gravity model fits well the data. Population, GDP per capita and distance have the correct

expected sign and are highly significant in all cases. The negative impact of distance on migration correctly reflect increased risk and cost, hence reflecting lower probability to migrate to distant places. Negative coefficient of GDP per capita difference suggests that people are more likely to migrate the greater is the expected improvement in their wages as argued in the theory. The impact of destination country population is shown to be 3.6 times larger than the impact of the origin country population in 2010, compared to only 1.1 in 1960. This result suggests that migrants are more attracted by larger labor markets offering much more job opportunities.

Unlike Lewer and Van den Berg (2008), contiguity variables are shown to positively affect migration and their impact does not subside over time. This can be easily confirmed by looking at data from important migration corridors such as Mexico–USA, Russia–Ukraine, Ukraine–Russia, Bangladesh–India, Kazakhstan–Russia, China–Hong Kong which account for more than 27 million of migrant people. Likewise, migration flows are shown to be related to ex–colonizer countries because the coefficient of former colony is positive and significant. It is worth noting that its effect has declined since 1960 by almost 30%. This means that colony relationships remain important when competed to other migration factors. However, common language, which was found to be insignificant in 1960, turned positive and highly significant in 2010, suggesting that migration outlook improved for educated people who at least master host countries languages. The incred impact of human capital corroborates this finding. In fact, it is found that human capital difference coefficient increased from −0.15 to −0.29 in 1960 and 2010, respectively, which means that the attraction of countries with high human capital has doubled as a result of either migrating to study or to work.

The study also found that institutions' had an impact on migration. It was found that polity 2 difference, which measures the stance of political regime and related institutions, affects positively migration. The index ranges from fully autocracies to fully democracies. However its impact is weak in magnitude when compared to socioeconomic conditions, which captures unemployment, consumer confidence and poverty. These conditions are shown to be more relevant in explaining migration since its coefficient is 12 times greater than that of polity 2 in 2010. When it comes to migration restrictions and integration policies, Visa Restrictions and MIPEX indexes are found to affect immigration positively and significantly. More precisely, in model 5 of the year 2010, we employed Visa Restrictions imposed by origin countries (going from 26 for Afghanistan to 166 for UK). The index ranks countries according to travel freedom their citizens enjoy and thus proxies their capacity to immigrate. Inversely, MIPEX index used in model 6 of the year 2010 measures integration policies of 34 recipient countries mainly from Europe in addition to the USA, Canada, Norway, Switzerland, Australia and Japan. It reveals whether all residents are guaranteed equal rights, responsibilities and opportunities which is the case in Sweden, Portugal, Canada and Australia for instance, and less in Japan and most of eastern European countries. It is worth noting that integration policy is revealed to affect migration 6 times more than migration restriction itself.

Table (3): Total migrants' determinants

	1960			2010					
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Pop Origin	⋆1.38e−08			⋆4.5e−09				⋆4.5e−09	⋆7.6e−09
	(0.004)			(0.000)				(0.000)	(0.000)
Pop destination	⋆1.58e−08			⋆1.6e−08				⋆1.6e−08	⋆1.8e−08
	(0.000)			(0.000)				(0.000)	(0.000)
GDPpc difference	⋆−0.00004			⋆−0.00004				⋆−0.00004	⋆−0.00001
	(0.006)			(0.000)				(0.000)	(0.001)
Distance	⋆−0.00009	⋆−0.0001	⋆−0.00009	⋆−0.0001	⋆−0.00013	⋆−0.0001	⋆−0.0001	⋆−0.0001	⋆−0.0001
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Colony	⋆3.788	⋆3.189	3.177	⋆2.707	⋆2.256	⋆2.055	⋆1.958	⋆2.528	⋆2.139
	(0.000)	(0.000)	(0.426)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Common language	0.047	−0.1487	0.08	⋆1.123	⋆0.9595	⋆1.29	⋆1.219	⋆1.121	⋆0.893
	(0.807)	(0.459)	(0.751)	(0.000)	(0.000)	(0.000)	(0.000)	(0.807)	(0.807)
Contiguity	⋆3.127	⋆3.4966	⋆3.152	⋆2.854	⋆2.1569	⋆1.867	⋆2.251	⋆3.048	⋆2.876
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Human capital difference		⋆−0.1582			⋆−0.2923				
		(0.000)			(0.000)				
Polity 2 difference			⋆−0.036			⋆−0.02			
			(0.018)			(0.086)			
Socioeconomic difference							⋆−0.2547		
							(0.000)		
Visa Restrictions								⋆0.013	
								(0.000)	
Integration policy									⋆0.081
									(0.000)
Constant	⋆6.725	⋆8.0012	⋆8.262	⋆7.243	⋆9.0238	⋆9.268	⋆8.94	⋆6.226	⋆3.371
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
.Number of obs	11772	19881	10609	30927	18480	22765	16750	29582	5856
.Nonzero obs	6521	9752	6543	8289	6568	7209	6195	7972	4412
.Zero obs	5251	10129	4066	22638	11912	15556	10555	21610	1444
(Wald chi2(5	564.2	279.18	137.7	1496.2	631.1	488.1	338.4	1282.6	735.6
Prob > chi2	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Vuong test	2.07	6.53	4.47	8.9	10.2	9.9	8.41	8.91	6.82
	(0.019)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.019)	(0.000)

p−values in parentheses. ⋆ Significant at 1%; ⋆⋆ Significant at 5% and ⋆⋆⋆ Significant at 10%.

4. Conclusion

This paper developed an extended gravity model of migration in line with the recent developments initiated by Santos Silva and Tenreyro (2006) and Burger and Linders (2009) to tackle the inconsistency of the traditional log-linearised gravity equation in the presence of over-dispersion and excess zero flows. Total migrants stock in the years 1960 and 2010 for 202 countries were used to investigate whether the determining factors of migration have changed since the sixties. Income difference and selectivity based on human capital and language are found to be very relevant in explaining migration as argued in the literature. Strikingly, human capital magnitude has almost doubled over the period while common language turned positive and highly significant in 2010. This suggests that migration likelihood improved for educated people and less in favor of neighbor countries or ex-colonies. From the perspective of the migrants, it seems that socioeconomic conditions reflecting unemployment, consumer confidence and poverty in host countries are much more relevant than the quality of the institutions and the political regime. Likewise, integration policies in host countries are revealed to be more relevant than their migration restrictions.

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