2011

Environmental Quality and Migration

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ENVIRONMENTAL QUALITY AND MIGRATION

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A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
Master of Science

Department of Economics
in the Graduate School
Southern Illinois University Carbondale
December 2011

RESEARCH PAPER APPROVAL

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Approved by:

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November 9, 2011

AN ABSTRACT OF THE RESEARCH PAPER OF

XU XU, for the Master of Science degree in Economics, presented on November 7, 2011, at Southern Illinois University Carbondale.

TITLE: Environmental Quality and Migration

MAJOR PROFESSOR: Dr. Kevin Sylwester

The main object of this paper is to present a cross-country analysis of the relationship between environmental quality and migration. To achieve this goal we examine how pollution interacts with income to influence different types of migration. The statistical results show that for very poor countries, pollution is negatively related to migration. Skilled workers, especially females, are more likely to emigrate due to the pollution in source countries. However, higher income acts as compensation and makes people more tolerant of pollution.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Would poor environmental quality lead to brain drain? A report released from a think tank, Civic Exchange, in 2008 shows that a quarter of Hong Kong's residents would consider migrating because of the poor air quality. Over half the people surveyed with post-graduate educations are considering leaving, along with 37 percent of university graduates. Only 22 percent of residents with a high school education are thinking about leaving. Besides education, income level seems to affect peoples' moving decision. Nearly half of the residents who are making $92,000 or more per year are considering emigrating because of the city's bad air, whereas only 27 percent of people making between $30,000 and 40,000 are considering leaving. This may be due to the cost associated with emigrating.

The survey results show that environmental quality can act as an important push factor that affects people's migration decisions. This issue has been addressed before, but mainly for interregional migration, especially within the United States. Cebula and Vedder (1973) seek to answer the question whether contemporary American migration can be significantly explained by environmental factors as air pollution, crime rates, or climate. Air pollution turns out to be not significant at the 12 percent level in their sample. Hsieh and Liu (1983) develop a model to explore the relationships between interregional migration in US and regional variations of quality of life. The results suggest that

the pursuance of better environmental quality is the dominant factor in explaining interregional migration.

Why is the migration rate, or rather the brain drain rate, higher in some economies than in others? Answering this question needs cross-country data on emigrant stocks, which has only in this decade become available. This is also why even though the increase of international migration has long been recognized; its determinants have not been well understood yet.[1]

Brain drain, or skilled workers' migration, is one of the biggest concerns associated with international migration. There is a great amount of literature, mainly theoretical, on the consequences of brain drain, while the determinants of brain drain have been addressed less. For the few papers examining the macroeconomic determinants of why the level of brain drain varies across countries (Docquier et al., 2007; Belot and Hatton, 2008; Beine et al., 2008), none of them consider that bad environmental quality could be a potential push factor.

In addition to determining if poor environmental quality is a push factor, we also allow its potential as a push factor to be smaller in richer countries. For the economy as a whole, clean air is a luxury good. The greater an economy's GDP per capita, the more likely that it can devote resources to reduce air pollution. For individuals from a specific source country, it is plausible to assume that only when their income gets to a certain level will they move to a cleaner place, since only then do they care more about environmental quality and can actually afford

1 See Gordon (2010) for a review of dataset about international migration.

it. However, it is also possible people's tolerance for pollution would be higher if they could earn a higher income in the source countries. Therefore, the purpose of this paper is to examine the association between migration and environmental quality. We then test for interaction effects between environmental quality and income upon migration. We further explore whether skilled migration is more sensitive to pollution and whether male skilled workers and female skilled workers respond to pollution differently.

CHAPTER 2

METHODOLOGY

The impact of air pollution on migration is estimated using a cross-sectional approach. For each variable, we examine the data for year 2000.

The focus of our analysis is on the relationship between migration rates, m_i, environmental quality, ENV_i, GDP per capita and its squared value(GDP_i, GDP_i^2), and other control variables.

$$m_i = a_i + a_1 * GDP_i + a_2 * GDP_i^2 + a_3 * ENV_i + a_4 * CONTROLS_i + a_5 * ENV_i * GDP_i + \epsilon_i$$

where i is a country index.

For the dependent variable, this paper uses the dataset developed by Docquier, Lowell, and Marfouk (2007) (hereafter, DLM). This dataset considers international migration by gender and educational attainment. We use this dataset because of the report about Hong Kong mentions people with different educational background and income levels reacting to pollution differently. Instead of using individual level data, we use aggregate migration and income data to see whether that is the case for international migration. DLM is based on the aggregation data collected in host countries, where information about the birth country, gender, age and educational attainment of immigrants is available. They collect gender-disaggregated data from the 30 members of the OECD, with details on birth countries and three levels of educational attainment: $s = m$ for immigrants with upper-secondary education, $s = h$ for those with post-secondary education and $s = l$ for those with less than upper-secondary education

(including lower-secondary, primary and no schooling). Let $M_{t,g,s}^{i,j}$ denote at time t the stock of adults aged 25+ of gender g, education level s, born in country i and migrate to country j:

$$M_{t,g,s}^{i} = \sum_{j} M_{t,g,s}^{i,j}$$

Denoting $N_{t,g,s}^{i}$ as the stock of individuals aged 25+ at time t and born in source country i, the migration rate is defined as:

$$m_{t,g,s}^{i} = \frac{M_{t,g,s}^{i}}{N_{t,g,s}^{i}}$$

Where the native population $N_{t,g,s}^{i}$ is proxied by the sum of the resident population living in the country $i\left(R_{t,g,s}^{i}\right)$ and the stock of emigrants from i:

$$N_{t,g,s}^{i} \equiv R_{t,g,s}^{i} + M_{t,g,s}^{i}$$

DLM uses population data by age provided by the United Nations and several sources on the average educational attainment of the resident population to compute $R_{t,g,s}^{i}$.

Brain Drain[2]

The term "brain drain" was created by the Royal Society of London in a 1963 report to refer to the exodus of British scientists to the United States and Canada following World War II. The term is often referred to as skilled migration from less to more developed countries. Brain drain is defined in the International Encyclopedia of Human Geography as "the emigration of educated and skilled

2 In this paper, we use “brain drain” and “skilled migration” interchangeably.

labor power, professionals or intellectuals outside of their native country, be it developing or developed".

Here according to DLM, the brain drain rate is defined as

$$m_{g,s}^{i} = \frac{M_{g,s}^{i}}{N_{g,s}^{i}}$$

That is, the ratio of the stock of skilled emigrants to the educated population born in the source country. They first aggregate over both genders and all education levels and so consider $m_i = \frac{M_i}{N_i}$ but then use the above ratio to consider individual genders and skill levels. We will do likewise in this paper.

Variables of Interest

Environmental quality ENV_i of the source country is used. The report about Hong Kong blames poor air quality as the factor that pushes people to move out of Hong Kong. So in the baseline regression we will only look at the air quality as our environmental quality indicator. The aggregate emissions data used in this paper were obtained from the World Resources Institute. In particular, the pollutants studied (sulfur dioxide, nitrogen dioxide, and carbon monoxide) have been the focus of considerable public policy attention. All of these pollutants can have important adverse health consequences.

Sulfur dioxide (SO_2) is produced when fossil fuels are burned and is the primary cause of acid rain. Short-term exposure to SO_2 causes eye irritation, coughing, worsening of asthma and respiratory-tract infections. Long-term exposure to SO_2 can result in respiratory illness. Also, SO_2 can react with other

compounds in the atmosphere to form small particles. These particles can penetrate deeply into sensitive parts of the lungs and can cause or worsen respiratory disease, and can aggravate existing heart disease, leading to increased hospital admissions and premature death.[3]

Nitrogen dioxide (NO_2) is produced by generators, power plants and motor vehicles. It is the indicator for the larger group of nitrogen oxides. Besides contributing to the formation of ground-level ozone, NO_2 is linked with a number of adverse effects on the respiratory system. [4]

Carbon monoxide (CO) is a major atmospheric pollutant in some urban areas, mainly from the exhaust of internal combustion engines, but also from incomplete combustion of various other fuels. CO can trigger serious respiratory problems. In addition, CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues.[5]

The means and standard deviations for all the variables used in estimation are provided in Table 1. There is considerable variation within the sample. Table 2 shows the distribution of observations by income level. The less-developed countries are not under-represented in the sample.

TABLE 1: SAMPLE CHARACTERISTICS

	Sample Mean	Standard Deviation	Number of Observations
$Ln(SO)$	4.21529	2.650629	182

3 See http://www.epa.gov/air/sulfurdioxide/health.html

4 See http:// http://www.epa.gov/air/nitrogenoxides/health.html

5 See http://www.epa.gov/airquality/carbonmonoxide/health.html

$Ln(NO_2)$	4.533232	2.440548	185
$Ln(CO)$	6.593662	2.646357	184
Total Migration Rate	7.103458	10.74596	188
Skilled Migration Rate	20.91049	22.57153	188

Notes: The three environmental quality indicators are measured in thousand metric tons.

TABLE 2: SAMPLE CHARACTERISTICS (2)

	Low Income	Middle Income	High Income
Number of Economies	34	102	49

Notes: Classification based on World Bank guidelines.

Control Variables

We control for GDP per capita and its squared value (GDP_i, GPD_i^2) of the source country. It is evident that GDP per capita matters to the level of migration because the increases in GDP per capita make migration affordable. However, further increases in GDP per capita in source countries reduce people's incentive to emigrate since there are less income differentials between source and destination countries. This result has been found in the literature (e.g., Rotte and Vogler, 2000, and Mayda, 2010). Including the square of GDP per capita allows us to capture this inverted U-shape relationship between income and migration rates. We use the World Development Indicators and use year 2000 GDP per capita level. Previous studies also identify inverted-U relationships between pollution and economic development (see Selden and Song, 1994).

Population is also a plausible candidate in explaining why migration rates are different across countries. Population determines the pool of brain drain. In an economy where the population is large, one can expect that more people will migrate. However, studies also show that countries with smaller population

experience larger brain drains (see Beine et al., 2008). As for environment, an explosive growth in population and a steep increase in environmental degradation have been witnessed simultaneously in the past (see Panayotou, 2000). The fact that there is little agreement on the relationship between population and growth cannot rule out the possibility that population may affect environmental quality. In the regression, we use the World Development Indicators year 2000 population (POP_i).

The institution quality at source countries $(INST_i)$ may also affect both migration and environment. Bad institutions such as violation of property rights can act as push factors (see Beine et al., 2008). Also, some institutions may negatively affect the environment. The literature on political determinants of environmental quality is more limited and still developing. A consensus seems to be emerging that democracy contributes to higher environmental quality (see Bernau and Koubi, 2009). Data on governance were obtained from the Worldwide Governance Indicators, which include institution quality of over 200 countries and territories measuring six dimensions of governance starting in 1996: Voice and Accountability (VA), Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. We use year 2000 data on VA as our measure of institutions. It captures the extent to which a country's citizens are able to participate in selecting their government, freedom of expression, freedom of association, and a free media. It can be regarded as a proxy for democracy.

Some characteristics of regions, such as culture or geography, may affect migration and environment. We add regional dummies to control for regional specific effects. [6]

From Table 3 we can see that, as for migration rates, there are no big variations among different regions as among countries. Nevertheless, we will still control for regional differences in some specifications.

TABLE 3: SOURCE COUNTRIES DIVIDED BY REGIONS

Region	(1)	(2)	(3)	(4)	(5)
R1	29	7.14	21.19	19.54	24.56
R2	20	7.32	21.18	19.52	24.56
R3	31	7.34	21.45	19.75	24.89
R4	33	7.25	21.25	19.58	24.62
R5	20	7.13	20.99	19.37	24.30
R6	8	6.76	20.46	18.79	24.03
R7	47	7.09	21.03	19.40	24.37

Notes: (1): Number of economies; (2): Total migration rate; (3): Skilled migration rate; (4): Males' skilled migration rate; (5): Females' skilled migration rate. For all four types of migration rates, we use year 2000 data.

6 The World Bank classifies countries into seven geographical regions: East Asia & Pacific (R1), Europe & Central Asia, Latin America & Caribbean (R4); Middle East & North Africa (R5), North America, South Asia (R6), and Sub-Saharan Africa (R7). We break down Europe & Central Asia into two parts, one is Western Europe, and the other is Europe and Central Asia that contain the Former Soviet Bloc Communities (R2). We then create a new group that includes Western Europe with North America (R3).

CHAPTER 3

RESULTS

We consider the role of environmental quality in two ways. First, we look at the impact of environmental quality on the degree of migration. The analysis is carried out for four different types of migration. The results show no evidence that pollution is positively correlated with migration.

Second, we investigate whether and to what extent migrants coming from different source countries with different income levels behave differently in terms of their response to pollution. This is done by introducing interaction terms between pollution and GDP per capita. Table 4 and Table 5 examine the determinants of total migration rates and skilled migration rates. Table 7 shows factors related to skilled migration rates by gender.

TABLE 4: FACTORS RELATED TO TOTAL MIGRATION RATE

	(1)	(2)	(3)	(4)	(5)	(6)
$Ln(GDP)$	21.74	23.92	29.93	10.57	11.64	17.78
	(6.23)***	(6.70)***	(7.12)***	-7.03	-7.56	(7.85)**
$\left(Ln(GDP)\right)^2$	-1.16	-1.29	-1.51	-0.55	-0.61	-0.84
	(0.38)***	(0.40)***	(0.39)***	(0.42)	(0.45)***	(0.44)*
$Ln(POP)$	-2.59	-2.21	-1.82	-2.50	-1.83	-1.30
	(0.64)***	(0.68)***	(0.57)***	(0.64)***	(0.71)***	(0.59)**
VA	3.09	3.04	2.95	1.90	1.88	1.62
	(0.88)***	(0.91)***	(0.88)***	(1.01)*	(1.06)*	(1.03)*
$Ln(SO\_2)$	5.05			4.07		
	(1.95)***			(1.88)**		
$Ln(NO_2)$		3.84			2.56	
		(2.14)*			(2.08)	
$Ln(CO)$			4.96			3.87
			(2.09)**			(2.02)*

$Ln(GDP) * Ln(SO_2)$	-0.59			-0.48		
	(0.23)***			(0.23)**		
$Ln(GDP) * Ln(NO_2)$		-0.49			-0.38	
		(0.26)*			(0.25)	
$Ln(GDP) * Ln(CO)$			-0.69			-0.61
			(0.26)***			(0.24)**
R1				-2.16	-1.81	-0.91
				(2.71)	(2.81)	(2.74)
R2				-2.39	-2.26	-2.30
				(3.10)	(3.24)	(3.13)
R4				6.14	6.37	6.80
				(2.65)**	(2.80)**	(2.71)***
R5				-2.25	-2.01	-2.45
				(3.00)	(3.15)	(3.06)
R6				-4.45	-5.20	-5.64
				(4.04)	(4.22)	(4.06)
R7				-4.34	-4.15	-3.19
				(3.02)	(3.19)	(3.12)
Constant	-51.78	-64.84	-101.35	-2.30	-14.17	-53.09
	(28.58)*	(30.11)**	(34.81)***	(31.40)	(33.23)	(36.98)
No. of Observations	172	174	173	172	174	173
R-squared	0.41	0.40	0.43	0.50	0.48	0.52

Notes: Dependent variable is total migration rate.

Standard errors reported in parentheses.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table 4 shows the results about total migration rates. Columns (4)-(6) include regional dummies in the regression.

We find the usual inverted-U relationship between migration and GDP per capita in source countries. At low levels, income has a positive impact on the migration rates since it alleviates liquidity constraints. As income increases further, the income differences with the destination countries fall, which reduce the incentive to migrate.

Countries with larger population size have lower total migration rates. This may due to the fact that people are more likely to remain in larger countries. The issue of small states has been analyzed thoroughly in Beine et al., (2008).

Institution variable seems to exert significant influence. Voice and accountability is positively correlated to migration, which seems counterintuitive. Higher value of voice and accountability means better institution, which should be negatively related to migration according to our expectation. The result is robust when using the other institutional variables mentioned above. One possible explanation is that a freer institution means the country is more open, therefore allowing more international human capital flow (see Weinberg, 2011). Less democratic countries may limit migration.

The three air pollution indicators and three interaction terms are included in three separate regressions since the pollution indicators are highly correlated with each other. The coefficients of the pollution indicator turn out to be positive and significant in the baseline regression. Specifically, the estimated coefficient of sulfur dioxide is significant at 1 percent level, while the ones for nitrogen dioxide and carbon monoxide are significant at 10 percent and 5 percent respectively. The estimated coefficients of the interaction terms are negative and significant. The negative sign means pollution is less related to migration among higher income countries.

Controlling for regional dummies, the coefficient of nitrogen dioxide is still positive but not significant. The results for the other two environmental quality variables still hold but decrease.

TABLE 5: FACTORS RELATED TO SKILLED MIGRATION RATE

	(1)	(2)	(3)	(4)	(5)	(6)
$Ln(GDP)$	15.23	18.48	23.59	6.06	6.89	10.76
	(13.55)	(13.95)	(15.22)*	(15.32)	(15.71)	(16.58)
$\left(Ln(GDP)\right)^2$	-0.96	-1.07	-1.36	-0.44	-0.37	-0.59
	(0.82)	(0.84)	(0.84)*	(0.92)	(0.93)	(0.92)
$Ln(POP)$	-5.56	-5.16	-4.88	-5.31	-3.72	-2.83
	(1.40)***	(1.42)***	(1.22)***	(1.40)***	(1.47)***	(1.26)**
VA	5.13	5.32	4.90	2.59	2.71	1.85
	(1.91)***	(1.89)***	(1.88)***	(2.20)	(2.20)	(2.18)
$Ln(SO_2)$	6.22			4.17		
	(4.24)			(4.10)		
$Ln(NO_2)$		7.11			4.16	
		(4.47)*			(4.32)	
$Ln(CO)$			5.26			2.03
			(4.47)			(4.26)
$Ln(GDP) * Ln(SO_2)$	-0.78			-0.50		
	(0.51)			(0.49)		
$Ln(GDP) * Ln(NO_2)$		-0.96			-0.72	
		(0.54)*			(0.52)	
$Ln(GDP) * Ln(CO)$			-0.77			-0.56
			(0.54)			(0.52)
R1				3.17	5.22	4.86
				(5.90)	(5.84)	(5.79)
R2				-9.43	-8.60	-9.28
				(6.76)	(6.74)	(6.61)
R4				14.40	14.77	16.55
				(5.79)**	(5.81)***	(5.73)***
R5				-2.83	-2.35	-3.28
				(6.55)	(6.54)	(6.45)
R6				-6.73	-8.52	-8.67
				(8.80)	(8.77)	(8.57)
R7				0.93	2.18	3.97
				(6.59)	(6.63)	(6.58)
Constant	50.01	27.45	3.81	82.95	53.21	31.17
	(62.11)	(62.69)	(74.39)	(68.46)	(69.03)	(78.08)
No. of Observations	172	174	173	172	174	173
R-squared	0.36	0.40	0.37	0.50	0.48	0.48

Notes: Dependent variable is skilled migration rate.

Standard errors reported in parentheses.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

From Table 5 we can see that income is not strongly related to skilled migration rates. The results for population and institution variables still hold. As for the environmental quality variable, only nitrogen dioxide is positively and significantly correlated with skilled migration. The survey of Hong Kong's residents shows that people with higher education are more likely to emigrate because of their concerns of pollution. Our results do not support that skilled migration rates are more closely related to environmental quality.

For robustness check, we exclude high income countries from our sample.

TABLE 6: FACTORS RELATED TO MIGRATION RATES (FOR MIDDLE AND LOW INCOME COUNTRIES)

	(1)	(2)	(3)	(4)	(5)	(6)
$Ln(GDP)$	8.74	7.76	14.29	8.15	10.55	12.42
	(2.01)***	(2.20)***	(3.03)***	(4.41)*	(4.45)**	(6.60)*
$Ln(POP)$	-2.03	-1.62	-1.71	-4.81	-4.44	-5.15
	(0.80)***	(0.82)**	(0.65)***	(1.76)***	(1.67)***	(1.41)***
VA	1.71	1.84	1.64	3.17	3.45	3.27
	(1.17)	(1.24)	(1.17)	(2.58)	(2.51)	2.55)
$Ln(SO_2)$	10.58			15.39		
	(2.89)***			(6.35)**		
$Ln(NO_2)$		7.79			17.26	
		(3.09)***			(6.26)***	
$Ln(CO)$			11.59			13.80
			(2.09)**			(6.58)**
$Ln(GDP) * Ln(SO_2)$	-1.39			-2.07		
	(0.37)***			(0.82)***		
$Ln(GDP) * Ln(NO_2)$		-1.08			-2.37	
		(0.40)***			(0.80)***	
$Ln(GDP) * Ln(CO)$			-1.59			-1.88
			(0.39)***			(0.84)**
Constant	-27.75	-25.06	-72.30	37.80	15.16	11.59
	(22.65)	(23.29)	(26.71)***	(49.72)	(47.26)	(58.27)
No. of Observations	127	129	128	127	129	128
R-squared	0.46	0.43	0.43	0.38	0.43	0.39

Notes: For columns (1)-(3), dependent variable is total migration rate. For columns (4)-(6), dependent variable is skilled migration rate.

Standard errors reported in parentheses.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

TABLE 7: FACTORS RELATED TO SKILLED MIGRATION RATES BY GENDER

	(1)	(2)	(3)	(4)	(5)	(6)
$Ln(GDP)$	7.97	9.98	12.13	6.45	10.00	12.00
	(4.23)**	(4.27)**	(6.31)*	(4.85)	(4.90)**	(7.29)*
$Ln(POP)$	-4.20	-3.75	-4.54	-5.87	-5.56	-6.11
	(1.69)***	(1.60)**	(1.34)***	(1.94)***	(1.83)***	(1.55)***
VA	2.62	2.88	2.75	3.72	3.95	3.65
	(2.47)	(1.24)	(2.44)	(2.83)	(2.76)	(2.82)
$Ln(SO_2)$	13.26			19.49		
	(6.09)**			(6.98)**		
$Ln(NO_2)$		14.84			22.29	
		(6.00)**			(6.89)***	
$Ln(CO)$			12.59			17.04
			(6.29)**			(7.27)**
$Ln(GDP) * Ln(SO_2)$	-1.82			-2.49		
	(0.79)**			(0.90)***		
$Ln(GDP) * Ln(NO_2)$		-2.10			-2.90	
		(0.77)***			(0.88)***	
$Ln(GDP) * Ln(CO)$			-1.75			-2.21
			(0.81)**			(0.93)**
Constant	28.41	8.09	3.69	68.85	37.24	29.25
	(47.71)	(45.26)	(55.67)	(54.67)	(51.99)	(64.33)
No. of Observations	127	129	128	127	129	128
R-squared	0.36	0.41	0.37	0.36	0.41	0.36

Notes: Dependent variable for columns (1)-(3) is males' skilled migration rate; for columns (4)-(6) is females' skilled migration rate.

Standard errors reported in parentheses.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Leaving high income countries out of our sample, environmental quality variables are significantly correlated with both types of migration. This may because brain drain is mainly one direction: from middle and low income countries to high income countries. Therefore, it is more proper to focus only on middle and low income countries as source countries when studying factors

related to skilled migration. Table 6 also shows that the absolute values of the estimated coefficients of environmental quality variables are higher for skilled migration as compared with total migration rates. This offers some evidence that people with higher education are more sensitive to pollution. However, further examination shows that at the median level of Ln(GDP), an increase in pollution is associated with a decrease in migration. For $Ln(SO_2)$, the threshold value of Ln(GDP) is 7.43. 35.38 percent of our sample has Ln(GDP) less than 7.43. For this 35.38 percent, an increase in pollution is associated with an increase in migration whereas for the remaining 64.62 percent, an increase in pollution level is associated with a decrease in migration. [7] Perhaps people in richer countries can afford to somehow avoid the pollution. Or higher income can act as compensation and makes people more tolerant of pollution.

Are female and male migrants weighting air quality differently when making migration decisions? To answer this question, we run previous regressions but with females' skilled migration rates and males' skilled migration rates separately. We only consider middle and low income countries in our sample due to the reasons we mentioned above. Results in Table 7 show that pollution act as a push factor for both males and females. The estimated coefficients of the environmental variable on females' skilled migration rate are larger and even more significant than on males' skilled migration rate. This

7 The results are robust for $Ln(NO_2)$ and $Ln(CO)$.

finding provides some evidence that migrants of different gender group react to air pollution differently.

CHAPTER 4

CONCLUSION

This paper finds evidence that for very poor countries, bad environmental quality is a push factor for migration but not necessarily for countries with higher incomes. People with higher education are more likely to emigrate because of pollution. The results also show that skilled females may migrate due to their concerns of environmental quality. However, there are several caveats that could temper this conclusion.

First, we only use three air quality indicators as proxies of environmental quality of source countries. This may leave out other environmental quality variables that potentially affect people's migration decision. In future work, including other measures for environmental quality may help us better understand the issue studied here.

Second, there is possible reverse causality in the model. Previous migration may affect both current migration and current environmental quality, thus causing biased estimation. Clark et al. (2007) find positive correlation between current migration flows and lagged migration shocks. One possible explanation is that previous migrants help newer migrants in becoming established in a destination country which reflects migration networks. With more people who are concerned of the environmental quality emigrating, it is possible that the environment of the source countries might get worse. If this is the case, then it would be the previous migrants affecting current migration and current environmental quality at the same time, which would lead to biased estimates.

Finally, there are several shortcomings embedded in the DLM dataset such as OECD countries differ in how they define immigrants and educational attainment. Perhaps such measurement error may also lead to biased results.

With all these potential shortcomings in mind, we are hesitant to interpret these estimates causally. The main intention of this paper is to bring environmental quality into people's attention when analyzing international migration. We attempt to test whether bad air quality could be a push factor for migration, especially skilled migration, and we get some interesting results. We believe a lot of future work should be done to better understand this issue.

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Research Paper Title:
Environmental Quality and Migration

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