



**HAL**  
open science

# The determinants of internal migration in a developing country: quantitative evidence for Indonesia, 1930-2000

Jelle van Lottum, Daan Marks

## ► To cite this version:

Jelle van Lottum, Daan Marks. The determinants of internal migration in a developing country: quantitative evidence for Indonesia, 1930-2000. *Applied Economics*, 2011, pp.1. 10.1080/00036846.2011.591735 . hal-00719482

**HAL Id: hal-00719482**

**<https://hal.science/hal-00719482>**

Submitted on 20 Jul 2012

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



**The determinants of internal migration in a developing country: quantitative evidence for Indonesia, 1930-2000**

Journal:	<i>Applied Economics</i>
Manuscript ID:	APE-2010-0371.R1
Journal Selection:	Applied Economics
Date Submitted by the Author:	29-Jan-2011
Complete List of Authors:	van Lottum, Jelle; University of Cambridge, Geography Department Marks, Daan; International Institute of Social History
JEL Code:	J61 - Geographic Labor Mobility Immigrant Workers < J6 - Mobility, Unemployment, and Vacancies < J - Labor and Demographic Economics, C50 - General < C5 - Econometric Modeling < C - Mathematical and Quantitative Methods
Keywords:	Indonesia, Gravity model of migration, Economic development, Migration

SCHOLARONE™  
Manuscripts

1  
2  
3 **The determinants of internal migration in a developing country: quantitative**  
4 **evidence for Indonesia, 1930-2000**  
5  
6  
7

8  
9 J. van Lottum<sup>a\*</sup> and D. Marks<sup>b</sup>  
10

11  
12 <sup>a</sup> *Cambridge Group for the History of Population and Social Structure, Geography*  
13 *Department, University of Cambridge, Cambridge, UK*  
14

15  
16  
17 <sup>b</sup> *International Institute for Social History Amsterdam / Faculty of Economics,*  
18 *Utrecht University, Utrecht, the Netherlands*  
19

20  
21  
22  
23 \* Corresponding author. E-mail: [jv266@cam.ac.uk](mailto:jv266@cam.ac.uk); Tel: +44(0)1223 333194  
24  
25  
26  
27

28  
29 **Keywords:** Internal Migration; Indonesia; Gravity Model; Policy; Development  
30

31  
32 **JEL codes:** J61; J68; N15; O15  
33  
34  
35  
36  
37

38 **Abstract**

39 This study specifies and estimates a gravity model for interprovincial migration in  
40 Indonesia. Analyzing five cross-sections for Indonesia's 26 provinces for 5 survey  
41 years between 1930 and 2000 we show that throughout the twentieth century  
42 economic factors were more important in the explanation of interprovincial  
43 migration patterns in Indonesia than planned migration policy aimed at the  
44 redistribution of the population. In addition, our regression analysis demonstrates  
45 that the urban primacy of Jakarta, Indonesia's capital, had a strong effect on the  
46 direction and size of migration flows. Our findings thus suggest that the costly  
47 government-supported migration is not very successful and that a strongly  
48 centralized government induces migration flows to the capital. These findings have  
49 policy implications for other developing countries.  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## I. Introduction

Immigration is a controversial issue in developed and developing countries alike, and increasingly economists have dealt with explaining its causes and effects (Lewer and Van den Berg, 2008). The economic approach to immigration has, however, been mainly applied to international migration, and mostly on migration flows between developed countries. The number of empirical studies that attempt to model internal migration in developing countries is still relatively limited, and the lion's share of such studies has relied on the work of Harris and Todaro (1970) which focuses on rural-urban migration (a two sector model). The present article has a different aim and methodology in that it studies developments in Indonesia's interprovincial migration flows between 1930 and 2000 by applying a modified *gravity model*. Using Borjas' (1989) concept of immigrant markets and their gravitational behaviour we aim to study the main determinants of migration flows in Indonesia during a period where it changed from being part of the Dutch colonial empire to one of the largest economies in (Southeast) Asia. Our key aim is to determine which factors have driven internal population movements in Indonesia between 1930 and 2000. We are particularly interested in the effect of deliberate government programs to promote migration from specific provinces, and how the (changing) economic and social conditions in the sending and receiving provinces influenced the inclination to migrate.

We have specified and estimated a modified gravity model of migration using migration flows for five survey years covering seven decades: 1930, 1971, 1980, 1990 and 2000. The approach in estimating the model for migration is similar to that of Lewer and Van den Berg (2007) and Karemera *et al.* (2000) the only difference

1  
2  
3 being that they applied a gravity model on *international* migration while our model  
4  
5 aims the estimate a model of *internal* population movements. In addition, following  
6  
7 in particular Karemera *et al.*'s (2000) successful methodology of ranking the  
8  
9 migration elasticities (or the beta-coefficients) for the five survey years, we aim to  
10  
11 compare the importance of the determinants of internal migration in Indonesia  
12  
13 through time.  
14  
15  
16

17 This article is in five parts. Section II presents an outline of internal migration  
18  
19 in Indonesia between 1930 and 2000. Section III lays out the theoretical assumptions  
20  
21 of our model, and discusses the data and the econometric procedures we applied in  
22  
23 this study. Section IV discusses the results. Finally, in section V we will present our  
24  
25 conclusions.  
26  
27  
28  
29  
30  
31

## 32 **II. Internal migration in Indonesia, 1930-2000**

33  
34  
35  
36 Indonesia is an important case study. It is the fourth most populous country in the  
37  
38 world with more than 200 million inhabitants in 2000. Furthermore, it is the world's  
39  
40 largest archipelago, consisting of *ca* 17,000 islands which span more than 5,000 km  
41  
42 eastward from Sabang in northern Sumatra to Merauke in Irian Jaya (see Map 1). If  
43  
44 one would superimpose a map of Indonesia over one of Europe, one will find that it  
45  
46 stretches from Ireland to Iran; compared to the United States, it covers the area from  
47  
48 California to Bermuda.  
49  
50  
51

52  
53 The available sources for the twentieth century show that internal migration  
54  
55 in Indonesia is far from a recent phenomenon. Already under Dutch rule – Indonesia  
56  
57 declared independence in 1945, which was only acknowledged by the Dutch in 1949  
58  
59 – it already had a highly geographically mobile population. According to the 1930  
60

1  
2  
3 population census no less than 11.5% of the total indigenous population of Indonesia  
4  
5 lived outside their district of birth (Volkstelling, 1930) although only half of this  
6  
7 (5.6%) moved beyond the provincial borders. Still, in absolute figures this boils  
8  
9 down to a number of 3.3 million interprovincial migrants. Throughout the twentieth  
10  
11 century, interprovincial migration increased significantly. In 1971 about 5% of the  
12  
13 total population lived in another province than the province of birth, which was more  
14  
15 or less equal to the level of internal migration during the colonial period. However,  
16  
17 from the 1970s onwards interprovincial migration increased significantly. In the  
18  
19 following decade the number of interprovincial migrants rose to 7.0 %, in 1990 it  
20  
21 reached 8.2 % and by 2000 it had increased to about 10.1 %, indeed roughly double  
22  
23 the share of 1930 and 1970.  
24  
25  
26  
27  
28

29 The – mostly sociological – literature on internal migration in colonial  
30  
31 Indonesia points out at least three factors that contributed to interprovincial  
32  
33 population movements in Indonesia. Firstly, in the first half of the twentieth century  
34  
35 the number of Dutch plantations in the Outer Islands increased strongly.<sup>1</sup> Since  
36  
37 labour was scarce here, planters recruited people from Java. Secondly, in 1905 the  
38  
39 Dutch government considered Java to be overpopulated and introduced a program to  
40  
41 resettle people from Java to the Outer Islands. Migrant families were given  
42  
43 (monetary) migration premiums and could in addition receive a credit, which had to  
44  
45 be repaid within a given period of time. Thirdly, the concentration of colonial  
46  
47 activity in Java also led to a number of growing urban centres such as present-day  
48  
49 Jakarta (which was known as Batavia prior to independence), Surabaya and  
50  
51 Semarang (Hugo, 1980, 114). According to Pelzer (1945, 175) these cities attracted  
52  
53  
54  
55  
56  
57  
58  
59  
60

---

<sup>1</sup> Due to Java's importance as core region, other parts of the archipelago are usually referred to collectively as the 'Outer Islands'.

1  
2  
3 people from the crowded interior because of the employment opportunities they  
4  
5 offered.  
6  
7

8 As the figures above pointed out, from the 1970s onwards interprovincial  
9 migration in Indonesia remained to be an important phenomenon. The causes for  
10 internal migration mentioned in the literature on *post*-colonial Indonesia are roughly  
11 similar to those mentioned in the studies on the Dutch period. The concentration of  
12 economic activity on Java and in particular in Jakarta, overall income differentials,  
13 and the government policy of transmigration are commonly regarded as the most  
14 important explaining factors for interprovincial population movements in Indonesia  
15 since independence. Tirtosudarmo (2009), however, speculates that due to  
16 substantial reduction in the government capacity to move people under  
17 transmigration policy, in recent years migration has become predominantly a  
18 function of the labour market economy. The latter is something we will return to in  
19 our analysis.  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35

36 This brief overview of the mostly qualitative literature on internal migration  
37 in Indonesia highlights a number of factors that are deemed to be important in  
38 determining migration patterns in Indonesia: relative income, migration policy in the  
39 shape of transmigration, but also the role of Jakarta as urban primate. In the  
40 following section we will not only test the hypotheses whether these factors had  
41 indeed a statistical effect, but also determine their relative importance and whether  
42 changes over time can be observed.  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54

### 55 **III. A gravity model of internal migration in Indonesia, 1930-2000**

56  
57  
58  
59  
60

#### *Theoretical framework*

1  
2  
3 In this section we evaluate the factors affecting migration flows between regions by  
4 applying a gravity model. The starting point of the gravity model of migration is the  
5 assumption that migration is driven by the attractive force between migrant source  
6 and destination location and impeded by the costs of moving from one country to  
7 another (Ravenstein, 1885, 1889; Zipf, 1946). The hypothesis that people migrate if  
8 the expected earnings exceed the costs of the move (using distance as a proxy for the  
9 cost of migration) was further developed in the work of Greenwood (1975) and  
10 Borjas (1989). The latter proposed a model of immigration, taking into account a set  
11 of variables in the host and destination country that can potentially influence the size  
12 and composition of the immigrant influx: economic performance; immigration  
13 policies, political orientation; and education levels.  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28

29 Our model is based on the theoretical considerations of Borjas (1989), whose  
30 model is built on three basic equations: a wage earning function for the country of  
31 origin, one for the country of destination, and a function that takes into account the  
32 costs of moving between the two. However, as Karemera *et al.* (2000) have argued,  
33 neither Borjas nor Greenwood provides econometric estimates of the elasticities of  
34 migration with regard to the characteristics in their models. Therefore, in this article,  
35 we follow the successful approach of Karemera *et al.* (2000) and Lewer and Van den  
36 Berg (2007) in formulating and estimating a gravity model of migration. In doing so  
37 we aim to empirically derive migration impact elasticities for the five survey years in  
38 our Indonesia dataset. Subsequently, we will compare the impact of the elasticities  
39 diachronically, by means of ranking the beta-coefficients derived from the regression  
40 analyses for 1930, 1971, 1980, 1990 and 2000.  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57

*The gravity model*

Let us first look at formulation of the basic gravity model, which includes the theoretical assumption mentioned above. The basic assumption of our model is that migration is expected to be positively related to the population in the origin and destination. *Ceteris paribus*, the more people there are in a source region, the more people are likely to migrate; the larger the population in the destination region, the larger is the labour market for immigrants. In addition, wage differentials between sending and receiving provinces are also likely to influence migration patterns.

Following the neo-classical assumption of the labour market model in which migrants are regarded as rational actors who want to better themselves, differences in wages trigger population movements. At the same time, we assume migration to be negatively related to the distance between sending and receiving region since one is likely to incur higher costs if one needs to travel further. A final factor we control for in our basic model is that people are likely to move to neighbouring provinces – the concept of contiguity.<sup>2</sup> To control for this phenomenon, we include a contiguity dummy in our model (see also Lewer and Van den Berg, 2007). The foregoing considerations lead to the basic gravity equation

$$\ln(\text{mig}_{ij}) = \alpha_0 + \alpha_1 \ln(\text{pop}_i) + \alpha_2 \ln(\text{pop}_j) + \alpha_3 \text{rely}_{ij} + \alpha_4 \ln(\text{dist}_{ij}) + \alpha_5 \text{contig} + u_{ij} \quad (1)$$

where  $\text{mig}_{ij}$  represents the migration from source region  $i$  to destination region  $j$ ,  $\text{rely}_{ij}$  is the ratio of source region to destination region of log per capita incomes,

---

<sup>2</sup> The effect of the contiguity dummy is not directly captured in the distance variable, since we measure the distance variable as the distance between geographic centres of provinces. Moreover, since some provinces are separated by sea the distance between these provinces can be large, despite the fact that these provinces share a contiguous border.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

$dist_{ij}$  is the logged distance between source region  $i$  and destination region  $j$ ,  $contig$  is a dummy variable with the value of 1 if provinces have a common boundary and 0 otherwise, and  $u_{ij}$  is an error term. The expected signs of the coefficients are  $\alpha_1 > 0$ ,  $\alpha_2 > 0$ ,  $\alpha_3 < 0$ ,  $\alpha_4 < 0$  and  $\alpha_5 > 0$ .

The model can be improved by controlling for two other factors: transmigration and urban primacy. We will first deal with the issue of transmigration. The transmigration policy was initiated under Dutch colonial rule during the early twentieth century and taken over by the Indonesian government after independence. Transmigration had three main goals. First of all, the government aimed to use this policy measure to distribute the population more evenly by moving millions of Indonesians from the densely populated islands (Java, Bali, Madura) to the outer, less densely populated islands, indeed to achieve a more balanced demographic development and to alleviate demographic pressure (see Map 1 for an overview of the transmigration provinces). Secondly, it was aimed at the reduction of poverty by providing land and (thus) new opportunities to poor landless settlers. Finally, the colonial and later national government used this policy measure to exploit more effectively the agricultural potential of the outer islands. To study the effect of transmigration we include a dummy variable

$$\ln(mig_{ij}) = \alpha_0 + \alpha_1 \ln(pop_i) + \alpha_2 \ln(pop_j) + \alpha_3 rely_{ij} + \alpha_4 \ln(dist_{ij}) + \alpha_5 contig + \alpha_6 trans\_mig + u_{ij} \quad (2)$$

in which  $trans\_mig$  is a transmigration dummy, which is 1 for migration from Java to a transmigration region and 0 otherwise.

1  
2  
3 The second influence on internal migration in Indonesia we want to control  
4 for is urban primacy. A primate city is the major city in a country, which as a result  
5 plays a dominant role on different levels. It not only is a city that encapsules a large  
6 proportion of the urban population of a country, but is also the political, economical,  
7 cultural and transportation center of a nation (Ades and Glaeser, 1995; Henderson,  
8 2000). The general definition is that whenever the ratio of the size of the first to that  
9 of the second city exceeds two, the city size is said to be primate (Mutlu, 1989: 611).

10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Jakarta has clearly been the primate city of Indonesia throughout the  
twentieth century. At the beginning of the twentyfirst century it was more than twice  
as populous as the second largest city, Surabaya (in the province of East Java).  
Jakarta's population in 2005 was 8.8 million which is 3.2 times the population of  
Surabaya (2.75 million). Moreover, the combined population of Surabaya, Bandung  
(West Java) and Medan (North Sumatra) in 2005 – the second, third and fourth  
populous cities in Indonesia respectively – was only 7.1 million: still well below the  
number of inhabitants of Jakarta (United Nations, *World Population Prospects*). To  
study the influence of urban primacy on internal migration patterns in Indonesia we  
include a dummy variable for Jakarta in the basic gravity model (Equation 1), which  
suggest the following equation.

$$\ln(\text{mig}_{ij}) = \alpha_0 + \alpha_1 \ln(\text{pop}_i) + \alpha_2 \ln(\text{pop}_j) + \alpha_3 \text{rely}_{ij} + \alpha_4 \ln(\text{dist}_{ij}) + \alpha_5 \text{contig} + \alpha_7 \text{Jkt} + u_{ij} \quad (3)$$

in which Jkt is a dummy which is 1 for migration to Jakarta and 0 otherwise. Clearly,  
this dummy bears the risk of bringing in the problem of multicollinearity in the

1  
2  
3 model, since Jakarta is also the province with relatively high per capita income. Yet,  
4  
5 in estimating the model we do not find large changes in the estimated regression  
6  
7 coefficients when a predictor variable is added or deleted, and we do not find a high  
8  
9 R squared with low values for t-statistics (Alheety and Gore 2009; Bhattacharyya  
10  
11 2009). Neither do the correlation matrices point to this as a problem (see appendix  
12  
13 table A2).  
14  
15

16  
17 The foregoing considerations combined suggests the following augmented  
18  
19 gravity equation  
20  
21

$$22 \ln(\text{mig}_{ij}) = \alpha_0 + \alpha_1 \ln(\text{pop}_i) + \alpha_2 \ln(\text{pop}_j) + \alpha_3 \text{rely}_{ij} + \alpha_4 \ln(\text{dist}_{ij}) + \alpha_5 \text{contig} +$$

$$23 \alpha_6 \text{trans\_mig} + \alpha_7 \text{Jkt} + u_{ij}$$

$$24$$

$$25$$

$$26$$

$$27$$

$$28$$

$$29$$

$$30$$

$$31$$

$$32$$

$$33$$

$$34$$

$$35$$

$$36$$

$$37$$

$$38$$

$$39$$

$$40$$

$$41$$

$$42$$

$$43$$

$$44$$

$$45$$

$$46$$

$$47$$

$$48$$

$$49$$

$$50$$

$$51$$

$$52$$

$$53$$

$$54$$

$$55$$

$$56$$

$$57$$

$$58$$

$$59$$

$$60$$

$$(4)$$

### 34 *Data*

35  
36 The migration data is based on lifetime migration flows taken from population  
37  
38 censuses in 1930, 1971, 1980, 1990 and 2000. In 1930 the Dutch colonial  
39  
40 government held a population census in Indonesia, which is considered a well-  
41  
42 organised modern census (Van der Eng 2002: 488). Since Indonesian independence  
43  
44 in 1945 population censuses were conducted for the years 1961, 1971, 1980, 1990  
45  
46 and 2000. Yet, unfortunately, the 1961 census does not contain information on  
47  
48 migration flows.  
49  
50

51  
52 The available data provides matrices consisting of 650 migration flows  
53  
54 between the provinces of Indonesia for the respective benchmark years. For the years  
55  
56 1930 and 2000 we had to make some adaptations, because in these survey years  
57  
58 Indonesia's provincial division differed from the intermediate ones. Currently,  
59  
60

1  
2  
3 Indonesia consists of 33 provinces, seven of which have been created since 2000. In  
4  
5 1930 the colonial government had divided the Netherlands-Indies in 36  
6  
7 administrative regions. For consistency we consolidated these 36 administrative  
8  
9 regions and 33 provinces in 2000 and into 26 provinces, which were in place  
10  
11 between 1971 and 2000 (see Map 1).  
12  
13

14  
15 The distance variable in our analysis was calculated between the geographic  
16  
17 centres (or centroids) of the provinces using ArcGis software. Since 1970, data on  
18  
19 regional Gross Domestic Product (GDP) per capita has been published by the  
20  
21 Indonesian Central Bureau of Statistics (BPS) in their annual statistical yearbooks.  
22  
23 For 1930 we had to rely on provincial wage data taken from Dros (1992).  
24  
25  
26  
27  
28

#### 29 **IV. Results**

30  
31  
32  
33  
34 Table 1 provides the regression results for the 4 models in the 5 benchmark years.  
35  
36 All estimated variables have the expected sign and almost all are statistically  
37  
38 significant at the 1% level. In all cases the simple gravity model (Equation 1) already  
39  
40 explains at least 57.2% of the observed variation in the depended variable  
41  
42 interprovincial migration, which increases when the dummy variables for  
43  
44 transmigration (Equation 2) and urban primacy are estimated (Equation 3). In all  
45  
46 instances the highest (adjusted) R square is reached in the most elaborate model  
47  
48 (Equation 4) with a minimum of 0.60 in 1971 and a maximum of 0.69 in 1990.  
49  
50  
51

52  
53 A number of interesting results emerge from the regression analysis, from  
54  
55 which we want to point out three main issues. Firstly, our analysis demonstrates that  
56  
57 the transmigration dummy is not only insignificant for 1930, 1971 and 1980, the  
58  
59 coefficients are also very small during these years. This confirms more qualitative  
60

1  
2  
3 studies evaluating transmigration until the 1980s (Van der Wijst, 1985; World Bank,  
4 1988). For 1990 and 2000, however, transmigration has a statistically significant  
5  
6 effect on migration patterns. This can be attributed to renewed focus on  
7  
8 transmigration since the 1980s. Substantial loans by the World Bank and the Asian  
9  
10 Development Bank, combined with bilateral financial assistance made it possible to  
11  
12 expand the transmigration programme. As a consequence in the period 1980-1990  
13  
14 ten times more people were resettled than in the decades since the beginning of state-  
15  
16 sponsored transmigration (Adhiati and Bobsien, 2001). Resettlement figures  
17  
18 remained high in the first half of the 1990s, but the programme collapsed as a result  
19  
20 of the Asian Crisis. Nevertheless, the ranking of the beta-coefficients in Table 2  
21  
22 reveals that the effect of the transmigration policy – mainly due to massive financial  
23  
24 input – became statistically significant from the 1990s onwards and also showed that  
25  
26 its effect was higher in magnitude compared to other years. Still, its impact remained  
27  
28 relatively limited compared to other factors: table 2 shows that the beta rank of the  
29  
30 transmigration dummy was seventh for the years 1930, 1971 and 1980, only fifth for  
31  
32 1990 and 2000.  
33  
34  
35  
36  
37  
38  
39  
40

41  
42 Secondly, a strikingly important determinant of migration patterns in  
43  
44 Indonesia is the role of urban primacy, as proxied by our Jakarta dummy. Since  
45  
46 Indonesia's independence in the 1940s this variable has become the dominant factor  
47  
48 in explaining internal migration patterns. Clearly, the island of Java is Indonesia's  
49  
50 economic core region, and Jakarta is the centre of this core. This explains its  
51  
52 attractiveness for migrants through three channels. First of all, as Krugman and Livas  
53  
54 (1992) have demonstrated in their study on Mexico City, net transport costs are  
55  
56 lower for domestic goods in the central city because firms are located in that city. As  
57  
58 a result workers come to the city attracted by the relatively lower prices for domestic  
59  
60

1  
2  
3 goods. Another factor that explains the significant effect of the Jakarta dummy is  
4  
5  
6 Indonesia's trade and price intervention. In general, the Indonesian government  
7  
8 adopts a policy of protecting manufacturing activities and taxes primary sector based  
9  
10 activities. This has led to protection of the urban sector of Java, and Jakarta in  
11  
12 particular (Garcia-Garcia, 2000). Finally, since its independence Jakarta has also  
13  
14 been Indonesia's political core. As suggested by Ades and Glaeser (1995), urban  
15  
16 giant leaders often extract wealth out of the hinterlands and distribute in the capital.  
17  
18 This pulls migrants to the city because of the demand created by the concentration of  
19  
20 wealth. Our analysis indicates that this theory can also be applied to Indonesia.  
21  
22  
23

24  
25 Finally, the theory that underpins the basic gravity model predicts that wage  
26  
27 differentials between sending and receiving regions are likely to be an important  
28  
29 determinant in a well functioning, open economy and corresponding labour market.  
30  
31 Interestingly, the results of our estimation show that this variable was not an  
32  
33 important determinant of interprovincial migration in Indonesia. The most likely  
34  
35 explanation for this is the fact that Indonesia is characterized by a dual labour  
36  
37 market, with a rigid formal market and a widespread informal sector. In 2010 no less  
38  
39 than 68.6 per cent of the labour force was employed in the informal sector (OECD  
40  
41 2010). In additions, our relative wage variable measures provincial per capital GDP  
42  
43 rather than actual income in the informal sector. As Harris and Todaro (1970) have  
44  
45 argued, an important determinant for migration is expected rather than actual income  
46  
47 differentials. Most likely we are unable to capture the (expected) income dynamics  
48  
49 in the informal sector, where indeed most of the migrants end up.  
50  
51  
52  
53  
54  
55

## 56 57 **V. Concluding remarks** 58 59 60

1  
2  
3 This study applied a gravity model of model of migration on interprovincial  
4 migration in Indonesia between 1930 and 2000. The theoretical framework of our  
5 study was Borjas' (1989) model of migration, while the application of the traditional  
6 gravity model on migration flows was based on the work of Lewer and Van den  
7 Berg (2007) and Karemera *et al.* (2000). In order to capture the potential  
8 determinants of internal migration flows we augmented the traditional gravity model  
9 by including variables dealing with contiguity, migration policy and urban primacy.  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19

20 This article demonstrated that the gravity model is very suitable for an  
21 analysis of internal migration flows in a large developing country such as Indonesia,  
22 not only for relatively recent migration flows, but also for more historical migration  
23 movements. Our analysis showed that all in all five survey years, from 1930 up until  
24 2000, the signs of the coefficients was as expected, and the augmented gravity model  
25 explained a very large portion of the variation of the dependent variable, internal  
26 migration. Given that the number of empirical studies that apply gravity models on  
27 migration is still relatively limited, and the fact the application of the gravity model  
28 on Indonesian migration flows for over a period of 70 years – covering different  
29 political and economic settings – was successful, our study should thus be regarded  
30 as a next step in the testing of the robustness and overall validity of the model.  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45

46 Our analysis showed that in Indonesia between 1930 and 2000 wage  
47 differentials between sending and receiving provinces were relatively unimportant,  
48 while the presence of an urban primate in the shape of Jakarta was the most  
49 important determinant of migration. Nevertheless, the fact that other factors seemed  
50 to have had less influence is perhaps equally interesting. One of the main  
51 conclusions of this study is that a policy of supported migration (transmigration in  
52 the Indonesian case) is not only costly, but also of relatively limited effect. Our  
53  
54  
55  
56  
57  
58  
59  
60



1  
2  
3 regression analysis showed that migrants have a tendency to base their decision on  
4  
5 the more tangible prospect of economic betterment, either in the shape of  
6  
7 improvements of one's (expected) income or the attractiveness of moving to a  
8  
9 primate city, than on the less concrete prospect of moving to a region that lacks these  
10  
11 features – even if this move is supported financially by the government. This in turn  
12  
13 suggests that in order to influence migration patterns, for instance as a means of  
14  
15 alleviating demographic pressure or to even out the negative effects of lopsided  
16  
17 regional economic growth, it seems more effective to focus on the development of  
18  
19 less developed regions directly than simply to promote migration to them and thus  
20  
21 create economic development in an in-direct way. Indonesia is in this respect an  
22  
23 interesting case since it already has adopted decentralization measures since the  
24  
25 beginning of the twenty-first century, and as such has begun to redistribute power  
26  
27 and wealth; as a result in recent years Jakarta has already lost importance as  
28  
29 economic and political core. Whether this will in fact result in different  
30  
31 interprovincial migration patterns, i.e. a less central role for Jakarta, and thus a more  
32  
33 evenly distributed population, as indeed our analysis suggests, is yet too early to tell  
34  
35 and is therefore a topic for future research.  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## References

Alheety, M. I.; Gore, S. D. (2009), 'Two Strategies for Removing Multicollinearity',  
*Bulletin of Statistics and Economics*, **3**, pp. 62-79.

Ades, A. F. And E. L. Glaeser (1995) Trade and Circuses: Explaining Urban Giants,  
*The Quarterly Journal of Economics*, **110**, pp. 195-227.

Adhiati, M. A. S.. and Bobsien, A. (2001) Indonesia's Transmigration Programme:  
an Update, Report for Down to Earth, International Campaign for Ecological Justice  
in Indonesia. Available at <http://dte.gn.apc.org/ctrans.htm> (accessed 15 February  
2010).

Bhattacharyya, S. (2009), 'Unbundled Institutions, Human Capital and Growth',  
*Journal of Comparative Economics*, **37**, pp. 106–120.

Borjas, J.G. (1989) Economic Theory and International Migration, *International  
Migration Review*, **23**, pp. 457-485.

Dros, N. (1992), *Changing Economy in Indonesia: a Selection of Statistical Source  
Material from the Early 19th Century up to 1940, Volume 13: Wages 1820-1940*,  
Amsterdam

Garcia-Garcia, J. (2000) Indonesia's Trade and Price Interventions: Pro-Java and  
Pro-Urban, *Bulletin of Indonesian Economic Studies*, **36**, pp. 93-112.

1  
2  
3 Greenwood, M. (1975) Research on Internal Migration in the United States: a  
4 Survey, *Journal of Economic Literature*, **13**, pp. 397-433.  
5  
6

7  
8  
9  
10 Harris, J.R. and Todaro, N.O., 'Migration, unemployment and development: a two  
11 sector analysis', *The American Economic Review*, **60** (1970), pp. 126-142.  
12  
13

14  
15  
16  
17 Henderson, V. (2000) How Urban Concentration Affects Economic Growth, World  
18 Bank Policy Research Working Paper No. 2326, World Bank.  
19  
20

21  
22  
23  
24 Karemera, D, Iwuagwu Oguledo, V., and Davis, B. (2000) A Gravity Model  
25 Analysis of International Migration to North America, *Applied Economics*, **32**, pp.  
26 1745-1755.  
27  
28  
29  
30

31  
32  
33  
34 Krugman, P. and Livas, R. (1992) Trade Policy and Third World Metropolis, NBER  
35 Working Paper No. 4238, NBER, Cambridge, Mass.  
36  
37  
38  
39

40  
41 Lewer, J. J. and Van den Berg, H. (2008) A Gravity Model of Immigration,  
42 *Economics Letters*, **99**, pp. 164-167.  
43  
44  
45  
46  
47

48 Mutlu, S. (1989) Urban Concentration and Primacy Revisited: An Analysis and  
49 Some Policy Conclusions, *Economic Development and Cultural Change*, **37**, pp.  
50 611-639.  
51  
52  
53  
54  
55

56  
57  
58 OECD (2010), *OECD Economic Surveys Indonesia*, OECD, Paris.  
59  
60

1  
2  
3 Pelzer, K. J. (1945), *Pioneer Settlement in the Asiatic Tropics*, New Haven: Yale  
4 University Press.  
5  
6

7  
8  
9  
10 Ravenstein, E. (1885) The Laws of Migration, *Journal of the royal Statistical*  
11 *Society*, **48**, pp. 167-235.  
12  
13

14  
15  
16  
17 Ravenstein, E. (1889) The Laws of Migration: Second Paper, *Journal of the Royal*  
18 *Statistical Society*, **52**, pp. 241-305.  
19  
20

21  
22  
23  
24 Tirtosudarmo, R. (2009), *Mobility and Human Development in Indonesia*, UNDP  
25 Human Development Research Paper 2009/19, United Nations, New York.  
26  
27

28  
29  
30  
31 Eng, Pierre van der (2002), Bridging a Gap: Reconstruction of Population Patterns in  
32 Indonesia, 1930-61, *Asian Studies Review*, **26**, pp. 487 — 509.  
33  
34

35  
36  
37  
38 Van der Wijst, T. (1985), Transmigration in Indonesia: An Evaluation of a  
39 Population Redistribution Policy, *Population Research and Policy Review*, **4**, pp. 1-  
40  
41  
42  
43  
44  
45  
46  
47

48  
49 World Bank (1988) *Indonesia: The Transmigration Program in Perspective*,  
50 Washington DC.  
51  
52

53  
54  
55 Zipf, G. (1946) The  $P_1P_2/D$  hypothesis: on the Intercity Movement of Persons,  
56  
57  
58  
59  
60  
*American Sociological Review*, **11**, pp. 677-686.

1  
2  
3 *Volkstelling* 1930, Landsdrukkerij, Batavia.  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

For Peer Review

**Table 1. Regression results**

	Gravity model of migration	Testing for urban primacy effect	Testing for transmigration effect	Extended gravity model
	(1)	(2)	(3)	(4)
<b>1930</b>				
Pop <sub>i</sub>	0.608 (16.2)**	0.608 (16.3)**	0.621 (15.4)**	0.623 (15.4)**
Pop <sub>j</sub>	0.236 (6.24)**	0.230 (6.09)**	0.233 (6.17)**	0.227 (6.00)**
Rely <sub>ij</sub>	-0.126 (-3.06)**	-0.126 (-3.07)**	-0.137 (-3.18)**	-0.139 (-3.21)**
D <sub>ij</sub>	-0.619 (-5.26)**	-0.223 (-5.10)**	-0.222 (-5.01)**	-0.215 (-4.83)**
Contiguity dummy	0.611 (4.57)**	0.617 (4.62)**	0.628 (4.64)**	0.635 (4.71)**
Jkt dummy		0.255 (1.72)		0.261 (1.77)
Transmigration dummy			-0.077 (-0.87)	-0.085 (-0.06)
N	340	340	340	340
R <sup>2</sup>	0.617	0.620	0.617	0.621
Adj. R <sup>2</sup>	0.612	0.614	0.612	0.614
<b>1971</b>				
Pop <sub>i</sub>	0.630 (16.8)**	0.602 (16.6)**	0.640 (16.0)**	0.615 (15.9)**
Pop <sub>j</sub>	0.192 (5.38)**	0.199 (5.80)**	0.189 (5.27)**	0.195 (5.66)**
Rely <sub>ij</sub>	-0.273 (-6.14)**	-0.220 (-5.07)**	-0.273 (-6.14)**	-0.220 (-5.08)**
D <sub>ij</sub>	-0.287 (-8.24)**	-0.278 (-8.30)**	-0.283 (-8.02)**	-0.272 (-8.03)**
Contiguity dummy	0.421 (3.79)**	0.427 (3.99)**	0.431 (3.84)**	0.439 (4.08)**
Jkt dummy		0.929 (7.18)**		0.933 (7.20)**
Transmigration dummy			-0.046 (-0.71)	-0.060 (-0.96)
N	623	623	623	623
R <sup>2</sup>	0.570	0.603	0.571	0.604
Adj. R <sup>2</sup>	0.567	0.600	0.567	0.600
<b>1980</b>				
Pop <sub>i</sub>	0.637 (22.3)**	0.617 (22.5)**	0.634 (20.0)**	0.615 (20.3)**
Pop <sub>j</sub>	0.196 (6.94)**	0.205 (7.62)**	0.197 (6.88)**	0.206 (7.54)**
Rely <sub>ij</sub>	-0.164 (-5.05)**	-0.117 (-3.71)**	-0.163 (-5.01)**	-0.116 (-3.69)**
D <sub>ij</sub>	-0.370 (-12.2)**	-0.357 (-12.3)**	-0.371 (-12.1)**	-0.358 (-12.2)**
Contiguity dummy	0.284 (2.85)**	0.295 (3.12)**	0.281 (2.81)**	0.294 (3.08)**
Jkt dummy		0.938 (8.06)**		0.938 (8.05)**
Transmigration dummy			0.013 (0.22)	0.009 (0.16)
N	641	641	641	641
R <sup>2</sup>	0.645	0.678	0.645	0.678
Adj. R <sup>2</sup>	0.643	0.675	0.642	0.675

	Gravity model of migration	Testing for urban primacy effect	Testing for transmigration effect	Extended gravity model
	(1)	(2)	(3)	(4)
<b>1990</b>				
Pop <sub>i</sub>	0.549 (23.8)**	0.550 (24.5)**	0.502 (19.7)**	0.504 (20.3)**
Pop <sub>j</sub>	0.274 (11.9)**	0.255 (11.2)**	0.287 (12.5)**	0.268 (11.8)**
Rely <sub>ij</sub>	-0.120 (-5.30)**	-0.090 (-3.95)**	-0.116 (-5.18)**	-0.086 (-3.84)**
D <sub>ij</sub>	-0.407 (-13.9)**	-0.400 (-14.0)**	-0.423 (-14.5)**	-0.415 (-14.6)**
Contiguity dummy	0.165 (1.71)	0.171 (1.82)	0.126 (1.32)	0.133 (1.43)
Jkt dummy		1.601 (6.26)**		0.683 (7.08)**
Transmigration dummy			0.232 (4.14)**	0.225 (4.11)**
N	650	650	650	650
R <sup>2</sup>	0.668	0.685	0.677	0.693
Adj. R <sup>2</sup>	0.666	0.683	0.674	0.690
<b>2000</b>				
Pop <sub>i</sub>	0.509 (21.8)**	0.515 (22.5)**	0.469 (18.1)**	0.477 (18.7)**
Pop <sub>j</sub>	0.277 (11.9)**	0.263 (11.5)**	0.288 (12.4)**	0.274 (11.9)**
Rely <sub>ij</sub>	-0.143 (-6.23)**	-0.109 (-4.60)**	-0.147 (-6.43)**	-0.113 (-4.81)**
D <sub>ij</sub>	-0.419 (-14.42)**	-0.411 (-14.2)**	-0.432 (-14.6)**	-0.424 (-14.6)**
Contiguity dummy	0.182 (1.89)*	0.189 (2.01)*	0.149 (1.55)	0.158 (1.68)
Jkt dummy		0.590 (4.94)**		0.575 (4.84)**
Transmigration dummy			0.192 (3.40)**	0.181 (3.27)**
N	650	650	650	650
R <sup>2</sup>	0.669	0.681	0.675	0.686
Adj. R <sup>2</sup>	0.667	0.678	0.672	0.683

Note: \*\*: denotes test statistics significance at the 1% level; \*: significant at the 5% level.

**Table 2. Estimated beta coefficients**

	1930		1971		1980		1990		2000	
	Beta	Rank	Beta	Rank	Beta	Rank	Beta	Rank	Beta	Rank
Popi	0.623	2	0.615	2	0.615	2	0.504	2	0.477	2
Popj	0.227	4	0.195	6	0.206	5	0.268	4	0.274	4
Relw	-0.139	6	-0.220	5	-0.116	6	-0.086	7	-0.113	7
D	-0.215	5	-0.272	4	-0.358	3	-0.415	3	-0.424	3
Contiguity	0.635	1	0.439	3	0.294	4	0.133	6	0.158	6
Jkt dummy	0.261	3	0.933	1	0.938	1	0.683	1	0.575	1
Transmigration dummy	-0.085	7	-0.060	7	0.009	7	0.225	5	0.181	5

For Peer Review



## Appendix

Table A1: summary statistics

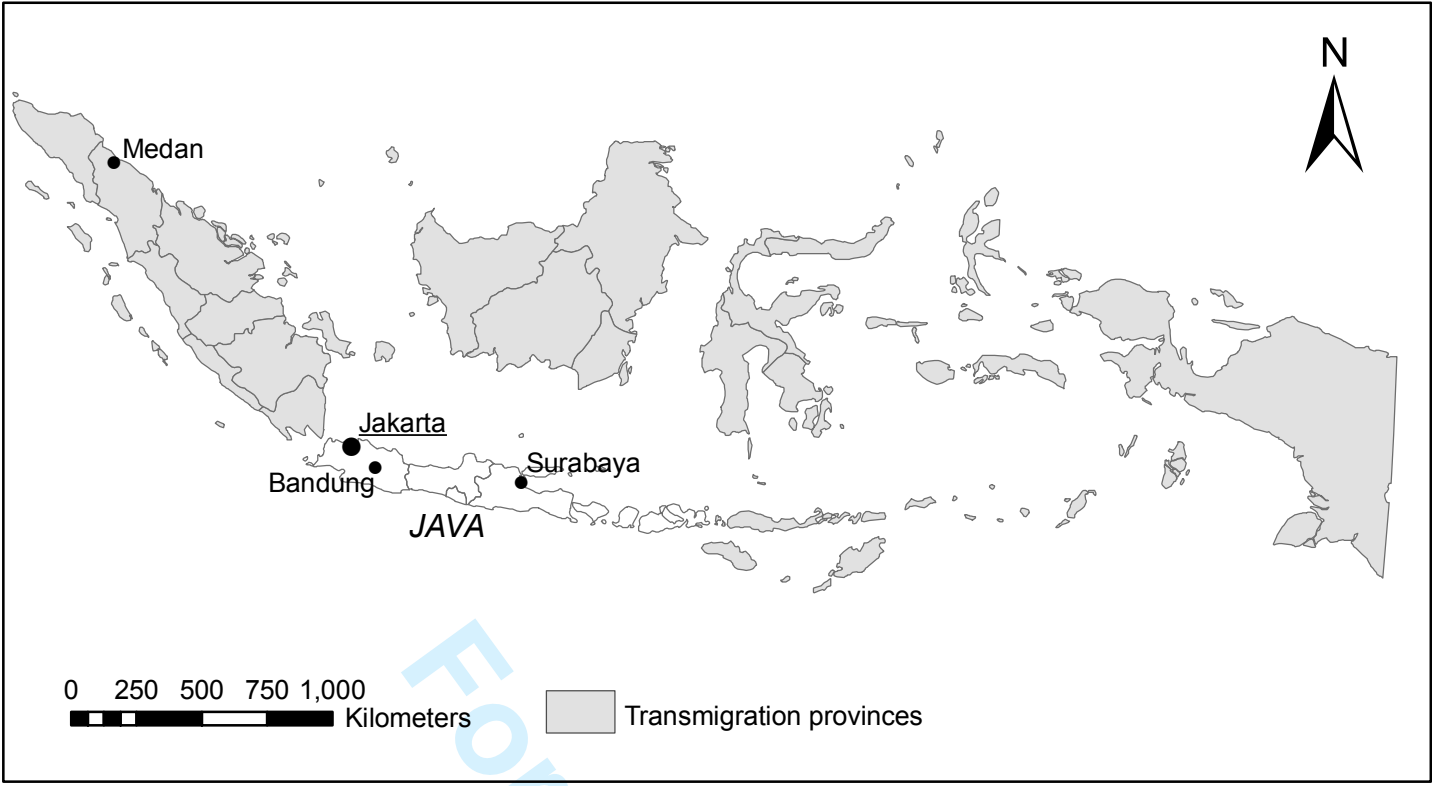
	Transmigrat ion dummy	Lmigij	LPopi	LPopj	LDij	Relyij	Jkt_dummy	Cont
<b>1930</b>								
Mean	0,23	6,22	14,19	14,18	6,91	1,01	0,05	0,11
Median	0,00	6,20	14,10	14,10	6,95	1,00	0,00	0,00
Standard Deviation	0,42	2,21	1,17	1,18	0,72	0,11	0,22	0,31
Sample Variance	0,18	4,89	1,37	1,38	0,52	0,01	0,05	0,09
Kurtosis	-0,33	-0,40	-0,45	-0,47	0,64	-0,07	14,17	4,65
Skewness	1,29	0,24	0,36	0,36	-0,77	0,29	4,01	2,57
Range	1,00	10,64	4,09	4,09	3,89	0,55	1,00	1,00
Minimum	0,00	1,61	12,37	12,37	4,30	0,76	0,00	0,00
Maximum	1,00	12,24	16,45	16,45	8,20	1,31	1,00	1,00
Count	340	340	340	340	340	340	340	340
<b>1971</b>								
Mean	0,21	6,46	14,65	14,63	7,04	1,07	0,04	0,09
Median	0,00	6,39	14,57	14,57	7,12	1,00	0,00	0,00
Standard Deviation	0,41	2,38	1,14	1,16	0,69	0,39	0,20	0,29
Sample Variance	0,17	5,69	1,30	1,36	0,48	0,15	0,04	0,08
Kurtosis	0,00	-0,26	0,42	0,37	0,71	0,42	20,13	6,09
Skewness	1,41	0,06	0,36	0,29	-0,71	0,81	4,70	2,84
Range	1,00	13,55	5,13	5,13	4,13	2,07	1,00	1,00
Minimum	0,00	0,00	11,92	11,92	4,30	0,40	0,00	0,00
Maximum	1,00	13,55	17,05	17,05	8,43	2,48	1,00	1,00
Count	623	623	623	623	623	623	623	623
<b>1980</b>								
Mean	0,21	7,32	14,88	14,87	7,05	1,03	0,04	0,09
Median	0,00	7,25	14,76	14,76	7,13	1,00	0,00	0,00
Standard Deviation	0,41	2,14	1,04	1,04	0,69	0,25	0,19	0,29
Sample Variance	0,16	4,57	1,07	1,07	0,48	0,06	0,04	0,08
Kurtosis	0,09	-0,34	0,33	0,33	0,73	-0,30	20,85	6,21
Skewness	1,45	0,27	0,98	0,99	-0,72	0,49	4,77	2,86
Range	1,00	10,81	3,79	3,79	4,13	1,23	1,00	1,00
Minimum	0,00	2,83	13,44	13,44	4,30	0,56	0,00	0,00
Maximum	1,00	13,65	17,23	17,23	8,43	1,79	1,00	1,00
Count	641	641	641	641	641	641	641	641

	<b>Transmigrat ion dummy</b>	<b>Lmigij</b>	<b>LPopi</b>	<b>LPopj</b>	<b>LDij</b>	<b>Relyij</b>	<b>Jkt_dummy</b>	<b>Cont</b>
<b>1990</b>								
Mean	0,20	7,82	15,18	15,18	7,06	1,01	0,04	0,09
Median	0,00	7,67	14,99	14,99	7,13	1,00	0,00	0,00
Standard Deviation	0,40	2,13	0,94	0,94	0,69	0,13	0,19	0,29
Sample Variance	0,16	4,55	0,88	0,88	0,47	0,02	0,04	0,08
Kurtosis	0,15	-0,40	0,34	0,34	0,74	0,50	21,21	6,36
Skewness	1,47	0,20	1,07	1,07	-0,74	0,43	4,81	2,89
Range	1,00	11,46	3,40	3,40	4,13	0,78	1,00	1,00
Minimum	0,00	2,48	13,98	13,98	4,30	0,68	0,00	0,00
Maximum	1,00	13,95	17,38	17,38	8,43	1,46	1,00	1,00
Count	650	650	650	650	650	650	650	650
<b>2000</b>								
Mean	0,20	8,20	15,23	15,23	7,06	1,01	0,04	0,09
Median	0,00	8,20	15,05	15,05	7,13	1,00	0,00	0,00
Standard Deviation	0,40	2,09	0,99	0,99	0,69	0,12	0,19	0,29
Sample Variance	0,16	4,37	0,99	0,99	0,47	0,01	0,04	0,08
Kurtosis	0,15	-0,37	0,30	0,30	0,74	0,42	21,21	6,36
Skewness	1,47	0,15	1,06	1,06	-0,74	0,39	4,81	2,89
Range	1,00	11,29	3,47	3,47	4,13	0,75	1,00	1,00
Minimum	0,00	2,94	14,06	14,06	4,30	0,69	0,00	0,00
Maximum	1,00	14,23	17,54	17,54	8,43	1,45	1,00	1,00
Count	650	650	650	650	650	650	650	650

Table A2: Correlation matrix

	Transmigration dummy	Lmigij	LPopi	LPopj	LDij	Relyij	Jkt_dummy	Cont
<b>1930</b>								
Transmigration dummy	1							
Lmigij	0,295	1						
LPopi	0,546	0,646	1					
LPopj	-0,252	0,159	-0,054	1				
LDij	0,105	-0,382	-0,031	-0,037	1			
RelLWcooliej	-0,556	-0,272	-0,401	0,423	-0,002	1		
Jkt_dummy	-0,129	0,104	-0,008	0,106	-0,100	0,051	1	
Cont	-0,165	0,344	-0,035	0,004	-0,663	-0,014	-0,039	1
<b>1971</b>								
Transmigration dummy	1							
Lmigij	0,137	1						
LPopi	0,494	0,501	1					
LPopj	-0,198	0,360	-0,063	1				
LDij	0,056	-0,507	-0,169	-0,180	1			
relyij	0,384	0,003	0,614	-0,558	0,006	1		
Jkt_dummy	-0,106	0,266	-0,014	0,122	-0,065	-0,174	1	
Cont	-0,137	0,339	0,017	0,033	-0,639	-0,016	-0,037	1
<b>1980</b>								
Transmigration dummy	1							
Lmigij	0,225	1						
LPopi	0,499	0,591	1					
LPopj	-0,191	0,294	-0,047	1				
LDij	0,048	-0,524	-0,122	-0,126	1			
relyij	0,275	0,064	0,506	-0,484	-0,002	1		
Jkt_dummy	-0,103	0,248	-0,006	0,077	-0,067	-0,175	1	
Cont	-0,135	0,335	0,005	0,0243	-0,636	-0,012	-0,035	1

<b>1990</b>									
Transmigration dummy	1								
Lmigij	0,297	1							
LPopi	0,483	0,595	1						
LPopj	-0,178	0,313	-0,04	1					
LDij	0,042	-0,553	-0,140	-0,140	1				
relyij	-0,039	-0,126	0,004	-0,021	0,005	1			
Jkt_dummy	-0,101	0,225	-0,006	0,158	-0,069	-0,232	1		
Cont	-0,132	0,329	0,016	0,034	-0,635	-0,006	-0,035	1	
<b>2000</b>									
Transmigration dummy	1								
Lmigij	0,262	1							
LPopi	0,485	0,585	1						
LPopj	-0,1788	0,308	-0,04	1					
LDij	0,042	-0,577	-0,158	-0,158	1				
relyij	-0,038	-0,184	-0,136	0,116	0,009	1			
Jkt_dummy	-0,101	0,202	-0,004	0,096	-0,069	-0,284	1		
Cont	-0,132	0,347	0,023	0,040	-0,635	-0,007	-0,035	1	
<b>Total sample, 1930-2000</b>									
Transmigration dummy	1								
Lmigij	0,219	1							
LPopi	0,467	0,611	1						
LPopj	-0,191	0,364	0,052	1					
LDij	0,053	-0,478	-0,108	-0,112	1				
relyij	0,163	-0,051	0,292	-0,296	0,004	1			
Jkt_dummy	-0,106	0,202	-0,013	0,100	-0,073	-0,158	1		
Cont	-0,138	0,317	0,003	0,023	-0,640	-0,011	-0,035	1	



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

For Peer Review