Urban Externalities and Migration Flows

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Abstract

The influence of urban externalities on migration flows is an issue not yet fully covered by the literature. This paper investigates whether changing dwellings across cities is associated with those externalities using urban-urban migration data at municipality level. Results show that migration is affected by them not only locally, but also when neighbouring effects are taken into account.

Keywords: Internal Migration, Urban Externalities, Neighbouring Effects.

JEL Classification: R23, O15, O18, J11, D62

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Introduction

Migration is as old as human beings. Moreover, reasons for changing dwellings have not changed dramatically over the years, since the majority of moves relate to individual decisions about where to maximize utility by looking at economic, social and environmental aspects. The majority of these aspects has been studied in previous works, as shown in the survey of Greenwood (1997) for developed world and Lucas (1997) for developing countries. Nevertheless, some areas are not fully covered by the existent publications. A vein which has not been completely explored yet is whether urban externalities are linked to migration. This paper contributes to the literature by investigating the relationship between migration flows and those externalities.

Examples of urban externalities include *inter alia* varieties of entertainment (such as cinemas, theatres and restaurants, for example), pollution, congestion and violence.[1] As they occur where people reside, they might affect inhabitants' decision on where to live. However, they are a result of social interactions which enables them to present an additional feature: neighbouring effects. For example, a city surrounded by others with high levels of violence is affected by this neighbouring effect. Therefore, neighbouring effects of urban externalities might be interesting to address as they are not restricted to the region where they are located. Urban externalities may hence have an impact not only where they are located, but also in surroundings areas.

Since they are urban externalities, urban-urban migration flows are the key movements to be investigated. Although developed countries experience much more of this type of migration, some developing countries are already so urbanized that urban-urban migration occurs more often than rural-urban. Additionally, developing countries might experience a much more diverse range of places than rich countries, as regional disparities seem wider. Brazil is a good example to investigate how urban externalities might impact migration flows. First, it is a highly urbanized country, as urban population surpassed rural in the 70s and nowadays it is over 80%. Moreover, urban-urban migration pattern is much more frequent than rural-urban, according to Brazilian Censuses. Second, urban externalities are extremely unevenly distributed across space in Brazil. For example, Carvalho, Cerqueira and Lobao (2005) and Waiselfisz (2007) have shown violence is spatially concentrated in Brazilian metropolitan areas.

Three types of urban externalities will be considered in this paper, entertainment options, congestion and violence, yet a special focus will be given to the latter. Habitat (2007) pointed out that people are even more affected by violence in Less Developed Countries (hereafter referred to as LDC), including psychologically, socially and economically. Brazil is an extreme case on this particular issue. According to the UN Office of Drugs and Crime (UNODC), homicides rates in Brazil are one of the highest in the world, as it states: "Levels of small arms violence in countries at 'peace' can be as high, or even higher, than levels in war zones. For example, total gun deaths in the city of Rio de Janeiro between 1997 and 2000 exceeded conflict deaths in war zones such as Afghanistan, Sierra Leone and Uganda during the same period." in IANSA (2007), page 4.

Using urban to urban migration flows of the 1991 and 2000 Brazilian Censuses at city level, results suggest that they seem to be associated. Negative externalities, such as congestion, tend to push migrants towards other cities, while positive externalities, for instance entertainment options, seem to pull them. As it regards violence, local crime rates are negatively associated to migration flows, but neighbouring cannot be neglected. Controlling for origin and destination characteristics, crime rates at origin seem to be more associated to migration flows than their value at destination.

The paper is structured in six sections aside this introduction. The next section presents some theoretical and empirical aspects of the interaction between migration and urban externalities. The empirical strategy is detailed in Section 2. Section 3 presents a data description, followed by descriptive statistics. Results are presented in Section 5. Finally, the last section concludes.

1. Migration Aspects: Theory and Empirics

Molho (1986) and Greenwood (1997) are examples of papers that undertake reviews of migration theories. The authors present many theories to explain why people migrate, such as human

[1] Some authors, such as Tabuchi and Thisse (2002) and Blomquist and Hoehn (1987), have called these urban externalities as amenities / disamenities (the former has called them as social externalities). However, as they result from agglomeration processes, we prefer to call them as urban externalities.

capital approach and random utility. A recent contribution not mention by those two surveys is the New Economic Geography (NEG), started with Krugman (1991). This branch of the literature investigates how population distribution could be influenced by migration. Models in this research field treat some individuals as movers and their freedom to move from one region to another, considering regions' differences, determines the size of each place.

Despite which theory is considered, a common feature among them is that people decide to migrate mainly due to economic reasons, such as real wage differentials. Whenever there are economic differences between two locations, for instance, workers are tempted to migrate. Therefore, economic reasons are the crucial forces to affect whether a person is willing to move or not. However, other issues, such as externalities, might be relevant for migration decisions once economic aspects are controlled. In order to tackle the issue of externalities and migration, two venues may be explored: one theoretical; another empirical.

Theoretically, real wages differentials are the main pull factor to explain migration in NEG models. People tend to move to places with higher real wages. As a result of agglomeration forces and assumptions made, such as homogeneous consumers, catastrophic agglomeration occurs whenever trade costs reduce, since workers migrate towards regions with higher real wages, leading to a herding effect. As a consequence all urban externalities end up occurring only where economic activity takes place.

In order to contribute to this literature, Tabuchi and Thisse (2002) point out that taste heterogeneity acts as a centrifugal force in NEG models, in which different people prefer to live in distinctive areas, since each person values the attributes of regions differently. Even when trade costs reduce towards zero, catastrophic agglomeration does not occur due to this centrifugal force (taste heterogeneity). They also investigate whether this catastrophic agglomeration occurs when regions differ. In other words, when one place has more natural amenities than the other, this area will attract migrants and the other expels them. Their results practically remain the same and places with more amenities generally present a larger population. However, workers could decide to locate in a region with low level of amenities when: (i) transport cost are at intermediate levels; and (ii) when differentials in taste heterogeneity and externalities are not substantially high to be distinguished by workers.

The authors focus only on natural amenities, such as temperature and scenic beauty. Urban externalities are not treated since they vary with population size.[2] They acknowledge the absence of urban externalities as a limitation to their model. Their justification for not including urban externalities into the model is that some urban externalities depend on the number of residents because these externalities are produced with increasing returns to scale. How important are natural amenities and urban externalities for an individual decision to move is a challenging question, as they state. Moreover, the answer for this question varies according to the development stage of a particular region which is being investigated. In other words, it deserves an empirical investigation.

In the empirical side, there is a literature investigating what kind of regions characteristics might being captured by economic variables such as wages. Rosen (1979) addresses how city attributes could explain wages in a migration contest, especially by stating how some of them can be captured by wages. His findings suggest most of the city's attributes are significant to explain wages, such as pollution, climate and market conditions. Crowding and crime are not significant to explain wages. Other papers address this issue using different types of externalities, including crime rates, to be captured by wages, but different results emerge. Violence, for instance, is a good example of the diversity of outcomes. Blomquist, Hoehn et al. (1987) find that increase in violence reduces wages, Clark and Cosgrove (1991) and Blackaby and Murphy (1991) papers show the opposite. These findings suggest that although wages could capture natural amenities, such as climate, certain urban externalities, such as violence, cannot be properly reflected in wages, since it is not clear which impact it has on them. One explanation is that, since urban externalities vary over time (as wages do); it is difficult to adapt wages to time-varying characteristics. As a consequence, a time varying attribute can play a role in migration flows as they might not be reflected in economic variables.

The issue of urban externalities, especially violence, in city size has already been covered by the existent literature. Cullen and Levitt (1999) investigate whether violence is able to impact city size

[2] As said previously, those authors have called urban externalities as social amenities.

using USA data. Their main conclusion is that each reported city crime is associated with approximately a one-person decline in city residents. Although migration might be the main part in explaining city size, it is not the only part as birth and death rates play also their role at city size. In order to overcome this shortcoming, the authors also estimate how violence impacts net migration and results remained the same. Additionally, their findings suggest that out-migration is much more impacted by violence than a decrease in new arrivals. Da Mata, Deichmann, Henderson, Lall and Wang (2007) examine the determinants of city growth in Brazil. Among those determinants, they found, for instance, violence is able to impinge city growth. Those evidence show that city size is impacted by urban externalities, such as violence. However, both papers are silent to where those people are coming from and where they are moving to. If they are migrating from regions with similar violence levels, then it is not a reason for migrating. Moreover, some crime rates reported are homicides, such as used in Da Mata et al (2007). Then, a decrease in city size might be an increase in death rates (and eventually in fertility rate as a consequence) rather than a change in migration patterns. Thus, this paper contributes to the existent literature by evaluating whether urban externalities might impact migration flows rather than just city growth.

2. Empirical Strategy

Migration is empirically investigated by using the gravity equation gathering information of origin and destination, which includes any type of variable interfering in migration flows, such as wages. In this paper, urban externalities will be tested to evaluate whether they are relevant for migration flows or not. For urban externalities, we investigate violence, entertainment variety and pollution/congestion. The econometric framework is described in equation 1.

(1)

$$\ln shm_{ij,t} = \beta_0 + \beta_1 dist_{ij} + \beta_2 \ln wage_{it} + \beta_3 \ln wage_{jt} + \beta_4 \ln externality_{it} + \beta_5 \ln externality_{jt} + \gamma_1 Controls_{jt} + \gamma_2 Controls_{it} + u_{ij,t}$$

Where shm_{ijt} is the share of migrants from origin i to destination j over total at time t; $dist_{ij}$ is the distance between localities i and j; $wage_{it}$ is the wage of origin i at time t; $wage_{jt}$ is the wage of destination j at time t; $externality_{it}$ is the measure of urban externality at origin i at time t; $externality_{ij}$ is the measure of urban externality at destination j at time t; $Controls_{ti}$ is any variable to control for origin i at time t; $Controls_{tj}$ is any variable to control for destination j at time t; u_{ijt} is the error term; and all others are parameters to be estimated.

Initial approach is to estimate equation (1) by OLS, but there are issues which might lead to biased estimators. An initial problem resides on where any urban externality is potentially endogenous. For example, violence might be one case, since it is not clear whether it impacts migration flows or the other way around. Another issue is measurement error of any externality, for example, any violence measure is a proxy for fear of crime and it is the latter which impacts migration flows (not the former). These shortcomings lead to biased estimates of parameters and it should therefore be tackled by using instruments in IV estimation. Therefore, two-stage-least-squares (2SLS, henceforth) will be implemented to tackle this issue.

If endogeneity results from unobserved characteristics constant overtime, then fixed effects eliminates this time-invariant characteristic and providing non-biased estimators. As gravity equation uses information from destination and origin, it is crucial to control for unobservable characteristics at both. Pair-wise fixed effects control for all unobservable characteristics at origin and destination affecting migration flows. Controlling for unobservable characteristics presents a cost: it is not possible to use any time invariant observable characteristic. For example, this restriction imposes eliminating distance in the traditional gravity equation. As our variables of interest (urban externalities) vary in time, fixed effects may be interesting to estimate as well.

Another drawback faced by this work, which leads to biased estimated parameters, is the non-existence of migration flows between some regions. The intuition behind this bias is that having information only from non-zero migrations flows, “undesirable” destinations are not considered and their attributes are discarded. Therefore, evaluating migrations decisions using only information of chosen places might lead to biased estimates, since information of non-chosen cities has not been taken into account. Santos Silva and Tenreyro (2006) show an alternative to estimate when zeros are present in a gravity equation. Their methodology is to estimate the econometric specification by a

Poisson Pseudo-Maximum Likelihood where the dependent variable remains in its level (not in log) and the explanatory variables are taken in logs. Results from Santos Silva and Tenreyro (2006) show that estimating a gravity equation by Poisson with zeros or not demonstrate no substantial difference. The main reason why truncation has little effect in this case is that observations with zero migration correspond to pairs for which the estimated value of migration is close to zero. The corresponding residuals are hence also close to zero and their elimination from the sample has limited impact.

Aside econometric drawbacks, urban externalities might have spatial effects as people in surrounding cities can also benefit for (or suffer with) those externalities. If a neighbouring city has many bars, restaurants and theatres, then inhabitants from those surrounding places are able to access those options of entertainment. Additionally, Plane (2004) argues there is a lack of use of spatial models in the migration literature. As migration flows between any pair of regions are also potentially influenced by neighbouring characteristics from origin and destination, it is relevant to investigate whether spatial lags of urban externalities may be able to affect migration patterns. Equation 2 presents an extended version of equation 1 including spatial effects.

(2)

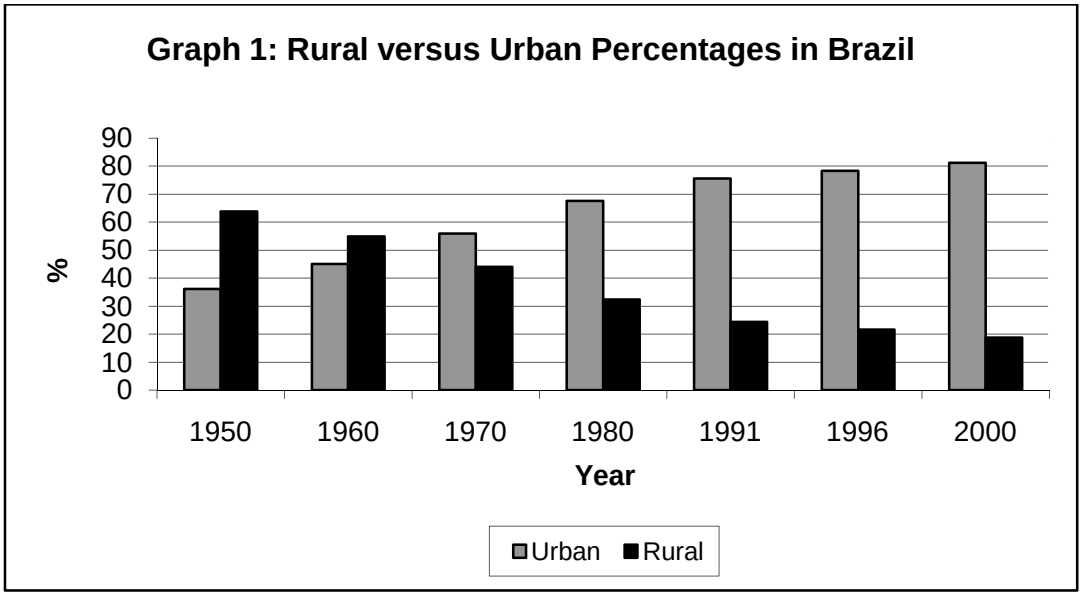
$$\ln shm_{ij,t} = \beta_0 + \beta_1 dist_{ij} + \beta_2 \ln wage_{it} + \beta_3 \ln wage_{jt} + \beta_4 \ln externality_{it} + \beta_5 \ln externality_{jt}$$
$$+ \beta_6 W \ln externality_{it} + \beta_7 W \ln externality_{jt} + \gamma_1 Controls_{jt} + \gamma_2 Controls_{it} + u_{ij,t}$$

Where W is a spatial matrix to taking into account neighbouring effects on migrations flows. For spatial lag, two types of matrices are used: contiguity; and a number of nearest cities. The reason of using the contiguity matrix is fairly obvious, since urban externalities in neighbouring cities may affect migration decision. One possible criticism is that not only contiguous municipalities should be considered since two cities separated by a bay or river, for example, might have much more interaction because a bridge connects them than another two sharing a border. Therefore, using a number of nearest cities matrix overcome this shortcoming.

Summing up, the empirical strategy uses traditional gravity equation estimated by OLS as a benchmark. Since urban externalities might be endogenous, 2SLS procedure is implemented using instruments. As migration may be influenced by unobservable characteristics, pair-wise fixed effects are performed. The concern of biased estimation due to zero migration flows on a gravity equation is sorted out by using Poisson Pseudo-Maximum Likelihood where only non-zero migration flows is taken into account. All of these methods are used when estimating urban externalities with or without spatial lags.

3. Data Description

The migration literature in LDC mainly investigates rural-urban migration, as summarized in Lucas (1997). Even recently, papers addressing this type of migration either theoretically (Chaudhuri (2000) and Basu (2000), for example) or empirically (Bhattacharrya (2002) and Saracoglu and Roe (2004)) have been common. The trend towards a more urban society is however also something common in LDC. In LDC countries, urban population was 29.6 % in 1980, by 2005 the percentage increased to 42.7% according to United Nations (2007). In South America, urban population was even more important, where 81.8% were living in cities in 2005 compared to 68.3% in 1980. Brazil is not an exception to these figures, as Graph 1 shows.



Source: Brazilian Statistical Institute (IBGE), elaborated by authors.

Brazil has experienced a substantial change in people's residence status in the last 50 years. In the 50s, two out of three Brazilians were living in rural areas.[3] However, the urban population became larger than the rural in the 70s. It has steadily increased since and more than 80% of Brazilians live in cities nowadays. This indicates a strong urbanization process occurred in this country and it makes Brazil a suitable candidate to understand issues of urban externalities influencing people's decision to migrate. Therefore, urban-urban migration data extracted by two Brazilian Censuses (1991 and 2000) elaborated by the Brazilian Statistical Institute (acronym IBGE in Portuguese) are reasonable examples to investigate this phenomenon, as urban population was predominant and growing moderately. This information is available in those two Censuses since there is a question to where the interviewed family was living 5 years before, turning it feasible to construct migration flows knowing origin and destination. In total, there are 3,559 geographical units for this investigation.

Although microdata seem to be the best way to answer those questions, they are not available and also questionable. For example, violence affects not only who has been victimized but also relatives and friends. The level of violence in each location influences moreover the whole society by its publicity in local press, such as radio, newspaper and TV. Even when someone is not related to the victim, he/she might be influenced by what happened to someone else just by being informed about the crime committed. Using regional level data can therefore satisfactorily evaluate whether urban externality is correlated to migration flows.

For covariates, different sources are used. For wages and number of employees, two sources are used in each period: Economical Censuses and Government Registration of Firms (*Cadastro Central de Empresas* [CEMPRE]). Since our data is from people who were living in a different city 5 years before Census year, then comparison between wages should be done before their new residence. Economical Censuses are from 1985 (migration flows from 1986 to 1991) and CEMPRE from 1996 (migration from 1995 to 2000). Although they represent two different data sources, they have exactly the same sample (all formal firms in Brazil) and they are elaborated by the same institute (IBGE). Due to data availability, it is possible to distinguish wages into two different sectors: manufacturing and services. The non-existence of living cost at a much disaggregated level appears as a barrier to create real wages for empirical research. Combes, Duranton and Overman (2005) and Sudekum (2007) pointed out however that housing prices determine living cost when trade freeness is low. This is indeed the case under this study since no trade cost exists (apart from transport cost) within the Brazilian economy. Average housing prices at each location are therefore used as a measure of living

[3] The definition of urban population according to IBGE encompasses any person living in dwellings located in municipalities, villas or even isolated agglomerations of dwellings regardless their size, demographic density or any other criterion. Rural dwellings are those not situated in these urban areas.

cost sourced by IPEA. Even though it looks like a rough proxy, it has been shown theoretically viable, empirically tested by Sudekum (2007), aside it is the only data available. [4] Then real wages, nominal wages per employee divided by housing prices, are used to pick up wage disparities.

For urban externalities, three are investigated in this paper: violence; entertainment options; congestion/pollution. The number of firms in the service sector, including bars, restaurants, theatres, is used to control for entertainment options, sourced by IPEADATA.[5] Population density measure is utilized to capture a sort of externalities, such as congestion and pollution, sourced by IBGE. Additionally, a quadratic in population density is used in order to pick up turning points. The number of homicides per 100,000 inhabitants in each locality is used as a measure of violence. This information is available from the Mortality Integrated System (*Sistema Integrado de Mortalidade*, acronym SIM) of database of the Brazilian Health Ministry, called Health Database (*Bando de Dados do Sistema Unico de Saude* – DATASUS*)*. Data comprise from 1980 until 2002. The level of crime five years before the census is taken into consideration since it is within this period that people change dwellings.

For controls, we use different types of measures. Urban population in each city is used to control for size measures, source by IBGE. Percentage of males in each city may also be used to capture any gender issue related to migration, since men are more likely to migrate according to the pools (source IBGE). Market Potentials are created by using GDP measures provided by IPEA for the period analyzed. Distance was calculated by using the Great Circle Formula from each region centre point. Finally, considering that some export regions might be attractive for migrants, then exporting status is created by assuming that a city which has exported on average more than US$ 500 million.[6]

Infrastructure measures are also used as controls. For health access, the number of doctors per inhabitant and the percentage of highly qualified nurses catalogued by UNDP are used in the estimation process. The number of years spent on schooling and percentage of illiterate people in each locality is used to control for education infrastructure (source IBGE). Regarding physical infrastructure, the percentage of dwellings with electricity, water supply and sewage is utilized for this purpose (source IBGE).

Distance to the state capital and to the Brazilian capital (Brasilia) sourced by IPEADATA are other variables which might be used to capture any movement related to job opportunity in government institutions, since some people move to the capital to start a career as a civil servant. In order to capture the informal sector, the amount of money deposited in the bank might be utilized for this purpose because it is quite common for people working in this sector to have banking and/or saving accounts (source Brazilian Central Bank).

4. Descriptive Statistics

4.a Migration in Brazil.

Some papers provide some descriptive analysis of Brazilian migration pattern. Andrade, Santos and Serra (2000) showed that medium size cities in Brazil have increased their participation in the urban population from 9% in 1970 to 14% in 1996. Jannuzzi and Jannuzzi (2002) analyse migration, urban growth and real estate attractiveness of Sao Paulo, the economic centre. They find that Sao Paulo lost inhabitants due to the migration process which occurred from the 1980s onwards, as evidenced in Martine (1994) and Baeninger (2000). They conclude that people migrated to cities around Sao Paulo in order to avoid high house prices. Their paper provides one indication that migration towards medium size cities can be related to people leaving metropolitan cities, as evidenced by Andrade et al (2000).

Vasconcellos and Rangel (2005) analyse Brazilian migration patterns using the last two Census data as this paper does. They provide a detailed descriptive analysis of the migration process in Brazil during this period using city level data. Comparing both periods, the authors conclude that migration flows have remained the same within the period analyzed. They find moreover not only that 10% of Brazilians over five years of age have migrated from 1986 to 1991 and from 1995 to 2000, but also that people from the southeast and the northeast were the majority of them (65% in 1991 and

[4] It is also feasible to obtain wages from the agriculture sector, but the focus here is urban-urban migration and this sector does not operate in urban areas.

[5] For more information, check www.ipeadata.gov.br.

[6] Other measures were used, such as US$ 1 billion and US$ 100 million, but results remained practically similar.

71% in 2000). The population of the southeast has the greater positive net result for migration flows in contrast with the population of the northeast which revealed the largest negative net result for migration flows. The average distance is slightly greater than 400 km, but more than 60% of migrants change their residence within 250 km, of which half (around 30% of the total) do so within 50 km. A reasonable part occurs from metropolitan cities towards their neighbours, which can be interpreted as individuals looking for better house prices, as suggested by Jannuzzi and Jannuzzi (2002). Another finding is that the level of intra-state migration (between cities within the same state) is significantly higher than the level of inter-state movements (across cities in different states). All of these together indicate that distance matters. Considering all possible migration flows, around 1% is non-zero. One issue not covered by these two papers just mentioned is the identification between rural and urban as origins and destinations, which is considered in this current paper.

It is common sense that rural-urban migration is the standard pattern in LDC as Lucas (1997) states, but developing countries may present completely different migration flows. India, for example, is an exception to this rule. Skeldon (1986) shows that 57% of migration in India was rural-rural according to their 1981 Census. Focusing on rural-urban migration, Nelson (1976) argues Latin America differs from Africa/Asia by migration period status. In the latter, it is basically transitory and in the former, permanent. This explains partially why Latin America is much more urbanized than other parts in LDC. Considering this, it is possible to expect that rural-urban migration might be less important for migration flows in Latin America, especially in Brazil which presents higher urban rates. Table 1 shows Brazilian migration flows by distinguishing between rural and urban migration as origin and/or destination.

Table 1: Numbers and Percentage of Migration in Brazil

	1991		2000	
	Migrants (in millions)	%	Migrants (in millions)	%
Urban to Urban	8.0	62%	9.9	72%
Urban to Rural	1.1	8%	1.1	8%
Rural to Urban	2.3	18%	1.7	13%
Rural to Rural	1.5	11%	0.9	7%
Total	12.9	100%	13.7	100%

Source: Censuses of 1991 and 2000 (IBGE).

The table presents how migration from rural to urban still plays an important role, but it is more than evident that urban-urban is much more relevant than any other. While migration from rural to urban has decreased not only in volume (from 2.3 million to 1.7 million), but also in share (from 18% to 13%), migration between urban areas has increased in both: volume and share. This issue presents a completely different pattern between the two censuses analyzed, since urban-urban migrations become even more important than rural-urban. In total, around 13 million people change their residence every five years according to the two Censuses, representing around 10% of the Brazilian population, as pointed out by Vasconcellos and Rangel (2005). Indeed, a volume of the entire Brazilian population changed their address to another city every half century after considering these figures. People move therefore 1.4 times during their lifetime if Brazilian life expectancy is considered.[7]

4.b Urban Externalities in Brazil: Violence

As seen in the previous section, Brazilian migration pattern is predominately urban-urban, where urban externalities are present. In order to exemplify how urban externalities can be important to explain migration flows in LDC, we will focus on a particular externality: violence. As reported in UN-Habitat (2007), urban population is increasingly being affected by criminality, especially in developing countries where a huge proportion of them lives in poor areas with lack of infrastructure and labour opportunities.

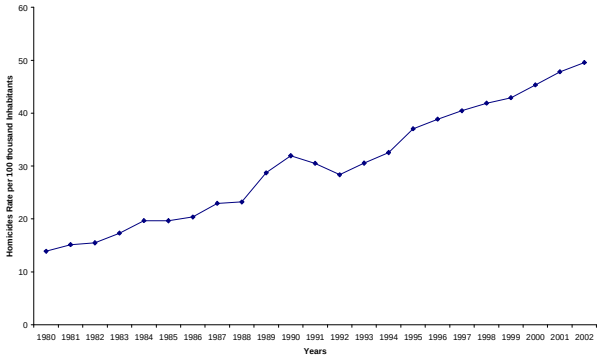
In Latin American countries, and especially in Brazil, violence also represents an important issue in their societies. Carvalho, Cerqueira, Lobao and Rodrigues (2007) estimated cost of violence

[7] According to IBGE, Brazilian life expectancy was 70 years in 2000.

has reached 5.09% of Brazilian GDP in 2004. Additionally, UN-Habitat (2007) mentions how the fear of violence affects people's life, since they state that even when crime rates reduce, the sense of insecurity may remain high, hence lessening people's quality of life. Social life can also be affected by violence. For example, more than 60% of Brazilians feel unsafe walking home at night, according to Nuttall, Eversley and Rudder (2002). Summing up, crime imposes economic, social and psychological negative effects.

In order to have an idea of how violence has developed in Brazil, Graph 2 presents homicides rates per 100 thousand inhabitants from 1980 until 2002. As shown, there is an upward tendency of this crime over the whole period. It started at a rate of roughly 14 deaths per 100 thousand inhabitants and reached nearly 50 per 100 thousand inhabitants which represent an annual increase of 6%. This demonstrates how this issue has become so prominent over the last couple of decades.

Graph 2: Brazilian Homicide Rates from 1980 until 2002



Source: SIM-DATASUS, Brazilian Health Ministry

The distribution of crime varies substantially across municipalities where some present reasonably low crime rates while others resemble armed conflict areas. In order to evaluate how violence is distributed across these regional units over the period, Table 2 reports statistics of the five-year average homicide rates from the 3,659 cities under study.

Table 2: Descriptive Analysis of Violence in Brazil

Homicides per 100 thousand inhabitants	1986-1991	1995-2000
Unweighted Average	8.6	9.5
Median	5.6	6.1
Standard Deviation	10.2	11.6
Maximum	116	140
Minimum in Cities with Crime Record	0.24	0.34
Number of Cities with no Crime Record	624	524

Source: SIM-DATASUS, Brazilian Health Ministry

First, cities present on average lower crime rates compared to national figures, since homicides rates across cities are below 10 homicides per 100 thousand inhabitants while at the national level they are 26 from 1986-91 and 41 from 1995-00. This represents higher crime rates in more populous regions. The upward tendency shown in Graph 2 is also noticed nevertheless at Table 2 by any descriptive statistics considered. This increase has not been homogeneous across cities, since the standard deviation increased which means more heterogeneity across cities. Also the number of cities with no statistical record of homicide rates has reduced after a decade.

The minimum and maximum values observed also provide an indication of crime rates rising over the years in each locality. The maximum five-year average registered is from a city belonging to the Sao Paulo metropolitan region which may indicate that big metropolitan areas are in fact the most

dangerous.[8] More generally, Carvalho et al. (2005) and Waiselfisz (2007) provide evidences that areas with high crime rates include the most important metropolitan areas, such as Rio de Janeiro and Sao Paulo. It is thus evident that populous regions are among those with the higher crime rates.

Waiselfisz (2007) explores how geographically violent rates are distributed over Brazil. One of his findings show that the top 10% more violent cities concentrates more than 70% of all homicides rates in 2004. Moreover, these municipalities are generally big cities as those cities represent 42% of the Brazilian population. Taking into consideration the average homicide rate in 2004, those 10% more violent cities are four times more violent than the national figure.[9]

Although Waiselfisz (2007) shows graphically that violence is spatially concentrated, they do not test it statistically. Carvalho et al. (2005) not only present some maps to show this pattern, but they also investigate whether Brazilian homicides rates across municipalities are spatially correlated. Their findings back up the map evidence. This violence spatial correlation allows us to consider that violence might have neighbouring effects. One example of how violence might affect economic measures, locally and/or in surrounding areas, is given by Gibbons (2004). Gibbons tries to investigate whether housing prices may be affected by violence. Using a neighbourhood data set, his results suggest that violence, locally and in surroundings areas, affects housing prices in London.

With regards to migration, violence might have a spatial effect due to some reasons. For example, even living in a city with low levels of violence, if neighbouring areas show high criminality records then inhabitants of this safer area might fear that sometime in the near future violence might increase in their locality. Therefore, spatial effects of violence may influence people's decision to migrate. Another feature is that people may work and live in different cities as happens in some metropolitan areas in Brazil. Although people may live in relatively peaceful areas, they may work in areas where criminality levels are higher. Therefore, facing more violence while working might affect people's decision to move to another area. If this happens, neighbouring effects of violence are influencing people's decision as to where to live.

Considering urban-urban is the most common type of migration for the Brazilian case, it is possible to analyze whether these movements are associated to urban externalities. The preliminary descriptive statistics presented in this section provide some indication this might be the case, however this is just rough evidence which needs to persist under econometric scrutiny as there are many other aspects affecting people's decision to migrate.

5. Econometric Results

Only places where migration between two localities was greater than zero are taken into account for econometric results in this section. Even though this restriction on the data reduces the sample substantially, there are still more than 100 thousand valid observations for the two years investigated.[10] Poisson pseudo-maximum likelihood does not present a substantial difference when estimating with or without zero, as discussed earlier.[11] Most of the explanatory variables are normalized by national figures.[12] An unemployment rate of a region *j*, for example, is divided by the Brazilian unemployment rate. This avoids some national time trend (such as recession and/or inflation) which may be associated with changes, but it does not remove time changes between localities. However, time dummy is also included to pick up any other time trend not presented in the observable variables. Additionally, it is important to mention that standard errors are robustly estimated throughout this whole section.

Before presenting any outcome, it is important to discuss the process of choosing instruments. One urban externality investigated in this paper, violence, is endogenous because it is not clear whether violence impacts migration flows or the other way around. Another issue is that the violence

[8] Sao Paulo metropolitan region is the most populated region in Brazil and Diadema is the city where crime rates are beyond 100 homicides per 100 thousand inhabitants at both periods.

[9] This explains why national figures present a higher increase in homicide rates, as shown in Graph 2, than the unweighted average homicide rates across municipalities, as Table 2 presents.

[10] Some regions have no doctor; therefore it is not possible to take log. This observation is therefore discarded. Levels, instead of log of the variable, are also used for estimation to overcome this issue and similar results emerge (available upon request).

[11] Results from a random sample of 500 thousand migration flows from all observations, including zeros and non-zeros, are available upon request.

[12] Exceptions are those time invariant, such as distances and dummy variables.

measure used here does not represent all crimes; moreover, it is the fear of crime which leads people to other places, and not crime rates. These shortcomings lead to biased estimates of any parameter. It should therefore be tackled by using instruments in an IV estimation. Investment on security is a potential instrument, since it may only affect migration flows via its effects on violence. State governments are responsible for practically most of the Brazilian police system. The percentage of security expenditures on each state budget may be hence used to instrument violence, sourced by the National Treasury Secretariat from the Ministry of Finance. Although this might represent a response to criminality increase, some precautions are taken trying to avoid it. One strategy was taking information lagged in time. Therefore, only the level of security expenditure time-lagged is used for this purpose. By taking it lagged in time, government expenditures on security are previous violence records and migration flows. Therefore, time lagged information of security expenditure could be correlated with the violence measure, which may have a direct effect on migration flows. One additional feature of this instrument is its regional dimension which is actually larger than the unit used in this study (city level). It makes this instrument even more exogenous, since cities within the same state are considered similar, when they are actually much more heterogeneous, including in violence terms. Another issue is related to the spatial dimension of violence, since increasing crime rates in one city might be explained by the reduction in a neighbouring city. A government intervention in a broader geographical scale is able to tackle this issue. Since endogeneity may have other venues as mentioned in the empirical strategy, two additional methods are implemented: Fixed Effects Pairwise; Pseudo-Poisson. Table 3 shows a summary of the results from the model presented in Equation 2 estimated by four different methods: OLS (1st column), 2SLS (2nd column), Pairwise Fixed Effects (3rd column) and Poisson Pseudo-Maximum Likelihood (last column).[13]

Table 3: Results Gravity Equation

Dependent Variable	(i)	(ii)	(iii)	(iv)
Share of Migrants	OLS	2SLS	FE	Poisson
Distance	-0.42	-0.41	-	-0.89
	(0.003)***	(0.004)***	-	(0.014)***
Share of Pop. Destination	-2.62	-2.91	-1.39	-11.50
	(0.185)***	(0.212)***	(1.307)	(0.625)***
Share of Pop. Origin	1.27	1.31	4.40	4.15
	(0.183)***	(0.197)***	(1.253)***	(0.717)***
Violence Destination	0.01	-0.09	-0.04	0.004
	(0.004)***	(0.028)***	(0.020)*	(0.011)
Violence Origin	0.06	0.05	0.05	0.10
	(0.004)***	(0.020)***	(0.019)***	(0.012)***
Pop. Density Destination	-0.03	-0.08	-0.64	0.03
	(0.025)	(0.028)***	(0.160)***	(0.083)
Pop. Density Sqr. Destination	-0.01	-0.01	-0.02	-0.01
	(0.001)***	(0.001)***	(0.017)	(0.004)*
Entertainment Destination	0.11	0.11	0.02	0.32
	(0.010)***	(0.010)***	(0.051)	(0.039)***
Pop. Density Origin	0.22	0.22	0.40	0.31
	(0.028)***	(0.028)***	(0.187)*	(0.086)***
Pop. Density Sqr. Origin	0.02	0.02	0.03	0.04
	(0.002)***	(0.002)***	(0.019)	(0.006)***
Entertainment Origin	-0.04	-0.04	0.08	0.00
	(0.010)***	(0.010)***	(0.05)	(0.03)
Constant	-8.23	-7.94	5.82	-3.72
	(0.126)***	(0.139)***	(2.823)**	(0.436)***
Observations	113,307	113,307	113,307	113,307
R-squared	0.28	0.28	0.02	0.06
First Stage R-squared	-	0.52 / 0.47	-	-
First Stage F-stat.	-	2,661 / 2,197	-	-

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

[13] Results from all covariates are available upon request.

Before focusing on the interested variables (urban externalities), an overview of other variables is suggestive. In general, results show the majority of the variables are relevant to explain migration flows, since most of the estimated parameters are significant, but not all of them have the expected sign. For instance, distance presents the negative and significant sign in all procedures. Wages in services seem to attract migrants because it has a positive and significant value in 2SLS at destination, but non significant in other methods. Manufacturing real wages however mainly present the wrong sign. Similar outcomes are found nevertheless in Crozet (2004) in which services tend to explain more internal migration than manufacturing sector.

Some other variables show interesting results. Distance to state and federal capitals also present very robust results showing the closer a city is to any capital, the more people migrate to these localities. This may represent some migration related to labour opportunities in State or Federal governments, as mentioned earlier, where people move to the capital after being enrolled as a civil servant. Urban size corroborates findings from Andrade et al. (2000) as the larger a city is the more people are moving from. In other words, migration flows is from large cities to smaller ones. This is an indication of the increased importance of medium-sized cities in urban population. This outcome may be interpreted as the other non controlled negative externalities (such as other types of crime apart from homicides) are greater than any other positive one, social network for example.

Entertainment options and population density (representing a congestion/pollution) present expected signs, but differences exist. While entertainment options present robust results at destination, population density shows at origin. In other words, people are willing to live in areas with more entertainment options yet they also seem to be avoiding denser areas (where congestion is more evident). Population density at destination and entertainment options at origin corroborates these findings as they are negative for the former and positive for the latter. Population density has a further feature as shown by their squared value estimated. Outcomes suggest that increasing returns occurs, in other words, as population density square at destination is negative, then the negative correlation of population density and migration flows tend to increase as a city becomes more densely populated. Similar interpretation is feasible with population density at origin, but in an opposite direction (positive). Those robust results provide us evidence that urban externalities have a correlation to where people decide to live.

Our focus variable, violence, has a positive and significant sign when estimating by OLS in both places: destination; and origin. However, parameter estimated is biased as explained previously. It is hence important to instrument it to see whether this positive association changes. After using instruments in the 2SLS, it is possible to notice that violence becomes negative at destination and remains positive at origin. Nevertheless, some more diagnosis should be done in order to evaluate the adequacy of those instruments. First Stage results of IV procedure present some evidence whether instruments are statistically correlated to the endogenous variable. Security measure can explain substantially the endogenous variable, since R-square of the first stage is around 0.50. Additionally, F-statistic of first stage backs up those findings as shown in Table 3. Staiger and Stock (1997) formalized the definition of weak instruments, but researchers have found that any F-statistic in the first stage exceeding 10 would lead to the conclusion that instruments are sufficiently strong. Therefore, instruments used in this work would be considered strong following Staiger and Stock (1997) definition, since F-statistic are far beyond the threshold mentioned.[14]

As 2SLS results ought to be corroborated by other strategies, two further methods are implemented. Pairwise fixed effect presents even further evidence that violence is relevant for migration flows. Controlling for unobservable characteristics, violence remains positive for origin and negative for destination, therefore people are migrating to safer areas and leaving dangerous cities. Poisson Pseudo-Maximum Likelihood results, in the last column, provide even further evidence that violence at origin is effectively expelling people, but they do not corroborate that they are moving to safer places, since violence at destination is not statistically significant. These outcomes suggest violence is relevant in explaining migration patterns: cities with higher crime rates tend to expel inhabitants to other areas. The migration literature suggests that fear of crime leads people to move

[14] As there is only one instrument for each endogenous variable, thus it is not possible to perform Sargan Overidentification Test.

towards medium-sized cities, even though the level of crime could be similar between origin and destination. Brazilian case presents however that the level of violence might be strongly correlated to these fears, since results suggests that it is negatively correlated to migration flows.

As discussed previously, neighbouring effects of violence might be relevant in explaining migration flows because violence affects people's well being not only locally but in surrounding areas as well. The main explanation is due to social interaction of violence. Table 4 shows a summary of the results with spatial lag variable,[15] while the first four columns present results using the contiguity matrix, the last four show outcomes using the four nearest neighbours' matrix.[16]

Table 4: Neighbouring Effects

Spatial Lag Matrix	Contiguity				Four Nearest Neighbours			
Dependent Variable	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Share of Migrants	OLS	2SLS	FE	Poisson	OLS	2SLS	FE	Poisson
Distance	-0.41	-0.40	-	-0.88	-0.42	-0.46	-	-0.89
	(0.004)***	(0.008)***	-	(0.014)***	(0.003)***	(0.097)***	-	(0.014)***
Share of Pop. Destination	-2.59	-1.92	-2.37	-11.40	-2.59	-2.68	-1.28	-11.66
	(0.196)***	(0.551)***	(1.387)*	(0.645)***	(0.185)***	(0.513)***	(1.318)	(0.633)***
Share of Pop. Origin	1.40	4.42	4.27	3.87	1.41	-3.78	4.58	4.46
	(0.196)***	(1.837)**	(1.320)***	(0.695)***	(0.184)***	(10.113)	(1.262)***	(0.729)***
Violence Destination	0.01	-0.39	-0.04	-0.01	0.01	1.56	-0.04	0.03
	(0.006)	(0.228)*	(0.024)*	(0.015)	(0.005)*	(2.978)	(0.022)**	(0.019)
Spatial Violence Destination	0.00	0.24	-0.01	-0.01	0.00	-1.02	0.00	-0.04
	(0.006)	(0.167)	(0.026)	(0.016)	(0.006)	(1.854)	(0.024)	(0.020)**
Violence Origin	0.04	-0.97	0.02	0.06	0.04	1.67	0.03	0.06
	(0.006)***	(0.572)*	(0.022)	(0.018)***	(0.005)***	(3.394)	(0.021)	(0.020)***
Spatial Violence Origin	0.03	0.97	0.07	0.06	0.04	-1.66	0.04	0.07
	(0.006)***	(0.558)*	(0.024)***	(0.019)***	(0.006)***	(3.415)	(0.022)*	(0.021)***
Pop. Density Destination	-0.04	-0.17	-0.70	-0.04	-0.03	0.40	-0.61	0.04
	(0.026)	(0.064)***	(0.170)***	(0.081)	(0.025)	(0.864)	(0.162)***	(0.084)
Pop. Density Sqr. Destination	-0.01	-0.02	-0.04	-0.01	-0.01	0.00	-0.02	-0.01
	(0.001)***	(0.002)***	(0.018)**	(0.004)**	(0.001)***	(0.025)	(0.017)	(0.004)*
Pop. Density Origin	0.22	0.38	0.38	0.31	0.24	-0.26	0.36	0.32
	(0.029)***	(0.103)***	(0.198)*	(0.086)***	(0.028)***	(0.990)	(0.189)*	(0.085)***
Pop. Density Sqr. Origin	0.02	0.05	0.04	0.04	0.02	-0.04	0.03	0.04
	(0.002)***	(0.019)**	(0.020)*	(0.006)***	(0.002)***	(0.126)	(0.020)	(0.006)***
Entertainment Destination	0.11	0.10	-0.01	0.32	0.11	0.07	0.03	0.32
	(0.011)***	(0.016)***	(0.054)	(0.039)***	(0.010)***	(0.076)	(0.051)	(0.039)***
Entertainment Origin	-0.04	0.00	0.06	0.00	-0.04	-0.07	0.08	0.00
	(0.011)***	(0.03)	(0.053)	(0.032)	(0.010)***	(0.090)	(0.051)	(0.030)
Observations	101,270	101,270	101,270	101,270	112,661	112,661	112,661	112,661
R-squared	0.28	0.14	0.03	0.05	0.28	0.15	0.03	0.06

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In general terms, results remain substantially similar to previous estimations. The farther a location is, the less people migrate (distance negative), as well as large cities are expelling people towards smaller cities (share of urban population at destination being negative and at origin, positive). Entertainment options and population density also present identical outcomes, as people tend to move from places with less leisure options to those with more and from crowded areas to less ones. Differences are between the type of spatial matrix is used, since outcomes with contiguity spatial link shows outcomes more robust.

Regarding violence, differences and similarities with previous results occur. Considering contiguity matrix first, results suggest that the inclusion of spatial lag does not interfere on how the level of violence at destination might affect migration flows, as their value remains negative in two methods (2SLS and FE) and non significant in other two (OLS and Poisson). Moreover, spatial lag of

[15] For simplicity, only results of urban externalities and distance are shown in Table 4. Full outcomes are available upon request.

[16] The only way that nearest neighbours might present different outcomes is by replacing contiguous cities. As the mode from contiguous is four, the four nearest cities are used to construct the spatial matrix.

violence at destination seems not to have any impact on people's decision to where to move. On the other hand, violence at origin is substantially impacted by the introduction of spatial lag. Before, all methods show the level of crime in a city tend to expel inhabitants to other areas, yet outcomes do no present this pattern so robust after including the spatial lag (only OLS and Poisson are positive). However, the spatial lag of violence at origin is positive in all tries, which means that if neighbouring cities present high crime rates then people tend to migrate to other areas.

When we consider the nearest neighbours, distinct outcomes emerge. Violence at destination becomes even less relevant to impact migration flows, since only FE present expected sign. However, Poisson results show a negative sign for the violence spatial lag, which was not obtained when using contiguity matrix. Considering violence at origin, outcomes remain quite similar to contiguity matrix. The only difference is that spatial lag of violence estimated by 2SLS is not significant anymore. Overall findings suggest that neighbouring effects seem to be associated to migration flows and they do not reduce the importance of local crime on migration, especially at origin.

5. Conclusion

This paper investigates whether urban externalities are correlated to urban-urban migration flows using Brazilian city level data. In general, urban externalities investigated here cannot be neglected to explain people's decision to move, as outcomes suggest that, controlling for other aspects, they matter for migration flows.

Entertainment options seem to be an important pulling factor for migration flows which means that people do migrate towards cities with larger options of restaurants, shops, and others. Negative externalities, such as congestion, appear to be the pushing force representing people's desire to move from highly dense populated cities. Urban population outcomes corroborate Andrade et al. (2000) findings in which medium-sized cities are increasing their participation in the Brazilian urban population since larger places are repelling inhabitants towards smaller cities.

Looking at violence, results suggest it is negatively correlated to Brazilian migration flows. Places offering lower levels of crime rates tend to have more people moving towards them, yet criminality at origin tend to expel inhabitants more consistently, as results are more robust at origin than at destination. Neighbouring effects are also tested and outcomes show cities with high violence levels in their surrounding territories do not attract migrants. Additionally, cities surrounded by violent places also repel people towards other places. It is therefore safe to conclude that it is not possible to exclude criminality as a factor affecting migration patterns.

In terms of public policy, this paper highlights that urban externalities are relevant to attract or expel migrants when externalities are positive or negative, respectively. First, it is important to emphasize that urban infrastructure, especially transports, should be considered as one main driver to attract migrants, since congestion measure has shown a negative relationship with migration flows. Cities densely populated are expelling inhabitants to other cities. Urban transport system in Brazil is not comparable to other cities in the developed world, especially controlling for their size. According to Burdett and Sudjic (2011), São Paulo metropolitan area, the biggest in Brazil, has more 19 million inhabitants and only 331 km of metro and rail lines dedicated to passenger transportation in this metropolitan area. London, New York and Berlin, all metropolitan areas smaller than Sao Paulo, have more than double the kilometres of metro and rail lines utilized by their inhabitants. Investing in urban mobility systems will, therefore, attract migrants to larger cities, especially those who actually use public transport, mainly blue-collar workers.

It is also worth emphasizing that urban externalities effects are not only local, but also in surrounding areas. Subsequently, if a government is seeking to attract migrants to any municipality, they should not neglect the attributes of their neighbouring cities, since levels of criminality in those cities expel inhabitants from the target city to other places. In other words, public policy should address the problem of violence on a large geographical scale instead of focusing on a single city. Rio de Janeiro (host of the Olympic Games in 2016 and some 2014 World Cup games, including the final match), for example, is a city where the State Government is implementing policies in its shantytowns (called "favelas") but ignoring the level of violence in other surrounding cities. Although governments have to start from a specific point and then spread it to other areas, the actual government has not shown their population any plan to implement policies in surrounding cities, including those where poverty levels are higher, such those in the Baixada Fluminense. So far, most of the projects to reduce criminality are in "favelas" close to rich neighbourhoods within the City of Rio. If they really want to

make a city attractive for migrants, they have to be more effective in reducing criminality in the whole metropolitan area, not just in the capital and their posh neighbourhoods.

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