"The Impact of Refugess on Per Capita Income"
A Gravity Model Approach

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Abstract

I extend the bilateral Gravity Model of migration by Vanderkamp (1977) based on Newton’s Law to a unilateral instrumental variable strategy for refugees, which is able to reflect time dependent shocks. Controlling for population size, trade openness, unemployment and the migrant stock in a panel data for subsequent members of the European Monetary Union in the short and mid run after the Balkan crisis leads to a significant negative impact of incoming refugees on the host country’s per capita income.
I Introduction

The current refugee crisis in Europe with its peak in summer 2015 leaves space for speculations of different political camps regarding future development of destination countries. In order to create an objective discussion base this paper uses non-judgemental economic factors to show the impact of incoming refugees on Per Capita Income (PCI). Working with panel data for European countries in the short and medium run after the Balkan crisis leads to a significantly positive dependence between PCI and refugees. To get the direct impact instead of a dependence, incoming refugees are instrumented. Adopting the bilateral Gravity Model (GM) for migration from Vanderkamp (1977) based on Newton’s Law is the basic framework to solve this causality problem. The aim is to find a modification for that GM to fit for refugees. Due to their legal status and their reason for leaving, there is a distinction between refugees and migrants. It is not possible to model refugees as a constant share of incoming migrants. Two major problems occur when transferring from migrants to refugees. Refugee flows are neither bilateral, nor constant over time. The aim is to get a unilateral model for host countries, which is able to reflect time dependent shocks representing the major reason to leave the country of origin. Host countries are subsequent members of the European Monetary Union in the period 1990-2005.

This paper is not a discussion about the distribution of money, or who profits and who suffers from accommodation of refugees. It shows potential models for the dependence with PCI in the first part and the direct impact on PCI in the second part. In Figure 1 there is a positive relation between PCI in United States Dollar (USD) and incoming refugees in logarithms (logs). Beside the fact that this is a pooled Ordinary Least Squares (OLS) regression, where the panel structure is completely ignored and control variables are not present, it does not represent a causal effect, but gives a first suggestion about a potential linkage. The positive outliers are country-specific, namely Ireland and Luxembourg. Removing them from the dataset, or implementing dummy variables for a connection to the European mainland or minimum size for recorded countries, to smooth the positive dependence, has no consequences in the robustness for later results. If the sample size is reduced, it is possible to show that the final results fit also into a data set that has shown an even stronger link between refugees and PCI before. Running a Fixed Effect (FE) model regression, without instrumented refugees, but with implemented control variables
also assumes a positive dependence (Appendix 1).

The relation of Gross Domestic Product (GDP) to inhabitants does not allow for further interpretations on the condition of individuals, since this only represents an average. Experiences of population parts may vary greatly and are not subjects of this paper.

After introducing into the topic, this paper is divided into three sections. Starting with the research design containing previous literature and the empirical strategy provides a logical structure to walk along. Summarizing the results from other studies and combining legal framework with economic theory leads to several control variables and hypothesis. The third section shows empirical results within this previous mentioned design. Section four concludes.

II Research Design

Previous literature is mainly based on migration. A few studies about effects of refugee movement either belong to social studies (Turner 2016), or try to model long term effects of the current Western European crisis with estimated data (Bach et al. 2017). Going through these migration papers, legal framework and theoretical basis provides not only
different specifications and outcomes. It also shows important variables that have to be controlled for. It is controlled for population size, to cover the differences in size between countries (Ruist 2014). Previous literature provides varying outcomes on different labour market conditions (Borjas & Ramey 1995). To exclude them, the unemployment rate is implemented as a control variable as well. Taking classical growth theory into consideration, openness to other countries is an important driving factor (Harrison 1996). Because financial openness and trade openness share similar characteristics (Bekaert et al. 2005), only one of them is included, openness for trade. It is measured as the sum of imports and exports relative to GDP. The control variable ‘migrant stock’ results from legal framework. Migrants attract further migrants and refugees, due to the fact that family members follow each other, because they are allowed to do so in most of the countries, based on national migration law (Fawcett 1989). Even if refugees cannot determine the time point to leave, they often favour same destinations as migrants. Whether they can enforce their desire is usually depending on how far the Dublin agreement is respected at that time (Hurwitz 1999). The 1990 Dublin Convention entered into force in 1997 as a reaction of the unstructured flow of refugees in the beginning of the nineties. The treaty regulates that refugees stay in the country, which they first enter while crossing the European external border. This Dublin system based on the Schengen Agreement failed and has never been enforced until now (Guild 2006).

Either costs for the reception of refugees predominate, or a country can economically benefit. Whether it can profit from cultural growth is not measurable. Another possibility is a balance of these two effects with a zero outcome. With the acceptance of refugees, local labour markets change (Borjas & Ramey 1995), a redistribution in social system spendings takes place (Eger 2009) and new markets emerge, or existing markets are widened (Jacobsen 2005).

The pooled OLS (Figure 1) and the FE regression without instruments show a positive dependence between incoming refugees and PCI (Appendix 1). To test the real impact in this dataset, the econometric framework is adjusted to avoid potential sources of errors or difficulties. In detail this section deals with the problem of reverse causality, effected by the refugee’s freedom of choice regarding their destination. For this purpose the incoming refugees will be instrumented by a individual modified version of the Gravity Model approach for migrants.

Instrumental Variables (IVs) can overcome the bias in measurement of the variable of
interest. The aim is to eliminate the causality problem, where the explanatory variable is endogenous. Endogeneity occurs when an implemented variable correlates with the error term. So the IV has to be uncorrelated with it, but has to be highly correlated with the biased endogenous explanatory variable (Wooldridge 2015): incoming refugees. Converting these conditions into statements, the IV has to be exogenous, or valid $\text{Cov}(IV, u) = 0$ and strongly correlated with $x$ $\text{Cov}(IV, x) \neq 0$, which states the relevance. In the first step of developing an IV, the validity of the instrument has to be justified by economic theory and common sense. It is not possible to test it directly for an exactly identified model with one endogenous variable being instrumented, because an unbiased estimator for $u$ is unavailable. The relevance condition can be tested; the higher the correlation, the stronger the IV. If the IV is only weakly correlated with the variable of interest, the instrument is not as efficient as the OLS estimator (Wooldridge 2015). Weak instruments often cause biased coefficients.

This development of the IV is often referred to the first stage of a Two Stage Least Squares (2SLS) regression. The predicted value $\hat{x}$ replaces the former variable in the second step, where the relation of interest is tested. Then OLS is possible, because the explanatory variable is no longer correlated with the error term and therefore does not violate the OLS assumption. There are $n-1$ control variables, both existing in the first and second step, with different impacts on $y$ ($\beta$) and $\hat{x}$ ($\delta$).

$$y = \beta_0 + \beta_1 \times \hat{x} + \sum_{k=2}^{n} \beta_k \times c_k + u$$

$$\hat{x} = \gamma_0 + \gamma_1 \times IV + \sum_{k=2}^{n} \delta_k \times c_k + v$$

In a previous paper about effects of migration (Felbermayr et al. 2010) based on Frankel and Romer’s trade relation (1999), the authors use a GM to instrument the explanatory variable. Due to the fact that refugees share similar criteria with migrants not about their time point of leaving, but of their destination choice, it is an appropriate starting point for the development of an IV. Because the number of refugees highly correlates with the political, health and economic situation in the country of origin, there has to be an additional time varying factor to represent the volatile part of refugee flows into host countries. Besides validity and relevance, the IV has to fit into the panel data, representing a unique value for each destination and year. Countries may differ from each other regarding factors, which are constant over time. These factors may influence both
independent and dependent variables. In theory it is impossible to exclude all factors
driving the outcome of the regression with control variables, therefore the aim is to get as
close as possible to an exclusion of all country-specific factors with a FE model.
The original GM based in natural science is applied to many economic issues in the 1960s.
Newton’s physical theory of gravity is first transferred to analyse international trade flows
(Tinbergen 1962, Pöyhönen 1963). An explanation of migration flows is also possible with
a modified form of this model (Vanderkamp 1977, Lewer & Van den Berg 2008). Modelling
with gravity equations appeared in textbooks not until 2004 (Feenstra 2004). Since the
model is successful, but not common sense, this section sketches the basics of the GM for
migration.
Newton’s law states that a force of attraction between two bodies is proportional to the
product of their masses and inversely proportional to the square of the distance of their
centres. For bilateral trade relations the masses, represented by GDP, in relation to the
distance between these national economies correlate with the trading volume. Further
applications are among others tourism (Sheldon & Var 1985), commuting (Flowerdew &
Aitkint 1982) and especially migration (Vanderkamp 1977). In this processes these
models can be applied at a global level, as well as almost in any desired size or regional
coverage. Gravity equations for varying subjects have different results, so specific additional
endogenous variables, intercepts or slopes cannot be assumed as given by theory or
empiricism.
According to Vanderkamp (1977) the basic version of bilateral migration flows between
country i and j modelled with a GM is defined by the product of numbers of inhabitants
in relation to their geographical distance to each other. Using logs of these factors allows
to regress their individual impact ($\beta$, $\gamma$, $\delta$) on migrants. Then $\alpha$, $\beta$ and $\gamma$ are expected to
be positive, $\delta$ negative.

$$Flow_{ij} = \alpha \times \frac{Population_i^\beta \times Population_j^\gamma}{Distance_{ij}^\delta}$$

This simplified version immediately shows a major problem. According to this equation,
the amount of immigrants is the same in both countries i and j, because it is bilateral.
In the literature it is shown that the more similar these two countries are, the more this
basic version is able to reflect real empirical observations (Karemera et al. 2000). Vice
versa if the two countries vary, additional push and pull factors have to be implemented to model the real flow. Safer conditions, higher political or institutional power (Glaeser et al. 2004) and especially better economic opportunities in the destination country, like lower unemployment rates or higher wages (Borjas 1987) push the migration flow. But in this case it is impossible to implement previous mentioned factors as additional instruments, due to the variable of interest PCI, which is highly correlated with all of them. An implementation would violate the validity assumption for IV’s. Because unemployment and population size are already control variables, they are also existing in the first step of the 2SLS regression to model the incoming refugees. The instrument is the only variable, which is excluded in the second step. In this case unemployment and population size of the host country are factors for the choice of destination, but cannot determine the main reason to leave. So a highly volatile time varying factor is still missing.

To get a relevant and valid instrument for panel data, the idea of a time dependent shock in relation to a geographical distance variable is developed further. The mortality rate of male adults as the numerator in a Gravity equation is able to reflect the volatility of incoming refugee flows precisely. Due to the fact that the mortality rate in the Balkan area is constant over all potential host countries and the distance variable is constant over time, the relation of these two fits for panel data. For simplification and because there is no interest in a bilateral, but rather in a unilateral relationship, the distance variable is also modified. Replacing it with an isolation variable, which is the average distance of the host country’s capital to all former Balkan states adapts the dataset requirements (Appendix 2).

\[ ref_{it} = \beta_0 + \beta_1 \cdot Mor_{jt} / Iso_i + \beta_2 \cdot pop_{it} + \beta_3 \cdot Une_{it} + \beta_4 \cdot Tra_{it} + \beta_5 \cdot mig_{it} + \epsilon_{it} \]

Variables with a small initial letter are in logs. Relations stay in real values. \( Mor_{jt} \) is the mortality rate of male adults in the Balkan area \( j \) in year \( t \). \( Iso_i \) determines the country \( i \) specific isolation variable. \( pop_{it} \), \( Une_{it} \), \( Tra_{it} \) and \( mig_{it} \) are panel data variables for population size, unemployment rate, trade openness and the total migrant stock of potential hosts. \( \beta_0 \) is the intercept. \( \beta_1 \) and \( \beta_2 \) are expected to be positive, since they are the driving factors of the GM containing distance, population size and the numerator shock term. It is not possible to predict \( \beta_3 \), \( \beta_4 \) and \( \beta_5 \), because they are mainly implemented to control in the second stage. \( \epsilon_{it} \) determines the error term.
III Empirical Results

With 18 countries (Appendix 2) over 16 years the sample size has its maximum at 288 observations. Due to the fact that the Slovakian Republic is founded in 1993, Estonia and Slovenia in 1991 and an overall inconsistency of data mining in the beginning of the nineties in East European countries, the regression contains 246 observations, where all variables exist for the panel. In the empirical section a significance level of ≥ 95 percent is assumed. The first stage regression leads to a highly significant impact of the Threat variable (IV): mortality rate in relation to isolation, on incoming refugees in logs (Table 1). The IV even fulfils a significance level of 99,9 percent. Also pop and Une define the refugee flow into country i. Taking the estimated $\hat{r}_f$ variable from the first stage to the

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Table 1: Two Stage Least Squares Regression

second shows a negative significant impact on PCI. Control variables pop and Une are significant in the second stage as well. The population size pushes and the unemployment rate pulls the PCI.

If the test statistics are assumed to be representative and the dataset is not gathered with mistakes, there is a negative impact of incoming refugees represented by the IV strategy
on PCI for this time period and the dependent countries of destination. The pooled OLS and non-instrumented FE model results (Appendix 1) do not present good estimators, due to endogeneity bias. Even when these estimations, theory and previous papers show it, incoming refugees do not have a positive impact on PCI.

Because $pop$ is included as a control variable in the second stage, it also appears in the first stage, which makes the first stage a GM approach plus a Threat term illustrating time varying shocks in the flow of refugees. Even when the dataset is modified with deleting outliers in the way that there is a more obvious positive dependence when using pooled OLS and FE model regression without instruments, the IV strategy is able to provide robust negative causal impact. Due to individual national law for refugees to enter labour market, a lagged impact is considerable, but not existing in any lagged estimations.

The Cragg-Donald Wald F statistic is a measure of weakness (Cragg & Donald 1993). It is compared to Stock and Yogo’s (2001) critical values. If the instrument is weak, then the bias of the IV estimator can be larger than the OLS estimator bias. The critical values of Stock and Yogo define the largest possible bias of 2SLS in comparison to the OLS estimator. They provide a list of levels, in which the rejection of maximum relative bias caused of weak instruments is presented. Setting the maximum acceptance level to ten percent leads to a support of the IV in the FE model with instrumented refugees, to be non-weak. The Cragg-Donald Wald F statistic is 37.73, which is more than twice as high as the required 16.38 for a maximum ten percent bias acceptance level.

Neither an over-, nor under-identification test is necessary, because it is uniquely defined with one endogenous variable instrumented by one instrument.

### IV Conclusion

To figure out the real impact of refugees on PCI this paper starts with a brief overview of previous literature and their methodology. Incoming refugees affect both labour markets and public finance. It is not clearly defined whether this results in a positive impact based on new public revenues, spillover-effects in refugee industries, or a raise in productivity levels. It can also result in a negative impact regarding the new spending for the social system and the related reallocation of economic support measures. Because of these various side-effects, the regression also controls for the unemployment rate to cover labour market changes and the population size, so it is possible to observe a relative impact. Also basic
economic growth theory is strongly based on the inflow of capital and goods from abroad. That is why trade openness is also taken into account as a control variable. Because the Dublin Regulation is not applied at any time, refugees’ choice of destination is assumed to be free. A positive dependence between PCI and refugees therefore needs to be considered with caution. Dependence does not mean impact. So the high correlation of incoming refugees on PCI may also be reasoned by the preference of refugees for a country with a good economic situation, represented by the PCI. The GM approach is taken into consideration to get rid off the causality problem. This model is developed to represent a bilateral flow of migrants from one country to another on the base of Newton’s Gravity Law. Due to the fact that refugees are unequal to migrants and cannot be represented by a constant share of the mass and because a bilateral flow does not fit into the panel data of host countries over time, the model has to be developed further. Reasons for leaving the country as a refugee are based on the economic, political, or health conditions of the country of origin. The dataset of future European Countries in the time period 1990-2005 contain highly varying inflows of refugees over time. That is why the GM in its pure form does not represent the refugees in a good way. Adult male mortality rate replaces the numerator of the division with the isolation variable, which is the average distance to all capitals of refugees’ origins. With this instrument it is possible to reflect the endogenous variable of incoming refugees in a non-weak way. Mortality rates in origin countries do not correlate with the hosts PCI and also a geographical constant value cannot be related to the response variable. Therefore the validity assumption is not violated. Running a 2SLS regression with this instrument results in a significant negative impact of refugees on PCI. Also the impact of the instrument is highly significant. In the first step variables that are not excluded for the second step influence the incoming refugees, too. Unemployment, but above all the size of the host’s population has a major impact on these refugee flows. Without the population part in the first step, large countries in Northern or Western Europe only get a small share of the incoming people. That makes this unilateral instrumental strategy to a GM plus a Threat variable, or shock term. An implementation of a dummy variable for Greece, which is geographical responsible for the initial reception, is not necessary since Dublin is not applied and they have the smallest isolation variable anyway. The number of battle deaths in the Balkan area as the numerator of the Threat term is not suitable for this time period. It can reflect a short term, but due to too high volatility
and years without any recorded deaths, it does not fit to this data. For further analysis on the current refugee crisis, battle deaths in Syria may represent the reason for flight better than mortality rates, since conflicts and numbers of refugees reached their peak simultaneously in 2015. The control variables trade openness from economic theory and the migrant stock from the legal framework do not show a significant impact. To summarize the results, refugees have free choice of destination, so they mostly end in countries, which are economically strong. The predicted positive impact through previous literature is not confirmed. In this dataset and with this methodology it is possible to show a significant negative impact of refugees on PCI. The panel adequate relation of mortality rate to isolation, the population size of host countries and the unemployment rate are significant driving factors of incoming refugees and therefore suitable for the instrument estimation.
V References


Data

PCI
GDP divided by midyear population equals PCI. In this case, it is calculated by the sum of gross value added by all resident producers plus taxes and minus any subsidies that are not calculated in the value of the products. Also operating depreciation is ignored. National data are standardized for USD. These statistics are collected from World Bank national accounts and Organization for Economic Co-operation and Development (OECD) National Accounts data files.

Refugees
The term asylum seeker, or refugee is defined as a person outside her or his country denying to go back, because of political, religious, or racial reasons. The country of origin is unable, or unwilling to protect the individual. As soon as this persons gets accepted, it is officially a refugee. Data is provided by United Nations High Commissioner for Refugees (UNHCR) and the Statistical Yearbook. The UNHCR collects and summarizes their data on refugees from governmental agencies and non-governmental organizations (NGOs). Beside this there are estimates providing non observable data. Data for countries that lack a registration process, is estimated on the base of resettlement programs and recognition data over a five, or ten year period.

Population
Population is the number of residents within geographical borders. This includes all individuals ignoring legal status or citizenship. The only exceptions remaining are applicants for asylum. They continue to count as members of their country of origin until they are accepted. An increase in population results on birth-death rate bigger than one, or on immigration. The dataset has mostly national population censuses as primary sources. Because of the fact that these surveys are not collected in every year, values for previous and following years are interpolated or extrapolated in respect to the demographic development. Midyear estimates representing annual data. Numbers are gathered by United Nations Population Division: World Population Prospects, Census reports and other statistical publications from national statistical offices, Eurostat: Demographic Statistics, United Nations Statistical Division: Population and Vital Statistics Report
(various years), U.S. Census Bureau: International Database, and Secretariat of the Pacific Community: Statistics and Demography Programme.

Unemployment Rate
The rate of unemployment is defined by the International Labour Organization (ILO) as the share of labour market that is without work, but available for a actual lower demand of a country’s economy. Unemployment rate is gathered by the ILO, Key Indicators of the Labour Market database.

Migrant Stock
The migrant stock is the number of people born in a country, in which they do not live, including refugees. This is also an estimation. The stocks at a time point are obtained from population censuses. In cases the data is not available, data of foreign population is used for estimations. After the collapse of the Soviet Union people living in one of the newly independent countries, who were born in another were classified as international migrants. To estimate them the World Bank uses the 1989 census of the Soviet Union. This is not a problem, because migration to one of them is not a part of this paper. Data is gathered by United Nations Population Division, Trends in Total Migrant Stock: 2012 Revision. The data is stock data and estimated for the previous five year time period. In order to make it suitable to the data, this variable is interpolated for a second time between two five year values, in order to get an annual reference data.

Trade Openness
Trade openness is the ratio of the sum of exports and imports to the GDP of a country. It is the annual weighted average. The World Bank summarizes data from World Bank national accounts and OECD National Accounts data files.

Distance
The Centre for Prospective Studies and International Information (CEPII) is the main French institute for research into international economics. The CEPII calculates different measures of bilateral distances in kilometres. The distances between the two capitals of interest are important. Due to the lack of the three Balkan states Kosovo, Serbia and Montenegro the data for these is added external. Therefore the distances from the capitals
Pristina, Belgrade and Podgorica to the capitals of the European Monetary Union are calculated in addition. For detail, the bilateral distances of all origin and destination countries are presented in Appendix 2.

Mortality Rate
This rate is the measure of male adults, which die between age 15 and 60 per 1,000 male adults. Due to the fact that this is an important indicator for the health status in a country, it is taken into account in order to evaluate an instrumental strategy. It also increases, when the country has national or international conflicts, which makes it an multilevel indicator. Because Balkan countries in the dependent period mostly hire men in this age cluster, the mortality rate for male adults reacts stronger to an increase of battle-related deaths than the mortality rate of the whole population. Originally this data is a five year period survey. Data in between is linearly interpolated by The Worldbank. The whole dataset is gathered by national censuses or sample surveys. This rate is only needed for the Balkan states, as it is expected to be a reason for leaving the country. Kosovo is the only of the twelve countries, which is not represented in the initial dataset. In order to estimate an average value for a depending year in the Balkan area, all mortality rates are summed up and divided by the eleven countries, for which data is available.
Table 1: (Appendix 1) Pooled OLS and FE model

|        | PCI Coef. | Std. Err. | t     | P > |t| | 95% Conf. | Interval   |
|--------|-----------|-----------|-------|-----|---|------------|------------|
| ref    | 2252.68   | 287.0659  | 7.85  | 0.000| | 1687.19   | 2818.17    |
| pop    | -3056.488 | 1263.182  | -2.42 | 0.016| | -5544.827 | -568.1483  |
| Une    | -169.0721 | 156.8559  | -1.08 | 0.282| | -478.0622 | 139.918    |
| mig    | 4631.524  | 882.5565  | 5.25  | 0.000| | 2892.978  | 6370.07    |
| Tra    | 146.9526  | 16.59078  | 8.86  | 0.000| | 114.2705  | 179.6347   |

<p>|        | PCI Coef. | Std. Err. | t     | P &gt; |t| | 95% Conf. | Interval   |
|--------|-----------|-----------|-------|-----|---|------------|------------|
| ref    | 670.2209  | 386.6532  | 1.73  | 0.084| | -91.74074 | 1432.183   |
| pop    | 61365.05  | 11840.7   | 5.18  | 0.000| | 38031.07  | 84699.04   |
| Une    | 20.94768  | 125.0968  | 0.17  | 0.867| | -225.5755 | 267.4708   |
| mig    | 5815.432  | 1634.134  | 3.56  | 0.000| | 2595.111  | 9035.754   |
| Tra    | 83.04442  | 20.32078  | 4.09  | 0.000| | 42.9991   | 123.0897   |</p>
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