

Quantifying the social drivers of remittances in the European Union

By José Andrés Martínez* and Iñigo Moré **

Abstract

We have found that a significant statistical relationship exists between remittances and the employment of foreigners. This relationship allows us to consider the number of migrant workers employed in a host country as the primary social driver of remittances. The relationship varies depending on the country where the foreign worker is employed and we have identified four different patterns among members of the European Union. Cluster analysis reveals that country selection is conditioned in some way by the nature of the labor market, and technological development may pose a barrier to entry for the workers who are most likely to send the largest amounts of remittances.

Keywords: remittances, regression models, quantifying, clustering

Introduction

Most of the existing literature about remittances is focused on the immigrant's decision to send money, exploring the determinants of remittances in detail, and this has attracted a great deal of interest at both the macro and micro levels (Hagen-Zanker, Siegel, 2007). The number of immigrant workers in a host country has been mentioned in the literature as an important factor in sending remittances. In an early article on the topic Elbadawi & Rocha (1992) noted that "the effect of an increase in the number of workers on remittances is proportional, ceteris paribus". Freund and Spatafora (2005) estimated "that doubling the migrant stock in OECD countries would lead to about a 75 percent increase in recorded remittances". But so far we lack a detailed model on the relationship between remittances and the number of immigrant workers.

Our paper quantifies the relationship between the number of migrant workers and remittances using a regression model for sixteen European Union countries. The main questions investigated are:

1. Are remittances and the number of immigrant workers statistically related?
2. What is the elasticity parameter of sending remittances?
3. If remittances are related to the number of immigrant workers, is the relationship universal or are there differences in the rate of remittances per worker among countries?

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Our starting point is fairly simple. We assume that the necessary condition for an immigrant to remit is to have money. Of course nothing guarantees that migrants who have income will automatically remit, but remittances are impossible if they have no money. It may have been obtained through investments, savings, loans, gifts or work. But in reality, very few immigrants have all those possibilities open to them: for most of them, the salary they earn for their work is their sole source of income. Therefore we consider the universe of people who can send money home to be the migrants who are working in a foreign country.

Some researchers have selected the total number of immigrants in the host country as an alternative. Of course, being an immigrant is a precondition to being a sender of remittances. But the total number of immigrants contains a huge percentage of people who by definition are unlikely to be in a position to remit, such as minors, students, homemakers, and the elderly. Moreover, even in times of economic crisis there may be a stream of immigrants arriving who have no intention of working, such as the wealthy northern Europeans who want to spend their retirement by the sea in Mediterranean countries.

We decided to test our hypothesis using data on European Union member countries, since the EU is by far the largest remittance sender in the world according to the World Bank's ranking shown in Table 1. Among the top 10 in the ranking of sending countries, five belong to European Union (from Spain to Netherlands). This means that the euro is the leading currency used worldwide in sending remittances.

Table 1

World ranking of money senders (remittances, employee's compensation, and migrant transfers)
in millions US dollar

Position	Country	Remittances 2006	Remittances 2007
1	European Union	71,301	87,741
2	United States	43,922	45,643
3	Russian Federation	11,438	17,716
4	Switzerland	14,377	16,273
5	Saudi Arabia	15,611	16,068
6	Spain	11,015	14,728
7	Germany	12,416	13,860
8	Italy	8,437	11,287
9	Luxembourg	7,561	9,281
10	Netherlands	6,802	7,650

Source: World Bank

Note: The World Bank, following Ratha (2003), publishes annual statistics on remittances by adding data for remittances, compensation of employees and migrants' transfers. This practice has been criticized by several authors (Chami et al 2008).

Description of the data

This paper is based on Eurostat data for remittances, compensation of employees, and the number of migrant workers. Other data is from The Conference Board. All data is as of June 30, 2010, unless otherwise specified.

Table 4
Description of the data

Source	Item	Measure	Frequency	Period
Eurostat	Remittances	Millions of euros	Quarterly	Q1 2005 – Q4 2009
	Compensation of employees	Millions of euros	Quarterly	Q1 2005 – Q4 2009
	Number of foreign workers	Thousands	Quarterly	Q1 2005 – Q4 2009
	Avg. gross wages, industry and services	Euro	Annual	2007
The Conference Board	Fiscal pressure on the labor costs	Percentage	Annual	2007
	Labor productivity calculated in the GDP per worker (\$/hr.)	Dollar	Annual	2009

Eurostat offers detailed statistics on remittances sent from the European Union. Unlike the World Bank, Eurostat does tabulate a total for remittances, compensation of employees and migrants' transfers. While the World Bank offers data on an annual basis, Eurostat data on remittances is on a quarterly basis, as is standard for other statistics such as GDP and labor market conditions. Eurostat is also more selective than the World Bank in so far as what they publish. While the World Bank reports remittances data for European countries such as the United Kingdom, Malta, Slovakia and Denmark, Eurostat does not report them. This does not necessarily mean that the statistical office of the European Union considers their data substandard; in fact Eurostat does not explain the reasons for their absence, and just states "data not available". The fact is that it is not compulsory for member countries to report remittances data to Eurostat. The most likely explanation for their absence is a formal one, that those countries just produce data on remittances on an annual basis and not on a quarterly basis. But this is more than enough to raise questions about their quality. Much more, considering that countries such as the United Kingdom also do not report the destination breakdown of their remittances.

Leaving periodicity and quality aside, the third distinctive feature of Eurostat data is that they are denominated in euros, the currency of almost all the countries involved, which allows for comparability.

Eurostat data on compensation of employees is also on a quarterly basis. Data related to the number of foreign workers is from the labor force survey (EU-LFS), a household survey conducted throughout EU member states. This survey provides quarterly results on labor participation for people age fifteen and over as well as on persons outside the labor force. European national statistical agencies are responsible for the sample and the questionnaires, conducting the interviews, and forwarding the results to Eurostat. The results for each country include the whole population and a breakdown between nationals and foreigners based on their passport, not on their country of birth.

There are also data on average gross annual earnings in industry and services, by gender, covering remuneration (wages and salaries) in cash paid directly to the employee, before any deductions for income tax and social security contributions that are paid by the employee; data is presented for full-time employees in "industry and services". There is also a measure of the tax wedge on the labor cost that represents the relative tax burden for an employed person with low earnings.

Finally we also use the measure of labor productivity per hour worked for 2009 in terms of US\$ (converted to 2009 price level with updated 2005 EKS PPPs). EKS is the method used by Eurostat and the OECD to calculate purchasing power parities (PPPs) for basic headings and to aggregate the PPPs for basic heading in order to obtain PPPs for each level of aggregation up to and including GDP.

To test the relationship between remittances and the number of foreign workers we have selected 16 European Union countries that have data available on both remittances and the number of foreign workers.

Table 2
Selected countries in the analysis

Country	Abbreviations
Belgium	BE
Czech Republic	CZ
Germany	DE
Greece	GR
Spain	ES
France	FR
Italy	IT
Cyprus	CY
Luxembourg	LU
Hungary	HU
Netherlands	NL
Austria	AT
Poland	PL
Portugal	PT
Finland	FI
Sweden	SE

EU member countries that are not included and the reasons for their exclusion are as follows:

Table 3
European Union Countries excluded from the analysis

Country	Reason for exclusion
Bulgaria	Labor Force Survey incomplete
Denmark	No data on remittances
Estonia	Zero remittances for all quarters
Ireland	No data on remittances & Labor Force Survey incomplete
Latvia	Binary remittances data: either zero or one
Lithuania	Labor Force Survey incomplete
Malta	No data on remittances
Romania	Labor Force Survey incomplete
Slovenia	Zero remittances for most quarters
Slovakia	No data on remittances
UK	No data on remittances

Remittances: an overview

In recent years, the potential for remittances to reduce poverty and foster economic development has attracted more and more institutional initiatives and academic research.

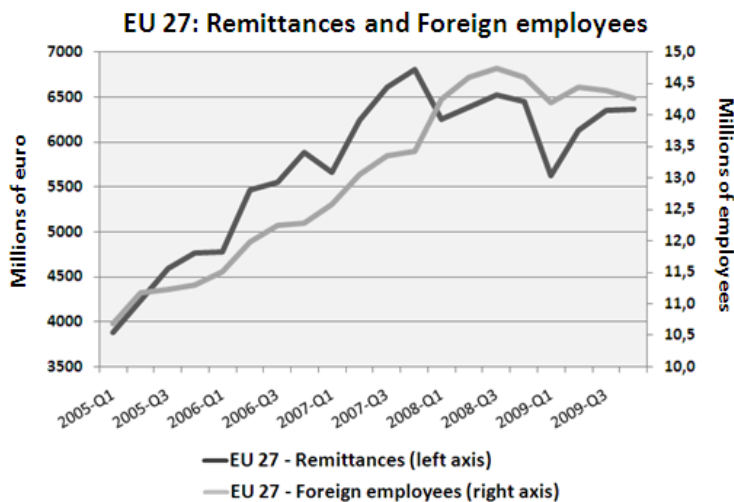
One of the most striking features of migrants' remittances was their continuous growth both in Europe and worldwide during the last few decades. World Bank statistics show that inflows of remittances in 2008 (\$375,015 million) were 181 times greater than in 1970 (\$2,064 million). But this trend came to a halt in 2008-2009. The World Bank announced a 6.1% decrease in the 2009 global volume of remittances and forecasted just a slight increase of 1.4% for 2010 (World Bank, 2009).

The situation was very similar in the European Union. For the first time since Eurostat began to publish such data, remittances sent from the EU entered into a crisis in the third quarter of 2008. On a year-on-year basis the decrease for this quarter was just 1.4%, but it was followed by further decreases of 5.3% in the fourth quarter of 2008, 10.0% in the first quarter of 2009, 4.0% in the second quarter, 2.5% in the third

quarter and 1.4% in the fourth quarter of 2009. Total remittances in 2009 (€24,478 million) were 4.4% less than in 2008 (€25,615 million).

Focusing on data for the EU 27, trends in remittances and the number of foreign workers go in parallel, as we can see in Graph 1. Note how after 1Q-2008, the amount of remittances falls below the number of employees, even when there are two axes, which suggests a change in the dynamic. And this change might indicate that the economic capacity of migrant workers was shrinking during that period of world crisis.

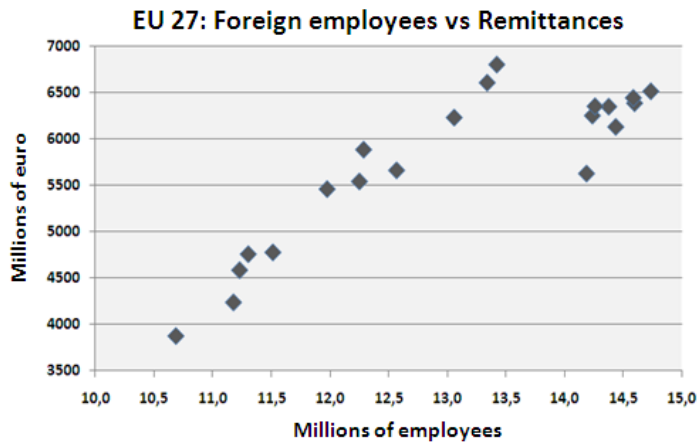
Graph 1



Source: Eurostat. Own elaboration

Eliminating the influence of time, we calculate a linear correlation of 0.8707 between remittances and the number of migrant workers. In Graph 2 we can see the scatter-plot of both variables, and we can sense the possibility of estimation by means of a regression model. The graph tends to have a slightly logarithmic shape, but we think that applying a logarithmic transformation to estimate a model would not be correct because the graph reflects the onset of the crisis. Therefore, it doesn't show the natural dynamic of remittances when the number of migrant workers changes. Our aim is to estimate the elasticity of remittances in response to the number of migrant workers.

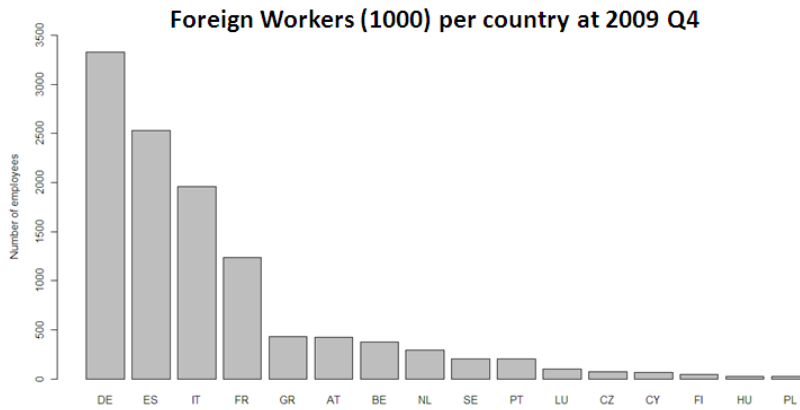
Graph 2



Source: Eurostat. Own elaboration

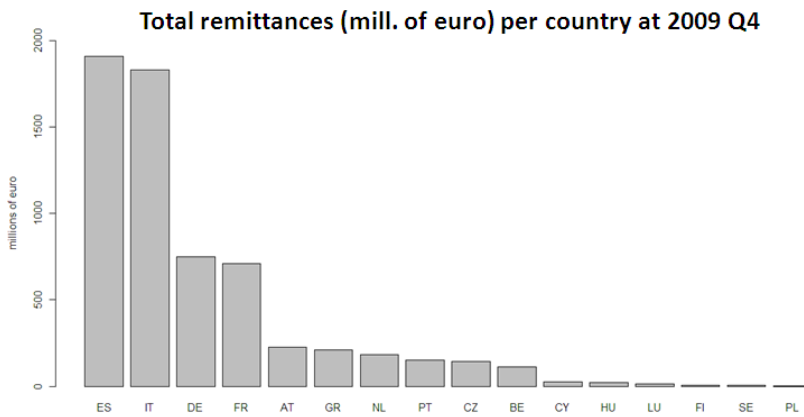
One important detail that stands out without in-depth analysis is that the relationship between migrant workers and remittances shows significant differences among countries. Germany (DE) and Spain (ES), which had a similar number of foreign workers in the fourth quarter of 2009, show large differences in terms of remittances sent. (See Graphs 3 and 4 below.)

Graph 3



Source Eurostat. Own elaboration

Graph 4



Source Eurostat. Own elaboration

Econometric framework

The objective of this section is to explain the models used to estimate the relationship between employed foreign workers and their remittances in order to answer the question of how the number of foreign workers affects remittances. For this purpose we will use a linear regression of the number of employed foreign workers on the amounts sent. The models will be used for each country included in the present study and can be written as:

(1) Model for remittances:

$$\text{remitt}_{i,t} = \beta_i \text{lfsforeign}_{i,t} + \varepsilon_{i,t}$$

(2) Model for remittances + compensation of employees:

$$\text{remitt_comp}_{i,t} = \beta_i \text{lfsforeign}_{i,t} + \varepsilon_{i,t}$$

We are going to use two models. The first model will simply explore the relationship between remittances and the number of migrant workers. The second model will analyze the relationship between remittances plus compensation of employees (a broader definition of remittances in balance of payments accounting) and the number of migrant workers. Keep in mind that personal transfers (Balance of Payments Manual 6th edition) or “workers’ remittances” (BPM5) are to be recorded separately from compensation of employees according to IMF guidelines. Workers’ remittances are defined as transfers made by foreigners who have lived in the host country for more than a year and they are recorded as unrequited transfers in the balance of payments. Compensation of employees represents the gross income of short-term workers and is recorded in the income accounts of the balance of payments. In practice, however, IMF member countries often find it difficult to separate the two categories, and their statistical agencies have developed their own particular methodologies for compiling the data.

In the equations, *remitt* is the measure of remittances from country *i* at time *t*, *lfsforeign* represents the number of foreign employees in country *i* at time *t*, and ε is an error term for errors in the remittances variable.

The Beta parameter is a quantification of how remittances or remittances plus compensation of employees increase when the number of foreign workers increases. The regression model is defined

without a constant because the constant lacked statistical significance in tests of our previous analyses and had no interpretive value in the context of this analysis ¹.

Estimation models

Equations (1) and (2) will produce estimates using the Ordinary Least Squares (OLS) method and R statistical language. The β_i -coefficient is used to compare the average of quarterly remittances (defined as remittances plus compensation of employees) per person and country; a larger parameter value means a larger amount of money sent.

Equation (1): remittances

Column 3 in Table 5 contains the estimated values for the beta parameter. In the next two columns we can compare the outcomes for the hypothesis H0: beta = 0: first the t-statistic, and then the p-value associated with that statistic. In all cases the parameters are significantly different from zero. This is a clear indication that the number of migrant workers is a driver of remittances.

Table 5

Worker's remittances, versus foreigner's employment: Regression-Based Tests

Abbreviation	Ajusted R2	Beta	t-Value H0: Beta = 0	Pr(> t) Beta test
BE	0,991	0,278	46,42	<2e-16 ***
CZ	0,982	1,856	32,89	<2e-16 ***
DE	0,999	0,235	149,30	<2e-16 ***
GR	0,947	0,529	18,96	8.4e-14 ***
ES	0,991	0,695	46,85	<2e-16 ***
FR	0,983	0,638	34,48	<2e-16 ***
IT	0,989	0,907	42,68	<2e-16 ***
CY	0,870	0,282	11,62	4.45e-10 ***
LU	0,971	0,168	25,88	2.82e-16 ***
HU	0,971	0,680	25,91	2.75e-16 ***
NL	0,997	0,602	79,47	<2e-16 ***
AT	0,989	0,468	42,37	<2e-16 ***
PL	0,759	0,118	8,00	1.68e-07 ***
PT	0,975	0,737	27,91	<2e-16 ***
FI	0,996	0,106	67,86	<2e-16 ***
SE	0,989	0,026	42,29	<2e-16 ***

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The relatively high adjusted R2 values (column 2 of Table 5), which are over 95% for most countries, show that in most cases remittances can well be approximated by the number of foreigners employees.

To interpret the meaning of the beta parameter we need to remember that the measure for remittances is millions of euros (0.278 x 1,000,000 = €278,000 per 1,000 employees and quarter), while on the other side of the equation the measure is thousands of employees (278,000/1,000 = €278 per quarter and person employed). Finally, remember that we are using quarterly data (€ 278 per quarter and 278/3 = €93 per month per person employed).

¹ If the regression model specifies a constant, it allows for the possibility of remittances without any foreign workers.

Focusing on a particular country in order to interpret the results of the model, on average each foreign citizen working in Belgium sends € 278 in remittances each quarter, or €93 a month.

The following table shows average monthly remittances (in euros) as estimated by the regression model.

Table 6
Estimation of sending remittances per foreign worker (in

Country	Average sent per quarter	Average sent per month
BE	278	93
CZ	1856	619
DE	235	78
GR	529	176
ES	695	232
FR	638	213
IT	907	302
CY	282	94
LU	168	56
HU	680	227
NL	602	201
AT	468	156
PL	118	39
PT	737	246
FI	106	35
SE	26	9

It is striking to see that average monthly remittances per foreign worker in the Czech Republic are estimated to be €619. Perhaps this estimate is derived from inaccurate data on remittances. One way to verify the estimates is to calculate the economic sacrifice that remittances in these amounts would represent for the immigrants. We will do this for each country by calculating the ratio of the estimated average remittances per foreign worker and average net monthly wages in that country.

The following table contains estimates of average net wages in 2007, using data on average gross wages in industry and services and the fiscal pressure on the labor cost.

Table 7

Average earnings in industry and services of full-time employees in enterprises with 10 or more employees (year 2007)

Abbreviation	Average gross annual €	Tax wedge on labour cost %	Average net annual €	Average net monthly € **
BE	38659	50	19330	1611
CZ *	8284	40	4962	414
DE	40200	48	20984	1749
GR *	16739	34	10981	915
ES	21891	36	14076	1173
FR	32413	45	17697	1475
IT	NA	43	NA	NA
CY	21310	12	18774	1565
LU	45284	30	31744	2645
HU	8952	46	4834	403
NL	42000	41	24906	2076
AT	37716	44	21083	1757
PL *	8178	43	4702	392
PT	15345	33	10281	857
FI	36114	38	22318	1860
SE	36871	43	20906	1742

* Czech Republic: data of 2006, Greece: data of 2003, Poland: data of 2006

** Twelve payments

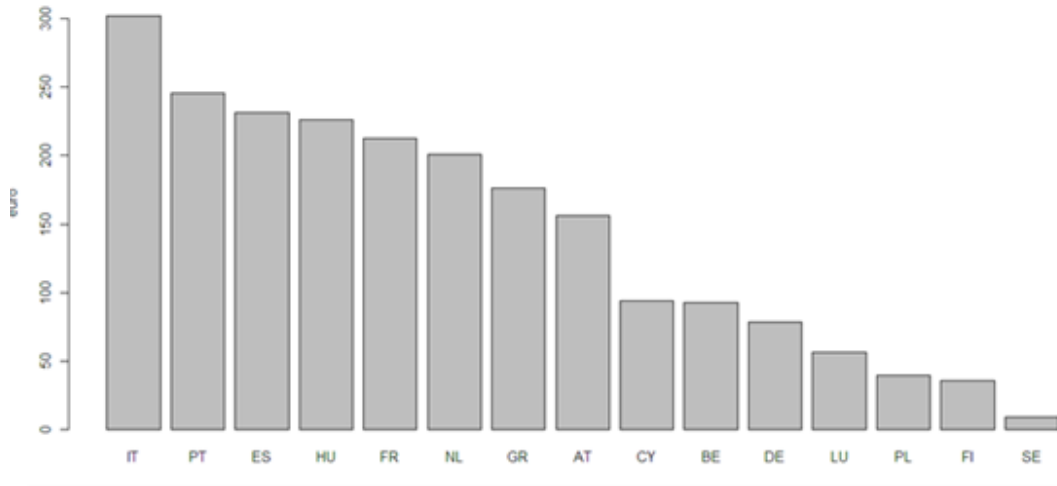
Table 8 shows estimates of the economic sacrifice that sending remittances in the amounts estimated would represent, on average, for foreign workers in each country. As we might have suspected, the sacrifice estimated for foreign workers in the Czech Republic is more than 100%, which is reason enough for us to eliminate this country from the following analysis.

Table 8

Foreign workers' average economic sacrifice in sending remittances

Country	Average monthly remittances (€)	Average net monthly wages (€)	Remittances as percent of net wages
BE	93	1611	5,7%
CZ	619	414	149,6%
DE	78	1749	4,5%
GR	176	915	19,3%
ES	232	1173	19,7%
FR	213	1475	14,4%
IT	302	NA	NA
CY	94	1565	6,0%
LU	56	2645	2,1%
HU	227	403	56,2%
NL	201	2076	9,7%
AT	156	1757	8,9%
PL	39	392	10,1%
PT	246	857	28,7%
FI	35	1860	1,9%
SE	9	1742	0,5%

Graph 5 shows average monthly remittances per foreign worker:

Graph 5**Estimated average monthly remittances per foreign worker (euros)**

Source: own elaboration

It is noteworthy that in general, Mediterranean countries lead the ranking in remittances per worker and countries such as Portugal and Hungary, which are not outstanding in terms of total amounts of remittances sent, have a high level of remittances per foreign worker.

Equation (2): remittances and compensation of employees

Table 9 shows results from the model for remittances plus compensation of employees. (Results are presented in the same form as in Table 5.)

Table 9

Workers' remittances plus compensation of employees versus number of foreigners employed: Regression-Based Tests

Country	Adjusted R2	Beta	t-Value H0: Beta = 0	Pr(> t) Beta test
BE	0,971	1,823	25,98	2.62e-16 ***
CZ	0,977	7,210	29,24	<2e-16 ***
DE	0,968	0,790	24,57	7.37e-16 ***
GR	0,970	0,776	25,23	4.51e-16 ***
ES	0,993	0,841	54,61	<2e-16 ***
FR	0,989	0,814	42,12	<2e-16 ***
IT	0,995	1,264	60,08	<2e-16 ***
CY	0,912	1,093	14,42	1.10e-11 ***
LU	0,990	17,509	43,38	<2e-16 ***
HU	0,978	7,175	29,68	<2e-16 ***
NL	0,993	2,577	52,60	<2e-16 ***
AT	0,993	1,203	52,74	<2e-16 ***
PL	0,906	8,049	13,95	1.96e-11 ***
PT	0,966	1,141	24,01	1.12e-15 ***
FI	0,997	1,734	80,90	<2e-16 ***
SE	0,974	0,741	27,20	<2e-16 ***

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Again we get high values for the adjusted R2 (column 2 of Table 9), above 95% for most countries. This shows that remittances plus compensation of employees could be well approximated by the number of foreigners employed.

Owing to the fact that the amounts considered for this model are higher than in the previous case where compensation of employees was not included, all the beta parameters must be greater² than those in the previous model. Even knowing this fact, the results show significant differences for countries such as Luxembourg, Hungary and Poland.

² Except in cases where data on compensation of employees was not available

Table 10
Differences between parameters in both estimations

Country	Beta remit.	Beta remit. & compensations	Difference (2nd-1st)
BE	0,278	1,823	1,546
CZ *	1,856	7,210	5,354
DE	0,235	0,790	0,555
GR	0,529	0,776	0,247
ES	0,695	0,841	0,146
FR	0,638	0,814	0,176
IT	0,907	1,264	0,357
CY	0,282	1,093	0,812
LU	0,168	17,509	17,341
HU	0,680	7,175	6,495
NL	0,602	2,577	1,974
AT	0,468	1,203	0,735
PL	0,118	8,049	7,931
PT	0,737	1,141	0,404
FI	0,106	1,734	1,628
SE	0,026	0,741	0,715

* Not a reliable estimate.

The large differences found in some countries may have several possible explanations. Either they are countries that do not send large quantities of remittances, but do record a large amount of compensation of employees, as would appear to be the case with Luxembourg and Poland, or they are countries that send large amounts of remittances while hosting foreign workers who receive wages that are higher than those of the typical remittance sender, as is the case in Hungary.

Table 11 shows the differences between countries for both measures.]

Table 11
 Estimation of sending remittances plus compensation of
 employees per foreign worker (in euros)

Country	Average sent per quarter	Average sent per month
BE	1823	608
CZ	7210	2403
DE	790	263
GR	776	259
ES	841	280
FR	814	271
IT	1264	421
CY	1093	364
LU	17509	5836
HU	7175	2392
NL	2577	859
AT	1203	401
PL	8049	2683
PT	1141	380
FI	1734	578
SE	741	247

Inference on the estimated parameters

In the previous section we produced a point estimate of the beta parameter of one equation model. That parameter is the expected value (or mean) of monthly remittances per country and worker; however, expected value is not always the most representative statistic, because data do not always follow an unbiased distribution. We would also like to have a measure of the variability of the estimation of monthly remittances sent without assuming that our data follow a normal distribution³.

In order to find the confidence intervals of the average variations in the amount of money sent relative to the number of foreign employees, we are going to estimate the distribution of the beta parameters of the regressions through a bootstrap resampling technique. We resample 1500 times per country, estimate the parameter of the equation model, and gather the results to build the empirical distribution.

Inference on equation (1): Remittances

³ It is possible to get an estimate of the standard deviation of the parameters assuming the normal distribution of the observed data.

The following are results of the confidence intervals with a significance level of 95% for the beta parameters from the first equation (remittances vs. number of foreign

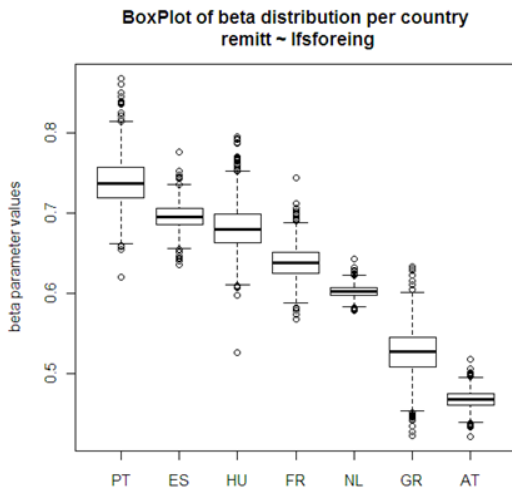
Table 12
Inference on beta parameters of remitt. vs foreigner's employment: Regression-based Confidence Intervals

Abbreviations	Beta	Mean of Beta parameter distribution	Standard deviation of Beta parameter distribution	95% confidence Lower limit	95% confidence Upper limit
BE	0,278	0,2774	0,0064	0,2669	0,2877
DE	0,235	0,2353	0,0017	0,2324	0,2383
GR	0,529	0,5296	0,0298	0,4802	0,5752
ES	0,695	0,6943	0,0154	0,6693	0,7182
FR	0,638	0,6375	0,0189	0,6075	0,6689
IT	0,907	0,9072	0,0217	0,8723	0,9431
CY	0,282	0,2808	0,0297	0,2283	0,3289
LU	0,168	0,1683	0,0071	0,1568	0,1800
HU	0,680	0,6815	0,0290	0,6371	0,7323
NL	0,602	0,6027	0,0078	0,5904	0,6161
AT	0,468	0,4680	0,0121	0,4479	0,4883
PL	0,118	0,1180	0,0183	0,0930	0,1470
PT	0,737	0,7384	0,0296	0,6928	0,7880
FI	0,106	0,1061	0,0016	0,1035	0,1088
SE	0,026	0,0259	0,0006	0,0248	0,0270

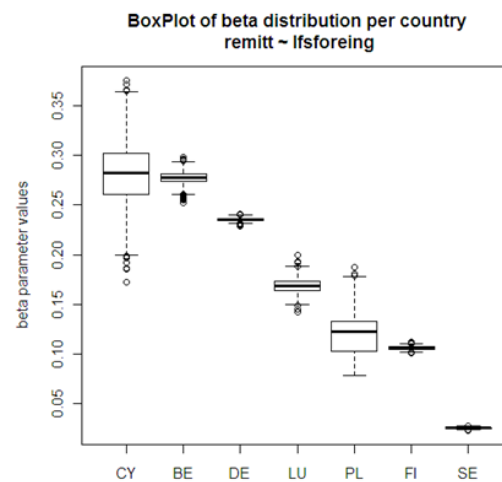
workers)

Graphs 6 and 7 show the box plot diagrams of the beta distribution for each country.

Graph 6



Graph 7



Note that we have divided the chart in two because of the differences in scale. The graphic presentation indicates statistically significant differences in average remittances per foreign worker per quarter among the countries analyzed. Remarkable variability is apparent in countries such as Portugal, Hungary, Greece, Cyprus and Poland with a biased distribution for the beta parameter. This wide variation could be the result of changes in remittances per worker during the period analyzed or it might arise from other sources of variability in the published data.

Inference on model of equation (2): Remittances and compensation of employees

Next are the results of the confidence intervals with a significance level of 95% for the beta parameters from the second equation (remittances plus compensation of employees vs. foreign workers).

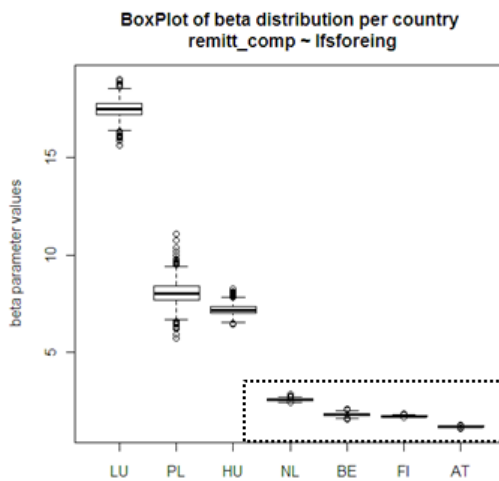
Table 13
Inference on beta parameters of remitt. and compensations vs foreigner's employment: Regression-based Confidence Intervals

Abbreviations	Beta	Mean of Beta parameter distribution	Standard deviation of Beta parameter distribution	95% confidence Lower limit	95% confidence Upper limit
BE	1,823	1,8217	0,0773	1,6872	1,9476
DE	0,790	0,7901	0,0355	0,7337	0,8491
GR	0,776	0,7746	0,0326	0,7174	0,8266
ES	0,841	0,8400	0,0155	0,8142	0,8654
FR	0,814	0,8137	0,0206	0,7800	0,8480
IT	1,264	1,2635	0,0228	1,2262	1,3006
CY	1,093	1,0949	0,0907	0,9576	1,2437
LU	17,509	17,5138	0,4058	16,8506	18,2092
HU	7,175	7,1761	0,2470	6,7551	7,5984
NL	2,577	2,5760	0,0493	2,4955	2,6568
AT	1,203	1,2022	0,0245	1,1605	1,2407
PL	8,049	8,0746	0,6031	7,1525	9,0748
PT	1,141	1,1420	0,0537	1,0565	1,2372
FI	1,734	1,7346	0,0223	1,7008	1,7707
SE	0,741	0,7404	0,0286	0,6942	0,7877

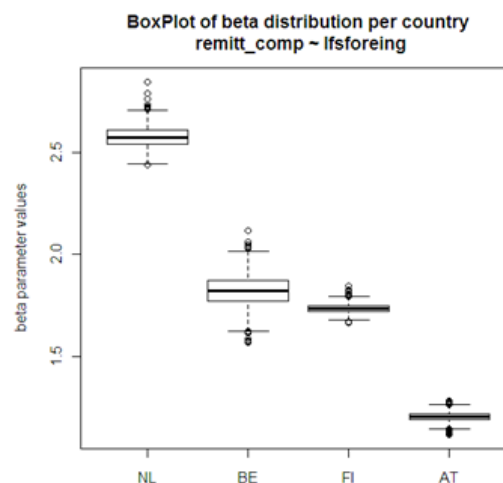
Countries

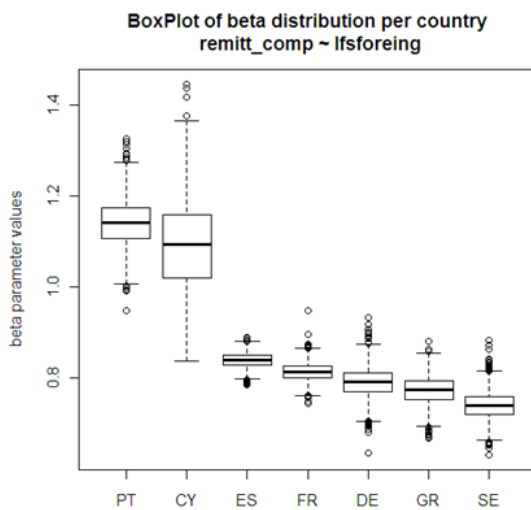
The following box plots represent the empirical distribution of the beta parameter for each country. (Note the large difference in scale for Luxembourg, Poland and Hungary.)

Graph 8



Graph 9



Graph 10

Once again the graphs show impressive variability in the empirical distribution of the beta parameter for some countries: in this case Portugal and Cyprus.

Analysis of residuals of the regression models

Although all the regression models have a global goodness-of-fit at a very high level of confidence, the estimates produced by the models differ significantly from the real data observed for many of the countries analyzed. In some cases the published quarterly data are in agreement with the estimates of the average per quarter for a year; therefore although the model explains the trend accurately, the residuals do not follow a normal distribution. The Durbin Watson test on the residuals of the regression shows that there is autocorrelation. This might be due to the average estimates and other mathematical manipulations in the published data, or it could be due to an econometric effect. In almost all the cases analyzed the residuals could be modeled using a first order moving average model (MA (1)).

Characterization of the countries

In the previous sections we have quantified the relationship between remittances and the population of foreign workers. Differences in average remittances (remittances alone or remittances plus compensation of employees **or both**) per person have been identified by country. The differences suggest that not all foreign workers send money home to their countries of origin, or that not all foreign workers send the same amount of money, or both, and this seems to depend on their host country. In conclusion, the dynamics of remittances vary according to the country where the immigrants work.

What are the elements of this situation? Without considering cultural factors and immigrants' personal motivations in selecting a host country, we will look for groups of countries that show similar dynamics in remittances. We will analyze the following four items and present the results graphically in order to identify any patterns that may exist among the countries. The four items are:

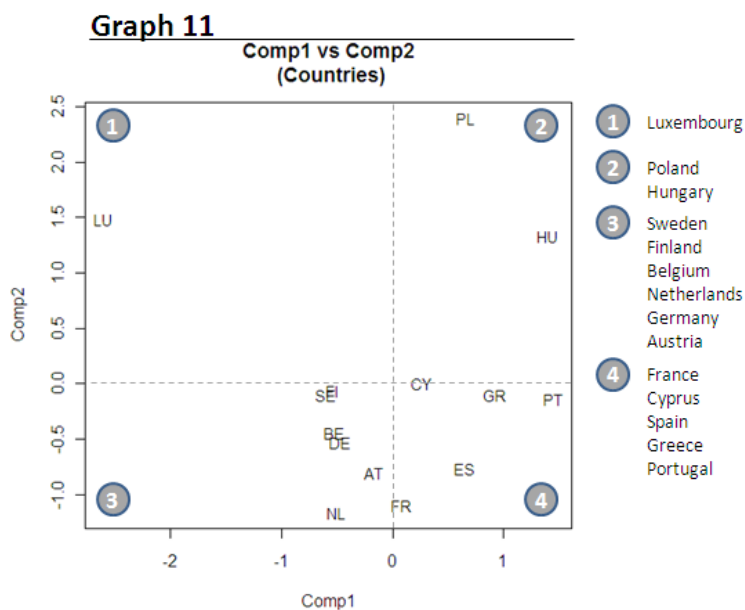
- Average remittances per person per month
- Average remittances plus compensation of employees by person per month
- Average net wage by country
- Average per hour productivity for each country

Labor productivity relies on type of work (for example, more or less labor-intensive), personal and cultural factors, labor market flexibility, technology and innovation, and workers' levels of training, among other factors.

The first two items represent the immigrant's behavior in terms of sending remittances and the last two represent conditions in terms of technological development in the host country, conditions which may act as a barrier to low-skilled immigrants.

The first two variables used are the beta parameters from the models analyzed previously. Average productivity per hour is from The Conference Board and the average net wages are from EUROSTAT.

We will start by positioning the countries in the following graph based on the first two components:



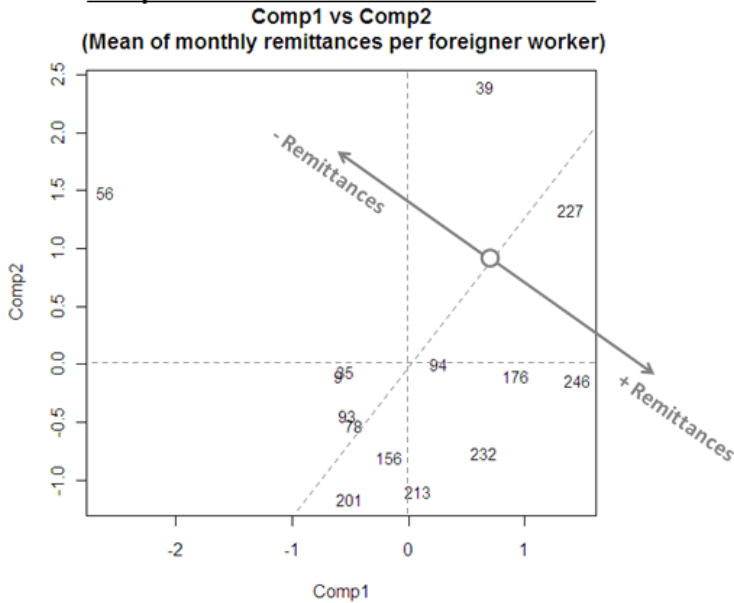
If we draw a horizontal and a vertical line intersecting at point (0, 0), we obtain four groups of countries⁴. At first glance, the countries can be grouped as Western Europe and the Mediterranean, Central and Northern Europe, Eastern Europe, and Luxembourg standing alone.

The next step is a graph of the estimated values of the first two components superimposed over the abbreviated country names, in order to further describe the four groups.

Graph 12 shows the estimated values for monthly remittances per person and each country:

⁴ Italy is not included because of missing data on average net wages.

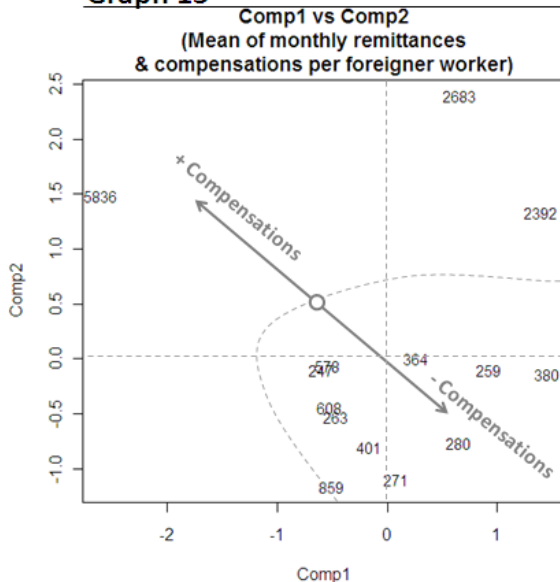
Graph 12



By adding a diagonal line to Graph 12, we can approximate the path of growth and decline in remittances per person per month. The farther down and to the right a country is positioned along the line, the larger the average amount of remittances sent, and the farther up and to the left, the smaller the amount sent.

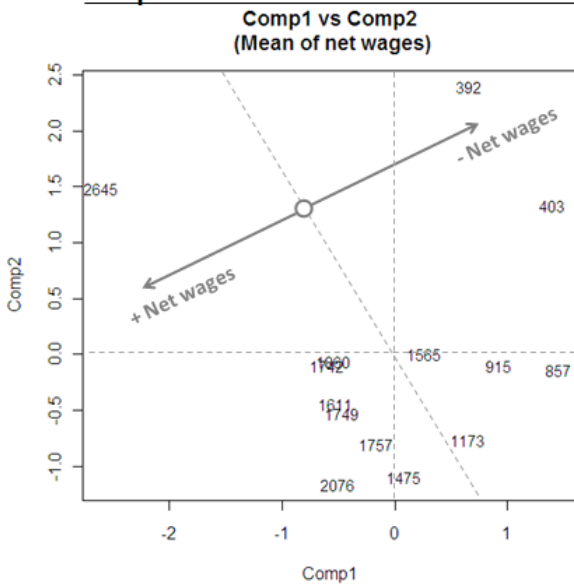
Next we continue the analysis using the estimated values for monthly remittances and compensation of employees per worker.

Graph 13



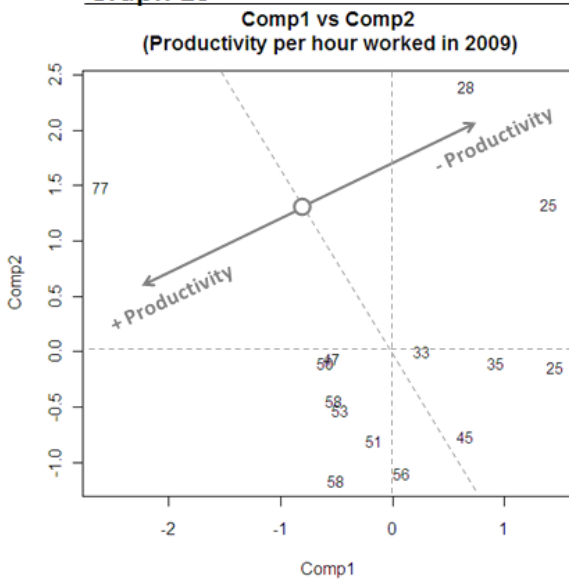
The estimated values of monthly remittances and compensation of employees do not result in a linear division. In three countries, Luxembourg, Poland and Hungary, compensation of employees is significantly higher than in the rest, and it appears that the estimated average decreases as a country approaches the lower right corner.

Graph 14



A graph of the mean of average net wages does show a linear division among groups of countries, and it is possible to identify a line of increase-decrease in net salaries. In addition, the line indicating increase-decrease in net wages matches a line representing productivity per hour worked, as can be seen in Graph 15.

Graph 15



Analyzing the data from the four graphs above, along with the position of each of the countries as shown in Graph 11, we may characterize the four groups in terms of sending remittances as follows:

Group 1: The foreign worker in these countries receives a quite large compensation (of employees in the terms defined in balance of payments) but does not send remittances. From a statistical point of view, this

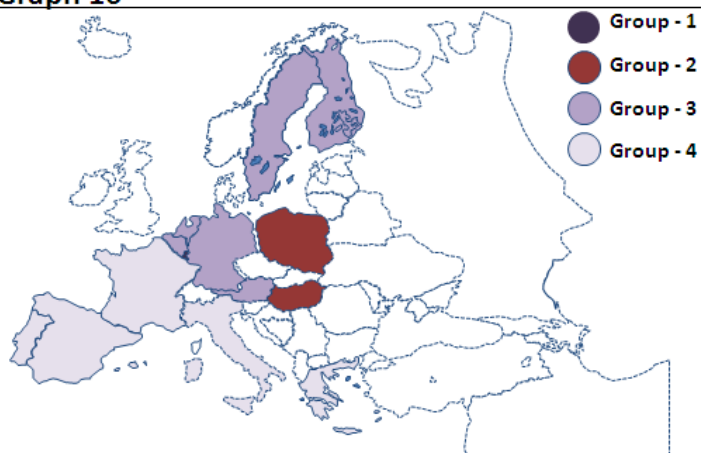
means that senders are considered short term workers, maybe border workers. This group holds countries with a relatively high rate of productivity per person. It appears that the typical foreign worker is highly skilled and does not need to send remittances.

Group 2: The foreign worker in these countries receives a large amount of compensation while his remittances are variable. His productivity per hour is quite low. This group is composed of Eastern European Union countries. It appears that the typical foreign worker is an expatriate professional but in the case of Hungary the typical foreign worker appears to be low-skilled or someone who works for the purpose of sending remittances (remittance worker), probably from an Eastern European country that is outside of the European Union.

Group 3: In the countries that compose this group, the average foreign worker has a significant amount of compensation and also of remittances. Geographically, those countries belong to the Central and Northern European Union. Those countries have high rates of productivity. The typical foreign worker seems to be a border worker (living in one country but working in the neighbor country)

Group 4: The amounts remitted per person in countries that compose this group are the largest; however compensation is the lowest. Productivity rates in those countries are medium-low. Geographically, they belong to Western European Union and Mediterranean countries (also from EU). The foreign worker in this group is a highly active sender of remittances. The foreign worker in this group is a highly active sender of remittances the fits in the definition of remittance worker.

Graph 16



Conclusions

In contrast with others studies, our analysis concentrates on quantification of the relationship through statistical modeling, and not on the workers' personal reasons for sending remittances. This has several advantages, including the possibility of comparing quantities among countries, the capacity to build forecasts and to use the estimations along with other socio-economic variables to identify patterns. Sixteen countries are analyzed in a single equation model, showing differences in the estimated parameters. Therefore, a direct measure of foreign workers' effect on remittances is examined.

For the period analyzed, total remittances sent from 16 European Union countries have a correlation of .8707 with their number of active foreign workers. This value allows us to consider the number of migrant workers employed in the host country as the primary social driver of remittances in so far as work or earnings are a prerequisite for remittances.

The global goodness-of-fit at a very high level for most models performed makes it possible to quantify remittances sent per worker and period observed, and gives us the capability to build forecasts of remittances.

There are statistically significant differences in the average remittance by person and quarter among the analyzed countries, which means that the foreign worker does not exhibit a standard pattern of sending money.

It is possible that other drivers could affect the sending of remittances since we have also found that the relationship between remittances and the employment of foreigners varies depending on the country where the foreign worker is employed. In this sense, we have identified four different behaviors. It is therefore likely that any other drivers that are affecting remittances could be the labor market and/or personal factors.

Regardless of cultural factors and personal motivation in the selection of a foreign country in which to work, cluster analysis shows evidence that country selection is somehow conditioned by the kind of labor market and that technological development could be a barrier to entry for the workers who may have the greatest propensity to send remittances

Finally, remittances are closely related to labor market characteristics. The consequences are important for destination countries, since the crisis has bitten more deeply into countries in the European Union that have higher remittances per foreign worker.

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