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Worker remittances and government behaviour in the receiving countries

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Abstract
We estimate the impact of worker remittances on savings, taxes, and public expenditures on education, all as a share of GDP, for about thirty years in two samples of countries with per capita income above and below $1200 using dynamic panel data methods. Governments of the poorer sample raise less taxes in the short run but more in the long run and spend more money on education when remittances come in; in the richer sample they raise less taxes and spend less on education in response to remittances but this is almost completely compensated by the positive response of expenditure on education to higher savings, which results from remittances as well.

Jel Codes: F24, H20, H52
Key words: Remittances, tax revenue, government expenditures and education.

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1. Introduction

The literature on the effects on worker remittances has mainly focused on behaviour of private households, but has said little about the reaction of governments in the receiving countries. For example in the survey of Lucas (2005) the word ‘tax’ appears but always without any referencing to any empirical work. Whereas some countries like Morocco are well known to tax worker remittances heavily and therefore worker remittances should be expected to increase tax revenues, it is also possible that growth is increased and therefore the ratio of tax revenues as a share of GDP may go up or down and other countries provide tax incentives to attract remittances (Ratha 2004). In addition, other determinants of taxation like savings may increase as well and therefore remittances may have an indirect effect on taxation via them.

Similarly, we do not find any information about the reaction of public expenditure on education to the appearance of worker remittances although theoretical work uses ‘the assumption … that the diaspora bear the costs of education’ (Wei and Balasubramanyam 2006. p.1608). This naturally raises the question whether the government then reduces or increases its own efforts. As a matter of subjective selection we think that this is a highly relevant government variable, as it contributes to human capital formation, which is important for many aspects of economic development.

We will therefore focus on the effects of worker remittances on tax revenues and public expenditure on education, all expressed as a share of GDP. We will try to explain empirically the determination of these variables for two sets of countries, one with per capita above and the other below $1200 in order to figure out how poor and less poor developing country governments react to remittances and other determinants. The poorer sample consists of 52 and the richer one of 56 countries, for which we had data on worker remittances and development aid. The poorer countries also had lower growth rates of the GDP per capita in the past (1960-2005), less than 1 per cent as opposed to more than 2 per cent for the richer sample.

Of course with these questions we are no longer in the realm of pure economics but rather also in politics. We will try to find preliminary answers via an estimate of an empirical model for two panels of countries to be explained in section 2. In section 3 we describe the data and the econometric method used. In section 4 we present the results. Section 5 summarizes and points to issues for further research.

2. An empirical model

We specify the following tax function explained below using the index ‘i ‘ for countries and ‘t’ for time.

$$taxy_{it} = a_{0,i} + a_1 taxy(-1)_{it} + a_2 savgdp_{it} + a_3 (wr/gdp)_{it} + \ldots + u_{it} \qquad (1)$$

For the explanation of tax revenues as a share of GDP, *taxy*, the first argument besides a country-specific constant is its lagged value, *taxy(-1)*. More substantially then, taxability is well known to be limited by poverty in poor countries. Poverty itself can be expressed in many ways. Mostly per capita income is used followed by a discussion of distribution issues. The idea used here, related to traditional surplus debates, is that the savings ratio, *savgdp*, reflects how much of their income people can miss in view of existence minimum requirements, how ever measured. In rich or less poor countries savings ratios may also reflect how much people can care for themselves. The idea for poor countries then would suggest that we get a positive sign for the coefficient of savings, but a negative one for less poor countries provided they are not too poor still. Worker remittances, *wr,* as a share of GDP, can be considered as a sort of marginal income received.[2] The question then is whether governments want to tax this at higher rates in the spirit of progressive taxation or at lower rates, as under special tax incentives intending to attract remittances. A negative sign could also imply that the effect of the GDP per capita, not discussed in this paper, is larger than that on taxes. We will also explore the use of quadratic terms for all regressors. The last term in the regression is the residual. In principle, we might have used per capita income rather than the savings variable. However, it has a growth trend and even when employing quadratic and cubic

[2] Ratios with a fraction sign are taken in the algebraic version; 3% then is 0.03. Ratios without fraction sign are in addition multiplied by one hundred as in the World Development Indicators.

terms with or without a time trend the tax variable would go out of bounds in all simulation exercises we have carried out. We have also tried out literacy as a regressor because it might be a motive fro raising taxes and is relevant for some development issues, but it has turned out to be insignificant. The use of natural logarithms besides quadratic and cubic terms has been tried out as well for all variables.

Remittances may not only have a direct effect on tax ratios, but also an indirect effect via savings ratios. For savings ratios we specify the following the regression.

$$SAVGDP_{it} = b_{0,i} + b_1 SAVGDP(-1)_{it} + b_2(WR/GDP)_{it} + b_3(ODA/GDP)_{it} + \qquad (2)$$

$$+ b_4 D(LOG(GDPPC_{it})) + b_5 LOG(1+RI(-1)_{it}) + b_6 (PEEGDP)_{it} + b_7 (nm/l)_{it} + \ldots + e_{it}$$

Again there is a country-specific constant and a lagged dependent variable. Worker remittances are international transfers received by private households. They enhance disposal income. As a share of GDP this can be used to enhance or reduce savings ratios depending on whether they go more or less than proportionately into consumption or savings (Griffin 1970). Official development aid being international transfers as well also enhances disposal income of the country, mostly of the government though. This also may provide an incentive to increase or decrease savings ratios and therefore we add it also as a regressor, *oda/GDP*. The growth rate of the GDP per capita, *GDPPC*, and the interest rate, *RI*, may have an impact as in basic macroeconomic textbooks to the extent that people are looking into the future. Public expenditure on education, *PEEGDP*, may reduce the private incentives to save and reduces government savings directly. Net immigration, *nm*, taken as a share of the labour force, *l*, to correct for country size may enhance savings ratios if the immigrants bring high savings with them to the country of arrival. Conversely, emigrants may dis-save because they probably prepare their emigration by saving money to carry the cost of migration. The last term in the regression is the residual.

On the expenditure side, public expenditure on education as a contribution to financing the development of capability or human capital building is one of the most discussed items in development studies. We specify the following regression.

$$PEEGDP_{it} = c_0 + c_1 PEEGDP(-1)_{it} + c_2\ TAXY_{it} + c_3 SAVGDP_{it} + c_4\ (WR/GDP)_{it}$$

$$+ c_5\ (ODA/GDP) + \varepsilon_{it} \qquad (3)$$

Besides the constant and the lagged dependent variable, the more tax money is available, the more can go to education. The more people save, the more they signal that the government should do the same in regard to education. Worker remittances may discourage public expenditure on education, because the government may think that people can take care of them selves more than before. On the other hand, education may become accessible in poor countries if private and public money support it, but not if only one of them does so. This would provide an incentive to put more public money into education. Development aid should encourage, for example via co-financing between donors and governments, public expenditure on education. But it is also possible that more aid on that purpose leads to less public money. Again, the last term is the residual. There are three channels then along which remittances affect public expenditure on education. First, they have a direct impact. Second, there is an impact via savings and third, there is an impact via the tax ratio, which in turn depends itself on an effect via savings.[3]

3. Data and econometric method

All data are taken from the World Development Indicators, World Bank (2007), where definitions are given. More detailed information is available from the sources mentioned below. Worker remittances are official receipts in constant (2000) US$ and do not contain compensation of residents going across the border to work in neighbouring countries. The data stem from Balance of Payments Statistics.[4] Flows going via financial investments and withdrawals from related accounts are not included (see IMF 2005, p.99). Unofficial receipts may be high - Freund and Spatafora (2005) estimate that

[3] As a matter of cross checking, we did not find an impact of remittances on aid.

[4] In the WDI there are surprisingly many zero values, which are quite implausible because they are preceded and followed by positive values of non-negligible size. We have turned them into ‘non available’.

informal remittances are between 35 and 75 per cent of the official ones - and important but we have no way to deal with the issue directly[5] (see Adams and Page 2005).[6] Taxes are only those of the central government. This is a limitation, but the most well know federal states like the USA and Germany are not in our sample. Savings are gross of depreciation but include net current transfers and net income from abroad. Data on official development aid include loans containing at least a grant element of 25%. When taking remittances and aid as a share of GDP, we use algebraic expression, meaning the 3% is 0.03. For the other data, taken from the WDI as they are expressed there, shares of GDP are multiplied by 100, then 3% is just 3. Data of the GDP per capita, *gdppc,* are in constant (2000) US$ and stem from national accounts. Interest rates, *ri* are real rates as obtained by use of the GDP deflator and taken from the IMF IFS Yearbook. Data on public expenditure on education, *peegdp,* are from the UNESCO and we assemble them from several versions of the World Development Indicators.[7] Data on migration are five-year estimates of the United Nations Population Division. Labour force data are from the ILO.

We use data for 108 countries for which data are available for remittances and aid.[8] We divide these countries into two groups, those with a GDP per capita that is above and below $1200 because Kernel density estimates for the years 1960, 1970, 1980 , 1990 and 2000 show peaks at around $1000. The number of countries around this peak is fairly constant. Analysis of growth rates shows that the countries in the poor group have an average growth rate below 1% in the period 1960-2005. Those in the less poor group have growth rates above 2%. Another important difference between the two groups is that for the richer sample it holds that remittances are a larger share of GDP than aid is: 4% and 2% respectively. But for the poorer sample this often stated result is by far not true.

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[5] Panel data on remittance fees, which cause unofficial receipts, would be an interesting addition here. But we are not aware of their availability.

[6] We would like to point out though that GDP data also underestimate economic activity because of the neglect of the informal sector. Schneider and Enste (2000, Table 2) report values of 25-76% of GDP for developing countries. This is the same order of magnitude as for remittances. For developed countries these values are lower. Informal remittances are falling as a share of the official ones. It is not clear though that the share of the informal sector is falling in developing countries over time. The imperfection of remittances data is broadly discussed in all related papers. That of GDP data is not discussed anymore although it may be as severe.

[7] The versions since 2005 cover only data since 1998.

[8] Using development aid as a criterion leads to the inclusion of several former communist countries in the samples.

Aid is more than 9% and remittances are above 3% in the poor sample. Panel homogeneity then is hardly a convincing assumption in regard to both the level and the growth rates of the GDP and therefore we split the sample. In the richer sample we will then have 56 countries and 52 in the poorer (see Appendix A for the lists of countries). Further splits will be postponed to further research, when more econometric information on adequate splits becomes available. Data are not available for all other variables though and therefore our regressions will often cover less than the 52 or 56 countries.

For all variables, we follow a basic econometric lesson for macroeconomic variables, to include the lagged dependent variable. It tends to be highly significant in most circumstances and therefore is always included in order to avoid an omitted variable bias (see Greene 2003, Chaps. 19 and 20). By implication we consider dynamic panels. The basic econometric lesson here is that in dynamic panels the coefficient of a lagged dependent variable, when using a fixed effects estimator, has a downward bias of an order of magnitude of *1/T*. This is an expected value of the bias. Its standard deviation allows for having a much higher or lower bias. The best response to this currently is the use of a systems GMM estimator by Arrelano and Bover (1995), which combines the level equations as presented above with their version in first differences, imposing equality constraints on the respective regressors. As many regressors are under suspicion of endogeneity, we use instruments also for some of the regressors other than the lagged dependent variable in this approach. The method of calculation is called ‘orthogonal deviations’. It does not estimate the intercept of the above equations. Therefore we will leave the coefficient in its general form or alternatively we could present the estimation results in terms of first differences, which would cost more space though. The GMM approach minimizes a quadratic form called the J-statistic. If the instruments used are identical to the regressors, the J-statistic is zero. When other instruments are used, the J-statistic increases. It should not increase too much. A high Sargan p-value indicates that it is not increasing too much. Therefore we report the J-statistic, the Sargan p-value and the standard error of regression whenever we use the Arellano-Bover method. In some cases though, we find that the GMM estimator for the lagged dependent variable is below that from the fixed effects estimator. This may be due to the fact that the number of periods for which we have data is in the order of magnitude of thirty. The order of magnitude of the bias then is 1/30. Baltagi (2005, Chap. 8) points out that in this case the bias may still be 20% due to its variation. But, if going to the other direction, it may also be zero. In these cases we use the fixed effects estimator and report a value of the intercept, the adjusted R-square and the Durbin Watson statistic for serial correlation. All regressions are based on unbalanced panels.

4. Results[9]

We present here the regression results first for the countries with GDP per capita above $1200 indicated by an 'a' in the equation number and then the result for the countries below $1200 indicated by a 'b' in the equation number. For the sake of brevity, we abbreviate the savings ratio as '*s* ', the remittance ratio as '*w*', the peegdp as '*p*', *d(log(gdppc))* as '*g*', real interest rates as '*r*', and the development aid ratio as '*d*'. In parentheses we present p-values, the significance levels, rounded upwards.[10] Instruments are shown in Appendix B.

$$taxy_{it} = a_{0,i} + 1.05taxy(-1)_{it} - 0.005taxy^2(-1)_{it} - 0.18s_{it} + 0.004s_{it}^2 - 15.87w_{it}^2 + u_{it} \qquad (1a)$$

(0.00) (0.06) (0.014) (0.015) (0.12)

Per.: 33 (1973-2005); Countries: 41; Obs.: 406; S.E.[11]:1.48; J-stat.: 349.7; Sargan p-val.: 0.025

$$taxy_{it} = 1.3 + 0.83taxy(-1)_{it} + 0.001taxy^2(-1)_{it} + 0.05s_{it} - 7.53w_{it} + 51.12w_{it}^2 + u_{it} \qquad (1b)$$

(0.047) (0.000) (0.018) (0.002) (0.09) (0.001)

Per.:31 (1975-2005) ; Countries: 35; Obs.: 348; S.E.:1.66; Adj.R^2.: 0.97; DW: 2.02

For both panels remittances have a negative direct impact on the tax ratio, as the quadratic term in the second equation has a very low value. For the same reason the effect in the first equation may be weak. The savings ratio has a negative effect in the first

[9] This section is based on the Appendix 'Regression output' in the working paper version. Coefficients here are rounded.

[10] The corresponding standard errors are SUR-PCSE (Panel Corrected Standard Errors of the seemingly unrelated regression type), which essentially correct for remaining serial correlation.

[11] Standard error of regression

equation and a positive effect in the second equation. Therefore we look at the impact of remittances on savings next.

$$s_{it} = 7.81 + 0.47s(-1)_{it} + 35.5w_{it} + 17.4g_{it} + 1.61 \cdot \log(1+ r(-1)_{it}) -1.2LOG(1+r(-2)_{it}) +188.9d_{it}^{2} \quad (2a)$$

(0.00) (0.00) (0.00) (0.00) (0.37) (0.21) (0.00)

Periods: 29(1977- 2005); Countries: 29; Obs.: 508; S.E.:3.51; Adj.R^2.: 0.85; DW: 1.75.

$$s_{it}=b_{0,i}+0.63s(-1)_{it}+89.9w(-1)_{it}-387.7w(-1)_{it}^{2}-0.005P_{it}^{2}-23.7d_{it}+42.36d(-1)_{it}^{2}+25.58(NM/L)_{it} \quad (2b)$$

(0.00) (0.002) (0.0002) (0.00) (0.12) (0.027) (0.001)

Per.:6 (1980-2005); countr.:32; Obs.:65; S.E.:3.41; J-stat.:29.24; Instr.Rank:34.

In both samples the savings ratio is enhanced by worker remittances, because in the poorer sample the inverted u-shape effect has a negative slope only when remittances are more than 11.5% of the GDP. For the richer sample this means that remittances have a negative impact on the tax ratio, directly and indirectly via savings. The question then is how this affects public expenditure on education. For the poorer sample the negative direct effect of remittances on the tax ratio now is counterbalanced by a positive indirect effect coming from the positive effect of remittances on savings.

There are some other interesting effects in these regressions. The effect of development aid on savings has been debated controversially since decennia (see Doucouliagos and Paldam (2006) for a survey). One possibility for this is coming out of our regressions. In richer countries savings are enhanced, but in poorer countries savings are reduced. This is plausible in the sense that in poorer countries more money goes to emergency and poverty fighting - that is present needs rather than future needs -, and this money may be matched by that of the government and thereby also contribute to a reduction in savings. For richer countries, especially when aid is tied to trade, such as buying machines from the donor country, imperfect fungibility of money allows driving aid into savings rather than consumption. In short, the controversies of the past may be due to panel heterogeneity, stemming from different behaviour of poor and less poor countries. Moreover, in the poorer sample, higher public expenditure on education reduces the savings ratio, which probably is the case, because these countries have imperfect credit markets in regard to investment in human capital, forcing people to save before investing in education. More public money then reduces the pressure to save before schooling. Credit rationing may explain why interest rates are not relevant for poor countries. For less poor countries they are insignificant, but dropping them reduces the adjusted R-squared by seven percentage points. Therefore we speculate that the insignificance is due to approximate collinearity with other variables, for example the growth rate of the GDP per capita and the remittances. Finally, it seems remarkable that net immigration enhances savings in the poor sample. Probably this is the case because migrants bring some savings with them at amounts higher then the average value in the country, or it is because they do contribute to savings but not yet to the GDP. From the narrow perspective of the paper these variables mainly serve the purpose of avoiding an omitted variable bias.

Next, we look at public expenditure on education in order to see how they depend on tax ratios, savings ratios, remittances and aid.

$$P_{it} = 0.84 + 0.93P(-1)_{it} - 0.03P(-1)_{it}^{2} + 0.02TAXY_{it} + 0.02s(-1)_{it} - 32.25w_{it}^{2} - 17.78T^{(-1)} \quad (3a)$$

(0.15) (0.00) (0.03) (0.15) (0.03) (0.00) (0.01)

Per.: 25 (1981-2005); countries: 40; Obs.: 269; S.E. = 0.51; Adj. $R^2 = 0.92$; DW: 1.91

$$P = c_{0,i} + 0.91P(-1)_{it} - 0.029P(-1)_{it}^{2} + 0.044TAXY_{it} + 1.74d(-5)_{it} + 0.1LOGw(-1)_{it} \quad (3b)$$

(0.00) (0.002) (0.002) (0.001) (0.004)

Per.:24 (1982-2005); countr.:30; obs.:184. S.E.:0.34; J-stat.:139.6; Inst Rank:134; Sargan p.: 0.25

For both groups of countries we find also a quadratic term of the lagged dependent variable. Higher tax revenues are used for higher public expenditure on education, but only with a small coefficient below 5%. For all other variables we find different government behaviour in poor and less poor countries. In the less poor countries a higher savings ratio seems to work as a signal to governments, that higher expenditure on education is desirable, but there is no such effect in the poorer sample but development aid has a similar effect. Remittances, often used for private financing for education, induce governments to reduce public expenditure on education in richer countries'. In poorer countries though, remittances induce more public expenditure, perhaps because only private and public means together can achieve something. In the richer sample time has a positive but declining effect, because there is an inverse, vanishing time trend with a negative sign.

The logic coming up from the above regressions for the richer sample is that remittances have an impact on savings, remittances and savings have an impact on taxation, and remittances, savings and taxation have an impact on public expenditure on education. For the poorer sample this is slightly more complicated because the public expenditure on education appears also in the equation for the savings ratio, but savings do appear in that for public expenditures on education, whereas aid does. We differentiate the above equations with respect to these variables in order to analyze the effect of changes in remittances on savings ratios, tax ratios and public expenditure on education as a share of GDP. As we think that the other variables might be affected only slightly by remittances and the differentiated variables we keep them constant. For the richer sample the constancy assumption refers to the growth rate of the GDP per capita, the interest rate and the development aid, all in the savings equation. For the poorer countries they regard aid and migration. They all react only slightly in preliminary simulations with more complex models.[12] In particular, there is a literature in regard to the effects of remittances on growth rates, which does not come to unanimous results. Results are dependent on the choice of instrumental variables (see Lucas 2005).[13]

The results for the effects of remittances on ratios of taxation, savings and public expenditure on education are derived in Appendix C and summarized in Table 1.

TABLE 1 OVER HERE

[12] For example, in regressions for nm/l (not shown here), the latter reacts only by .07% (7/10000) to dw = 0.01. Multiplied by the coefficient of 25.58 in equation (2b) this adds 0.018 to a savings ratio of about 17. Together with interaction effects with other variables this may have a larger impact though, for example if migration affects labour force growth and this affects GDP per capita growth. We leave these more complex models to further research. The orders of magnitude obtained here also appear in preliminary simulations with more complex models.

[13] Moreover, we will indicate in a different paper that they are beleaguered by problems of approximate collinearity with the lagged dependent variable, because income effects are prominent in development economics.

The *impact effect* in columns one and four refer to the direct effect in the same period of remittances in the respective regressions if remittances go up by one percentage point, for example from 3% to 4% of GDP, in symbols, dw = 0.01, keeping all other variables constant. In the richer sample remittances have a positive impact on savings, but a negative one on the tax and public expenditure ratios. In the poorer sample the tax ratio also reacts negatively, but the other variables are affected only with a time lag and therefore the impact effect is zero.

Short run effects add the indirect effects of the first period to the impact effects for the richer sample using the impact effects as lagged values. For the poorer sample we add also effects of the second period, because of the lags. For the richer sample we see that the short run effect on the tax ratio is even more negative because the increase of the savings ratio reduces the tax ratio. Public expenditure on education is lightly less negative in the short run compared to the impact effect, because the savings ratio has a positive impact here. For the poorer sample the appendix shows that the short run effects, with a '*d*'now indicating a change, are strongly interdependent: *dt* depends on *ds*, *ds* depends on *dP*, and *dP* depends on *dt* and they all dependent directly on *dw*. These interdependencies can be calculated by solving a system of three equations. The result appears in column six in Table 1. Savings are increased by remittances. Tax ratios are decreased even further beyond their impact effect through their lagged dependent variables. Savings ratios mitigate this a bit. Then, public expenditure on education increases in spite of the decrease in the tax ratio, because remittances have a positive direct impact. The negative effect of the latter on savings is a negligible effect. For the both samples, the long run effects show higher savings ratios through the multipliers. This has a negative impact on the tax ratio in the rich sample but a positive one in the poor sample, where the negative short run effect is turned into a positive long run effect on taxes. This latter effect drives up public expenditure on education. In the richer sample the positive effect on savings almost outweighs the negative ones - from remittances directly and taxes indirectly - on expenditure for education.

It should be noted that a change of remittances of $dw = 0.01$ – one percentage point - used in the above analysis is about 25% of what we currently have in the data. The response of savings seems large, but the other responses are just fractions of percentage points as can be seen from the columns containing the levels of the variables in 2005.

5. Summary and conclusion

Summing up, savings increase strongly through remittances in both samples. Taxes are reduced through remittances and this is reinforced by higher savings in the richer sample but outweighed in the poorer sample in the long run, when savings are strong enough. Public expenditure on education are negatively affected in the short run in the richer sample, directly through higher remittances and indirectly by lower taxes, but in the long run changes of savings are high enough to bring the total long run effect to almost zero. In the poorer sample, public expenditure on education increases directly through remittances, although this effect is mitigated in the short run by lower taxes, and in the long run taxes are higher and lead to even higher public expenditures on education.

The poorer sample therefore clearly benefits from remittances as far as savings and public expenditure for education are concerned. These are revenues that can be viewed as a return to earlier emigration and a corresponding brain drain. For the richer sample taxation is lower in the short and in the long run; public expenditure on education is dis-improved in the short run, but only slightly so in the long run, when large increases in savings enhance public expenditure on education.

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Appendix A: List of Countries

Countries with GDP per capita above $1200 (2000):

Albania, Algeria, Argentina, Aruba, Belarus, Belize, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Cape Verde, China, Colombia, Costa Rica, Croatia, Cyprus, Dominican

Republic, Ecuador, Egypt, El Salvador, Estonia, Guatemala, Hungary, Jamaica, Jordan, Kazakhstan, Latvia, Lebanon, Libya, Lithuania, Macao, Malta, Mexico, Morocco, Namibia, New Caledonia, Oman, Panama, Paraguay, Peru, Romania, Russian Federation, Samoa, Seychelles, Slovak Rep., Slovenia, Suriname, Swaziland, Thailand, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Uruguay, Venezuela.

Countries with GDP per capita below $1200 (2000):
Armenia, Azerbaijan, Bangladesh, Benin, Bolivia, Burkina Faso, Cambodia, Cameroon, Comoros, Congo Rep., Cote d'Ivoire, Djibouti, Ethiopia, Ghana, Guinea, Guyana, Haiti, Honduras, India, Indonesia, Kenya, Kyrgyz Republic, Lesotho, Madagascar, Malawi, Mali, Mauritania, Moldova, Mongolia, Mozambique, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Papua New Guinea, Philippines, Rwanda, Senegal, Sierra Leone, Sri Lanka, Sudan, Syria, Tajikistan, Tanzania, Uganda, Ukraine, Vanuatu, Yemen, Zimbabwe.

Appendix B: Instrumental variables

This appendix provides the list of instruments used in the regression, starting with the number of the respective regressions. The first number after a variable gives the first lag used and the second the last lag. These are used as dynamic instruments then (see Baltagi (2005, Chap.8). If only one lag is mentioned we have a simple standard instrument.
(1a) (TAXY,-2,-3), ($TAXY^2$,-2,-3), (s, -1,-3), (s^2,-1,-3), (w^2,-1,-1).
(2b) (s,-2,-2), s(-1), $(s(-1))^2$, (P^2,-1,-2), (d,-1,-1), (d^2,-1,-2), (nm(-5)/l(-5)).
(3b) (P,-2,-2), (TAXY,-1,-2), (P^2,-2,-2), d(-5), (LOG(w),-1,-2).

Appendix C: Derivation of Effects of Remittances on savings, taxes and public expenditures on education, all as a share of GDP.

For the *richer sample* we get the effects as follows.

From equation (2a) we get $ds_{it} = 0.47ds(-1)_{it} + 35.5dw_{it}$. The impact effect, defined as the direct immediate effect of a right-hand side variable on a left-hand side variable then is $ds_{it} =$

35.5dw_{it}. Dropping the indices, with dw = 0.01 we get ds = 0.355. The long run effect, defining by setting all lags of a variable equal to each other, is ds = 35.5dw/0.53 = 0.67.

From the tax equation (1a) we get dtaxy = 1.05dtaxy(-1) - 0.005taxy(-1)2d(taxy(-1)) - 0.18ds +0.004s2ds-15.87w2dw. Evaluating at w = 0.043, we get an *impact effect* of dtaxy = -15.87w2dw = -15.87x0.043x2x0.01=-0.013648. Adding the impact effect of the savings ratio to this for a constant lagged tax ratio, we get the *short run effect* dtaxy = - 0.18ds +0.004s2ds-15.87w2dw. Evaluating at w=0.043 and s=19 (both values as of 2005), we get

dtaxy = - 0.18ds +0.004s2ds-15.87w2dw = -.18x0.355+0.004x19x2x0.355-15.87x0.043x2x0.01 = -2. 3588$\times 10^{\ 2}$.

The *long run effect* of dt can be obtained by using the long run effect of ds = 0.67, and evaluating the equation dtaxy = 1.05dtaxy(-1) - 0.005taxy(-1)2d(taxy(-1)) - 0.18ds +0.004s2ds-15.87w2dw at (data from 2005)[14] s=19, t=18.44, w=0.043, dw = 0.01, and setting dt equal for all lags. The results is dt = -0.24, which implies a multiplier effect of 10.2 times the short run effect.

From equation (3a) we get dP = 0.93dP(-1) -0.03P(-1)2dP(-1) + 0.02dTAXY + 0.02ds(-1) - 32.25w2dw. The *impact effect* then is: dP = -32.25w2dw = -32.25x0.043x2x0.01 = -2. 7735$\times 10^{\ 2}$. Including the *short run effect* on taxes into the short run effect on public expenditures on education yields: dP = 0.02dTAXY -32.25w2dw = 0.02x0.034 -2. 7735$\times 10^{\ 2}$ = -2. 8207$\times 10^{\ 2}$. For the *long run effect* we get dP = 0.93dP -0.03P2dP + 0.02dTAXY + 0.02ds - 32.25w2dw. Evaluating at p =5.25 implies dP(1-0.93+ 0.03x5.25) = 0.02(-0.24) + 0.02(0.67)(-2. 7055$\times 10^{\ 2}$), which yields and dP = -5. 7818$\times 10^{\ 3}$.

For the *poorer sample* we get the effects as follows.

From equations (1b), (2b) and (3b) we get, with t abbreviating taxy and dropping the indices it and treating aid and migration (and residuals) as constants:

dt = 0.83dt(-1) + 0.001t(-1)2dt(-1) + 0.05ds -7.53dw + 51.12w2dw

ds = 0.63ds(-1) + 89.9dw(-1) -387.7w(-1) 2dw(-1) - 0.005P2dP

dP = 0.91dP(-1) - 0.029P(-1)2dP + 0.044dt + 0.1(1/w(-1))dw(-1)

---

[14] In long run simulations with a more complex system, we get s=17.35, t= 18.8, w= 0.022. The long run result then is -0.25 rather than -0.24.

For the evaluation of *all effects* dw =0.01 we use data values as from 2005: w = 0.035, s = 17.2, p = 3.83, t = 13.45. Impact effects are:

dt = -7.53dw + 51.12w2dw = -7.53x0.01 + 51.12x0.035x2x0.01 = -3. 9516$\times 10^{2}$

As impact effects are by definition those of the same period we get ds = dP = 0.

By implication, *short run effects* defined above as belonging to the same period, which is the standard definition, would not differ from impact effects. We can re-define the short run as the effect of the second period, using the impact effects as lagged values. Then we get:

dt =

0.83dt(-1) + 0.001t(-1)2dt(-1) + 0.05ds -7.53dw + 51.12w2dw

= 0.83x(-0.039561) + 0.001x13.45x2(-0.039561) + 0.05ds -7.53x0.01 + 51.12x0.035x2x0.01

ds = 0.63ds(-1) + 89.9dw(-1) -387.7w(-1) 2dw(-1) - 0.005P2dP

= 89.9x0.01 -387.7x0.035x2x0.01 - 0.005x3.83x2dP

dP = 0.91dP(-1) - 0.029P(-1)2dP(-1) + 0.044dt + 0.1(1/w(-1))dw(-1)

= 0.044dt + 0.1(1/0.035)x0.01

Dt depends on *ds, ds* depends on *dP*, and *dP* depends on *dt*. These can be calculated by solving the system of three equations. The result, dp=2. 6720$\times 10^{2}$, ds=0.62659, dt=-4. 2086$\times 10^{2}$ appears as column six (short run) in Table 1.

For the long-run effects, we use again the same initial values and *dw=0.01* and set all lagged values equal to each other.

dt = 0.83dt + 0.001x13.45x2dt + 0.05ds -7.53x0.01 + 51.12x0.035x2x0.01

ds = 0.63ds + 89.9x0.01 -387.7x0.035x2x0.01- 0.005x3.83x2dP

dP = 0.91dP - 0.029x3.83x2dP + 0.044dt + 0.1(1/0.035)x0.01

The result is: $dP = 0.13546$, $ds = 1. 6822$, $dt = 0.31164$. The negative impact effect of remittances on taxes is outweighed by the indirect impact via savings, in the short and in the long run. Taxes, savings and public expenditure on education, all taken as a share of GDP increase.

Table 1

Short and long run effects of a one percentage point increase in remittances as share of GDP on savings and tax ratios and public expenditure as a share of GDP.

Sample →	above $1200				below $1200			
Change of↓	impact	short run	long run	2005 level	impact	short run	long run	2005 level
savings ratio	0.355	0.355	0.67	19	0	0.63	1.68	17.2
tax ratio	-0.0136	-0.0236	-0.24	18.44	-0.0395	-0.042	0.31	13.45
peegdp	-0.0277	-0.0282	-0.00578	0.043	0	0.027	0.135	3.83

Appendix Regression Output (not for publication)

A12: table08tax2ab

Dependent Variable: TAXY
Method: Panel Generalized Method of Moments
Transformation: Orthogonal Deviations
Date: 03/17/08 Time: 10:08
Sample (adjusted): 1973 2005
Periods included: 33
Cross-sections included: 41
Total panel (unbalanced) observations: 406
2SLS instrument weighting matrix
Period SUR (PCSE) standard errors & covariance (d.f. corrected)
Instrument list: @DYN(TAXY,-2,-3) @DYN(TAXY^2,-2,-3) @DYN(SAVGDP,
-1,-3) @DYN(SAVGDP^2,-1,-3) @DYN((WR/GDP)^2,-1,-1)

	Coefficient	Std. Error	t-Statistic	Prob.
TAXY(-1)	1.050769	0.109567	9.590168	0.0000
TAXY(-1)^2	-0.005053	0.002632	-1.919692	0.0556
SAVGDP	-0.184630	0.074234	-2.487145	0.0133
SAVGDP^2	0.004238	0.001720	2.464096	0.0142
(WR(-1)/GDP(-1))^2	-15.87425	10.10720	-1.570589	0.1171

Effects Specification

Cross-section fixed (orthogonal deviations)

Mean dependent var	0.058897	S.D. dependent var	1.871583
S.E. of regression	1.481470	Sum squared resid	880.0962
J-statistic	349.7049	Second-Stage SSR	1048.453
Instrument rank	313.000000		

U12: table08tax8

Dependent Variable: TAXY
Method: Panel Least Squares
Date: 03/14/08 Time: 17:16
Sample (adjusted): 1975 2005
Periods included: 31
Cross-sections included: 35
Total panel (unbalanced) observations: 348
Period SUR (PCSE) standard errors & covariance (d.f. corrected)

	Coefficient	Std. Error	t-Statistic	Prob.
C	1.314148	0.658089	1.996915	0.0467
TAXY(-1)	0.832806	0.055322	15.05366	0.0000
TAXY(-1)^2	0.001195	0.000500	2.392220	0.0173
WR/GDP	-7.527626	4.324509	-1.740689	0.0827
(WR(-1)/GDP(-1))^2	51.12401	15.11266	3.382861	0.0008
SAVGDP	0.053474	0.016439	3.252861	0.0013

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.978395	Mean dependent var	14.14302
Adjusted R-squared	0.975660	S.D. dependent var	10.63530
S.E. of regression	1.659252	Akaike info criterion	3.958393
Sum squared resid	847.9596	Schwarz criterion	4.401175
Log likelihood	-648.7603	Hannan-Quinn criter.	4.134673
F-statistic	357.6466	Durbin-Watson stat	2.024422
Prob(F-statistic)	0.000000		

A12: table02sav1

Dependent Variable: SAVGDP
Method: Panel Least Squares
Date: 08/06/07 Time: 15:45
Sample (adjusted): 1977 2005
Periods included: 29
Cross-sections included: 45
Total panel (unbalanced) observations: 508
Period SUR (PCSE) standard errors & covariance (d.f. corrected)

	Coefficient	Std. Error	t-Statistic	Prob.
C	7.806542	0.793568	9.837269	0.0000
SAVGDP(-1)	0.474389	0.038187	12.42285	0.0000
WR/GDP	35.49262	7.355089	4.825587	0.0000
D(LOG(GDPPC))	17.42039	4.807019	3.623950	0.0003
LOG(1+RI(-1)/100)	1.610827	1.801629	0.894094	0.3717
LOG(1+RI(-2)/100)	-1.196885	0.949427	-1.260640	0.2081
(ODA/GDP)^2	188.8652	32.53590	5.804825	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.865135	Mean dependent var	20.19073
Adjusted R-squared	0.850380	S.D. dependent var	9.074664
S.E. of regression	3.510148	Akaike info criterion	5.444183
Sum squared resid	5630.760	Schwarz criterion	5.868896
Log likelihood	-1331.822	Hannan-Quinn criter.	5.610727
F-statistic	58.63168	Durbin-Watson stat	1.751464
Prob(F-statistic)	0.000000		

U12: table02savnm6ab

Dependent Variable: SAVGDP
Method: Panel Generalized Method of Moments
Transformation: Orthogonal Deviations
Date: 03/27/08   Time: 10:39
Sample (adjusted): 1980 2005
Periods included: 6
Cross-sections included: 32
Total panel (unbalanced) observations: 65
2SLS instrument weighting matrix
Cross-section weights (PCSE) standard errors & covariance (d.f. corrected)
Instrument list: @DYN(SAVGDP,-2,-2) WR(-1)/GDP(-1) (WR(-1)/GDP(-1))^2 @DYN((PEEGDP)^2,-1,-2) @DYN(ODA/GDP,-1,-1) @DYN((ODA /GDP)^2,-1,-2) (NM(-5)/L(-5))

	Coefficient	Std. Error	t-Statistic	Prob.
SAVGDP(-1)	0.627879	0.081599	7.694652	0.0000
WR(-1)/GDP(-1)	89.85603	26.27448	3.419897	0.0012
(WR(-1)/GDP(-1))^2	-387.6637	98.24869	-3.945739	0.0002
(PEEGDP)^2	-0.004987	0.001071	-4.655805	0.0000
ODA/GDP	-23.69436	14.78820	-1.602248	0.1145
(ODA(-1)/GDP(-1))^2	42.35966	18.57321	2.280687	0.0263
NM/L	25.58441	7.202632	3.552092	0.0008

Effects Specification

Cross-section fixed (orthogonal deviations)

Mean dependent var	-0.981859	S.D. dependent var	4.235361
S.E. of regression	3.408199	Sum squared resid	673.7174
J-statistic	29.23967	Second-Stage SSR	1103.989
Instrument rank	34.000000		

A12: table06peegdp12fe

Dependent Variable: PEEGDP
Method: Panel Least Squares
Date: 04/01/08 Time: 15:49
Sample (adjusted): 1981 2005
Periods included: 25
Cross-sections included: 40
Total panel (unbalanced) observations: 269
Period SUR (PCSE) standard errors & covariance (d.f. corrected)

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.841762	0.571702	1.472379	0.1423
PEEGDP(-1)	0.925265	0.150441	6.150347	0.0000
PEEGDP(-1)^2	-0.029186	0.013230	-2.206074	0.0284
TAXY	0.021840	0.015049	1.451255	0.1481
SAVGDP(-1)	0.021995	0.010092	2.179421	0.0303
(WR/GDP)^2	-32.24673	5.592720	-5.765841	0.0000
@TREND^(-1)	-17.78019	6.594776	-2.696102	0.0076

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.936092	Mean dependent var	4.428699
Adjusted R-squared	0.923196	S.D. dependent var	1.838897
S.E. of regression	0.509625	Akaike info criterion	1.644184
Sum squared resid	57.91698	Schwarz criterion	2.258893
Log likelihood	-175.1427	Hannan-Quinn criter.	1.891052
F-statistic	72.58625	Durbin-Watson stat	1.910055
Prob(F-statistic)	0.000000		

U12: Table06peegdp10fe

Dependent Variable: PEEGDP
Method: Panel Generalized Method of Moments
Transformation: Orthogonal Deviations
Date: 04/01/08 Time: 14:32
Sample (adjusted): 1982 2005
Periods included: 24
Cross-sections included: 30
Total panel (unbalanced) observations: 184
2SLS instrument weighting matrix
Period SUR (PCSE) standard errors & covariance (d.f. corrected)
Instrument list: @DYN(PEEGDP,-2,-2) @DYN(TAXY,-1,-2)
@DYN(PEEGDP^2,-2,-2) ODA(-5)/GDP(-5) @DYN(LOG(WR/GDP),-1,
-2)

	Coefficient	Std. Error	t-Statistic	Prob.
PEEGDP(-1)	0.909303	0.096496	9.423239	0.0000
TAXY	0.043761	0.013649	3.206182	0.0016
PEEGDP(-1)^2	-0.029185	0.009129	-3.196880	0.0016
ODA(-5)/GDP(-5)	1.744375	0.513043	3.400057	0.0008
LOG(WR(-1)/GDP(-1))	0.102859	0.034365	2.993124	0.0032

Effects Specification

Cross-section fixed (orthogonal deviations)

Mean dependent var	-0.142425	S.D. dependent var	0.385767
S.E. of regression	0.340819	Sum squared resid	20.79216
J-statistic	139.6326	Second-Stage SSR	26.51787
Instrument rank	134.000000		

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