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Worker Remittances and Growth: The Physical and Human Capital Channels [1]

Thomas Ziesemer[2]

Abstract

Remittances may have an impact on economic growth through channels to physical and human capital. We estimate two variants of an open economy model of these two channels consisting of seven equations using the general method of moments with heteroscedasticity and autocorrelation correction (GMM-HAC) with pooled data for four different samples of countries receiving remittances in 2003. The countries with per capita income below $1200 benefit most from remittances in the long run because they have the largest impact of remittances on savings. Their remittances account for about 2% of the steady-state level of GDP per capita when compared to the counterfactual of having no remittances. Their ratio of the steady-state growth rates with and without remittances is 1.39. Transitional gains are higher than the steady-state gains only for the human capital variables of this sample. As savings react much more strongly than investment an important benefit of remittances is that less debt is incurred and less debt service is paid than without remittances. The elasticity of the GNI/GDP ratio with respect to the remittance/GDP ratio is .002. All effects are much weaker for the richer countries.

JEL class.: O15, J61, C33. Keywords: remittances, growth, simultaneous equation model.

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1. Introduction

Besides foreign aid, trade and debt, remittances of former migrants have become a source of increasing amounts of foreign exchange for their country of origin. Most countries' remittances have remained below 10% of GDP. For some countries as Jordan and Yemen they are structurally as high as 20%. The highest values of more than 60% are observed in years of serious trouble like Lebanon in the end of the 1980s, and more than 20% in Albania, Cape Verde in the beginning of the 1990s, Bosnia in the end of the 1990s, and Haiti in the beginning of this millennium. One of the interesting related questions is how this affects growth. There are three papers on this question so far. Glytsos (2005) estimates the impact of remittances on consumption, investment, output and imports for five countries in a traditional, dynamic Keynesian model[3]. He finds long term multipliers of (on average) 2.3 for income (and .6 for investment). The paper is rich in discussing the related ups and downs of remittances and other variables. Chami et al. (2005) have argued that remittances provide an incentive to reduce effort and thereby make weak economic performances more likely. They find negative impacts of remittances on growth. Giuliano and Ruis-Arranz (2005) find positive growth effects for financially less developed countries. These papers use growth regressions, which tell us whether or not there is an effect on growth but not why and how it works (see Durlauf, Johnson, Temple forthcoming). Besides demand, moral hazard and financial development as treated in these papers, the channels to physical and human capital may be important as well. In order to get insights into the economic mechanism leading from remittances to growth and the size of the effect we set up a simultaneous equation model. We are not afraid that one mis-specified equation contaminates the others[4], because we use well-established equations, and get very plausible results.

The model dealing with this consists of seven equations, six of which are available in the literature and slightly adjusted for our purpose. First, remittances as a share of GDP are explained by an equation similar to that of Chami et al. (2005) and others earlier[5] containing the differences of income and interest rates in the host country and the country of origin. Second, remittances are added to an equation explaining the savings ratio similar to that in Loayza et al. (2000). Third, an increase in savings reduces the gap between investment and savings, which in turn reduces domestic interest rates as found by Obstfeld and Rogoff

[3] There is no price mechanism, no technology or resource constraint. Lagged dependent variables make the model dynamic.
[4] This is the main reason why estimation of systems is less widely spread according to Akhand and Gupta (2002). However, in recent times more papers try this.
[5] See also El-Sakka and McNabb (1999) and the references there.

(2001). Fourth, an interest rate reduction has a positive impact on the investment/GDP ratio in a standard investment function. Fifth, enrolments in primary schooling are a non-linear function of their own past values and changes of development aid and, for poorer countries, the savings ratio. Sixth, a higher savings ratio (except for poor countries) together with higher enrolments in primary education leads to higher literacy five years later.[6] Seventh, thus enhanced investment shares and literacy enhance transitional growth rates and the level of per capita income in standard growth equations related to the model by Mankiw, Romer and Weil (1992) and linked to open economy situations by Barro, Mankiw and Sala-i-Martin (1995) assuming that borrowing is proportional to physical capital. When the initial value of GDP per capita is replaced by world income growth as suggested by models with imported inputs there are also effects on the permanent growth rate.

We use data from the World Development Indicators (2005) for a sample with 96 countries, which had at least one dollar of remittances in 2003, and three sub-samples. We estimate the seven equations simultaneously for pooled data allowing for contemporaneous correlation between them. In both cases we use the General method of moments allowing for weak exogeneity.

In section 2 we set up a model that explains our line of thought on how remittances have an impact on growth. In section 3 the data and the econometric method are explained. Section 4 explains the results of the estimates. In section 5 we calculate the direct, short-run (similar to impact) effects of remittances on the endogenous variables for the two models. Section 6 presents the long run solution of the transitional growth model with and without remittances. Section 7 does the same for the permanent growth model. Section 8 analyses stability and transitional gains. Section 9 analyses the debt service dynamics implicitly by considering the impact of remittances on the GNI/GDP ratio. Section 10 summarizes and concludes.

2. The Model

The starting point of the model is the equation explaining worker remittances as a percentage of GDP. This is formulated in equation (1).

$$wr/gdp = c_{11} + c_{12}wr(-1)/gdp(-1) + c_{13}\log(OEC) + c_{14}(\log(gdppc(-2)) + c_{15}\log(1+ri(-2)) + c_{16}\log(1+rius(-1)) + c_{17}time + u_{1(it)} \quad (1)$$

Remittances, *wr/gdp*, are assumed to be driven by differences in the income per capita of the recipient and the sender. Therefore we include the income of the recipient country. The sender

[6] Equations for literacy have been estimated by Akhand and Gupta (2002), Mazumdar (2005) and Verner (2005).

knows his own current income. As most of the migrants go to the OECD countries we represent his income by per capita income of the OECD, *OEC*.[7] The sender will have information on the recipient country only from data about earlier years because it takes about a year in many countries to make the data. An indicator of the recipients' income is therefore Gross Domestic Product per capita with two lags, *gdppc(-2)*. The two income variables need not have the same coefficient because the OECD income is only a crude proxy that comes in because we use only one indicator for the host country of the senders. We do not use the Gross National Income as the IMF IFS Yearbook reports that some developing countries include remittances here although it should not be included in net factor income from abroad but rather be treated as transfers.[8] Moreover, senders are more likely to receive information on GDP then those of GNI through the media. The sender might consider saving the amount of money rather than transferring it. Therefore we use the real interest rate of the USA, *rius*, as an indicator of these opportunity costs. On the other hand the sender might consider putting the money into a bank account in the recipient country. Therefore we also include the real interest rate of the recipient country, *ri,* with the same information lag as for the GDP per capita variable. Finally, remittances are assumed to depend on their own past value, a constant and a time trend, which will be dropped if insignificant. As real interest rates can be highly negative we add a value of 1 to it, before taking natural logarithms, because we use interest rates in their scientific notation, that is, 5% is indicated by '.05'. Essentially equation (1) above is the one that appears also in Chami et al. (2005). Using natural logs or not for the remittance variable does not matter for the results in this equation. For the relation with the next equation it is more convenient to have it without logs. The first index of each coefficient indicates the number of the equation and the second that of the regressor. Further below we will provide equations explaining the (growth of) GDP per capita and the dynamics of the interest rates. The US interest rate and the GDP per capita of the OECD will not be determined in the model. We add residuals, *u*, whose first index is that of the equation and the second refers to the observation of country *i* at point in time *t*.

The next step is to explain the impact of worker remittances on savings in equation (2).

$$savgdp = c_{21} + c_{22}savgdp(-1) + c_{23}d(wr/gdp) + c_{24}d(log(gdppc)) + c_{25}log(1+ri(-1)) + c_{26}((oda/gdp)-(oda(-1)/gdp(-1))) + c_{27}((oda/gdp)-(oda(-1)/gdp(-1)))^2 + u_{2(it)} \quad (2)$$

[7] Chami et al. (2005) use the real income of the USA instead.
[8] It should be noted though that data by the IMF and the World Bank try to correct for this.

Basically, we assume that the savings ratio, *savgdp,* is driven by its own past value and, as in most of the literature (see Loayza et al. 2000, Table 1), by the growth of GDP per capita and by real interest rates. As disposable income is conceptually probably a better variable but also less available in terms of data we may add changes of worker remittances to the regression, which are part of disposable income but not part of GDP. The idea here is that higher disposable income and therefore remittances lead to a higher savings ratio as in models using the difference of consumption and a consumption minimum in the utility function when the country in question is close to that minimum. This is quite plausible here because remittances reduce poverty (see Adams and Page 2005). As an equation with a lagged dependent variable is similar to one on changes in savings here we take changes of remittances as a variable. Moreover, we add changes of official development aid and their squared term to the regression because aid might be significant according to the single-equation-estimation literature (see Paldam and Doucouliagos 2005a). Levels or their logs turned out to be insignificant.

If remittances enhance savings they should diminish the difference of investment and savings, which is the additional demand or flow variable of foreign debt. This should reduce interest rates as captured by equation (3).

$$\log(1+ri) = c_{31}+c_{32}\log(1+ri(-1))+c_{33}\log(1+ri(-2))+c_{34}(invgdp(-1)-savgdp(-1))+c_{35}(invgdp(-1)-savgdp(-1))^2 + c_{36}d(\log(OEC(-1))) + c_{37}(\log(1+rius(-1))-\log(1+rius(-2))) + u_{3(it)} \quad (3)$$

There are several possible rationales for this equation. First, Obstfeld and Rogoff (2001) have derived such a relation between the current account and the interest rate (without the other variables included here) from a two period model with transport costs. Second, in Bardhan (1967) and later publications on growth under capital movements by others one finds the assumption that large countries may have an impact on the world market interest rate and therefore on there own interest rate through a lower or higher stock of net debt per unit of GDP. If so, this should also hold for the flow of net debt. It is questionable here whether the countries involved have monopoly power. But they may have this as a group if their behaviour goes into the same direction. Third, it is plausible to relate domestic interest rates to the sum of LIBOR/EURIBOR or Prime Rate plus a country specific spread or risk premium. Edwards (1984) has shown that they depend on the ratio of debt to GDP or GNI. This ratio is lower one period after investment net of savings has grown by less than the GDP. Banks and rating agencies then can verify that less new debt relative to GDP is incurred and may reduce spreads. Therefore we use the lagged variable of the current account deficit or investment minus savings. Moreover, Belloc and Gandolfo (2005) argue that this relation may be non-linear based on data analysis. Therefore we include a squared term of the investment-savings difference. Moreover, two lagged dependent variables, the change in the US interest rate, and the growth rate of the OECD are included. The change in the US interest rate will be highly insignificant in all but one of the estimates. But the growth rate of the OECD, which is highly correlated with the US interest rate, is significant. The reason probably is that it enhances exports and therefore less new debt has to be incurred leading to lower spreads, or alternatively an impact on the exchange rate.

If remittances via enhanced savings and lower net debt demand reduce interest rates, the link to physical capital is gross fixed capital formation as a share of GDP, *gfcfgdp*. This is captured as in equation (4).

$$\log(gfcfgdp) = c_{41} + c_{42}\log(gfcfgdp(-1)) + c_{43}\log(1+ri(-1)) + c_{44}\log(1+rius(-1)) + c_{45}d(\log(gdppc(-1))) + c_{46}d(oda/gdp) + c_{47}d((oda/gdp)^2) + u_{4(it)} \quad (4)$$

Gross fixed capital formation as a share of GDP is assumed to depend on its own lagged value, interest rates and lagged growth rates as an indicator of the business cycle, expectations and the future need for investment. The lag in the interest rate variable indicates that it takes time to get the information on interest, order and deliver machines, and implement them. The domestic as well as the foreign interest rate indicate different types of opportunity costs. Moreover, as in the savings equation we add the changes of official development aid as a linear quadratic trend, again because levels or their logs turned out to be insignificant. Adding remittances directly here rather than only via the savings function makes the interest variable in this equation highly insignificant and violates the standard macroeconomic approach of making a clear assumption whether a decision is taken by firms or households. Households decide upon savings and firms decide where and how much to invest. But in open economy equilibrium savings are invested, at home or abroad. Therefore the fact that remittances are invested is not in contradiction with having remittances only in the savings equation. For development aid this may be different to the extent that donors can enforce that aid is invested without with drawing domestic means. This is the reason why we have included aid here. Perfect withdrawal then should render aid insignificant.

Besides the impact of remittances on physical investment via enhanced savings, reduced debt demand and interest rates, the higher savings from more remittances may complement primary school enrolments in their effect on literacy. This is captured in equation (5).

$$\text{lit} – \text{lit}(-5) = c_{51} + c_{52}\text{lit}(-5) + c_{53}\text{sepri}(-5) + c_{54}\text{savgdp}(-5) + c_{55}(\text{lit}(-5))^2 + c_{56}\text{peegdp}(-5) + u_{5(it)} \qquad (5)$$

Literacy, *lit*, is assumed to depend on its own lagged value in a linear-quadratic way, on enrolment in primary schooling five years earlier, *sepri*, and the savings available at the moment of enrolment. These can be used to avoid credit constraints. Public expenditures on education as a share of GDP are also included. Enrolments are significant in the cross-country regression of Verner (2005), and Mazumdar (2005) has suggested public expenditure on education as a share of GDP. It is insignificant in his cross-country regressions but significant in our pooled estimate, which suggests that there is a dynamic impact.

Literacy data are used as a proxy for human capital. They have a pretty good variation over time and across countries. In figure 1 we show the kernel density estimate using the Epanechnikov-Silverman approach (see Silverman 1986). The distribution has decreasing maximum and increasing minimum values and goes from a slight twin peak structure to one that is increasingly skewed.

FIGURE 1 ABOUT HERE

Enrolment in primary schooling, *sepri*, is assumed to be a quadratic function of its lagged value and its square, and again savings at the moment of enrolment and the change of development aid, which is sometimes tied to investment in education through conditions imposed by donors.

$$\text{sepri} – \text{sepri}(-5) = c_{61} + c_{62}\text{sepri} + c_{63}(\text{sepri}(-5))^2 + c_{64}((\text{oda/gdp})-(\text{oda}(-5)/\text{gdp}(-5))) + c_{65}((\text{oda/gdp})-(\text{oda}(-5)/\text{gdp}(-5)))^2 + c_{66}\text{savgdp} + u_{6(it)} \qquad (6)$$

If remittances have increased fixed capital formation indirectly via enhancement of savings, reduction of net debt flows and reduction of interest rates and the literacy via savings, both physical and human capital investments may have an impact on the (transitional) growth rate.[9] Equation (7) endogenizes the growth rate.

$$\log(\text{gdppc})-\log(\text{gdppc}(-5)) = c_{71} + c_{72}\log(\text{gdppc}(-5)) + c_{73}\log(\text{gfcfgdp}) + c_{74}\log(\text{gfcfgdp}(-5)) + c_{75}\text{lit}(-5) + c_{76}(d(\log(l))+.04) + \text{lagged dependent variables} + u_{7(it)} \qquad (7a)$$

We use five-year intervals here for two reasons. First, we do want to get rid of business cycle effects. Second, we do not want to apply the method of using five-year averages for reasons given in Loayza et al. (2000) and Attanasio et al. (2000). As usual in growth regressions we use the level of the GDP per capita at the beginning of a period as a regressor. In regard to the investment as a share of GDP variable Attanasio et al. (2000) have pointed out that growth

[9] An early contribution to the relation between literacy and growth is Azariadis and Drazen (1990).

regressions tend to use the investment data over the same period as the dependent variable whereas vector-autoregressive approaches use lagged investment and both get opposite signs. As the authors point out, this is hard to explain. We use both, current and lagged investments. Then, in a steady state both have equal values and can have the same role as the savings ratio in a Cass-Koopmans growth model if the difference of their coefficients is positive. They can differ, however, outside the steady state and will increase over time if the utility function has a consumption minimum to be reached for positive utility (see Dollar and Burnside 1997)[10]. Table 1 confirms this empirically for the past. Savings ratios for poorer countries had positive growth rates, whereas those of richer countries had negative growth rates. Investment rates are still growing in all samples. The literacy variable proxies for human capital and will have an impact on transitional growth and the long-run level of GDP per capita.[11] Moreover, the growth rate of employment plus depreciation[12], approximated here by that of the labour force, has a negative impact on the transitional growth rate and the steady-state level of GDP per capita. Finally, we will add some lagged dependent variables as an autocorrelation correction hoping that this absorbs the business cycle effects and allows interpreting the other regressors as growth effects. Equation (7a) then is a regression equation as usually obtained from the neoclassical growth model (see Mankiw, Romer, Weil 1992 and Islam 1995) enhanced by lagged investments. It will be used to calculate the effects of remittances on the level of the GDP per capita. As time trends were always insignificant we will call this the transitional growth model.

In models with imported inputs (see Bardhan and S.Lewis 1970) one finds also the growth rate of exports at constant terms of trade, which should be an income term in an export demand function and therefore is approximated here by the growth rate of the world GDP. When using this variable the initial value of equation (7a) becomes insignificant and current literacy becomes significant in addition to the lagged one. This leads to a modified equation:

$$\log(gdppc) - \log(gdppc(-5)) = c_{71} + c_{72}\log(gfcfgdp) + c_{73}\log(gfcfgdp(-5)) + c_{74}lit + c_{75}lit(-5) + c_{76}(d(\log(l))+.04) + c_{77}d(\log(world)) + \text{lagged dependent variables} + u_{7(it)} \quad (7b)$$

[10] The aspect cited here does not appear in the version published later.
[11] Illiteracy also captures inequality, because the illiterate are likely to be poor. In related work we found that Gini-cefficients of education get insignificant in growth regressions when literacy is included. Castello and Doménech (2002) found that Gini coefficients of income change sign in growth regressions when Gini coefficients of education are included. By implication of the two findings literacy is likely to capture much of inequality.
[12] This constant term changes nothing but the value and significance of the constant c_{71} in the equation.

Constant long-run growth in the world economy or by the OECD allows for positive permanent growth in this model. Equation (7b) will be used to calculate the impact of remittances on the long-run growth rate of the model. We call this the permanent growth model.

3. Data and econometric method

All data are taken from the WDI (World Development Indicators) 2005. We include 99 countries selected by the criterion of having at least one dollar of remittances received in 2003. Other criteria yield a lower number of observations. From the complete sample of 99 countries we drop three not having GDP data and call the sample remit96. We generate a second sample by eliminating those twelve countries that did not receive development aid. This eliminates OECD countries. We call this sample remaid84. Next, we divide this sample into those above and under (constant 2000) $1200 GDP per capita, a12 and u12. The reason is that we found in earlier work that the 70 countries below $1200 have no growth when looking at the period 1960 to 2003. However, both samples have 42 countries only, because many of the poor countries do not provide the relevant data. Estimating the model for four different samples will tell us how robust our model is in regard to dis-aggregation or how differently poor and rich countries with and without OECD countries react to remittances in regard to the level or the rate of growth.

The data on remittances are official receipts in constant 2000 US$. Unofficial receipts may be high and important but we have no way to deal with the issue (see Adams and Page 2005). Similarly, OECD countries are likely to have two-way remittances. But including or excluding them from our estimates changes very little. Data of the GDP per capita, *gdppc* and *OEC* are in constant 2000 US$ and stem from national accounts. Interest rates, *ri* and *rius*, are real rates as obtained by use of the GDP deflator and taken from the IMF IFS Yearbook into the WDI data. Savings, *savgdp,* are gross national savings from national accounts, calculated as GDP minus consumption, plus net current transfers and factor income from abroad and expressed as a share of GDP. As investment, *invgdp*, relates to the demand of net debt flows we use gross capital formation (formerly gross domestic investment) as a percent of GDP. The major difference with gross fixed capital formation as a share of GDP, *gfcfgdp*, is the inventories, which are not investments that add to the capital stock as usually written into a production function. All savings and investment data come from the national accounts. Literacy data, *lit*, from the UNESCO are available in the WDI for 75 of our 99 countries for more than 30 years.[13] Data on public expenditure on education are from the UNESCO and we take those of the World Development Indicators 2004.[14] Data on official development aid, containing at least a grant element of 25% on the interest rate benchmark of 10%, stem from the OECD. Finally, enrolment into primary schooling, *sepri*, refers to data from UNESCO on the gross enrolment of a vintage, that is, older people who go to primary school make it possible for this number to get above 100%.

The average values of some of these data are presented in Table 1. These data show that all samples have positive growth rates of GDP per capita, but the poorest one has the lowest growth rate. Investment/GDP ratios are higher in richer samples and have higher growth rates in poorer samples. Savings/GDP ratios are highest in the middle-income groups and also have higher growth rates for poorer countries. Investment/GDP ratios are higher for all countries than savings/GDP ratios inducing higher indebtedness. Investment/GDP ratios have higher growth rates than savings/GDP ratios, implying that the indebtedness will also grow more quickly than in the past. Average remittances per unit of GDP are 2-3 % but with a growth rate of 2-5%, which is larger for poorer samples.

TABLE 1 OVER HERE

We estimate equations (1)-(7) as a system for pooled data. In the estimation of the system for pooled data we assume contemporaneous correlation, which means that the residuals of the equations may be correlated with each other for a given point in time. The reason for this is that the variables do not only have growth effects but follow also a business cycle. Therefore the residuals are likely to move together. Moreover, we assume absence of serial correlation and weak exogeneity, which means that the residuals of an equation may be correlated with future regressors, but not with current or earlier ones. The interaction of these assumptions makes it possible that for example the remittances variable in equation (2) is correlated with the residuals of equations (1) and (2). Therefore lagged regressors should be used as instrument for the remittance variable in these equations. Moreover, we cannot exclude the possibility that the residuals follow moving averages. This makes the first lags of all left-hand variables, when they appear on the right-hand side, also endogenous. With or without moving average residuals, the second lags of all left-hand side variables will be admissible instruments. We then use the General Method of Moments (GMM) in connection

[13] The total availability is as indicated below Figure 1.
[14] The 2005 version covers only data since 1998.

with the heteroscedasticity and autocorrelation correction (HAC) for the covariance matrix.[15] An alternative might be to estimate the equations single wise after checking for fixed effects redundancy. In case of redundancy, two-stage least squares methods could be used. If fixed effects are not redundant we might employ methods as explained in Chapter 8 of Baltagi (2005). However, we prefer to take the interaction of the residuals of different equations on board, because they contain the business cycle effects and therefore will be correlated, and therefore we use only the systems approach sacrificing the fixed effects, which would add 95 coefficients to each equation. The losses are likely to be small though, because in some equations fixed effects are redundant according to the standard Hausman test, and those where they are not redundant have a lower Schwarz information criterion when including fixed effects.

4. Estimation results

For the systems estimate the results are summarized for the four samples in Appendix 1a-e for the transitional growth model *and* for the permanent growth model, because the estimates of the first six equations are identical when estimated together with those of equations (7a) *or* (7b). Both can be found in the Appendix.[16] As we correct in the growth equations for serial correlation bias this seems to limit the effects of contemporaneous correlation on the estimated coefficients. Only for the u12 sample do we get slightly different results between the two systems of regressions.

For the *96* countries receiving remittances the estimate in Appendix 1a is done without the inclusion of an aid variable, because they are available only for 84 countries and the results for that sample are shown in Appendix 1b. All coefficients have the expected sign. The significance is worse than *10%* only for four coefficients: the effect of domestic interest rates on receiving remittances in equation (1a); the effect of primary school enrolments on the

[15] This improves the efficiency, but does not remove a potentially present serial correlation bias, which would also invalidate the used instruments. The only hint what to do about serial correlation, if anything, is to add lagged dependent variables (see Greene 2003). However, except for equations (7) we have already added all significant lagged dependent variables. There is nothing in addition we can do, but conceding that there may be an additional small serial correlation bias, which then is likely to exist also in the literature from which we have taken the specification of the equations. Introducing serial correlation processes by assumption leads us to a ‘near singular matrix’ warning, not when doing it only for one equation alone but when doing it for several. Therefore, and because the instruments approach would not avoid endogeneity, we abandon this possibility, hoping that a potential serial correlation bias, if any, is small in view of the fact that the cross section dimension is much larger here than that of time.

[16] The contemporaneous correlation of the residuals of different equations matters mostly in the significance of variables, when searching for the best specification, in particular, when figuring out whether a level, first differences, log or log differences of a variable are most significant. As it turned out, it is always one of the specifications that are compatible with steady-state requirements as known form basic growth theory.

change of literacy in equation (5'); and the constants of the two growth equations (7a') and (7b'). Only the last of these exceeds the *20%* significance level slightly. In the first equation, the positive sign of the OECD per capita income and the negative one of the domestic GDP per capita are in accordance with the altruistic and strategic motives of migration and with those motives, which do not generate a clear expectation of the sign (see Rapoport and Docquier 2005). The US interest rate and the OECD income have a stronger impact than the domestic counterparts. This will also be the case in all estimates for other samples given below. It confirms the result by Vargas-Silva and Huang (2006) for a smaller sample that home country variables have a weaker impact on remittances than host country variables. The main channel to physical capital has the expected, significant coefficients: remittances have a positive effect on savings, c_{23}; savings have the expected negative effect on interest rates, c_{34}, and also the quadratic term is significant; interest rates have a negative impact on gross fixed capital formation, c_{43}; gross fixed capital formation has a positive impact on growth rates, which is larger than the negative effect of the lagged value, $c_{73,\ 74}$ and $c_{72,\ 73}$ for the two growth equations respectively. For the human capital channel, savings enhance literacy, c_{54}, and literacy enhances growth rates in both growth equations, c_{75} and $c_{74,75}$ respectively – where in the latter case the positive current effect is larger than the negative lagged effect. How strong these effects are will be calculated in the next section.

For the *84* countries receiving remittances and aid in 2003 the results can be found in Appendix 1b. These are very similar to those of the larger sample. The insignificant variables now are US interest rates in equation (1''), again the enrolment variable in the literacy equation, the constant in the second growth equation, and, though very close to the *10%* level, the OECD growth rate in the interest equation, and the constant in the first growth equation. By implication the channels to physical and human capital have only significant variables although with slightly different values. But the model gives reasonable results after the elimination of the OECD countries from the larger sample. The development aid variable appears only in the form of first differences. Under the steady-state assumption that aid as a share of GDP should be constant this result implies that aid has neither a level effect nor a growth rate effect in the long run. In spite of the similarity with the 'medicine model' of development aid defined by the squared term (see Doucopoulos and Paldam 2005b) we would like to caution that we do not include all the variables, especially for economic policy, which have featured prominently in the aid effectiveness debate. Our motivation to include aid does not stem from a desire to contribute to the aid effectiveness debate but rather from the desire not to underestimate the equations of our model. In the transition though aid has a positive effect on savings, investment and primary school enrolment as long as it is increasing and below *25%* (for investment even *50%*). When aid is a constant share of GDP though, there is no effect anymore.[17]

For the *42* countries with GDP per capita *above $1200* and receiving remittances and aid in 2003 we get quite some more insignificant results in Appendix C. This may be partly due to the fact that now the number of observations is about half of what it was in the previous sample and less than half of the first one. Mostly, then the coefficients are also smaller. With some exceptions results do not improve (in terms of adjusted R-squared) if we take out these insignificant variables. As overestimation does not produce biases whereas underestimation does (see Davidson and McKinnon 2004) it is less risky to keep them on board. We have eliminated though the quadratic terms of the aid variable from the equations for savings and primary school enrolment. Also, the quadratic term of the investment-savings difference has been dropped in the interest equation, where the second lag is replaced by the change of the US interest rate. In the investment equation, the aid variable now has a higher peak at about *.8* before it is getting negative. In the growth equations almost all variables have smaller coefficients in absolute terms now. The current interest rate rather than the lagged one is significant now in the savings equation, and for literacy in the second growth equation we lag by one year more than in the other regressions. In regard to the main channels, the impact of savings on interest rates is significant only at the *20%* level and so is the impact of current investment on the growth rate in the first growth equation. For the second growth equation the significance is even worse, both because the coefficients have become smaller and the standard errors are larger than in the larger samples. In the first equation for remittances the coefficient of the lagged dependent variable has gone down form *.89* in the previous sample to *.83* in this one. By implication we should expect that it goes up for the other half of the larger sample.

For the *42* countries with GDP per capita *below $1200* and receiving remittances and aid in 2003 the coefficient of the lagged dependent variable is slightly larger than unity and differs insignificantly from unity. Therefore we have taken the first difference as the dependent variable. The result can be improved by adding quadratic terms but then the forecast follows these terms and makes very unrealistic predictions for the steady-state needed below. There are five coefficients with marginal significance levels (p-values) between *10* and *20* percent

[17] When interpreting the equations in the spirit of first-differenced models - that is the case where the coefficient of the lagged dependent variable has a unit coefficient – one may be more positive about the long-run effects of aid. But here we stick to the exact formal derivation of steady-state results as carried out in the next section.

and one worse than *20%*, which is the enrolment variable in the literacy equation. It has a very low coefficient too. Compared to the sample of countries with income above *$1200*, the quadratic term for aid in the savings equation is again significant and so is the quadratic investment-savings difference in the inters equation as they were in sample of *84* countries receiving aid. The linear term for the aid variable in the investment equation has been taken out. Most importantly now the lagged savings variable does not appear in the literacy equation but rather the current one appears in the school enrolment equation. This suggests that in the richer countries one need savings from earlier times to bring children through primary schooling, but in the poorest countries the bottleneck are current savings to start primary schooling.

Comparing the results across the four samples also yields some interesting insights. We see larger coefficients of changes in remittances on savings in samples of poorer countries: a coefficient of *.68* for the richest sample of *96* countries;[18] *.69* for the second richest sample of countries with income above *$1200, a12*; *.88* for the *84* aid receiving countries; *1.85* and *1.91* respectively for the poorest sample, u12. This may reflect the lower financial development of poorer countries as indicated by Giuliano and Ruiz-Arraz (2005).

Among the non-OECD countries, labour force growth has a more negative and world income growth a more positive sign the poorer the countries are.

We would have expected the public expenditure on education has a weaker effect the richer the countries are as found by Otani and Villanueva (1990). This holds except for the poorest sample, which has the lowest coefficient.

For the growth regressions for the transitional growth model, equations (7a), the coefficient of the initial value, which is also the rate of convergence, is very low. This indicates the possibility that permanent growth is reasonable as well. Indeed the growth regression for the permanent growth model, equations (7b), has never a lower adjusted R-squared than the growth regressions for the transitional growth model, equations (7a).

In order to understand the basic idea of the model it may be good to look first at the direct effects of changes in remittances on the endogenous variables, in particular the growth rate. For that purpose we abbreviate the variables as follows. w is worker remittances as a share of GDP. s is the savings ratio. f is gross fixed capital formation as a share of GDP. $1+r$ is the

[18] Savings and investment rates are percentage multiplied by 100 in the WDI. Our own calculations wr/GDP are not multiplied by 100. If they were, the coefficient would be lower by a factor 100. This explains the difference between the values in the Appendix such as 68 and the ones used here, .68.

gross interest rate. *li* is the literacy rate. *p* is the rate of primary school enrolment. *g* is the growth rate of GDP per capita. *x* is a multiplication sign.

5. The direct effect of a change in the rise of remittances on the endogenous variables

The results for this part are collected in Table 2. We illustrate the derivation of the results in terms of the model equations (1) - (7a) and numerically for the largest sample of 96 countries receiving remittances in 2003. In standard macroeconomic models one would speak of the impact effect. However, we have lags here and therefore call it direct effect.

TABLE 2 OVER HERE

From equation (2), a one percent difference of *dw*, *d(dw)=1*, the change in the remittance/GDP ratio, yields:

$$ds = c_{23}ddw = .682ddw = .682.$$

This means that an increase of *dw* by one percentage point increases savings by almost *.7* percentage points. Note that the panel average of *ddw = .0138*, and not unity as in our example. Therefore all effects could be multiplied by this number to get the realistic values according to the panel average. Or alternatively, it takes *70* years to get the effect assumed, *ddw = 1*.

The effect of this change in the savings ratio on the interest rate according to equation (3) is:

$$d(log(1+r)) = [c_{34} + c_{35}\ 2(f\text{-}s)]\ d(f\text{-}s).$$

With an evaluation at a panel average of *f-s = 4.06* and *d(f-s) = -ds =-.682* from above[19], the direct effect of remittances on interest rates using the numbers of Appendix 1a is:

$$d(log(1+r)) = [c_{34} + c_{35}\ 2(f\text{-}s)]\ d(f\text{-}s) = [0.003426\text{-}0.00023x2x4.06]x(\text{-}.68) = -1.048x10^{-3}.$$

The gross interest rate changes by about (-*.1%)*. This change of the interest rate causes a percentage change of gross fixed capital formation according to equation (4) of

$$dlogf = c_{43}\ dlog(1+r) = -.056325 \text{ x } (-1.048x10^{-3}) = 5.9x10^{-5}.$$

[19] For *f-s* the value for the sample with *84* countries is *4.8*, for the u12 sample it is *6.075*. For the a12 sample it is not need because the quadratic term of investment minus savings is dropped from the estimate. The value is *3.6*. Note that these values also represent the yearly additional foreign debt incurred as a percentage of the GDP. Whether this is suggestive of weak or strong capital movements is left to the reader.

As we are dealing with the direct effect only, this change in *f* has not been taken into account in the previous step, when trying to find the effect on interest rates. The effect of the change in savings on that in literacy according to equation (5) is

$$d(li) = c_{54}ds = 0.022622x.682 = 1.542x10^{-2}.$$

Literacy changes by one and a half percent five years after the enhancement of savings. According to the growth equation we get the direct effect as (note that values from five years before are given)

$$dloggdppc = g = c_{73}dlogf + c_{75}dl = 0.040971x5.9x10^{-5} + 0.000306x1.542x10^{-2}$$
$$= 2.420 \times 10^{-6} + 4.721x10^{-6} = 7.141x10^{\{-6\}}.$$

This a very small percentages change of the GDP per capita. Interestingly though, the effect via human capital or literacy is twice as large as that via physical capital. Effects calculated so far are rewritten in the first column of Table 2. For the other samples they can be found in the second through fourth column of Table 2.

When dropping the OECD countries, the sample *remaid84* has larger effects in absolute terms than the complete sample. Also the second difference of the remittance/GDP ratio, *w*, is larger. The relative strength of physical and human capital is now the other way around; physical capital has a growth effect that is twice as large as that of human capital.

When splitting the sample we find for the poor countries, sample *u12*, that the effect of remittances on savings is much larger; the fall in interest rates is larger than in the samples considered previously; the effect on investment is about the same as for the *84* aid receivers; the effect on literacy is much smaller because the elasticity of primary school enrolment on literacy is very weak. Human capital has a lower and physical capital a higher effect on growth compared to all other samples. The second difference of the remittance/GDP ratio is twice as large as for the remaid84 sample.

For countries above *$1200*, sample a12, things are quite different. The impact of remittances on savings is about the same as for the largest sample. The fall in interest rates is much lower than in all other samples. Correspondingly the effect on investment is much weaker. The effect on literacy is a bit larger though. The total effect on growth is about the same as for the *96* countries, but slightly larger in both components. Note however, that these are effects for *ddw = 1*, the second difference of the remittance/GDP ratio is taken to be unity. The major difference between the a12 sample and the others is that the panel average of *ddw* is negative for the a12 sample. The actual yearly effects therefore have the opposite signs but are much smaller in absolute terms. This is the reason why it is useful to split the analysis into the effects for *ddw=1* and the actual size of the change in the rise of remittances.

Overall, we can say that poorer countries do not only have a stronger impact of remittances on savings as pointed out above, but also a stronger direct effect on growth.

The direct effects considered here do little more than illustrating the basic ideas that drove the set up of the model. The indirect effects, as indicated above for the gross fixed capital formation on interest rates come from the calculated changes on all endogenous variables again. Multiplier effects then also take into account that all changing variables have an impact on their own future values and of course all the three sorts of effects then interact. What one would like to know than is the total long run effect on the level and the growth rate of the GDP per capita.

6. The long-run solution of the transitional growth model with and without remittances

In this section we first solve the model for transitional growth – using equations ($7a^{i-iv}$) and not (7b) - for its steady-state values and than do it again under the assumption of no change of remittances. A steady state is defined as follows: A zero growth rate of the GDP per capita for the receiving countries and interest rates, a constant but positive growth rate for the GDP of the OECD and the labour force variable; equation (1) then implies a constant change of the remittance/GDP ratio, i.e. a constant *d(wr/GDP)*; constant aid, savings, investment and gross fixed capital formation, all as a share of GDP; constant public expenditure on education as a share of GDP, enrolment in primary schooling and a constant literacy rate. As an implication of this definition, our variables and there lagged values must then be identical, except for *logOEC*, which has a positive but constant time trend. Of course, a zero growth rate makes only sense in the absence of disembodied technical change (net of labour force growth multiplied by a measure of decreasing returns). Trying to capture it by use of a time trend in the regression has never had any significant effect. The constant in equation (7b) also cannot be taken as representing technical change because it has turned out to be negative. If there is technical change it must be embodied in the gross fixed capital formation, and, of course, having used literacy as an argument, a total-factor-productivity residual is smaller than without a human capital variable. Therefore we do not find a significant time trend.

As the model has quadratic terms of the investment-savings difference, the enrolment in primary schooling and the literacy rate, we cannot solve it in ‘one shot’ after implementing the above assumptions but rather must proceed in certain steps.

The first step is to take first differences of equation (1) and employ the steady-state assumptions. The result is

$$d(wr/gdp) = c_{13}/(1-c_{12})dlog(OEC)$$

For the OECD we assume a steady-state growth rate of *2%*. This is obtained from running an autoregressive instrumental variable regression of log(OEC) on a time trend and three lags and calculating the steady-state value of the growth rate. This change is permanently positive because the OECD grows more quickly in a steady state than the receiving countries whose steady-state growth has been set to zero in this section of the paper. The results for the steady-state change of the remittance/GDP ratio are summarized in Table 3 for the first three samples. For the u12 sample, equation ($1a^{iv}$) in the Appendix shows that we cannot solve independently for the change of the remittance/GDP ratio. It can be shown that for past OECD growth rates of about *2.5%* the time trend in *log(oec)* and the time trend in the regression cancel out. Using the abbreviation from the end of section 4 this leaves us with

$$d(w) = c_{11} + c_{13}*log(OEC(0)) + c_{15}*log(1+r) + c_{16}*(log(1+r)-log(1+rius(-2)))$$

A regression of *log(OEC)* on a polynomial of time yields an initial value for *log(OEC)* of *9.12*. An autoregressive instrumental variable model of order one for the US interest rate yields a steady state value of about *4.3%*. Using these values and the estimated coefficients from equation ($1a^{iv}$) we get the results noted in Table 3, where the right-hand side remains a function of the domestic interest rate. However, the term with the interest rate is $2.05x10^{-4}xlog(1+r)$. As *log(1+r)* is also a number like *8%* this expression is of the order of magnitude of $16x10^{-6}$ and therefore can be dropped, leaving us with the number presented in Table 3. The yearly change in the remittance/GDP ratio lies between one tenth and eight tenths of a percent. For non-OECD countries, it is larger the poorer the sample is.

TABLE 3 OVER HERE

The next step uses equations (2)-(4), imposes the steady-state assumptions and results, inserts the estimated coefficients and solves for *f*, *s*, and *r*, the investment/GDP ratio, the savings/GDP ratio and the domestic interest rate. In doing so we equalize the investment/GDP ratio with gross fixed capital formation per unit of GDP plus a constant of about *1.4%* (different for each sample) from regressing them on each other, which represents the percentage share of inventories, as both follow a one-to-one correlation. The procedure in greater detail is to solve (4) for *f*, (2) for *s* and form *f-s*; together with (3) this gives two functions in *f-s* and *r*. Solving, *r* can be inserted into (2) to get *s* and then *f* follows. For three of the samples we get two solutions, of which one makes no sense because interest rates and savings rates are highly negative and investment rates exorbitantly positive. Therefore these are ignored. The more detailed procedure described above, results in the solutions of Table 3. All samples but the poorest have higher investment than savings in the steady state, which indicates that debt accumulation continues also in the steady state. The poorest sample may be credit rationed and has savings about as high as investment, but at a low interest rate, as savings are slightly higher.

Next, we can go to the equation for enrolments. This can be solved independently except for the last sample where we will use the savings rate just derived. As this is an inverted u-shape function, the partially stable equilibrium is the one with higher enrolments. The panel average value is larger than the threshold value. Therefore we use this high value as the steady-state value. Surprisingly, steady-state enrolments rates are higher for poorer samples.

Now we can solve for the literacy rate provided we have a long-run value for public expenditure on education. We run an autoregressive least-squares-dummy-variable[20] regression on the lagged value and its quadratic value, resulting in a steady-state value between *3* and *5%* as documented in the first line of Table 3. This equation also has an inverted u-shape form. The lower steady-state value though has negative numbers in all cases. The higher steady-state values for literacy are amazingly close to *100%*. The fact that they are even a fraction of a percent above *100%* indicates a small bias in the estimate or in the data.

Finally, using all results obtained so far we can calculate the steady-state level of the GDP per capita from the last regression of the model, equations ($7a^{i\text{-}iv}$), provided we have a steady-state value for the growth of the labour force. We run a least-squares-dummy-variable regression of the labour force growth rate on its lags, with linear and quadratic terms and calculate the steady-state values, which are around 2%, with higher values for poorer countries. The steady-state values obtained for the GDP per capita are about five to ten times larger than the panel averages of Table 1 because of the low rate of convergence to the steady state.

Some of the results for the remaid84 sample are less plausible, because they are not between those of its parts, the a12 and u2 sample. This is the case for the gross fixed capital formation, and the GDP per capita. These steady-state results may indicate a heterogeneity

[20] These estimates will be biased. Assuming fixed effects and using first difference methods does not provide us with a value for the constant, which we need in order to calculate a value for the steady state. Fixed effects LSDV results are very similar to those for the pooled regression. As they are multiplied by a coefficient of .04 in the regression all these values have a small impact. The results should be taken as assumptions anyway, because we do not have an elaborate explanation for these exogenous variables by definition.

bias or a bias in the calculation by dropping the GDP per capita growth rate from the equations. Moreover, literacy rates of *100%* seem to be nice at the first glimpse, but with enrolment rates below *100%* they are actually less nice. An assumption reconciling this is that there may be ways of getting literacy without primary schooling: pre-school without subsequent primary school, autodidact learning, teaching by parents or other persons, or some unschooled people leave the country, and get late education in the host country. Alternatively, we might simply have a biased estimate. Note that we do not have this problem for the poorest sample. For the others we should not take the absolute values too seriously, and the effects with and without remittances may still be indicative.

In panel (b) of Table 3 we present the numbers that are obtained when setting the changes in the remittances equal to zero when running through the whole calculation again. In panel (c) we take differences of panel (a) and (b) for all variables that are already percentage expressions. For the GDP per capita we calculate the percentage difference by dividing the difference by the value obtained when remittances are included. The result is less than a half percent higher GDP per capita due to remittances for the a12 sample, but *2%* for the u12 sample. The larger sample has growth level effects between those of the a12 and the u12 sample. We will concentrate on the smaller samples.

The increase in enrolments in turn can only have a minor impact on literacy because literacy goes to *100%* anyway. These gains almost vanish in the steady state. Therefore they are transitional gains from driving literacy to *100%* in a quicker speed.

Remittances have a very strong impact on savings and enrolments of the u12 sample and, less so, on the a12 sample. This leads also to a fall in interest rates. However, investment does not react strongly to this.

In sum, the transitional gains from higher enrolment rates going from *95* to *100%*, the permanent gains from paying less interest to debtors because of a savings rate that goes from *12* to *20%* and the *2%* increase in GDP per capita for the u12 sample may represent a considerable welfare gain. For countries above *$1200* though these gains are fairly small.

7. The long-run solution of the permanent growth model with and without remittances

In the previous section the formal analysis to find steady-state results was eased by the assumption of zero growth rates in the steady state. This allowed us to drop the growth rate of the GDP per capita from equations (1), (2) and (4). This is not possible anymore in a model with permanent growth, which drops the assumption of zero growth. We therefore solve the model in the same procedure but proceed iteratively for the growth rate. First, we have to find a steady-state growth rate of the world economy used in equations ($7b^{i\text{-}iv}$). We run an instrumental variable regression of that rate on its own lagged value using second lags as instruments. The result is a steady-state growth rate of about *3.4%*. Next, we assume a certain value of the growth rate of the domestic economy. If that one does not come out in the end, we adjust it, and go through the whole procedure again until the assumed growth rate equals the one coming out. This process stops when the rounding by the program used does not allow further refinements. The major difference in terms of results is that for all samples, steady-state growth rates are positive though small, *.23%*, *.22%*, and *.37%* for the first three samples.[21] For the poorest sample we find a result of a 'positive-zero' growth rate, or more exactly less than *2.8* percent of a percent, $2.75x10^{-4}$. The counterfactual exercise of dropping remittances shows that the ratio of the growth rates obtained with and without remittances is less *1.004* for the first three samples but *1.39* for the sample of the poorest countries below *$1200* per capita income according to panel (c) of Table 4. Literacy goes to hundred percent anyway and remittances make a difference of less than a half percent. However, primary school enrolments are enhanced by remittances and speed up the move to the steady state, leading to transitional gains from remittances via savings to enrolments and quicker movement of literacy to hundred percent. For the poorest sample this effect is larger again than for the others. Similarly, gross fixed capital formation per unit of GDP increases by one percentage point in the poorest countries but much less so in the other samples, because they react only weakly to the decrease in interest rates that is caused by the increase in savings.

TABLE 4 OVER HERE

In sum, the major effects are that remittances bring the steady-state primary schooling enrolment rates from *95* to *100%*, the savings rate from *12%* to *21%*, and the growth rate from $1.9x10^{-4}$ to $2.75x10^{-4}$ for the sample of countries with per capita income below (constant 2000) *$1200* and reduce the foreign debt service. The ratio of these growth rates is *1.39*,

[21] Of course, the growth rates would be larger if we would assume a lower growth rate of the labour force. Note however, that in times of increasing participation the labour force growth will be higher than the population growth.

which means that the growth rate is *39%* percent higher than without remittances. For the richer sample these effects are much smaller. Transitional gains may be higher.

8. Stability and transitional gains

Steady-state results as presented in the previous section are only interesting if the steady states are stable. Therefore we should present a stability analysis. Moreover, besides the steady state, the transition is also interesting. In order to obtain a stability analysis and the transitional path, we iterate the estimated model of Appendix 1 forward in a deterministic way and repeat this after setting the remittance term in the savings equation equal to zero, in order to get the counterfactual of 'what would have happened hypothetically without remittances'. This allows us to see the transitional path and whether or not it goes to the steady-state values. We do this for two samples, the a12 and the u12 sample, and for the transitional and the permanent growth model. To be able to do this, we have to construct initial values, because the data deliver them only per country whereas our model has estimated parameters, which are averages across countries and over time. We construct the initial values by running fixed effect regressions of the variables on a constant and a polynomial of time. All other assumptions carry over from the previous analysis. We only have to add a data series on development aid per unit of GDP, which was not necessary for the steady-state analysis. In order to get that we run a regression of aid/GDP ratio on its own two or three lagged values. The results for stability are summarized in Figure 2. In Figure 3 we plot the differences of the variables with and without remittances for the transitional and the permanent growth model in order to make the undiscounted gains during the transition visible.

FIGURE 2 ABOUT HERE

Stability

The strongest fluctuations can be seen in the series for real interest rates. After the phase of fluctuations they get smooth for the a12 sample but turn into a zig-zag pattern for the u12 sample. One can take it from the regression results of Appendix 1 that interest series are based on yearly data. The regressions based on five-year lags – enrolment, literacy and GDP per capita (growth) – have been turned in to yearly data by making five initial values. All zig-zag patterns in figure 2 are getting smoother over time around *2010* as they should for unique, stable steady states. The strongly upward sloping line for the a12 countries is the remittance/GDP ratio. In *2100* it has a value of about *12.5%* in the transitional growth model and of *9.3%* in the permanent growth model, because the positive growth rate of the u12 countries have a mitigating effect on the flow of remittances in equation (1). If iterating forward to *2700* it would still be at reasonable values of about *88%* and *79%* respectively. Ultimately, these graphs show stability, which can be shown more exactly when we would show the forward iterations for some hundred years more.

FIGURE 3 ABOUT HERE

Transitional gains

We consider the a12 sample first. Figure 3a shows the difference for the endogenous variables for the iteration with and without the remittance term. For the savings/GDP ratio there is first a surprising fall. Once this period is over, the difference in the savings/ratio goes to a value that is *.9%*, which means that the ratio is higher with remittances than without, and then approaches its steady-state difference of *.8%*. In the transition, interest rates are more frequently higher than lower and then approach a very low difference of *-.002*. The more frequently positive differences are reflected in the difference for the gross fixed capital formation per unit of GDP. This first goes down before it goes up and approaches a positive long-run difference after a slight overshooting. However, this is not more than *.04* percent in the long run and the transitional phase with higher values does not really more than the worse phases. The undiscounted transitional gains seem to be smaller than the undiscounted steady-state gains in regard to physical capital formation. In regard to literacy we see that it is higher in the long run, but also much less so in the transitional phase.

For the u12 sample we do not get a counterintuitive phase first, but rather savings rates are higher right from the beginning. Interest rates are lower with remittances and gross fixed capital formation, as a percent of GDP are higher, as expected. Primary school enrolments are much higher with remittances. It is here for the first time that we see that transitional gains may be higher than the long-run gains if the discounting of the future is strong enough. Similarly, the differences in the literacy rate are stronger in the transition than in the long run.

9. GNI/GDP growth

With savings reacting much more strongly to remittances than investment, it is clear that the incurrence of new debt is strongly reduced and so are future interest payments. In other words, without remittances poor countries would pay much more debt service. When savings get larger relative to investment there should be less debt accumulated on the way to the steady state. By implication less interest on debt should be paid and GNI should grow more quickly than the GDP and this effect should be stronger for the u12 sample than for the a12 sample, because the enhancement of savings is much stronger in the u12 sample. Although these results have been derived for the steady state, with remittances flowing for quite some years this should also be in the data. In order to check this we run regressions of the following type for both samples:

$$\log(GNI) - \log(GDP) = \beta_0 + \beta_1(\log(GNI(-1)) - \log(GDP(-1))) + \beta_2 \log(WR(-1)/GDP(-1))$$

Table 5 shows least-squares-dummy-variable (LSDV) estimators in column one. With about fourteen observations per country the LSDV estimates may be biased. Therefore we present the Anderson-Hsiao estimator in column two. As these estimates are inefficient, we also employ the orthogonal-deviation estimator by Arellano and Bover (see Baltagi (2005, chap.8)). For the u12 sample we get a coefficient for the remittance variable of about .002 from all three methods. They are also significant except in the Anderson-Hsiao estimator, which, however, is known to be inefficient. For the a12 sample the coefficients are much smaller and even negative for the Anderson-Hsiao estimator. The significance is also weaker for all three methods. This confirms our interpretation that remittances have a stronger impact on the difference between GNI and GDP in the poorer sample of countries below *$1200* (u12) as reflected in the stronger impact of remittances on the savings ratio. This means that the growth rates for the ratio of GNI and GDP is proportional to the growth rate of the remittance/GDP ratio with a coefficient of *.002* for the u12 sample and at best half that value for the a12 sample. Obviously this insight makes it clear that the open economy property of our model is important.

TABLE 5 OVER HERE

10. Summary and Conclusion

The innovations of this paper are as follows. The main idea is that remittances enhance savings; savings do two things. First, they reduce interest rates, which encourage investment. Second, savings enhance either school enrolment or keep the school participation in tact by ensuring finance, thus enhancing literacy. Investment and literacy then enhance the level or the growth rate of the GDP per capita. This is the main channel in the model. We built a model of six equations from recent modern literature and add a seventh one for enrolment in primary schooling. Then we enhance the savings equation to include remittances. We extend the equation relating the current account and the interest rate by a quadratic term, the OECD GDP per capita growth rate and, for one of the samples, changes in US interest rates. The growth equation is enhanced to include lagged in addition to current investment and includes literacy as a human capital variable. All equations are estimated jointly as a system with pooled data using the General Method of Moments with heteroscedasticity and autocorrelation corrected standard errors for four different samples.

The estimates show that the model works well for all the samples with only minor modifications mostly related to the functioning of capital markets. The number of insignificant variables is very low for each sample, especially along the main channel of the argument from remittances via savings to investment and literacy, with a slightly weaker performance for the countries with per capita income above *$1200*.

Estimation results are as follows. Remittances have higher growth rates in poorer countries. Their change has a positive impact on savings, which is stronger in poorer countries. Among the non-OECD countries, labour force growth has a more negative and world income growth a more positive sign the poorer the countries are. The rate of convergence is very low in the transitional growth model, which may be taken as an indication that the permanent growth model is more adequate even for countries without technical change, which import capital goods, and pay for them by exports, which are pulled by world income growth. Its adjusted R-squared is never lower than that of the transitional model.

The *direct effect* along the main channel of the argument is very small. The largest are observed for countries below per capita income of *$1200*. But even here for the GDP per capita it is only some millionths of a percent.

In the steady state of the transitional growth model, remittances explain *2%* of the GDP per capita for the countries below *$1200* and less than ½ percent for the countries above *$1200*, between one and three tenths of a percentage point of literacy, between *.8* and *9* percentage points of the savings ratios, but less than one percentage point of investment, and between zero and seven percentage points of enrolments.

In the steady state of the transitional growth model, we get almost the same results. The ratio of growth rates of the sample with countries having per capita income below *$1200* with and without remittances is *1.39*, which means that it is *39%* higher with remittances, because it is very low without. For the other samples the enhancement of the growth rate is negligible.

With *39%* of the growth rate and *2%* of the level of steady-state GDP per capita remittances make a strong contribution to the growth of the countries below *$1200*. This compares to a multiple of traditional estimates of the costs of inflation, monopolies, and business cycles (see Lucas (1990), p314), and the 1% of Nordhaus' first estimate of the cost of greenhouse gas emissions or Balassa's early estimates of the gains from international trade. However, this should not lead to any sort of development optimism because the steady-state growth rate is $2.75x10^{-4}$ with remittances instead of $1.9x10^{-4}$ without remittances. It remains very small.

Similarly, countries below *$1200* in 2003 will go to *$5749* with remittances instead of *$5635* without remittances. *2%* is a strong contribution for one variable only, but of course do not change the whole picture, simply because a poor country, which gets *2%* richer, is still a poor country.

Stability is shown through forward iteration of the model.

The undiscounted transitional gains are lower than the undiscounted steady-state gains for all variables except for primary school enrolment and literacy of the countries below per capita income of *$1200*.

As savings react much stronger to remittances than investment does, less debt is accumulated and less debt service is paid. As a consequence the elasticity of the GNI/GDP ratio with respect to the remittance/GDP ratio is *.002* for the countries below *$1200* and at best *.001* for the countries above *$1200*.

Remittances have a remarkable effect on the level and the growth rate and the GNI/GDP ratio of the countries below *$1200* per capita income. This is partly already in the data. For this part the interpretation is that welfare would have been less without remittances. However, given the fact that steady-state effects are far in the future the contribution of remittances will continue to work.

This paper has not suggested anything for policy. However, given the moderate performance of official development aid one gets the impression that remittances are more effective in enhancing growth. As a suggestion for future research we therefore like to raise the questions (i) whether or not remittances should be taxed less on both sides, the sender countries and the receiving countries, and (ii) whether or not this should be financed through a reduction of official development aid or through other means like reduction of inefficient subsidies.

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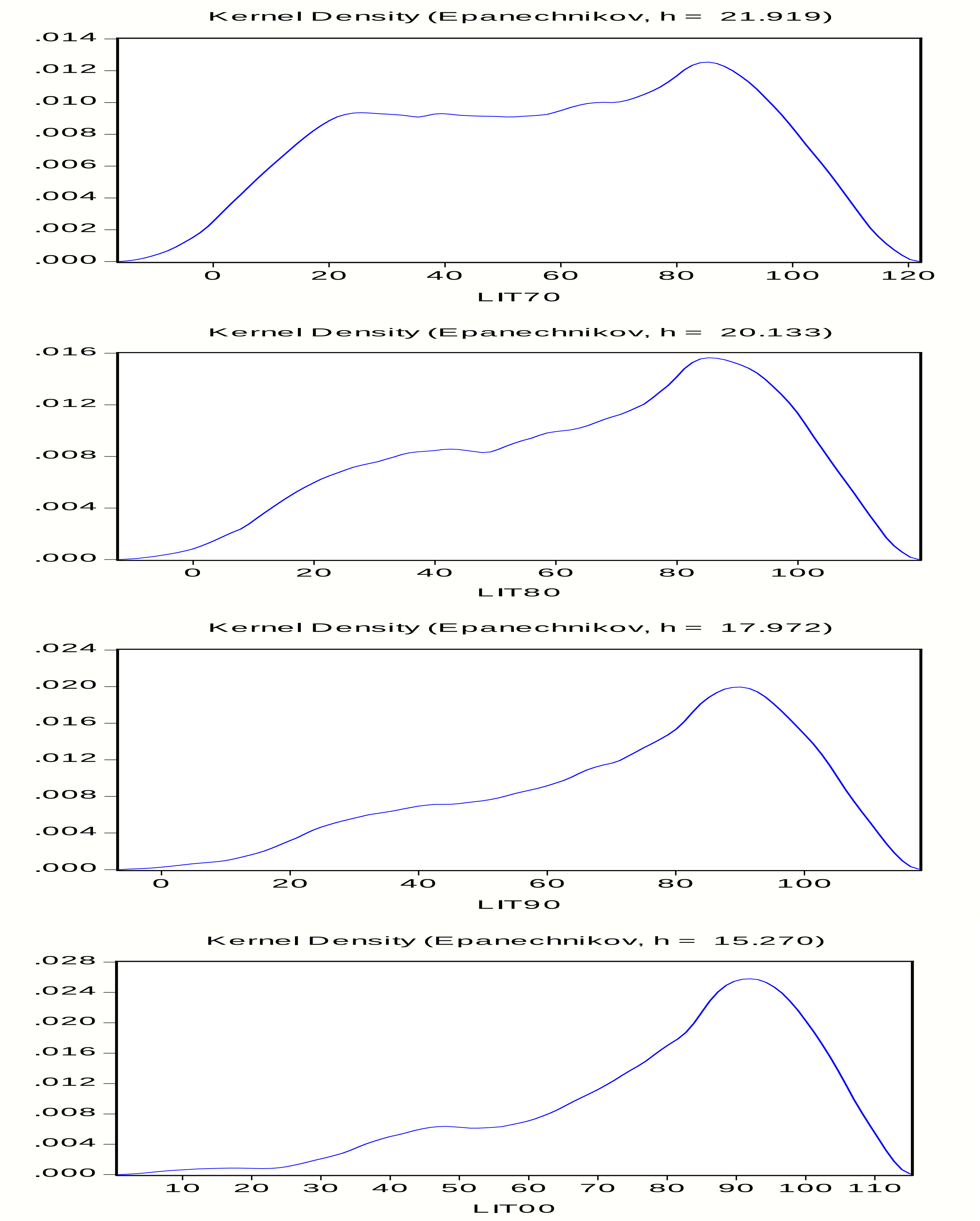
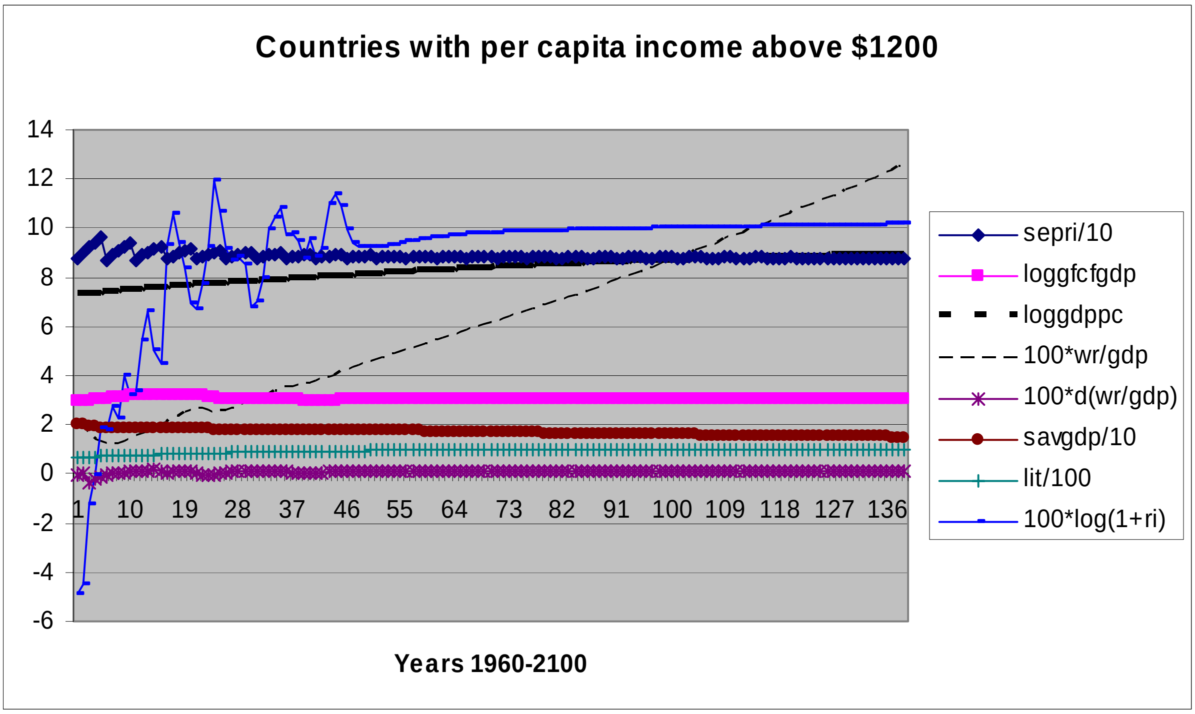
Figure 1



Kernel density estimates for literacy in 121 countries for 1970, 1980, 1990, and 114 countries in 2000.

Figure 2a Stability of the transitional growth model



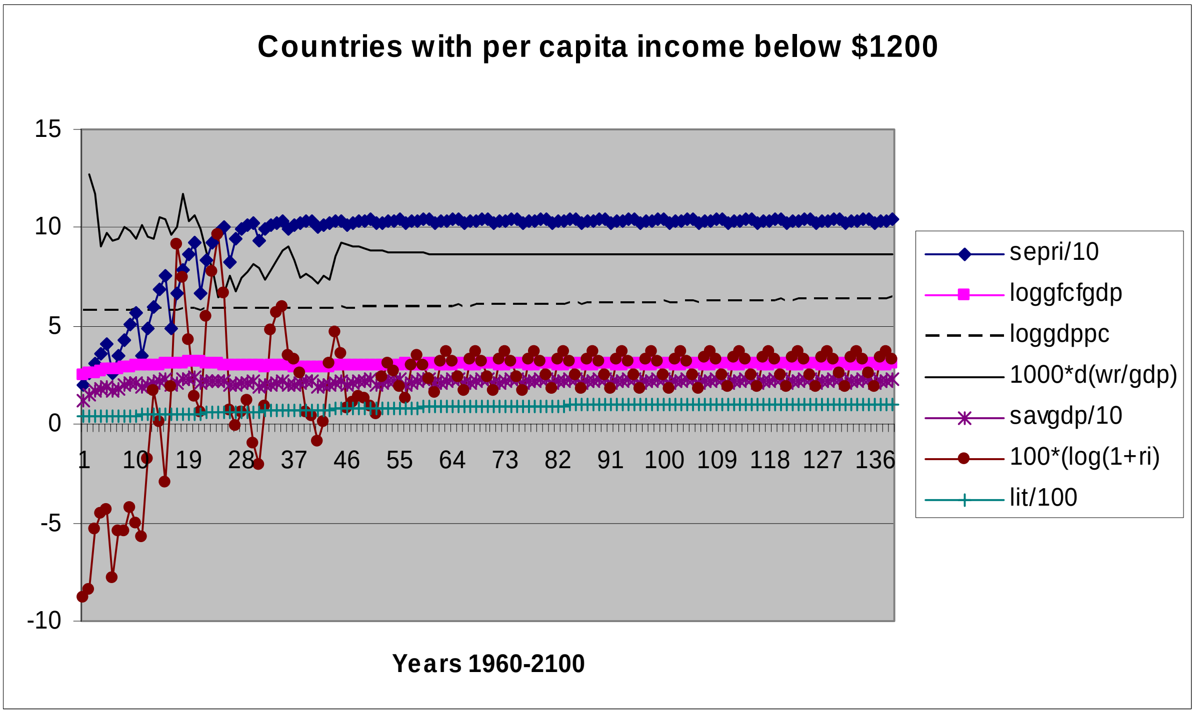
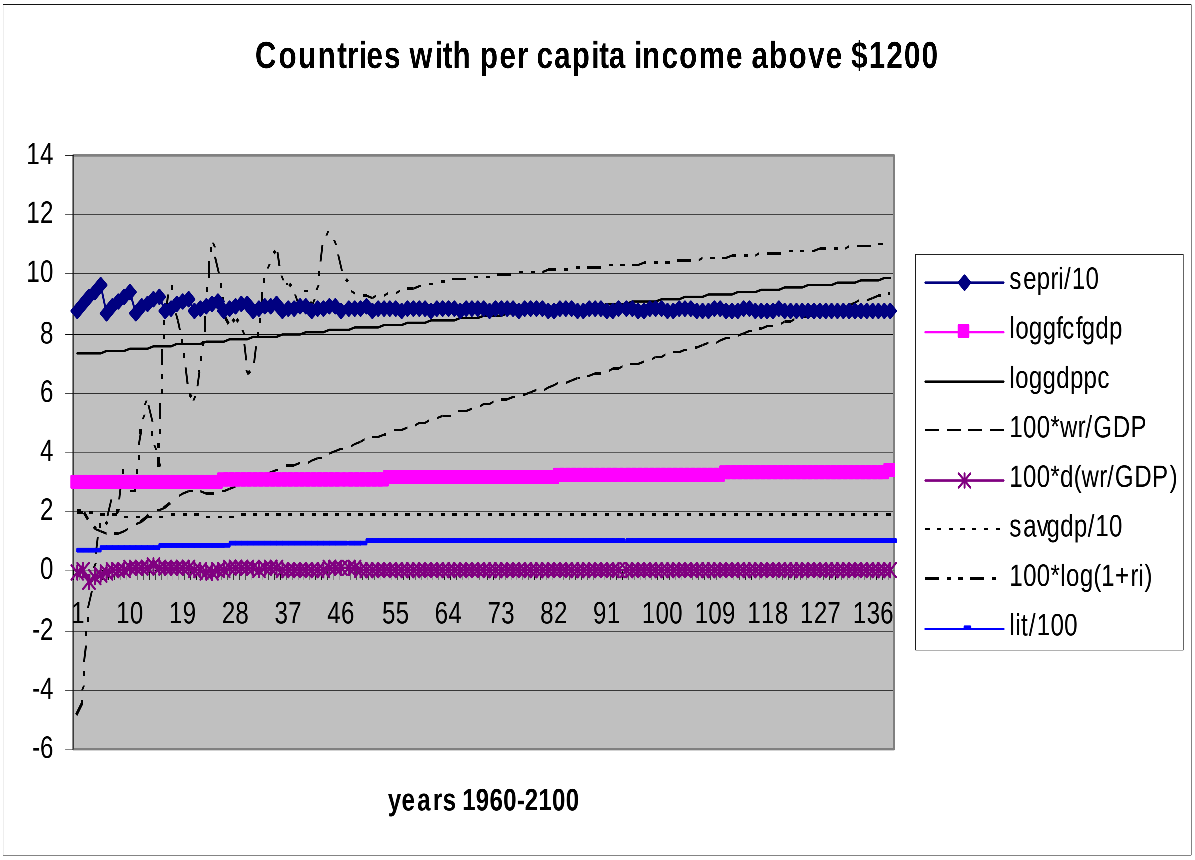


Figure 2b Stability of the permanent growth model



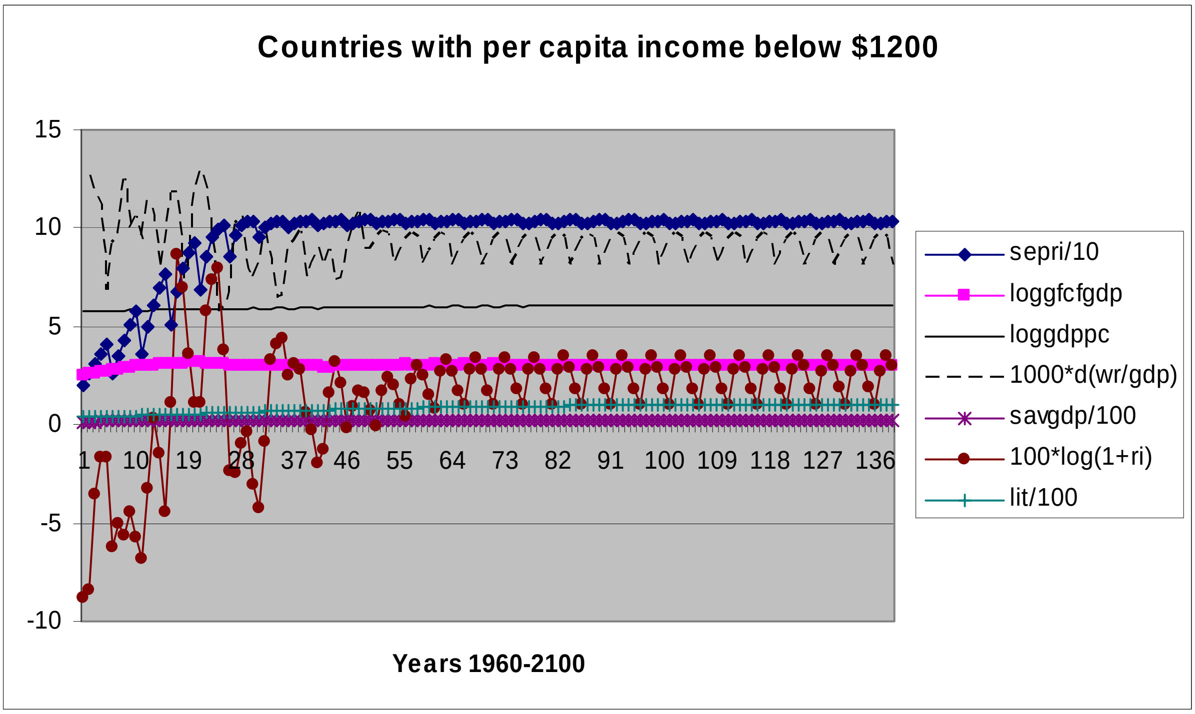


Figure 3a Differences for endogenous variables of the permanent growth model in % for countries with per capita income above $1200

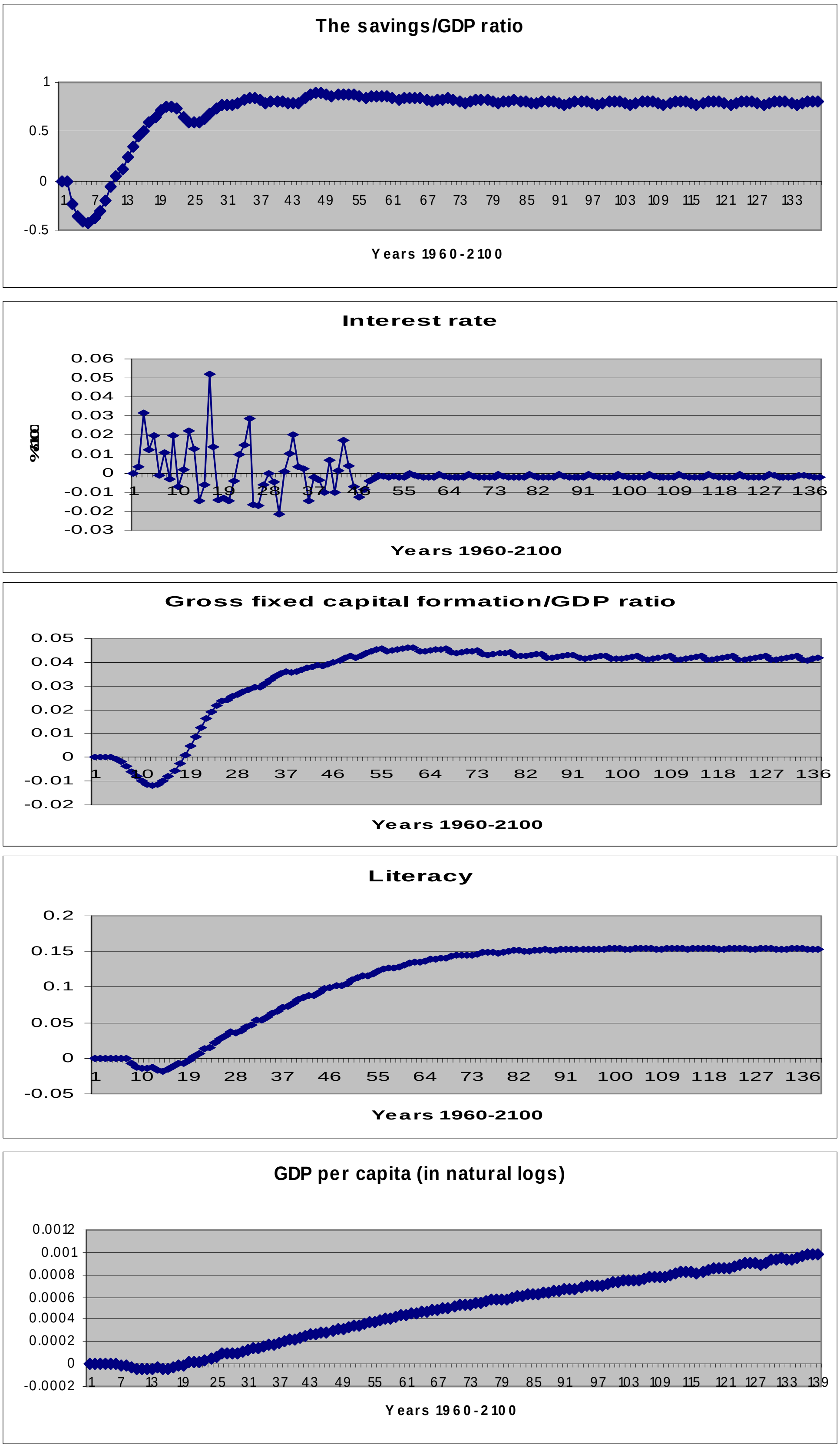


Figure 3b Differences for endogenous variables of the permanent growth model in % for countries with per capita income below $1200

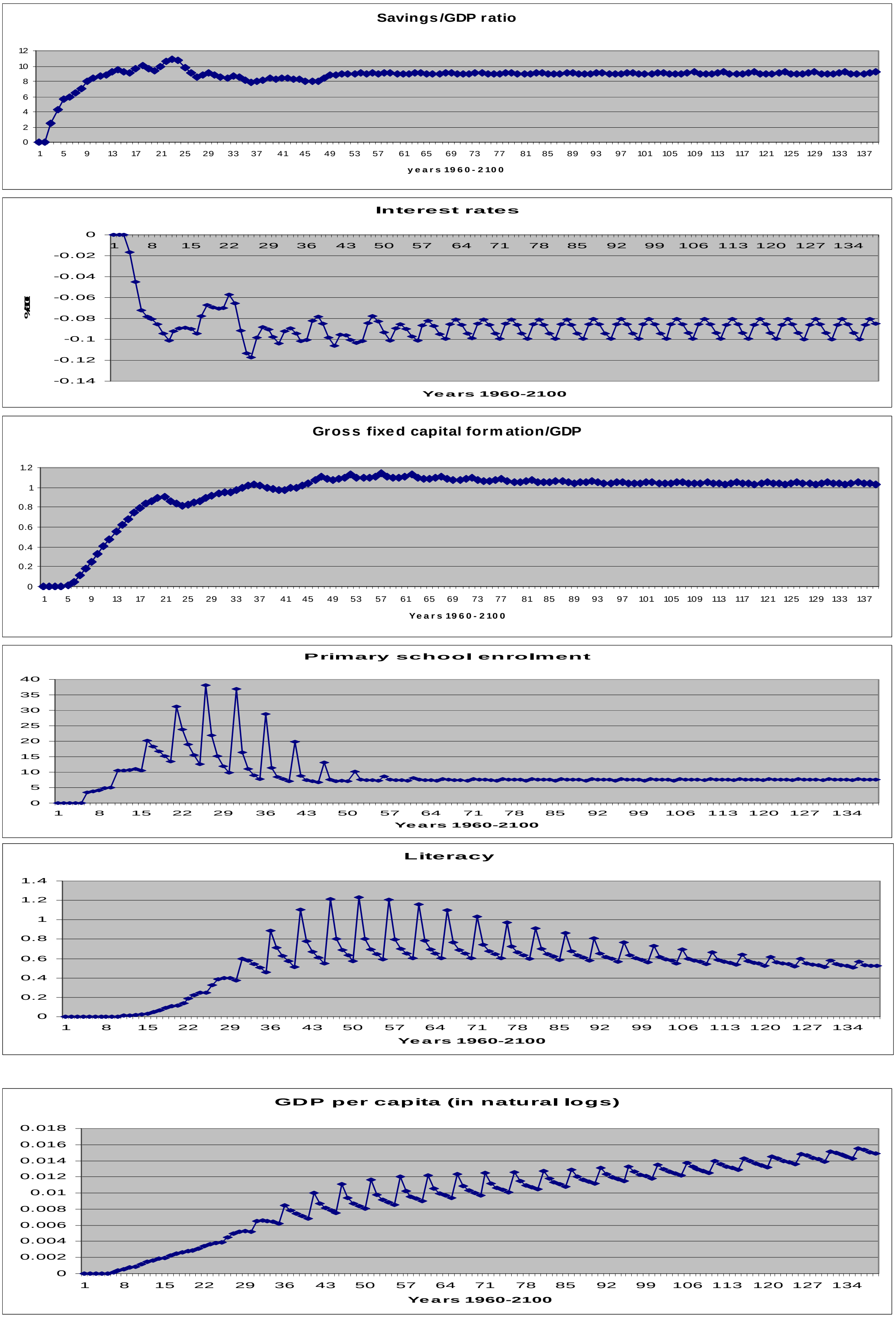


Table 1 Data description of the four country samples[a]

Panel average of Variable/Sample	Remit96	Aid84	A12	U12
Remittances/GDP	0.0235	.0263	.032	.02
Growth rate of remittance/ GDP ratio	.02	.04	.03	.048
GDP per capita $	3884	1660	2860	500
Growth rate of GDP per capita	.0155	.0127	.019	.007
Investment/GDP	.228	.213	.227	.199
Savings/GDP	.181	.171	.192	.148
Growth rate of Investment/GDP	.003	.006	.0016	.012
Growth rate of Savings/GDP	-.001	.00016	-.0014	.009

a Least-squares dummy variable regressions of the variable on a constant and, for growth rates, for the natural log of the variable on a constant and a time trend.

Table 2 The direct effect of changes in remittances on the endogenous variables (c)

Sample ***Change in***	*Remit96*	*Remaid84*	*a12*	*u12*
savings (ds)	0.682	0.88	0.69	1.845
interest in %	$-1.048*10^{-3}$	$-5.1*10^{-3}$	$-4.58*10^{\{-4\}}$	$-6.47*10^{(-3)}$
investment in %	$5.9*10^{-5}$	$3.5*10^{-4}$	$8.4*10^{\{-5\}}$	$3.443*10^{\{-4\}}$
literacy (*dl*)	$1.54*10^{-2}$	$2.103*10^{-2}$	$2.33*10^{\{-2\}}$	$9.1*10^{\{-3\}}$
GDP per capita in % (a)	$(2.4+4.7)10^{-6}$	$1.4*10^{-5}+6.8*10^{-6}$	$(2.5 + 5.2)10^{-6}$	$1.65*10^{-5}+3.8*10^{-6}$
ddw (b)	0.0138	0.016	-0.0004	0.037

(a) sum of investment and literacy effect
(b) second difference of the remittance/GDP ratio; multiplication factor for all effects above to get yearly effects
(c) Calculated for *ddw = 1*, a one percent change of the rise in remittances per unit of GDP,*dw*.

Table 3 **The steady-state solution of the transitional growth model in %**

Sample	*Remit96*	*Remaid84*	*a12*	*u12*
Variable				
publ.exp education /GDP in %	3.97	3.79	4.57	3.22
labour force growth rate in %	1.93	2.07	1.95	2.20
(a)	*With remittances*			
yearly difference in remittances/GDP	0.2	0.2	0.1	0.9
Gross fixed capital formation/GDP	19.5	20.1	19.9	19.8
Gross savings/GDP	14.9	14.0	13.4	20.5
real interest rate	9.2	9.9	10.9	3.4
enrolment rates primary school	93.3	97.3	88.0	102.4
literacy rate	100.4	100.5	100.3	102.7
GDP per capita in $	35922	22096	11311	5749
(b)	*Without remittances*			
yearly difference in remittance/GDP	0	0	0	0
Gross fixed capital formation/GDP	19.5	20.1	19.8	18.9
Gross savings/GDP	13.9	12.6	12.5	12.4
real interest rate	9.3	10.0	11.1	11.4
enrolment rates primary school	93.3	97.3	88.0	95.5
literacy rate	100.3	100.3	100.1	102.4
GDP per capita in $	35685	21907	11267	5635
(c)	Percentage differences			
Gross fixed capital formation/GDP	0.01	0.00	0.05	0.91
Gross savings/GDP	1.01	1.49	0.89	8.18
real interest rate	-0.11	-0.03	-0.21	-7.92
enrolment rates primary school	0.00	0.00	0.00	6.92
literacy rate	0.13	0.20	0.17	0.26
GDP per capita (percentage change)	0.01	0.01	0.00	0.02

Steady state assumptions:
OECD per capita income growth rate: 2%
US interest rate: 4.3%

Table 4	**The steady-state solution of the permanent growth model in %**			
Sample	*Remit96*	*Remaid84*	*a12*	*u12a*
Variable				
publ.exp education /GDP	3.97	3.79	4.57	3.22
labour force growth rate in %	1.93	2.07	1.95	2.20
(a)	*With remittances*			
yearly difference in remittances/GDP	0.2	0.2	0.1	0.9
Gross fixed capital formation/GDP	19.8	20.4	20.1	20.1
Gross savings/GDP	15.6	14.7	14.4	21.4
real interest rate	9.2	9.9	10.7	2.3
enrolment rates primary school	93.3	97.3	88.0	103.1
literacy rate	100.5	100.6	100.5	102.9
GDP per capita growth rate	0.2296	0.2175	0.3572	0.0275
(b)	*Without remittances*			
yearly difference in remittance/GDP	0.0	0.0	0.0	0.0
Gross fixed capital formation/GDP	19.8	20.4	20.1	19.0
Gross savings/GDP	14.6	13.3	13.6	12.3
real interest rate	9.3	10.0	10.9	11.4
enrolment rates primary school	93.3	97.3	88.0	95.4
literacy rate	100.4	100.4	100.3	102.4
GDP per capita growth rate	0.2	0.2	0.4	0.0
(c)	Percentage differences			
Gross fixed capital formation/GDP	0.015	0.014	0.041	1.050
Gross savings/GDP	0.989	1.469	0.790	9.111
real interest rate	-0.145	-0.096	-0.185	-9.031
enrolment rates primary school	0.000	0.000	0.000	7.654
literacy rate	0.120	0.200	0.160	0.490
GDP per capita growth rate	0.001	0.001	0.001	0.008
Ratio of growth rates with and without remittances	1.002	1.004	1.002	1.393

Steady state assumptions:
OECD per capita income growth rate: 2%
US interest rate: 4.3%
World GDP growth rate: 4.3%

Table 5 **The impact of worker remittances on the ratio GNI/GDP (a)**

Dependent variable: *log(GNI)-log(GDP)*

	Countries below $1200 (u12)		
Regressors/Method	LSDV	Anders.-Hsiao (b)	Arellano-Bover (c)
constant	0.00414	-0.00025	-
	(0.3461)	(0.8513)	-
log(GNI(-1))-log(GDP(-1))	0.637	0.551	0.670
	(0.0000)	(0.0013)	(0.0000)
log(wr(-1)/GDP(-1))	0.0023	0.0018	0.0023
	(0.0115)	(0.3582)	(0.0136)
Countries	41	40	40
Total observations:	574	525	533
Standard error of regression	0.0186	0.0247	0.0186
	Countries above $1200 (a12)		
	LSDV	Anders.-Hsiao (b)	Arellano-Bover (d)
constant	-0.0018	-0.0003	-
	(0.54)	(0.75)	-
log(GNI(-1))-log(GDP(-1))	0.71	0.80	0.71
	(0.0000)	(0.0005)	(0.0000)
log(wr(-1)/GDP(-1))	0.0010	-0.0003	0.0010
	(0.1225)	(0.8839)	(0.1234)
Countries	41	40	40
Total observations:	637	590	596
Standard error of regression	0.015	0.021	0.015

(a) marginal significance level (p-values) in parentheses based on panel corrected standard errors
(b) First differences of all variables are used.
Instruments: Constant, (LOG(GNI(-2)) - LOG(GDP(-2))), D(LOG(WR(-1)/GDP(-1)))
(c) Orthogonal deviations of all variables are used.
Instruments: Dynamic (LOG(GNI)-LOG(GDP),-2,-2); LOG(WR(-1)/GDP(-1))
Instrument rank: 32. J-statistic: 43
(d) Orthogonal deviations of all variables are used.
Instruments: Dynamic (LOG(GNI)-LOG(GDP),-3,-3); LOG(WR(-1)/GDP(-1))
Instrument rank 33. J-statistic: 66.7

Appendix 1a: Results of the GMM-HAC Systems Estimate for 96 countries receiving remittances in 2003 (p-values in parentheses)

WR/GDP = **(1')**
-.083+.89WR(-1)/GDP(-1)+.009LOG(OEC)-.00097LOG(GDPPC(-2))+.002LOG(1+RI(-2))-.036LOG(1+RIUS(-1))
(.0025) (.0)[22] (0.0012) (0.0008) (0.175) (0.07)
Instruments: C, WR(-2)/GDP(-2), LOG(GDPPC(-2)), LOG(OEC), LOG(1+RI(-2)), LOG(1+RIUS(-1)).
Obs.: 1334; Adj.R^2 = 0.92.

SAVGDP=1.38+0.88SAVGDP(-1)+68D(WR/GDP)+34.6D(LOG(GDPPC(-0)))+2.93LOG(1+RI(-1)) **(2')**
(.0) (.0) (0.063) (0.002) (0.023)
Instr.: C, SAVGDP(-2), D(WR(-2)/GDP(-2)), D(LOG(GDPPC(-1))), LOG(1+RI(-2)), LOG(1+RI(-3)).
Obs.: 1214; Adj.R^2 = 0.84.

LOG(1+RI= 0.04+0.8(LOG(1+RI(-1)))+0.003(INVGDP(-1)-SAVGDP(-1))-0.0002(INVGDP(-1) –
(0.001) (.0) (0.02) (0.054)
SAVGDP(-1))^2 -0.27LOG(1+RI(-2))-0.69D(LOG(OEC(-1))) **(3')**
(0.02) (0.06)
Instr.: C, LOG(1+RI(-1)), LOG(1+RI(-2)), INVGDP(-2)-SAVGDP(-2), (INVGDP(-2)-SAVGDP(-2))^2, D(LOG(OEC(-1))). Obs.: 1325; Adj.R^2 = 0.51.

LOG(GFCFGDP)= **(4')**
0.34+.89LOG(GFCFGDP(-1))-.056LOG(1+RI(-1))-.57LOG(1+RIUS(-1))+.63D(LOG(GDPPC(-1)))
(.0) (.0) (0.06) (0.002) (0.038)
Instr.: C, LOG(GFCFGDP(-2)), LOG(1+RI(-2)), LOG(1+RIUS(-1)), D(LOG(GDPPC(-2))),.
Obs.: 1410; Adj. R^2 = 0.86.

LIT - LIT(-5)= 1.6+0.13LIT(-5)+ 0.003SEPRI(-5)+ 0.02SAVGDP(-5) -0.0015LIT(-5)^2+0.04PEEGDP(-5) **(5')**
(.004) (.0) (.16) (.066) (.0) (0.005)
Instr.: C, LIT(-10), SEPRI(-5), SAVGDP(-5), LIT(-5)^2, PEEGDP(-5). Obs.: 163; Adj.R^2 = 0.83.

SEPRI = -9.56 + 1.48SEPRI(-5) -0.004SEPRI(-5)^2 **(6')**
(0.001) (.0) (.0)
Instr.: C SEPRI(-5) SEPRI(-5)^2. Obs.: 301 ; Adj. R^2 = 0.79.

LOG(GDPPC)-LOG(GDPPC(-5)) = 0.04-.007LOG(GDPPC(-5))+ .04LOG(GFCFGDP) -.03LOG(GFCFGDP(-5))
(0.15) (.0008) (0.004) (0.002)
+0.0003 (LIT(-5)) -.52 (D(LOG(L)) +.04) + 1.08 (LOG(GDPPC(-1))-LOG(GDPPC(-6)))
(0.003) (0.001) (.0)
-0.16 (LOG(GDPPC(-2))-LOG(GDPPC(-7))) - 0.1 (LOG(GDPPC(-3))-LOG(GDPPC(-8))) **(7a')**
(0.002) (0.006)
Instr.: C, LOG(GDPPC(-10)), LOG(GFCFGDP(-5)), LOG(GFCFGDP(-1)), LIT(-5), D(LOG(L))+.04, LOG(GDPPC(-1)), -LOG(GDPPC(-6)), LOG(GDPPC(-2))-LOG(GDPPC(-7)), LOG(GDPPC(-3))-LOG(GDPPC(-8)). Obs.: 1475; Adj.R^2 = 0.86.

LOG(GDPPC)-LOG(GDPPC(-5)) = -.035 + .045LOG(GFCFGDP(-0)) -.03LOG(GFCFGDP(-5))+ .0032LIT(-0)-
(.21) (.0008) (.0016) (.025)
0.0031LIT(-5) -.61(D(LOG(L)) +.04) +.81D(LOG(WORLD)) +1.1 (LOG(GDPPC(-1)) -LOG(GDPPC(-6)))
(.025) (.001) (.0) (.0)
-.17(LOG(GDPPC(-2))-LOG(GDPPC(-7))) -.11(LOG(GDPPC(-3))-LOG(GDPPC(-8))) **(7b')**
(.002) (.0015)
Instr.: C, LOG(GFCFGDP(-1)), LOG(GFCFGDP(-5)), LIT(-1), LIT(-6), (D(LOG(L))+.04), D(LOG(WORLD)), (LOG(GDPPC(-1))-LOG(GDPPC(-6))), (LOG(GDPPC(-2))-LOG(GDPPC(-7))), (LOG(GDPPC(-3))-LOG(GDPPC(-8))). Obs.: 1368; Adj.R^2 = 0.87.

Regression	(a)	(b)
Determinant residual covariance	$4.15x10^{-07}$	$4.29x10^{-07}$
J-statistic	0.000158	0.000159

[22] '(.0)' indicates that the marginal significance level (p-val.) is zero until the four-digit level.

Appendix 1b: Results of the GMM-HAC Systems Estimate for 84 countries receiving remittances and aid in 2003 (p-values in parentheses)

WR/GDP = **(1'')**
-.12+.89WR(-1)/GDP(-1)+.013 (LOG(OEC))-.00096(LOG(GDPPC(-2)))+.002LOG(1+RI(-2))-.03LOG(1+RIUS(-1))
(.001) (.0) (.001) (0.02) (0.08) (0.19)
Instr.: C, WR(-2)/GDP(-2), LOG(GDPPC(-2)), LOG(OEC), LOG(1+RI(-2)), LOG(1+RIUS(-1)).
Obs.: 1077; Adj. R^2 = .92.

SAVGDP = 1.56+0.86SAVGDP(-1)+ 87.9D(WR/GDP) +45.6D(LOG(GDPPC(-0)))+ 2.2LOG(1+RI(-1))
(.0) (.0) (0.03) (0.001) (0.027)
+ 15.7 ((ODA(-0)/GDP(-0))-(ODA(-1)/GDP(-1))) -28.7 ((ODA(-0)/GDP(-0))-(ODA(-1)/GDP(-1)))^2 **(2'')**
(0.03) (0.05)
Instr.: C, SAVGDP(-2), D(WR(-2)/GDP(-2)), D(LOG(GDPPC(-1))), LOG(1+RI(-2)), LOG(1+RI(-3)), (ODA/GDP)-(ODA(-1)/GDP(-1)), ((ODA/GDP)-(ODA(-1)/GDP(-1)))^2. Obs.: 974; Adj. R^2 = 0.82.

LOG(1+RI)= .04+.81(LOG(1+RI(-1)))+ .004(INVGDP(-1) -SAVGDP(-1)) -.0002 (INVGDP(-1) - SAVGDP(-1))^2
(.006) (.0) (0.05) (0.07)
-0.26(LOG(1+RI(-2))) -0.75D(LOG(OEC(-1))) **(3'')**
(0.026) (0.105)
Instr.: C, LOG(1+RI(-1)), INVGDP(-2)-SAVGDP(-2), (INVGDP(-2)-SAVGDP(-2))^2, LOG(1+RI(-2)), D(LOG(OEC(-1))). Obs.: 1074; Adj. R^2 = .51.

LOG(GFCFGDP)) = 0.34+0.9LOG(GFCFGDP(-1)) -0.07LOG(1+RI(-1)) -0.87LOG(1+RIUS(-1))
(.0) (.0) (.02) (.001)
+0.67D(LOG(GDPPC(-1))) +0.88D(ODA/GDP) -0.89D((ODA/GDP)^2) **(4'')**
(0.05) (0.01) (0.02)
Instr.: C, LOG(GFCFGDP(-2)), LOG(1+RI(-2)), LOG(1+RIUS(-1)), D(LOG(GDPPC(-2))), D(ODA/GDP), D((ODA/GDP)^2). Obs.: 1104; Adj. R^2 = 0.86.

LIT-LIT(-5) = 1.62+.126LIT(-5)+ .0036SEPRI(-5)+ .024SAVGDP(-5) -0.0015LIT(-5)^2+0.05PEEGDP(-5) **(5'')**
(.004) (.0) (.186) (0.06) (.0) (0.005)
Instr.: C, LIT(-10), SEPRI(-5), SAVGDP(-5), LIT(-5)^2, PEEGDP(-5). Obs.: 142; Adj. R^2 =.81

SEPRI = -13.76 + 1.68SEPRI(-5) -0.0055SEPRI(-5)^2 + 42.1((ODA(-0)/GDP(-0))-(ODA(-5)/GDP(-5)))
(.0) (.0) (.0) (0.005)
-99.3 ((ODA(-0)/GDP(-0))-(ODA(-5)/GDP(-5)))^2 **(6'')**
(0.056)
Instr.: C, SEPRI(-5), SEPRI(-5)^2, (ODA/GDP)-(ODA(-5)/GDP(-5)), ((ODA/GDP)-(ODA(-5)/GDP(-5)))^2
Obs.: 196; Adj. R^2 = 0.83.

LOG(GDPPC)-LOG(GDPPC(-5)) = .05-.008LOG(GDPPC(-5)) + .04LOG(GFCFGDP) -.03LOG(GFCFGDP(-5))
(.11) (.0008) (.004) (.0017)
+.0003(LIT(-5)) -0.5(D(LOG(L))+.04) +1.08(LOG(GDPPC(-1))-LOG(GDPPC(-6)))
(.002) (.004) (.0)
-0.16(LOG(GDPPC(-2))-LOG(GDPPC(-7))) -0.1 (LOG(GDPPC(-3))-LOG(GDPPC(-8))) **(7a'')**
(.004) (.006)
Instr.: C, LOG(GDPPC(-10)), LOG(GFCFGDP(-5)), LOG(GFCFGDP(-1)), LIT(-5) D(LOG(L))+.04, LOG(GDPPC(-1)) - LOG(GDPPC(-6)), LOG(GDPPC(-2))-LOG(GDPPC(-7)), LOG(GDPPC(-3))-LOG(GDPPC(-8)).
Obs: 1362; Adj. R^2 = 0.86

(LOG(GDPPC)-LOG(GDPPC(-5))) = -0.037 + 0.045LOG(GFCFGDP(-0)) -0.03LOG(GFCFGDP(-5))+
(0.20) (.001) (.002)
.00333LIT(-0) -.00319LIT(-5) -.609(D(LOG(L))+.04) +.83D(LOG(WORLD)) +1.1(LOG(GDPPC(-1)) -
(.02) (.02) (.002) (.0) (.0)
LOG(GDPPC(-6))) -.17(LOG(GDPPC(-2))-LOG(GDPPC(-7))) -.12(LOG(GDPPC(-3)) -LOG(GDPPC(-8))) **(7b'')**
(.0027) (.0016)
Instr.: C, LOG(GFCFGDP(-1)), LOG(GFCFGDP(-5)), LIT(-1), LIT(-6), (D(LOG(L))+.04), D(LOG(WORLD)), (LOG(GDPPC(-1))-LOG(GDPPC(-6))), (LOG(GDPPC(-2))-LOG(GDPPC(-7))), (LOG(GDPPC(-3))-LOG(GDPPC(-8))). Obs.: 1260; Adj. R^2 =.87.

Regression	(a)	(b)
Determinant residual covariance	8.84×10^{-07}	9.19×10^{-07}
J-statistic	0.000939	0.000943

Appendix 1c: Results of the GMM-HAC Systems Estimate for 42 countries with GDP per capita above $1200 and receiving remittances and aid in 2003 (p-values in parentheses)

WR/GDP = -0.05+0.83WR(-1)/GDP(-1) +0.011(LOG(OEC)) -0.007(LOG(GDPPC(-2)))+ 0.006LOG(1+RI(-2)) –
(0.24) (.0) (0.02) (0.003) (0.07)
0.019LOG(1+RIUS(-1)) **(1''')**
(0.61)
Instruments: C, WR(-2)/GDP(-2), LOG(GDPPC(-2)), LOG(OEC(-0)), LOG(1+RI(-2)), LOG(1+RIUS(-1)).
Observations: 526; Adj. R^2 = 0.93

SAVGDP = 1.1+0.9SAVGDP(-1)+ 69.1D(WR(-0)/GDP(-0))+ 30D(LOG(GDPPC(-0))) +1.33LOG(1+RI(-0)) +
(0.09) (.0) (.13) (0.15) (0.63)
26((ODA(-0)/GDP(-0))-(ODA(-1)/GDP(-1))) **(2''')**
(0.004)
Instr. : C, SAVGDP(-2), D(WR(-2)/GDP(-2)), D(LOG(GDPPC(-1))), (ODA/GDP)-(ODA(-1)/GDP(-1)), LOG(1+RI(-1)), LOG(1+RI(-2)), LOG(1+RI(-3)). Obs.: 479; Adj.R^2 =0.84

LOG(1+RI) = 0.04+0.7(LOG(1+RI(-1))) + 0.0007(INVGDP(-1) -SAVGDP(-1)) -0.74D(LOG(OEC(-1)))
(.0) (.0) (0.2) (0.005)
+0.38(LOG(1+RIUS(-1))-LOG(1+RIUS(-2))) **(3''')**
(0.14)
Instruments: C, LOG(1+RI(-1)), INVGDP(-2)-SAVGDP(-2), D(LOG(OEC(-1))), LOG(1+RIUS(-1))-LOG(1+RIUS(-2)), INVGDP(-3)-SAVGDP(-3). Obs.: 536; Adj. R^2 = 0.51.

(LOG(GFCFGDP)) = 0.5+0.84LOG(GFCFGDP(-1)) -0.18LOG(1+RI(-1)) -0.67LOG(1+RIUS(-1))+
(.0) (.0) (0.006) (0.04)
0.5D(LOG(GDPPC(-1))) + 0.54D(ODA/GDP) -3.5D($(ODA/GDP)^2$) **(4''')**
(0.185) (0.31) (0.07)
Instr.: C, LOG(GFCFGDP(-2)), LOG(1+RI(-2)), LOG(1+RIUS(-1)), D(LOG(GDPPC(-2))), D(ODA/GDP), D($(ODA/GDP)^2$). Obs.: 544; Adj. R^2 = 0.81.

LIT -LIT(-5) = 1.72+0.11LIT(-5) + 0.005SEPRI(-5)+ 0.034SAVGDP(-5) -0.0014$LIT(-5)^2$+0.14PEEGDP(-5) **(5''')**
(0.29) (0.026) (0.018) (0.017) (.0) (0.006)
Instr: C, LIT(-10), SEPRI(-5), SAVGDP(-5), $LIT(-5)^2$, PEEGDP(-5). Obs.: 91; Adj. R^2 = 0.88.

SEPRI = -11.9 + 1.46SEPRI(-5) - 0.004$SEPRI(-5)^2$ + 27.7((ODA(-0)/GDP(-0))-(ODA(-5)/GDP(-5))) **(6''')**
(0.001) (.0) (0.004) (0.13)
Instr.: C, SEPRI(-5), $SEPRI(-5)^2$, (ODA/GDP)-(ODA(-5)/GDP(-5)).
Obs.: 118; Adj. R^2 = 0.85.

LOG(GDPPC)-LOG(GDPPC(-5)) = .11 -.01LOG(GDPPC(-5))+ .03LOG(GFCFGDP) -.024LOG(GFCFGDP(-5))
(.08) (.001) (.197) (.085)
+ 0.0002(LIT(-5)) -0.41(D(LOG(L))+.04) +1.17(LOG(GDPPC(-1))-LOG(GDPPC(-6)))
(.13) (.02) (.0)
-0.24(LOG(GDPPC(-2))-LOG(GDPPC(-7))) -0.13(LOG(GDPPC(-3)) -LOG(GDPPC(-8))) **(7a''')**
(0.0025) (0.004)
Instr.: C, LOG(GDPPC(-10)), LOG(GFCFGDP(-5)), LOG(GFCFGDP(-1)), LIT(-5) D(LOG(L))+.04, LOG(GDPPC(-1))-LOG(GDPPC(-6)), LOG(GDPPC(-2))-LOG(GDPPC(-7)), LOG(GDPPC(-3))-LOG(GDPPC(-8)).
Obs.: 749; Adj. R^2 = .85.

(LOG(GDPPC)-LOG(GDPPC(-5))) = -.03 + .034LOG(GFCFGDP(-0)) -.02LOG(GFCFGDP(-5)) + .002LIT(-1)
(.52) (.13) (.11) (.38)
-0.002LIT(-6) -0.38(D(LOG(L))+.03) + 0.72D(LOG(WORLD)) +1.15(LOG(GDPPC(-1))-LOG(GDPPC(-6)))
(.37) (.06) (.0004) (.0)
-0.22 (LOG(GDPPC(-2))-LOG(GDPPC(-7))) -0.14(LOG(GDPPC(-3))-LOG(GDPPC(-8))) **(7b''')**
(.0035) (.0015)
Instr.: C, LOG(GFCFGDP(-1)), LOG(GFCFGDP(-5)), LIT(-1), LIT(-6), (D(LOG(L))+.03), D(LOG(WORLD)), (LOG(GDPPC(-1))-LOG(GDPPC(-6))), (LOG(GDPPC(-2))-LOG(GDPPC(-7))), (LOG(GDPPC(-3))-LOG(GDPPC(-8))). Obs.: 731; Adj. R^2 = 0.85.

Regression	(a)	(b)
Determinant residual covariance	4.43×10^{-08}	4.57×10^{-08}
J-statistic	0.001897	0.001884

Appendix 1d: Results of the GMM-HAC Systems Estimate of the transitional growth model for 42 countries with GDP per capita below \$1200 and receiving remittances and aid in 2003 (p-values in parentheses)

wr/gdp -(wr(-1)/gdp(-1)) =
.61 -.066(log(OEC)) -.05log(1+ri(-2)) +.0017trend + .05 (log(1+ri(-2))-log(1+rius(-2)))
(.006) (.006) (0.02) (0.0027) (0.02)
Instr.: c, (log(OEC)), log(1+ri(-2)), log(1+ri(-2))-log(1+rius(-2)), trend. Obs.: 562. Adj.R^2: 0.053. **(1a^{iv})**

savgdp = 1.88+0.83savgdp(-1)+ 185d(wr(-0)/gdp(-0))+ 57d(log(gdppc(-0)))+ 2.56log(1+ri(-1))
(0.002) (.0) (0.07) (0.008) (0.037)
+ 13.5 ((oda(-0)/gdp(-0))-(oda(-1)/gdp(-1))) -29((oda(-0)/gdp(-0))-(oda(-1)/gdp(-1)))^2
(0.06) (0.04)
Instr.: c, savgdp(-2), d(wr(-1)/gdp(-1)), d(log(gdppc(-1))), log(1+ri(-2)), log(1+ri(-3)), (oda(-0)/gdp(-0))-(oda(-1)/gdp(-1)), ((oda(-0)/gdp(-0))-(oda(-1)/gdp(-1)))^2. Obs.: 500. Adj.R^2: 0.79. **(2a^{iv})**

log(1+ri)= 0.035+0.83(log(1+ri(-1)))+ 0.008(invgdp(-1) -savgdp(-1)) -0.00037(invgdp(-1) - savgdp(-1))^2
(0.16) (.0) (.07) (.06)
-0.3 (log(1+ri(-2))) -1.2d(log(oec(-1)))
(0.015) (0.16)
Instr.: c, log(1+ri(-1)), (invgdp(-2) - savgdp(-2)), (invgdp(-2) - savgdp(-2))^2 , log(1+ri(-2)), d(log(oec(-1))).
Obs.: 544. Adj. R^2: 0.52 **(3a^{iv})**

(log(gfcfgdp)) = .28+0.91log(gfcfgdp(-1)) -.05log(1+ri(-1)) -.74log(1+rius(-1))+ .96d(log(gdppc(-1)))
(.0) (.0) (0.19) (0.05) (0.12)
+1.31d(oda/gdp) -1.35d((oda/gdp)^2)
(0.0008) (0.0015)
Instr.: c, log(gfcfgdp(-2)), log(1+ri(-2)), log(1+rius(-1)), d(log(gdppc(-2))), d(oda/gdp), d((oda/gdp)^2).
Obs.: 560. Adj. R^2: 0.88. **(4a^{iv})**

lit-lit(-5) = 1.63 + 0.13 (lit(-5)) + 5.76x10^{-05} (sepri(-5))^2-0.0015(lit(-5)^2) +0.03peegdp(-5)
(0.009) (.0) (0.23) (.0) (0.008)
Instr.: c, lit(-10), sepri(-5)^2, lit(-5)^2, peegdp(-5). Obs.: 69. Adj. R^2 = 0.55. **(5a^{iv})**

sepri = -20 + 1.91sepri(-5) -0.008sepri(-5)^2 + 44 ((oda(-0)/gdp(-0))-(oda(-5)/gdp(-5))) +0.59savgdp(-0)
(0.04) (.0) (0.005) (0.15) (0.06)
Instr.: c, (sepri(-5)), sepri(-5)^2 ((oda(-0)/gdp(-0))-(oda(-5)/gdp(-5))), savgdp(-1). Obs.: 56. Adj.R^2 = 0.74. **(6a^{iv})**

log(gdppc)-log(gdppc(-5)) = .12-.01log(gdppc(-5))+.048 log(gfcfgdp -.047log(gfcfgdp(-5))+.0004(lit(-5))
(.007) (0.06) (0.0015) (0.0001) (0.01)
-1.07(d(log(l))+.04)) +.99(log(gdppc(-1))-log(gdppc(-6))) -.156(log(gdppc(-2))-log(gdppc(-7)))
(0.03) (.0) (0.005)
Instr.: c, log(gdppc(-10)), log(gfcfgdp(-5)), log(gfcfgdp(-1)), lit(-5) d(log(l))+.04, log(gdppc(-1))-log(gdppc(-6)), log(gdppc(-2))-log(gdppc(-7)), log(gdppc(-3))-log(gdppc(-8)). Obs. : 613. Adj. R^2 = 0.87. **(7a^{iv})**

Determinant residual covariance	3.15x10^{-06}
J-statistic	0.004250

Appendix 1e: Results of the GMM-HAC Systems Estimate of the permanent growth model for 42 countries with GDP per capita below $1200 and receiving remittances and aid in 2003 (p-values in parentheses)

wr/gdp -(wr(-1)/gdp(-1)) =
0.64 -0.07(log(OEC)) -0.055log(1+ri(-2)) + 0.0018trend + 0.055(log(1+ri(-2))-log(1+rius(-2)))
(.0045) (0.004) (0.017) (0.002) (0.017)
Instr.: c, log(OEC), log(1+ri(-2)), log(1+ri(-2))-log(1+rius(-2)), trend. Obs.: 562. Adj. R^2 = 0.053 **(1b^{iv})**

savgdp = 1.78+0.83savgdp(-1) + 191d(wr(-0)/gdp(-0)) + 53d(log(gdppc(-0))) + 2.6log(1+ri(-1))
(0.004) ((.0) (.06) (.01) (0.03)
+ 13.5 ((oda(-0)/gdp(-0))-(oda(-1)/gdp(-1))) -27.6((oda(-0)/gdp(-0))-(oda(-1)/gdp(-1)))^2
(0.06) (.05)
Instr.: c, savgdp(-2), d(wr(-1)/gdp(-1)), d(log(gdppc(-1))), log(1+ri(-2)), log(1+ri(-3)), (oda(-0)/gdp(-0))-(oda(-1)/gdp(-1)), (oda(-0)/gdp(-0))-(oda(-1)/gdp(-1))^2. Obs.: 500. Adj. R^2 = 0.79. **(2b^{iv})**

log(1+ri) = .035 + .83log(1+ri(-1)) + .008(invgdp(-1) -savgdp(-1)) + .00037(invgdp(-1) - savgdp(-1))^2
(0.16) (.0) (.07) (.06)
-.3log(1+ri(-2)) -1.22d(log(oec(-1)))
(.015) (.16)
Instr.: c, log(1+ri(-1)), (invgdp(-2) - savgdp(-2)), (invgdp(-2) - savgdp(-2))^2, log(1+ri(-2)), d(log(oec(-1))).
Obs.: 544. Adj. R^2 = 0.52. **(3b^{iv})**

log(gfcfgdp) = .28+.92log(gfcfgdp(-1)) -0.05log(1+ri(-1)) -0.78log(1+rius(-1))+.91d(log(gdppc(-1)))
(.0001) (.0) (0.215) (.04) (.14)
+1.32d(oda/gdp) -1.33d((oda/gdp)^2)
(0.0007) (0.0017)
Instr.: c, log(gfcfgdp(-2)), log(1+ri(-2)), log(1+rius(-1)), d(log(gdppc(-2))), d(oda/gdp), d((oda/gdp)^2).
Obs. : 560. Adj. R^2 = 0.88. **(4b^{iv})**

lit - lit(-5) = 1.63 + .13(lit(-5)) + 5.76x10^{-05}(sepri(-5))^2 -.0015(lit(-5)^2) +0.03peegdp(-5)
(0.009) (.0) (.226) (.0) (0.008)
Instr.: c, lit(-10), (sepri(-5))^2 , (lit(-5)^2), peegdp(-5). Obs.: 69. Adj. R^2 = 0.547652. **(5b^{iv})**

sepri = -20 + 1.91sepri(-5) -0.008sepri(-5)^2 + 44((oda(-0)/gdp(-0))-(oda(-5)/gdp(-5))) +0.59savgdp(-0)
(0.04) (.0) (.005) (.15) (.06)
Instr.: c, (sepri(-5)), sepri(-5)^2 , ((oda(-0)/gdp(-0))-(oda(-5)/gdp(-5))), savgdp(-1). Obs.: 56. Adj. R^2 =0.74. **(6b^{iv})**

(log(gdppc) - log(gdppc(-5))) = .03 + .054log(gfcfgdp(-0)) -.048log(gfcfgdp(-5)) +.0049lit(-0) - 0.0048lit(-5)
(.49) (.0005) (.0001) (.026) (.03)
-1.53 (d(log(l))+.04) +1.002d(log(world(-0)))+1.1(log(gdppc(-1))-log(gdppc(-6)))-.25(log(gdppc(-2))-log(gdppc(-7)))
(0.0065) (0.0003) (.0) (.0004)
Instr.: c, log(gfcfgdp(-1)), log(gfcfgdp(-5)), lit(-1), lit(-6), (d(log(l))+.04), d(log(world(-0))), (log(gdppc(-1)) - log(gdppc(-6))), (log(gdppc(-2))-log(gdppc(-7))). Obs.: 572. Adj. R^2 = 0.87. **(7b^{iv})**

Determinant residual covariance	3.65x10^{-06}
J-statistic	0.002409

List of abbreviations[23]

1+r	*gross domestic interest rate*
a12	*sample of countries of remaid84 with gdppc above $1200*
c_{ij}	*Coefficient of variable j in equation i.*
ddy	*second difference of y*
dy	*first difference of y*
g	*growth rate of gdppc*
GDP	*Gross Domesstic product*
gdppc	gross domestic product per capita
GNI	Gross national income (Gross National Product)
gfcfgdp (f)	gross fixed capital formation as a share of GDP
GMM-HAC	General Method of Moments with heteroscedasticity and autocorrelation correction
invgdp (i)	investment as a share of GDP
J-statistic,	value of the GMM objective function at estimated parameters.
l	labour force
LIBOR/EURIBOR	*London Inter Bank Offer Rate/ European Inter Bank Offer Rate*
lit (li)	literacy rate
log	natural logarithm
LSDV	least-squares-dummy-variable estimators
oda	official development aid
oec	GDP per capita of the OECD
peegdp	public expenditure as a share of GDP
remaid84	sample of countries as remit96 if official development aid is obtained
remit96	sample of countries receiving remittances in 2003 with GDP data available
ri (r)	real domestic interest rate
rius	real US interest rate
savgdp (s)	savings as a share of GDP
sepri (p)	primary school enrolment,
u12	*sample of countries of remaid84 with gdppc below $1200*
world	GDP of the world economy
WDI	World Development Indicators
wr (w)	worker remittances
x	multiplication sign in some formulas
*	multiplication sign in some real numbers

[23] The second abbreviation in parentheses is used only in section 5.

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