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October 6, 2010

Do Worker Remittances Reduce Output Volatility in Developing Countries?

Ralph Chami, Dalia Hakura, and Peter Montiel

Abstract

Remittance inflows have increased considerably in recent years and are large relative to the size of many recipient economies. The theoretical and empirical effects of remittance inflows on output growth volatility are, however, ambiguous. On the one hand, remittances have been a remarkably stable source of income, relative to other private and public flows, and they seem to be compensatory in nature, rising when the home country's economy suffers a downturn. On the other hand, the labor supply effects induced by altruistic remittances could cause the output effects associated with technology shocks to be magnified. This paper finds robust evidence for a sample of 70 remittance-recipient countries, including 16 advanced economies and 54 developing countries that remittances have a negative effect on output growth volatility, thereby supporting the notion that remittance flows are a stabilizing influence on output.

JEL Classification Numbers: D02, D64, F02, F22, F24

Keywords: Remittances, output volatility, developing countries

I. INTRODUCTION

Remittance inflows have increased considerably in recent years and have become quite large relative to the size of many recipient economies. There is evidence that these flows behave very differently from other resource flows to developing countries, including both private and official capital flows, FDI, and aid. In particular, remittances are private household to household transfers often involving transactions between economic agents that are altruistically linked. They have been a remarkably stable source of income relative to other private and public flows, and they seem to be compensatory in nature, rising when the home country's economy suffers a downturn. This combination of stability and countercyclicality has led some to believe that remittances play a stabilizing role at the aggregate level in recipient countries.

However, while these characteristics of remittance flows may suggest that they should be expected to play a stabilizing role, the issue is not clear-cut, either theoretically or empirically. From a theoretical perspective, some observers have noted that the labor supply effects induced by altruistic remittances could cause the output effects associated with technology shocks to be magnified (see Chami, Cosimano and Gapen, 2006). Empirically, while remittance flows may be more stable than other foreign exchange inflows, they are not insensitive to macroeconomic developments in the source countries, and thus represent a potential channel for the international transmission of business cycles, implying that greater "openness" to remittance flows, other things equal, may not be stabilizing. The current global slowdown, for example, adversely affected the demand for migrant labor in both the industrialized and the Persian Gulf countries, the main sources of remittance income. Consequently, remittance flows have fallen for the first time in decades. According to a recent World Bank report, remittance flows are estimated to

have fallen by 5 to 8 percent in 2009. Other studies report that remittances to Philippines, Mexico, the Middle East and Africa dropped considerably. For example, Cali and others (2008) report that remittances to Kenya fell by 38% in 2008.

The adverse effect of high output volatility on economic growth was first emphasized by Ramey and Ramey (1995), and output volatility has also been recognized to have direct adverse effects on welfare, particularly where opportunities for consumption smoothing are limited. The issue of whether a large role of remittance receipts tends on average to be stabilizing or otherwise is therefore an important one, particularly in the context of developing countries, where both growth and stability objectives are highly valued.

This paper is an empirical investigation into the issue of whether the size of remittance flows is an important determinant of growth volatility. We employ cross-section OLS and Generalized Method of Moments (GMM) panel regressions to explain the standard deviation of real per capita GDP growth for a sample of 70 countries, including 16 advanced economies and 54 developing countries. Our objective is to determine whether the ratio of remittance receipts to GDP helps to explain the volatility of growth in these economies after controlling for a large number of variables that have been cited in the literature as potential determinants of such volatility. We find a robust, statistically significant negative effect of remittance flows on the volatility of real GDP growth: in other words, remittance inflows have tended to be stabilizing on average.

The structure of the paper is as follows: to isolate the effect of remittance inflows on growth volatility, it is important to properly control for other potential determinants of growth volatility. Accordingly, Section II provides an overview of the literature on the determinants of growth volatility that is intended to identify the appropriate set of controls. Our first estimates, based on cross-section OLS regressions, are presented in Section III. To handle the potential endogeneity of remittance flows, Section IV relies on panel GMM estimations respectively. In Section V, we consider the possibility that the effects of remittance flows on the stability of GDP growth may be nonlinear. A final section summarizes and concludes. The paper also contains a data appendix describing sources for the data used in the estimations as well as variable definitions.

II. DETERMINANTS OF GROWTH VOLATILITY

A stylized fact of cross-country growth performance is that growth rates are not very persistent (Easterly, Kremer, and Summers, 1993). This volatility in growth rates is important not only for its direct welfare effects, but also because it may affect the average growth rate itself, as mentioned above. Consequently, there is a growing literature attempting to explain growth volatility. The explanations that have been adduced to date tend to emphasize factors of three types: exogenous shocks, persistent characteristics of the domestic economic and policy environment that are responsible for generating or amplifying shocks, and deeper institutional factors making for social, political, and economic instability. We review each of these in succession, and conclude the section with a brief description of the effects of remittance flows on volatility that have been identified in the literature to date.

A. Exogenous Shocks

Easterly, Kremer and Summers (1993) note that the lack of persistence in growth rates in the face of substantial persistence in the types of explanatory variables typically included in cross-country growth regressions suggests an important role for low-persistence shocks in determining growth rates. Empirically, they find that changes in decade-average growth rates are highly correlated with changes in the terms of trade, with variations in civil strife (measured by war casualties on domestic soil), with vulnerability to debt crises, and with changes in inflows of external transfers as a share of GDP. These results have been confirmed with more recent data by Calderon, Loayza and Schmidt-Hebbel (2005). Using a sample of 76 countries over the period 1960-2000, they find that growth volatility is significantly affected by low-persistence external shocks. These include shocks to the terms of trade, to resource inflows, and to partner-country growth. Recent research has also highlighted an important effect of domestic policy shocks – especially higher volatility in discretionary fiscal spending measured as the standard deviation of cyclically adjusted government spending--for increasing output volatility (see Fatás and Mihov 2003, and Hakura, 2009).

B. Persistent Country Characteristics

Subsequent work has focused on the roles of more persistent economic characteristics on volatility. Such characteristics include country size, income per capita, openness to trade, share of government consumption in GDP, degree of financial development, and degree of integration with world capital markets.

Furceri and Karras (2007) argue that country size matters because larger economies tend to have a more diversified structure of production, and thus are less vulnerable to sector-specific shocks. Their diversified production structure should therefore make larger countries more stable. The sectoral composition of domestic production may also be affected by a country's level of development. Koren and Tenreyro (2004) argue that changes in income per capita are associated with patterns of sectoral specialization that have implications for macroeconomic volatility. Specifically, they find that as countries grow, they tend to concentrate production in less risky sectors. The degree of sectoral concentration in production also appears to decline initially with development, before flattening out and eventually reversing very gradually. Higher levels of income are also associated with reduced levels of country-specific risk, holding constant the structure of production. The upshot is that poor countries are more volatile because they have a less diversified production structure, because they specialize in more volatile types of production, and because they have other income-related characteristics that are associated with increased levels of domestic macroeconomic risk.

The role of trade openness has proven to be more controversial. For example, Rodrik (1998) notes that increased trade openness tends to be associated with a larger share of government consumption in GDP across countries, and explains this correlation as the outcome of a social mechanism to cope with macroeconomic risk: he argues that increased openness is associated with higher macroeconomic volatility, especially when exports are highly concentrated and the prices of export goods are themselves volatile. Thus, it is not just the variability of international commodity prices that matters, or how large a weight specific commodities carry in the country's export basket, but also how large exports are relative to the

size of the economy. The latter two factors are persistent characteristics of the domestic economy that determine its vulnerability to fluctuations in commodity prices. Rodrik argues that a large share of government consumption in GDP reduces risk, because the government sector is a "safe" sector in the sense that the level of government employment as well as of government purchases from the rest of the economy are relatively stable. He argues that more open economies can therefore achieve enhanced income stability by increasing the share of government consumption in GDP. The upshot is that increased trade openness, a larger share of exports devoted to primary commodities, and more volatile terms of trade should all be associated with increased macroeconomic volatility, while a larger share of government consumption in GDP should be associated with reduced volatility.[1]

Several authors have considered the roles of domestic financial development and capital account openness as determinants of volatility. Caballero (2000) argues that macroeconomic volatility in Latin America has been driven by two main factors: a low state of domestic financial development and weak links with international financial markets. Both Easterly, Islam and Stiglitz (2000) as well as Cecchetti, Lagunes and Krause (2005) support the view that domestic financial sector development tends to reduce volatility.[2] However, while Caballero (2000) considers that *weak* financial integration enhances volatility in Latin America, other authors have

[1] However, both components of Rodrik's hypothesis have been disputed by others. Easterly, Islam and Stiglitz (2000) note that the effect of trade openness on volatility may actually be ambiguous *ex ante*, since theory suggests that, while enhanced trade openness may leave a country more exposed to external shocks (as noted by Rodrik), it may be stabilizing in the face of domestic shocks. Moreover, government consumption has been shown to be volatile (Fatás and Mihov, 2003, and Hakura, 2009) as well as procyclical (Talvi and Vegh, Montiel and Serven 2005) in many developing countries which suggests that a larger share of government consumption in GDP may actually *enhance* rather than reduce macroeconomic volatility in such countries. Accordingly, the effect of the share of government consumption in GDP on growth volatility may depend on a country's income level.

[2] However, Easterly, Islam, and Stiglitz conclude that the effect of financial development may be nonlinear, weakening at higher levels of financial development

reached exactly the opposite conclusion. Those who argue that financial openness is destabilizing emphasize two characteristics of capital flows that tend to be destabilizing: they tend to be procyclical (Stiglitz, 2000), and international capital markets may often respond in a disproportionate manner to domestic shocks, as noted in the "sudden stop" literature.

C. The Institutional Environment

While budgetary institutions and financial sector development are two aspects of the domestic institutional environment that may affect macroeconomic volatility, several authors have emphasized that deeper aspects of the domestic institutional environment may be even more important in affecting volatility. Rodrik (1998) for example, points to the quality of domestic institutions of internal conflict management. These affect macroeconomic volatility through the country's response to external shocks. Such shocks often give rise to social conflict, and in countries with poor institutions of domestic conflict management, the result may be a growth collapse. This analysis points to indices of ethnic fragmentation, of democratic rights, and of the quality of government institutions, as potential "deep" empirical determinants of macroeconomic volatility. Acemoglu and others (2003) go even further in linking volatility to the quality of the domestic institutional environment. They argue that an institutional environment that places only weak constraints on politicians and political elites itself generates volatility, even in the absence of exogenous shocks. There is a variety of mechanisms that could generate this effect. For example, in the absence of such constraints, a turnover of power from one group to another is likely to imply the implementation of redistributive policies, which can be expected to destabilize aggregate economic performance. Moreover, since the opportunity to implement such policies implies that the group that obtains political power can make large economic gains for

itself by doing so, jockeying for political power is likely to be intense under these circumstances, generating social conflict that manifests itself in macroeconomic instability.

D. Remittance Flows

How do remittance flows fit into all this? The theoretical effects of remittance inflows on macroeconomic volatility are ambiguous in principle. The presence of remittance flows represents an additional dimension of macroeconomic openness, and to the extent that remittance flows are both exogenous and volatile, they would tend to induce volatility to the recipient economy much like volatility in the terms of trade or in capital flows. However, the evidence suggests that remittances are both relatively stable, compared to other types of external flows, and that they behave countercyclically (see Chami and others, 2003, 2008, and references therein). This being so, conditional on the quality of the domestic institutional environment, we would expect remittance flows to be macroeconomically stabilizing, in the same sense that countercyclical fiscal policy would be.

However, there are several *caveats* to this argument. First, to the extent that fluctuations in growth are driven by labor-supply responses to technology shocks, countercyclical remittance flows may actually tend to amplify those responses – e.g. if a positive technology shock elicits an increase in labor supply because the real wage is temporarily high, and if remittance flows contract in response to the resulting increase in domestic income, the negative income effect associated with the contraction in remittances may reduce household demand for leisure, thereby magnifying the increase in the supply of labor. Thus, if income effects on the supply of labor are

large and remittances are countercyclical, their presence may magnify volatility in GDP growth (see Chami and others, 2006).

Remittance flows may also affect volatility through effects on the quality of domestic institutions. The presence of remittance flows may enhance financial development in the recipient country, a factor which, as mentioned above, has been found to be stabilizing. On the other hand, at a more fundamental level, the availability of remittance income may undermine the quality of other domestic economic institutions. There is evidence, for example, that reliance on remittance flows may have an adverse effect on the quality of governance in the recipient countries (Abdih and others, 2008). If so, the recipient economy may be more susceptible to being destabilized by economic shocks, whether domestic or external in origin.

The evidence to date on the effects of remittance flows on volatility is limited and mixed. The IMF (2005) found that an increase in the share of remittance flows in GDP was associated with a (statistically and economically) significant reduction in volatility of GDP growth, suggesting that the stabilizing influence of countercyclical remittance flows on aggregate demand – and possibly the effects of such flows on domestic financial development – may outweigh their supply-side and institutional effects. These results were supported by Bugamelli and Paterno (2008), who found that remittance flows reduced growth volatility in a cross-section of 60 emerging and developing economies after controlling for trade and financial openness, financial development, and volatility of monetary policy. More recently, Craigwell, Jackman and Moore (2010), using a large country panel, found heterogeneous effects across various country groupings. On average (for the full sample), remittance flows helped to mitigate the effects of adverse output shocks, but exerted no significant influence on consumption and investment

volatility. For small island economies, they found that, while larger remittance flows tended to reduce output volatility, remittances played an important role in transmitting international business cycles (Jackman, Craigwell, and Moore, 2010). By contrast, Neagu and Schiff (2009), using a sample of 116 countries, find that remittance flows have been destabilizing or have had no effect on output volatility in 80 percent of the countries they examined.

Our own work is in the spirit of Bugamelli and Paterno (2008), but we build on their work by focusing on worker remittances (scaled by GDP) as the dependent variable, rather than the sum of remittances and employee compensation, by significantly expanding the set of control variables to reflect the findings of the literature reviewed in this section, by using panel data, by examining the robustness of our results to alternative estimation strategies and country samples, and by considering an alternative strategy to address the potential endogeneity of remittance flows, in the form of GMM estimation.[3]

III. ORDINARY LEAST SQUARES ESTIMATION

This section reports the results of cross-section OLS regressions explaining the standard deviation of real per capita GDP growth over the 1970–2004 period for a sample of 70 countries, initially including 16 advanced economies and 54 developing countries.[4] We focus on the pre-global financial crisis period because macroeconomic volatility increased in all countries in this period, which was also associated with widespread declines in remittance flows. Including this

[3] The important differences in the behavior of workers' remittances and employee compensation are described by Chami and others (2008), who emphasize the pitfalls in aggregating these two types of current account flows.

[4] Our sample is restricted by the availability of separate data on workers' remittances, rather than the sum of remittances and employee compensation, which are aggregated in the BOP accounts of a large number of countries.

period in the sample would therefore bias the results toward finding a negative relationship between remittances and volatility that could be spurious. Our concern is with the role of the ratio of workers' remittances to GDP in these regressions, but as indicated above, to avoid omitted variable bias we control for a large number of variables that have been used in other studies examining output volatility, as described in the previous section. Our control variables include relative income, relative income squared, terms of trade volatility, trade openness, financial openness, government consumption, institutional quality, an indicator of financial sector development, a trade concentration ratio, and an indicator of the commodity composition of exports (a data appendix contains data sources and variable definitions).

We begin with cross-section estimation. The explanatory variables are constructed as averages over the 1970–2004 period except for the relative income variable, which is measured by its value in 1970. We require that at least fifteen years of data are available to calculate the average of a variable. Also, the average of a variable is calculated including only those years for which the data are not missing for all the explanatory variables included in the regression. Table 1 reports output volatility and the average ratio of workers remittances to GDP over the 1970-2004 period for each country in the sample. The average remittance flow into the 70 countries over the 1970-2004 sample period is 1.7 percent of GDP, compared with a median flow of 0.4 percent of GDP. The three largest recipients of remittances relative to GDP in our sample over this period were, in order, Jordan (19 percent of GDP), Egypt (8.2 percent of GDP), and El Salvador (7 percent of GDP). The data show that some industrial countries also received substantial remittances (Portugal, 5.7 percent of GDP, Greece, 2.1 percent of GDP, Cyprus, 0.6 percent of GDP, and Spain, 0.5 percent of GDP). The average volatility of per capita output

growth is 4.4 percent for the 1980-2004 period and compares with a median of 3.6 percent. Table 2 provides descriptive statistics for all the explanatory variables included in the regressions.

As a first step, we estimate an OLS regression that includes all the possible explanatory variables in the regression. The results are reported in column 1 of Table 3. The remittance variable has a negative coefficient with a p-value of 0.12 percent. Column 2 differs from column 1 in that the former includes an interaction term between government consumption and an industrial-country dummy, to allow for the possibility that procyclicality in government spending in developing countries may cause the effect of the size of the government sector on macroeconomic volatility to differ in the two types of countries. This modification did not prove to be important and left the estimated effect of remittance flows on growth volatility unchanged. As seen in columns 1 and 2, the key control variables appear to be those related to the country's external trade – i.e., the share of primary commodities in exports, degree of trade openness, and terms of trade volatility. The point estimate of the coefficient on the ratio of worker remittances to GDP is negative in both cases, and is statistically significant at the 95 percent level when the effects of the share of government consumption in GDP are allowed to differ between industrial and developing countries (column 2).

Preferred specifications are obtained after dropping insignificant variables and restricting the countries included in the regression sample to be the same as for the regression that includes all of the explanatory variables. Column 3 drops all insignificant control variables except the government consumption variables from the regression and is our preferred OLS specification for the full sample. Among the control variables, only the trade and fiscal variables provide

significant explanatory power. The key result, however, is that the effect of workers' remittances continues not only to be negative and statistically significant, but essentially unchanged in magnitude. Thus, a higher ratio of remittances to GDP tends to reduce the volatility of real GDP growth, after controlling for other statistically significant determinants of growth volatility.

The full sample includes both industrial and developing countries, but as shown in column 4, this result is unchanged when the sample is restricted to developing countries, with the magnitude of the coefficient on the remittance variable essentially identical to that for the full sample. Indeed, the stabilizing effects of remittance flows are actually significantly stronger than these results would suggest, because the estimated coefficient of the remittance ratio is significantly affected by a single outlier. Specifically, Jordan is by far the largest remittance recipient in the sample, but also happens to be characterized by substantial volatility in GDP growth during the sample period. Omitting Jordan from the sample, as in column 5, almost doubles the absolute value of the coefficient of the remittance ratio in the full sample and increases its statistical significance to the 99 percent level. Finally, including a variable capturing discretionary fiscal policy volatility tends to weaken the effect of many of the explanatory variables, but the findings on the remittance variable are robust to the inclusion of the fiscal volatility variable (columns 6 and 7). Indeed, even though Jordan is excluded in these regressions because of lack of data, the coefficient of the remittance variable is comparable to that in column 5 and is significant at the 99 percent level of confidence.

The results of the cross-country OLS regressions therefore identify a negative partial relationship between workers' remittances and the volatility of output growth, and this

relationship can be estimated rather precisely. Giving this relationship a causal interpretation, an increase in the workers' remittances-to-GDP ratio of one percentage point would lead to a reduction of about 0.3 in the standard deviation of GDP growth, according to the preferred regression results. This represents a 7 percent reduction in growth volatility relative to the average in the sample.

IV. GENERALIZED METHOD OF MOMENTS PANEL ESTIMATION

Such a causal interpretation may not be warranted, of course. If macroeconomic volatility increases emigration, or if migrant remittances are motivated by altruism—a desire by migrants to compensate family when they encounter bad times, including an uncertain economic environment—remittance inflows may increase in response to increased macroeconomic volatility in the recipient country. In this case, estimates of the effect of remittances on output volatility derived from OLS estimation may be biased upwards (making them less negative or more positive than the underlying true parameter). If this bias is present, therefore, the stabilizing effects of remittance flows may actually be *understated* by the results of the last section.

Research on the macroeconomic effects of remittances has addressed this problem through the use of instrumental variables. Two key features govern the selection of an instrument for remittances: the instrument must be correlated with remittances, and it must satisfy an exclusion restriction—its effect on individual country growth volatility must operate solely through its effect on remittances and should not be otherwise correlated with output volatility in

individual countries.[5] Previous authors have used time-invariant variables such as proxies for geographic distance from host countries such as latitude (e.g., Bugamelli and Paterno, 2008), or migrant-weighted GDP in host countries (Aggarwal and others, 2006). However, the former is likely to be weakly correlated with remittance flows, and the latter is unlikely to satisfy exclusion restrictions, since recipient countries are likely to be economically linked to host countries through a variety of channels in addition to remittance flows.

In light of these potential pitfalls, we have opted instead for a GMM panel estimation approach. A GMM panel method has several advantages over OLS as a statistical approach to examining the relationship between remittances and output volatility. First, estimation using panel data—that is, pooled cross-section and time series data—allows one to exploit the time series nature of the relationship between remittances and output volatility. Since the magnitude of remittance flows has changed substantially over time, this is an important advantage. Second, the GMM panel estimator controls for the potential endogeneity of the remittance variable as well as the other explanatory variables. The GMM regression specifications reported in the paper control for the endogeniety of the remittances-to-GDP and the trade openness variables (in line with previous studies that have included trade openness, e.g. Calderon and others, 2005). The results reported here are robust to controlling only for endogeneity of the remittances-to-GDP ratio.

In order to conduct the GMM estimations, the data are organized into a panel consisting of 70 countries over the 1980-2004 period (the 1970s data are dropped in the panel estimations

[5] Hakura (2009) shows that output volatility in developing countries is mostly explained by country-specific effects. Therefore, a downturn in one developing country which could trigger higher remittances is not highly correlated with high output volatility in all other low-income countries which would trigger higher total remittances.

because the remittance data are missing for many countries during those years). The data are averaged over non-overlapping five-year periods so that -- data permitting-- there are five observations per country (1980-1984, 1985-1989, 1990-1994, 1995-1999, and 2000-2004). Table 4 provides a description of the data.

The regression is specified as follows:

$$v_{i,t} = \beta' X_{i,t} + \eta_i + \varepsilon_{i,t}$$

where $v_{i,t}$ is the volatility of output growth, measured as the standard deviation of the growth rate over the relevant five-year period; *X* represents the set of explanatory variables discussed previously; η_i is an unobserved country-specific effect; ε is a time- and country-specific error term; and the subscripts i and t represent country and time period, respectively. Time period dummies are also included to capture period-specific effects.

The standard assumptions that (i) the error term is not serially correlated; and (ii) the explanatory variables are weakly exogenous (i.e. they are uncorrelated with future realizations of the error term), yield the following moment conditions:

$$E[X_{i,t-s} \cdot (\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \quad \text{where } i = 1,\ldots, N,\ t = 3,\ldots,T \text{ and } s \geq 2.$$

This condition allows the use of suitably lagged levels of the variables as instruments, after the equation has been first-differenced to eliminate the country-specific effects. The explanatory variables are the same as in the case of the OLS cross-section regression estimation of the last section, with the exception of the indicator of the commodity composition of exports, which is fixed for each country over time and, therefore drops out in the first differenced equations.

It is worth noting that, while the GMM difference estimator has important advantages for our purposes, it is also subject to some important shortcomings. Specifically, the difference estimator has been found to have poor finite sample properties (bias and imprecision) when the lagged levels of the series are only weakly correlated with subsequent first differences, and therefore make weak instruments. This has been found to be the case when the explanatory variables are highly persistent or close to a random walk. To reduce the potential biases and imprecision associated with the difference GMM estimator, an extended GMM estimator is used that combines in a system the regression in differences with one in levels (see Blundell and Bond, 1998). The instruments for the regressions in differences are suitably lagged levels of the series, as described above. The instruments for the regressions in levels are in turn suitably lagged first differences of the variables. These are appropriate instruments assuming that $E[\Delta x_{i,t}\eta_i] = 0$, which yields the additional moment conditions:

$$E[\Delta x_{i,t-s}(\eta_i + \varepsilon_{i.t})] = 0 \text{ for } s = 1.$$

The consistency of the GMM estimator depends on the validity of the instruments. We test the validity of the instruments using three specification tests. The first is the standard Sargan test of

overidentifying restrictions, which tests the overall validity of the instruments by analyzing the sample analog of the moment conditions used in the estimation process. The second test, the difference Sargan test, examines the validity of the additional moment conditions imposed in the levels equations by the system GMM estimator. The third test examines the hypothesis that there is no second-order serial correlation in the first-differenced residuals.

The system panel results are reported in Table 5. The table reports five sets of estimates. In the first column, we present OLS panel estimates for the full sample. The signs of the parameter estimates are the same as those in the cross-section regressions. Most importantly, the coefficient on the remittance ratio remains negative, though it is not significant at standard levels in this case. The second column presents within-group estimates, which eliminate cross-sectional variation by introducing country fixed effects. These estimates yield similar results, except that the control variable capturing trade openness now becomes significant. Columns 3-5 report the GMM system estimates, with columns 3 including the full sample, column 4 excluding Jordan and column 5 reporting results only for developing countries. These results confirm the findings from the cross-section OLS regressions. The remittances variable is negative and statistically significant at standard levels in all three of these regressions. The magnitude of the effect of remittances on volatility is very similar across these three regressions, and the pattern of coefficients on the control variables is similar as well. Thus, the full-sample GMM results are robust to dropping industrial countries from the sample and excluding Jordan. Notice in particular that while the coefficient on the remittance variable is very similar across the three samples used in the GMM regressions, it is much larger in absolute value in the GMM

regressions than in the OLS and within-group regressions, supporting our conjecture that OLS estimation tends to understate the effects of remittance flows on growth volatility.

The panel GMM system estimates pass the specification tests. The Hansen test and the difference Sargan tests, which focus on the additional instruments used by the system, do not reject the validity of the instruments. The additional instruments in the system GMM therefore seem to be valid and highly informative. The serial correlation tests also do not reject the econometric model due to serial correlation.

V. TESTING FOR NONLINEAR EFFECTS

There is some evidence that the macroeconomic effects of worker remittances in the recipient economies may depend on the size of remittance flows – i.e., the effects of the remittance variable may be nonlinear (see Abdih and others, 2008, Chami and others, 2006 and 2008). If this nonlinearity extends to the effects of remittance inflows on the volatility of GDP growth, the results of the previous section may disguise some heterogeneity in the stabilizing effects of remittance inflows. Chami and others (2006, 2008), using a stochastic dynamic general equilibrium model with endogenous labor supply, show that at a high level of remittance-to-GDP ratio may actually enhance output volatility due to the negative impact of these flows on the labor supply of remittance-dependent households. Abdih and others (2008) show that high levels of remittance-to-GDP may actually lead to higher levels of corruption. One possible explanation could be that countries that over a long sample period had high remittances have felt less need for reforms and thus have left the economy with a narrow base prone to exogenous shocks.

To test for the existence of a nonlinear effect of remittances on growth volatility using the OLS and GMM system estimators, the remittance variable is interacted with a dummy variable that takes the value of 1 for remittance ratios greater than r^* percent and zero otherwise, and this interaction term is included as an additional explanatory variable in the regressions reported earlier. Remittance cutoffs from 0.5 to 0.5 percent below the maximum value of the remittance ratio to GDP in the sample (the highest feasible cutoff) are explored, by increments of 0.5 percent. The test for no nonlinear effect amounts simply to the test of the null hypothesis that the coefficient on the interactive variable is equal to zero. Under OLS, the optimal cutoff is the one that minimizes the residual sum of squares. Under the GMM system estimator, the optimal cutoff is the one that minimizes the Hansen test statistic when the same instrument set is used in all the equations. The tests for the optimal cutoff instrument the interactive remittance variable using lagged levels and lagged differences of the square of the remittances to GDP ratio in the differenced and level regressions respectively. Once the optimal cutoff is selected, the instruments of the interactive remittance variable are allowed to be the lagged level and differences of the variable itself.

The OLS results are reported in Table 6, for the full sample and excluding Jordan. The optimal cutoff value for the remittance variable that minimized the sum of squared residuals in the regression proved to be 2 percent of GDP. Using this cutoff value generated results that were very similar to those derived previously. Again, all of the control variables have the expected sign and the signs of the coefficients on both remittance variables (above and below the cutoff value) are negative and significant at the one percent level. The intriguing result is that the effect of remittance inflows on growth volatility indeed appears to be highly nonlinear: in countries

where remittance inflows exceed 2 percent of GDP an additional percentage point of GDP of remittance inflows has a much weaker moderating effect on growth volatility than in countries that receive inflows of less than 2 percent of GDP. Thus remittance inflows are stabilizing on average for all recipients, but the stabilizing effects of remittance inflows appear to be achieved rather quickly (i.e., at relatively low remittance-to-GDP ratios) and to weaken when inflows are very large.

The GMM estimates are reported in Table 7, once again for panels with the full sample, excluding Jordan, and only including developing countries. The nonlinear effect appears to be even stronger in the GMM estimates than in the OLS estimations. The stabilizing effects of an additional percentage point of remittance inflows on the volatility of GDP growth appear to be almost a full order of magnitude smaller in countries that receive inflows in excess of 2 percent of GDP than in countries with inflows below 2 percent of GDP.

VI. AN APPLICATION: REMITTANCES AND OUTPUT STABILITY IN THE MIDDLE EAST AND NORTH AFRICA

The nonlinearity in the effects of remittances on growth volatility may play an important role in interpreting the welfare effects of remittance flows in specific contexts. As an example, this section considers the contribution of remittance receipts to macroeconomic stability in countries in the Middle East and North Africa (MENA).

Remittance flows into MENA countries have been large and relatively stable during the 1975−2004 period. However, this is where the nonlinearity in the effects of remittances on growth stability becomes important. Because the level of remittance inflows exceeded 2 percent

of GDP throughout the period, we estimate that the contribution of such inflows to reducing volatility has in fact been *lower* for countries in the MENA region than for developing countries elsewhere over much of the 1975−2000 period (Table 8). Developing countries in Asia and the Western Hemisphere are only now starting to receive remittances in excess of 2 percent of GDP, suggesting that the volatility-reducing effects of remittances in these regions may also be declining.

Nonetheless, impacts on volatility can remain important when changes in remittance flows are large, even when countries are already large inflow recipients. For example, many MENA countries receive a large amount of their remittance inflows from GCC oil exporting countries. Consequently, periods with high oil prices have been associated with substantial increases in remittance flows to these countries, and the most recent period of high oil prices was no exception. Remittances increased in MENA countries such as Pakistan (from 2 percent of GDP in 2001 to 4 percent of GDP in 2006) and Egypt (from 3 percent of GDP in 2001 to 5 percent of GDP in 2006) by about 2 percent of GDP over the last five years. Applying the relevant coefficient estimate from Table 7, this suggests that the increase in remittance flows may have contributed to a reduction in growth volatility by about 0.4 percent for these countries respectively in these years.

VII. SUMMARY AND CONCLUSIONS

We have provided evidence that remittance flows have indeed contributed on average to reducing the volatility of GDP growth in remittance-receiving countries, even after controlling for a large number of other potential determinants of growth volatility and taking into account the possible effect that growth volatility may itself exert on remittance flows. This provides an

important channel through which remittance inflows may affect both growth and welfare in remittance-receiving countries.

However, the evidence on the existence of threshold effects suggests that the stability-enhancing effects of remittances appear to be achieved rather quickly, so whatever benefits may be associated with very large remittance flows, enhanced macroeconomic stability may not loom large among them. This emphasizes the importance of strengthening macroeconomic resilience through other means in countries that are very large recipients of remittances. Fortunately, remittance resources may themselves provide the means to do so, including possibly through broad-based taxation of consumption, increases in which have been financed in many countries from remittance inflows. An efficient VAT with limited exemptions could net for the domestic government a substantial share of the resources received through remittance inflows by countries that are large remittance recipients. These resources could be used to boost the human capital of the domestic population by improving health and education services, to alleviate infrastructure bottlenecks, and to improve the business climate so as to maximize the spillover effects of remittance inflows to the broader economy.

Table 1: Output Volatility and Workers Remittances

Country	Output volatility (std. deviation of per capita output growth, 1970–2004)	Workers remittances to GDP, averages 1970–2004	Country	Output volatility (std. deviation of per capita output growth, 1970–2004)	Workers remittances to GDP, average 1970–2004
Chile	6.7	0	Niger	7.2	0.4
Denmark	2.2	0	Spain	1.7	0.5
Finland	3.5	0	Paraguay	3.5	0.5
Iran	8.7	0	New Zealand	2.3	0.5
Kenya	3.1	0	Cyprus	5.2	0.6
Malaysia	2.8	0	Colombia	1.9	0.9
Papua New Guinea	14.5	0	Peru	5.8	1.0
Syria	6.9	0	Mexico	3.6	1.0
United States	2.8	0	Uganda	4.7	1.2
Venezuela	5.6	0	Philippines	4.2	1.3
Cote d`Ivoire	6.1	0	Nigeria	6.1	1.4
Japan	2.0	0.004	Malta	5.5	1.5
Ireland	3.3	0.01	India	2.2	1.5
Thailand	3.1	0.01	Togo	5.3	1.6
Norway	1.9	0.01	Guatemala	2.2	1.6
Malawi	6.7	0.02	Ecuador	3.4	1.8
Gabon	7.1	0.02	Greece	2.5	2.1
Zimbabwe	9.7	0.02	Turkey	4.1	2.1
Hungary	3.6	0.02	Senegal	5.0	2.5
Sweden	2.0	0.02	Sudan	4.4	2.7
Argentina	6.4	0.04	Honduras	3.9	2.8
France	1.4	0.1	Mali	5.6	3.9
Republic of Korea	4.3	0.1	Tunisia	1.5	4.2
Ethiopia	10.3	0.1	Dominican Republic	3.5	4.7
Madagascar	3.4	0.1	Sri Lanka	3.1	5.0
Cameroon	7.4	0.1	Nicaragua	3.9	5.0
Austria	2.0	0.2	Pakistan	2.0	5.0
Italy	1.9	0.2	Jamaica	3.5	5.2
Ghana	7.3	0.2	Burkina Faso	3.5	5.7
Panama	4.7	0.2	Portugal	3.1	5.7
Trinidad &Tobago	9.2	0.3	Morocco	4.8	6.6
Belgium	1.7	0.3	El Salvador	2.9	7.0
Indonesia	4.2	0.3	Egypt	2.7	8.2
Bolivia	1.8	0.4	Jordan	6.8	19.0
Poland	3.1	0.4			
Costa Rica	3.5	0.4	Average	4.4	1.7
			Median	3.6	0.4

Table 2: Descriptive Statistics of Dependent and Explanatory Variables 1970 – 2004
(70 Observations)

Variable	Mean	Maximum Value	Minimum Value	Standard Deviation
Output Volatility (standard deviation of per capita GDP growth)	4.4	14.5	1.4	2.4
Workers' remittances to GDP	1.7	19.0	0	2.9
Relative initial income (income relative to U.S. in 1970)	0.3	1.0	0.03	0.3
Relative initial income squared	0.1	1.0	0.001	0.2
Primary commodity export composition	38.1	98.2	0.8	30.2
Trade concentration ratio	1.9	4.2	0.0	0.9
Terms of trade volatility	11.3	29.4	1.7	6.7
Trade openness to GDP	62.9	215.9	11.9	35.2
Private credit to GDP	0.4	1.5	0.03	0.3
Bureaucracy quality	6.7	12	0	3.1
Financial openness (the stock of foreign assets and liabilities to GDP)	130.7	721.8	31.2	106.4
Government consumption to GDP	20.7	54.8	7.3	7.7
Government consumption to GDP*industrial country dummy	4.3	25.7	0.0	8.2

Table 3: Ordinary Least Squares Regression Results
Dependent Variable is: Volatility of Output Growth, 1970 – 2004

	OLS (1)	OLS (2)	OLS (3)	OLS (4)	OLS (5)	OLS (6)	OLS (7)
Workers remittances to GDP	-0.17	-0.17 *	-0.164*	-0.17	-0.31**	-0.31**	-0.36**
	(0.11)	(0.10)	0.098	(0.11)	(0.11)	(0.12)	(0.12)
Relative initial income (1970)	1.27	1.61					
	(3.92)	(3.80)					
Relative initial income squared	-3.45	-2.74					
	(3.70)	(3.42)					
Primary commodity export composition	0.02 *	0.02	0.016*	0.02*	0.02**	0.02**	0.01
	(0.01)	(0.01)	0.009	(0.01)	(0.01)	(0.01)	(0.01)
Trade concentration ratio	-0.24	-0.29					
	(0.34)	(0.34)					
Terms of trade volatility	0.09 *	0.09 *	0.09*	0.09*	0.07*	0.06	0.04
	(0.05)	(0.05)	0.046	(0.05)	(0.04)	(0.04)	(0.03)
Trade openness to GDP	0.02 **	0.01 *	0.012*	0.01*	0.01*	0.01	0.01
	(0.01)	(0.01)	0.006	(0.01)	(0.01)	(0.01)	(0.01)
Private credit to GDP	-1.00	-0.68					
	(1.05)	(0.98)					
Bureaucracy quality	0.09	0.12					
	(0.19)	(0.20)					
Financial openness	-0.002	0.00					
	(0.00)	(0.00)					
Government consumption to GDP	0.06	0.06	0.066*	0.07	0.04	0.06	0.06
	(0.04)	(0.04)	0.038	(0.04)	(0.04)	(0.04)	(0.04)
Government consumption to GDP*industrial country dummy		-0.06	-0.064**		-0.07**	-0.09**	-0.01
		(0.06)	0.028		(0.03)	(0.03)	(0.03)
Volatility of discretionary fiscal policy							1.48**
							(0.46)
Constant	1.28	1.19	1.189	1.15	2.06*	2.19*	-0.54
	(2.17)	(2.17)	1.061	(1.23)	(1.11)	(1.24)	(1.11)
R-squared	0.39	0.40	0.37	0.26	0.40	0.40	0.46
Number of observations	70	70	70	54	69	61	61
Countries excluded				Industrial countries	Jordan		

Notes: Output growth volatility is the standard deviation of real GDP per capita growth over 1970-2004. Robust standard errors are in parentheses. See Data appendix for variable definitions. A * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level.

Table 4: Panel Data Description, 1980 – 2004
(5-year period observations, 330 observations)

Variable	Mean	Maximum Value	Minimum Value	Standard Deviation
Output Volatility (standard deviation of per capita GDP growth)	3.4	18.7	0.3	2.7
Workers remittances to GDP	1.8	22.3	0.0	3.4
Terms of trade volatility	9.6	57.1	0.6	8.2
Trade openness to GDP	64.5	227.1	10.3	38.8
Government consumption to GDP	20.7	59.3	4.7	8.2
Government consumption to GDP*industrial country dummy	4.1	27.6	0.0	8.1

Table 5: Panel Regression Results

Dependent Variable is: Volatility of Output Growth, 1980 – 2004

(5-year period observations)

	OLS Levels		Within Groups		GMM-SYS		GMM-SYS		GMM-SYS	
Workers remittances to GDP	-0.06		-0.08		-0.17	**	-0.19	**	-0.15	*
	(0.05)		(0.06)		(0.08)		(0.07)		0.09	
Terms of trade volatility	0.10	**	0.10	**	0.09	**	0.08	**	0.08	**
	(0.03)		(0.03)		(0.03)		(0.03)		0.03	
Trade openness to GDP	0.00		0.02	**	0.01		0.01		0.00	
	(0.00)		(0.01)		(0.01)		(0.01)		0.01	
Government consumption to GDP	0.03		0.05		0.03	*	0.02		0.03	
	(0.02)		(0.05)		(0.02)		(0.02)		0.02	
Government consumption to GDP*industrial country dummy	-0.07	**	0.17	*	-0.08	**	-0.08	**		
	(0.02)		(0.10)		(0.02)		(0.02)			
Constant	2.42		-0.35		2.31	**	2.68	**	3.0	**
	(0.69)		(1.16)		(0.81)		(0.88)		0.9	
Diagnostic statistics										
R-squared	0.24		0.14		-		-		-	
# observations	330		330		330		325		258	
# countries	70		70		70		69		54	
Countries excluded							Jordan		Industrial countries	
Minimum # observations per country	2		2		2		2		3	
Average # observations per country	4.7		4.7		4.7		4.7		4.8	
Maximum # observations per country	5		5		5		5		5	
Hansen test	-		-		5.21		6.69		5.50	
A-B test for AR(1)	-		-		-3.26	**	-3.27	**	-3.14	**
A-B test for AR(2)	-		-		-1.12		-1.09		-0.92	

Notes: Output growth volatility is the standard deviation of real GDP per capita growth over five year periods. Robust standard errors are in parentheses. See Data appendix for variable definitions. A * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level. Period dummies are included in the estimations

Table 6: Nonlinear Ordinary Least Squares Regression Results

Dependent Variable is: Volatility of Output Growth, 1970 – 2004

	OLS	OLS
Workers remittances to GDP(wrgdp)*dummy =1 if wrgdp <=2% (α)	-1.41 **	-1.51 **
	(0.51)	(0.50)
Workers remittances to GDP (wrgdp) *dummy =1 if wrgdp >2% (β)	-0.21 **	-0.35 **
	(0.10)	(0.12)
Terms of trade volatility	0.10 **	0.08 *
	(0.05)	(0.04)
Trade openness to GDP	0.01 **	0.01
	(0.01)	(0.01)
Primary commodity export composition	0.01	0.02 *
	(0.01)	(0.01)
Government consumption to GDP	0.08 **	0.06
	(0.04)	(0.04)
Government consumption to GDP*industrial country dummy	-0.08 **	-0.08 **
	(0.03)	(0.03)
Constant	1.33	2.14 **
	(0.98)	(1.04)
R-squared	0.43	0.45
Number of observations	70	69
F test α=β	7.1 **	6.9 **
Countries excluded		Jordan

Notes: Output growth volatility is the standard deviation of real GDP per capita growth over 1970-2004.
Robust standard errors are in parentheses. See Data appendix for variable definitions.
A * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level.

Table 7: Nonlinear GMM System Estimation

Dependent Variable is: Volatility of Output Growth, 1980 – 2004

(5-year period observations)

Workers remittances to GDP(wrgdp) *dummy=1 if wrgdp <=2%	-1.43	**	-1.59	**	-1.45	**
	(0.69)		(0.68)		(0.49)	
Workers remittances to GDP (wrgdp) * dummy=1 if wrgdp>2%	-0.19	**	-0.17	**	-0.19	*
	(0.09)		(0.08)		(0.11)	
Terms of trade volatility	0.10	**	0.10	**	0.09	**
	(0.03)		(0.03)		(0.03)	
Trade openness to GDP	0.011		0.01		0.00	
	(0.008)		(0.01)		(0.01)	
Government consumption to GDP	0.03	*	0.03		0.03	
	(0.02)		(0.02)		(0.02)	
Government consumption to GDP*industrial country dummy	-0.09	**	-0.09	**		
	(0.02)		(0.02)			
Constant	2.32	**	2.39		3.09	**
	(0.89)		(0.89)		0.88	
Diagnostic statistics						
# observations	330		325		258	
# countries	70		69		54	
Minimum # observations per country	2		2		3	
Average # observations per country	4.7		4.71		4.78	
Maximum # observations per country	5		5		5	
Countries excluded			Jordan		Industrial countries	
Hansen test	12.18		13.41		8.04	
A-B test for AR(1)	-3.34	**	-3.34	**	-3.26	**
A-B test for AR(2)	-0.98		-0.92		-0.79	

Notes: Output growth volatility is the standard deviation of real GDP per capita growth over five year periods. Robust standard errors are in parentheses. See Data appendix for variable definitions. A * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level. Period dummies are included in the estimations.

Table 8: Estimated Impact of Remittances on Volatility

	Developing Asia	Industrial countries	MENA	Transition countries	Africa	Western Hemisphere
1975-1979	-0.64	-1.45	-0.93		-0.7	-0.43
1980-1984	-1.99	-1.67	-1.10		-0.8	-0.56
1985-1989	-1.95	-1.35	-0.89	0	-1.0	-1.20
1990-1994	-2.13	-1.02	-0.80	-0.08	-1.2	-2.39
1995-1999	-2.56	-0.75	-0.79	-0.37	-1.4	-0.52
2000-2004	-0.54	-0.52	-0.86	-0.71	-2.8	-0.88

Data Appendix

This appendix provides the definition and data sources for the variables used in the regressions that are reported in the paper. It also defines the country groupings. With the exception of the output volatility and the terms of trade volatility variables, the data are averaged over the 1970–2004 period, unless otherwise indicated, for the cross-section OLS regressions. For the variables that are included in the GMM panel estimations outside of the volatility variables, the data are averaged over non-overlapping five-year periods (1980-1984, 1985-1989, 1990-1994, 1995-1999, and 2000-2004).

A. Data Definitions and Sources

Variables included in the preferred regression specification

Volatility of per capita output growth is defined as the standard deviation of annual real GDP per capita growth over the 1970–2004 period in the OLS cross-section regressions and over each 5-year period in the GMM estimations. Per capita real GDP growth is measured using data on real per capita GDP in constant dollars (international prices, base year 2000) obtained from the Penn World Tables (PWT), Version 6.2.

Workers remittances is the ratio of workers remittances to GDP. The source of the data is the World Bank's World Development Indicators.

Terms of trade volatility is measured as the standard deviation of the annual change in the terms of trade over the 1970–2004 period in the OLS cross-section regressions and over each 5-year period in the GMM estimations. The source of the data is the IMF's WEO database.

Trade openness is defined as the sum of imports and exports of goods and services divided by GDP in constant 2000 prices. The source of the data is the Penn World Tables, Version 6.2.

The *commodity export composition* is the share of primary commodities in total exports. For each country, the average share of primary commodity exports in total exports over the 1999-2004 period is calculated. The calculations are based on information on 44 commodities. The source of the data is the UN Comtrade database.

Government consumption is the ratio of government consumption to GDP in constant 2000 prices. The source of the data is the Penn World Tables (PWT), Version 6.2.

Variables not included in the preferred regression specification

Relative income is the level of real per capita income relative to the United States (squared). The data on real per capita GDP in constant 2000 prices is obtained from Penn World Tables, Version 6.2.

Relative income squared is the square of relative income.

Trade concentration ratio is the ratio of exports to a country's three largest trading partners in total exports. The source of the data is the IMF's Direction of Trade Statistics.

Financial openness is defined as the ratio of the stock of foreign liabilities and foreign assets to GDP. The source of the data is Lane and Milesi-Ferretti (2006).

Financial sector development is proxied by the average ratio of private sector credit to GDP. The source of the data is Beck, Demirgüç-Kunt, and Levine (2006).

Institutional quality is proxied by an indicator of bureaucracy quality—the strength and expertise of the bureaucracy to govern without drastic changes in policy or interruptions in government services. Alternative indicators of institutional quality also examined in the paper include the following: (1) an index of corruption—the degree of all forms of corruption such as patronage, nepotism, and suspiciously close ties between politics and business; (2) an index of the rule of law—the strength and impartiality of the legal system and the extent of popular observance of the law; and (3) an aggregate index of institutional quality constructed as the equally weighted average of the bureaucracy quality, corruption, and rule of law indices. The indices are reported in the International Country Risk Guide. Each index is constructed as the average over the 1984-2005 period. The indices are re-scaled from 1 to 12, where high values indicate good institutions.

Volatility in discretionary fiscal spending is measured as the standard deviation of cyclically-adjusted government spending over the 1960–2000 period from Fatás and Mihov (2003).

B. Country Coverage

The section lists all the countries included in the paper. The set of countries included is determined by the availability of the data for all the explanatory variables.

Industrial countries (16):
Austria, Belgium, Cyprus, Denmark, Finland, France, Greece, Ireland, Italy, Japan, New Zealand, Norway, Portugal, Spain, Sweden, and the United States.

Developing countries (54):

Africa
Burkina Faso, Cameroon, Cote d'Ivoire, Ethiopia, Gabon, Ghana, Kenya, Madagascar, Malawi, Mali, Niger, Nigeria, Senegal, Togo, Uganda, and Zimbabwe.

Asia
India, Indonesia, Republic of Korea, Malaysia, Philippines, Sri Lanka, and Thailand.

Middle East and North Africa

Egypt, Iran, Jordan, Malta, Morocco, Pakistan, Sudan, Syria, Tunisia, and Turkey.

Transition countries
Hungary and Poland.

Western Hemisphere
Argentina, Bolivia, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Papua New Guinea, Paraguay, Peru, Trinidad & Tobago, and Venezuela.

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