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Rainfall, financial development, and remittances: Evidence from Sub-Saharan Africa ☆

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ABSTRACT

We use annual variations in rainfall to examine the effects that exogenous, transitory income shocks have on remittances in a panel of 41 Sub-Saharan African countries during the period 1970–2007. Our main finding is that on average rainfall shocks have an insignificant contemporaneous effect on remittances. However, the marginal effect is significantly decreasing in the share of domestic credit to GDP. So much so, that at high levels of credit to GDP rainfall shocks have a significant negative effect on remittances, while at low levels of credit to GDP the effect of rainfall on remittances is significantly positive.

1. Introduction

For many developing countries and most importantly for Sub-Saharan African countries, remittances constitute a significant source of foreign exchange and income. According to the World Bank, "tens of millions of African migrants scattered around the world could mobilize more than $100 billion a year to help develop the impoverished continent". The World Bank says "there's around $40 billion a year in officially recorded remittances—cash sent by migrants back to their home countries—and an estimated $50 billion in diaspora savings that could be leveraged for low-cost project finance".[1] Given the economic significance of remittances to the developing world, the causes of remittances to these countries is an issue of key importance for both academics who study the determinants of economic growth in the developing world and economic policy makers. In particular, for the economic policy response to transitory income shocks it is key to understand whether the response of remittances to transitory income shocks is positive, negative, or zero.

Obtaining an estimate of the causal effect that transitory income shocks have on remittances is complicated by a possible reverse causal effect of remittances on income. Remittances may have a positive effect on income if they are used to increase investment, yet they could equally have a negative income effect if they are spent to finance consumption (inducing a real exchange rate appreciation) or lead to a reduction in labor supply because of positive wealth effects.[2] The empirical literature on remittances is well aware of this simultaneity problem and has addressed it using instrumental variables techniques.[3] However, a second key issue when dealing with identifying the causal relationship between transitory income shocks and remittances that has not received sufficient attention in the literature is whether the transitory change in income is due to a transitory change in productivity, or whether it is due to a transitory but abrupt change in the capital stock that could be the consequence of events such as natural disasters or wars. The reason why this distinction matters is that basic economic theory tells us that beyond the transitory change in income, it is the marginal product of capital that is relevant for the decision to send remittances if these remittances are driven by an investment motive. If the remittances are on the other hand driven by an insurance motive, then it is solely the transitory nature of the income shock that matters. At the macroeconomic level, there are events (for example, natural disasters or wars) where a decrease in income may be associated with an increase in the marginal product of capital. Observing an average within-country relationship between transitory income changes and

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[1] See http://www.smartmoney.com/news/on/?story=on-20110330-000243.

[2] See for example Amuedo-Dorantes and Pozo (2006), Bansak and Chezum (2009), or Acosta et al. (2009).

[3] See for example Yang (2008) and Yang and Choi (2007).

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remittances does not allow to distinguish, therefore, whether at the macroeconomic level remittances are driven by an investment, an insurance motive, or both.[4]

The starting point of our empirical analysis of Sub-Saharan African countries is that year-to-year variation in rainfall is a shock to agricultural productivity. According to the World Development Indicators (2010), the average share of agriculture in value added is about one third in the Sub-Saharan African countries. Hence, year-to-year variation in rainfall can have large effects on aggregate incomes per capita and on the return to capital, that do not go in opposite directions, through rainfall's effect on agricultural productivity. Moreover, year-to-year variation in rainfall is a plausibly exogenous shock to Sub-Saharan African economies that is of highly transitory nature: the sample average AR(1) coefficient on rainfall is 0.17 and a distributed lag model shows that the significant effect on income per capita vanishes after about one year.

Our panel fixed effects analysis that uses the within-country variation in remittances and rainfall yields two main results. First, year-to-year variations in rainfall have on average an insignificant contemporaneous effect on remittances to Sub-Saharan African countries. This result is robust to controlling for country and year fixed effects, country-specific linear time trends, as well as the exclusion of extreme rainfall observations (i.e. droughts and floods), a distributed lag model that allows to distinguish short-run from medium/long-run responses, and a dynamic panel data model that controls for adjustment dynamics in remittances.

Our second main finding is that the marginal effect of transitory rainfall driven income shocks on remittances significantly varies across Sub-Saharan African countries' GDP share of domestic credit to the private sector. This difference in marginal effects is so strong that at high levels of credit to the private sector transitory increases in income had a significant negative effect on remittances. Hence, while in countries with low domestic private capital remittances responded significantly positively to transitory income shocks, in countries where domestic private capital as a share of GDP was relatively high the remittance flow response was significantly negative.

One possible interpretation of our findings is that they are consistent with an investment motive of remittance flows. The reason is that, if farmers' ability to obtain finance is a function of their wealth then a positive rainfall shock that increases farmers' income will slacken finance constraints and lead to an increase in investment. Therefore, when domestic capital to the private sector is thin, so that the percentage share of domestic private sector finance for each investment project is small and the percentage share of remittance finance is relatively large, a positive rainfall shock that increases investment will induce a particularly large remittance response (which, according to the investment motive, has the purpose to partially finance investment projects). On the other hand, as the percentage share of domestic private sector finance increases, the role of remittances in exploiting domestic investment opportunities diminishes. Thus, an increase in domestic finance to the private sector makes it less likely that the observed remittance flow response behaves as if it follows an investment motive.

Given this interpretation of why domestic credit to the private sector plays an important role in shaping the effect of rainfall on remittance flows, it is important to note that our findings are not inconsistent with the presence of an insurance motive of remittances. This is because in Sub-Saharan African countries with relatively high domestic credit to the private sector (where the investment motive should be less relevant as argued above) we find that the remittance response is significantly negative. Hence, in Sub-Saharan African countries where investors have relatively good access to credit, the obtained remittance response to exogenous rainfall shocks is consistent with an insurance motive of remittance flows.

There exist several papers on the determinants of remittances that are related to our study. Using a sample of middle and low income countries and focusing on cross-country variation Freund and Spatafora (2008) show that remittances are significantly lower in countries where transaction costs are higher. Sayan (2006) investigates the business-cycle behavior of remittances for 12 developing countries and fails to find strong evidence for a significant average countercyclical relationship. Sayan's study does not use exogenous, transitory rainfall shocks to examine the effects that within-country changes in income have on remittances however. On the other hand, Yang (2008) documents that exogenous income shocks due to hurricanes lead to a significant increase in workers' remittances to poor countries.

Yang's (2007) study and focus on hurricanes is closely related to our focus on rainfall driven income shocks. This is because hurricanes, like rainfall, are a transitory shock to income. However, a crucial difference between rainfall and hurricanes is that the later has a large negative (destruction) effect on the economy's capital stock. This means that an analysis that uses hurricanes as an exogenous, negative transitory income shock to examine the insurance motive of remittances is problematic because the response can also be consistent with an investment motive since the hurricane may be associated with a higher, transitory return to capital. A further key difference between our study and Yang (2007) is that Yang (2007) does not focus on the role of cross-country differences in financial development. In light of our focus on these cross-country differences, it is important to note that the negative relationship between rainfall and remittances, that Yang and Choi (2007) document in their micro-data study of the Philippines during July 1997 to October 1998, is consistent with our second main finding that at relatively high levels of the GDP share of domestic credit to the private sector the relationship between rainfall and remittances is significantly negative.[5]

There are a number of reasons why our empirical analysis focuses on the group of Sub-Saharan African countries. First, recent research on the macroeconomic effects of rainfall on income has shown that the significant effects of rainfall on GDP per capita are limited to the Sub-Saharan African region (see for example Barrios et al., 2010). That is, for other regions such as Asia and Latin America there is no significant average effect of rainfall on aggregate income. Second, according to PWT and WDI data the average ratio of remittance flows over total investment is about one-quarter in these economies. This suggests that remittances flows could be an important source of finance for the group of Sub-Saharan African countries.[6] Third, there is a significant policy debate on the causes of Sub-Saharan Africa's

[4] To see this formally, consider an economy operating under a simple constant returns to scale production function $Y = AK^{\alpha}L^{1-\alpha}$, with $0<\alpha<1$. In this economy average income per capita $y \equiv \frac{Y}{L} = A\left(\frac{K}{L}\right)^{\alpha}$ decreases if, say, due to a natural disaster there is a decrease in the capital stock K that decreases the capital labor ratio. Notice that this reduction in K increases the marginal product of capital $MPK = \frac{\partial Y}{\partial K} = A\left(\frac{K}{L}\right)^{\alpha-1}$ and hence the incentives to send remittances in order to exploit higher returns. A positive average response of remittances to negative changes in income can therefore be consistent with both, an insurance and an investment motive. However, an estimation approach that uses an exogenous variable which does not affect income and the return to capital in opposite ways can overcome this problem.

[5] According to WDI (2010), the average ratio of private sector credit to GDP in the Philippines during the 1997–1998 period was 0.58. Plugging this value into our estimates yields a negative relationship between rainfall and remittances that is significant at the 5% level. Thus, our macro panel data results are consistent with the micro panel data evidence that is provided by Yang and Choi (2007) on rainfall and remittances in the Philippines.

[6] According to WDI (2010), in 2007 the total volume of remittance flows to Sub-Saharan African countries was US$18.6 billion; US$63.3 billion for Latin American countries, US$133.8 billion for South-East Asian countries; and US$33.4 billion for Middle East and North African countries. While Sub-Saharan Africa thus plays a more minor part in terms of the total global flow of remittances, this does not mean that for the Sub-Saharan African region remittance flows are an unimportant source of finance. To the contrary, the 2007 GDP share of remittances for Sub-Saharan Africa was 2.4%, 1.7% for Latin America, 0.7% for East Asia and the Pacific, 4.4 percent for South Asia; and 2.2% for the Middle East and North Africa.