



WP/03/189

IMF Working Paper

Are Immigrant Remittance Flows a Source of Capital for Development?

*Ralph Chami, Connel Fullenkamp, and
Samir Jahjah*

IMF Working Paper

IMF Institute

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Prepared by Ralph Chami, Connel Fullenkamp, and Samir Jahjah¹

Authorized for distribution by Roland Daumont and Samir El-Khouri

September 2003

Abstract

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The role of remittances in development and economic growth is not well understood. This is partly because the literatures on the causes and effects of remittances remain separate. We develop a framework that links the motivation for remittances with their effect on economic activity. Because remittances take place under asymmetric information and economic uncertainty, there exists a significant moral hazard problem. The implication is that remittances have a negative effect on economic growth. We test this prediction using panel methods on a large sample of countries. The results indicate that remittances do have a negative effect on economic growth, which indicates that the moral hazard problem in remittances is severe.

JEL Classification Numbers: D1, D64, D82, F2, F22, O15

Keywords: remittances, altruism, asymmetric information, private income transfers, moral hazard, economic growth

Authors' E-Mail Addresses: rchami@imf.org; cfullenk@econ.duke.edu; sjahjah@imf.org

¹ Ralph Chami is a deputy division chief in the IMF Institute. Connel Fullenkamp is Visiting Professor, Department of Economics, Duke University. Samir Jahjah is an economist in the IMF Institute. The authors would like to thank Adolfo Barajas, Roland Daumont, Samir El-Khouri, Andrew Feltenstein, Mohsin S. Khan, Miguel Messmacher, Peter Montiel, Mika Saito, Sunil Sharma, Ilhyock Shim, and Gabriel Srouf for their thoughtful comments and suggestions.

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I. INTRODUCTION

The role of immigrant remittances in economic development continues to be an important issue for researchers and policymakers. Both groups are attracted to immigrant remittances because they represent a substantial flow of financial resources, predominantly from developed economies to developing economies. For example, Buch et al (2002) estimate that total remittances (plus compensation of employees) averaged \$81 billion per year during the 1990s. Our own estimates, containing remittances only, peaked at over \$59 billion per year in the mid-1990s. It is difficult to see these numbers and not think that remittances could be an important tool for economic development. Indeed, a common theme motivating much of the research on immigrant remittances is that if they can be better understood, then perhaps they can either be shown to promote development on their own, or they can be channeled into productive investment by wise policies. This sentiment appears in papers by Straubhaar (1986), Elbadawi and Rocha (1992), El-Sakka and McNabb (1999), Buch et al (2002) and others.

But despite the large interest in immigrant remittances, their role in development remains unclear. First, simply gathering accurate data on remittances is extremely difficult because many remittances are not channeled through the payment system and therefore do not appear in the official statistics on remittances. In addition, remittances tend to be studied one country or one migrant group at a time. That is, one paper studies, say, the causes of the remittances of Turkish guest workers living in Germany, and another studies the uses of remittances by Pakistani families. The results, predictably, are quite variable across studies, which hinders general inference. Finally, the literature on remittances lacks a unifying framework that would enable researchers to see the big picture. The existing literature examines the causes and effects separately, using different analytical approaches.

While obtaining accurate and comprehensive data on remittances may be impossible, it should be possible to specify an analytical framework that links together the causes and effects of remittances. Ideally, the two strands of the literature should work together. From a theoretical standpoint, it is highly desirable to link the causes of remittances to particular effects in order to trace remittances through the economy. And theory should shape our empirical expectations. Different causes of remittances ought to imply different economic effects, so that the effects could help researchers discern between different theories of remittance determination. In addition, some causes may imply unanticipated effects of remittances that would otherwise be overlooked. A unified framework that models both the causes and the effects of remittances, therefore, can lead to a better understanding of the role that remittances currently play, and ultimately to better policy.

In this paper, we develop a unified framework for modeling the causes of remittances and tracing their effects through the economy, in order to examine whether remittances are now or could be a source of capital for economic development. Our framework is built on two aspects of remittances that have important implications for the modeling strategy. We begin with the reminder that despite their aggregate size, remittances are made up of millions of individual, private, nonmarket income transfers. Therefore, the appropriate foundation for our model is the economics of such transfers. This literature originates

with Becker's (1974) economics of the family, and indeed many researchers in migration and remittances now use the family as the basic unit of analysis. But not all of the recent innovations from the literature on intrafamily transfers have yet been integrated into the study of remittances. One particularly important recent extension to this work shows how nonmarket transfers interact with the rest of the market economy.² It is this interaction of nonmarket transfers with market activity that can link the causes and effects of remittances in a single model.

A second characteristic of remittances that we believe to be fundamental is that the remitter and the recipient of the transfer are separated by long distances—often, oceans—for long periods. This implies that the remitter cannot directly observe the activities of the recipients of the transfers, and must settle for occasional contact through telephone calls, letters, or visits home. That is, remittance transfers take place under conditions of asymmetric information. Since economic uncertainty is also present for both the remitter and the recipients of the transfers, this implies that remittances are subject to significant agency and moral hazard problems. This aspect of remittances has not been formally addressed, to date, which seems a curious omission. Researchers in other disciplines, most notably in finance, have found that asymmetric information has a profound effect on behavior, to the extent that asymmetric information problems are now considered to be the driving force behind many of the phenomena we observe in markets. Given the size of remittance transfers, and the inherent nature of the information asymmetry in migration, we expect that asymmetric information will exert strong influences on the behavior of the recipients of remittances.

We specify a model of remittances that is built on three features suggested by the preceding two observations. First, we motivate remittances by appealing to the economics of the family. There are many ways to incorporate the economics of the family into the model, and we discuss them in more detail below. In our model, the relationship between migrant and family is characterized by altruism, so that the utility of the migrant depends on the utility of his family members at home. This implies that remittances will be sent in order to help the family avoid shortfalls created by a poor economy or simple bad luck. In other words, the model implies that remittances are compensatory transfers, which should fluctuate countercyclically.

The model also contains a key linkage between the family and the market: the family members who do not migrate participate in the domestic labor market. The labor market, whose outcomes are derived from the output market, is the source of uncertainty facing the family. But the outcomes in the markets depend on the actions of all the family members, which are influenced by the receipt of remittances. Although each individual worker is a price taker, the realization of output and wages responds to the aggregate behavior of the workers. Thus, the receipt of remittances has an effect on overall output, which in turn affects the likelihood of needing remittance transfers.

² See, for example, Bruce and Waldman (1990, 1991), Chami (1996, 1998), Coate (1995), Cremer and Pestieau (1996, 1998), and Cox (1986), among others.

Finally, in our model, family members interact under asymmetric information. Since our model already implies that remittances are compensatory transfers, and it links the actions of the recipients to the probability of needing compensation, a moral hazard problem between the remitters and the recipients emerges. In reality, the moral hazard problem can be manifested in many ways. Recipients can decrease their labor force participation, limit their job searches, reduce labor effort, or invest in riskier projects, among other actions.³ But no matter how the moral hazard manifests itself, its effect is to induce the recipients to act in ways that tend to decrease expected output. Thus, asymmetric information and the moral hazard problem it engenders lead in our model to a negative effect of remittances on economic activity.

Thus, our model leads to two main testable implications: first, remittances are compensatory and hence countercyclical; and second, remittances have a negative impact on GDP growth. Rather than test these implications on a single country, we collect a panel of aggregate data on remittances that includes up to 113 countries over (up to) 29 years, and use panel estimation methods to take advantage of cross-sectional variation. This is the first study to use panel methods to analyze remittances. In addition, we use instrumental variables to separate the cause and effect relationships. We find that the data confirms the countercyclical nature of remittances, which is consistent with the model's implication that remittances are compensatory transfers. In addition, we also find that remittances are negatively associated with economic growth. This result is also consistent with our model, in which remittances are subject to significant moral hazard problems that increase the likelihood of poor economic performance. Together, these results imply that remittances do not act like a source of capital for economic development, at least for now, and moreover that there are significant obstacles to transforming them into a significant source of capital.

The paper proceeds as follows: Section II reviews the literature on remittances, Section III presents a unified framework for analyzing the motivation and implication of remittances, Section IV presents the empirical estimation, and finally Section V discusses the results and presents policy implications.

II. THE LITERATURE ON REMITTANCES

Our purpose in discussing the literature is to motivate the choice of a single model that can analyze both the causes and effects of remittances. As mentioned above, the literature on remittances can be divided into two separate strands.⁴ One strand takes a microeconomic approach and examines the causes and uses of remittances. This literature tends to examine both causes and uses of remittances because the main data sets it

³ The finance literature has many examples of this behavior, such as the asset substitution problem and the outsider equity effect. See, for example, Jensen and Meckling (1976).

⁴ Taylor (1999) presents an extensive review of the literature on remittances.

employs consist of household surveys. Several researchers have also used aggregate data to investigate the causes of remittances, however. The other strand of the literature focuses on the effects of remittances and uses macroeconomic models (that are not based on individual maximizing behavior) to estimate the impact of remittances. Neither branch of the literature employs formal theoretical analysis very extensively, so that the empirical research on remittances has produced more stylized facts than hypothesis tests comparing different theories. The formal theories of remittances that have been developed focus mainly on explaining the causes of remittances, so we begin with them.

The theoretical literature on remittances is large, in the sense that many researchers have at least informally suggested theories describing their role in the economy in order to motivate an empirical exercise. But most theories offered have tended to follow a common theme. Early approaches to the theory of remittances identified and described various costs and benefits to remitting. Russell (1986) summarizes these. Stark and Bloom (1985) realized that the appropriate unit of analysis in migration and remittance questions is the family, because the entire family is sharing, and trading off, the costs and benefits of remitting. Therefore, the recent theoretical literature on the role of remittances has focused on, and can be categorized by, the possible roles that the family or family relationships can play in shaping remittance choices.

Many economists, even before the advent of the New Economics of Labor Migration (NELM), acknowledged that family ties in the form of mutual caring are probably a prime motivation for remitting. The earliest papers on remittances, such as Johnson and Whitelaw (1974), mention altruistic motivations for remittances. Lucas and Stark (1985, p. 902) write that "Certainly the most obvious motive for remitting is pure altruism—the care of a migrant for those left behind. Indeed, this appears to be the single notion underlying much of the remittance literature." They go on to specify an altruistic utility function in which the migrant's utility includes the consumptions of the other members of the household. This, however, is the maximum extent of formalization of the altruistic model of remittances.

Instead, more recent theories have focused on the idea that there can be self-interested reasons for remitting as well, which nevertheless center on the family. These self-interested theories of remittances are still based on the family because they view the family as a business or as a nexus of contracts that enables the members to enter into Pareto-improving arrangements. Several different types of businesses or contracts are possible, which has led to various self-interested models of remittances. In the initial paper of this sort, Lucas and Stark (1985) suggest that migrants may have investments that need to be tended while they are away, so they will use other family members as their agents. The remittances sent by the migrant are used to care for the migrant's interests, but they also contain some compensation for the agents.

Another potential role for the family is that of financial intermediary. Stark (1991), as well as Agarwal and Horowitz (2002) and Gubert (2002), suggest that the family can function as an insurance company that provides members with protection against income shocks by diversifying the sources of income. On the other hand, Poirine (1997) and Ilahi

and Jafarey (1999) model the family as a bank that finances migration for some members. The borrowers remit funds in order to repay the loans, which are put toward more loans to further the interests of other individual family members.

But these arrangements may not be as self-interested as they first appear. Altruism has been shown to motivate risk-sharing behavior, and Chami and Fisher (1996) show that altruism can be a mechanism by which independent agents find partners with whom to enter into risk-sharing arrangements.⁵ Even if the remittance arrangements are truly self-interested, the self-enforcing mechanism on which they depend may actually be altruism—that is, the migrant will live up to her obligations because she cares about the family members who are the counterparties to the agreement. This idea is explored in Stark and Lucas (1988). Thus, although the motivations to remit are doubtlessly complex, altruism between family members appears to be a good benchmark to use when modeling the interaction of causes and effects of remittances.

Now we turn to the empirical literature on immigrant remittances, again with the object of finding guidance for choosing a model. Elbadawi and Rocha (1992) present a detailed review and insightful analysis of the literature on the causes of immigrant remittances, which applies well to all remittances. They divide this literature into two main strands: the “endogenous migration” approach, and the “portfolio” approach. The endogenous migration approach is based on the economics of the family, as discussed above, which includes but is not limited to motivations based on altruism. The portfolio approach isolates the decision to remit from the decision to migrate, and likewise avoids issues of family ties. In this view, the migrant earns income and decides how to allocate savings between host country assets and home country assets. Remittances are a result of deciding to invest in home country assets. The portfolio view, therefore, is an informal theory of remittances that supports the view that remittances behave like other capital flows.

The endogenous migration approach to remittances implies that the set of variables most useful for determining the level of remittances includes economic data that describes the economic situations facing the migrant and the family, and demographic data that describes the strength of family ties or the existence of other family arrangements. For example, the length of the migrant’s stay in the host country is thought to weaken the desire of the migrant to remit because the migrant comes to regard herself more and more as a permanent migrant who has formed her own independent household. In the portfolio view, the rates of return on various assets, or return differentials, should influence remittances. The variables used in such studies include interest rate differentials on comparable deposit accounts offered in the host and home (labor-sending) countries, incentive interest rates offered on home country deposits, black market exchange premium (if any), the return on real estate in the home country, inflation rates, and other returns. In addition, political risk and uncertainty may also affect the decision to remit.

⁵ On the role of the family in risk sharing and income pooling, see Abel and Kotlikoff (1988), Altonji, Hayashi, and Kotlikoff (1992), and Townsend (1994), among others.

In practice, few papers that perform empirical estimations of remittance determination use only the endogenous migration approach or the portfolio approach.⁶ For example, Wahba (1991) divides remittances into “fixed” remittances, which go toward family support, and “discretionary” remittances, which are investment flows. The fixed remittances depend on family characteristics like size and income level, and therefore may be explained by the endogenous migration view.⁷ In general, empirical analyses include some demographic variables such as the stock of migrants in the host country (or family characteristics in studies that use micro data), economic variables such as wages or income, and financial variables such as interest rates.⁸ The demographic and income variables tend to be significant in nearly all estimations, while the financial variables’ significance varies depending on the sample and specification. This is probably the most reliable stylized fact to come out of the empirical literature on the causes of remittances. While most papers have found evidence consistent with altruistic behavior, only a few papers such as Lucas and Stark (1985) and Agarwal and Horowitz (2002) have tested altruism against alternate family arrangements. Lucas and Stark find evidence in favor of self-interested behavior in Botswana, while Agarwal and Horowitz find evidence in favor of altruism in Guyana.

There are few academic papers that directly address the economic effects of remittances, and we detail those below. But numerous papers and anecdotal reports have been written about the uses of remittance funds. In general, the anecdotal reports observe that the recipients of remittances use the funds to increase family consumption rather than to invest in businesses or other productive assets, with the implication that remittances are not benefiting the recipient economies. The academic papers have investigated the claims made in the anecdotal reports, generally using survey data. The picture that emerges on the uses of remittances is somewhat confusing, primarily because the studies consider one country at a time, and also because the samples tend to be quite small. Thus, the results in this area are quite varied and seemingly contradictory. We believe, however, that three stylized facts emerge from this literature.

The first stylized fact is that a significant portion, and often the majority, of remitted funds are spent on consumption. Papers finding this include Oberai and Singh (1980) and Durand et al (1996). Gilani (1981) found that most of the remittances to their sample of

⁶ Straubhaar (1986) is a paper that relies only on the portfolio approach.

⁷ Nothing in the portfolio approach necessarily contradicts the endogenous migration approach. One may think of the portfolio view in terms of a “selfish” immigrant who only cares about the earnings on her own savings, which she intends to keep for herself. See, for example, Glytsos (1988).

⁸ See, for example, Swamy (1981), Bannerjee (1984), Glytsos (1988), El-Sakka and McNabb (1999).

households in Pakistan are spent on consumption, followed by residential investment. Glytsos (1993) finds a nearly identical spending pattern for remittances to Greece.

The second stylized fact is that a significant, though generally smaller, part of remittances does go into uses that we can classify as saving or investment. Alderman (1996) and Adams (1998), using survey data for Pakistan, find that remittances tend to be invested in land and buildings. Brown (1997), using survey data for Western Samoa and Tonga, finds that housing expenditures are the single largest expenditure out of remittance income. Adams (1991) finds in a sample of 74 Egyptian households that the receipt of remittances increases the marginal propensity to invest, primarily in residences and land.

The third and final stylized fact is that the household saving and investment that are done using remittances are not necessarily productive in terms of the overall economy. Several researchers emphasize that the expenditures on housing, land and even jewelry constitute saving and investment, at least for the individual household. While this is true, the effects of such saving on overall economic activity should be considered carefully. When existing houses and land change hands, for example, this is not in itself a productive activity. Only when new capital goods such as equipment are purchased and put into service is the aggregate capital stock or its productivity actually enhanced. Sofranko and Idris (1999) show in the case of Pakistan that very little of the remittances received from Pakistani migrants to the Middle East is channeled into actual business investment. Lopez and Seligson (1991) survey small businesses in El Salvador to measure the impact of remittances on small business development, and report that forty percent of business owners who receive remittances do not invest any of them in the business.⁹ One notable exception is the result of Taylor (1992), who finds evidence that remittances to some farmers in Mexico increased their investment in cattle, which is their main investment opportunity. The total picture, therefore, suggests that the appropriate stylized fact is that immigrant remittances are used to increase the family's consumption and stock of wealth, but not necessarily the overall economy's stock of wealth.

When viewed together, the literature on the causes of remittances and the literature on the uses of remittances tend to reinforce each other. The literature on the causes of remittances has found evidence consistent with the notion that family ties based on altruism motivate much of the remitting that occurs. Altruism in this context is the immigrant's concern over the income or consumption levels of the family members left behind in the source country. The evidence on the uses of remittances appears to complement the evidence on the causes. Most of the remitted funds are spent on consumption goods and residential investment, which can be interpreted as revealing the remitter's concern that her family has sufficient food, clothing and shelter. If the families were using the remitted funds against the wishes of the remitter, one would think that the remitter would eventually learn of this misuse and reduce or end her remittances.

⁹ This particular study has several interesting findings, but unfortunately, it tends to raise more questions than it answers.

Nonetheless, there does exist evidence that some remittances do go toward productive investment.

A relatively small literature considers the impact of remittances on the overall economy. While this literature uses macroeconomic models that do not incorporate the stylized facts from the microeconomics-based literature, it is still influenced by at least one of the arguments made above. In particular, researchers have pointed out that even if remittances are totally spent on consumption, there will still be a benefit to the receiving economy, to the extent that at least some of the funds are spent on domestically provided goods and services. The argument is based on a simple Keynesian multiplier story. Stahl and Habib (1989) use input-output tables for Bangladesh to construct a simple remittance multiplier for the years 1976–1988. The average value for this multiplier is about 1.24, and this is basically a consumption effect. Nishat and Bilgrami (1991) use a simple Keynesian structural model to estimate the remittance multiplier for Pakistan. They find a multiplier of 2.43, which operates primarily through the consumption effect. The model is extremely simple—consumption, investment, import demand and taxes are each single-equation functions of disposable income or GNP—so this estimate should be used with caution. Glytsos (1993) also uses input-output tables to construct a remittances multiplier for Greece, obtaining an overall estimate of 1.7. Adelman and Taylor (1990) construct a social accounting matrix for Mexico and find an output multiplier of 3.2 for remittances. Durand, Parrado and Massey (1996) further explore the implications of Adelman and Taylor's analysis.

The multiplier stories capture at least the short-run impact of remittances on the receiving economy. But there is virtually no macroeconomic evidence about the impact of remittances on longer-term economic growth. What little microeconomic evidence does exist, however, suggests that remittances may in fact be detrimental to long-run growth. One piece of evidence that is quite suggestive comes from Kozel and Alderman (1990). They perform a labor force participation and labor supply study of Pakistan using data from the 1986 PIDE survey. They find a significant negative impact of remittances on the labor force participation of males. Similarly, Itzigsohn (1995) also finds, in a sample of Caribbean Basin cities, that remittances significantly lower the labor force participation of household heads as well as other members of the families. The studies do not indicate, unfortunately, what other activities the recipients are pursuing. It is possible that remittances make it possible for them to pursue education, which should enhance long-term growth. But they could also be enjoying more leisure, which would depress economic growth.

Finally, an interesting perspective on the long-run impact of remittances comes from two papers that extend the work of Gilani et al (1981). Amjad (1986) extends Gilani et al by making inferences about aggregate data based on survey data on the uses of remittances from an ILO/ARTEP Phase II migration study for Pakistan. The analysis uses the survey data to estimate the uses that the remittances are going to (primarily consumption, residential investment and other investment), and compares these numbers with the actual increases in aggregate consumption, residential construction, and investment. He finds that remittances have financed significant portions of the increases in the aggregate

quantities. He also anecdotally links growth rates in specific industries to remittance inflows. But Ahmed (1986) comments on Amjad and points out that Pakistan's investment-GDP ratio has stagnated despite the remittance inflows and that, in general, Pakistan's productive infrastructure has been allowed to deteriorate despite the inflow of remittances. Therefore, he argues, remittances have not added much to GDP growth.

This exchange makes concrete an underlying question raised by the numbers on remittances, and by those who argue that they are used as capital flows to finance investment. Given that remittances are quite large relative to the sizes of many developing economies, if their role were principally a capital flow to finance development, why hasn't their impact on economic development in at least a handful of countries been documented? Of course, this evidence may well exist, but not be apparent because of the lack of a unified model to capture the causes and effects of remittances. We therefore turn to the modeling next.

III. A UNIFIED FRAMEWORK FOR ANALYZING REMITTANCES

Our goal is to construct not only a simple model of remittances but also a framework that allows for future additions or modifications. Accordingly, we develop a model that motivates remittances through altruism and follows their effect on the recipients' labor market behavior. But we believe that it should be relatively easy to modify this model in order to include other motivations and other effects. In addition, while our model assumes that the decision to migrate has already been made, this could be added as an initial stage by researchers who wish to model both the migration and remittance decisions.

We envision a country made up of a large number of identical two-person families in which one of the members has migrated and is earning an exogenous income in the foreign country. We refer to this person as the immigrant, and identify her with the subscript I . The family member who remains in the home country, whom we refer to as the recipient and associate with the subscript R , works in the domestic labor market. The recipient is risk averse and works for a risk-neutral firm. Output x in the recipient's country is uncertain, and can either be low χ_L , or high χ_H . The probability the low-output state occurs is $p(e)$, where e is the worker's effort and is unobservable to the firm; we assume $p' < 0$ and $p'' > 0$. Wages are w_L in state L and w_H in state H , where $w_L < w_H$. The difference in wages across states of nature reflects firms' responses to the moral hazard in the labor market.

The activities we model take place during a single period, but in the following order. First, firms set the terms of the wage contract. Firms choose w_L and w_H to maximize expected profits, while competition drives expected profits to zero. Hence

$$E\pi(w_L, w_H; e) = p(e)\chi_L + (1 - p(e))\chi_H - [p(e)w_L + (1 - p(e))w_H] = 0. \quad (1)$$

Next, the immigrant chooses a transfer and remits it to the recipient. The immigrant would like to do this because she is altruistic toward her relative. Thus the immigrant's utility, U_I , depends on the recipient's utility, U_R :

$$EU_I = u(c_I) + \beta EU_R$$

where $c_I = y_I - t$ is the immigrant's net consumption, y_I is her (exogenous) income, and t is the transfer (or other transfer) to her relative. If y_I is small, the equilibrium transfer is zero. As y_I grows, at some point the immigrant can increase her expected utility by consuming one dollar less herself and transferring that dollar to her relative, thereby receiving the value of the relative's marginal utility, discounted by β . We focus on the case where transfers are operative, and thus assume y_I is sufficiently large that $t > 0$ in equilibrium. The timing of transfers is such that t is given before the state of nature is revealed.¹⁰ Note that the immigrant neither knows nor directly observes the relative's effort level.¹¹ This lack of observability of the relative's effort level gives rise to a moral hazard problem between the immigrant and the relative.

The next step is that the recipient chooses a level of effort to expend on the job. Expected utility to the recipient-worker is given by:

$$EU_R = p(e)u_R(w_L + t) + (1 - p(e))u_R(w_H + t) - v(e).$$

Let $u_{RL} \equiv u_R(w_L + t)$ and $u_{RH} \equiv u_R(w_H + t)$. We assume u_R is strictly increasing, concave, and twice continuously differentiable. The disutility of effort, v , is an increasing, strictly differentiable convex function. Once effort is chosen, output is realized, and, finally, wages are paid according to the labor contract.

Before we move on to examine the implications of this model, we point out how the basic structure can be modified or expanded in useful ways. Note that in this model, income in the recipient's country is uncertain, which reflects higher risk and possibly inefficiencies in information or production, relative to the host country. Such differences serve as the motivation for migrating, and could be elaborated on in a model that explicitly includes the migration decision. In addition, we model the recipient as expending effort in the labor market in a way that affects his income. Alternatively, we could model the recipient as expending effort (and income) on investment projects that have uncertain returns.

¹⁰ Relaxing this assumption would only strengthen our results, since allowing an altruistic immigrant to observe output and hence wages before committing to a transfer would yield a transfer that provides the relative the same consumption across both states of nature, *i.e.*, full insurance (see Chami (1996)).

¹¹ We could, alternatively, allow for state-contingent transfers, but they do not affect the present analysis (see Chami (1998)).

Finally, we motivate remittances through altruism on the part of the immigrant, but other motivations based on exchange can be added to or substituted for altruism. Adding an exchange-based motivation requires that the recipient expend effort on looking after the interests of the immigrant as well as the recipient's own interests, which is easily accommodated in this structure.

A. Solving for Effort, Transfers and Wages

The model is solved using backward induction, so we first examine the worker's choice of effort. The optimal level of effort is given by the first-order condition:

$$(u_{RL} - u_{RH})p' - v' = 0 \quad (2)$$

Thus $e^* = e^*(b, w_L, w_H)$. Using the fact that $u_{RH} > u_{RL}$ so $u'_{RH} < u'_{RL}$, we have $e_b^* < 0$, $e_{w_L}^* < 0$, and $e_{w_H}^* > 0$.¹² These conditions say that transfers, through an income effect, reduce effort. On the other hand, raising the benefits of high output (that is, the wage paid plus transfer received), or reducing the benefits of low output increase effort. It is important to note that the change in the recipient-worker's equilibrium effort for a small change in income is the same whether income is in the form of wages or transfers:

in taking derivatives with respect to e^* , one can show that $\frac{\partial e^*}{\partial t} = \frac{\partial e^*}{\partial w_L} + \frac{\partial e^*}{\partial w_H}$, so that an

increase in the transfer is equivalent to an increase in wages in both states of nature. Given this equivalence, it is clear why the recipient reduces effort when remittances increase: remittances are a substitute for labor income. The moral hazard problem arises in this model when the relative takes advantage of the immigrant by making this substitution, or in other words by using remittances to purchase a reduction in labor effort.

Next comes the solution for remittances. The first-order condition for the immigrant is:

$$\frac{\partial EU_I}{\partial t} = -u'_I + \beta [p(e)u'_{RL} + (1-p(e))u'_{RH}] + \beta \{ [u_{RL} - u_{RH}] p' - v'(e) \} \frac{\partial e^*}{\partial t}. \quad (3)$$

This expression is composed of three parts: $-u'_I$, the decrease in the utility of consumption because of additional transfers; $\beta [pu'_{RL} + (1-p)u'_{RH}]$, which is the direct effect of the relative's utility on his immigrant's utility, and is positive; and $\beta \{ [u_{RL} - u_{RH}] p' - v'(e) \} \frac{\partial e^*}{\partial t}$, which reflects the effect of the moral hazard problem

¹² The derivation is provided in the Appendix.

between the immigrant and the relative. In this last term, higher transfers allows the relative exploit the immigrant more by lowering his effort (recall that $e_i^* < 0$), which in turn increases the probability of the low-output state. However, the term in braces is nothing more than the first-order condition for the relative (equation 2), and hence is zero in equilibrium; holding wages constant, the immigrant completely internalizes the effect that the transfer has on the relative's labor supply. Equation (3) reflects the fact that, at the margin, the immigrant is an altruist, and transfers are compensatory in nature. Solving (3) implicitly for t^* , we find that $t^* = t(w_L, w_H, e^*, \beta)$, where $\partial t^* / \partial w_H < 0$ while $\partial t^* / \partial \beta > 0$.¹³

The immigrant's reaction to changes in the relative's wage income illustrates that the immigrant intends for remittances to protect the recipient-worker against negative income shocks. This is a function of the compensatory nature of altruistically-motivated transfers. Thus, from the perspective of the immigrant as well, remittances are non-market substitutes for wages. But the immigrant intends for the remittances to be used only in case of a bad realization of output, not to enable the recipient to reduce her labor effort. The immigrant and the relative do not see eye to eye, even though both understand that remittances are a substitute for market wages. This too is characteristic of the moral hazard problem.¹⁴

Firms, anticipating the reaction that wages have on remittances and worker effort, offer wages in each state to maximize profits, subject to a zero-expected-profit condition. Rearranging (1), the zero-profit condition yields the following relationship between wages in good and bad states of nature:

$$w_L^* = \chi_L + (x_H - w_H) \frac{(1 - p(e^*))}{p(e^*)} \quad (4)$$

Note that this expression indicates an inverse relationship between w_L^* and w_H . Firms then choose w_H to maximize profits (equation (1)), while their equilibrium choice of wages is subject to the constraint in equation (4). Differentiating the zero-profit condition (4), we have:

$$\frac{dw_L^*}{d\beta} = \frac{p'}{p^2} (x_H - w_H) \frac{\partial e^*}{\partial t} \frac{\partial t^*}{\partial \beta} < 0.$$

¹³ The derivation of these expressions is shown in the Appendix.

¹⁴ Timing the remittances so that they occur after output is realized will not solve this problem and in fact will exacerbate it. This is discussed in more detail below.

Thus an increase in the degree of altruism immigrants have toward their relatives reduces the wage paid in bad states of nature. Also from the zero-profit condition,

$$\frac{\partial w_L^*}{\partial w_H} = -\left(\frac{1-p}{p}\right) < 0,$$

so an increase in the degree of altruism leads to an increase in the wage paid in good states of nature.

B. Implications for the Causes and Effects of Remittances

The above discussion of the model points to one main implication regarding the causes of remittances. The optimal remittance function shows that remittances are compensatory in nature, rising with the level of altruism and falling as the recipient's wage in the high-output state rises. In addition, because we know from the firm's problem that w_H and w_L are inversely related, it follows that the level of remittances rises as w_L falls. Thus, there should be a negative relationship between measures of the recipients' income and the level of remittances. This relationship is the opposite of what an exchange-motivated model of remittances would imply (see Lucas and Stark (1985)). In addition, this is also the opposite relationship from what one would expect if remittances functioned as investment flows.

The model also has an important implication regarding the effects of remittances. Given that both recipients and firms react to remittances, the net effect of remittances on output may seem unclear. An increase in remittances will reduce recipients' work effort, which lowers output, but firms react by increasing the dispersion of wages, which will tend to increase work effort and offset the drop in effort caused by an increase in remittances. But increasing the dispersion of wages cannot overcome the effect of remittances on effort, and hence on output. The immigrant and the recipients impose a negative externality on the market. That externality, however, is not priced out completely by the market, due to the moral hazard problem. Firms cannot sign exclusivity contracts with workers that prohibit them from receiving remittances; and they cannot observe effort. The net effect is therefore that remittances will have a negative impact on output. This again differs from what one would expect if remittances were investment flows or were used for investment by their recipients.

Although not directly measurable or testable, the model's implication for welfare is nonetheless interesting to note. The drop in average output implied by lower labor effort may not affect the recipients' welfare, since their income has been supplemented with remittances and presumably they can purchase imports as well as domestically produced goods and services. But their welfare is affected by an increase in income risk, which is attributable to the impact of remittances. Recall that risk-aversion on the part of workers implies that $w_L > x_L$ and $w_H > x_H$, and that an increase in remittances moves w_L and w_H further apart from one another, and closer to the value of marginal output in their respective states of nature. This reduces the insurance aspect of wages, placing more risk with risk-averse workers and less with risk-neutral firms. Intuitively, immigrants take as

given the wage rate when making transfer decisions. The aggregate effect of transfers, however, causes firms to react to the effort-reducing incentives of transfers by reinforcing the incentives that different wages across states of nature provide. Thus transfers in effect crowd out wages from the standpoint of the distribution of risk across economic agents. These effects suggest that altruistically-motivated transfers, through their effect on the equilibrium wage rates, reduce welfare.

C. Model Extensions and Implications

In this section we discuss further extensions and modifications to the model, so as to accommodate other issues that have arisen in the literature on private incomes transfers in general, and to test the robustness of our theoretical predictions.

One issue is whether our theoretical results hinge on our assumption of asymmetry in altruism that is present in our model. For example, one issue concerns the impact of mutual caring or symmetric altruism, that is, the effect of remittances on effort if the recipient shared the remitter's altruism. Stark (1991), in the presence of perfect and complete information, and in the absence of market considerations, shows that unless mutual altruism is high and symmetric, the more selfish individual will continue to free ride on the more altruistic benefactor. In this case, Stark and Bernheim (1988) show that the altruist cannot even credibly commit to a punishment strategy, and as a result, a moral hazard problem is present, even in the absence of informational problems. In our case, this implies that remittances will continue to have negative effect on effort. Chami and Fischer (1996), in a model where informational asymmetry between the players is present, but in the context of insurance markets, show similar results. That is, unless altruism is mutual, and high enough, such that each individual values the other's utility as much as they value their own, moral hazard will continue to exist, leading to lower effort and adverse insurance market reaction. Moreover, when the incomes of the recipient and remitter are not identical, in particular, if the remitter's income is higher than that of the recipient—as it has to be the case for transfers to be positive—symmetric altruism that is high is not enough to reduce the moral hazard problem, a point made by Chami and Fullenkamp (2002).

Another extension would consider the case of merit goods, that is, when the remitter cares about certain actions that he would like the recipient to undertake, such as higher effort, $U_I(c_I, u_R, e_R)$. Work by Becker (1991), Chami (1998), and Mulligan and Philipson (1999) shows that the moral hazard problem is reduced somewhat, but at the margin the benefactor continues to be an altruist and, as a result, the remittances are still compensatory and as a result will continue to reduce effort.

A further consideration is the timing of moves adopted in our model. The model assumes remittances are chosen before the output is observed. A natural question arises as to how would our results change should remittances follow output realization. Bruce and Waldman (1991), in the presence of perfect and complete information, show that delaying transfers would only lead to Buchanan's (1975) well known "Samaritan's Dilemma," where the recipient would overconsume in the early stage and thus induce a higher transfer from the altruistic benefactor. Chami (1996), in a model with asymmetric

information, shows that indeed, effort will be lower in the case where transfers are delayed, than in the case where the transfers are committed beforehand. Hendrik (2000) shows that precommitting to such transfers is also welfare enhancing.

Finally, an important concern is how would our results change if such remittances were not altruistically motivated, but were a result of co-insurance arrangements among the family members? Arnott and Stiglitz (1991) consider a model with mutual co-insurance arrangements among individuals in the context of insurance markets characterized by moral hazard problems. When informational asymmetries exist between partners, they show that such nonmarket co-insurance arrangements lead to lower effort by each recipient. The problem again is the inability of each individual to verify the level of effort exerted by the recipient of aid. They propose "peer monitoring" as the solution to the problem.

IV. DATA AND ESTIMATION

In order to test the implications of our model, we collected a panel of aggregate data on remittances from the World Bank's World Development Indicators database. The entire dataset includes 113 countries for which worker remittances are reported over the 1970–1998 period. It should be noted, however, that the number of countries for which there exist no less than 10 years of continuous observations is less than 50. Only 8 countries have remittances data available over the entire period. For the majority of countries, data are available only from the mid-1980s. Even then, the continuity of the data is not assured. For several countries, missing data are common. But spanning 113 countries over the period 1970–1998, this dataset is the most comprehensive one we are aware of in the remittances literature. Figure 2 shows the number of countries with data for selected subperiods.

In Table 1 and Figure 1, we present some general trends in remittances. The striking element is the rapid increase in worker remittances starting in the early 1990s following a decade of near stagnation. The observed increase could be explained by a real rise in remittances due to rising numbers of migrants around the world. But technological developments in the banking industry have also reduced the costs and increased the geographical reach over which transfers can be sent through financial institutions. This could mean that transactions that previously went unrecorded were brought into the formal banking system during this time, and therefore included in the official statistics. After 1997, worker remittances have declined sharply, mostly in low-income countries. For middle-income countries, the level of remittances remained around \$30 billion.

In addition to data on remittances, we also collected data on per capita GDP from the PennWorld table. Other variables used in the estimation are gross domestic investment, inflation, education enrollment, and net private capital flows, which are taken from the WEO. In Tables 2 and 3 we present country by country indicators of the importance of worker remittances, constructed using the data on remittances and aggregate measures of income. In Table 2, worker remittances as a fraction of GDP are reported in descending order. In several countries, remittances account for more than 15% of GDP. In Table 3,

remittances are reported as a percentage of exports of goods and non-factor services. For many countries, remittances are the most important source of foreign exchange.

The next step in describing our data is to examine the relationship between worker remittances and per capita GDP growth using standard cross-section as well as panel estimation. Our goal is simply to see what correlations exist in the data. We will introduce more sophisticated methods later to test the two implications of the model.

The cross-section is constructed as the average over the 1970–1998 period. The estimated equation is based on:

$$\Delta y_i = a_0 + a_1 y_{0i} + a_2 I_i + a_3 wr_i + e_i \quad (5)$$

where y is the log of real GDP per capita, y_0 is the initial value of y , I is the log of investment to GDP ratio, and wr is the log of worker remittances to GDP. An alternative to (5) is to estimate the relationship between a change in worker remittances, $dlog(wr)$, and growth:

$$\Delta y_i = a_0 + a_1 y_{0i} + a_2 I_i + a_3 \Delta wr_i + e_i \quad (6)$$

This specification better captures the dynamic nature of private transfers, and is therefore preferred. Regional dummies are also introduced as well as other variables, such as the ratio of net private capital flows to GDP ($npcf$).

The idea of estimating a panel is to provide heterogeneity in the estimated coefficients. Another advantage is to capture dynamic effects. We estimate the following specifications, with the objective of being as parsimonious as possible, first because our dataset is relatively small, and second to limit the endogeneity problem. It should be noted that including variables used in the traditional empirical literature, like education or macroeconomic instability, does not affect our results.

Common Slope:

$$\Delta y_{it} = a_0 + a_1 I_{it} + a_2 \Delta wr_{it} + a_3 ncpf_{it} + e_{it} \quad (7)$$

Equation (7) is estimated with and without regional dummies.

One-Way Fixed Effects:

$$\Delta y_{it} = a_{0i} + a_1 I_{it} + a_2 \Delta wr_{it} + a_3 ncpf_{it} + e_{it} \quad (8)$$

Two-Way Fixed Effects:

$$\Delta y_{it} = a_{0i} + a_1 t + a_1 I_{it} + a_2 \Delta wr_{it} + a_3 ncpf_{it} + e_{it} \quad (9)$$

The results of these estimations are in Tables 4 to 8, where Table 4 shows the results for using the log of worker remittances over GDP and Table 5 shows the results for using the growth rate of this variable. The main result of interest is that there is a robust negative correlation between the growth rate of immigrant remittances and per capita GDP growth. The coefficient estimates on worker remittances generally have at least marginal statistical significance and in some specifications the estimates are highly significant.

In Tables 6 to 8, we present panel data estimation using different specifications in order to check the robustness of the results. In general, Tables 6 to 8 present one similar set of specifications tested across different samples. Table 6 shows the results from using the full sample (1970–1998), while Table 7 shows the results for the 1985–1998 time period. Table 8 displays results when only those countries with ten or more years of continuous data are used over the 1985–1998 period. Each of these tables contains several different sets of estimates, depending on what slope specification is used. Each estimation includes the investment to GDP and worker remittances to GDP ratio as explanatory variables. Depending on the specification, we add the ratio of net private capital flows over GDP, and inflation to see how the results are affected. In most cases, we find a negative and significant relationship between remittances and growth. Over the period 1985–98, the results are stronger and more consistent (Tables 7). When restricting the sample to those countries with at least 10 years of continuous observation, the magnitude of the negative effect is increased (Table 8). This section reinforces the results obtained in the cross-section specification. Not only do remittances in low growth countries tend to be higher, but also higher remittances within a country are associated with lower growth.

The negative correlation between immigrant remittances growth and per capita GDP growth is an intriguing finding. It does not have an obvious interpretation, other than indicating that remittances fluctuate countercyclically. We take this result as a stylized fact to be further investigated in light of the model, which we turn to next.

Because it considers both causes and effects of remittances, the model brings to light an empirical issue that affects much of the existing work on remittances, but has been overlooked. In particular, as our model shows, there is an endogeneity problem: the main causes of remittances are also affected by remittances. This problem affects those studies that also use aggregate data to estimate the causes of remittances. Therefore, our empirical approach takes this issue into account.

In general, instrumental variables are used to deal with the endogeneity problem, and we follow this strategy. In the first stage, we estimate the growth rate of remittances as a function of other variables. In the second stage, the dependent variable is the growth rate of per capita GDP, and the fitted growth rates of remittances from the first stage are used as one of the explanatory variables. The results from the second-stage regression address the second implication of our model, that remittances negatively affect economic activity.

For the first-stage regression, we must choose instruments that are correlated with remittance growth but uncorrelated with the error term in the second-stage regression. The theoretical model does give some guidance in choosing instruments. Although our

model is technically static, it implies that remittances are sent in response to a low level of income realized previously, then labor effort for the current period is chosen, and finally this period's output is revealed. This timing suggests that we can estimate remittances based on a lagged measure of output. We have some flexibility in the choice of the output variable, because any income gap may generate private transfers from immigrant to their relatives in their home country. We choose, for the first stage regression, to use the ratio of the recipient country's per capita GDP to U.S. per capita GDP as the income variable. This ratio measures the difference between host country income and recipient country income, where the U.S. is a general proxy for all host countries. Most researchers find that a similar output measure is a significant determinant of remittances. Note, however, that we are estimating the growth rate of remittances rather than the level, and thus the lagged income gap rather than the concurrent income gap as an instrument.

Thus, the equation we estimate in the first-stage regression is:

$$\Delta wr_{it} = a_0 + a_1(y_i - y_{us})_{t-1} + a_2(r_i - r_{us})_t + v_{it} \quad (10)$$

where wr is the log of worker remittances divided by GDP, y is per capita output, and r is a real deposit or money market interest rate. This equation was estimated for each country, in order to obtain the best fit for worker remittances. We also estimated specifications in which the interest rate gap variable was excluded from the first-stage regression.

The second-stage regression is given by:

$$\Delta y_{it} = a_0 + a_1 I_{it} + a_2 d \widehat{wr}_{it} + a_3 npc_{it} + \varepsilon_{it} \quad (11)$$

where wr are fitted growth rates of remittances. Specifications with country fixed effects and random effects were also estimated.

The results of the first-stage regression are not reported because they are not relevant to the hypotheses being tested. However, a panel estimation of a specification similar to the first-stage regressions can provide further evidence on the model's implication that remittances are compensatory transfers. If we use the level of remittances as the dependent variable in equation (10), then we have a simple remittance-determination equation. The estimated coefficient on the income gap variable gives more evidence on the model's implication that remittances are compensatory transfers. If this coefficient is negative, this indicates that remittances increase when income in the home country is relatively depressed.

The results from this estimation are presented in Table 9. The estimated coefficient on the income gap is negative and significant, as the theory predicts. The result is also robust when the equation is estimated country by country. Of 49 countries, 29 had negative coefficients on the income gap and of these, 13 were statistically significant. Only 4 of the positive coefficients were significant. This evidence supports the idea that a primary

function of remittances is to compensate their recipients for bad economic outcomes, such as low output.

The results of the second-stage regressions are presented in Table 10. Table 10 presents a set of specifications tested on the same sample but using different sets of instruments. Each specification contains several different sets of estimates, depending on what slope specification is used (common slope, fixed and random effects) and which instrumental variables are used. The sample period is the 1985–98 time period. But the set of instruments changes across the three subsections of the table. As before, the striking result is the consistently negative coefficient on the (fitted) growth rate of worker remittances which is marginally significant when the simple set of instruments (Table 10, section I) is used, but highly significant otherwise. The negative and significant relationship between the growth of worker remittances and the growth rate of GDP is robust to the many different specifications and panel methods employed. These results support the second implication of our model, that remittances have a negative impact on GDP growth.

As expected, the coefficients on investment and net private capital flows are positive. The contrast between the negative effect of remittances and the positive effect of foreign direct investment (as part of net private capital flows) is further evidence that remittances should not be considered equivalent to capital flows. Chuhan, Claessens, and Mimingi (1998), and Sarno and Taylor (1997) find that in the case of portfolio flows, economic growth (as proxied by credit ratings, which are strongly procyclical) has a strong positive relationship with capital flows. Similarly, Ram and Zhang (2002), as well as Rajan, Siregar and Sugema (2003) show that foreign direct investment (FDI) is positively associated with output growth during the decade of the 1990s.

V. CONCLUSION AND POLICY IMPLICATIONS

In this paper, we have developed a unified model for examining the causes and effects of remittances on an economy. Using the model, we show that altruistically motivated remittances intend to compensate their recipients for bad economic outcomes, but also create incentives that lead to moral hazard problems. The moral hazard problem created by remittances can be severe enough to reduce economic activity. Our empirical estimations reveal considerable evidence both that remittances tend to be compensatory in nature and that they have negative affects on economic growth. At the very least, we have demonstrated that remittances differ greatly from private capital flows in terms of their motivation and their effects. Remittances, at least currently, do not appear to be a significant source of capital for economic development.

An equally important question that we have not yet addressed is whether remittances can be channeled into economic development in the future, given the right policies. Unfortunately, our model and our empirical results both indicate that this is likely to be quite difficult. Transforming remittance flows into development capital would require changing the very nature of remittances, from compensatory transfers to investments. This in turn implies that policies would have to convince remitters and their recipients that they would be better off by investing a greater portion of these flows into productive

investments. This is likely to be a difficult task, given the economic circumstances of most immigrant-sending households.

In addition, some way around the moral hazard problem would have to be found. The fundamental problem lies in the lack of observability of the recipient's actions. Delegated monitoring of some sort may help mitigate the problem, along the lines of Arnott and Stiglitz' proposed peer monitoring. In the case of remittances, they could potentially be channeled through microfinance institutions, development and multinational financial institutions that would play the role of delegated monitor acting on behalf of the immigrant.

The prospect of converting remittances to development capital is even more daunting if we think of immigrant remittances as returns to flows of human capital across national boundaries. Immigrant remittances can be thought of as dividends from human capital assets invested by the family in economies where their return is relatively high. In other words, sending members abroad may already represent the family's main investment project, which has a much higher return than investment opportunities at home, including human capital investment. If this is the main motivation behind migration, then it implies that remittances are intended to be a main source of family income and will be devoted primarily to consumption. This view goes beyond the analysis of our paper, but is consistent with our view of remittances as altruistically motivated income transfers. This is a possibility that should be investigated, by embedding a model of remittance determination in a model of migration. This is a task for future research.

The mechanism responsible for the negative relationship between immigrant remittances and economic growth in this paper is the moral hazard problem. In this paper, we highlight the impact of the moral hazard problem that exists between remitters and recipients. The dependency on these transfers induces recipients to use remittances as a substitute for labor income, and to lower their work effort. Because the recipients of remittances are price takers, they do not see that this raises the probability that output will be low and they will need more remittance transfers in the future. The aggregate impact of moral hazard can be quite significant, and our empirical results suggest that this particular moral hazard problem does affect economic activity in many economies.

The effects of moral hazard persist despite the reaction by market forces. Our model highlights how markets may react in order to realign the incentives of workers, where these incentives have been affected by the presence of the remittances. We chose to show the market's reaction through a particular aspect of the wage contract: firms increase the dispersion of wages, lowering the insurance aspect of wages while raising the incentive part. But the general point here is that markets will shift risk back to risk-averse agents, and this can be achieved through various ways. For example, if wages are not allowed to be manipulated freely by firms, say due to minimum wage legislation, firms may react by reducing the fringe or insurance-type benefits of wage contracts, such as seniority, or by favoring hourly wage contracts (which allow quantity adjustment through layoffs) versus long-term contracts. Yet another manifestation of how markets may deal with this moral hazard problem is through firm size and business organization. The preponderance of

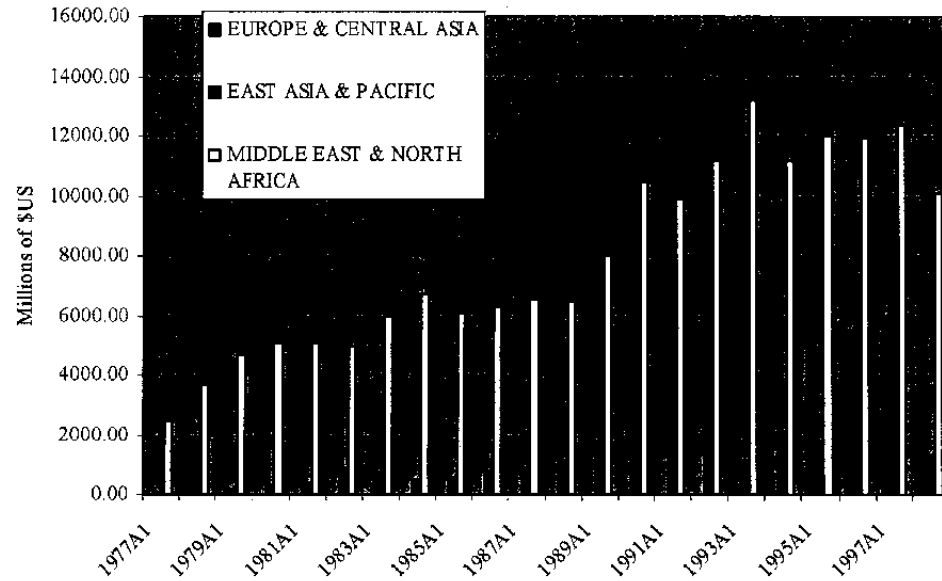
large numbers of small to medium-size firms and family-owned businesses in developing countries is in part a reaction to moral hazard, since these entities are able to deal with informational asymmetry problems much more effectively than large, publicly owned firms. No matter how the market reacts to the moral hazard problem, the result will be risk shifted back to the households, and less efficient production. What will be interesting for future research, however, is to measure the impact of these market reactions on specific processes such as employment dynamics and firm-level development.

A further sobering realization about the moral hazard problem discussed in this paper is that this is not necessarily the only moral hazard problem present in economies that receive large quantities of remittances. Governments, too, may succumb to a moral hazard problem created by the receipt of remittances. As Table 3 shows, remittances provide a major source of foreign exchange for many countries. In the absence of remittances, it is likely that many countries' exchange rates, and in turn their domestic economic policies, would come under (greater) pressure. But the receipt of large remittance flows removes or mitigates this pressure. Therefore, the government may be able to ignore imbalances in the domestic economy and avoid taking politically costly steps to address them. At worst, governments could intentionally pursue politically beneficial but economically unwise policies, in the expectation that remittance flows will continue to insulate the domestic economy from any negative consequences. Such policies would likely exacerbate the conditions that led to large-scale migration and remittance transfer, leading to heavier dependence on immigrant remittances and decreased effort on the part of domestic workers, firms, and entrepreneurs.

This paper shows that moral hazard is yet another aspect of remittances that must be taken into account if we are to understand their full effect on the labor-sending economy. The moral hazard only appears when we utilize our framework, which integrates the causes and effects of remittances in one model. The model, which focuses exclusively on the moral hazard problem, shows that this problem can be severe enough to reduce economic growth, even though remittances are altruistic transfers intended to cushion the recipients against poor economic performance. We find evidence in a large panel of countries that remittances move countercyclically, and that remittances do have a negative impact on output growth. Clearly, more investigation into remittances is necessary in the context of our integrated framework, in order to make finer distinctions between short-run and long-run effects of remittances, and to test different motivations for remitting against one another. There is also much work to be done on designing policies to help countries realize the potential benefits of remittances, especially since our work has revealed another significant obstacle in the way of policymakers.

Figure 1. Worker Remittances by Region and Country Types

Workers Remittances by Regions: 1977 - 1998
(World Bank Development Indicators)



Workers Remittances by Country Types: 1977 - 1998
(World Bank Development Indicators)

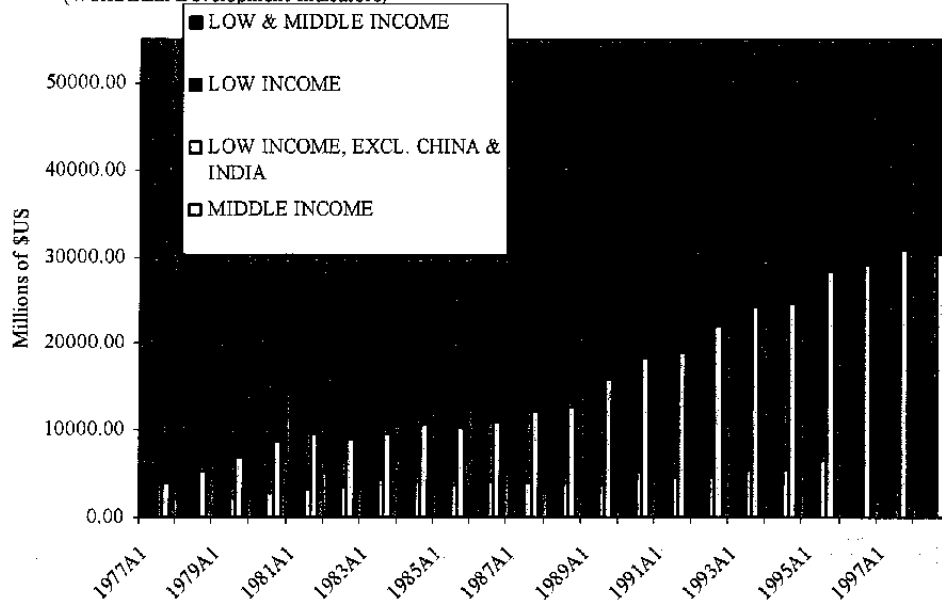
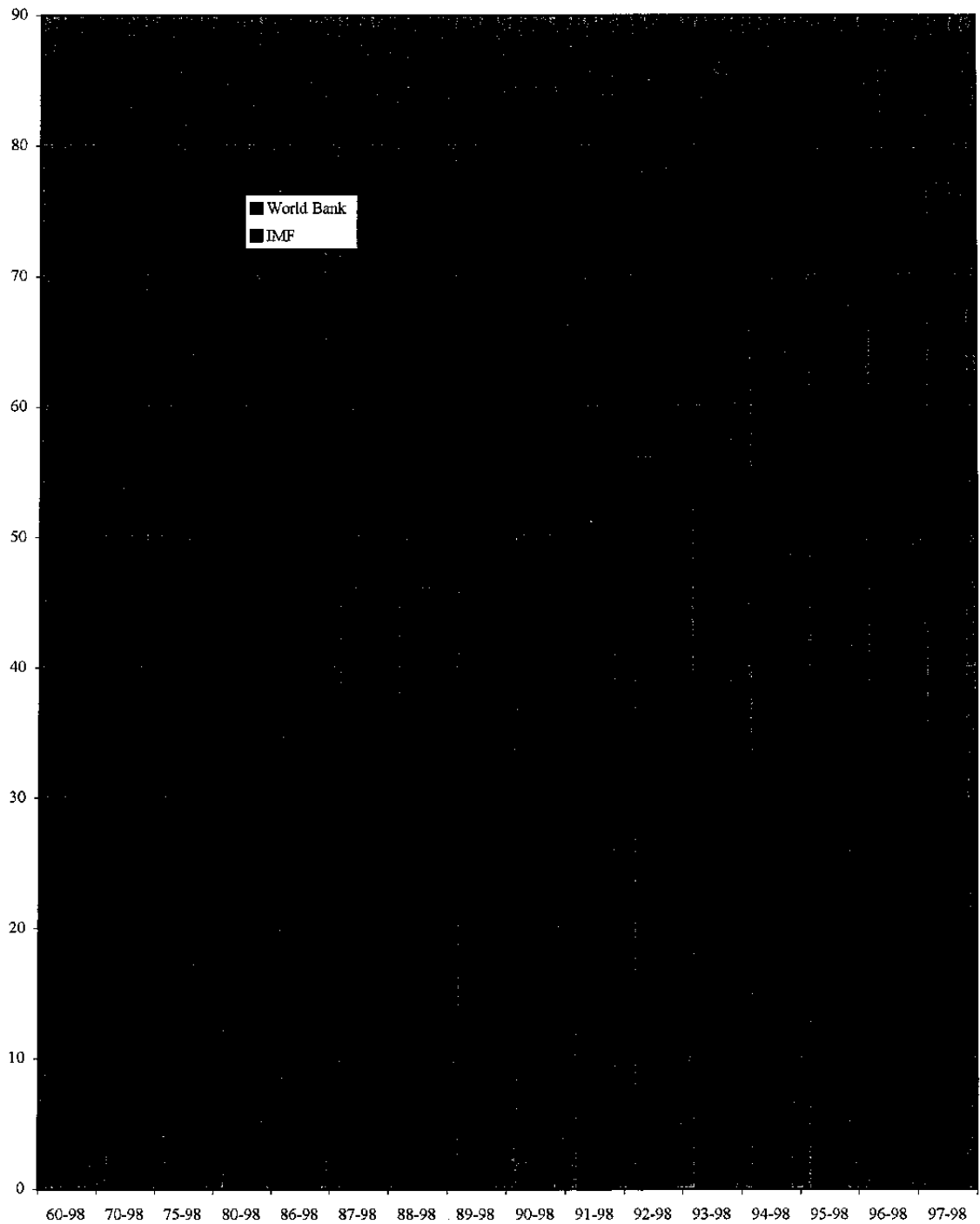


Figure 2. Number of Countries with Data Available Over the Specified Range



Source: World Bank and IMF

APPENDIX I

A.1

Taking the differential of the first-order condition for the worker:

$$e_1^* \equiv \frac{\partial e^*}{\partial t} = -\frac{(u'_{RL} - u'_{RH})P'}{(u_{RL} - u_{RH})P'' - v''} < 0$$

$$e_2^* \equiv \frac{\partial e^*}{\partial w_L} = -\frac{u'_{RL}P'}{(u_{RL} - u_{RH})P'' - v''} < 0$$

$$e_3^* \equiv \frac{\partial e^*}{\partial w_H} = \frac{u'_{RH}P'}{(u_{RL} - u_{RH})P'' - v''} > 0$$

A.2

Writing out the second order condition for transfers gives,

$$\Delta \equiv \frac{\partial^2 EU_I}{(\partial t)^2} = u''_I + \beta \left\{ P'(e^*)[u'_{RL} - u'_{RH}]e_1^* + P(e^*)[\beta u''_{RL}] + (1 - P(e^*))[\beta u''_{RH}] \right\}.$$

Rearranging terms, we have

$$\Delta \equiv \frac{\partial^2 EU_I}{(\partial t)^2} = \beta P u'_{RL} \left\{ \frac{P' e_1^*}{P} + \frac{u''_{RL}}{u'_{RL}} \right\} - P' e_1^* u'_{RH} + u''_I + \beta(1 - P)u''_{RH}.$$

Note that all the terms save the one in braces are negative, thus a sufficient condition for the concavity of the immigrant's surplus function is:

$$A.1 \quad \frac{-u''_{RL}}{u'_{RL}} > \frac{P' e_i^*}{P}, \text{ where } i = 1, 2.$$

The above assumption implies that a sufficient condition for an interior solution to the immigrant's problem is that the relative is sufficiently risk averse, such that the direct impact of a change in his wealth on his marginal utility of wealth, in the bad state, exceeds the indirect impact of wealth on the probability of a low output occurring through its effect on the relative's effort.

To sign the derivative of t^* with respect to β , differentiate the first-order condition for the immigrant (3):

$$\frac{dt^*}{d\beta} = \frac{-[pu'_{RL} + (1-p)u'_{RH}]}{\Delta} > 0.$$

Similarly, for the derivative of t^* with respect to w_H , we have:

$$\frac{\partial t^*}{\partial w_H} = \frac{-\beta[(1-P)u''_{RH} + (u'_{RL} - u'_{RH})]p'e_3^*}{\Delta} < 0.$$

Appendix Table 1. Worker Remittances: Developments
(in millions of \$US)
(1970–1998)

	1970–74	1975–1979	1980–84	1985–89	1990–94	1995–98	1998
Worker remittances	1456	11958	23352	27549	42967	59402	56005

Source: World Bank

Appendix Table 2. List of Countries and Worker Remittances (in % of GDP)
(1970–1998)

	Mean	Maximum	Minimum	Std. Dev.	Observations ¹
Lebanon	34.8	64.0	17.3	17.7	9
Samoa	23.9	35.7	12.4	6.2	21
Eritrea	23.2	32.6	17.6	5.2	7
Yemen, Rep.	23.1	32.1	17.6	5.1	9
Tonga	18.9	32.3	11.8	6.3	15
Albania	16.8	22.4	11.6	4.0	7
Cape Verde	16.7	21.2	12.5	3.1	13
Jordan	16.2	24.0	2.1	6.9	29
Dominica	8.1	19.6	3.8	4.3	23
Kiribati	7.6	10.1	5.4	1.4	10
Egypt	7.2	13.5	0.3	4.0	29
St. Vincent and the Grenadines	7.0	9.1	5.8	1.2	10
Portugal	6.8	10.6	3.0	2.4	24
Morocco	6.5	8.5	5.3	0.9	24
Burkina Faso	6.4	10.3	3.4	1.9	25
Haiti	6.0	8.6	3.1	1.7	19
St. Kitts and Nevis	6.0	12.0	1.4	3.8	15
El Salvador	5.9	12.0	0.3	4.2	22
Grenada	5.6	7.2	3.9	1.3	13
Vanuatu	4.7	8.5	2.5	1.6	15
Sri Lanka	4.5	6.4	0.2	2.0	24
Pakistan	4.5	10.1	0.7	2.7	29
Benin	4.5	8.0	1.3	1.4	24
Somalia	4.4	9.5	1.0	3.4	5
Jamaica	4.4	12.0	1.0	3.8	23
St. Lucia	4.3	7.4	2.8	1.5	11
Nicaragua	4.3	9.4	0.5	3.2	7
Belize	4.3	9.9	2.1	2.4	15
Comoros	4.2	8.2	1.1	2.1	19
Tunisia	3.9	4.9	3.1	0.5	23
Antigua and Barbuda	3.9	15.2	1.6	3.9	11
Dominican Republic	3.8	8.4	0.8	2.2	29
Mali	3.7	5.9	1.9	0.9	23
Sudan	2.7	4.8	1.0	1.1	17
Croatia	2.5	3.0	2.0	0.4	6
Greece	2.4	2.8	1.9	0.3	22
Turkey	2.4	3.8	1.5	0.6	25
Bangladesh	2.2	3.6	0.0	1.1	24
Honduras	2.1	4.1	0.7	1.1	12
Senegal	1.9	2.6	0.5	0.4	24
Barbados	1.9	2.7	1.2	0.5	12

	Mean	Maximum	Minimum	Std. Dev.	Observations ¹
Malta	1.9	5.7	0.1	1.6	28
São Tomã and Príncipe	1.8	10.0	0.0	2.7	13
Guatemala	1.8	2.4	0.5	0.7	11
Nepal	1.7	2.4	1.1	0.3	24
Seychelles	1.5	2.4	1.0	0.5	9
Algeria	1.3	3.1	0.5	0.8	22
Cyprus	1.3	1.8	0.9	0.3	13
Costa Rica	1.2	1.3	1.1	0.1	4
Togo	1.2	2.0	0.7	0.5	21
India	1.1	2.9	0.1	0.7	29
Nigeria	1.0	5.3	0.0	1.6	22
Mexico	0.9	1.4	0.3	0.3	19
New Zealand	0.7	1.0	0.2	0.2	20
Guinea-Bissau	0.7	0.9	0.4	0.2	5
Philippines	0.6	1.3	0.2	0.2	22
Peru	0.6	0.7	0.4	0.1	9
Spain	0.6	0.9	0.3	0.2	24
Mauritania	0.6	4.2	0.1	0.8	24
Poland	0.6	0.6	0.5	0.0	5
Armenia	0.5	0.7	0.4	0.1	4
Colombia	0.5	1.8	0.1	0.5	29
Oman	0.5	1.1	0.2	0.2	20
Cameroon	0.4	0.8	0.1	0.2	19
Niger	0.4	0.9	0.1	0.2	22
Cambodia	0.4	0.5	0.3	0.1	7
Belgium	0.4	0.5	0.0	0.2	24
Djibouti	0.3	0.3	0.2	0.1	4
Namibia	0.3	0.3	0.2	0.0	9
Slovenia	0.3	0.4	0.1	0.1	7
Italy	0.3	0.5	0.0	0.2	29
Austria	0.2	0.4	0.1	0.1	22
Aruba	0.2	0.3	0.2	0.1	4
Panama	0.2	0.4	0.0	0.1	18
Indonesia	0.2	0.8	0.0	0.2	16
Congo, Dem. Rep.	0.2	0.3	0.1	0.1	8
Guinea	0.2	1.1	0.0	0.4	8
Madagascar	0.2	0.4	0.0	0.1	19
Trinidad and Tobago	0.2	0.7	0.0	0.2	24
Belarus	0.2	0.2	0.1	0.0	4
Ghana	0.1	0.4	0.0	0.1	20
Korea, Rep.	0.1	0.3	0.0	0.1	19
Zimbabwe	0.1	0.3	0.0	0.1	6
Brazil	0.1	0.4	0.0	0.1	20
Rwanda	0.1	0.3	0.0	0.1	19

	Mean	Maximum	Minimum	Std. Dev.	Observations ¹
Moldova	0.1	0.2	0.0	0.1	4
China	0.1	0.5	0.0	0.1	17
Paraguay	0.1	0.7	0.0	0.2	8
Lesotho	0.1	0.1	0.1	0.0	4
France	0.1	0.1	0.0	0.0	24
Suriname	0.1	0.2	0.0	0.1	4
Kyrgyz Republic	0.1	0.1	0.0	0.1	6
Switzerland	0.1	0.1	0.1	0.0	17
Bolivia	0.1	0.7	0.0	0.2	18
Chad	0.0	0.1	0.0	0.0	8
Sweden	0.0	0.1	0.0	0.0	12
Hungary	0.0	0.1	0.0	0.0	4
Argentina	0.0	0.0	0.0	0.0	6
Norway	0.0	0.0	0.0	0.0	15
Lithuania	0.0	0.0	0.0	0.0	6
Romania	0.0	0.0	0.0	0.0	5
Gabon	0.0	0.0	0.0	0.0	11
Estonia	0.0	0.0	0.0	0.0	5

Sources: World Bank and IMF

Appendix Table 3. List of Countries and Worker Remittances (1970–1998)
(in % of Exports of Goods and Non Factor Services) (1970–1998)

	Mean	Maximum	Minimum	Std. Dev.	Observations ¹
Lebanon	269.2	355.7	166.2	73.8	9
Cape Verde	161.0	1103.8	55.2	218.9	22
Albania	137.9	166.1	120.0	17.7	7
Eritrea	88.0	115.3	65.8	20.7	7
Samoa	80.6	129.9	34.1	22.5	22
Yemen, Rep.	67.1	100.6	46.3	18.6	9
Tonga	57.0	100.4	11.1	24.0	19
Burkina Faso	53.7	101.6	21.8	19.0	25
Jordan	41.3	65.7	14.1	16.6	29
Haiti	38.1	55.9	23.6	9.7	19
Sudan	37.6	52.6	13.7	11.7	17
Pakistan	37.3	84.5	9.3	25.1	29
Bangladesh	32.7	64.8	2.0	15.5	24
Egypt	31.6	57.4	2.7	15.8	29
Morocco	29.4	39.3	19.9	5.3	24
El Salvador	27.8	70.5	0.9	22.3	22
Portugal	27.5	47.2	9.2	12.3	24
Turkey	25.6	68.5	7.8	19.4	25
Comoros	24.0	38.4	7.0	10.1	19
Mali	22.9	33.7	14.0	4.9	23
Benin	20.1	41.4	6.4	8.6	24
Kiribati	19.4	36.3	12.1	7.9	10
Dominica	19.1	54.8	7.1	13.1	23
Somalia	15.5	28.7	2.9	11.2	5
Greece	15.2	19.2	11.1	2.8	22
India	15.2	28.1	3.9	6.8	29
Sri Lanka	15.1	22.2	1.4	6.7	24
Dominican Republic	13.4	18.3	2.8	4.6	29
Grenada	12.7	16.7	9.2	2.7	13
Nepal	12.6	19.3	7.3	3.2	24
Nicaragua	12.5	26.3	3.2	7.5	7
St. Vincent and the Grenadines	11.8	13.6	9.9	1.2	10
Tunisia	10.6	13.7	7.7	1.8	23
St. Kitts and Nevis	10.3	21.6	2.5	6.8	15
Vanuatu	10.3	17.5	5.6	3.9	15
Guatemala	9.7	13.4	3.4	3.5	11
Jamaica	7.8	19.5	2.1	5.7	23
Belize	7.5	16.1	4.3	3.8	15
Senegal	6.5	10.2	1.3	1.8	24
St. Lucia	6.1	9.9	4.2	1.9	11

	Mean	Maximum	Minimum	Std. Dev.	Observations ¹
Guinea-Bissau	5.9	9.4	3.5	2.4	5
Croatia	5.9	7.7	3.4	1.6	6
Honduras	5.6	9.2	2.9	1.9	12
Peru	5.3	6.6	3.0	1.1	9
Algeria	5.3	11.9	1.8	2.9	22
São Tomã and Príncipe	4.7	22.9	0.1	6.4	13
Antigua and Barbuda	4.7	18.6	1.8	4.9	11
Mexico	4.3	5.5	3.0	0.9	19
Colombia	3.6	9.5	0.6	2.9	29
Barbados	3.5	4.8	2.5	0.7	12
Spain	3.3	7.4	1.8	1.8	24
Armenia	3.1	4.1	2.6	0.7	4
Togo	3.1	4.6	1.4	1.1	21
Seychelles	2.7	4.3	1.6	0.9	9
New Zealand	2.7	3.3	0.5	0.6	20
Cyprus	2.6	4.0	1.9	0.6	13
Nigeria	2.5	16.0	0.0	4.5	22
Philippines	2.5	4.1	0.6	0.9	22
Malta	2.5	10.1	0.1	2.4	28
Costa Rica	2.2	2.6	1.6	0.4	4
Poland	2.1	2.2	1.9	0.1	5
Niger	2.0	4.4	0.7	1.1	22
Cameroon	1.8	3.3	0.3	0.8	19
Cambodia	1.7	2.9	1.0	0.8	7
Brazil	1.5	5.5	0.0	1.7	20
Mauritania	1.4	11.7	0.2	2.3	24
Congo, Dem. Rep.	1.3	2.6	0.3	0.8	8
Italy	1.3	3.2	0.1	0.9	29
Rwanda	1.1	3.6	0.2	0.9	19
Madagascar	1.0	2.4	0.0	0.8	19
Oman	0.9	1.8	0.5	0.3	20
China	0.7	2.3	0.1	0.7	17
Guinea	0.7	4.7	0.0	1.6	8
Indonesia	0.7	1.4	0.1	0.4	16
Austria	0.7	0.9	0.3	0.2	22
Djibouti	0.7	0.7	0.6	0.1	4
Ghana	0.6	1.6	0.0	0.5	20
Belgium	0.6	1.0	0.0	0.3	24
Zimbabwe	0.6	1.2	0.0	0.4	6
Namibia	0.5	0.6	0.4	0.1	9
Belarus	0.5	0.6	0.4	0.1	4
Slovenia	0.4	0.6	0.2	0.2	7
Korea, Rep.	0.4	0.7	0.1	0.2	19
Trinidad and Tobago	0.4	1.5	0.0	0.5	24

	Mean	Maximum	Minimum	Std. Dev.	Observations ¹
Bolivia	0.4	4.7	0.0	1.1	18
Lesotho	0.4	0.5	0.3	0.1	4
Chad	0.3	0.9	0.0	0.3	8
Paraguay	0.3	1.5	0.1	0.5	8
France	0.3	0.5	0.2	0.1	24
Panama	0.3	0.6	0.0	0.2	18
Kyrgyz Republic	0.3	0.4	0.1	0.1	6
Moldova	0.2	0.3	0.1	0.1	4
Argentina	0.2	0.3	0.1	0.1	6
Uganda	0.2	0.2	0.1	0.0	2
Switzerland	0.2	0.2	0.1	0.0	17
Aruba	0.1	0.2	0.0	0.1	8
Sweden	0.1	0.2	0.0	0.0	12
Hungary	0.1	0.1	0.0	0.0	4
Suriname	0.1	0.1	0.0	0.0	4
Romania	0.1	0.1	0.0	0.0	5
Norway	0.0	0.1	0.0	0.0	15
Lithuania	0.0	0.0	0.0	0.0	6
Gabon	0.0	0.0	0.0	0.0	11
Estonia	0.0	0.0	0.0	0.0	5

Sources: World Bank and IMF

Appendix Table 4. Worker Remittances (in per cent of GDP) and Growth:
Cross Section Estimation OLS (1970–1998)

Dependant variables: Real GDP growth	I	II	III Quadratic
Constant	-0.009 (-0.588)	-0.009 (-0.505)	-0.011 (-0.650)
Log(y_0)	0.0004 (1.213)	0.001* (1.755)	0.001** (2.175)
Log(I/GDP)	0.014*** (2.725)	0.014** (2.613)	0.014** (2.599)
NPCF/GDP		0.056 (1.425)	0.064* (1.640)
WR/GDP	-0.006 (-0.222)	-0.039 (-1.463)	0.072 (1.006)
(WR/GDP) ²			-0.443* (-1.669)
East Asia		0.003 (0.505)	0.003 (0.576)
East Europe & Central Asia		-0.016*** (-3.317)	-0.014*** (-3.137)
MENA		0.007 (1.193)	0.007 (1.240)
South Asia		0.005 (0.630)	0.004 (0.507)
Western Europe		-0.009 (-1.473)	-0.007 (-1.200)
Sub Sahara Africa		-0.004 (-1.108)	-0.004 (-0.97)
Number of countries	113	113	113
R-squared	0.07	0.25	0.27

Note: Value of t statistics in parentheses; * significant at 10%; ** significant at 5%;
*** significant at 1%.

Appendix Table 5. Worker Remittances Changes and Growth: Cross Section Estimation
OLS (1970–1998)

Dependant variables: Real GDP growth	I	II
Constant	0.003 (0.156)	0.002 (0.105)
Log(y_0)	0.001 (1.32)	0.001** (2.101)
Log(I/GDP)	0.010** (2.056)	0.011* (1.922)
NPCF/GDP		0.057 (1.433)
Dlog(WR)	-0.013** (-2.454)	-0.011** (-2.036)
East Asia		0.0003 (0.071)
East Europe & Central Asia		-0.014*** (-2.969)
MENA		0.004 (0.721)
South Asia		0.004 (0.548)
Western Europe		-0.008 (-1.412)
Sub Sahara Africa		-0.005 (-1.338)
Number of countries	111	111
R-squared	0.11	0.25

Note: Value of t statistics in parentheses; *, ** and *** significant respectively at 10, 5, and 1%.

Appendix Table 6. Worker Remittances and Growth: Panel Estimation (1970–1998)

Dependant variables: GDP per capita Growth	I	II	III	IV
	Common slope	Common slope and regional dummies	Common slope and NPCF	2-way fixed effects
Constant	-0.1050*** (-9.269)	-0.0932*** (-7.345)	-0.0979*** (-7.810)	
LOG(1/GDP)	0.0384*** (10.523)	0.0347*** (8.628)	0.0360*** (9.060)	0.0567*** (7.470)
dlog(WR/GDP)	-0.0044* (-1.707)	-0.0044* (-1.704)	-0.0031 (-1.213)	-0.0050* (-1.886)
NPCF/GDP			0.0004* (1.884)	
East Asia		-0.0021 (-0.429)	-0.0028 (-0.572)	
East Europe & Central Asia		0.0117 (1.373)	0.0116 (1.390)	
MENA		0.0022 (0.527)	0.0023 (0.558)	
South Asia		0.0146*** (2.975)	0.0149*** (3.091)	
Western Europe		0.0051 (1.130)	0.0054 (1.223)	
Sub Sahara Africa		-0.0108*** (-2.962)	-0.0094*** (-2.593)	
Number of observations				
Number of countries	83	83	83	83
R-squared	0.08	0.10	0.11	0.17

Note: Value of t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix Table 7. Worker Remittances and Growth: Panel Estimation (1985–1998)

Dependant variables: GDP per capita Growth	I	II	III	IV	V
	Common slope	Common slope and regional dummies	Common slope and NPCF	2-way fixed effects	Fixed effects and Inflation
Constant	-0.0978*** (-7.569)	-0.0827*** (-5.766)	-0.0823*** (-5.746)		
LOG(I/GDP)	0.0361*** (8.680)	0.0323*** (7.107)	0.0319*** (7.039)	0.0670*** (6.562)	0.0551*** (6.697)
dlog(WR/GDP)	-0.0054* (-1.876)	-0.0051* (-1.778)	-0.0052* (-1.803)	-0.0059** (-2.005)	-0.0056* (-1.722)
NPCF/GDP			0.0004** (1.966)		
Inflation					-0.0044*** (-2.680)
East Asia		-0.0026 (-0.494)	-0.0030 (-0.569)		
East Europe & Central Asia		0.0106 (1.153)	0.0102 (1.120)		
MENA		-0.0070 (-1.482)	-0.0067 (-1.420)		
South Asia		0.0108* (1.887)	0.0110* (1.922)		
Western Europe		0.0033 (0.651)	0.0036 (0.704)		
Sub Sahara Africa		-0.0143*** (-3.550)	-0.0138*** (-3.407)		
Number of observations					
Number of countries	83	83	83	83	83
R-squared	0.09	0.12	0.12	0.38	0.27

Note: Value of t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix Table 8. Worker Remittances and Growth: Panel Estimation (1985–1998)
(reduced sample comprising countries with at least 10 years of continuous observations)

Dependant variables: GDP per capita Growth	I	II	III	IV	V	VI
	Common slope	common slope and regional dummies	Common slope and NPCF	2-way fixed effects	Fixed effects and Inflation	Fixed effects and private capital flows
Constant	-0.1169*** (-8.601)	-0.0948*** (-6.161)	-0.0913*** (-5.924)			
LOG(I/GDP)	0.0428*** (9.726)	0.0360*** (7.399)	0.0342*** (6.957)	0.0673*** (6.719)	0.0506*** (6.461)	0.0455*** (5.932)
dlog(WR/GDP)	-0.0086*** (-2.767)	-0.0085*** (-2.756)	-0.0085*** (-2.779)	-0.0074** (-2.434)	-0.0065** (-2.155)	-0.0065** (-2.199)
NPCF/GDP			0.0006** (2.391)			0.0005** (2.330)
Inflation					0.0000 (-1.469)	
East Asia		0.0112** (1.963)	0.0126** (2.200)			
East Europe & Central Asia		0.0101 (0.961)	0.0116 (1.111)			
MENA		-0.0065 (-1.465)	-0.0055 (-1.229)			
South Asia		0.0115** (2.227)	0.0129** (2.495)			
Western Europe		0.0027 (0.535)	0.0040 (0.784)			
Sub Sahara Africa		-0.0129*** (-3.116)	-0.0122*** (-2.969)			
Number of observations						
Number of countries	49	49	49	49	49	49
R-squared	0.14	0.18	0.18	0.39	0.30	0.31

Note: Value of t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix Table 9. Determinants of Worker Remittances

Dependant variables: Worker remittances in percent of GDP	I Fixed Effects (IV: Income Gap)
Income gap between country <i>i</i> and the USA	-16.98*** (-5.28)
Real interest rate GAP between country <i>i</i> and the USA	0.02 -0.13
Number of observations	597
Number of countries	49
R-squared	0.87

Note: *** indicate significant at 1% level.

Appendix Table 10. Worker Remittances and Growth: Panel Estimation, Instrumental Variable Estimation (1985–1998)

Dependant variables: GDP per capita Growth	I			II			III		
	Common slope	Fixed Effects	Random Effects	Common slope	Fixed Effects	Random Effects	Common slope	Fixed Effects	Random Effects
	(IV: Income Gap)			IV: Income+Interest rate gap, excluding developed countries			IV: Income+Interest rate gap, including developed countries		
Constant	-0.1086*** (-8.151)		-0.1183 (-7.067)	-0.1118*** (-7.254)		-0.1215*** (-6.288)	-0.1130*** (-8.004)		-0.1243*** (-7.019)
LOG(I/GDP)	0.0405*** (9.371)	0.0505*** (-6.500)	0.0436 8.046	0.0414*** (8.394)	0.051*** (5.83)	0.0444*** (7.197)	0.0423*** (9.326)	0.054*** (6.7)	0.0460*** -8.085
dlog(WR/GDP)	-0.0233** (-2.499)	-0.0045 (-0.331)	-0.01574 (-1.441)	-0.0306*** (-3.480)	-0.0227** (-2.12)	-0.0266*** (-2.79)	-0.0320*** (-4.051)	-0.0244** (-2.440)	-0.0283*** (-3.240)
NPCF/GDP	0.0003* -1.936	0.0002 -0.917	0.0003 -1.441	0.0009*** (2.698)	0.0009*** -2.487	0.0009*** (2.644)	0.0003* (1.729)	0.0001 (0.668)	0.0002 (1.222)
Number of observations	658	658	658	512	512	512	603	603	603
Number of countries	48	48	48	42	42	42	49	49	49
R-squared	0.15	0.28	0.22	0.12	0.31	0.26	0.17	0.31	0.25

Note: ***, **, * indicate significant at the 1, 5, and 10 % level respectively

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