DOCUMENT DE TRAVAIL DT/2015-23

Modeling and Measuring Information Asymmetry in the Context of Senegalese Migrants' Remittances

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Abstract

Much optimism has been invested in the developmental role of migrants' remittances as altruism and frequent interactions should facilitate investments by migrants in their countries of origin. But geographical dispersion can foster strategic behavior. We develop a model of transfers from the Senegalese diaspora based on socio–anthropological evidence of remittances earmarked by migrants for investments or expenditures by their households of origin, especially durable assets. The model allows for information asymmetry and monitoring by the migrant. It shows that it may be optimal for recipients to behave strategically and we may observe systematic discrepancies between recipients' and senders' reports of the goods to be financed by transfers. Novel matched data enable us to test and find support for the model's predictions.

Keywords : Asymmetric Information ; International migration ; Remittances ; Senegal

JEL classification : D82, F22, F24

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Résumé

Les envois de fonds des migrants suscitent de grands espoirs en termes de développement. Altruisme et contacts réguliers entre les membres d'une même famille devraient faciliter l'investissement par les migrants dans leur pays d'origine. Mais l'éloignement géographique peut aussi générer des comportements stratégiques. Nous modélisons ici les envois de fonds de la diaspora sénégalaise, en nous appuyant sur la démonstration par la littérature socio–anthropologique du désir des migrants d'affecter leurs envois à tel poste de dépense ou d'investissement, notamment l'achat de biens durables, dont le foyer d'origine a la charge. Notre modèle prend en compte l'asymétrie d'information qui peut exister entre migrants et foyer d'origine, ainsi que les activités de contrôle mises en œuvre par le premier. Il démontre qu'il peut être optimal pour les bénéficiaires d'envois de fonds d'adopter un comportement stratégique et qu'il est ainsi possible d'observer un écart systématique entre les déclarations de ceux qui envoient et reçoivent des fonds quant aux biens qu'ils visent à financer. Des données appariées innovantes nous permettent d'évaluer les prédictions du modèle, qui se trouve conforté par le travail empirique.

Mots–clés : Information privée et asymétrique ; Migration internationale ; Envois de fonds ; Sénégal

Classification JEL: D82, F22, F24

1 Introduction

Why migrants remit and how they determine the amounts they send has attracted both policymakers' and scholars' interest. Over 70% of officially recorded remittances flow into low– or middle–income countries (World Bank, 2014b). This totals US$404 billion in 2013 or three times the size of official development assistance (World Bank, 2014a), a manna that could be harnessed for economic development—see Maimbo and Ratha (2005), *inter alia*. Productive investment of remittances should moreover benefit from the altruism and close–knit relationships that characterize households, facilitating coordination and the enforcement of agreements (Carling, 2008).

Remittances worldwide are nevertheless overwhelmingly spent on consumption and recurrent household needs. A major reason may be the pattern of control of household resources (Chimhowu et al., 2005). Indeed, migrants often initiate investment, deciding for instance to build a house and start a business out of a desire to return home, while recipients would rather continue allocating funds to consumption (ibid.).

A leading—yet relatively understudied—mechanism behind such control issues is the private information held by recipients on how remittances are used. Geographical dispersion is indeed inherent in transnational households and monitoring costs are expected to be much higher than for co–resident members, aggravating the consequences of diverging preferences. This paves the way for strategic behavior, one manifestation of which is information manipulation, and carries important implications as reducing information asymmetry and control issues might stimulate remittances or help channel them toward more productive uses (Yang, 2011).

The Senegalese diaspora offers a suitable setting for the study of information asymmetry in the context of international migration and remittances. Emigration has a long history there, both to neighboring African countries such as Mauritania and to distant Europe. It is also a major support of the Senegalese economy: 11.18% of its GDP was accounted for by international remittances in 2011 (World Bank, 2014b) and 7 out of 10 Senegalese households have at least one emigrant (Some, 2009). [1] Therefore, even

1. It is interesting to note that 76% of Senegalese households' transfer receipts originate from family members (De Vreyer et al., 2008).

if geographical dispersion is a hotbed of information asymmetry and manipulation, we would expect Senegalese transnational households to have developed all possible hedges against it.

This paper's discussion of information asymmetry and manipulation within Senegalese transnational households is grounded in qualitative evidence and empirical work. It relies on matched data on Senegalese migrants and their households of origin where a stylized fact emerges (presented in Section 5.1): Migrants systematically report a higher number of assets owned—refrigerators, DVD players, bicycles, cars, etc.—by their households of origin than the latter themselves. A similar finding obtains when one considers the quality of their dwellings.

The stylized fact is in line with findings from a growing literature on information asymmetry and control issues in geographically dispersed households. Evidence suggests that migrants seek more control over the use of the remittances they send (Ashraf et al., 2011; Chin et al., 2010; Batista and Narciso, 2013), in particular through in–kind transfers (De Laat, 2008; Torero and Viceisza, 2013; Batista et al., 2013), and transfer recipients alter their behavior based on the observability of their actions (Azam and Gubert, 2005; Chami et al., 2005; Chen, 2006, 2013). [2]

A final strand in the literature, to which this study belongs, goes one step further by contrasting the information held by remittance senders and recipients. De Weerdt et al. (2014) use cross–reports from domestic migrants and their households of origin in Tanzania to construct a measure of misperception of each other's consumption. They find a lack of systematic misperceptions but show that transfers increase with recipients' perception of the donor's income. Likewise, Seshan and Zubrickas (2014) rely on reports of Qatar–based migrants' earnings collected from the migrants and their wives in Kerala. They find that wives tend to underestimate their husbands' overseas earnings and that this pattern correlates with lower annual remittances sent home. De Weerdt et al. (2014) and Seshan and Zubrickas (2014) highlight the importance of transfer *senders'*

2. Other papers highlight that *migrants* indulge in strategic behavior—see Chort et al. (2012) on Senegalese migrants, and Ambler (2012). It is worth noting that Ambler (2012) finds evidence of migrants taking advantage of private information but cannot conclude that recipients behave strategically in her setting.

private information.[3] Our stylized fact hints in the opposite direction—at information asymmetry about transfer *recipients*.[4]

Our first contribution (Section 2) is to replace the stylized fact in the context of the Senegalese transnational household economy in order to qualitatively identify leading remittance motives and potential sources of strategic behavior. We rely on the socio–anthropological literature and a semi–qualitative study of Senegalese migrants specifically designed to shed light on the stylized fact.[5] We find evidence that migrants earmark some of their transfers, especially for real–estate investments, productive ventures, or the refurbishment or equipment of the family compound back home, and report information asymmetry and manipulation issues.

The qualitative evidence lays the foundations for our second contribution (Section 3): a model of Senegalese migrants' remittances in an information–asymmetry framework. Whereas De Weerdt et al. (2014) and Seshan and Zubrickas (2014) focus on the impact on remittances of observed gaps in survey reports, we shall lay emphasis on investigating whether such gaps can be attributed to information manipulation by transfer recipients. Evidence of information asymmetry is indeed lacking: Since migrants are likely to have developed mechanisms to monitor the use of their remittances, it is unclear *a priori* whether it may be optimal for recipients to deviate from earmarking contracts. Subsequently, we shall rely on the model to establish that residual information asymmetry may explain the stylized fact of systematic discrepancies between recipients' and senders' reports of the goods to be financed by transfers. Predictions are derived to shed light on the effects of information asymmetry on remittance behavior.

3. McKenzie et al. (2013) also suggests that Tongan migrants to New Zealand misrepresent their earnings *downwards* to their transfer recipients.

4. Other papers focus on information asymmetry between co–resident household members—see Ashraf (2009), Castilla and Walker (2013) and Ziparo (2014).

5. Because it was not the sole focus of the matched data that we use for the empiricis (see Section 4), a short questionnaire was developed in order to delve further into information asymmetry, and implemented in October 2012 in Château Rouge. This area of Paris is densely populated by and attracts (from the rest of the conurbation) many Senegalese migrants. The semi–qualitative survey assesses whether information asymmetry is a concern for the migrant with questions on earmarking of transfers, suspicion, monitoring and sanctions. Furthermore, the interviewees were presented with the stylized fact identified in the matched data and asked to put forward the most plausible hypotheses. Great care was taken in letting the interviewees express themselves and in gathering qualitative information. Due to the qualitative dimension of the survey, 20 migrants were interviewed.

After a presentation of the data (Section 4), Section 5 provides evidence of the stylized fact and shows that it is consistent with the model's predictions. It also deals with potential alternative interpretations and pays particular attention to measurement error.

Section 6 concludes.

2 Transfers and information in Senegalese transnational households

Family networks play a major financial role in Senegal and decisions to emigrate have often been described as a household strategy (Chort and Senne, 2013; Boltz–Laemmel and Villar, 2014, *inter alia*). In spite of distance, Senegalese migrants remain closely linked to their "household of origin," as they themselves call the place where they were born, grew up and where their siblings and parents still live (ibid.). This is also where redistribution norms are inculcated and internalized (Platteau, 2012). [6]

Building a house "back home" comes up repeatedly in studies of Senegalese migrants. Although most of their remittances are meant to finance daily expenses, real estate and the improvement and equipment of housing has become a growing concern for them (Fall, 2003). As Dia (2007) puts it: "It is fashionable among migrants nowadays to have a house built in the village [although the existing house might be large enough]. Oftimes, building does not suffice; the house must be adorned with all the attributes of 'modernity': a TV set, a VCR, a telephone, and electrification thanks to solar panels." [7] Expanding or refurbishing the family compound through remittances thus embodies migrants' desire to return to their households of origin and offers a tangible signal of their efforts to maintain ties (Boltz–Laemmel and Villar, 2014).

Money is sent back home and then the onus is on relatives living in the household of origin to purchase the materials needed for construction or the equipments of the new building (Dia, 2007). More generally, the semi–qualitative survey showed that a

6. Even for those born at destination, the link to the household of origin, i.e., to the place where the *parents* (usually, the father) were born and raised, remains strong. Boltz–Laemmel and Villar (2014) report the story of a man born in the capital, Dakar, but building a house in Fatick, where his father was born and had returned, with the project of moving there someday too.

7. Translation by the author.

third of respondents do not always give recipients a free hand as far as how transfers should be spent. They instead earmark remittances for particular purchases, through in–kind transfers or verbal instructions.

Migrants' preferences over the use of remittances need not be in line with their relatives' back home. To the contrary, Dia (2007) explains that migrants are often "accused of imposing decisions on the villagers and thus of abusing their new monetary power". Migrants on the other hand fear that members of the household of origin rather keep the money, do not purchase all that is necessary or use up the transfers in a short time. Conflicts with relatives in Senegal over money, its use and the implementation of investment projects may thus emerge, so that remittances create a familial economy characterized by "a struggle for controlling the resources from migration" (Dia and Adamou, 2003). [8]

Different members of the transnational household are also subjected to different emergencies or pressures. Most of the time, migrants are not directly solicited for financial assistance; but their left–behinds, first and foremost their spouses, are pressured into redistributing as requests from closer relatives are more difficult to turn down (Boltz–Laemmel and Villar, 2014). [9]

Conflict over the use of remittances is not the only instrument that recipients and senders can resort to in order to impose their views. Information manipulation is another.

It is worth noting here that, migrants may use private information about their earnings or their situation in the destination country to reduce the amounts they have to remit (Chort et al., 2012). Now, if the stylized fact we intend to explain is due to information manipulation, we would expect it to originate in *recipients'* behavior since it

8. Translation by the author. It is worth emphasizing that we make no claims about whose preferences—the recipients' or the senders'—are more conducive to household welfare or economic development. It may well be that *migrants'* projects are unproductive. Conspicuous consumption among Senegalese migrants is well–documented—e.g., in Dia (2007) and Boltz–Laemmel and Villar (2014). However, migrants—the ones actually making remittance decisions—do seem more inclined to invest in productive ventures back home—see Chimhowu et al. (2005).

9. Such pressures can have nefarious consequences. Platteau (2012) imputes the failure of Senegalese shopkeepers who had taken over from the Mauritanians expelled during the 1989 war on the obligation to grant credit and poorer customers' (mostly relatives and neighbors) "perceived right to consider the loan taken as a (forced) gift".

pertains to items identified as promoted by migrants in the literature. We thus focus on information asymmetry about the household of origin's actions.

Invested funds are reported to be subject to taxation by those in charge in Senegal without the agreement of the migrants, who often "bemoan the lack of people worthy of trust among their kith and kin" (Fall, 2003) and of "reliable intermediaries" (ibid.) in general in the country of origin.[10] According to Marfaing (2003), the majority of migrants have experienced the failure of their own business projects in Senegal as business funds are regularly swallowed up in the event of emergencies.

Our semi–qualitative survey asked respondents to speculate on the stylized fact emerging from the matched data: Most maintained that the discrepancies observed were due to the household of origin lying to the migrant in order to extract more or secure transfers. This result is strongest for assets.[11] The most frequent story pertains to durable goods not being purchased, contrary to the migrant's wishes, or sold, if bought by the migrant directly. Respondents often mentioned fancy clothes or participation in "baby naming ceremonies" (*ngénte* in Wolof) as the destination of the embezzled transfers.

This is evidence of information asymmetry and manipulation, whereby relatives back home exploit private information about how remittances are spent to further their own interests. As one migrant in the semi–qualitative survey put it: "We only know what they tell us." Half the interviewees had doubts about the information received from their main transfer recipients and thought their earmarking was not followed or information was distorted in order to extract rents.

Migrants however do exert themselves to improve the information they receive. This may mean reducing the fungibility of transfers by sending them to shopkeepers so as to allocate them beforehand (Dia, 2007), remitting in kind[12] or monitoring trans-

10. Translation by the author.

11. 15 out of 20 indicted the household of origin for the observed discrepancies. 7 of those understood the stylized fact immediately and spontaneously answered without the interviewer listing possible options; 12 came up with an anecdote or an example to illustrate their answers.

12. Customers' comments posted on the website of Niokobok, a firm specializing in in–kind transfers to Senegal, eloquently reflect the relationship between control issues and in–kind remittances: For instance, one customer explains that it allows her/him to "make sure the money is really used by the household" as "you are always afraid that the money is not managed well when you are far away," according to another—see https://www.niokobok.com/reviews-7.html [Accessed on September 21, 2015].

fer recipients through phone calls, visits to the household of origin and contacts with other migrants or neighbors from the same community. Fall (2003) highlights that "migrants choose to maximize the benefit of their stays back home by managing their own projects themselves"—see also Dia (2007).

If information manipulation is detected, reputation seems the main leverage for punishment. In the semi–qualitative survey, respondents explained that they would threaten to cut remittances or badmouth their households of origin to punish them for swerving from their instructions.

3 Theoretical framework

The review of the literature on remittance allocations within Senegalese transnational households has revealed conflicts between senders and recipients, and a strategic use of information by the latter, especially as migrants earmark transfers for specific goods or services. Among those, housing and equipment of the house seems to take pride of place. The rest of the paper shall thus focus on asset ownership, [13] for which we can anticipate, based on a solid body of socio–anthropological evidence, in which direction disingenuous households of origin should bend the information they share with migrants. [14]

This is already part of the explanation for the stylized fact observed in our data and presented in Section 5.1: The household of origin could take advantage of private information on the use of transfers to avoid sanctions. Nevertheless, we saw that migrants do monitor the use of remittances they send, which ought to be modeled explicitly.

3.1 Soft–information model

The framework delineated in this section can be traced back to Mookherjee and Png (1989). They develop a moral–hazard model inspired by Grossman and Hart (1983) but allow agents' utility to depend partly on what they report, thus creating an incentive for them to misrepresent their actions. To counter this, the principal can "audit" the

13. Because of the more complex structure of the housing quality variables, Section 5 shall focus on asset ownership. Corresponding results for housing characteristics are displayed in Appendix F.

14. Conversely, different motives for remittances can lead to incompatible predictions about information manipulation when it comes to aggregate variables such as earnings or wealth. For instance, we would expect the household of origin, should they behave strategically, to either play down or inflate their wealth depending on whether remitters are believed to be motivated by altruism or inheritance, respectively.

information communicated.

In our remittance context, we assume the principal to be the migrant, denoted m, and the agent her household of origin, h. The migrant wants to increase the consumption of a good (X). The migrant may eventually move back to Senegal and live in the house she built and equipped, or run the business she invested in. But in the meantime her investments are realized by and benefit h. Examples of X are refrigerators or cars for durable assets and roof material or the number of rooms for housing.

Note that X may serve a productive purpose, e.g., a refrigerator can be used to store refreshments for sale. The model is more general than what the data, presented in Section 4, enable us to test: It applies to any good or service X that m favors and finances relative to any private consumption good Y that she disapproves of or does not wish to promote. For instance, an alternative interpretation is that m is paternalistic and derives utility from h's consumption of some goods but not others.

Both m's and h's preferences are common knowledge thanks to a long and daily interaction prior to migration. The migrant thus knows what h would have done in autarky, i.e., without her remittances.

In autarky, h maximizes its utility subject to a budget ω from the consumption of X and Y, which have unit costs p_X and p_Y, respectively. We denote $X^*(\omega)$ the optimal consumption of X given ω. Earnings ω are assumed constant or varying only marginally so that m estimates them as well as h's optimal $X^*(\omega)$ accurately. [15] However, h is subject to some shock $\tau \in [0, 1]$ that reduces its disposable income to $\omega(1 - \tau)$.

τ can stand for some pressure that m does not feel or understand, e.g., from close relatives or friends of h's but not of hers, or an emergency she disapproves of. Alternative interpretations of τ are possible, e.g., h may suffer from a lack of self–control or bend the earmarking of the contract temporarily and prefer not to bother m, although they eventually fail to restore the contractual equilibrium. But the way this shock is

15. The assumption of a constant ω can be relaxed. If ω has a stochastic component and h may misrepresent its earnings to m in order to extract more transfers, misrepresentations about X (see below) are still possible, albeit of a smaller magnitude.

modeled here—as a dent in disposable income—corresponds to the argument of social pressure to share put forward in the literature.

We assume for simplicity that τ can take on only two values. But *which* level of τ will be realized is unknown *ex ante*: $\tau = 0$ occurs with probability π and $\tau > 0$ with probability $(1 - \pi)$. This uncertainty stems from random circumstances affecting h, e.g., a neighbor or distant relative accidentally falling ill. However, h can observe τ and its consumption decisions are determined by whether or not it is subject to it, as stated in Problem 1:

***h*'s problem in autarky:**

$$\max_{X,Y} W^h = u^h(Y) + v^h(X) \tag{1a}$$

$$\text{s.t.} \quad \omega(1-\tau) = p_X X + p_Y Y \tag{1b}$$

In autarky, m is unable to invest in X by definition; and h consumes $X^*(\omega(1-\tau))$. We however assume that m has positive demand for X, so that if she is not satiated by h's autarky consumption level of X she would benefit from transferring resources to h to increase the quantity of X that it consumes. X then becomes a public good co–financed by m and h. They agree on a contract whereby m sends remittances t to finance X but only *over and above* h's contribution in autarky. [16]

According to the contract, m sends remittances $t(\omega, X^{*m})$, where X^{*m} is the total X (autarky level *plus* what is financed through t) she targets, and h is supposed to spend it all on X so that $X_{hh} = X^*(\omega) + \frac{t}{p_X}$, where X_{hh} is the level of X chosen by h. This notation anticipates on the empirical section, which compares h's (X_{hh}) and m's (X_{hm}) reports of X. The issue is that X cannot be observed by m due to geographical distance so that strategic behavior can arise, whereby h regards t as fungible income that it can spend on either X or Y, thus consuming $X^*(\omega + t)$ instead of $X^*(\omega) + \frac{t}{p_X}$.

Let us note that since Problem 1 is known to m, she can predict h's attitude perfectly, except that, after t is sent, h is subject to the random shock τ that she cannot

16. The contract could specify that m finances all of X; m would thereby be acknowledging that a portion of t, corresponding to $p_X X^*(\omega)$ is effectively fungible.

observe. The potential levels of τ are assumed to be known to m but she ignores in which state of the world h is: π or $(1-\pi)$.

After X_{hh} is realized h reports a message $\widehat{X_{hh}}$ to m. The actual X_{hh} is unobservable to, and $\widehat{X_{hh}}$ unverifiable by m. However, observability can be partly restored *ex post* through m's monitoring of h's consumption of X. This requires investing Q at a cost $l(Q)$, with $l'(Q) > 0$. Examples of monitoring activities include phone calls, physical visits to h, the collection of information from neighbors, relatives or fellow migrants from the same village, etc. $l(Q)$ also incorporates m's intrinsic ability to monitor h, including geographical dispersion. [17]

A crucial feature is that m's monitoring technology is imperfect and a deviation $\widehat{X_{hh}} \neq X_{hh}$ is detected only with probability $0 \leq q(\widehat{X_{hh}} - X_{hh}; Q) \leq 1$, where Q increases the probability of detection. False positives are assumed away: $q(0; Q) = 0$. After investigating, m thus becomes convinced either that $\widehat{X_{hh}} > X_{hh}$ or that $\widehat{X_{hh}} = X_{hh}$. We denote m's belief after monitoring by $\alpha(q(\cdot))$, where the function $\alpha(\cdot)$ yields 1 with probability q and 0 with probability $1-q$. If $\widehat{X_{hh}} \neq X_{hh}$ is exposed, m metes out a utility cost F to h, the effect of which is to distort h's preferences toward the earmarking of t favored by m. We assume F fixed so that there is a limit to sanctions m can inflict on h. [18]

The model is a one–shot game. Although this simplification is introduced for tractability, investment in X may not be frequent enough that the migrant can avail herself of past experiences. Moreover, we saw that h is often the only or best intermediary back home and that migrants may not have credible future sanctions at hand—such as putting an end to transfers or to their relationship with h.

We assume for simplicity that there is no commitment problem: As long as $Q > 0$ is invested, monitoring is run; and m cannot but inflict punishment F on h if $X^{*m} \neq X_{hh}$ is detected. [19]

17. A more complex understanding of the costs and benefits of monitoring is possible. Phone calls, for instance, may cut both ways: They enable m to monitor h but also give h the opportunity, in a model with transfers for other purposes than investment in X, to request more money. Such a risk would increase $l(Q)$.

18. Note that an alternative to a fixed F would be to add a "limited liability constraint" (in terms of utility) in Problem 2 below.

19. F has no cost in the model. Commitment would not hold if F harmed m too. Besides, the marginal

Figure 1 summarizes the sequence of the game.

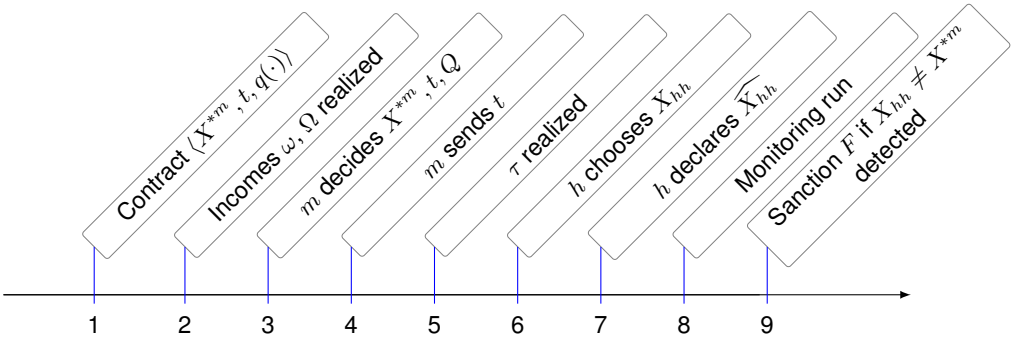

Figure 1: Sequence of the game

More formally, h solves Problem 2 last based on variables set by m (and singled out by stars). Problem 3 however takes into account, through backward induction, h's best reaction (also flagged by stars) to determine m's optimal transfer t (equivalently, her target X^{*m}) and other choice variables.

***h*'s problem:**

$$\max_{X,Y} W^h = u^h(Y) + v^h(X) - F\alpha(q(X^{*m} - X; Q^*)) \tag{2a}$$

$$\text{s.t.} \quad \omega(1-\tau) + t^* = p_X X + p_Y Y \tag{2b}$$

***m*'s problem:**

$$\begin{aligned}\max_{c,t,Q} W^m = {} & u^m(c) + \pi v^m(X^*(\omega + t; Q)) \\ & + (1-\pi) v^m(X^*(\omega(1-\tau) + t; Q))\end{aligned} \tag{3a}$$

$$\text{s.t.} \quad \Omega = c + p_t t + l(Q) \tag{3b}$$

Notation is as follows: Y (c) is h's (m's) private consumption good; $u^i(\cdot)$ and $v^i(\cdot)$,

cost of monitoring h, once Q has been sunk, may be close to 0. Contacts and visits also signal affection or abidance by norms (unmodeled here) so that m may derive benefits while inquiring about her investments in X.

$i = h, m$, are concave and twice differentiable utility functions; p_t is what sending one unit of t costs m, while the price of c is normalized to 1; and Ω is m's earnings. All prices are assumed positive definite and common knowledge.

It is important to note that although m increases the resources available to h through t, participation in the contract is not trivial for remittance recipients—see Appendix A. Whenever the participation constraint is not met, disconnecting t from X^{*m} is the only way for m to induce participation.

Now, provided h finds it worthwhile to participate, can it be optimal for them to strategically deviate? A strategic behavior in this context means that h regards t as fungible income that can be spent on either X or Y. Whether h deviates from the contract depends on a number of factors, as the incentive compatibility constraint detailed in Appendix B makes it clear. The key result is that even when m can monitor h's consumption of X, h may optimally deviate under certain conditions determined by the structural parameters. The incentive to deviate is unambiguously reinforced by the cost of observing h's actions and thus geographic dispersion, as captured by Q.[20] Absent monitoring, h always has an incentive to deviate, which is clearly strengthened by higher t—see Appendix B. This implies that any increase in t that m might contemplate must be checked by a concomitant improvement in her ability to detect and sanction deviations.

Indeed, maximizing W^m with respect to t and Q, we obtain—see Appendix D:

$$\frac{\partial t}{\partial Q} = \frac{l'(Q)}{p_t} \tag{4}$$

Equation 4 tells us that $\frac{\partial t}{\partial Q}$ is unambiguously positive. This positive covariance at the optimum between t and Q means that even though there may be heterogeneity in Q–t pairs, due to migrants' and households' having different structural parameters, at the equilibrium we expect Q and t to move in the same direction. Moreover, we see that it increases with $l(Q)$: The more difficult or costly it is for m to monitor h,

20. We can verify that h's incentive to deviate is stronger when $\tau > 0$—see Appendix C. This result holds when one abstracts from monitoring. Interestingly, the introduction of monitoring renders the effect of τ ambiguous because the higher τ, the larger the deviation all else equal, and thus the more likely it is that the deviation is detected.

the stronger the (positive) correlation between t and Q. We would thus expect $\frac{\partial t}{\partial Q}$ to increase with geographical distance, although this effect might be attenuated by p_t.

3.2 Discrepancies between migrants' and households' reports

Anticipating on the empirical Section 5, what m reports when no deviation is detected deserves some discussion. We should indeed observe $X_{hm} = X_{hh} < \widehat{X_{hh}}$ after a deviation was successfully detected. But if what m reports in the survey is what she believes and her expectations are rational, X_{hm} should incorporate, whenever h does not deviate or monitoring fails, the probability that h was in fact disingenuous conditional on no deviation being detected. However, this is likely to be computationally demanding for m. Moreover, m may incur a psychological cost from reporting $X_{hm} < \widehat{X_{hh}}$, which would be tantamount to indicting h of misrepresentations, without any tangible evidence. We therefore argue that misrepresentations by h should show in the comparison of X_{hm} and X_{hh} whenever they go undetected.

3.3 Predictions of the model

A few main predictions result from the model.

First, h may rationally deviate from the contract and because of the uncertainty inherent in their behavior (which is due to τ) and in m's monitoring, the migrant may systematically report $X_{hm} \geq X_{hh}$. Subsequently, the model predicts $\Delta \geq 0$. Note that if we relax the assumptions that ω is constant and that τ is ignored in the contract, $\Delta \geq 0$ remains possible but becomes theoretically less likely, which would in turn strengthen empirical evidence of misrepresentations.

Second, h's incentives to deviate from the contract are expected to be stronger when observability is lower. This would originate in a higher $l(Q)$, due to m's intrinsic characteristics or the environment of the relationship, such as geographical distance.

Third, Q and t should co–vary positively, and the lower the observability of h's actions, the stronger the correlation. Intuitively, this can be explained by the fact that higher t means larger benefits from deviations, which calls for improved monitoring.

4 Presentation of the data

In order to test the model's predictions, we draw on matched data from the MIDDAS project (2009–2010).[21] MIDDAS first contacted migrants in the host country, aspiring to be nationally representative of the Senegalese immigrant population in France, Italy and Mauritania.[22] The migrants were asked to put the survey team in touch with their households of origin, who were then interviewed at home in Senegal and presented with a thorough questionnaire that painstakingly describes and follows the complex structure of Senegalese households, made up of several subgroups or "cells".[23] Table 1 summarizes information about sample size and composition.

It is worth noting that although not all migrants' households of origin could be matched, resulting in rather small sample sizes, sample selection seems rather mild—see Seror (2012) and Chort and Senne (2013) for econometric analyses. Moreover, information asymmetry is likely to be less of an issue in the matched than in the unmatched sample, as migrants and households of origin should exhibit stronger ties in the former. Evidence of information asymmetry and manipulation in Section 5 should therefore be understood as a lower bound compared to the population.

Matched data shall enable us to compare migrants' and households' reports (denoted X_{hm} and X_{hh}, respectively) of a set of household characteristics X, and thus *measure* discrepancies (Δ) that potentially coincide with gaps between m's and h's information sets. The variables available are characteristics of h's dwelling, which we ordered by increasing quality (studied in Appendix F), and the number of different assets they own, as stated by m and h.[24] The discussion in Section 2 gives us confidence that migrants earmark remittances to such goods and exhibit a higher preference for them than their households of origin.

21. "Migration and development in Senegal: an empirical analysis using matched data on Senegalese migrants and their origin households". For a detailed presentation of the project, see `http://www.dial.ird.fr/projets-de-recherche/projets-anr/middas` [in French; accessed Sep. 15, 2015].

22. For an overview of the sampling procedure, please refer to Chort et al. (2012).

23. The household questionnaire was based on "Pauvreté et Structure Familiale" (PSF)—see De Vreyer et al. (2008) for a description.

24. The surveys also allow us to match reports about h's ownership of traditional agricultural tools, such as plows and hoes. We choose not to study them here because (i) there are few agricultural households in the sample and therefore those variables exhibit little variation, and (ii) they are unlikely to belong to the superior goods favored by m.

Table 1: Sample size and composition by country

	France	Italy	Mauritania	Pooled
Stage 1: Migrant samples				
Number of surveyed migrants	302	303	327	932
...% of women	*24.2*	*22.8*	*36.4*	*28.1*
Stage 2: Origin household samples				
Matching rate (%)	*29.5*	*20.1*	*53.2*	*34.9*
Number of tracked households	89	61	174	324
...% in Dakar	*49.4*	*63.9*	*22.4*	*37.7*

5 Empirical test of the model's predictions

5.1 Predictions 1 and 2: Positive discrepancies

The model predicts that *(i)* h might derive benefits from information manipulation, leading to a possible overestimation of X by m, and *(ii)* these benefits are reduced by m's monitoring. We expect geographical distance to increase the cost of monitoring $l(Q)$ and thus deepen the gaps in reports observed in the data. Table 2 shows that Senegalese migrants living in Mauritania are significantly more likely to visit h frequently, or to remit in kind, which can be construed as proxies for the frequency and ease of monitoring. [25]

Table 2: Correlation between migration destination and monitoring proxies

	(1)	(2)	(3)
	Nb of visits to *h* per year	Days since last visit to *h*	% of total remittances to *h* in kind
m in Mauritania	0.65***	-190.38***	8.90***
	(0.14)	(61.24)	(1.51)
Constant	0.82***	794.68***	2.49***
	(0.05)	(43.72)	(0.36)
Observations	895	711	757

Standard errors in parentheses

The constant corresponds to the European mean dependent variable. m in Mauritania captures the effect of m being in Mauritania instead of Europe.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3 [26] illustrates our main stylized fact and tests the first two predictions of the

25. Conversely, migrants' places of residence within Mauritania do not show much variation along these proxies—see Table F1. Therefore, we argue that a dummy variable equal to 1 if m lives in Mauritania rather than in Europe is a better proxy for geographical distance and variation in Q.

26. Please note that as in all tables in the paper, robust standard errors are used.

model, i.e., that $\Delta \equiv X_{hm} - X_{hh} \geq 0$ and Δ decreases with observability.[27] Following evidence from Table 2, "m lives in Mauritania" is used as a proxy for higher observability. Col. 1 simply regresses the asset discrepancies on a constant and Col. 2 introduces the high–observability proxy. In most cases, the constant is positive and significant, while the slope coefficient is negative and significant.[28] These results support the predictions of the model.

It must be noted that the results from Col. 2 do not lend themselves to a causal interpretation. Migrants indeed select into different host countries based on unobservable characteristics. We choose to keep the specifications used to investigate Δ as pared down as possible since inadequate control variables can exacerbate rather than cure omitted variable bias if they are correlated with the error term. Controls might also reduce the endogeneity in the variable of interest but at the cost of netting out some of its interesting effects in terms of information asymmetry. Endogeneity shall be further discussed in Section 5.3.

5.2 Prediction 3: Covariance of transfers and monitoring

The third prediction of the model is that Q and t should co–vary positively. Testing this prediction is complicated by the obvious endogeneity of monitoring proxies and the fact that the remittances observed in the data cannot be unequivocally matched to expenses or consumption targets defined by the migrant.

The proxies used to approach Q are: the number of visits that m makes to h per year, the number of days since her last visit, the number of contacts per year with the first other emigrant from the same household of origin cited by m (a valuable source of information for m), the share of remittances that are received by h in kind (which help m impose a consumption pattern on h but suffer from transaction or transportation costs that increase with geographical distance) and the number of associations m belongs to

27. Table F2 does a similar exercise for characteristics of h's housing. Our results indeed rely on survey reports and are therefore subject to measurement error, which is discussed in detail in Section 5.3. Because of the more complex structure of measurement error in housing quality variables, Section 5 shall focus on asset ownership—see Appendix E for an explanation. Corresponding evidence for housing quality is however provided in Appendix F.

28. TV set clearly comes across as an exception. Interestingly, this is the asset that the highest proportion of matched households own. Only 16% do not have any TV set, as against 30% for radios and 43% for fans, the second most commonly owned assets in the data. The discrepancy most likely driven by "cluelessness" is also that for TV sets—see Table 6.

Table 3: Discrepancies between m's and h's reports of the latter's asset ownership ($X_{hm} - X_{hh}$)

	fridge		freezer		tvset		dvd		radio		cd		fan		bike		car		moto	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Constant	0.18***	0.24***	0.21***	0.30***	-0.22**	-0.43***	0.37***	0.35***	0.23**	0.34*	0.27***	0.50***	-0.08	-0.07	0.41***	0.72***	0.14***	0.27***	0.22***	0.34***
	(0.04)	(0.07)	(0.03)	(0.06)	(0.08)	(0.12)	(0.06)	(0.10)	(0.12)	(0.20)	(0.07)	(0.10)	(0.14)	(0.25)	(0.07)	(0.14)	(0.04)	(0.07)	(0.05)	(0.09)
m in Mauritania		-0.11		-0.17**		0.41**		0.04		-0.22		-0.42***		-0.03		-0.59***		-0.24***		-0.22**
		(0.08)		(0.07)		(0.17)		(0.11)		(0.24)		(0.13)		(0.28)		(0.15)		(0.07)		(0.10)
Observations	318	318	317	317	316	316	315	315	317	317	314	314	317	317	316	316	316	316	317	317

Standard errors in parentheses

The constant in Col. 1 (2) corresponds to the (European) mean Δ. m in Mauritania captures the effect on Δ of m being in Mauritania instead of Europe.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(also sources of information about h).[29]

All those proxies might be determined by m's affection for members of h, which could also drive altruistic transfers. We thus introduce dummies for whether m has a spouse or child living in h. Another obvious omitted variable is m's income, since Q is costly. If transfers serve an insurance purpose, we might also expect m to both send more and be more keen on getting news from a vulnerable h, driving coefficients upwards. We proxy this by an index of h's wealth using principal component analysis. Besides those obvious sources of endogeneity, variables pertaining to m's last visit to h are likely influenced by whether m ever went back to Senegal to visit h, a dummy that captures emotional ties as well as early–migration situations where m cannot remit much and might be waiting for a residence permit before she can travel back home. All those potential omitted variables are controlled for in Tables 4 and 5.

The data show that Senegalese migrants' remittances are mostly meant to finance daily consumption—see Chort and Senne (2013). Subsequently, regressing total t on proxies for Q offers a conservative test of Predication 3 as it should dilute the expected positive covariance rather than reinforce it.

Tables 4 and 5 first lend support to the model insofar as proxies that increase (decrease) with observability of h's actions, e.g., the number of visits to h (days since m's last visit), are positively (negatively) and mostly significantly associated with t. This is robust to various sets of controls, indicated by row titles. Second, the coefficients are larger and more often significant for the European (Table 5) than the Mauritanian sample (Table 4), which is also a prediction of the model.[30]

5.3 Robustness checks

5.3.1 Linking theory to empirics

Now that we have reproduced the stylized fact and tested the model's predictions, the link between the matched variables presented in Section 4 and the theoretical constructs they are supposed to embody deserves some discussion.

29. An additional variable, the number of phone contacts between m and h per year, is available for the European sample only—see Table F3.

30. Tables 4 and 5 are based on migrant survey data. The results are robust to focusing on the matched sample instead, albeit at the cost of reduced precision due to the smaller number of observations.

Table 4: Covariance between remittances and monitoring—Mauritanian sample

	(1) Nb of visits to h per year	(2) Days since last visit to h	(3) Nb contacts per year with main other emigrant from h	(4) % of total remittances to h in kind	(5) Nb of associations m belongs to
No controls	7.41	-0.05	3.22	6.48***	-26.10
	(11.67)	(0.03)	(3.36)	(2.18)	(40.07)
m's total income (€)	8.29	-0.05*	1.92	5.10**	-51.49
	(11.02)	(0.03)	(2.54)	(2.09)	(38.87)
Spouse lives with h	-1.52	-0.03	3.13	5.49***	-37.71
	(11.51)	(0.03)	(3.80)	(2.10)	(36.94)
m has child in h	4.59	-0.04	3.68	5.43**	-32.00
	(11.89)	(0.03)	(3.88)	(2.24)	(39.89)
h's wealth index	6.95	-0.06*	3.38	5.38**	-26.68
	(11.20)	(0.03)	(3.72)	(2.20)	(39.72)
All controls	0.18	-0.04	1.32	3.92*	-53.79
	(10.59)	(0.03)	(3.24)	(2.08)	(36.23)

Standard errors in parentheses

The dependent variable is total remittances sent by m in the past 12 months (in kind included). Col. 1 and 2 additionally control for whether m ever went back to visit h. Col. 4 includes a quadratic term. The regressions are estimated on the whole sample thanks to interactions with migrant location dummies.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Covariance between remittances and monitoring—European sample

	(1) Nb of visits to h per year	(2) Days since last visit to h	(3) Nb contacts per year with main other emigrant from h	(4) % of total remittances to h in kind	(5) Nb of associations m belongs to
No controls	112.15	-0.25**	12.57**	77.60***	189.48*
	(99.43)	(0.11)	(5.67)	(25.96)	(106.86)
m's total income (€)	83.25	-0.24**	9.73*	61.68**	123.79
	(100.06)	(0.11)	(5.29)	(25.99)	(109.95)
Spouse lives with h	108.93	-0.14	10.56*	80.16***	160.12
	(98.63)	(0.11)	(5.47)	(25.25)	(105.81)
m has child in h	92.01	-0.15	11.75**	64.05**	137.53
	(102.45)	(0.10)	(5.44)	(26.37)	(107.36)
h's wealth index	109.95	-0.22**	12.71**	69.46***	187.90*
	(99.57)	(0.11)	(5.73)	(26.16)	(108.62)
All controls	54.41	-0.09	7.96	48.69*	66.00
	(102.94)	(0.11)	(4.92)	(26.46)	(110.67)

Standard errors in parentheses

The dependent variable is total remittances sent by m in the past 12 months (in kind included). Col. 1 and 2 additionally control for whether m ever went back to visit h. Col. 4 includes a quadratic term. The regressions are estimated on the whole sample thanks to interactions with migrant location dummies.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The first two predictions of the model suggest we look into $\Delta \equiv X_{hm} - X_{hh}$. However, the X_{hm} observed in the data is likely to capture measurement error. Conversely, the Xs are familiar objects that h lives with daily, and the household survey was carried out at h's home, where the enumerators could see the Xs or at least infer likely amounts of assets owned and thus double–check with the respondent if the quantity stated sounded outlandish. Nevertheless, the following conclusions remain valid if we allow for measurement error in X_{hh}, provided it is less severe than in X_{hm}.

A small measurement error of model is presented in Appendix E. We simply summarize its key results here.

A first concern about the interpretation of the empirical $\widetilde{\Delta}$ as a reflection of undetected misrepresentations by h (Δ) is that migrants may be "clueless" about X_{hh} and provide a random response. Now, if the random response is on average larger (smaller) than X_{hh}, cluelessness can lead to artificially positive (negative) $\widetilde{\Delta}$s. [31]

In order to gauge the meaningfulness of our test of Prediction 1, we compute for each asset the propensity c of migrants to provide a clueless answer that we *would have* to assume to account for the discrepancies highlighted in Table 3. Put differently, we are looking for the hypothetical c that would balance perfectly informed ($X_{hm} = X_{hh}$) and clueless answers. The procedure is explained in Appendix E.1. Estimates of c are displayed in Table 6: The higher the estimated c, the more unlikely it is that the observed $\widetilde{\Delta}$ can be attributed to cluelessness.

Table 6 shows that for all assets (except TV sets) one would have to assume a share of clueless migrants in excess of 50% to account for observed discrepancies in the European sample, which is unrealistic given the regular contacts between m and h as illustrated in Table 2. Migrants' cluelessness is thus an unlikely confound of Prediction 1. We abstract from cluelessness in the rest of the discussion of measurement error.

Appendix E then focuses on two other sources of non–classical measurement error: mean reversion (Bound and Krueger, 1991) and systematic factors leading to an

31. I am indebted to Marcel Fafchamps for suggesting this source of non–classical measurement error.

Table 6: "Cluelessness" (c) necessary to account for observed discrepancies, by asset X

	fridge	freezer	tvset	dvd	radio	cd	fan	bike	car	moto
m in Mauritania	0.56	0.42	0.36	0.78	0.73	0.63	0.69	0.33	0.13	0.34
	[0.43,0.70]	[0.30,0.55]	[0.25,0.48]	[0.63,0.93]	[0.59,0.88]	[0.49,0.77]	[0.54,0.83]	[0.21,0.44]	[0.06,0.21]	[0.22,0.45]
m in Europe	0.66	0.75	0.28	0.80	0.66	0.91	0.60	0.79	0.73	0.58
	[0.51,0.81]	[0.60,0.91]	[0.17,0.39]	[0.64,0.96]	[0.51,0.81]	[0.75,1.07]	[0.45,0.74]	[0.64,0.95]	[0.58,0.89]	[0.44,0.73]
Observations	318	317	316	315	317	314	317	316	316	317

95% confidence intervals in brackets

The table displays the level of c (Eq. 17) needed to explain the Δ observed in Europe and in Mauritania.

overreporting of X_{hm}.

Mean–reverting measurement error does not jeopardize our test of Prediction 1 ($\Delta \geq 0$) based on the reports obtained from the surveys as it can only bias the estimate of Δ downwards. Artificial support for Prediction 1 can thus only originate from confounding factors leading to a systematic inflation of X_{hm}, studied in Section 5.3.2.

Prediction 2 invites us to further develop the measurement–error model. It suggests proxying h's room for information manipulation by determinants of $l(Q)$, such as geographical distance. The issue is that measurement error may not only affect the point estimate but also lead us to reject too often the null hypothesis that the proxy for $l(Q)$ has no effect. Based on the proxy used in Section 5.1, Appendix E.2 shows that if anything mean–reverting measurement error biases the estimate toward 0; it thus offers a conservative test of Prediction 2. On the other hand, the confounding factors mentioned above have the opposite effect and require a more in–depth treatment—see below.

5.3.2 Competing interpretations of the discrepancies

Although the model's predictions are borne out by the data and not easily accounted for outside the framework of information asymmetry, competing explanations for $\Delta > 0$—relying on $\delta_O > 0$ rather than $\delta_A > 0$, in the notation of Appendix E—must be investigated.

Tables 7 and 8 scrutinize the impact of confounding factors on the asset discrepancies.[32] Potential culprits are the following.

First, the migrant and household surveys were implemented on average 4, 5 and 8 months apart for the French, Mauritanian and Italian samples, respectively. Although a negative economic shock large enough that migrants' households divested and a drop in X is observed seems unlikely, the role of the time gap must be taken to the test as migrants' households of origin might follow a different growth path from the rest of the country. We use the exogenous time gap between the two surveys, standardized on the basis of m's and h's places of residence.

32. See Table F4 for housing characteristics.

Second, social desirability is a serious concern if either of m or h is more sensitive to it or if they react to different norms. [33] Insofar as social–desirability bias in survey response is a product of the interaction with an enumerator, we can control for this issue thanks to a dummy for whether m's enumerator was Senegalese or of Senegalese origin and another for whether m and her enumerator were of the same sex. Since enumerators were randomly assigned to interviewees, these variables are well identified.

Third, because of the structure of the household questionnaire, the respondent for h may have been asked to review the possessions of each "cell" of h, and some might have been more easily overlooked than in the migrant survey. If such were the case, we would however expect the number of members in h to be trimmed in a similar way in h's report. Hence, we use the discrepancy in the size of h as a control.

Fourth, h might have assumed a more restrictive definition of "h's ownership of X" than m, especially as X may belong to m although it is used by h. Transfer discrepancies raise a similar issue and can act as a robustness check: Whereas the migrant questionnaire seems to include investment funds from m to h in t, h was apparently asked about remittances the final consumers of which are the members of h. Tables 9 and 10 use Δt, a proxy (albeit endogenous) for inconsistencies in the delimitation of ownership. [34]

Tables 7 and 8 show that the proxies for confounding factors usually have the expected signs when significant. "Δ h size" and "Enumerator Senegalese" seem the most serious confounds. As expected, a large gap in reported h sizes corresponds to a large ΔX and migrants faced with a Senegalese enumerator may have been tempted to overstate the benefits brought to h by their transfers, reacting to strong remitting norms [35] and competition for prestige in the Senegalese diaspora. Compared to Table 3 we see that the confounds are seldom strong enough to knock the constant and Mauritania dummy out of significance. Finally, Tables 9 and 10 do not display significant results,

33. Indeed, some interviewees of the semi–qualitative survey deemed plausible that m exaggerated her role in improving h's living standard, and subsequently X.

34. See Table F5 for housing characteristics. Unfortunately, the transfers received and reported by h can be unambiguously attributed to m only in the French sample.

35. In the semi–qualitative survey, 12 out of 20 feel it is a "moral obligation" to remit to the household of origin.

which could be blamed on very small sample sizes. [36]

5.3.3 Dealing with endogeneity in the high–observability proxy

Although the previous tables lend little credence to alternative explanations for $\Delta > 0$, the second prediction of the model still needs to be buttressed as the significant and robust effect of the Mauritania dummy could be due to a host of unobservables.

Table 11 summarizes potential channels through which the Mauritania dummy may affect the discrepancies and the direction of the effect. Since we are interested in the sign and significance of the high–observability proxy rather than its point estimate, an omitted variable threatens the results if the bias it induces is of the same sign as that predicted by the model, i.e., if it is negative. This means that factors such as prospective migrants' dreading information manipulation by h and thus selecting into migration to Mauritania are not serious concerns since they bias the coefficient of interest toward 0. Conversely, if migrants who are less educated than h are both more likely to go to Mauritania than Europe and not to detect misrepresentations, then a negative bias obtains. Similarly, we would expect mutual affection between m and h to both lead them to favor nearby Mauritania as m's destination country and reduce the likelihood of nonzero Δ. Finally, it is also plausible that poorer households are less likely to be able to send migrants to distant Europe and perhaps more inclined to diverge from m in terms of preferences, inducing a negative bias.

It is important to note that a well–identified Mauritania dummy would still lump together two different determinants of $\Delta > 0$: Living just across the Senegal river means that monitoring is cheaper but also that remitting capacity and transfer embezzlement are more constrained. Both channels operate through h's strategic behavior: *ex post* through the monitoring of h's actions and *ex ante* since m knows that higher transfers mean stronger incentives to deviate from the contract, as shown in Section 3. Subsequently, this does not jeopardize the information–asymmetry hypothesis per se but it does mean that the only way to isolate the *monitoring* channel is to control for remitting capacity directly.

36. Other potential confounds, such as delays in information transmission and m's underestimating living costs in Senegal, were studied but found not to play a role—see Seror (2012).

Table 7: Impact of confounding factors on estimated asset discrepancies (1/2)

	fridge				freezer				tvset				dvd				radio			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Constant	0.18***	0.22***	0.24***	0.29***	0.21***	0.32***	0.30***	0.38***	-0.22**	-0.35**	-0.43***	-0.54***	0.37***	0.12	0.35***	0.09	0.23**	0.20	0.34*	0.22
	(0.04)	(0.07)	(0.07)	(0.09)	(0.03)	(0.06)	(0.06)	(0.07)	(0.08)	(0.15)	(0.12)	(0.16)	(0.06)	(0.09)	(0.10)	(0.11)	(0.12)	(0.17)	(0.20)	(0.23)
m in Mauritania			-0.11	-0.14			-0.17**	-0.15*			0.41**	0.44**			0.04	0.06			-0.22	-0.05
			(0.08)	(0.09)			(0.07)	(0.09)			(0.17)	(0.21)			(0.11)	(0.12)			(0.24)	(0.30)
Standardized time gap		0.09*		0.09*		-0.04		-0.04		-0.12		-0.12		-0.01		-0.00		0.13		0.13
		(0.05)		(0.05)		(0.04)		(0.04)		(0.10)		(0.09)		(0.06)		(0.06)		(0.14)		(0.14)
Enumerator and interviewee same sex		-0.04		-0.01		-0.20***		-0.16**		0.22		0.12		0.22*		0.20*		-0.14		-0.12
		(0.09)		(0.09)		(0.08)		(0.08)		(0.18)		(0.20)		(0.12)		(0.12)		(0.22)		(0.24)
Enumerator Senegalese		-0.09		-0.07		0.01		0.04		0.16		0.09		0.46***		0.45***		0.37		0.38
		(0.09)		(0.09)		(0.10)		(0.10)		(0.18)		(0.18)		(0.14)		(0.14)		(0.30)		(0.31)
Δ h size		0.00		0.00		0.00		0.00		0.03***		0.04***		0.01*		0.01**		0.05***		0.05***
		(0.00)		(0.00)		(0.00)		(0.00)		(0.01)		(0.01)		(0.01)		(0.01)		(0.02)		(0.02)
Observations	318	275	318	275	317	274	317	274	316	273	316	273	315	272	315	272	317	274	317	274
F all confounds = 0		1.21		0.99		2.03		1.29		4.12		4.91		3.79		3.56		3.29		3.16
p–value		0.31		0.42		0.09		0.27		0.00		0.00		0.01		0.01		0.01		0.01

Standard errors in parentheses

The constant in Col. 1–2 (3–4) corresponds to the (European) mean Δ. m in Mauritania captures the effect on Δ of m being in Mauritania instead of Europe.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Impact of confounding factors on estimated asset discrepancies (2/2)

	cd				fan				bike				car				moto			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Constant	0.27***	0.20**	0.50***	0.41***	-0.08	-0.25	-0.07	-0.24	0.41***	0.56***	0.72***	0.81***	0.14***	0.17***	0.27***	0.26***	0.22***	0.27***	0.34***	0.39***
	(0.07)	(0.09)	(0.10)	(0.12)	(0.14)	(0.20)	(0.25)	(0.27)	(0.07)	(0.13)	(0.14)	(0.17)	(0.04)	(0.06)	(0.07)	(0.07)	(0.05)	(0.09)	(0.09)	(0.12)
m in Mauritania			-0.42***	-0.49***			-0.03	-0.03			-0.59***	-0.60***			-0.24***	-0.19**			-0.22**	-0.29**
			(0.13)	(0.15)			(0.28)	(0.33)			(0.15)	(0.14)			(0.07)	(0.09)			(0.10)	(0.13)
Standardized time gap		0.02		0.02		0.21		0.21		-0.07		-0.07		-0.01		-0.01		-0.03		-0.03
		(0.08)		(0.08)		(0.17)		(0.17)		(0.10)		(0.09)		(0.04)		(0.04)		(0.05)		(0.05)
Enumerator and interviewee same sex		-0.12		-0.02		0.09		0.10		-0.28**		-0.14		-0.06		-0.02		-0.24**		-0.18*
		(0.14)		(0.14)		(0.27)		(0.29)		(0.14)		(0.12)		(0.09)		(0.09)		(0.11)		(0.11)
Enumerator Senegalese		0.45***		0.51***		0.51*		0.52*		-0.00		0.09		-0.05		-0.02		0.39**		0.43***
		(0.16)		(0.16)		(0.30)		(0.30)		(0.17)		(0.16)		(0.09)		(0.09)		(0.15)		(0.16)
Δ h size		0.02**		0.01*		0.04**		0.04**		0.02**		0.02*		0.01*		0.01*		0.00		-0.00
		(0.01)		(0.01)		(0.02)		(0.02)		(0.01)		(0.01)		(0.01)		(0.01)		(0.01)		(0.01)
Observations	314	271	314	271	317	274	317	274	316	273	316	273	316	273	316	273	317	274	317	274
F all confounds = 0		3.21		3.60		2.19		2.19		1.90		1.07		1.55		0.98		4.22		4.11
p–value		0.01		0.01		0.07		0.07		0.11		0.37		0.19		0.42		0.00		0.00

Standard errors in parentheses

The constant in Col. 1–2 (3–4) corresponds to the (European) mean Δ. m in Mauritania captures the effect on Δ of m being in Mauritania instead of Europe.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Impact of discrepancies in remittance reports (Δt) on estimated asset discrepancies (ΔX)—French sample only (1/2)

	fridge				freezer				tvset				dvd				radio			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Constant	0.09	0.15	0.03	-0.16	0.21**	0.26	0.19**	0.33*	-0.68***	-0.89***	-0.58***	-0.63**	0.04	0.10	0.07	0.16	-0.37	-0.04	-0.30	-0.25
	(0.07)	(0.16)	(0.08)	(0.18)	(0.09)	(0.21)	(0.08)	(0.19)	(0.16)	(0.31)	(0.14)	(0.25)	(0.16)	(0.29)	(0.13)	(0.22)	(0.27)	(0.45)	(0.26)	(0.35)
Δt (€1000)	0.04	0.05	0.01	-0.01	0.04*	0.04	0.02	0.03	0.01	-0.01	0.01	0.01	0.00	0.01	-0.01	0.00	0.04	0.09	0.02	0.02
	(0.02)	(0.04)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.05)	(0.08)	(0.04)	(0.06)	(0.05)	(0.05)	(0.04)	(0.04)	(0.09)	(0.14)	(0.09)	(0.11)
m's total income (incl. social benefits)		-0.00		0.00		-0.00		-0.00		0.00		0.00		-0.00		-0.00		-0.00		-0.00
		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)
Observations	50	49	75	72	50	49	75	72	50	49	75	72	50	49	75	72	50	49	75	72

Standard errors in parentheses

For each variable ΔX, Col. 1–2 (3–4) define Δt as missing (0) when no transfer by m was reported by h.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Impact of discrepancies in remittance reports (Δt) on estimated asset discrepancies (ΔX)—French sample only (2/2)

	cd				fan				bike				car				moto			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Constant	0.28*	0.35	0.26**	0.15	-0.96***	-0.81	-0.58*	-0.38	0.74***	0.87**	0.55***	0.28	0.16*	0.21	0.10	0.15	0.24	-0.04	0.17	0.06
	(0.14)	(0.26)	(0.12)	(0.20)	(0.25)	(0.49)	(0.31)	(0.48)	(0.23)	(0.43)	(0.19)	(0.36)	(0.08)	(0.18)	(0.07)	(0.13)	(0.15)	(0.32)	(0.13)	(0.26)
Δt (€1000)	0.01	0.02	-0.00	-0.02	0.09	0.10	0.05	0.07	0.09	0.10	0.07	0.04	-0.01	-0.00	-0.01	-0.00	-0.00	-0.04	0.06	0.04
	(0.03)	(0.04)	(0.03)	(0.04)	(0.09)	(0.11)	(0.08)	(0.08)	(0.08)	(0.10)	(0.07)	(0.08)	(0.03)	(0.02)	(0.02)	(0.02)	(0.05)	(0.06)	(0.06)	(0.07)
m's total income (incl. social benefits)		-0.00		0.00		-0.00		-0.00		-0.00		0.00		-0.00		-0.00		0.00		0.00
		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)
Observations	50	49	75	72	50	49	75	72	50	49	75	72	50	49	75	72	50	49	75	72

Standard errors in parentheses

For each variable ΔX, Col. 1–2 (3–4) define Δt as missing (0) when no transfer by m was reported by h.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Effect of m being in Mauritania on Δ: Potential channels of impact

Channel	Sign
Monitoring cost	–
Remitting capacity	–
m less educated than h	–
Info. asymm. problems likely	+
h's wealth	–
Mutual affection	–

In the absence of exogenous instruments, Table 12 revisits evidence on Prediction 2 with controls for obvious confounds. Unfortunately, these controls cannot be argued to be well identified. As a consequence, the results should be taken with a pinch of salt and are merely presented here to scrutinize the robustness of the effect of the high–observability proxy.

Table 12 regresses the discrepancies for each asset variable[37] on the Mauritania dummy and different controls (as indicated by row titles), all interacted with the high–observability proxy. The controls are the following: A variable equal to 1 if the migrant received some schooling while the head of her household of origin—who is usually entrusted with the remittances—did not, 0 when they have the same level of education and -1 when the migrant is less educated than h's head; a dummy equal to 1 if the migrant's spouse lives with h; a dummy equal to 1 when m has at least one child living with h; and an index of h's wealth, constructed thanks to principal component analysis—two versions of the index are tested, one based on asset ownership at the time of the survey and the other five years before, to alleviate part of reverse causality concerns, albeit at the cost of reduced sample size (275 instead of 310). Migrant's income is finally controlled for to try to disentangle the monitoring and remitting capacity channels, although this approach entails a risk of netting both effects out, since monitoring is costly.

We can see from Table 12 that when significant the Mauritania dummy remains

37. Although the Mauritania dummy was not found to be a significant determinant of housing quality discrepancies, Table F6 provides similar evidence on housing characteristics.

robustly negative.[38] Besides, the controls do not lead to statistically significantly different point estimates, even though they often enter the regressions significantly—especially the wealth index and proxies for affective ties—and with the expected negative sign.

6 Conclusion and discussion

The thread of this paper is a stylized fact emerging from matched data on Senegalese migrants interviewed in France, Italy and Mauritania and their households of origin in Senegal: Migrants tend to systematically overestimate or overstate the number of assets owned by their households of origin, as well as the quality of their dwellings. This pattern fits nicely into the picture of the Senegalese diaspora painted in the socio–anthropological literature. Senegalese migrants are indeed keen on sending remittances to invest in real estate or productive endeavors back home, or simply refurbish or equip their households' compounds. Transfer recipients on the other hand may have different preferences and be subjected to stronger pressures to share or spend, thereby causing conflicts and strategic behavior over the use of remittances.

Based on socio–anthropological evidence and the economic literature, we modeled Senegalese migrants' transfer behavior in an information–asymmetry framework. We established that even if much of the two parties' maximization problems is common knowledge, and allowing for monitoring, remittance recipients may still find it optimal to divert targeted funds and we may observe gaps between transfer senders' and recipients' reports that we can impute to information manipulation.

The empirical part of the paper establishes the stylized fact and tests additional predictions that are difficult to explain outside the information–asymmetry framework, providing evidence of increased information manipulation by remittance recipients when observability is lower.

A theoretical conclusion can finally be drawn: Even when monitoring is allowed to partially restore observability, the unitary and collective household frameworks may not be relevant empirically. Since transfer recipients may extract rents from senders

38. The only exception is TV sets, as in previous tables.

Table 12: Impact of geographical distance on the discrepancies between m's and h's reports of the latter's asset ownership ($X_{hm} - X_{hh}$), controlling for likely confounding factors

	(1) fridge	(2) freezer	(3) tvset	(4) dvd	(5) radio	(6) cd	(7) fan	(8) bike	(9) car	(10) moto
No controls	-0.11	-0.17**	0.41**	0.04	-0.22	-0.42***	-0.03	-0.59***	-0.24***	-0.22**
	(0.08)	(0.07)	(0.17)	(0.11)	(0.24)	(0.13)	(0.28)	(0.15)	(0.07)	(0.10)
m more educated than h's head	-0.18**	-0.17**	0.22	0.05	-0.29	-0.46***	-0.13	-0.50***	-0.20**	-0.23**
	(0.09)	(0.07)	(0.21)	(0.13)	(0.26)	(0.17)	(0.33)	(0.14)	(0.08)	(0.10)
Spouse resident in household of origin	-0.15	-0.13	0.42**	0.01	-0.12	-0.27**	-0.03	-0.64***	-0.23***	-0.18*
	(0.10)	(0.08)	(0.19)	(0.13)	(0.26)	(0.13)	(0.31)	(0.17)	(0.09)	(0.11)
At least one child lives in household of origin	-0.15	-0.13	0.41*	0.03	-0.26	-0.28*	0.02	-0.68***	-0.25**	-0.22*
	(0.11)	(0.09)	(0.21)	(0.15)	(0.28)	(0.15)	(0.34)	(0.19)	(0.10)	(0.12)
h's wealth index, h's report	-0.10	-0.19***	0.40***	0.02	-0.26	-0.44***	-0.11	-0.62***	-0.25***	-0.24**
	(0.08)	(0.07)	(0.14)	(0.12)	(0.22)	(0.12)	(0.25)	(0.15)	(0.07)	(0.10)
h's wealth index (5 y. bef. survey), h's report	-0.03	-0.15**	0.51***	0.05	-0.19	-0.37***	-0.09	-0.60***	-0.25***	-0.28***
	(0.08)	(0.07)	(0.16)	(0.13)	(0.23)	(0.14)	(0.30)	(0.17)	(0.08)	(0.11)
All controls but income	-0.24**	-0.15*	0.15	0.02	-0.40	-0.30*	-0.20	-0.61***	-0.25**	-0.28**
	(0.11)	(0.09)	(0.24)	(0.15)	(0.28)	(0.15)	(0.35)	(0.16)	(0.11)	(0.13)
m's total income (€)	0.01	-0.08	0.74***	-0.01	-0.07	-0.21	0.02	-0.43*	-0.34***	-0.11
	(0.14)	(0.12)	(0.28)	(0.20)	(0.33)	(0.18)	(0.47)	(0.23)	(0.12)	(0.17)
All controls	-0.05	-0.07	0.66**	0.03	-0.05	-0.01	0.09	-0.52**	-0.39**	-0.27
	(0.17)	(0.15)	(0.32)	(0.24)	(0.38)	(0.21)	(0.50)	(0.25)	(0.16)	(0.20)

Standard errors in parentheses

The table displays the Mauritania dummy coefficients, controlling for different factors in each row. Interactions between the Mauritania dummy and the controls are not reported.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

thanks to private information they can manipulate, the assumption or prediction (based on altruism) that migrants and their non–migrant relatives should arrive at efficient intra–household allocations that benefit the group as a whole is unwarranted.

Whether improving migrants' information about remittance use is beneficial to the transnational household and development in general however remains an open question that we reserve for future research. The developmental cost of information asymmetry in the remittance context hinges indeed on a comparison of the impacts of senders' and recipients' preferred uses of the remittance manna. Even though the investments in durable assets (and housing quality) studied in this paper may serve a productive purpose and trigger positive multiplier effects, a more precise assessment of the welfare impact of granting more information and thus more control to migrants is necessary.

Acknowledgements

I would like to thank my Ph.D. supervisor, Flore Gubert. I am also indebted to Jenny Aker, Cátia Batista, Marshall Burke, Isabelle Chort, Marcel Fafchamps, Marc Gurgand, Émilie Hu, Sylvie Lambert, Valentina Mazzucato, Marion Mercier, Ted Miguel, Jean–Noël Senne, Miri Stryjan, Roberta Ziparo and the participants in the 63rd Annual Meeting of the French Economic Association (Lyon, 2014), the 13th European Development Research Network PhD Workshop (Hannover, 2014), the 2015 American Economic Association Annual Meeting (Boston), the Centre for the Study of African Economies Conference 2015 (Oxford), the Hong Kong Polytechnic University APSS Research Seminar Series (Hong Kong, 2015) and the Department of Economics Seminar of Lingnan University (Hong Kong, 2015).

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Appendices

A Impact of remittances on *h*'s participation

Since m ignores τ in the contract[39] and sets a target X^{*m} that h must meet lest they incur F, h is expected to consume *less* than $Y^*(\omega(1-\tau))$ when $\tau > 0$ in order to reach the target X^{*m}. This reallocation of resources is indeed the only way to abide by the contract when $\tau > 0$.

Let us model this reallocation as h consuming $Y^*(\omega(1-\tau-L))$ instead, where $L \geq 0$. L is determined so that $X^*(\omega) + \frac{t}{p_X}$ can be reached with $\omega(1-\tau)$. This is feasible as long as $L \leq 1-\tau$. Then h accepts the contract if and only if:

***h*'s participation constraint:**

$$\text{Utility from participating when } \tau = 0 \begin{cases} \pi[u^h(Y^*(\omega)) + v^h(X^*(\omega) + \frac{t}{p_X})] \end{cases}$$

$$\text{Utility from participating when } \tau > 0 \begin{cases} +(1-\pi)[u^h(Y^*(\omega(1-\tau-L))) \\ +v^h(X^*(\omega) + \frac{t}{p_X})] \end{cases}$$

$$\geq$$

$$\text{Utility from not participating when } \tau = 0 \begin{cases} \pi[u^h(Y^*(\omega)) + v^h(X^*(\omega))] \end{cases}$$

$$\text{Utility from not participating when } \tau > 0 \begin{cases} +(1-\pi)[u^h(Y^*(\omega(1-\tau)) \\ +v^h(X^*(\omega(1-\tau)))] \end{cases}$$

Assuming $u^h(Y^*(\omega(1-\tau))) \neq 0$ and $\pi \neq 1$,—in which cases participation obtains trivially,—we have:

$$\frac{v^h(X^*(\omega) + \frac{t}{p_X}) - [\pi v^h(X^*(\omega)) + (1-\pi)v^h(X^*(\omega(1-\tau)))]}{(1-\pi)[u^h(Y^*(\omega(1-\tau))) - u^h(Y^*(\omega(1-\tau-L)))]} \geq 1 \qquad (5)$$

As can be seen from Equation 5, the participation constraint is not necessarily sat-

39. The alternative for m would be to base the contract on $\tau > 0$ and accept granting h a rent they can then spend as they please. If we relax this assumption and allow h to invoke $\tau > 0$ in order to obtain more remittances, the same result follows as from a stochastic ω: We still have $\widehat{X_{hh}} \geq X_{hh}$ but the two are more often equal.

isfied. We can however note that m can induce participation by raising t, which enters the numerator positively, provided $L \leq 1 - \tau$.[40] The decrease in h's utility due to L implies that there are cases such that m can induce participation only by disconnecting t from X^{*m}, e.g., by increasing t but keeping the target level of X unchanged, or, which boils down to the same, by basing the contract on states where $\tau > 0$—then m implicitly accepts to finance some Y when $\tau = 0$.

B Impact of remittances on *h*'s incentive to deviate

Deviation benefits h if and only if the following inequality does not hold:

***h*'s incentive compatibility constraint:**

$$\begin{aligned}
&\text{Gain from deviating when } \tau = 0 \begin{cases} \pi[u^h(Y^*(\omega + t)) + v^h(X^*(\omega + t)) \\ -u^h(Y^*(\omega)) - v^h(X^*(\omega) + \frac{t}{p_X})] \end{cases} \\
&\text{Gain from deviating when } \tau > 0 \begin{cases} +(1-\pi)[u^h(Y^*(\omega(1-\tau) + t)) \\ +v^h(X^*(\omega(1-\tau) + t)) \\ -u^h(Y^*(\omega(1-\tau-L))) - v^h(X^*(\omega) + \frac{t}{p_X})] \end{cases} \\
&\qquad\qquad \leq \qquad\qquad (6) \\
&\text{Cost of deviating} \begin{cases} F[\pi\alpha(q(X^*(\omega) + \frac{t}{p_X} - X^*(\omega + t); Q^*)) \\ +(1-\pi)\alpha(q(X^*(\omega) + \frac{t}{p_X} \\ -X^*(\omega(1-\tau) + t); Q^*))] \end{cases}
\end{aligned}$$

40. We also expect the ratio on the left–hand side of Equation 5 to increase with $\frac{p_X}{p_Y}$, h's preference for X relative to Y and their aversion to risk in their consumption of X relative to Y, all else equal. These elements are however beyond m's control.

The first derivative of constraint 6 with respect to t is:

$$\begin{aligned}
&\pi[u^{h\prime}(Y^*(\omega+t))\frac{\partial Y^*(\omega+t)}{\partial t}+v^{h\prime}(X^*(\omega+t))\frac{\partial X^*(\omega+t)}{\partial t}\\
&-\frac{1}{p_X}v^{h\prime}(X^*(\omega)+\frac{t}{p_X})]\\
&+(1-\pi)[u^{h\prime}(Y^*(\omega(1-\tau)+t))\frac{\partial Y^*(\omega(1-\tau)+t)}{\partial t}\\
&+v^{h\prime}(X^*(\omega(1-\tau)+t))\frac{\partial X^*(\omega(1-\tau)+t)}{\partial t}\\
&-\frac{1}{p_X}v^{h\prime}(X^*(\omega)+\frac{t}{p_X})]\\
&-\pi F\alpha'(\cdot)q'(X^*(\omega)+\frac{t}{p_X}-X^*(\omega+t);Q^*)[\frac{1}{p_X}-\frac{\partial X^*(\omega+t)}{\partial t}]\\
&-(1-\pi)F\alpha'(\cdot)q'(X^*(\omega)+\frac{t}{p_X}-X^*(\omega(1-\tau)+t);Q^*)[\frac{1}{p_X}-\frac{\partial X^*(\omega(1-\tau)+t)}{\partial t}]
\end{aligned} \tag{7}$$

The argument being symmetric for $\tau = 0$ and $\tau > 0$, let us focus on the former. We have:

$$\begin{aligned}
&u^{h\prime}(Y^*(\omega+t))\frac{\partial Y^*(\omega+t)}{\partial t}+v^{h\prime}(X^*(\omega+t))\frac{\partial X^*(\omega+t)}{\partial t}\\
&-\frac{1}{p_X}v^{h\prime}(X^*(\omega)+\frac{t}{p_X})\\
&-F\alpha'(\cdot)q'(X^*(\omega)+\frac{t}{p_X}-X^*(\omega+t);Q^*)[\frac{1}{p_X}-\frac{\partial X^*(\omega+t)}{\partial t}]
\end{aligned} \tag{8}$$

Now, since a fungible t necessarily increases consumption of both X and Y and therefore h's utility, the first two components in this sum are positive. Note that $v^{h\prime}(X^*(\omega+t))\frac{\partial X^*(\omega+t)}{\partial t} \geq \frac{1}{p_X}v^{h\prime}(X^*(\omega)+\frac{t}{p_X})$, since h should always prefer an interior solution to the corner solution imposed by the contract. Therefore, absent monitoring (the last term of the sum) we see that h always has an incentive to deviate and that this incentive is stronger, the larger the remittances. If we allow for monitoring, the incentive compatibility constraint may—but need not—be satisfied.

C Impact of τ on *h*'s incentive to deviate

The first derivative of constraint 6 with respect to τ is:

$$\begin{aligned}(1-\pi)[u^{h\prime}(Y^*\omega(1-\tau-L))\frac{\partial Y^*(\omega(1-\tau-L))}{\partial\omega(1-\tau-L)}(1+L'(\tau))\\ -u^{h\prime}(Y^*(\omega(1-\tau)+t))\frac{\partial Y^*(\omega(1-\tau)+t)}{\partial\omega(1-\tau)+t}\\ -v^{h\prime}(X^*(\omega(1-\tau)+t))\frac{\partial X^*(\omega(1-\tau)+t)}{\partial\omega(1-\tau)+t}\\ -F\alpha'(\cdot)q'(X^*(\omega)+\frac{t}{p_X}-X^*(\omega(1-\tau)+t);Q^*)\frac{\partial X^*(\omega(1-\tau)+t)}{\partial\omega(1-\tau)+t}] \quad (9)\end{aligned}$$

If we abstract from monitoring, we can see that the derivative of constraint 6 with respect to τ is equivalent to: $(1-\pi)[\frac{\partial W^h}{\partial\tau}$ when h abides by the contract $-\frac{\partial W^h}{\partial\tau}$ when h deviates], where obviously $\frac{\partial W^h}{\partial\tau}<0$. Now, since the contract pushes h into a corner solution and moreover h needs to reduce their consumption of Y when $\tau>0$ in order to meet the target X^{*m}, we know that $\frac{\partial W^h}{\partial\tau}$ is larger in absolute value when h is compliant. Therefore, absent monitoring h is more likely to deviate when $\tau>0$ than when $\tau=0$.

D Covariance of *t* and *Q*

From the F.O.C.s of Problem 3, we have:

$$t: \quad v'(\cdot)\frac{\partial X^*}{\partial t}-\lambda p_t=0 \quad (10)$$

$$Q: \quad v'(\cdot)\frac{\partial X^*}{\partial Q}-\lambda l'(Q)=0 \quad (11)$$

Since $l'(Q)>0$ and assuming that $\frac{\partial X^*}{\partial Q}\neq 0$, we have:

$$\frac{p_t}{l'(Q)}=\frac{\frac{\partial X^*}{\partial t}}{\frac{\partial X^*}{\partial Q}} \quad (12)$$

$$\therefore \quad \frac{p_t}{l'(Q)}\frac{\partial X^*}{\partial Q}=\frac{\partial X^*}{\partial t} \quad (13)$$

Assuming $t(Q)$ differentiable, by the Chain Rule we get:

$$\frac{p_t}{l'(Q)}\frac{\partial X^*}{\partial t}\frac{\partial t}{\partial Q} = \frac{\partial X^*}{\partial t} \tag{14}$$

Assuming that $\frac{\partial X^*}{\partial t} \neq 0$ and since $p_t > 0$:

$$\frac{p_t}{l'(Q)}\frac{\partial t}{\partial Q} = 1 \tag{15}$$

$$\therefore \quad \frac{\partial t}{\partial Q} = \frac{l'(Q)}{p_t} > 0$$

E Measurement error

We model h's and m's survey answers as follows:

$$\widetilde{X_{hh}} = X_{hh} \tag{16}$$

$$\widetilde{X_{hm}} = (1-c)(1+\zeta+\delta_A+\delta_O)X_{hh} + cr + \nu \tag{17}$$

where $\widetilde{X_{hi}}$ denotes the (potentially error–ridden) report of the true information X_{hi} held by $i = h, m$; $\zeta \in [-1, 0]$ captures a negative correlation between the report and the error–free variable, which Bound and Krueger (1991) call "mean–reverting measurement error" and is particularly likely for bounded variables such as X; $\delta_A \geq 0$ corresponds to the inflation in h's message to m possible under information asymmetry; $\delta_O \geq 0$ stands for factors leading to a systematic inflation of the migrant's report; ν is such that $\mathrm{E}[\nu] = 0$ and $\mathrm{E}[X_{hh}\nu] = 0$; and c is the migrant's propensity to provide a "clueless" random answer r. We shall deal with cluelessness first and then discuss the impact of the other sources of measurement error.

Two points are worth noting. First, X in Equations 16 and 17 refers to durable asset ownership. The structure of the error is more complex for housing quality variables; they are meant to be ordinal but because m's quality ranking is unknown, we cannot exclude that further measurement error has been introduced. Asset ownership on the other hand is a ratio variable stated by m and h themselves. Moreover, the former are often bimodal, whereas the latter are strongly unimodal.

Second, Equation 17 immediately tells us that Prediction 1 ($\Delta \geq 0$) can be tested with $\widetilde{\Delta}$ as long as $\delta_O = 0$. Indeed, ζ being negative it can only bias our estimate of Δ downwards. We show in Appendix E.2 that this holds true even when the effect of ζ is allowed to vary with distance. Given our assumptions about ν, artificial support for Prediction 1 can only originate in the positive δ_O, studied in Section 5.3.2, or from cluelessness—see below.

E.1 Cluelessness

Considering for simplicity that X_{hi} is a binary variable, i.e., equal to 1 if h owns at least one unit of X according to i and 0 otherwise, an intuitive way of modeling clueless migrants' behavior is to assume that their answers follow a Bernoulli distribution of mean .5, responding 0 or 1 with equal probability. We assume that the probability c is the same for all respondents but may differ across assets. [41]

Rewriting Equation 17 to focus on cluelessness, we have:

$$\widetilde{X_{hm}} = (1-c)X_{hh} + cr \tag{18}$$

$$\therefore \quad c = \frac{\widetilde{\Delta}}{r - X_{hh}} \tag{19}$$

Since we assumed that $r = .5$, we can replace c by $\widetilde{\Delta}/(.5 - X_{hh})$. Averaging over all individuals in the sample yields the desired quantity c.

Estimates of c are displayed in Table 6.

E.2 Measurement error in the test of Prediction 2

Rephrasing the measurement error model to focus on discrepancies in reports, we get:

$$\begin{aligned}\widetilde{\Delta} = \widetilde{X_{hm}} - \widetilde{X_{hh}} &= (1 + \zeta + \delta_A + \delta_O)X_{hh} - X_{hh} + \nu \\ &= \Delta + (\zeta + \delta_O)X_{hh} + \nu\end{aligned}$$

41. Assuming the converse yields qualitatively similar results—available upon request.

where $\Delta \equiv \delta_A X_{hh}$ represents the true discrepancy due to information asymmetry, which we intend to highlight empirically. [42]

E.2.1 Focusing on ζ

Focusing on ζ, we have $\widetilde{\Delta} = \Delta + \zeta X_{hh} + \nu$ and we want to estimate $\Delta = \beta MAU + \epsilon$, where MAU is a dummy variable equal to 1 if m is in Mauritania and 0 if she lives in Europe, and ϵ is assumed to be uncorrelated with MAU and to have zero expectation. Since being in Mauritania both increases observability and reduces potential transfers, which leads to a decrease in Δ—see Section 5.3,—we expect $\beta \leq 0$.

Using OLS, we obtain:

$$\widehat{\beta} = \frac{\text{cov}(MAU, \widetilde{\Delta})}{\text{var}(MAU)} = \frac{\text{cov}(MAU, \Delta + \zeta X_{hh} + \nu)}{\text{var}(MAU)} \tag{20}$$

$$= \frac{\text{cov}(MAU, \beta MAU + \zeta X_{hh} + \nu + \epsilon)}{\text{var}(MAU)} = \frac{\beta \sigma^2_{MAU} + \zeta \sigma_{MAU, X_{hh}}}{\sigma^2_{MAU}} \tag{21}$$

$$= \beta + \zeta \beta_{X_{hh}, MAU} \geq \beta \tag{22}$$

where $\beta_{X_{hh}, MAU}$ denotes the coefficient on MAU in a regression with X_{hh} as the dependent variable. Given the lower living standard in Mauritania than in Europe, $\beta_{X_{hh}, MAU}$ is expected to be negative and the data support this conjecture. Therefore, $\widehat{\beta}$ *over*estimates β, which goes counter to Prediction 2.

What about the effect of ζ on the significance of $\widehat{\beta}$? From Equation 22, we have:

$$\text{plim}\widehat{\beta} - \beta = \zeta \beta_{X_{hh}, MAU} \tag{23}$$

and

$$\widehat{\epsilon} = \widetilde{\Delta} - \widehat{\beta} MAU = \Delta + \zeta X_{hh} + \nu - \widehat{\beta} MAU \tag{24}$$

$$= \epsilon - (\Delta - \beta MAU) + \Delta + \zeta X_{hh} + \nu - \widehat{\beta} MAU \tag{25}$$

$$= \epsilon - (\beta - \widehat{\beta}) MAU + \zeta X_{hh} + \nu \tag{26}$$

Calling σ^2_ϵ the variance of ϵ and $\widehat{\sigma^2_\epsilon}$ its estimator (and using a similar notation for

42. The results are robust to introducing information manipulation into Equation 17 additively rather than as a fraction of X_{hh}, $\delta_A X_{hh}$, because they do not rely on the correlation between Δ and X_{hh}—see below.

ν), we have:

$$\text{plim}\widehat{\sigma_\epsilon^2} = \sigma_\epsilon^2 + \zeta^2\beta_{X_{hh},MAU}^2\sigma_{MAU}^2 + \zeta^2\sigma_{X_{hh}}^2 + \sigma_\nu^2 + \zeta^2\beta_{X_{hh},MAU}\sigma_{X_{hh},MAU}$$

(27)

$$\therefore \text{plim}\widehat{s} \equiv \text{plim}\frac{\widehat{\sigma_\epsilon^2}}{\widehat{\sigma_{MAU}^2}}$$

$$= \frac{\sigma_\epsilon^2 + \zeta^2\beta_{X_{hh},MAU}^2\sigma_{MAU}^2 + \zeta^2\sigma_{X_{hh}}^2 + \sigma_\nu^2 + \zeta^2\beta_{X_{hh},MAU}\sigma_{X_{hh},MAU}}{\sigma_{MAU}^2}$$

(28)

$$= s + \zeta^2\beta_{X_{hh},MAU}^2 + \zeta^2\frac{\sigma_{X_{hh}}^2}{\sigma_{MAU}^2} + \frac{\sigma_\nu^2}{\sigma_{MAU}^2} + \zeta^2\beta_{X_{hh},MAU}^2$$

(29)

$$= s + 2\zeta^2\beta_{X_{hh},MAU}^2 + \zeta^2\frac{\sigma_{X_{hh}}^2}{\sigma_{MAU}^2} + \frac{\sigma_\nu^2}{\sigma_{MAU}^2} \tag{30}$$

$$\therefore \frac{\text{plim}t}{\sqrt{n}} = \frac{\text{plim}\widehat{\beta}}{\text{plim}\sqrt{\widehat{s}}} = \frac{\beta + \zeta\beta_{X_{hh},MAU}}{\sqrt{s + 2\zeta^2\beta_{X_{hh},MAU}^2 + \zeta^2\frac{\sigma_{X_{hh}}^2}{\sigma_{MAU}^2} + \frac{\sigma_\nu^2}{\sigma_{MAU}^2}}} \tag{31}$$

$$\therefore \left|\frac{\text{plim}t}{\sqrt{n}}\right| \leq \left|\frac{\beta}{\sqrt{s}}\right| \tag{32}$$

Since the numerator in Equation 31 is greater than β and β is expected to be negative, ζ biases our t–statistics toward 0 (and may even yield the wrong sign on β). The denominator is clearly greater than $\sqrt{s}$, which also biases also t–statistics downwards.

E.2.2 Allowing mean–reverting measurement error to be exacerbated by distance

It is likely that the element in $\widetilde{X_{hm}}$ that is negatively correlated with X_{hh} increases with the geographical distance between m and h. We model this as follows:

$$\widetilde{\Delta} = \Delta + \zeta(1 - \eta MAU)X_{hh} + \nu$$

where $\eta \in [0; 1]$.

Adapting Equation 20 yields:

$$\widehat{\beta} = \frac{\text{cov}(MAU, \Delta + \zeta(1 - \eta MAU)X_{hh} + \nu)}{\text{var}(MAU)} \tag{33}$$

$$= \frac{\text{cov}(MAU, \beta MAU + \zeta(1 - \eta MAU)X_{hh} + \nu + \epsilon)}{\text{var}(MAU)} \tag{34}$$

$$= \frac{\beta\sigma^2_{MAU} + \zeta\sigma_{MAU,X_{hh}} - \zeta\eta\sigma_{MAU,X_{hh}MAU}}{\sigma^2_{MAU}} \tag{35}$$

$$= \beta + \zeta\frac{\sigma_{MAU,X_{hh}} - \eta\sigma_{MAU,X_{hh}MAU}}{\sigma^2_{MAU}} \tag{36}$$

Based on the binary nature of MAU, it can be shown that $\sigma_{MAU,X_{hh}MAU} \geq 0$. Since $\zeta \leq 0$, $\eta \geq 0$ and $\sigma_{X_{hh},MAU} \leq 0$, it still holds that $\widehat{\beta} \geq \beta$.

E.3 Focusing on δ_O

Focusing on δ_O, we now have:

$$\widehat{\beta} = \beta + \delta_O\beta_{X_{hh},MAU} \leq \beta \leq 0 \tag{37}$$

because $\delta_O \geq 0$ and $\beta_{X_{hh},MAU} \leq 0$. δ_O therefore represents a serious confound in the test of Prediction 2, considered in Section 5.3.2.

F Additional empirical evidence

Table F1: Correlation between migration destination (within Mauritania) and monitoring proxies

	(1) Nb of visits to *h* per year	(2) Days since last visit to *h*	(3) % of total remittances to *h* in kind
m in Rosso, Mau.	1.02**	-269.62***	8.75*
	(0.44)	(98.12)	(5.06)
m in Nouakchott, Mau.	0.56***	-172.30**	9.75***
	(0.15)	(68.04)	(1.78)
m in Nouadhibou, Mau.	0.78*	-211.01*	4.80*
	(0.42)	(123.74)	(2.83)
Constant	0.82***	794.68***	2.49***
	(0.05)	(43.78)	(0.36)
Observations	895	711	757
m in Rosso = m in Nouakchott	0.99	0.91	0.04
p–value	0.32	0.34	0.85
m in Rosso = m in Nouadhibou	0.15	0.16	0.47
p–value	0.70	0.69	0.50

Standard errors in parentheses

The constant corresponds to the European mean dependent variable. The regressors capture the effect of m being in different Mauritanian locations instead of Europe.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table F2: Discrepancies between m's and h's reports of the latter's housing characteristics ($X_{hm} - X_{hh}$)

	(1) House type (quality)	(2) Nb of rooms	(3) Roof material (quality)	(4) *h* own their dwelling
Constant	0.22*	2.16***	0.15*	0.10***
	(0.12)	(0.48)	(0.08)	(0.03)
m in Mauritania	0.00	-0.52	0.02	-0.00
	(0.15)	(0.81)	(0.11)	(0.04)
Observations	316	304	308	319

Standard errors in parentheses

The constant corresponds to the European mean Δ. m in Mauritania captures the effect on Δ of m being in Mauritania instead of Europe.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table F3: Covariance between remittances and the number of phone calls between m and h—European sample only

	(1) Nb phone calls to h per year
No controls	23.90***
	(4.13)
m's total income (€)	22.04***
	(4.15)
Spouse lives with *h*	20.35***
	(4.21)
m has child in h	18.61***
	(4.24)
h's wealth index	23.32***
	(4.08)
All controls	15.55***
	(4.27)

Standard errors in parentheses

The dependent variable is total remittances sent by m in the past 12 months (in kind included). The regressor of interest is the number of phone calls between m and h per year.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table F4: Impact of confounding factors on estimated housing discrepancies

	(1) House type (quality)	(2) Nb of rooms	(3) Roof material (quality)	(4) *h* owns their dwelling
Constant	0.22	1.55**	0.09	0.11***
	(0.16)	(0.66)	(0.10)	(0.04)
m in Mauritania	-0.02	0.43	-0.04	0.02
	(0.17)	(0.81)	(0.12)	(0.04)
Standardized time gap	-0.02	-0.02	0.02	0.03*
	(0.10)	(0.32)	(0.06)	(0.02)
Enumerator and interviewee same sex	0.08	-0.19	0.09	-0.06
	(0.17)	(0.77)	(0.12)	(0.04)
Enumerator Senegalese	-0.13	-0.21	0.19	0.06
	(0.18)	(0.85)	(0.15)	(0.05)
Δ h size	0.00	0.22***	-0.01	0.00*
	(0.01)	(0.04)	(0.01)	(0.00)
Observations	272	266	268	275
F all confounds = 0	0.20	7.60	1.58	2.28
p–value	0.94	0.00	0.18	0.06

Standard errors in parentheses

The constant corresponds to the European mean Δ. m in Mauritania captures the effect on Δ of m being in Mauritania instead of Europe.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table F5: Impact of discrepancies in remittance reports (Δt) on estimated housing discrepancies (ΔX)—French sample only

	House type (quality)				Nb of rooms				Roof material (quality)				h own their dwelling			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Constant	0.24	0.14	0.30*	0.35	3.28***	-0.51	2.98***	1.33	0.23	-0.14	0.26*	-0.11	0.10**	0.13	0.10***	0.19*
	(0.21)	(0.53)	(0.17)	(0.38)	(0.93)	(1.75)	(0.71)	(1.63)	(0.17)	(0.32)	(0.14)	(0.25)	(0.04)	(0.11)	(0.04)	(0.10)
Δt (€1000)	-0.10	-0.12	-0.07	-0.07	0.27	-0.21	0.21	0.03	0.04	-0.01	0.02	-0.03	-0.01	-0.01	0.01	0.01
	(0.06)	(0.07)	(0.06)	(0.06)	(0.44)	(0.38)	(0.32)	(0.28)	(0.05)	(0.06)	(0.05)	(0.05)	(0.02)	(0.01)	(0.02)	(0.02)
m's total income (incl. social benefits)		0.00		0.00		0.00*		0.00		0.00		0.00**		-0.00		-0.00
		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)
Observations	50	49	74	71	44	43	68	65	48	47	71	68	50	49	75	72

Standard errors in parentheses

For each variable ΔX, Col. 1–2 (3–4) define Δt as missing (0) when no transfer by m was reported by h.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table F6: Impact of geographical distance on the discrepancies between m's and h's reports of the latter's housing characteristics ($X_{hm} - X_{hh}$), controlling for likely confounding factors

	(1) House type (quality)	(2) Nb of rooms	(3) Roof material (quality)	(4) h owns their dwelling
No controls	0.00	-0.52	0.02	-0.00
	(0.15)	(0.81)	(0.11)	(0.04)
m more educated than h's head	0.22	-0.71	0.06	-0.02
	(0.17)	(0.88)	(0.12)	(0.05)
Spouse resident in household of origin	0.03	-0.99	0.05	-0.00
	(0.16)	(0.84)	(0.13)	(0.04)
At least one child lives in household of origin	-0.02	-1.07	0.11	0.02
	(0.17)	(0.95)	(0.15)	(0.05)
h's wealth index, h's report	-0.01	-0.41	-0.03	-0.00
	(0.15)	(0.80)	(0.11)	(0.04)
h's wealth index (5 y. bef. survey), h's report	-0.03	-0.67	-0.08	0.00
	(0.16)	(0.86)	(0.12)	(0.04)
All controls but income	0.18	-1.30	0.04	0.01
	(0.19)	(0.92)	(0.15)	(0.06)
m's total income (€)	0.06	0.49	0.24	0.00
	(0.26)	(1.53)	(0.19)	(0.07)
All controls	0.20	0.24	0.18	0.01
	(0.33)	(1.64)	(0.21)	(0.09)

Standard errors in parentheses

The table displays the Mauritania dummy coefficients, controlling for different factors in each row. Interactions between the Mauritania dummy and the controls are not reported.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$