Asymmetric Information and Remittances: Evidence from Matched Administrative Data*

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Abstract

Using new large-scale, administrative data matching remittances and monthly payroll disbursals, we demonstrate how migrants' earnings in the United Arab Emirates affect their remittances. We consider several types of income changes: Ramadan, weather shocks, a labor reform and returns to time in the UAE. We demonstrate that two key characteristics of the income changes that affect the income elasticity of remittances are the observability of the income and whether the income change is positive or negative. The results are consistent with a private information model where remittances are viewed as payments in an income-sharing contract.

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1 Introduction

The number of international migrants has been growing over time. Estimates from the United Nations suggest that the number has increased from 154 million in 1990 to over 230 million in 2013 (UN News 2013). The majority of international migrants originate from developing countries, and remittances to developing countries, valued at $325 billion in 2009, have exceeded foreign development aid and are approaching the magnitudes of foreign direct investment. International remittances may play an important role in the economic growth of poor countries. At a micro level, temporary migrants remit a substantial portion of their income to their families at home, and remittances have been shown to improve the economic outcomes of receiving households (Yang and Martinez 2005).

While migrants make substantial financial transfers to their families at home, the geographic separation inherent in international migration corresponds with substantial information asymmetries in the economic choices and outcomes of both sides.[1] Theoretical models of intra-household resource allocation emphasize the potential for different preferences among household members but have generally assumed perfect information (Chiappori 1988, Manser and Brown 1980, McElroy and Horney 1981, Lundberg and Pollack 1993). However, an emerging empirical literature suggests that asymmetric information within households over assets and income can affect the allocation of resources. Our paper contributes to the new literature that emphasizes the importance of asymmetric information in intrahousehold outcomes. Using new high frequency data on earnings and remittances of migrants, we examine whether private information that migrants have about their own earnings fluctuations affects their remittance patterns.

The prior empirical literature on asymmetric information and household behavior falls into two categories: laboratory experiments and field experiments.[2] In a laboratory setting bringing in husbands and wives, Ashraf (2009) shows that Filipino men deposit the experimental transfer to their own accounts when that decision is private, and commit to consumption when the decision is public. Ambler (2015) shows that Salvadorian migrants in Washington, DC remit a smaller share of a windfall given in a lab experiment when the total amount of the windfall is not revealed to the recipient. In a lab experiment in Kenya, Jakiela and Ozier (2012) find that women are willing to reduce their expected earnings to keep their income hidden from relatives. In addition to the lab experiments, there

[1] Seshan and Zubrickas (2014) interview both male migrants and their wives at home and find evidence that husbands working in Qatar underreport their earnings by about 20% to their wives at home in India. De Weerdt, Genicot and Mesnard (2014) find substantial information asymmetries over assets in family networks and that the discrepancies are positively correlated with physical distance.

[2] There is also a separate literature on asymmetric information across households rather than within households. See, for example, Kinnan (2014) and Townsend (1982).

is one related field experiment on asymmetric information. Goldberg (2010) runs public and private lotteries and finds that winners of public lotteries spend 35% more than winners of private lotteries in the period immediately after the lottery.

The experimental settings offer the ability to cleanly manipulate the flow of information. However, the evidence that exploits randomized variation in information generated in lab settings and in field experiments is limited to looking at small, one-time windfalls. One key contribution of our study is that we examine real-world variation in earned income. This distinction may be important as standard models of consumption smoothing suggest that individuals should respond differently to income fluctuations that are anticipated versus unanticipated and those that are permanent versus transitory.[3] By moving beyond windfalls, our paper contributes to our understanding of whether models of private information are relevant in explaining how remittances respond to variation in earned income. Also, because we exploit several income fluctuations that exhibit different characteristics, we can separate out whether the other characteristics of income fluctuations (transitory versus permanent and anticipated versus unanticipated) matter in addition to the observability of income (public versus private).[4]

We are able to take a new approach to examining motivations to remit because we have access to a unique data set of high frequency records that include millions of remittance transactions of migrants in the United Arab Emirates (UAE). Our main data are administrative records from a financial firm in the UAE that offers remittance services to individuals and payroll processing services to firms. We are able to match the remittance transactions data with administrative data on monthly earnings disbursals for hundreds of thousands of migrant workers from 2009 to 2012. To our knowledge, this is the only high frequency analysis of the relationship between earnings and remittances. Furthermore, our analysis may be subject to less measurement error and recall bias than other studies because we exploit records of actual remittance transactions and payroll payments rather than survey data. This is potentially quite important; as Kapur and Akee (2012) document using two independent sources of data on remittances into Indian bank accounts, actual remittance deposits are twice the self-reported amounts.[5]

This paper contributes to the growing literature on the economic drivers of the remittance be-

[3]Given that we examine anticipated and unanticipated as well as transitory and permanent income changes, this paper is also related to the empirical literature that tests models of consumption smoothing (Paxson 1993, Chaudhuri and Paxson 1993, Jacoby and Skoufias 1998, Jappelli and Pistaferri 2010, Khandker 2012). To our knowledge, we are the first paper to test whether migrants smooth remittances over various types of income fluctuations.

[4]We characterize income changes as public if they are easy to verify or observe by family members at home. This verification may involve asking other individuals working in the UAE about aggregate trends that are experienced by almost all migrants in the UAE.

[5]See also Grigorian, Melkonyan and Shonkwiler (2008).

havior of migrants (Dustmann and Mestres 2010, Lucas and Stark 1985, Rapoport and Docquier 2006, Yang 2008, Yang 2011). The primary existing models focus on altruism of the migrant towards the recipients and on exchange motives where the remittances are used to buy services such as taking care of assets and relatives or repayments of loans that financed migration. We develop a new framework of asymmetric information between migrants and their families at home where remittances are treated as a payment on an income-sharing contract that applies to the observable income of migrants. In this model, remittances should move with income differently depending on the degree to which the income fluctuation is observable by the family at home. In contrast, the observability of income should not matter under models of pure altruism towards families at home, or in standard exchange models. Another key prediction of the model of asymmetric information is that remittances should respond more to negative changes to income than to positive ones because migrants have incentive to hide positive news (if they can) and to share negative ones.

In our empirical work, we begin by documenting how month-to-month fluctuations in income correspond with changes in remittances. Our results show that overall remittances move positively with fluctuations in an individual's income. If we assume that these month-to-month fluctuations in income are exogenous, then the estimates suggest an income elasticity of remittances of around 0.33. Consistent with the prediction of the model of asymmetric information, we find that the income elasticity of remittances is much larger for negative changes than for positive ones.

To isolate exogenous variation in income, we examine four specific types of income changes and estimate the income elasticity of remittances. By varying in their characteristics including whether they are positive or negative and the ease of observability by families at home, we can test the predictions of the model. First, we show that remittances move positively with seasonalities in earnings, which are assumed to be easy to verify and hence public. The strongest seasonality is at Ramadan when there is a particularly large and negative impact on earnings, and this is passed through in remittances. Next, we examine the impact of weather shocks. We examine rainfall and heat shocks, measured as the deviation of precipitation and heat from the mean levels in each city and month, respectively. This follows in a large literature that uses weather shocks as a source of exogenous variation in income (Kazianga and Udry 2006, Jacoby and Skoufias 1998, Paxson 1992, Wolpin 1982). We find that earnings fall with these shocks, and the estimated income elasticity of remittances using weather variation is larger for more extreme weather realizations. To further separate the effects of the other attributes of income fluctuations, we use a labor reform that increased the earnings of workers to examine the impact of a permanent income shock on the remittance behavior of migrants. Because this is an aggregate shock, we characterize this as public. We find that income moves positively with this reform and this change

in income is passed through in remittances as well.[6] Furthermore , the elasticity associated with this positive shock is much smaller than for the negative income changes associated with weather and Ramadan.

We also look at the returns to time in the UAE for migrants, and find that migrants' earnings increase on average over their time in the UAE, while the average remittances decline.[7] Unlike the other income fluctuations, the estimated income elasticity of remittances using this variation is not positive. This does not appear to be driven by selection in the types of individual who choose to stay in or leave the UAE. Rather, the evidence suggests that this pattern is driven by a story of hidden income where an individual's rate of economic assimilation over time may not be fully known by families at home.

We provide evidence to support the idea that the individual gradient between time in the country and earnings is private information. Migrants with identical characteristics upon arrival can experience a positive or negative evolution in their earnings over time in the UAE; employers learn about the ability of workers and pay them differently according to their productivity. We also use oil prices to instrument for migrants' gradient of earnings over time. High oil prices when migrants' labor contracts begin correspond with higher contract salaries but lower (or negative) growth over time, while low oil prices correspond with lower contract salaries but higher growth in earnings over time.[8] Workers whose salaries increase over time remit a constant amount (or slightly less) over time. This is consistent with the idea that they hide their additional earnings over time from their families. In contrast, workers whose salaries decrease over time and do not have incentive to hide their long-run earnings trend remit less over time. We then look at variation in the share of co-workers that are from the same home location to examine whether the private information effect is mitigated when there are co-workers who might know and report a worker's earnings status to his family at home.

2 Background on Migrants in the UAE

Following the discovery of oil in the area, the United Arab Emirates was established in 1971 as a federation of seven Emirates: Abu Dhabi, Dubai, Sharjah, Ajman, Umm-al-Quwain, Ras al-Khaimah, al-Fujairah. The subsequent rapid economic growth of the UAE was accompanied by a large inflow of

[6] Thus, whether the income fluctuation is anticipated or not and whether it transitory or permanent does not affect the co-movement of remittances with income.

[7] Our result that migrants' income increases over their experience in the host country is consistent with the results in the literature on the assimilation of immigrants (Borjas 1994, LaLonde and Topel 1997).

[8] This is consistent with other papers in the labor literature that demonstrate that economic conditions at the start of labor contracts or when workers enter the labor market matter for initial labor outcomes, but there is some convergence over time (Aslund and Rooth 2007, Kahn 2010, Oyer 2006).

foreign workers. Recent statistics indicate that foreign workers constitute approximately 89% of the total population and 96% of the total labor force in the UAE (Forstenlechner and Rutledge 2011).[9]

Foreign workers enter the UAE on two to three year work visas that are tied with their work contracts with a specific employer.[10] An employer can fire migrant workers at any time, which corresponds with an almost immediate revocation of the work visa.[11] Migrant workers can terminate an existing contract with an employer in two ways. First, they can return to their home countries at any time. However, there are stipulations on how long they must stay in the home country (usually six months) before returning to the UAE on a new work visa. Workers who leave before fulfilling a contract must pay for their own airfare home while the cost is borne by the firm if the worker quits at the end of the contract. Second, workers can change to a new employer prior to the end of the contract without leaving the UAE only if they had written approval from their current employer. Prior to 2011, written approval was still needed if a worker wanted to change employers after completing a contract. After 2011, a new labor reform allowed workers the ability to switch employers at the end of their contract without written permission from the initial employer.

Workers enter the UAE on contracts that specify their minimum hours and the accompanying earnings for those hours. Despite these long-term contracts that specify minimum earnings, we demonstrate that most migrants experience substantial month-to-month fluctuations in wages (almost always above the amount stipulated in the contract) that is largely reflective of variation in hours worked, including overtime. Most contracts also include in-kind benefits, such as food and housing in labor camps. Other benefits include employer-provided health insurance, which is mandated by law.

Migration to the UAE is almost always considered temporary as there is no pathway for foreign workers to attain citizenship following years of legal residence. Furthermore, while foreign women can achieve citizenship through marriage, foreign men cannot and the vast majority of foreign workers are male.[12] The income requirements for workers to bring their spouses and families prevent most migrant workers from living with their families in the UAE.

It is illegal for firms or recruiting agencies to charge migrant workers fees for receiving a job

[9] While the UAE itself is a small country of under 10 million people, there are many similarities in the migration policies of countries within the Gulf Cooperation Council (GCC). Flows of individuals and money to and from this region are important; Weyl (2016) argues that GCC countries, including the UAE, are contributing substantially to reductions in *global* inequality because they are accepting huge numbers of migrants who earn much more than in their home countries and remit.

[10] Standard work visas were three years in length prior to 2011, and two years in length subsequently.

[11] Staying past the expiration of the work visa can lead to imprisonment. However, migrant workers are allowed to appeal unjust treatment by employers, such as withholding wages, in court.

[12] Intermarriage with Emirati nationals is legal but not encouraged. The government established the Marriage Fund in 1992, granting 70,000 dirham (19,064 USD) to Emirati couples at the time of marriage with an additional 40,000 dirham (10,890 USD) to the groom if they do not divorce in the first year.

assignment in the UAE. Recruiting agencies are supposed to receive their commissions only from firms in the UAE. While it is difficult to know the share of workers who pay recruitment fees and the average costs, informal interviews by Human Rights Watch (2009) indicate that almost all construction workers paid manpower firms in their home countries amounts ranging from USD$1,800 to USD$4,100 for a job assignment.

3 Conceptual Framework

This section presents a simple framework where remittances are the result of an income-sharing contract between households and migrants. Migrants have some private information about their income realizations in the host country. The model that we present here will have predictions that are unique from the standard existing models of remittances, including models of altruism and exchange. Appendix Section A adapts and presents simple versions of the models where remittances are motivated primarily by altruism or exchange to demonstrate that the key predictions of the model of asymmetric information cannot be explained by these other models.

3.1 Remittances as Payments in Income-Sharing Contracts under Asymmetric Information

Migrants in the host country earn income, y, which is comprised of two components, y_o and y_h, that vary in how difficult it is for family members at home to verify.[13] While migrants move to the UAE based on a job offer with an expectation of y, the actual income received month-to-month is subject to shocks that can be either positive or negative. Each income component has its own shock over time, denoted by μ_o and μ_h. Each of these components of income has its own cost for the family at home to verify, c_o and c_h, where $c_h > c_o \geq 0$. In other words, it is much more costly to verify fluctuations in the hidden component of income, y_h, than in the observable component of income, y_o, and this cost, c_h, can be infinite (so it can be impossible to verify this type of income).

The migrant promises to remit a fixed proportion, τ, of his income to families at home. Financing international migration can be expensive and remittances may be payments on the contract where families help finance the costs of migration.[14] Alternatively, τ may not be part of an explicit contract

[13] The model takes y as given. However, if we assumed instead that the migrant had some control over the components of his income, inefficiencies may arise from asymmetric information if the migrant prefers lower income that is hidden to higher income that is easy to observe. This type of behavior has been shown in lab experiments in the field by Jakiela and Ozier (2012).

[14] One potential welfare implication of asymmetric information over the migrant's income is that it may deter families from financing migration of one member.

based on financing migration but a social norm for income sharing. With each remittance transfer sent, the migrant provides a report on his income realization where the claim by the migrant is denoted by $\tilde{y}$. Given their receipt of $\tau\tilde{y}$, households at home can choose whether to incur the costs, c_h and c_o, to verify either of the components of income. If households find that $\tilde{y} < y$, they can inflict a punishment on the migrant, denoted by $m(y, \tilde{y})$. Punishments may include divorce or eviction from networks at home. Given that there is no path to citizenship for migrants in the UAE, almost all migrants anticipate that they must return to their home countries eventually and may want to have the advantages of their social networks when they return.

The utility of the migrant is increasing in his earnings, y, and decreasing in the amount he remits, $\tau\tilde{y}$, the severity of punishment and the probability that his family discovers that $y > \tilde{y}$. Thus, the migrant faces a tradeoff between lying about his income in order to keep more of the income for himself and the risk of being caught lying and punished. The household's utility is increasing in the amount of remittances received, $\tau\tilde{y}$, and makes a decision regarding whether or not to pay the costs for verifying the accuracy of the migrant's income report, $\tilde{y}$.

We do not make additional assumptions on the utility functions of the migrants or the households. It would be possible to directly incorporate other existing models of remittances, including the exchange motive or partial (though not pure) altruism. However, the current framework produces testable implications without further assumptions. The model of asymmetric information implies that remittances should tend to move with a migrant's overall income, y. As shown in Appendix Section A, this prediction is also consistent with the models of altruism and exchange. However, the model of asymmetric information is unique in predicting that whether the income fluctuation is easy for the households at home to observe (or verify) matters for remittances. We should see remittances moving with income fluctuations that are more public or observable. In contrast, remittances may move less or not move at all with positive income changes that can be hidden from the family at home. At the same time, migrants have more incentive to truthfully reveal private information about *negative* fluctuations in income than about positive fluctuations.

3.2 Summary of Empirical Predictions

Based on this framework, we can express the decision regarding remittances as a function of different changes in income where the subscript, k, denotes different types of income fluctuations and the superscript indicates whether the change is positive ($\Delta y_k^p > 0$) or negative ($\Delta y_k^n < 0$):

$$\Delta R = \beta^p(\gamma_k \Delta y_k^p) + \beta_k^n(\gamma_k \Delta y_k^n). \tag{1}$$

Relaxing the more stark assumption of the model where income is either fully observable or unobservable, the parameter γ_k captures the degree to which the income change is observable, where it equals 1 if it is fully observable to and verifiable by families at home and 0 if it is completely hidden (or the cost of verification is infinite). The parameters β^p and β^n_k denote the decision rules regarding how much to remit.

First, the model predicts $\beta^p > 0$, so the estimated income elasticity of remittances for positive income changes is positive ($\beta^p \gamma_k > 0$). Similarly, we expect migrants to remit less when they experience negative income fluctuations, so $\beta^n_k > 0$ and $\beta^n_k \gamma_k > 0$.

A key prediction is that the income elasticity of remittances depends on the observability of the income change. In other words, the income elasticity of remittances is larger for those positive fluctuations that are more observable.[15] In contrast, for negative income fluctuations, the framework has less strong predictions on whether the elasticity should increase or decrease with observability. It may be the case that the income elasticity of remittances for negative income fluctuations does not depend on observability at all because migrants have full incentive to pass through all of the income declines that they experience.[16] Alternatively, observability may still matter for negative fluctuations where migrants can try to pretend to experience even large declines than they really do with it is hard for families to observe and verify.

Another key testable prediction is that the estimated income elasticity of remittances should be greater for negative income changes than for positive ones because workers prefer to pass through negative events and hide positive ones. In other words, $\beta^p \gamma_k < \beta^n_k \gamma_k$ for same value of k. In addition, we can see whether $\beta^p < \beta^n$ averaged over all income fluctuations. This assumes that a similar component of all positive and negative income changes can be hidden.[17]

For the empirical tests, we examine four specific types of income fluctuations, which vary in how easy they are for households at home to verify. We argue that Ramadan and a labor reform that shifted workers' earnings are all observable. They are all aggregate shocks that would be easy for families at home to verify by asking other individuals with experience working in the UAE. We also look at different types of rainfall and heat shocks, and test the idea that more extreme weather events are more observable than smaller weather shocks. We also exploit the fact that the labor reform has a positive effect on earnings while Ramadan and weather shocks have negative effects.

[15] The elasticity, $\beta^p \gamma_k$, increases with γ_k.

[16] In other words, $\beta^n_k = \frac{\alpha}{\gamma_k}$ and the income elasticity of remittances for negative income fluctuations does not depend on observability.

[17] It is highly likely that there are events that are impossible to identify with our administrative payroll data but affect variation in earnings, such as month-to-month firm-level changes in labor demand or individual episodes of sickness.

Finally, we consider the idea that the returns to time in the UAE may be a private change to migrants' income in the UAE. Unlike the other income fluctuations, this one varies at the individual level and reflects firm learning about the individual productivity of the worker. Thus, it may be difficult for families at home to know if this gradient is positive, negative or zero for a specific migrant. While some migrants experience a positive change, almost the same number experience a negative one.[18] We also use oil prices in the month that the worker's contract begins to instrument for the gradient.

The private information model of remittances suggests that migrants will not reveal positive returns to time to their families at home but have more incentive to share information about the unobserved component of income if they experience negative returns to time in the UAE. Whether the returns to time are positive or negative should only have asymmetric effects under the model where migrants have private information.

Furthermore, we test the prediction of the model on the observability of income by exploiting heterogeneity across individuals in income observability driven by variation in the number of co-workers who are from the same home state. Having more co-workers from the same area may suggest that it is less difficult or costly for the migrant's household to verify how he is performing at a firm over time in the UAE, including whether the worker is promoted or demoted or how many overtime hours a person is working. Co-workers may also be able to provide additional information about how much a person is earning over time by observing their spending patterns in the UAE.

The different income fluctuations allow us to provide evidence in favor of a model of asymmetric information and to reject models of pure altruism or standard exchange models. In contrast to observability, remittances move with income regardless of other characteristics, in particular the predictability and the permanence of the income fluctuation. The results on transitory versus permanent and anticipated versus unanticipated income fluctuations also shed light on a model of altruism with consumption smoothing. If remittances finance the consumption of family members at home and the migrant wants to smooth their consumption (and has the savings technology to do so), then we would expect remittances to be smoothed over anticipated income fluctuations and move with unanticipated shocks.[19]

[18] This can be seen in the number of observations in Columns 1 and 2 of Table 9.

[19] This is discussed in greater detail in Appendix Section A.

4 Data

4.1 Payroll and Remittances Data

The data are from a financial company based in the UAE whose primary operations involve remittance and foreign exchange services. The firm is a very large player in this market, accounting for the majority of the total remittance flows out of the UAE and approximately 5% of total global remittance flows in 2010. In addition to funds transfer and exchange, the firm also offers payroll disbursal services in the UAE. Approximately 10-15% of the migrant labor force receive their earnings from this firm.

We obtained remittances transactions from the firm over the period from January 2009 to October 2012. Transactions can occur at any frequency, but in order to combine the transactions data with the salary, we aggregate transactions to a monthly level. The firm offers many types of transactions for remittances, including Western Union, Xpress Money, Associate Branch Transfer, Demand Draft. These options vary in their speed of delivery and locations for pickup in the home countries. The cost of remittance depends on the type but the cheapest options are about USD$4.50 per transaction; given the relatively low cost of remittances, it is likely that that migrants are using the formal channels observed in our data for remittances and not informal mechanisms such as sending cash back with individuals. Among the months in which remittances are observed to occur through this firm, the median and mode number of remittances transactions for each individual per month is one.

The firm also shared their records on payroll disbursals for the period from January 2009 to October 2012. The entire sample of employees receiving wage payments from the payroll firm include 427,265 unique individuals working in 20,366 firms. In the UAE, salaries are stipulated by law to be paid out on a monthly basis.[20] There are on average 17.6 monthly salary observations per worker (standard deviation of 10.1). A key advantage of the data is that they represent the actual income payment transferred by the third-party payroll processing firm from employers to workers. However, the observed earnings may not be representative of total compensation for several reasons. First, workers receive substantial in-kind benefits, including housing and food in dormitories. This is not a major concern for the analysis in the paper because the value of in-kind benefits is very unlikely to change month-to-month over a worker's contract with an employer.[21] Thus, we can remove the impact of in-kind benefits with individual fixed effects. Furthermore, the payments in-kind cannot be transferred abroad by the recipient like earnings can. Second, workers may supplement earnings

[20] Less than 5% of observations have multiple payments made to an individual in a month. We aggregate those numbers into the total earned in that month.

[21] The payroll data do not include information about the value of in-kind benefits each month, but within a firm and occupation class, workers are provided the same dormitory housing and cafeteria food.

in their primary jobs with informal work. This is unlikely to be as common in the UAE as in other contexts because it is illegal for migrant workers to receive compensation for work outside of the employer associated with their visas. In addition, migrant workers do not have a lot of free time; we estimate that the migrants in our data are working about 60 hours per week for their employer.[22]

One disadvantage of the data is that the amount of information available for each worker is very limited. The salary disbursal information is connected to an employee data set that contains a few individual characteristics including nationality, age, and gender. We do not observe hours worked in each month so we cannot calculate wage rates. We have no information about marital status or the economic situation of their families at home.

The details on merging the remittance transactions data and the payroll disbursals data are provided in Appendix B. To summarize the process, we use two key identifiers to link these two types of data. The first is a customer registration number that can appear in both data sets and is generated by the financial firm. For salary disbursals and transactions that are not linked using the customer registration number, we use another identifier called the labor card id number. This number is provided to migrant workers by the government and is unique to each worker-contract.

4.2 Ministry of Labor Administrative Data

In addition to the data set containing administrative records on payroll disbursals and remittance transactions, we also make use of data on migrant workers from the UAE Ministry of Labor (MOL). The MOL data contains detailed information on the terms of the labor contracts signed between migrant workers and firms in the UAE. Thus, we have information on the exact month in which the workers' jobs begin. We use this information to construct the amount of time that the migrant has been in the UAE. The MOL data also has individual characteristics that are not available in the other data set, including religion, education, and the salary and hours terms of the contract.

Another advantage of the MOL data is that it offers an individual identifier, called a person code, that is constant over time in addition to the labor card identifier which changes each time an individual signs a new contract. While the labor card identifier available in the financial transactions data would allow us to link panel observations of individuals within labor contracts, this person code allows us to link the panel observations in the payroll and remittance data across labor contracts. In other words, we use the person identifier to link individuals that sign additional contracts with the

[22]This estimate is based on the assumption that any earnings received above the contract earnings are the result of overtime hours and the legally mandated overtime rate is between 1.25 to 1.5 times the standard hourly wage. This does not include substantial commute times as workers are often transported by bus from labor camps in more remote areas to cities to work.

same firm after their initial two or three year contract expires and to link individuals who switch firms (if both firms use the the private company providing the data for payroll processing).

We merge together the payroll and remittances data with the data from the MOL using the labor card identification number.[23] We are able to match just over 80% of the observations in the payroll data with the MOL data.[24] The reason that we are unable to match all of the observations is largely driven by the fact that the MOL does not have jurisdiction over all migrant workers in the UAE. Domestic workers and any workers in free-zone areas of the UAE fall under the jurisdiction of the Ministry of the Interior rather than the Ministry of Labor. Comparing the MOL data that we received to UN population figures for migrant workers in the UAE in 2012 suggests that the MOL data covers approximately 80% of all migrant workers in the country.

4.3 Summary Statistics

Column 1 of Table 1 displays the summary statistics for the full sample of the remittance transactions. The complete remittances sample includes over 34 million individual-month observations. The average amount remitted in a month is 2668 dirham (USD $726) and India represents the destination for slightly over half of the occurrences of remittances.[25]

Column 2 of Table 1 presents characteristics of the workers for which we have salary data. Workers in this sample earn an average of 1434 dirham (USD $390) per month. About one-half of the sample reports being of Indian nationality. Over 99% of the employee sample are male. The average worker is around 36 years old. The data contain written information on workers' occupations, which were coded using the Standard Occupational Classification (SOC) system by at least two research assistants.[26]

Time in the UAE (in months divided by 10) is a time-varying variable, calculated using the first job that the worker had in the UAE based on data from the Ministry of Labor. On average, these migrants have been in the UAE for about two years.[27] There are two demographic variables available

[23] See Appendix B for more details on matching the MOL data to the financial transactions data from the private firm.

[24] See Appendix Figures A.1 and A.2 in Naidu, Nyarko and Wang (2016) for a comparison of the distribution of types of individuals that merge successfully between the MOL data and the payroll data. The earnings distributions of the unmatched MOL data and the data that matches into the payroll data is extremely similar for the lower end with some differences at the upper end of the earnings distribution suggesting that the payroll data is more oriented towards the median and lower end of the salary distribution of migrants and under-represents migrants at the high end of the earnings distribution.

[25] Nominal earnings and remittances are converted to real terms using the monthly consumer price index published by the UAE National Bureau of Statistics. These numbers are in 2007 dirham.

[26] If the two research assistants coded the written entry differently, we had another round of coding done independently by a third research assistant. In many cases, the written description was empty or too ambiguous to be coded. For example, a job description of "Worker" did not receive an SOC code. We thank Mengxing Lin, Marton Pono, and Cheng Xu for assistance in this coding.

[27] When an individual in the merged sample first appears in the payroll data, they have been in the UAE for 14 months

in the MOL that are not available in the financial firm data. We have information on religion and education for those salary observations that merge successfully with the MOL data. About a third of migrants report being Muslim and about 40% have high education, which we define as higher some secondary school education without having completed the secondary school degree.

Panel D presents the coefficient of variation for earnings and remittances within the duration of a work contract.[28] The coefficient of variation for monthly earnings disbursed to migrant workers is around 0.3. This indicates a substantial amount of month-to-month variation in earnings on each work contract. Thus, it is not the case that these workers are paid the same amount each month despite being on long-term work contracts. Our conversations with people in the UAE suggest that this variation is at least partially driven by monthly variation in hours worked and includes higher wages for overtime. There is also substantial month-to-month variation in the amount remitted. In fact, the coefficient of variation on remittances is even higher than on earnings. This provides some suggestive evidence that workers are not smoothing the amount remitted in response to income fluctuations.

The characteristics of individual-months in the sample that are successfully merged with both remittance and earnings information are in column 3 of Table 1. This is the main sample used in the analysis in the paper. The final merged sample that includes all of the demographic variables in addition to remittances and salaries includes 553,647 observations. The average amount remitted per month in the merged sample is much smaller than the average amount in the full remittances sample.[29] The average salary in the merged sample is higher than in the full payroll sample by about 120 dirham (33 USD) per month.[30] The summary statistics suggest that on average migrants are remitting about 85% of their monthly income. This is reasonable given that food and lodging is provided by employers for many migrant workers.[31] The characteristics of individuals in the merged sample are fairly similar to the full payroll sample along all of the observation characteristics. The merged sample has slightly more outdoor workers and their time in the UAE is slightly lower than in the sample with earnings only.

Analysis with the merged sample of positive observations of both remittances and salary requires

on average (with a standard deviation of 15 months).

[28] Unlike the other panels of the table, Panel D includes one observation per worker contract.

[29] Panel B of Appendix Figure A.1 shows the kernel densities of log monthly remittances for observations that merge with the salary data as compared with observations that do not merge with the salary data. The figure shows that the unmerged observations tend to be more extreme.

[30] Panel A of Appendix Figure A.1 shows the distribution of log monthly earnings in the merged sample and in the unmerged payroll sample. While the distributions are fairly similar, the sample of merged observations is slightly shifted to the right. This suggests that individuals that use this particular firm for remittances have slightly higher earnings than other individuals employed in firms that use the firm for payroll processing.

[31] In our field work at labor camps in the UAE, we observed many opportunities for migrants to spend money, including at shops and speciality restaurants located in the labor camps, and to use the internet and make phone calls. Migrants can also travel from the labor camp to the city to spend money on their days off.

the important assumptions on months in which either salary or remittance information (or both) are missing. Treating missing observations of salary disbursals as those in which they earned zero increases number of observations by only 2% and changes characteristics of the sample very little.

Missing observations of remittances occurs with greater frequency. Treating these observations as zero by replacing for months in which the individual sends remittances in both the previous calendar month and the consecutive calendar month increases the sample by 70%. Column 4 shows the summary statistics when we assume that unobserved observations of remittances are zero. Many of the characteristics of this sample are similar to the other merged sample in terms of age, gender, Indian nationality, religion and time in the UAE. In this scenario, migrants remit about 60% of their income.

For the bulk of the paper, we use the merged sample and assume that months in which observations of are similar to observations in which we observe both sets of information. This may be true for several reasons. First, they may be remitting through the company in our data but do not provide their customer registration number at the time of the transaction.[32] About 19% of remittance transactions in the data contain neither a customer registration number nor a labor card identification number and thus cannot be linked to an individual. Second, it is possible that migrants use several firms for remittances and they are behaving similarly but using another method of remittance in the months that we do not observe a remittance in our data.[33] Taken together, we estimate that at least three-quarters of the missing person-months of data look similar to the observed person months, so the best approach is to use the merged sample.

5 Relationship between Income and Remittances

5.1 Baseline Estimates

We begin by examining whether remittances vary with fluctuations in earnings. More specifically, we estimate the relationship between the logarithm of individuals' earnings and the logarithm of the amount that they sent in remittances. The relationship presented here is not necessarily the causal impact of fluctuations in earnings on remittance patterns. For example, individuals may choose to exert more effort, work more hours and receive higher earnings in months where they want to remit more

[32] If they forget to bring their customer registration number, they can still remit but all of the information such as name and address will need to be provided to the agent and typed into the system by the agent and they pay lower fees when using their customer registration number.

[33] Data collected by AC Nielsen over 2344 migrants between July 2015 to June 2016 suggest that 16% of customers switch routinely with the other large remittance service provider. This is likely to be an underestimate of total switching behavior because the survey questions do not ask about smaller competitors at all.

to their families.[34] The results in this section provide the statistical relationship between earnings and remittances whereas the subsequent analyses provide better identified estimates of the causal relationship between earnings and remittances.

The results are presented in Table 2. All the regressions include individual fixed effects, and year fixed effects. The standard errors are clustered at the individual level.[35] For each estimate, we present a parsimonious specification as well as one that allows the effects of individual characteristics (age, Indian nationality, male and an indicator for high education) to vary by year. Panel A includes only those person-month observations where there is both a remittance transaction and a salary disbursal. Panel B assumes that the migrant did not remit anything in months where no remittance is observed in our data. Panel C includes only those individuals for whom we have at least 12 months of non-missing data on both remittances and earnings. In addition to the parsimonious specification in column 1, column 2 adds year-month fixed effects and column 3 allows the effects of worker characteristics (age, Indian nationality, male and high education) to vary by year.

In Panel A, the results indicate that higher salaries of 10% correspond with 3.3% more remittances. All of the estimates in the table are significant at the 1% level. There are almost no differences in the estimates with and without year-time indicators and time-varying effects of worker characteristics. Thus, in the subsequent sections of the paper, we focus on the parsimonious specification with individual fixed effects.[36]

Despite the fact that workers are on fixed contracts, there is substantial variation in their earnings month-to-month that reflects variation in the hours that they have worked. The average absolute value of the change in earnings from the previous month for the same individual is 20%. If we assume that the variation in a worker's earnings is driven primarily by circumstances that are outside of the control of the individual worker, then the fixed effects estimate of the relationship between log earnings and log remittances provides the income elasticity of demand for remittances.

Panel B shows the estimates in which periods with no remittances recorded are treated as if there were no remittances. Here the coefficient estimates increase substantially and suggest an earnings-remittance elasticity that is close to one; each additional percent change in earnings maps into the same percent change in remittances. While the results indicate the magnitude of the relationship between

[34] Our conversations with managers and workers suggest that month-to-month variation in earnings is driven by variation in hours worked and that the firm managers have much more power over determining who gets additional hours than the workers do.

[35] Appendix Table A.1 includes lags and leads in earnings. The estimated coefficient on the contemporaneous month of earnings remains the same in magnitude and significance as without the leads and lags. The coefficients on the leads and lags are relatively small.

[36] The inclusion of these controls do not substantively change any of the results.

remittances and earnings depends on the assumptions made about the months in which transactions are not observed, the sign of the relationship remains the same and significant at the 1% level.

In Panel C, we limit the sample to individuals for whom we observe at least 12 months of non-missing observations of both remittances and earnings. The elasticities suggested by these estimates are around 0.4 and are significant at the 1% level. The similarity between these estimates and those in Panel A provides some suggestive evidence supporting the assumption that months for which we do not observe a remittance transaction are similar to months in which we do observe one (but the observation is not linked to others in our data because they did not provide their customer registration number during the transaction or they remitted through a competitor), and that using the merged sample is the best strategy. The remaining analyses in the paper use the sample limited to observations where both earnings and remittances are observed.

Next, we examine the prediction of the model that migrants have more incentive to hide positive fluctuations in their income and reveal negative income realizations. While using the total variation in income month-to-month does not allow us to separate out what is and is not observable to families, if the observability of the monthly positive and negative fluctuations in income are similar on average, then the model suggests the elasticity should be much larger for negative changes than for positive ones. One difficulty with testing whether the income elasticity of remittances are larger for positive fluctuations than for negative ones is identifying the appropriate base against which we can calculate whether an income realization is negative or positive. We start with a straightforward comparison that characterizes a positive change as one in which the individual's income is greater than in the previous month and a negative change if the individual's income is less than in the prior month. In other words, we estimate for individual i in year-month t:

$$Log\frac{R_{it}}{R_{i,t-1}} = \beta_0 + \beta_1 \left(Log\frac{E_{it}}{E_{i,t-1}} \times Pos \right) + \beta_2 \left(Log\frac{E_{it}}{E_{i,t-1}} \times Neg \right) + \beta_3 Pos + \delta_T + \epsilon_{it} \qquad (2)$$

where R denotes remittances, E earnings, $Pos = I(E_{it} > E_{i,t-1})$ is an indicator for positive income changes and $Neg = I(E_{it} \leq E_{i,t-1})$ an indicator for negative ones. We also include year fixed effects and month fixed effects, δ_T. The prediction of the model is that $\beta_1 < \beta_2$.

We also examine two alternative measures of positive and negative income changes. The first alternative calculates whether the individual's earnings deviations from their long-run average earnings are positive or negative. The second alternative measure generates indicator variables based on whether the individual's earnings deviations from their long-run trend are positive or negative. In these specifications, the dependent variable is log remittances and the independent variable is log

earnings.

Table 3 presents the impact of changes in earnings on changes in remittances where the even columns include year indicators and the odd columns year-month indicators. The first difference specification is presented in columns 1 and 2. Consistent with the prediction of the model, remittances move much more strongly with negative changes in earnings than with positive ones. The income elasticity of remittances for positive income changes is around 8% versus 26% for negative income changes. These estimates are significant at the 1%, and, importantly, are significantly different from each other.

The results where we define negative and positive changes as deviations from the individual's long-run mean are presented in columns 3 and 4. The gap in the elasticities is smaller than in the first difference estimates, but the magnitude of the elasticity continues to be larger for negative changes than for positive ones. More specifically, the elasticity is 25% for positive changes and 31% for negative ones. The estimates are significant at the 5% level. The corresponding estimates are almost identical when the positive and negative income changes are defined as deviations from individuals' long-run trends (in columns 5 and 6).

One potential concern is that the relationship between log earnings and log remittances is not linear, and some curvature in the relationship generates the observed asymmetries between positive and negative income changes. To address this, we estimate a non-parametric relationship between log remittances and log earnings (after removing individual and year fixed effects) in Appendix Figure A.2. There is a kink in the relationship at zero, which is consistent with the idea that the income elasticity of remittances is larger for negative changes than for positive ones. Otherwise, the relationship looks remarkably linear above and below the kink.

6 Isolating Specific Sources of Variation in Earnings

The previous results make use of all of the variation in earnings and remittances. However, a key concern is that we may not be sure that all of the changes in earnings are driving the corresponding changes in remittances. We try to isolate specific shocks and fluctuations to use as instruments for earnings. The instrumental variables estimation strategy requires two key assumptions. The first is that the instrument predicts earnings, and we can show this to be true for the four specific sources of variation that we look at. The second assumption is that these sources of variation only affect remittances through income and not through other channels.

6.1 Ramadan

While the vast majority of workers in the UAE are on multi-year contracts, seasonal variation in demand can affect monthly earnings through the amount of hours worked. Figure 1 shows the coefficients corresponding to each month in a regression with individual and year fixed effects where the omitted category is January.[37] The dotted lines give the 95% confidence interval. These estimates demonstrate that there is substantial variation over months in both earnings and remittances. Earnings dip in September and October; in those months, earnings are about 4% lower than in January. Panel B of Figure 1 displays the monthly coefficients for remittances. While there is substantial month-to-month variation in remittances, the seasonal pattern does mimic the pattern in earnings. Similar to earnings, remittances are lowest in September.

The most likely explanation for the stark seasonal pattern in September is the Muslim holiday of Ramadan. One implication of Ramadan for worker productivity is that adult Muslims are required to fast from dawn to sunset for 30 days.[38] As stipulated in the Federal Law Number 8 of 1980, the standard work day must be reduced by 2 hours during Ramadan in the UAE. Relatedly, many retail businesses reduce the hours that they are open. Thus, the monthly output of non-fasting workers is likely to decline during Ramadan as well.

While the timing of Ramadan varies year-to-year following the Islamic calendar, it includes at least part of the month of August in all four years for which we have data. Given that payment occurs on a monthly level and reflects the actual hours worked, payment received in September corresponds with workers' hours in August. Thus, our specification examines the impact of Ramadan on earnings and remittances in the subsequent month. Ramadan spills over into September in 2009 and 2010 and into July for 2012.

We estimate the impact of the timing of Ramadan on earnings and then use that as the first stage in an instrumental variables estimate of the relationship between earnings and remittances. The measure for Ramadan is an indicator variable that equals 1 if the lag of Ramadan overlaps with at least part of the month. The results are presented in Table 4. The odd columns include the full sample while the even columns are limited to the sample of individuals for whom we have an earnings observation for each of the 12 months. Panel A shows that Ramadan is associated with 2.9% lower earnings in that month relative to months without Ramadan. Restricting the sample to individuals

[37] The corresponding regression output is shown in Appendix Table A.2, where the odd columns display the full sample and the even columns display the observations where the individual has earnings observations for all 12 calendar months. While there is unlikely to be seasonal selection given that most workers are on multi-year contracts, in the even columns, we look at the sample with all 12 months to address the possibility of seasonal selection.

[38] For example, Schofield (2014) demonstrates that fasting during Ramadan decreases the productivity of rickshaw workers in India.

for which we have data covering the twelve months does not have much effect on the estimates.

We also make use of the fact that religion is available in MOL database.[39] We look at the interaction of the months covered by Ramadan and an indicator for whether the worker is Muslim. While aggregate output falls during Ramadan, we expect the output of Muslims to fall even more due to fasting. Thus, the interaction provides an additional test of whether the drop in earnings that we see in this time period is in fact driven by Ramadan. Ramadan reduces the earnings of non-Muslim workers by 1% and these estimates are significant at the 1% level. The impact of Ramadan is much larger among Muslims, who experience an additional 4% drop. These estimates are also significant at the 1% level.

Panel B shows the instrumental variables estimates. In columns 1 and 2, we find a 3% drop in earnings would correspond with a 6 to 7% drop in remittances. These estimates are significant at the 5% level. In columns 3 and 4, we see the income elasticity of non-Muslims remains large, positive and significant at the 1 and 10% levels in the full sample and the all 12 month sample, respectively. The income elasticity of Muslims is not significantly different from non-Muslims, though the interaction is negative. This suggests that Muslims may remit less but this is because they are earning less at Ramadan.

One potential concern with these estimates is that the remittance patterns around Ramadan are driven by the consumption demand either by families at home or by the workers in the UAE rather than declines in the migrants' income during Ramadan. To test this, we also look at heterogeneity in the effects of Ramadan by the share of migrants who are Muslim in each migrant's country of origin.[40] The key test is that families in countries without a substantial Muslim population and who are not Muslim themselves are unlikely to experience changes in consumption demands driven by the celebration of Ramadan. In contrast, consumption demands may change for Muslim families observing Ramadan or for non-Muslim families who are in countries with a sizable Muslim population.[41] Among a sample of *non-Muslim* workers in the UAE, we run the following first-stage regression of log earnings for individual i in month t from origin country j:

$$y_{ijt} = \beta_0 + \beta_1 Ramadan_{it} + \beta_2 Ramadan_{it} \times MuslimShrOrigin_j + \delta_i + \gamma_T + \epsilon_{ijt} \quad (3)$$

[39] The sample size falls because it is missing for many workers.

[40] In the top three countries of origin, more than 70% of Pakistani and Bangladeshi migrant workers in the UAE are Muslim whereas about 15% of Indians are Muslim. There are also several countries with substantial number of migrants in the UAE where almost none of the migrants are Muslim, such as Thailand.

[41] As an example of the latter case, many non-Christians in the United States celebrate Christmas and buy presents for friends and family.

where $Ramadan_{it}$ is an indicator variable for whether the month included Ramadan at all and $MuslimShrOrigin_j$ is the total share of migrants in the UAE from the migrant's origin country who are Muslim. We include only year indicators, denoted by δ_T, in this regression. The coefficient on α_1 gives the impact of Ramadan when none of the migrants from a country are Muslim. Adding α_1 and α_2 gives the total impact of Ramadan for workers from countries where all the migrants in the UAE are Muslim.

We also estimate the second-stage regression of log remittances where log earnings is instrumented with Ramadan:

$$R_{ijt} = \alpha_0 + \alpha_1 y_{it} + \alpha_2 y_{it} \times MuslimShrOrigin_j + \delta_i + \gamma_T + \epsilon_{ijt} \tag{4}$$

where α_0 gives the income elasticity of remittances for non-Muslims from countries without any Muslims and α_1 provides information on how that elasticity changes as the share of migrants from the same country who are Muslim increases. Under the alternative hypothesis where remittance patterns are driven by consumption demands by workers' families around Ramadan rather than by the declines in migrants' earnings, we would not expect to see a fall in the remittances of non-Muslim workers from countries without a substantial Muslim population ($\alpha_1 = 0$).

The results are presented in Table 5. The results do not support this alternative hypothesis. Remittances move significantly with earnings for non-Muslim workers from countries with no Muslim migrants in the UAE. In other words, remittances around Ramadan are following the movements in earnings in UAE rather than responding to consumption demands at home.

Another possibility is that remittances and earnings fall because Muslims are more likely to return home to visit for this holiday. Given that the regressions drop observations of months in which either remittances or earnings are not observed in the data, this can only be consistent with the results if they are only paid for part of the month because many workers are returning home for part of the month, and they remit a smaller amount because they are carrying cash home with them. To test for the possibility that travel by migrants during Ramadan is driving the patterns observed, Appendix Figure A.3 presents the kernel density of the logarithm of earnings in the months of Ramadan as compared with other months. The results demonstrate that the distribution of earnings shifts slightly to the left during the Ramadan. If the drop in earnings and remittances were explained by a sizable fraction of workers leaving the UAE for parts of the month that correspond to Ramadan, we would expect the distribution of earnings during Ramadan to be bimodal with a cluster of workers earning a small fraction of their usual salary rather than a shift in the whole distribution.

Given that information about income drops associated with Ramadan is easy to verify by families at home, the model of private information predicts that remittances should fall with this change in earnings. The results support this interpretation, but are also consistent with some other explanations for remittances to follow earnings, including pure altruism and exchange motives. Given that Ramadan is perfectly anticipated, the results do reject a model of remittance smoothing, assuming that there are no barriers to savings.

6.2 Weather Shocks

We follow a large literature that uses rainfall shocks as exogenous shocks to income to test for consumption smoothing (Paxson 1992, Wolpin 1982). In addition to looking at rainfall, we consider heat shocks in this context. We use daily temperature data from the World Meteorological Organization for five cities in the UAE: Abu Dhabi, Dubai, Fujairah, Ras Al-Khaimah and Sharjah. Thus, variation in weather is across both time and geographic space. We aggregate the daily information to the monthly level to merge into the monthly level earnings disbursal information. We calculate an average maximum temperature that averages all of the maximum daily temperatures in that city and month. We also calculate an average precipitation per month in each city by averaging across days in the month.

In Figure 2, the dots and the squares display the average maximum temperature in Fahrenheit and the average precipitation in inches across the months and cities in the data, respectively. The bands around the dots and squares provide information on the variation across cities in temperature and rainfall in each month. The upper band indicates the maximum value for a single city in that month and the lower band indicates the minimum value for a single city. Temperatures in the UAE are quite high in the summer with daily maximum temperatures exceeding 100 degrees Fahrenheit from May to September. The bands show that there is considerable variation across cities over the sample period. Rainfall is generally fairly low in the UAE with winter being wetter and March being the month with the greatest rainfall in the sample period. There is even more variation in rainfall across cities than there is in temperature.

While the figure provides a sense of seasonal variation in weather outcomes, the shocks are measured as the deviations of a city's weather realization in that month and year from the average weather realization experienced in that city in that calendar month across all years. To do this, we include city by month fixed effects. Thus, we remove the impact of seasonalities and focus on weather shocks that deviate from standard seasonal patterns in rainfall and temperature.

We consider whether worker output, and their corresponding earnings, declines when the weather

conditions are extremely hot or when it rains. These weather shocks are likely to affect the output of workers who are working outside. Many migrant workers are employed in the construction sector where productivity has been found to be negatively affected by rain and heat (Assaf and Al-Hejji 2006).

The results are presented in Table 6. Panel A provides estimates of the relationship between the different measures of weather shocks and log earnings. The independent variable in column 1 is the z-score in days with any precipitation in that city and month. A standard deviation increase in precipitation decreases earnings by 0.6%. The independent variable in column 2 is an indicator for whether there was an extreme rain outcome, which equals one if the number of days with rainfall is above the 80th percentile for that city and calendar month. Months with extreme rainfall correspond with 1% lower earnings. Both estimates are significant at the 1% level.

Columns 3 and 4 show that high temperatures also reduce earnings. A standard deviation increase in the number of days where the temperature is over 100 degrees reduces earnings by 0.6%. A month where the number of days over 100 degrees is greater than the 80th percentile in that city and calendar month corresponds to 1.2% lower earnings. These two estimates are significant at the 1% level.

Panel B of Table 6 shows the two-stage least squares estimates of the relationship between log remittances and log earnings, instrumented by the weather shocks. The estimates range from 1.7 to 2.8 and are all significant at the 1% level. Assuming that more massive weather events are easier for families at home to hear about or verify, we would expect the income elasticity of remittances to be larger for them than for smaller weather month-to-month deviations. Consistent with that prediction, the coefficient on earnings when instrumented by the extreme weather outcomes is more than 50 percent larger than when we instrument for the earnings with all of the variation in weather.

One important concern with the latter outcome is that variation in weather may affect consumption demands within the UAE directly rather than working solely through earnings. For example, in very hot temperatures, workers may prefer to pay more to eat at air-conditioned restaurants rather than at cheaper restaurants. This is a potential challenge to the assumption that weather shocks can be used as an instrument for earnings.

The results suggest that remittances fall in response to these weather-related income shocks. The scale of the weather shock may provide variation in the observability to families at home, and assuming more extreme weather outcomes are more observable, the estimates confirm the idea that the income elasticity of remittances is increasing in observability for negative shocks. Whether the income fluctuation is unanticipated as with the weather shocks or anticipated as with Ramadan does

not affect the relationship between migrants' earnings and remittances.

6.3 Labor Mobility Reform

We exploit a labor reform that was announced in December 2010 and implemented in January 2011. Prior to the reform, workers needed written permission, called a no objection certificate (NOC), from their existing employer to change firms at the end of their multi-year work contracts. Without written permission from their employers to change firms, workers could not directly change firms and either had to sign a new multi-year contract with their existing firms or leave the UAE for at least six months. The reform removed the NOC requirement at the end of the contract but made no changes to the terms and requirements during a contract. Thus, the reform gave workers more bargaining power with their employers by reducing the monopsony power of their existing employers. Naidu, Nyarko and Wang (2016) demonstrate that this reform has a very robust, positive effect on the earnings of existing workers.

We begin by replicating the baseline analysis of the impact of the reform on workers' earnings within our sample of individuals for whom we also observe remittance transactions.[42] Focusing on 7 periods of data around a contract expiration for each worker, we look at outcomes before and after the reform as well as before and after the worker's contract expires. Because the reform only applies to workers after their contracts expire and after the implementation of the reform, we can identify the causal impact of the reform with a difference-in-difference approach. More specifically, we estimate the following:

$$y_{it} = \beta_0 + \beta_1 Post2011 \times PostContractExpire_{it} + \beta_2 Post2011 \times ContractExpire_{it} + \delta_i + \delta_t + \epsilon_{it} \quad (5)$$

where $Post2011$ is an indicator for the calendar periods after the implementation of the reform in January 2011, $PostContractExpire_{it}$ is an indicator for the three periods after an individual's contract expires and $ContractExpire_{it}$ is an indicator for the period that a contract expires. The regressions also include year-month fixed effects, $delta_t$, and individual fixed effects, δ_i. The estimates of β_1 and β_2 provide information on whether the effects of contract expiration (estimated in a 7 month window around the expiration) after the reform are different from the effects before the reform.

The results are presented in Table 7. Panel A shows that the reform led to an increase in earnings of about 3.5% in the month of the contract expiration and 4% in the three months after the worker's

[42] See Naidu, Nyarko and Wang (forthcoming) for additional details on the reform and the estimation strategy.

contract expired.[43] These estimates are significant at the 1% and 10% levels, respectively.

In Panel B, we use the timing of the reform and individuals' contract expirations to instrument for log earnings. The income elasticity of earnings is close to 1 and significant at the 5% level. The elasticity close to 1 is consistent with the idea that this income shock is public as it increases the average earnings of all migrants following their contract expiration. The estimated elasticities for negative income changes (associated with Ramadan and weather) are much larger than for this positive income shock. This is consistent with the prediction of the model that migrants treat negative and positive income changes differently.

7 Time in the UAE

7.1 Empirical Strategy

So far, the income fluctuations that we have examined have been shocks that are likely to be publicly known and relatively easy for families at home to verify. We now examine how migrants' earnings change with their time in the UAE. The approach taken is similar to estimations of the rates of economic assimilation of immigrants in the literature. We estimate the following equation for individual i in year-month t:

$$y_{it} = \beta_0 + \beta_1 TimeinUAE_{it} + \delta_i + \delta_T + \epsilon_{it} \tag{6}$$

where the dependent variable in this first stage regression is the logarithm of earnings. The variable, $TimeinUAE$, is the number of months (divided by 10) that individual i has been in the UAE at period t. We are interested in the coefficient, β_1, which provides the impact of an additional 10 months of time in the country. The regressions also include individual fixed effects as well as year fixed effects and month fixed effects. Equation 6 assumes that the relationship between time in the UAE and earnings is log linear. We examine the validity of this assumption in two ways. First, we change the functional forms to include a quadratic function of time in the country. Second, to allow for full flexibility in the relationships, we estimate them with an indicator variable for each month that a worker has been in the UAE.

A common concern with this type of estimation is that the returns to assimilation in the host country are driven by selection into who stays (Borjas 1999). While the inclusion of individual fixed

[43] The magnitude of the effect is slightly different from those reported in Naidu, Nyarko and Wang (forthcoming) because we restrict the sample to those for whom we also have remittance transaction information, but the direction of the effect is the same.

effects should ameliorate much of this concern, we do several additional things to address this possibility. First, in addition to running equation 6 on the full sample of migrants, we also estimate it with a sample of migrants who are in their first multi-year contract. Given that migrants who leave without completing a contract must pay for their airfare home while those costs are borne by the firm for migrants who complete the full contract, the vast majority of migrants leave after a contract expires rather than mid-contract. Thus, this sample restriction should minimize the effects of selection. Second, we implement a bounding exercise to estimate the maximum effect that selection can have on the estimates in Section 9.

7.2 Estimates of Time in the UAE on Income and Remittances

Figure 3 presents the fully flexible coefficient estimates of each separate month of time in the UAE. The omitted category is the first month that the worker enters the UAE. In Panel A, the dependent variable is the logarithm of monthly earnings. The figure shows a strong positive within-individual relationship between time in the UAE and earnings. For most workers in the sample, the typical contract is for 36 months. Thus, it is interesting that the increase in earnings happens fairly linearly throughout that period; this suggests that growth in individuals' earnings occurs within the life of a labor contract. These estimates suggest that workers with more experience in the UAE either get higher wages or more hours within a labor contract. In contrast, Panel B indicates a strong negative within-individual relationship between experience in the UAE and remittances. Both panels provide visual support for the assumption of a linear relationship.

The results corresponding to equation 6 and to the quadratic specification where the dependent variable is log earnings are presented in Panel A of Table 8. The first two columns refers to the full sample and the last two columns to the sub-saple of migrants in their first labor contract in the UAE. According to the linear specification, controlling for time-invariant characteristics of individuals, a 10-month increase in time in the UAE corresponds with approximately 1.7% higher earnings. The estimates are significant at the 1% level and the magnitudes are economically large. The estimates of the quadratic relationship (column 2) and in linear specification using the first contract-only sample (column 3) are almost identical.

Panel B of Table 8 display the corresponding results of the two-stage least squares estimates of the relationship between log earnings and log remittances. Across the different samples and functional forms for the instrument, the relationship between earnings and remittances is negative and significant at the 1% level. In the full sample, the magnitude of income elasticity of remittances using this variation

is quite large at -5.7. The impact of time in the UAE on remittances is smaller when we limit the sample to those in their first contract.

The previous results have shown that remittances move in the same direction as income changes associated with Ramadan, weather shocks and the labor reform. However, the results here are quite different. While earnings increase over time in the UAE, average remittances decline over time. This result is consistent with a model where remittance payments are part of income-sharing contracts affected by asymmetric information.

7.3 Asymmetric Behavior Based on the Earnings-Tenure Profile

We examine an additional prediction of the framework in which migrants exploit private information about the evolution of their earnings. While on average migrants' earnings increase over time, there is heterogeneity in this across individuals. Migrants who experience a negative earnings-tenure profile have less incentive to hide this information than migrants who experience a positive earnings-tenure profile. Given the literature that documents that wages are sticky downwards, it may be surprising that earnings fall for a substantial number of migrant workers in the UAE. First, in informal conversations with migrant workers in labor camps, some did mention that their earnings had fallen over time. We think this is driven in part by a shift in hours or wages where good workers are given more overtime or higher wages.[44] Second, this correlation is between real earnings and time and workers' earnings which may be partially eroded by the lack of raises to adjust for inflation. Finally, this labor market is quite unique, so it is possible that the features of labor markets that drive nominal wage rigidity, such as efficiency wage stories, are not relevant here.

We examine asymmetries in the impact of changes in time in the UAE on remittances by whether the individual experienced a positive or negative earnings-time profile. In other words, we estimate the first-stage equation:

$$y_{it} = \beta_0 + \beta_1 TimeinUAE_{it} \times I(NegChange)_i + \beta_2 TimeinUAE_{it} \times I(PosChange)_i + \gamma_i + \delta_T + \epsilon_{it} \quad (7)$$

where we include the interaction between time in the UAE, denoted by $TimeinUAE$, and a time-invariant indicator variable that equans one if the person experienced a positive or negative correlation between time in the UAE and earnings, denoted by $I(PosChange)$ and $I(NegChange)$, respectively.[45] More specifically, the correlation is calculated with the full earnings sample as the within-person

[44] We do not observe hours worked and cannot test this idea directly. It is important to note that, based on our field work, workers have very little choice in the hours, including the amount of overtime, that they work.

[45] For each individual, either $I(NegChange)$ or $I(PosChange)$ equals one.

correlation coefficient between all of the observations of time and earnings for individuals who had three or more months of earnings data.[46] We also include individual fixed effects and indicators for month and for year. The coefficient, β_1, provides the impact of each additional 10 months of time in the UAE for individuals for whom the correlation between time and earnings is not positive. The coefficient, β_2, provides the impact of each additional 10 months for individuals for whom the correlation is positive.[47]

We estimate the following the second stage equation:

$$R_{it} = \alpha_0 + \alpha_1 y_{it} \times I(NegChange)_i + \alpha_2 y_{it} \times I(PosChange)_i + \gamma_i + \delta_T + \epsilon_{it}. \quad (8)$$

The model predicts that individuals will be more willing to reveal negative changes to income than positive ones, so in the second stage estimates with the dependent variable as remittances, we expect the absolute value of the magnitude of the coefficient estimate of α_1 to be greater than α_2.

The main concern with interpreting the results of this equation is that there are time-varying unobservable differences between the two types of individuals that affect their remittance behavior directly. For example, if individuals with a positive time-earnings profile are in white collar jobs that allow them to bring their families to the UAE and they do so after several periods to allow themselves to settle into their jobs, then an observed drop in remittances over time simply reflects the fact that they remit less when their nuclear family moves to the UAE.[48]

We consider the concern that individuals with positive and negative gradients are different by comparing characteristics and the initial economic behavior of the two groups of workers in Table 9. Column 1 refers to individuals whose earnings decrease over time, column 2 to individuals whose earnings increase over time and column 3 to the difference between the 1 and 2. There are about as many individuals for whom the gradient is positive as those for whom it is negative. The first three rows refer to the initial contract terms. While the differences in the initial terms of the contract are significant at the 5% level, the differences are economically small. For example, the difference in contract hours is 0.01 hours per day. Those whose earnings rise over time start with a contract salary that is about 4% higher than those whose earnings fall over time. The difference in average

[46] The results are similar using an alternative, time-varying measure of $I(NegChange)_{it}$ and $I(PosChange)_{it}$ constructed as whether the correlation of earnings and time is positive or negative up until that point in time t. This excludes months in which individuals have less than 3 months of recorded earnings.

[47] Mechanically β_1 must be negative and β_2 positive, but the magnitudes of the coefficients may be informative in comparison to the main outcome of interest, remittances.

[48] The minimum salary requirement for a migrant to bring family members to the UAE is 4000 dirham per month. As shown in Table 1, this is two standard deviations above the mean monthly income and represents about 1% of the sample. The results are not sensitive to dropping individuals whose contract salary eventually exceeds this threshold.

contract length is less than one month. The differences between the two groups in their demographic characteristics are economically small and the difference in their initial remittance is not significant. The ex-ante similarities along observable characteristics between the two types of workers may not be that surprising given that for most workers in the UAE, firms (or the recruiting firms that they hire) screen workers before they are given visas to enter the country. Thus, selection into the UAE is determined by the screening process of firms in addition to the pool of applicants who apply to work in the UAE. In addition, the rates of selection out of the UAE appear very similar for the two groups (Panel B). The probability that a worker leaves the UAE in any given month is about 2% regardless of whether their earnings are evolving up or down over time. Overall, the similarities between the two groups provide some assurance for the idea that these workers are quite similar at the time that they start working in the UAE, and that it may be unknown to the families at home whether the worker's earnings will evolve positively or negatively over time.

Appendix Figure A.4 presents a histogram of the share of employees in firms with more than 10 workers with positive growth in earnings over time. The mass of the distribution is in the middle. This suggests that the positive or negative trends over time in earnings usually occur within a firm. In other words, it is not the case that there are two types of firms, one that pays workers more over time and one that pays them less. This provides additional support for the idea that whether a person earns more over time or not is private information and not based on an observable characteristics like the firm at which he is employed.

The results are presented Table 10. In Panel A, for individuals for whom the correlation between their time in the UAE and earnings is negative, each additional 10 months of tenure corresponds with a 8% decline in their wages. For individuals for whom the correlation is positive, an increase in time in the UAE of 10 months maps into an average 13% increase in their wages. Both coefficients are significant at the 1% level. In column 2, we allow for time-varying effects of worker characteristics, and the magnitude and significance of the coefficients are very similar.

Panel B of Table 10 provides the estimates of the instrumental variables estimates of earnings on remittances where log earnings is instrumented with time in the UAE. For individuals with a negative earnings gradient, the income elasticity of remittances is 1.3 and significant at the 1% level. In other words, for every 10% decline in earnings over time, they reduce their remittances by 13%. In contrast, the income elasticity of remittances for those with a positive earnings gradient is -0.35 and significant at the 1% level. This is much smaller in magnitude and actually the opposite sign. This suggests that to some extent, the positive gradient types may actually pretend to be the other type and remit slightly less over time.

The results are consistent with the idea that migrant workers have private information about the evolution of their earnings in the UAE, and that they share the burden with their families at home when their long-run earnings decline. However, if their earnings evolve positively over time and this is hard for families at home to obseve, they continue to remit the same amount or less on average and do not pass along the extra earnings over time abroad. This result is not consistent with the standard models of remittances as altruism or exchange.

7.4 Exogenous Determinants of Individuals' Earnings Gradients

A key concern with the prior estimates is that whether an individual's earnings gradient over time is positive or negative is not exogenous. It is possible that workers with a positive earnings-time gradient are exerting more effort over time while workers with a negative earnings-time gradient are exerting less effort over time. The patterns in effort may be driven by different expectations for sharing with their families at home. There may be two groups of individuals - those with sharing rules that involve a proportion of their earnings and those who are expected to remit a fixed amount each month. Similar to predictions of models of sharecropping where sharecroppers have less incentive to exert effort than tenants that pay fixed rent, the former group under income sharing contracts may exert less effort and earn and remit less while the latter group under fixed payment contracts may exert more effort because they can keep all of the earnings from their additional effort.

To address this concern, we use local economic conditions driven in the month in which the migrants' contract begins to isolate exogenous variation in whether the gradient is positive or negative. To characterize local economic conditions in the UAE, we collect monthly oil price data from 2003 to 2012 to calculate whether oil prices were above the 80th percentile or below the 20th percentile in time periods of our administrative data.[49] We include firm fixed effects to allow for time-invariant firm wage setting behavior. We also include indicators for the year and for the month that contracts begin.

In column 1 of Table 11, we find that contracts that begin in months with very high oil prices (above the 80th percentile) have contract earnings that are 2.6% higher than contracts that begin with average oil prices (between the 20th to 80th percentile). This estimate is significant at the 1% level. Similarly, contracts beginning in months where oil prices are below the 20th percentile correspond to 1.3% lower contract earnings. As expected, labor demand moves with oil prices and the contract

[49] More specifically, we use WTI spot price data but our results are almost identical if we use Brent prices or futures prices. The UAE economy is heavily reliant on oil; according to the CIA World Factbook, more than 85% of GDP is oil exports.

terms offered to migrants reflects labor demand.

More importantly, extreme oil prices predict the gradient between earnings and time for migrants. As shown in column 2, workers who begin their contracts when oil prices are very high start with high contract earnings, but the slope of their earnings over time is less steep. More specifically, the correlation between earnings and time for workers who begin when oil prices are above the 80th percentile is 1.1% lower than workers who begin when oil prices are in the average range and the estimate is significant at the 1% level. Similarly, when oil prices are low, workers begin with lower contract earnings but the gradient over time is almost 1% greater than worker who began when oil prices were not extreme. The results are similar if we look at an indicator for whether the individual has a positive or negative gradient over time in column 3. Migrants who begin when oil prices are high are 1.3% more likely to have a negative gradient over time while migrant who begin when oil prices are low are 0.9% more likely to have a positive gradient.

Next, we use the indicators for very high and very low oil prices (corresponding with column 3) to instrument for whether the individual has a negative or positive earnings gradient to examine the relationship between earnings and remittances for these different types. This is presented in Panel C of Table 10 where log earnings is also instrumented by time in the UAE. The magnitudes of the coefficients change relative to Panel B, but the main take-aways are similar. The income elasticity of remittances is much larger for individuals whose earnings evolve down over time than for individuals whose earnings evolve up over time. For the negative gradient types when we use oil prices to identify the type, that elasticity is over 5 and is significant at the 10% level. For positive gradient types where their type is instrumented by extreme oil prices, the magnitude of the elasticity is less than 1 suggesting that for each additional 10 percent increase in earnings, they remit back about 5 to 6% more. However, this estimate is not significantly different from zero at the standard levels, so we cannot reject that they remit a constant amount over time while earnings more over time.

7.5 Asymmetric Behavior Based on Home Connections

We consider the idea that individuals who have more connections to communities at home are less able to hide growth in their earnings over time. Co-workers from the same community may have information about how a person's earnings evolve over time within the company and be able to report this information to family members in the home country.

The data include some information on the receiving location of the remittance. There is substantial variation in the type of information on the receiving location of the remittance over time,

country and over types of transactions. For many transactions, there is only country-level information available. For migrants from India, we cleaned and coded a string variable that contained the state that the remittance was sent.[50] We then create a variable for home connections that is based on the share of workers in the firm that are from the same state in India.[51] To examine heterogeneity by these home connections, we construct an indicator variable for whether a person's connections are above or below the median share of connections within the same state of 17%.

One concern is that individuals who have more co-workers from the same home state are different than individuals with few co-workers who are from the same home community. We examine baseline characteristics of individuals who have more or fewer connections within their firm to their home state in columns 4 through 6 of Table 9. For most characteristics, there is either very little statistical or economic difference between individuals with more connections to their home state as compared with those with fewer connections. For example, while the difference in the initial contract hours is statistically different between the two groups, a difference of 0.01 hours (or less than one minute) per day is economically not important. The one exception is that the difference in initial remittance between the two groups is statistically significant and not that small in magnitude at about 6%. However, the bias may work in the opposite direction as those with fewer connections remit more in their initial remittance. Finally, as shown in Panel B, the rates at which workers exit the UAE is similar regardless of whether they had more or fewer connections to their home state within their firm.

In Table 12, we present the impact of time in the UAE on the outcomes by both home connections and whether the individual's earnings increase or decrease over time. In Panel A, the relationships between time in the UAE and earnings for positive and negative changers are similar when we compare those with more or fewer home connections. This is reassuring as it suggests that differences across these two groups, those with more or fewer home connections, do not have very different gradients in earnings over time. It is difficult to think of alternative mechanisms for the results on home connections that affect remittances over time but do not affect earnings over time.

The results in Panel B are particularly interesting. Regardless of connections, there is a positive and significant income elasticity of remittances for individuals with a negative earnings gradient. The magnitude is 2 for those with less connections and 4 for those with more connections, and both estimates are significant at the 10% level. However, as shown in second row of Panel B, for workers whose salaries increase over time, remittances increase for those who have more state connections (and

[50] Migrants in the UAE are from 36 states and territories in India.

[51] For a different (and smaller) subset of remittance transactions not limited to India, we have a code identifying the district in which the transfer was received. The median person in this sub-sample has 7% of co-workers from the same district. The results are similar using district-level connections but the standard errors are larger.

this is significant at the 10% level). For individuals with fewer state connections, the magnitude of the effect is much smaller and not significantly different from zero. Testing coefficients across regressions, we found that the coefficients on the interaction, $LogEarnings \times Neg\_Changes$, are not significantly different for those with less or more connections, but the difference in the coefficient estimates of $LogEarnings \times Pos\_Changes$ is significantly different at the 5% level (with a p-value of 0.042).

These results suggest that having more co-workers from the same area may reduce the likelihood that migrant workers can fully hide whether they are earning more over time in the UAE. This can occur because co-workers provide monitoring. An alternative interpretation is that having more co-workers from the same place maintains the affinity that migrants have with their families over time.[52] The latter interpretation can still be consistent with the model of asymmetric information where migrants have less incentive to exploit private information about income gains when they feel more affinity to their home communities. These results provide additional support for the theory that remittances are viewed as an income-sharing payment to families at home. Thus, they are less likely to remit upward changes in income that can be hidden from their families at home, but they are willing to pass along negative changes in income to their families.

8 Alternative Explanations

8.1 Demand Shocks in Home Country

One alternative explanation is that the observed patterns in remittances are driven by demand shocks experienced by households at home rather than by variation in the earnings of migrants in the UAE. As discussed previously, it may be plausible that households at home, especially those who also observe Ramadan or are from Muslim countries, experience a change in their demand for remittances around this holiday. However, the results of Table 5 that look at the remittance behavior of non-Muslim migrants from areas without a large Muslim population do not support this interpretation.

Reassuringly, demand shocks by households at home cannot explain the variation in remittance patterns using weather shocks and the labor reform in the UAE. It is very unlikely that random deviations from standard seasonal patterns in rainfall and heat in a city and month in the UAE are correlated with demand shocks of households at home in different sending countries. Similarly, the identification strategy examining the effects of the labor reform use individual variation in the expiration dates of their contracts, and it seems very unlikely that the contract expiration dates

[52] If the variation in connections to home were driving the results, we would expect those with more connections to remit a larger share of any positive shocks to their income including observable ones. This is not consistent with the results in Appendix Table A.4 (column 6, Panel B).

which depend only on the start date of the contracts three years in advance are correlated with contemporaneous demand shocks of households at home.

8.2 Changes in Migrants' Preferences or Affinity over Time

Another possible explanation for the estimates of the returns to time in the UAE is that they reflect changes in the consumption patterns of migrants. Over time, migrants begin to acclimate to the higher prices for goods and services in the UAE or feel less affinity for family members at home. This mechanism leads them to keep more of their income for their own consumption in the UAE. This is consistent with the results of Table 8.[53] Under this alternative story, the observability of income does not matter and we should see any positive income fluctuations correspond to lower remittances the longer that a migrant remains in the UAE. Appendix Table A.3 shows that this is not empirically true; the signs on the interactions between time in the UAE (measured in months divided by 10 in column 1 or as an indicator for having been in the UAE more than 21 months in column 2) and log earnings are very small in magnitude and positive rather than negative. In other words, migrants do not remit less of all fluctuations in their income the longer that they stay in the UAE.

8.3 Loan Repayment

An alternative story is that migrants exploit information asymmetries in their earnings in the UAE but this asymmetry exists between the migrants and lenders. Under this scenario, migrants remit directly to lenders rather than their family members, and try to pay down their debt when they experience positive income fluctuations and less when they experience negative income fluctuations. This can be consistent with the results on home connections if lenders can verify migrants' claims about months with low earnings by contacting co-workers.

The remittances data include the purpose of the transaction with multiple options including family maintenance/savings, loan repayment, and investment. Across all transactions, the vast majority (96%) are for family maintenance/savings, suggesting that remittances are not sent directly to loan officers but to family members. However, it is possible that family members receive the remittances and in turn pay the loan officers.

Data collected in May 2015 by Suresh Naidu, Yaw Nyarko and Shing-Yi Wang over a sample of 195 Indian workers who interviewed for UAE construction jobs suggest that the average recruitment

[53] For this alternative story to be consistent with Tables 10 and 12, heterogeneity by individual type and home connections reflects very specific, unobserved differences across individuals in their consumption demands in the UAE rather than variation in the incentives and ability to hide income.

fee faced for a job placement in the UAE is 47,215 rupees (approximately USD$700 or 2585 dirham).[54] If the workers in our administrative data (who are in the UAE from 2009 to 2012) face similar fees and given that they remit an average of 1321 dirham per month (Table 1), they should be able to repay these loans in a few months. Figure 3 suggests that the negative relationship between time in the UAE and remittances persists for over for several years, even beyond the first standard three-year contract in the UAE. Thus, it seems unlikely that loan repayment alone can explain the evolution of remittances over time.

8.4 Savings Constraints in the UAE

Finally, it is possible that migrants follow a simple rule where they remit everything that they are not consuming. For example, this may be due to savings constraints in the UAE. Remittances are split between consumption of the household members and saving. This explanation is consistent with the results where remittances co-move with earnings. For this explanation to be consistent with the results on time in the UAE, we would need to further assume that migrants with positive income growth gain access to the financial system in the UAE over time (and begin saving in the UAE rather than in their home country) while migrants with negative income growth do not. However, this alternative story alone cannot account for results presented in Table 12 that show that heterogeneity in home connections alter the remittance patterns of migrants with positive time-earnings gradients. Given that migrants with more home connections have slightly initial higher earnings, we would expect them to have more access to the financial system in the UAE; instead of remitting less and saving in the UAE more, this group remits more over time.

9 Selection out of the Data

A key potential concern for the estimates presented in the paper is that selection of migrants out of the sample could affect the results. We address this concern by imputing earnings and remittances of individuals who leave the payroll sample using a method proposed by Manski (1990). The key idea is to examine whether the results are robust to fairly extreme assumptions about the individuals who are exiting the sample.

We make the assumption that the earnings of individuals in the periods in which they exit the sample would look like the 90th and the 10th percentile of their log earnings distribution. Similarly,

[54] The survey occurred in India over a sample of workers that had recently been interviewed by UAE construction firms for construction jobs.

we constructed imputed values for remittances by assuming that if they had remained in the sample, they would have remitted an amount equivalent to the 90th and 10th percentile of the distribution of their log remittances. This strategy maximizes the potential impact of sample selection on the estimates.

The baseline estimates that use the imputed values of remittances and earnings are displayed in Table 14. Column 1 presents the estimates where we assume that individuals who attrite from the data set would have had earnings and remittances in the 90th percentile, and column 4 presents the estimates were the attriters would have had earnings and remittances in the 10th percentile. The estimates are similar to each other and just slightly larger than the baseline fixed effects estimate presented in Panel A of Table 2. The stronger assumption is that individuals who leave the data would have 10th percentile earnings and 90th percentile remittances, or 90th percentile earnings with 10th percentile remittances. These estimates are displayed in columns 2 and 3, respectively. Under these assumptions, the earnings elasticity of remittances is smaller than when we ignore selection effects. However, the economic magnitude is still substantial; a 10% increase in earnings corresponds with a 2 to 2.5% increase in remittances. These estimates are significant at the 1% level. The other estimates presented in the paper are robust to addressing selection with this bounding exercise.

10 Conclusion

Using new high frequency data on earnings and remittances, we estimate the income elasticity of remittances. We investigate the impact of several specific changes in earnings of migrant workers on their remittance behavior. Our results show that the income elasticity of remittances is larger for income changes that are easier for families at home to observe or verify and for income changes that are negative rather than positive. Together, these results are not consistent with many leading models of remittances including a model of pure altruism or direct exchange. They are consistent with the model presented in this paper of income-sharing under asymmetric information.

These results have several policy implications. International migration represents an important opportunity for migrants to increase their income, and remittances are a large source of transfers for many households in developing countries. Understanding the motivations for why migrants remit can be important for policies that may affect the remittance behavior of migrants and for devising appropriate financial products for migrants. The results may be relevant in thinking about products that give migrants more control over the assets that they remit, such as those studied in Ashraf et al. (2014).

Migrants in the UAE are remitting the majority of their earnings each month. At the same time, their behavior reflects the idea that when given the opportunity, they prefer to keep more of the earnings that are hidden from their families. While we show some suggestive evidence that networks of workers from the same place in the home country may provide monitoring, more research is needed to fully understand the complex interplay between migrants and families at home. An important question is whether asymmetric information between migrants and their families leads to inefficient outcomes. One possible welfare consequence is that migrants may exert less effort in situations where additional effort may lead to situations that increase the observability of the migrant's earnings outcomes (such as promotions). More importantly, the inability to solve the asymmetric information problem fully may result in households being less willing to finance, or otherwise facilitate, the migration of one member.

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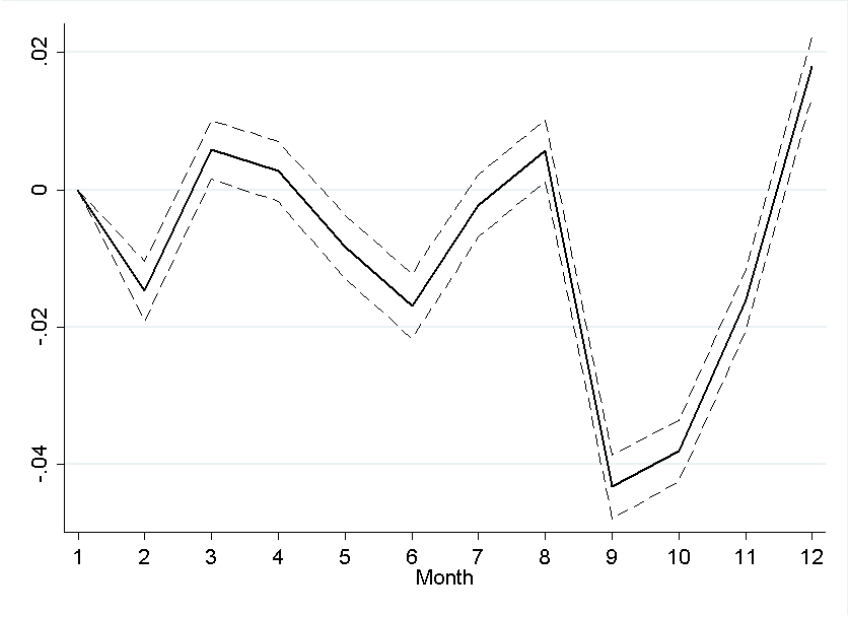
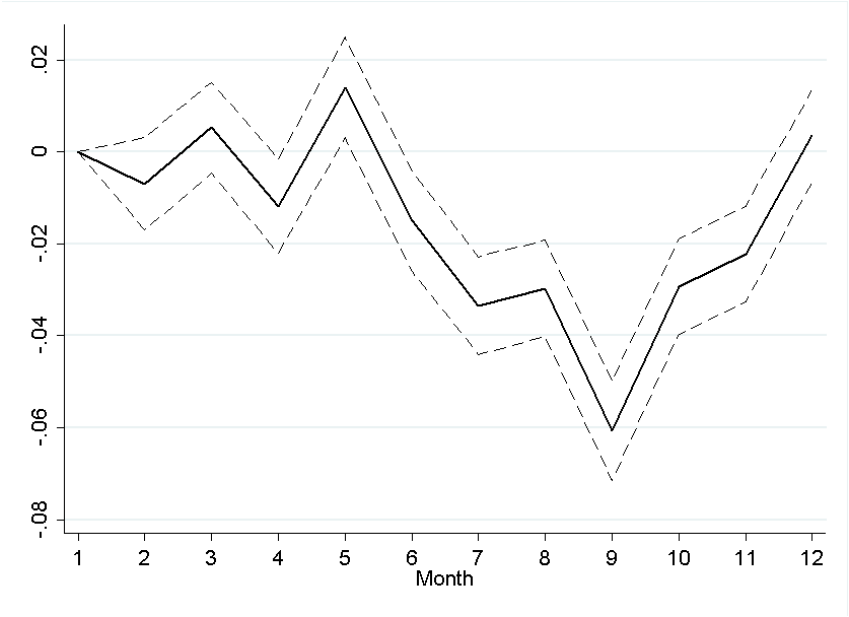
Figure 1: Coefficients from Estimates of Month on Earnings and Remittances

(a) Log Earnings

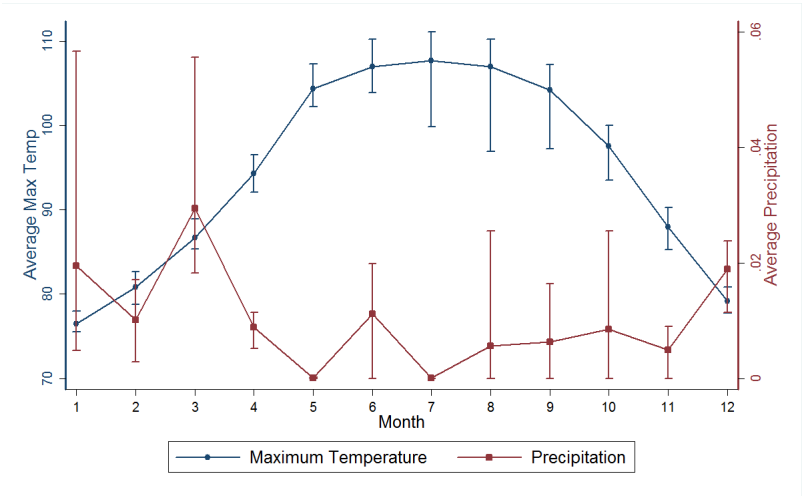


(b) Log Remittances



Notes: The estimated coefficients associated with each calendar month is given by the solid line. The regression includes individual fixed effects and year indicators. The omitted category in the regressions is January. The 95% confidence interval is given by the dashed lines.

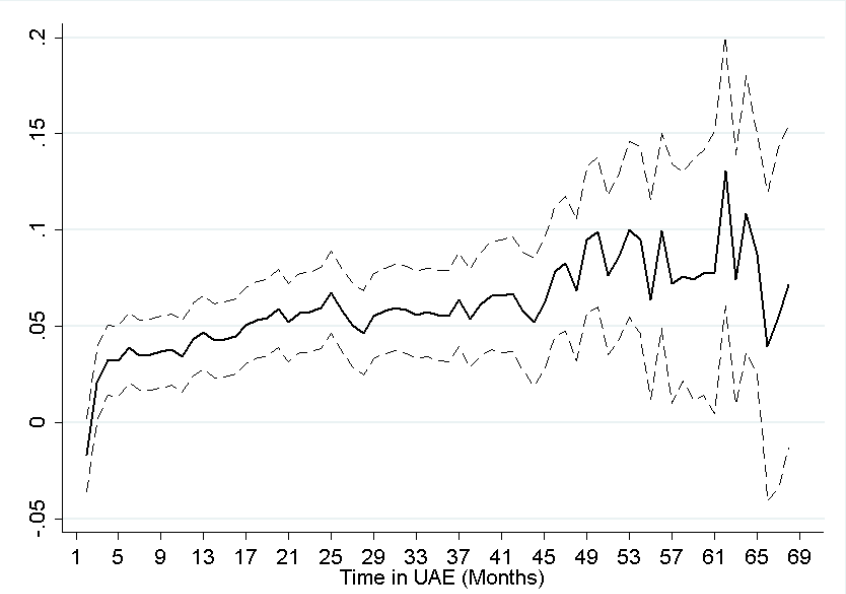
Figure 2: Average Precipitation and Temperature by Month



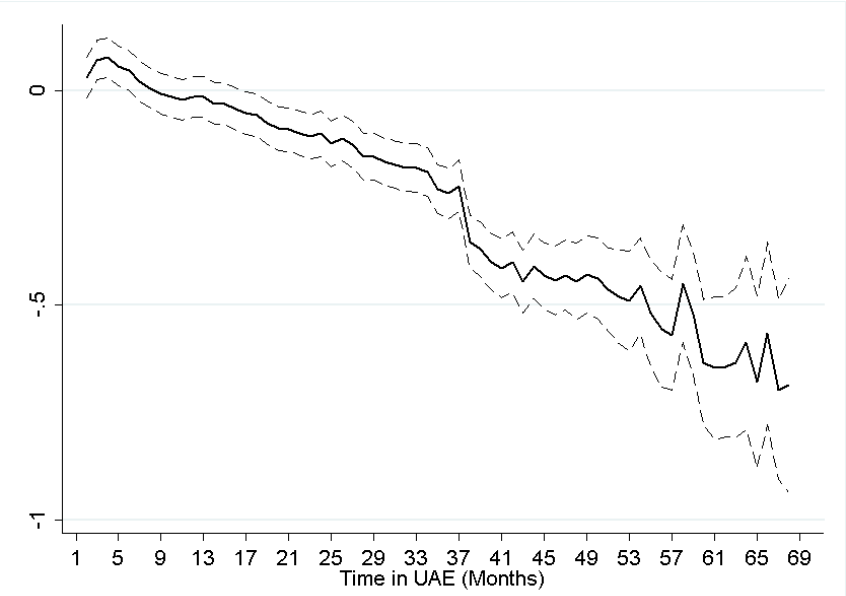
Notes: The dots give the monthly average across all days and cities of the maximum daily temperature. The bands give the value associated with city-level maximum and minimum monthly average. The squares indicate the monthly average precipitation across all days and cities. The corresponding bands provide the city-level maximum and minimum precipitation in that month.

Figure 3: Coefficients from Estimates of Time in the UAE on Earnings and Remittances

(a) Log Earnings



(b) Log Remittances



Notes: The estimated coefficients associated with each month of time in the UAE is given by the solid line. The regression includes individual fixed effects, year indicators and month indicators. The omitted category in the regressions is the first month of work. The 95% confidence interval is given by the dashed lines. The estimation sample is restricted to time in the UAE of up to 70 months.

Table 1: Summary Statistics

	Remittance Only Sample	Earnings Only Sample	Merged Sample	Unobserved Remittance as Zero
	(1)	(2)	(3)	(4)
Panel A: Financial Firm Variables				
Remittances	2668.2		1321.1	912.0
	(3069.5)		(1383.4)	(1305.4)
India	0.501	0.487	0.496	0.543
	(0.500)	(0.500)	(0.500)	(0.498)
Monthly Earnings		1433.7	1559.8	1474.1
		(1305.6)	(1214.9)	(1150.8)
Age		35.52	36.31	36.05
		(8.722)	(8.734)	(8.617)
Male		0.991	0.992	0.993
		(0.0926)	(0.0895)	(0.0845)
Observations	34997684	6521954	553647	927158
Panel B: Constructed Financial Firm Variable				
Outdoor Occupation		0.446	0.516	0.547
		(0.497)	(0.500)	(0.498)
Observations		2944509	269761	467419
Time in UAE		2.477	2.109	2.134
		(1.858)	(1.618)	(1.620)
Observations		5267546	537836	895480
Panel C: MOL Variables				
Muslim		0.340	0.323	0.313
		(0.474)	(0.468)	(0.464)
High Education		0.388	0.404	0.382
		(0.487)	(0.491)	(0.486)
Observations		5351152	551052	922782
Panel D: Within Contract Coefficient of Variation				
CV Earnings		0.278	0.295	0.295
		(0.195)	(0.173)	(0.173)
CV Remittances			0.700	1.124
			(0.478)	(0.583)
Observations		547572	112357	112668

Notes: Standard deviations in parentheses. Remittances and earnings are in real 2007 dirham.

Table 2: Fixed Effects Relationship between Log Earnings and Log Remittances

	(1)	(2)	(3)
Panel A: Merged Sample			
Log(Earnings)	0.325**	0.325**	0.326**
	[0.005]	[0.005]	[0.005]
Worker Controls	No	No	Yes
Year-Month Indicators	No	Yes	No
Observations	573132	573132	543655
Adjusted R^2	0.404	0.413	0.404
Panel B: Unobserved Observations as Zero			
Log(Earnings)	1.027**	1.004**	1.028**
	[0.012]	[0.012]	[0.012]
Worker Controls	No	No	Yes
Year-Month Indicators	No	Yes	No
Observations	957764	957764	904375
Adjusted R^2	0.176	0.182	0.175
Panel C: All Months Sample			
Log(Earnings)	0.403**	0.401**	0.398**
	[0.017]	[0.017]	[0.018]
Worker Controls	No	No	Yes
Year-Month Indicators	No	Yes	No
Observations	40969	40969	38739
Adjusted R^2	0.433	0.435	0.433

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. The regressions include individual fixed effects, year fixed effects and a constant term. Worker Controls allow for effects of age, Indian nationality, male and high education to vary by year. Panel A includes months in which both remittances and earnings are observed in the data. Panel B treats months in which remittances are not observed as zero remittances (so the dependent variable is the log of remittances plus one). Panel C is a subset of Panel A, limited to individuals for whom we observe both remittances and earnings for at least 12 months.

Table 3: Asymmetries in the Relationship between Log Earnings and Log Remittances

	First Diff		Fixed Effects		Fixed Effects	
	(1)	(2)	(3)	(4)	(5)	(6)
Log Earnings FD × Positive Δ_{FD}	0.082**	0.081**				
	[0.013]	[0.013]				
Log Earnings × Negative Δ_{FD}	0.259**	0.261**				
	[0.011]	[0.011]				
Log Earnings × Positive Δ_{mean}			0.252**	0.250**		
			[0.007]	[0.007]		
Log Earnings × Negative Δ_{mean}			0.309**	0.309**		
			[0.007]	[0.007]		
Log Earnings × Positive Δ_{trend}					0.251**	0.251**
					[0.007]	[0.007]
Log Earnings × Negative Δ_{trend}					0.304**	0.307**
					[0.007]	[0.007]
Year-Month Indicators	No	Yes	No	Yes	No	Yes
Observations	253028	253028	573132	573132	573132	573132
Adjusted R^2	0.018	0.019	0.558	0.565	0.558	0.565
F-test: $\beta_1 = \beta_2$ (p-value)	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. The regressions include $Positive\Delta$, year fixed effects and a constant term. Columns 2 through 6 also include individual fixed effects. The dependent variable is the first-difference of Log Remittances in Columns 1 and 2, and Log Remittances in Columns 3 through 6. Δ_{FD} defines the change in income relative to the previous period, Δ_{mean} defines the deviation of income from the long-run average, and Δ_{mean} defines the deviation of income from the long-run trend.

Table 4: Effects of Ramadan on Income and Remittances

	Full Sample	All Mos	Full Sample	All Mos
	(1)	(2)	(3)	(4)
Panel A: Impact on Log Earnings (First Stage)				
Ramadan	-0.029**	-0.026**	-0.013**	-0.011**
	[0.002]	[0.002]	[0.003]	[0.004]
Muslim × Ramadan			-0.042**	-0.040**
			[0.005]	[0.006]
Panel B: Impact on Log Remittances (2SLS)				
Log Earnings	2.085**	2.444**	3.697**	6.155+
	[0.154]	[0.213]	[1.343]	[3.161]
Muslim × Log Earnings			-1.069	-2.067
			[1.261]	[2.912]
Observations	524058	343415	216374	152666

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. Regressions include year fixed effects, individual fixed effects and a constant term.

Table 5: Effects of Ramadan on Income and Remittances by Muslim Share in Country of Origin

	Full Sample	All Months
	(1)	(2)
Panel A: Impact on Log Earnings (First Stage)		
Ramadan	-0.011*	-0.012*
	[0.005]	[0.005]
Ramadan X Muslim Share in Origin Country	-0.001	0.016
	[0.019]	[0.021]
Panel B: Impact on Log Remittances (2SLS)		
Log Earnings	2.883*	2.524+
	[1.375]	[1.315]
Log Earnings × Muslim Share in Origin Country	-0.005	-0.015*
	[0.009]	[0.007]
Observations	120261	83108

Notes: Sample restricted to non-Muslim workers. Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. Regressions include year fixed effects, individual fixed effects and a constant term.

Table 6: Impact of Weather Shocks on Income and Remittances

	Precipation	Extreme Rain	Temp > 100	Extreme Temp
	(1)	(2)	(3)	(4)
Panel A: Impact on Log Earnings (First Stage)				
Weather Measure	-0.006**	-0.010**	-0.006**	-0.012**
	[0.001]	[0.003]	[0.001]	[0.003]
Panel B: Impact on Log Remittances (2SLS)				
Log Earnings	1.676**	2.570**	1.760**	2.824**
	[0.293]	[0.862]	[0.451]	[0.782]
Observations	515137	515137	515137	515137

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. Regressions include fixed effects for year, city-month and individual and a constant term. Panel A presents the first stage estimates of the impact of weather measures on log earnings. Precipitation is measured in the z-score of the days with any rainfall in the month and average temp is measured as z-score of the number of days with average temperatures exceeding 100. Extreme rain and temperature are indicators for whether the weather realization is above the 80th percentile for that city and month. Panel B presents the two-stage least squares estimates of log earnings (instrumented by the weather measure denoted in the column heading) on log remittances.

Table 7: Impact of a Labor Reform on Income and Remittances

	(1)
Panel A: Impact on Log Earnings (First Stage)	
Post Reform X Post Expiration	0.040+
	[0.024]
Post Reform X Contract Expiration	0.035**
	[0.013]
Panel B: Impact on Log Remittances (2SLS)	
Log Earnings	1.078*
	[0.471]
Observations	43163

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. Regressions include year-month fixed effects, individual fixed effects and a constant term.

Table 8: Estimates of Time in the UAE on Income and Remittances

	Full Sample		First Contract Sample	
	(1)	(2)	(3)	(4)
Panel A: Impact on Log Earnings (First Stage)				
Time in UAE	0.017**	0.018**	0.018**	0.050**
	[0.002]	[0.003]	[0.003]	[0.005]
Time in UAE^2		-0.000		-0.008**
		[0.000]		[0.001]
Panel B: Impact on Log Remittances (Second Stage)				
Log Earnings	-5.701**	-5.616**	-4.392**	-1.531**
	[0.757]	[0.745]	[0.618]	[0.235]
Observations	494582	494582	448215	448215

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. Regressions include year fixed effects, month fixed effects, individual fixed effects and a constant term.

Table 9: Summary Statistics by Individual Type

	Changes over Time			Home State Connections		
	Negative	Positive	Diff	Less	More	Diff
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Individual Characteristics (Time-Invariant)						
Initial Contract Salary	1130.98	1182.72	-51.74*	1276.49	1299.07	-22.58*
	(1021.02)	(1037.71)		(971.51)	(1078.17)	
Initial Contract Hours	8.02	8.03	-0.01*	8.01	8.03	-0.01*
	(0.18)	(0.19)		(0.13)	(0.16)	
Initial Contract Length	34.13	33.35	0.79*	30.41	32.41	-2.00*
	(6.32)	(7.90)		(11.09)	(7.94)	
Initial Remittance	1163.08	1113.59	49.49	1039.88	973.97	65.91*
	(1007.40)	(983.03)		(963.12)	(874.54)	
Muslim	0.40	0.37	0.03*	0.18	0.20	-0.02
	(0.49)	(0.48)		(0.39)	(0.40)	
India	0.55	0.55	-0.00	0.96	0.97	-0.01*
	(0.50)	(0.50)		(0.20)	(0.16)	
Age	35.04	35.05	-0.01	35.25	35.05	0.20
	(8.63)	(8.62)		(8.83)	(9.01)	
Male	0.99	0.99	0.00	1.00	0.99	0.01*
	(0.10)	(0.10)		(0.03)	(0.08)	
Dubai	0.33	0.34	-0.01*	0.34	0.39	-0.04*
	(0.47)	(0.47)		(0.47)	(0.49)	
Observations	19188	18659		4741	5499	
Panel B: Time-Varying Variables						
Exit UAE	0.021	0.019	0.002*	0.025	0.021	0.004*
	(0.144)	(0.136)		(0.157)	(0.145)	
Observations	346684	284916		90199	125714	

Notes: Standard deviations in parentheses. * denotes significantly different at 5% level. The sample in Panel A includes one observation per person, while the sample in Panel B includes all observations per person.

Table 10: Asymmetries in the Effects of Time in UAE on Income and Remittances

	(1)	(2)
Panel A: Impact on Log Earnings (First Stage)		
Time X Neg_Changes	-0.078**	-0.076**
	[0.003]	[0.003]
Time X Pos_Changes	0.133**	0.135**
	[0.003]	[0.003]
Worker Controls	No	Yes
Panel B: Impact on Log Remittances (IV for Log Earnings)		
Log Earnings X Neg_Changes	1.303**	1.279**
	[0.067]	[0.068]
Log Earnings X Pos_Changes	-0.350**	-0.328**
	[0.053]	[0.053]
Observations	491170	466358
Panel C: Impact on Log Remittances (IV for interaction)		
Log Earnings X Neg_Changes	5.238*	6.080*
	[2.066]	[2.361]
Log Earnings X Pos_Changes	0.593	0.468
	[0.406]	[0.456]
Observations	487420	462973

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. Time in UAE refers to the number of months that they have been in the UAE divided by 10. Neg_Changes and Pos_Changes refer to individuals with negative and positive earnings gradients, respectively. In Panel B, Log Earnings is instrumented by time in the UAE where the first stage is in Panel A. In Panel C, Log Earnings is instrumented by time in the UAE and the two gradient types in the interaction are instrumented with the indicators for extreme oil prices. Regressions include year indicators, month indicators, individual fixed effects and a constant term. Worker Controls allow for effects of age, Indian nationality, male and high education to vary by year.

Table 11: Oil Prices and Earnings Outcomes

	Log Contract Salary (1)	Correlation between Earnings and Time (2)	I(Positive Correlation) (3)
I(Oil Price Above 80th)	0.026**	-0.011**	-0.013**
	[0.003]	[0.002]	[0.002]
I(Oil Price Below 20th)	-0.013*	0.009*	0.009*
	[0.006]	[0.004]	[0.005]
Observations	322022	322022	322022

Notes: Robust standard errors clustered by firm in parentheses. The independent variables are indicators for whether the oil price in the month that the worker's contract began was in the top or bottom 20% from 2003 to 2012. The regressions also include firm fixed effects, controls for the year and the month that the contract began. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively.

Table 12: Asymmetries in the Effects of Time in UAE and Home Connections on Log Remittances

	Less Connections	More Connections
	(1)	(2)
Panel A: Impact on Log Earnings		
Time in UAE × Neg_Changes	-0.105**	-0.094**
	[0.009]	[0.009]
Time in UAE × Pos_Changes	0.098**	0.132**
	[0.007]	[0.008]
Observations	58144	59928
Panel B: Impact on Log Remittances (2SLS)		
Log Earning × Neg_Changes	2.009*	4.189*
	[0.895]	[1.736]
Log Earning × Pos_Changes	0.117	2.077*
	[0.688]	[0.912]
Observations	53968	55085
Adjusted R^2	-0.203	-1.308

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. Regressions include year indicators, month indicators, individual fixed effects and a constant term. In Panel B, the indicator variables for whether the person has a negative or positive correlation between time and earnings are instrumented with indicators for whether the oil price was very high or low (above the 80th percentile or below the 20th percentile) in the month that the individual first entered the UAE, and Log Earnings is instrumented with time in the UAE.

Table 13: Instrumental Variables Estimates with Multiple Instruments

	Weather IVs		All IVs	
	Observable	Unobservable	Observable	Unobservable
	(1)	(2)	(3)	(4)
Log Earnings	3.343**	1.799**	1.664**	0.436**
	[0.423]	[0.314]	[0.244]	[0.024]
Observations	482500	482500	482500	482500
Hansen J Statistic	22.56***	0.411	118.46***	27.83***

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. Regressions include year indicators, month indicators, individual fixed effects and a constant term. The observable weather instruments (in column 1) are the indicators for extreme heat and precipitation. The less observable weather instruments (in column 2) are the number of days with any precipitation. All observable instruments (in column 3) includes the indicator for Ramadan in addition to the indicators for extreme heat and precipitation. All less observable instruments (in column 4) includes time in the UAE interacted with the positive and negative gradient types in addition to the number of days with any precipitation. The last row presents the Hansen J statistic testing for over-identification.

Table 14: Impact of Selection on the Relationship between Earnings and Remittances

	Log Remittances High		Log Remittances Low	
	(1)	(2)	(3)	(4)
Log Earnings High	0.391**		0.248**	
	[0.004]		[0.004]	
Log Earnings Low		0.203**		0.383**
		[0.004]		[0.004]
Observations	771635	771635	771635	771635
Adjusted R^2	0.435	0.423	0.428	0.439

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. Regressions include year fixed effects, individual fixed effects and a constant term. Missing values of remittances and earnings are imputed to have the 10th percentile in column 1 and the 90th percentile in column 2.

ONLINE APPENDIX - FOR ONLINE PUBLICATION ONLY

A Theoretical Appendix

A.1 Models of Altruism

Models of altruistic remittances posit that migrants get utility from the consumption of household members at home. We present a model that adapts Lucas and Stark (1985) and Rapoport and Docquier (2006). Consider a migrant who maximizes his own utility with respect to the amount remitted:

$$u_m = u[c_m(w - r), a_h u_h(c_h)] \tag{9}$$

where the migrant's consumption, c_m, depends on w, the migrant's earnings in the host country, less r, the amount remitted to the household at home. The altruism weight attached to the household at home is given by a_h.

Consumption of the household at home is given by $c_h = c(y + r)$ where y is the earnings of household members at home. A migrant chooses a level of r to maximize his utility, and two predictions result: $\partial r/\partial w > 0$ and $\partial r/\partial y < 0$. Given our data, one testable implication of the model of altruism is that remittances should rise and fall with the earnings of the migrant.[55] Under a model of pure altruism, remittances should move with income regardless of whether income is observable by others or not.

A.2 Models of Consumption Smoothing with Altruism

Models of altruism suggest that migrants treat the consumption of household members at home similarly to their own consumption in the host country (adjusted by an altruism weight). Under the permanent income hypothesis, migrants should attempt to smooth the marginal utility of consumption over short-run fluctuations in income (Friedman 1957, Carroll 2001).[56] The key empirical predictions of this model are that consumption should respond to unpredictable income shocks but not to predictable, transitory income changes. If remittances finance consumption of households at home, altruistic migrants should smooth their remittances over anticipated fluctuations in earnings.

A.3 Exchange Motives

Exchange-based models of remittances consider remittances as a method whereby migrants pay for some type of service at home, such as taking care of the migrants' children or elderly parents. Similarly, an exchange-based model may be such that remittances represent a repayment for the loans used to finance the migrant's international move or the migrant's human capital investments.

We present an outline from Rapoport and Docquier (2006) of the Cox's (1987) exchange motive model of remittance where migrants (and households at home) have no altruistic motives and migrants want to buy a service, X. The utility function of the migrant, denoted by m, and of the household, denoted by h, is given by $V^i(C^i, X)$ where $i = m, h$. The migrant's utility is increasing in X at a decreasing rate while the household's utility is decreasing in X at an increasing rate. The latter assumes that it is costly for the household to provide X and there is increasing disutility from this

[55] The other interesting implication is that remittances should fall with an increase in income of the household at home, but we do not have the data to explore this.

[56] The model relies on a number of assumptions, including that credit markets work perfectly such that individuals can borrow and lend at the same interest rate and quadratic preferences. Common extensions to the standard model relax some of these assumptions to allow for a failure of the credit market and buffer stock savings (Carroll 2001). We do not consider this idea in this paper because we do not observe cash-in-hand.

effort. For the migrant to participate in the exchange, the maximal amount that he is willing to remit, denoted by X, is such that: $V^m(I^m - R^{max}; X) = V^m(I^m; 0)$. Applying the implicit function theorem yields the result that R^{max} increases with the migrant's income. Like with the model of altruism, the exchange model predicts that remittances should increase with the migrant's income but that the observability of that income should not matter.[57]

B Data Appendix

B.1 Merging Payroll Disbursals and Remittance Transactions

We received hundreds of text files that represented two separate data sets on remittance transactions and payroll disbursals. The salary data is at the year-month level with occasional cases (less than 5%) in which the same individual receives multiple payments in a single calendar month. We aggregate those numbers to the total earned in that month. The remittance data is a transactions level data set and individuals can choose to remit at any frequency that they desire. However, the fee associated with remittances is a flat rate per remittance. The mean and median number of remittances per month in the data is one. Thus, in cases where there is more than one remittance in a calendar month, we aggregate those up to the monthly level to match with the salary disbursal data. Thus, the final data set is a panel of individuals at the monthly level.

The identifiers used in the salary data set are generated by the firm and called customer registration numbers. These numbers are also available for some observations in the remittance data, and we begin by linking remittance transactions and earnings disbursals using the employee registration number. Of the observations that remain unlinked, we next use the labor card identifier, which is a government issued identifier that is unique for every worker-contract, to match remittances and earnings. While the labor card identifer is not directly associated with earnings disbursals, we are able to link 95% of the employee registration numbers in the salary disbursal data set to an employees data set that contains their labor card identification number as well as some characteristics of the worker, such as age, country of origin and gender.

B.2 Merging the Payroll and Remittance Data with the MOL Data

Both the MOL data on labor contracts of migrant workers and the payroll processing records contain a UAE government issued identifier called the labor card id number. This numeric identifier is associated with each individual's contract. When workers change employer or sign a new contract with an existing employer, they receive a new labor card and a new labor card id number. We use this identifier to match the two data sets. We lose 107,698 individuals in the payroll processing data set who have missing, non-numeric or incomplete identifiers, driven by the fact that some individuals in the payroll processing data set do not provide their labor card id. Some individuals provide the company with their passport number or a driver's license, but the labor card id is used in the vast majority of cases. We are able to match 553,375 individuals in the payroll processing data with their contract information in the MOL data set. There are 25,883 individuals present in the payroll processing data that are not matched into the MOL data set. This reflects the fact that some migrant workers, including domestic workers and those working in the freezone areas of the UAE, fall under the jurisdiction of the Ministry of the Interior rather than the MOL.

[57] The exchange model has a distinct prediction from altruism; under the exchange model, remittances can increase with the incomes of the households at home.

Appendix Table A.1: Impact of Lags and Leads of Earnings on Log Remittances

	(1)	(2)	(3)	(4)	(5)
Log(Earnings)	0.323**	0.324**	0.334**	0.339**	0.335**
	[0.005]	[0.006]	[0.005]	[0.006]	[0.007]
Lag1 Log(Earnings)	0.044**	0.046**			0.051**
	[0.004]	[0.005]			[0.005]
Lag2 Log(Earnings)		0.023**			0.028**
		[0.005]			[0.005]
Lag3 Log(Earnings)		0.004			0.009+
		[0.005]			[0.005]
Lead1 Log(Earnings)			-0.028**	-0.031**	-0.033**
			[0.004]	[0.005]	[0.006]
Lead2 Log(Earnings)				0.018**	0.023**
				[0.004]	[0.005]
Lead3 Log(Earnings)				0.007+	0.011*
				[0.004]	[0.005]
Observations	523609	428683	540938	480236	363033
Adjusted R^2	0.404	0.403	0.404	0.399	0.396

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. The regressions include individual fixed effects, year fixed effects and a constant term.

Appendix Table A.2: Effects of Seasonalities on Income and Remittances

	Log Earnings		Log Remittances	
	Full Sample	All Months	Full Sample	All Months
	(1)	(2)	(3)	(4)
February	-0.015**	-0.012**	-0.007	-0.001
	[0.002]	[0.003]	[0.006]	[0.007]
March	0.006*	-0.001	0.005	0.003
	[0.003]	[0.003]	[0.006]	[0.007]
April	0.003	0.006*	-0.012+	-0.005
	[0.003]	[0.003]	[0.006]	[0.007]
May	-0.008**	-0.008*	0.014*	0.022**
	[0.003]	[0.003]	[0.006]	[0.008]
June	-0.017**	-0.018**	-0.015*	-0.006
	[0.003]	[0.003]	[0.006]	[0.008]
July	-0.002	-0.005+	-0.033**	-0.030**
	[0.003]	[0.003]	[0.006]	[0.007]
August	0.006*	0.004	-0.030**	-0.029**
	[0.003]	[0.003]	[0.006]	[0.007]
September	-0.043**	-0.040**	-0.061**	-0.059**
	[0.003]	[0.003]	[0.006]	[0.007]
October	-0.038**	-0.043**	-0.029**	-0.028**
	[0.003]	[0.003]	[0.006]	[0.007]
November	-0.016**	-0.022**	-0.022**	-0.020**
	[0.003]	[0.003]	[0.006]	[0.007]
December	0.018**	0.017**	0.003	0.007
	[0.003]	[0.003]	[0.006]	[0.007]
Observations	573132	359908	573132	359908
Adjusted R^2	0.715	0.704	0.391	0.360

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. Regressions include year fixed effects, individual fixed effects and a constant term.

Appendix Table A.3: Relationship between Log Earnings and Log Remittances by Time in the UAE

	(1)	(2)
Log Earnings	0.324**	0.323**
	[0.008]	[0.005]
Log Earnings × TimeinUAE	0.000	
	[0.003]	
Log Earnings × I(Time>21 Months)		0.003**
		[0.001]
Observations	543903	543903
Adjusted R^2	0.421	0.421

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. Regressions include year-month indicators, individual fixed effects and a constant term.

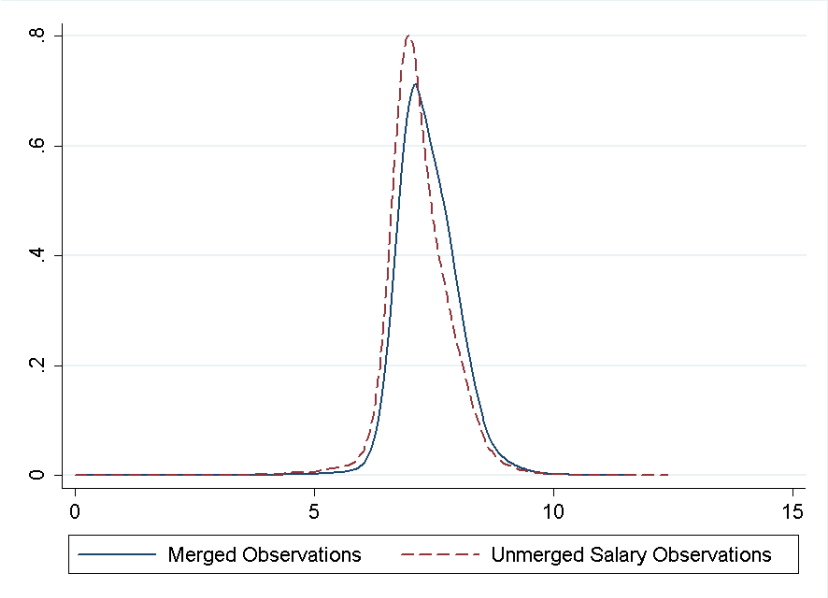
Appendix Table A.4: Home Connections and Remittance Behavior

	Ramadan	Precipitation	Extreme Rain	Temp > 100	Extreme Temp	Post Reform× Post Exp
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact on Log Earnings (First Stage)						
Variable	-0.015**	-0.008**	-0.028**	-0.008**	-0.004	0.077**
	[0.005]	[0.002]	[0.008]	[0.003]	[0.008]	[0.026]
Variable × I(Connections)	0.001	-0.003	0.002	0.004	-0.018+	-0.068
	[0.007]	[0.002]	[0.012]	[0.003]	[0.010]	[0.052]
Panel B: 2SLS Estimates of Log Remittances						
Log Earnings	3.600**	1.974**	1.977**	1.973**	1.977**	0.969*
	[0.819]	[0.645]	[0.689]	[0.630]	[0.704]	[0.403]
Log Earnings × I(Connections)	0.044	0.471	0.572	0.402	0.575	-0.074
	[0.032]	[0.607]	[0.825]	[0.423]	[0.558]	[0.050]
Observations	130734	128630	128630	128630	128630	7989

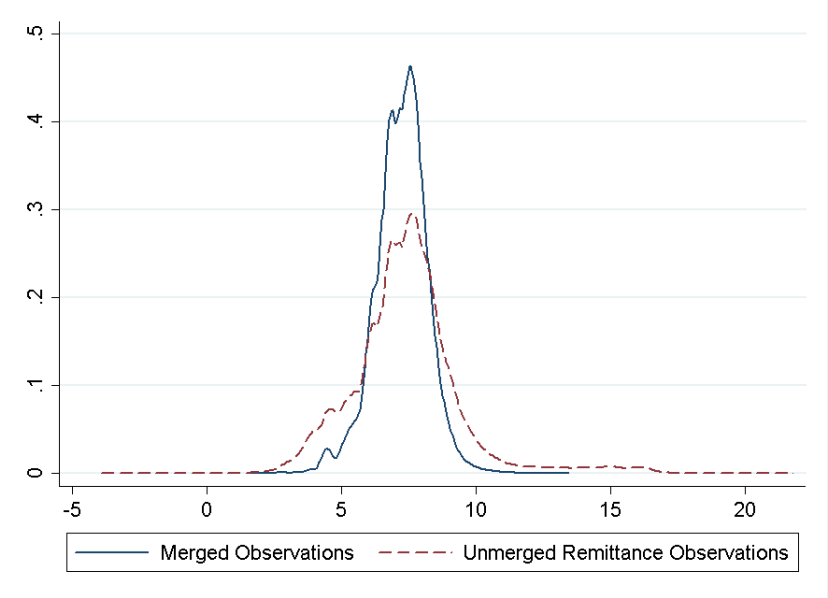
Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denote significance at the 10%, 5% and 1% levels, respectively. All regressions include individual fixed effects and a constant term.

Appendix Figure A.1: Kernel Density of Log Earnings and Log Remittances

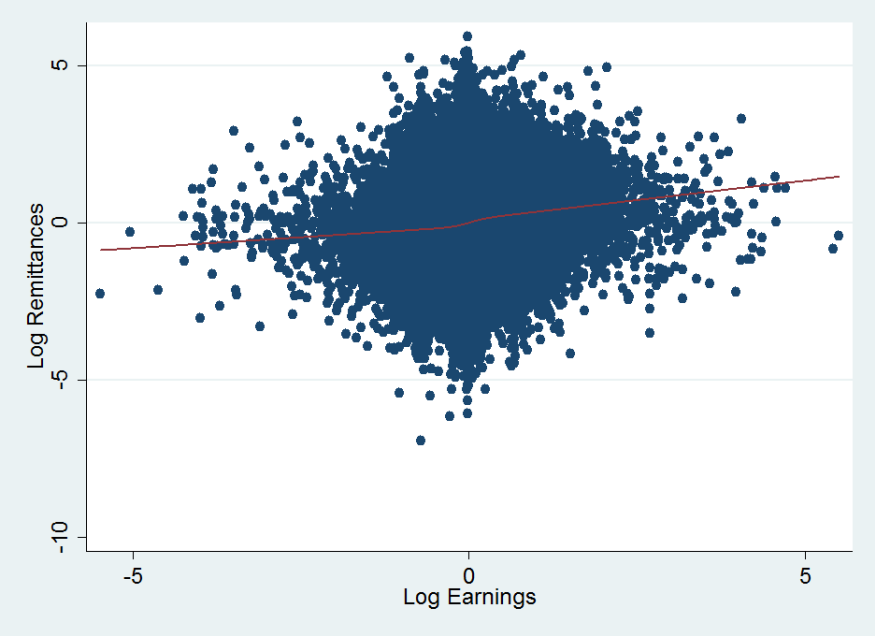
(a) Log Earnings



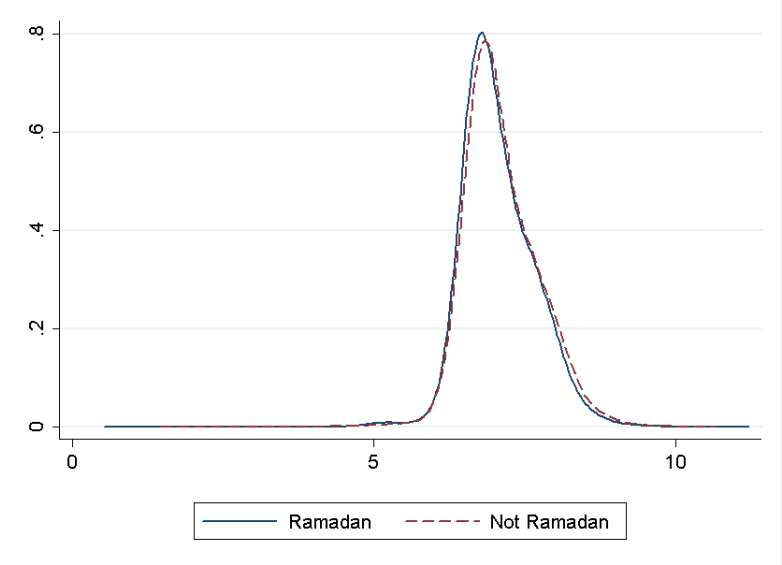
(b) Log Remittances



Appendix Figure A.2: Non-Parametric Relationship between Log Earnings and Log Remittanes



Appendix Figure A.3: Kernel Density of Log Earnings by Ramadan Months



Appendix Figure A.4: Histogram of Firms' Share of Workers with Positive Changes over Time