# How Do Remittances Respond to Income Fluctuations? Evidence from Matched Administrative Data[*]

Thomas Joseph      Yaw Nyarko      Shing-Yi Wang

IIM Udaipur      NYU      Wharton

October 13, 2014

**Abstract**

Using new administrative data matching remittance transactions and monthly payroll disbursals, we demonstrate how the fluctuations in earnings affect patterns of remittances among migrant workers in the United Arab Emirates. We estimate that the income elasticity of remittances is about 0.33. We show that patterns in remittances follow seasonal variation in earnings, particularly around the time of Ramadan. We examine two exogenous shocks to earnings, weather shocks and a labor reform. Remittances move with income for both of these shocks. Finally, we show that while earnings tend to increase the longer a migrant stays in the UAE, their remittances fall over time. All of the results are consistent with a private information model where remittances are viewed by the migrant worker as payments in an equity contract based on observable income. Our paper offers some insight into the motivations for remittances of migrant workers.

# 1 Introduction

Migrant remittances represent a large and growing share of international financial flows and sources of capital in developing countries. Estimates from the World Bank suggest that the flow of remittances by international migrants was valued at $325 billion in 2009. The value of remittances to developing countries has exceeded foreign development aid and is approaching the magnitudes of foreign direct investment. This suggests that international remittances may play a very important role for the economic growth and development of poor countries.[1]

Our paper examines how fluctuations in the income of migrants affect the amount that they remit. This paper contributes to the growing literature on the economic drivers of the remittance behavior of migrants (Dustmann and Mestres 2008, Lucas and Stark 1985, Rapoport and Docquier 2006, Yang and Choi 2007, Yang 2008). Our paper uses new data on remittances and earnings of migrant workers in the UAE to provide insight into the motivations for remittances. While some of the models that we examine, such as altruism, investment and saving, have already been tested in the literature, we offer new tests using a novel data set. We also consider new models where remittances may be viewed as payment for families financing the cost of migration.[2]

We are able to take a new approach to examining motivations to remit because we have access to a unique data set that offers high frequency records that include millions of remittance transactions. 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 of monthly earnings disbursals to 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.[3]

We apply several theoretical frameworks to understand the motivations for the remittance patterns of international migrants. We first consider a simple framework where remittances are pure altruism towards families at home, and where migrants get utility from the consumption of families

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[1]Recent research has demonstrated the benefits of remittance flows on the economic outcomes of households (Yang and Martinez 2005, Yang 2008).

[2]In outlining an agenda for important open questions on remittances and development, Clemens and Ogden (2014) emphasize the idea of financing migration as an important research agenda that is not well understood.

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

at home. This builds on theoretical and empirical work by Lucas and Stark (1985) on testing between altruism and self-interest. They test key predictions of a model of altruism, including the fact that remittances should move positively with the migrants' income and negatively with the household's income. While Lucas and Stark (1985) only has cross-sectional data from Botswana, we have a full panel data set.

Next, we draw upon standard models of consumption smoothing.[4] The permanent income hypothesis suggests that individuals respond differently to income fluctuations that are anticipated versus unanticipated and those that are permanent versus transitory. The main predictions of the model suggest that individuals are able to adjust saving and smooth consumption differently based on the type of shock to income. We examine whether there is evidence for remittance smoothing where remittances are treated as consumption or that migrants treat remittances as saving. The separation between whether remittances are saving and investment or current consumption is particularly relevant for the broader question of how remittance flows affect economic growth in developing countries. To our knowledge, we are the first paper to test whether migrants smooth remittances over various types of income fluctuations.

We also develop a new framework of asymmetric information between migrants and their families at home where remittances are treated as a payment on an equity contract that applies to the observable income of migrants. In this model, remittances should move with income differently depending on whether the income fluctuation is observable by the family at home or not. This is unique from related models of investment and strategic motives for remittances outlined in Rapoport and Docquier (2006). This idea is related to a literature that documents that differing preferences and private information between migrants and their families influence economic behavior. Ashraf, Aycinena, Martinez and Yang (2014), for example, find that migrants' preferences for saving and spending may differ from their families and this affects their savings behavior. They randomly vary the amount of control that El Salvadorean migrants and their families have over savings accounts in their home country, and find savings is increasing in the control that migrants have over the accounts.

We begin by documenting whether 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. This result can be consistent with many models. Thus, we test additional theoretical predictions to learn more about the mechanisms underlying these patterns.

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[4]A good overview is presented by Japelli and Pistaferri (2010).

First, we show that remittances move positively with seasonalities in earnings, which are public, anticipated and transitory. We find that Ramadan has a particularly large and negative impact on both earnings and remittances. Given that migrants can anticipate lower earnings during Ramadan, the decline in remittances can be explained in a few ways. It is possible that remittances are viewed as savings and are adjusted to smooth consumption. It is also consistent with the view that remittances are payments in an equity contract. It rejects the idea that remittances are consumption and smoothed over anticipated income fluctuations. While using seasonalities to test for the broader idea of consumption smoothing is common in the development literature (Paxson 1993, Chaudhuri and Paxson 1993, Jacoby and Skoufias 1998, Khandker 2002), we are first to test for remittance smoothing.

Next, we examine the impact of weather shocks on earnings and remittances. 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 (Hazianga and Udry 2006, Jacoby and Skoufias 1998, Paxson 1992, Wolpin 1982). We find that both earnings and remittances fall with this type of public, unanticipated, transitory shock. To further separate the models, we use a labor reform that increased the earnings of workers to examine the impact of an unanticipated, permanent shock on the remittance behavior of migrants. We find that both income and remittances move positively with this type of income change as well.

There is one type of income fluctuation for which we find that remittances move in an opposite direction from earnings: length of stay in the country. Migrants' earnings increase on average over their time in the UAE, while the average remittances decline. 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 the evolution of earnings over time may not be fully known by families at home. Our result that migrants' income increases over their experience in the UAE is consistent with the results in the literature on the assimilation of immigrants.[5]

Building on the idea that the returns to time in the UAE is private information, we examine two groups of migrants who appear identical at the time of their arrival in the UAE but differ based on the evolution of their earnings over time in the UAE. 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 also

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[5]See Borjas (1994) and LaLonde and Topel (1997) for reviews.

look at variation in the share of co-workers that are from the same home state to examine whether the private information effect is mitigated when there are co-workers who might know and report your earnings status to your family at home.

The results of the paper are consistent with the model where remittance moves positively with income fluctuations that can be fully observed by families at home but do not move much with positive income fluctuations that can be hidden. The results contribute to a new and growing literature that demonstrates that whether income is public versus private matters for intrahousehold outcomes (Ashraf 2009, Goldberg 2010, Jakiela and Ozier 2012).

# 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 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).

Foreign workers enter the United Arab Emirates on two to three year work visas that are tied with their work contracts with a specific employer.[6] The employer can fire migrant workers at any time, which corresponds with an almost immediate revocation of the work visa.[7] 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 UAE on a new work visa. Workers that leave before fulfilling a contract must pay for their own airfare home while the cost is born 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 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

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[6]Standard work visas were three years in length prior to 2011, and two years in length subsequently.
[7]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.

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.

The majority of migrant workers live in dormitory-like housing in labor camps. Given that several migrants share a single room, saving money in their living quarters in order to bring cash or other valuables back physically may not be a very secure option. According to data from the 2011 World Bank Global Findex survey of a randomly selected, nationally representative sample of about 1,000 individuals in the UAE, 78% did not save in a financial institution in the past 12 months. Given that this sample includes emiratis, who are UAE citizens, as well as migrants, this is likely to be an overestimate of the number of migrants that use financial institutions in the UAE to store savings. Thus, migrants are unlikely to save the earnings up over time in the UAE to bring cash and valuables physically back with them when they return to their home country either permanently or for a visit.

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.[8] 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 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 that 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 summarizes several simple frameworks for understanding the motivations that underlie the remittance behavior observed among migrants in the UAE. First, we consider a framework where remittances are altruism. Next, we apply the permanent income hypothesis to consider whether migrants treat remittances as savings or as consumption. Finally, we consider models that emphasize the idea that remittances are the result of a contract, either equity or debt, that finances the cost of

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[8]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.

migration.

## 3.1 Remittances as 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). Consider a migrant that maximizes his own utility with respect to the amount remitted:

$$u_m = u[c_m(w - r), a_h u_h(c_h)] \tag{1}$$

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:

$$c_h = c(y + r) \tag{2}$$

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.[9] Under a model of pure altruism, remittances should move with income regardless of whether income is observable by others or not.

## 3.2 Remittances as Savings or Consumption

Remittances may be viewed by migrants as a means to finance consumption of family members at home or a means for migrants to save.[10] To consider this possibility, we refer to the predictions of the classic model of the permanent income hypothesis (Friedman 1957, Carroll 2001). The key prediction is that the marginal utility of consumption is smoothed over short-run fluctuations in income such that:

$$E_{t-1} u'(c_{it}) = u'(c_{it-1}). \tag{3}$$

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[9] 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.

[10] The idea that the migrant values the consumption of family members at home and includes this consumption in his utility function is consistent with the previous model of pure altruism.

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.[11]

The key empirical predictions of this model are that consumption should respond to unpredictable income shocks but not to predictable, transitory income changes. Under the canonical version of the permanent income hypothesis, savings only responds to transitory changes in income and not to permanent ones. While we cannot directly observe the consumption patterns of the migrants in our sample, if we are testing the idea that remittances are savings, then we can test whether migrants smooth the difference between their monthly earnings and their monthly remittances. This also provides a test of the idea that remittances are viewed by the migrant worker as consumption. In this case, migrants should smooth their remittances over anticipated fluctuations in earnings. Finally, for fluctuations in earnings that are unanticipated and permanent, we should see a larger corresponding response in consumption than when the earnings fluctuations are unanticipated but transitory.

## 3.3 Remittances as Payments in Equity Contracts

Remittances might also be seen as a payment in an equity contract on observable income or a kind of tax on reported income of the migrant. To our knowledge, this concept has not previously been outlined in existing papers on the theory of remittances though it appears in models of non-unitary households. Let's assume that individuals earn two types of income, one type that they can hide from their families at home, $y_h$, and one type that is public and cannot be hidden from their families at home, $y_n$, such that their total income is given by:

$$y = y_h + y_n. \tag{4}$$

At least a fixed proportion, $\tau$, of public income must be remitted to the family at home. Financing international migration can be expensive and remittances may be payments on the equity contract where families help finance the costs of migration. We abstract away from how families abroad can enforce this tax or equity contract but migrants may face punishments including divorce or eviction from broader networks at home. Given that there is no path to citizenship, almost all migrants anticipate that they must return to their home countries eventually and may want to have the advantages of their family networks when they return. Assuming that the migrants' preferences over savings or the split of consumption across individuals differ from the households in the home country, this implies

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[11]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.

that remittances will move with income fluctuations that are public. In contrast, remittances should not move or may move less with positive changes in income that can be hidden from the family at home.

## 3.4   Remittances as a Debt Repayment

An alternative model where families help finance the migration of one family member is that remittances represent a loan repayment of the cost of migration. Unlike in the previous framework of an equity contract, the contract between the migrant and the other family members at home may be a debt contract. Thus, we may expect remittances, as repayment on the loan, to fluctuate with the income realizations of the migrant in the host country. As with the model of altruism, this type of model implies that the relationship between remittances and income should not depend on whether the income can be easily observed or not.

## 3.5   Summary of Testable Predictions

Table 1 summarizes the predictions discussed in this section. All of the models predict that remittances can move positively with some types of fluctuations in income. The model where remittances treated by migrants as consumption or savings suggest that the response of remittances to income fluctuations depends on several factors: whether the change in income is transitory or permanent and anticipated or not. We will be able to further distinguish the models by looking at income that is public versus private. The model where remittances are viewed as a payment in an equity contract on migrants' earnings (or a tax) suggests that remittances will move with observable income but not with income that can be hidden.

Seasonalities are predictable and observable. Under a model of consumption smoothing, we would expect remittances to be smoothed over these predictable fluctuations if remittances are viewed as consumption. Under the equity model, given that seasonalities are observable, remittances will move with them.

Weather shocks, including rainfall and extreme heat, offers a type of income shock that is unanticipated and transitory. Theory suggests that consumption and saving should fall in a period with an unanticipated, transitory declines in income. Assuming weather shocks are also easy to observe, the equity model implies that remittances should move with earnings fluctuations from weather shocks.

A co-movement between remittances and the previous two types of income fluctuations can be consistent with both the equity model and a model of consumption smoothing where remittances

are viewed as savings by migrants. A permanent, unanticipated shock to income provides a way to differentiate between the two models. For this, we examine a labor reform that shifted up workers' earnings to a new, higher level.[12] If remittances are treated as a mechanism for saving, a permanent, unanticipated shock to income will have no effect on saving. For changes in income that are unanticipated and permanent, the permanent income hypothesis further suggests that consumption should increase and the elasticity of this response should be greater than the unanticipated, transitory shock.

We also consider the idea that the returns to time in the UAE may be a viable unanticipated and permanent change to migrants' income in the UAE. The key with this type of change is that it may be less observable by families at home than the public income shock associated with the national labor reform. Given that on average, earnings increase with time in the UAE, remittances should also increase with time in the UAE if they are viewed as consumption. If remittances are viewed as savings, then remittances should not change with time in the UAE. Finally, to the extent that migrants can hide positive returns to experience, the equity model where remittances are a dividends payment on observable earnings predicts that remittances will not increase with returns to time in the UAE.

Next we exploit heterogeneity in the returns to time in the UAE. Some migrants experience a positive permanent change and other a negative one. The private information model of remittances suggests that migrants will not reveal positive returns to time to their families at home but may 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 equity model and not under the models of pure altruism, consumption, saving or loan repayment.

## 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.

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[12]While we consider this a type of permanent income shock, it can only last as long as workers stay in the UAE and it is important to note that workers cannot stay in the UAE forever. However, workers can continue to re-sign multi-year contracts and remain working in the UAE for decades. The vast majority of workers (over 90%) remain in the UAE after their first multi-year contract expires.

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. 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.[13] There are on average 17.6 monthly salary observations per worker. A key advantage of the data is that they represent the actual income payment transferred 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. This is not a major concern for the analysis in the paper because the value of in-kind benefits is very unlikely change month-to-month over a worker's contract with an employer; 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 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.

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 A. 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 an identifier generated by the financial firm. For salary disbursals and transactions that are not linked using the customer registration

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[13]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.

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

We merge together the payroll and remittances data with the data from the Ministry of Labor using the labor card identification number.[14] We are able to match just over 80% of the observations in the payroll data with the MOL data.[15] 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.

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[14]See Appendix A for more details on matching the Ministry of Labor data to the financial transactions data from the private firm.

[15]See Appendix Figures A.1 and A.2 in Naidu, Nyarko and Wang (2014) 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.

## 4.3 Summary Statistics

Column 1 of Table 2 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.[16]

Column 2 of Table 2 presents characteristics of the workers for which we have salary data. Workers in this sample earn an average of 1433 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 35 years old. The data contained written information on workers occupations, which were coded using the Standard Occupational Classification (SOC) system by at least two research assistants.[17] We then categorize outdoor occupations as construction, grounds maintenance, and farming. The remainder, including jobs in manufacturing and service, are categorized as indoor occupations. About half of the sample works in jobs that are likely to be outdoors, mainly construction.

Time in the UAE (in months divided by 10) is calculated using the first job that the worker had in the UAE based on data from the Ministry of Labor. There are two demographic variables available 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 than intermediate education, where intermediate is a category between completing primary school and secondary school.

Panel D presents the coefficient of variation for earnings and remittances within the duration of a work contract.[18] 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 initial

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[16]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.

[17]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.

[18]Unlike the other panels of the table, this panel includes one observation per worker contract.

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 2. 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.[19] The average salary in the merged sample is higher than in the full payroll sample by about 120 dirham (33 USD) per month.[20] 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. 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 are slightly lower than in the sample with earnings only.

Analysis with the merged sample of positive observations of both remittances and salary requires the assumption that months in which observations of either salary or remittance information (or both) are missing 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.[21] Many observations of remittances in the data contain neither a customer registration number or a labor card identification number. 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.

However, another possibility is that when salary or remittance is not observed in a month for an individual, this reflects the fact that the individual was not paid or did not remit. In other words, it may be more accurate to treat some of the missing observations as zero rather than missing. This may be particularly likely to be true for remittances where individuals may not remit every month. Informal conversations with foreign workers in the UAE suggest that they tend to remit once per month after

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[19]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.

[20]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 UAExchange for remittances have slightly higher earnings than other individuals employed in firms that use UAExchange for payroll processing.

[21]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.

receiving their paychecks, but our observed data suggest that individuals remit less frequently than once every month.

We construct an alternative measure of salary where we replace the measure of salary in months for which an individual is not observed to receive a salary disbursal with zero. This is only done for months in which the individual receives a salary in both the previous calendar month and the consecutive calendar month. Observations are kept as missing if the entire firm does not disburse a salary in that month (as this suggests that they may have chosen to pay salaries out through another method that month). Similarly, we also construct an alternative measure of remittances where we replace the value of remittances in months for which no remittance transactions are observed in the data with zero. This is only done for months between the time in which the first and last remittance transactions are observed in the data. This approximately doubles the total number of matched observations relative to the sample that is matched by positive observations of remittance transactions and salary disbursals.

Column 4 of Table 2 shows the characteristics of the sample with unobserved observations of salary filled in as zero. Many of the characteristics of this sample are similar to the other merged sample in terms of age, gender, firm size, Indian nationality, religion and tenure. The average salary for this sample is 1561 dirham per month and the average amount remitted per month is 1326 dirham. Finally, column 5 shows the summary statistics when we assume that unobserved observations of remittances are zero. In this scenario, migrants remit about 60% of their income.

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

The results are presented in Table 3. All the regressions include for individual fixed effects, and

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year fixed effects. The standard errors are clustered at the individual level.[22] 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 earn anything in months without a salary disbursal. Panel C shows the results with the sample where the migrant does not remit anything in months where no remittance is observed in our data.

Column 1 of Table 3 (Panel A) presents the fixed effects estimates of the relationship between salary and remittances in the sample in months where either remittances or salary are not observed are dropped. 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 time-varying effects of worker characteristics. Thus, in the results in the remainder of the paper, we focus on the parsimonious specification with individual fixed effects.

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 shocks 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.[23]

Panel B displays the fixed effects estimates that correspond with the sample in which the months where salary disbursal is not observed are treated as months in which earnings equal zero.[24] The coefficients drop substantially. Within-person changes in earnings of 10% map into 0.5% higher remittances. However, the results still suggest that fluctuations in earnings month-to-month correspond positively to changes in the remittance behavior of migrant workers.

Panel C shows the estimates in which unobserved remittance 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 remit-

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[22]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.

[23]This may be a reasonable assumption. 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.

[24]In the regressions in Panels B and C, the explanatory variable is the logarithm of earnings plus one. The results are almost identical if we use the inverse hyperbolic sine.

tances 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.

The results suggest that month-to-month fluctuations in earnings correspond with fairly large changes on the amounts that migrant workers remit each period. These results are consistent with a number of models of remittances. We present a new estimate of the income elasticity of remittances based on high frequency, administrative data. These estimates may be of interest to policy-makers who are interested in leveraging remittances as a mechanism of improving the well-being of households in developing countries. It provides an estimate of how remittances would respond to policies in more developed countries that affect the earnings of migrants.

One limitation of our data is that we need to make some assumptions regarding the implications of months in which we do not observe earnings or remittance transactions. It is reassuring that the positive relationship between month-to-month variation in earnings and remittances persists across several assumptions about months in which payroll disbursal and remittance transactions are not observed. The remaining analyses in the paper use the sample limited to observations where both earnings and remittances are observed.

# 6    Seasonalities

This section explores whether some of the fluctuations in migrants' earnings can be explained by seasonal variation in labor demand and whether remittances move with these seasonal, anticipated fluctuations in earnings. 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.[25] The dotted lines give the 95% confidence interval. 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 on are multi-year contracts, we look at the sample with all 12 months to address the possibility of seasonal selection. 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. There are smaller dips in earnings of around 1.5% in

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[25]Appendix Figure A.2 shows the average of the logarithms of earnings and remittances by month. Unlike the regression coefficients, these estimates do not remove individual and year fixed effects. The general patterns with the large troughs in autumn are similar to those shown in Figure 1.

February and June. Earnings peak in December when they are almost 2% higher 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 not mimic the pattern in earnings. Remittances decline fairly steadily from May to September. Similar to earnings, remittances are lowest in September.

## 6.1 Ramadan

The most stark seasonal pattern in earnings occurs in September and October, and remittances are also are their lowest point in September. The most likely explanation for this result 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.[26] 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 productivity 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 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 focus on the impact of the timing of Ramadan on earnings and remittances. The measure for Ramadan is lag of the number of days of Ramadan in the month (divided by 10).[27] 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 10 days of Ramadan is associated with 1.2% lower earnings in that month relative to months without Ramadan. Restricting the sample to individuals for which we have data covering the twelve months does not have much effect on the estimates. Interestingly, the magnitude of the impact of Ramadan on remittances is about twice as large. All of the estimates are significant at the 1% level.

Panel B makes use of the fact that religion is available in MOL database. We look at the interaction of the months covered by Ramadan as an indicator for whether the worker is Muslim.

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

[27]Appendix Table A.4 presents results where Ramadan is an indicator variable that equals 1 if the lag of Ramadan overlaps with at least part of the month.

While aggregate productivity falls during Ramadan, we expect the productivity 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. Ten days of Ramadan reduces the earnings of non-Muslim workers by about 0.6%. The impact of Ramadan is much larger among Muslims, who experience an additional 1.8% drop in earnings on top of that during the holiday compared to their non-Muslim counterparts. Non-Muslims reduce the amount of their remittances by around 2% during Ramadan. Muslims further reduce the amount that they remit by an additional 1.4% and this is significant at the 5% level. Workers can anticipate the earnings reductions associated with Ramadan, but they still reduce their remittances.

Part of the difference in the effects on remittances between Muslims and non-Muslims may stem from differences in consumption demand either by families at home or by the workers in the UAE rather than declines in the migrants' income during Ramadan. Another possibility is that remittances and earnings fall because Muslims are more likely to return home to visit for this holiday. The assumption would have to be that they are only paid for part of the month because they are returning home for part of the month, and that they remit a smaller amount because they are carrying cash home with them. To test for the possibility that consumption demand by workers' families or travel by migrants is driving the results, we break down the estimates by the top three countries of origin in Table 5. The estimates for India, Bangladesh, and Pakistan are shown in Panels A, B and C, respectively. More than 70% of Pakistani and Bangladeshi migrant workers in the UAE are Muslim whereas about 15% of Indians are Muslim. Given that individuals from Bangladesh and Pakistan are much more likely to be Muslim than Indians, it is not surprising that the declines in earnings are larger for migrants from these two countries. We also see some variation in the declines in remittances across these countries, but they are negative and significant for all three countries. It seems reasonable to assume that consumption demand around Ramadan varies across these three countries, especially given that India has a much lower share of Muslims in the data. Thus, this provides some additional assurance that the results are not being entirely driven by seasonal demand rather than by the impact of Ramadan on earnings.

The overall results suggest that workers do not smooth the amount of their remittances over time. According to the traditional version of the permanent income hypothesis, these results reject the idea that migrants view remittances as consumption that they would like to smooth but may be consistent with the idea that remittances are treated as saving. These results are also consistent with altruism and with the private information model.

# 7 Weather Shocks

There is 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 temperatures 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.

Figure 2 displays the average maximum temperature in Fahrenheit and the average precipitation in inches across the months in the data. The dots and the squares give the average across cities and days in the month. 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 the deviations of the weather outcome in that city and month.

We consider whether worker productivity, and their corresponding earnings, decline when the weather is extremely hot or when it rains. These weather shocks may affect the productivity of workers who are working outside. Many migrant workers are employed in the construction sector which is very likely to be affected by rain and heat. Assaf and Al-Hejji (2006) summarizes studies demonstrating the negative impact of rain and heat on productivity in the construction sector.

To estimate the impact of weather shocks on the outcomes of migrant workers, we include city by month fixed effects. The weather measure represents the deviation of a city's weather realization in that month from the average weather realization experienced in that city in that month. Thus, we remove the impact of seasonalities and focus on weather shocks that deviate from standard seasonal patterns in rainfall and temperature.

The results are presented in Table 6. The independent variable is the shock in average precipitation in Panel A and the shock in average maximum temperature in Panel B. The odd columns present the results for the full sample of workers and the even columns present the results with the interaction of the weather shock with an indicator for whether the worker is in an outdoor occupation. Appendix Table A.3 shows the results where the independent variables are measured in the shocks to the days of rainfall and the days where the maximum temperature fell into various ranges. The results are similar with measuring weather shocks in days per month rather than average units (of heat or rainfall) per month.

The estimates in Panel A indicate that rainfall shocks correspond with a reduction in earnings. A standard deviation increase in precipitation corresponds with a 1% fall in earnings and a slightly smaller response for remittances. As shown in the odd columns of Panel B, increases in the shocks to maximum temperature also reduce earnings and remittances. A standard deviation increase in the maximum temperature corresponds with a 4% decline in earnings and a 12% drop in remittances.

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 the channel of weather. For example, in very hot temperatures, workers may prefer to pay to eat at air-conditioned restaurants rather than at cheaper restaurants. The next set of results help isolate whether the impact of weather shocks on remittances is primarily driven by how the weather shocks affect earnings in that month. We examine heterogeneity in the impact by whether the individual is working outside in the even columns. The negative effect of rainfall shocks on earnings is significantly larger for outdoor work as compared with indoor work. The interaction is negative but not significant at the standard levels for remittances. While higher temperatures lead to significantly lower earnings and remittances for workers in indoor positions, the negative effect is significantly larger for those working outdoors. Overall, these results support the idea that the mechanism of the weather shocks is that it reduces the amount of time that workers can be productive outside.

The results suggest that remittances fall in response to these types of unanticipated, transitory income shocks. Thus, these results are consistent with the permanent income hypothesis but cannot help distinguish between whether remittances are viewed more as consumption or as saving. Furthermore, the results are consistent with the altruism model and the model of equity contracts.

# 8 Labor Mobility Reform

We exploit a labor reform that was announced in December 2010 and implemented in January 2011 to examine the impact of a positive, unanticipated, permanent income shock on remittance behavior. 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 (2014) 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.[28] 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 contract expires and after the implementation of the reform, we can identify the causal impact of the reform with this 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 and individual fixed effects. The estimates of $\beta_1$ and $\beta_2$ 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. The first column 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

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[28]See Naidu, Nyarko and Wang (2014) for additional details on the reform, the estimation strategy and the robustness checks.

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the worker's contract expired.[29] We see that remittances also increase as a result of the reform. They increase by about 12% in the three months after the worker's contract expires, and by 6.5% in the month of the worker's contract expiration. While the estimates for remittances are larger in magnitude than for earnings, they are not significantly different from the earnings effects.

While the previous results on the response of remittances to weather shocks and to seasonalities are consistent with a model of consumption smoothing where remittances are treated as a type of saving, these results do not support the hypothesis that workers adjust remittances to smooth their own consumption in the UAE. We see remittances increase with this permanent shock to income, contrary to what a model of consumption smoothing where remittances are saving would predict. This is consistent with the theory that remittances are a dividend payment on observable income and the model of altruism.

## 9    Time in the UAE

### 9.1    Empirical Strategy

So far, the income fluctuations that we have examined have been shocks that are likely to be publicly known. 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:

$$logY_{it} = \beta_0 + \beta_1 TimeinUAE_{it} + \gamma_i + \delta_T + \epsilon_{it} \tag{6}$$

where the dependent variable is either the logarithm of earnings or remittance of person $i$ in month $t$. We are interested in the coefficient, $\beta_1$, 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 relationships between time in the UAE and earnings and between time in the UAE and remittances are 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

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[29]The magnitude of the effect is slightly different from those reported in Naidu, Nyarko and Wang (2014) because we restrict the sample to those for whom we also have remittance transaction information, but the direction of the effect is the same.

country are driven by selection into who stays (Borjas 1999). We do several things to address this concern. 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 born 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 10.

One advantage of our data is that the information about time in the UAE within the firm is based on administrative records from the MOL on workers' first employment visas in the UAE. Unlike analyses that utilize survey data, the issue of measurement error is unlikely to be a large concern. While time in the host country is likely to be highly correlated with employer tenure, we separate the effects of firm tenure and time in the UAE in Appendix Table A.5.[30] For the purposes of our analysis, however, it is not important if the returns that we capture are specifically the returns to experience in the country rather than within the firm.

## 9.2    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 are presented in Panel A of Table 8. Panel B displays the same estimates for the sub-sample of migrants in their first labor contract in the UAE. According to the linear specification, controlling for time-invariant characteristics

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[30]*Tenure* is defined as the number of months (divided by 10) that individuals have spent at their current firm. The ability to identify both time in the UAE and firm tenure is driven by workers who change employers and for whom both of their employers are in the payroll processing data. Controlling for tenure does not have much effect on the relationship between experience in the UAE and earnings or remittances.

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 and in the first contract-only sample are almost identical.

The next two columns of Table 8 display the corresponding results where the dependent variable is the logarithm of remittances. The relationship between time in the UAE on remittances is negative. The linear specification suggests that each additional 10 months of tenure leads to a 9.6 percentage point decline in the amount remitted. The quadratic specification suggests a slightly smaller impact of an additional 10 months of time in the UAE (8.3%) compared to the linear specification. The impact of time in the UAE on remittances is slightly smaller when we limit the sample to those in their first contract.

The previous results with seasonalities, weather shocks and the labor reform have shown that these events cause remittances to move in the same direction as income. 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 two of the models discussed. It is consistent with a model where remittances are viewed as saving, and saving declines when permanent income rises. However, a permanent increase in income associated with the labor reform did not lead to the same fall in remittances that we see here. Thus, the results so far are supportive of the model of remittance payments acting as a dividend payment.

## 9.3 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 that 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 by a shift in hours or wages where good workers are given more overtime or higher wages.[31] Second, this correlation is between real earnings and time and workers' earnings 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.

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[31]We do not observe hours worked and cannot test this idea directly.

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:

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

where we include the interaction between time in the UAE, denoted by $TimeinUAE$, and an indicator for whether the person experienced a positive or negative correlation between time in the UAE and earnings, denoted by $I(PosChange)$ and $I(NegChange)$, respectively.[32] More specifically, the correlation is calculated with the full earnings sample as the within-person correlation coefficient between all of the observations of time and earnings for individuals that had three or more months of earnings data. We also include individual fixed effects and indicators for month and for year. The coefficient, $\beta_1$, 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, $\beta_2$, provides the impact of each additional 10 months for individuals for whom the correlation is positive.

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.

We consider this by comparing individual 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 and column 2 to individuals whose earnings increase over time. 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 at 0.12 months (less than 4 days). Those who earnings rise over time start with a contract salary that is about 3% higher than those who earnings fall over time. The difference in average contract length is less than one month. There are no significant differences between the two groups in their demographic characteristics or their initial remittance. 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

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[32]These variables are defined by whether the raw correlation between earnings and time in the UAE within the individual is positive or negative. The individual must have at least three observations of salary for this correlation to be calculated.

determined by the screening process of firms in addition to the pool of applications that 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 1.5% 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.3 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 50%. This suggests that the positive or negative trends over time in earnings usually occurs 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.

When the dependent variable is the logarithm of earnings, by construction $\beta_1$ must be negative and $\beta_2$ must be positive. This estimation provides magnitudes of the relationship between earnings and time that are useful for evaluating the effects on remittances. The results are presented in the first two columns of Table 7. 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 10% 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 11% increase in their wages.

The next two columns of Table 10 provides the estimates of equation 7 with the logarithm of remittances as the dependent variable. For individuals with a negative correlation between time and earnings, remittances fall the longer the migrant stays in the UAE. Each additional 10 months in the country corresponds with a decline in remittances of around 11%. This estimate is roughly similar to the impact on earnings over time for this group. However, the relationship between remittances and time looks quite different for individuals with a positive time-earnings profile look quite different. While time in the UAE increases the total earnings of this group, more time spent in the UAE leads to very little change in their remittances. An additional 10 months corresponds with 1.5% less remittances for individuals whose earnings grow over time but this estimate is not significantly different from zero with the inclusion of time-varying worker controls. In other words, while they earn more over time, they remit the same amount as the time that they spend in the UAE increases. This implies that the share of income that is remitted declines 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, 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 models of remittances as altruism, consumption, saving or debt payment.

## 9.4 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.[33] 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. 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 of 30%.

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 less connections within their firm to their home state in the last three columns of Table 9. For most of the 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 because the sample sizes are so large, 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 10%. However, the bias may work in the opposite direction as those with less 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 less connections to their home state within their firm.

We examine the impact of time in the UAE by the level of connections in Panel A of Table 11.

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

The impact of time in the UAE on earnings is quite similar regardless of whether an individual has more or less connections with their home state. This provides additional reassurance that differences in the level of home connections is not driven by unobserved characteristics of the individuals. Every 10 months, their earnings increase by about 3% and this is significant at the 1% level. On average, those with fewer connections remit less over time in the UAE. They remit 2.6% less every 10 months and this is only statistically significant at the 10% level. The magnitude of the effect is smaller for those with more connections and the effect is no longer significant at the standard levels. While those with more or less home connections experience similar declines in income over time, those with fewer connections to home at work remit less over time than those with more home connections.

In Panel B, we present the impact of time in the UAE on the three outcomes by both home connections and whether the individual's earnings increase or decrease over time. In columns 1 and 2, the relationships between time in the UAE and earnings for positive and negative changers are not significantly different for those with more or fewer home connections. The results in columns 3 and 4 are particularly interesting. They show that remittances decline significantly over time regardless of the degree of home connections for workers whose salaries decline over time. However, for workers whose salaries increase over time, remittances increase only for those who have more connections. For individuals with fewer connections, the magnitude of the effect is much smaller and not significantly different from zero.

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 state maintains the affinity that migrants have with their families over time. The latter interpretation is consistent with the fact that among individuals whose earnings fall over time, having more connections leads to a smaller drop in remittances than those with fewer connections. However, this difference is not statistically significant. These results provide additional support for the theory that the best model for the remittance behavior of migrants in the UAE is one where remittances are viewed as a dividend 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 long-run changes in income to their families.

# 10 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 that 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, 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 12. 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 Table 3. The stronger assumption is that individuals who leave the data would have 10th 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. Addressing selection with this bounding exercise has the largest impact on the estimates of the impact of time in the UAE on remittances. This is not surprising as those that remain in the UAE for longer amounts of time are likely to be different from individuals that choose to exit the country. We display the impact of time in the UAE (filled in to assume that migrant workers stay on an additional period) on the imputed values of remittances and earnings in Panel A of Table 13. The relationship between time in the UAE and earnings remains positive and significant at the 1% level in the case of the high earnings imputations and at the 10% level in the case of the low earnings imputations. Similarly, the relationship between time and remittances remains negative and

significant at the 1% level. After adjusting for selection, being in the UAE for an additional 10 months corresponds with 1.6% to 3.2% lower monthly remittances.

Panel B of Table 13 presents the impact of selection on the asymmetries in the earnings-remittances relationship given by equation 7.[34] The range of the effects of selection on these estimates is fairly tight and the conclusions remain unaltered. Individuals who stay longer in the UAE remit less if their earnings tends to decline; for each additional 10 months in the UAE, they earn 8 to 10% less and remit 6 to 9% less. However, for individuals for whom their earnings increases over time, their earnings increase by about 7% for each additional 10 months that they remain in the UAE but their remittances remain constant over time.

## 11  Conclusion

Using new high frequency data on earnings and remittances, we investigate the impact of fluctuations in earnings of migrant workers on their remittance behavior. Our results show that remittances move with several types of short-run fluctuations in income, including seasonalities, which are expected, and weather shocks, which are unexpected. They also move in the same direction as a long-run shock to income associated with a labor reform that gave workers more bargaining power with their employers. These results are consistent with several models, including remittances as altruism, saving, or a dividend payment. The estimates of the impact of the labor reform are not consistent with a permanent income model in which migrants treat remittances as their own consumption and attempt to smooth consumption over time.

While the labor reform was a public shock to the permanent income of migrants, we also examined a private change to permanent income. We identified that on average earnings tend to increase steadily over time and remittances tend to fall steadily over time. This suggests that migrants may treat fluctuations that can be hidden differently from those that are easily observed by families at home. Furthermore, this result is driven by a particular type of asymmetric behavior; those who earn less over time remit less but those who earn more over time remit about the same amount. This result is only consistent with the model where remittances are an dividend payment on observable income in an equity contract.

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

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[34]We simply forward fill the indicator for whether there is a positive correlation between earnings and time and do not re-calculate this indicator based on the additional imputed month.

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. It can also be important 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. While the data used in our analysis only includes information on earnings, remittances and demographics of the migrants in the UAE, the ability to combine data on the migrant's side with high frequency information about the families of the migrants at home would be instrumental in furthering this research agenda.

# A  Data Appendix

## A.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 are 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 a employees data set that contains their labor card identification number as well as some characteristics of worker, such as age, country of origin and gender.

## A.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.

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

(a) Log Earnings



(b) Log Remittances
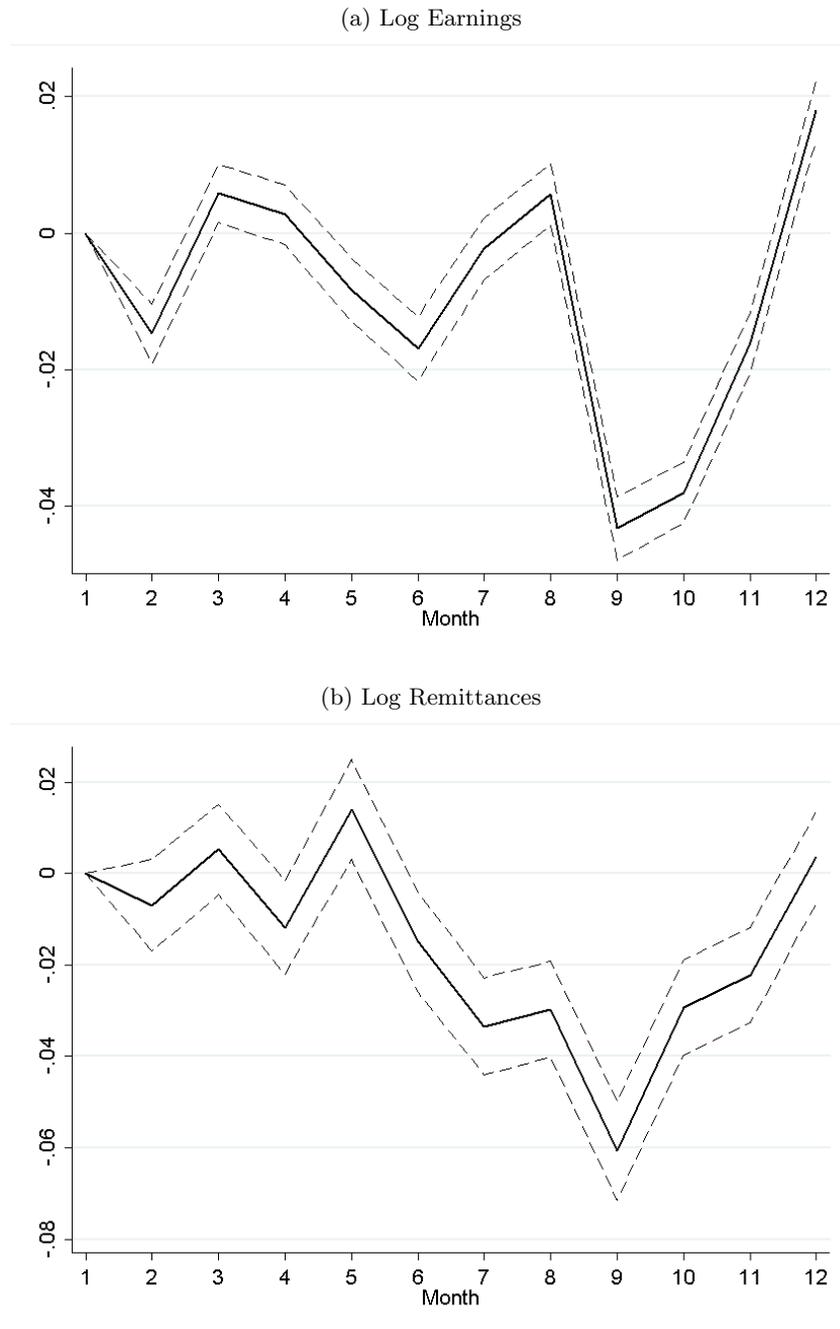


Notes: The estimated coefficients associated with each calendar month is given by the solid line. The regression includes individual fixed effects and year indicators. The omitted category in the regressions is January. The 95% confidence interval is given by the dashed lines.

Figure 2: Average Precipitation and Temperature by Month
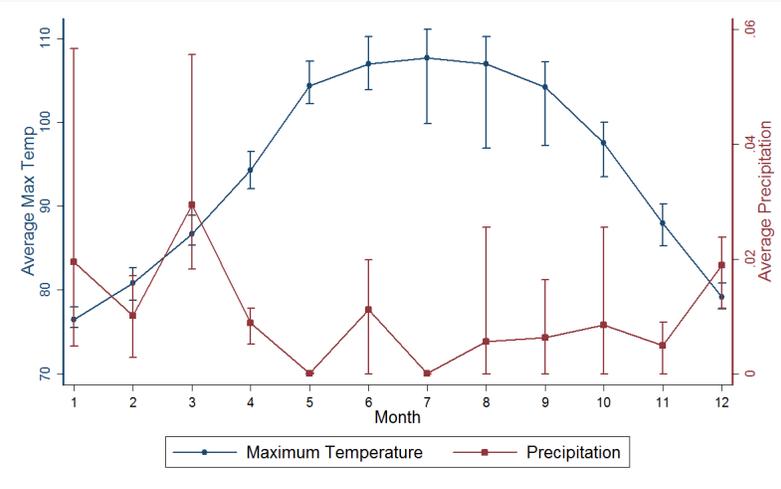


Notes: The dots give the monthly average across all days and cities of the maximum daily temperature. The bands give the value associated with city-level maximum and minimum monthly average. The squares indicate the monthly average precipitation across all days and cities. The corresponding bands provide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

Table 1: Summary of Theoretical Predictions

|  | Altruism | Consumption | Saving | Tax/Equity | Debt Payment |
|---|---|---|---|---|---|
| R co-move with Y | ✓ | ✓ | ✓ | ✓ |  |
| R move with seasonalities |  | x | ✓ | ✓ |  |
| R move with weather shocks | ✓ | ✓ | ✓ | ✓ |  |
| R move with labor reform | ✓ | ✓ | x | ✓ |  |
| R move with time in UAE | ✓ | ✓ | x |  |  |
| R move negatively with time | x | x | ✓ | ✓ |  |
| R asymmetric response | x | x | x | ✓ | x |

Notes: Y notes earnings, and R remittances. ✓indicates that the result is consistent with the model, x that the result rejects the model, and blank that the result can go either way in the model.

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

(a) Log Earnings



(b) Log Remittances
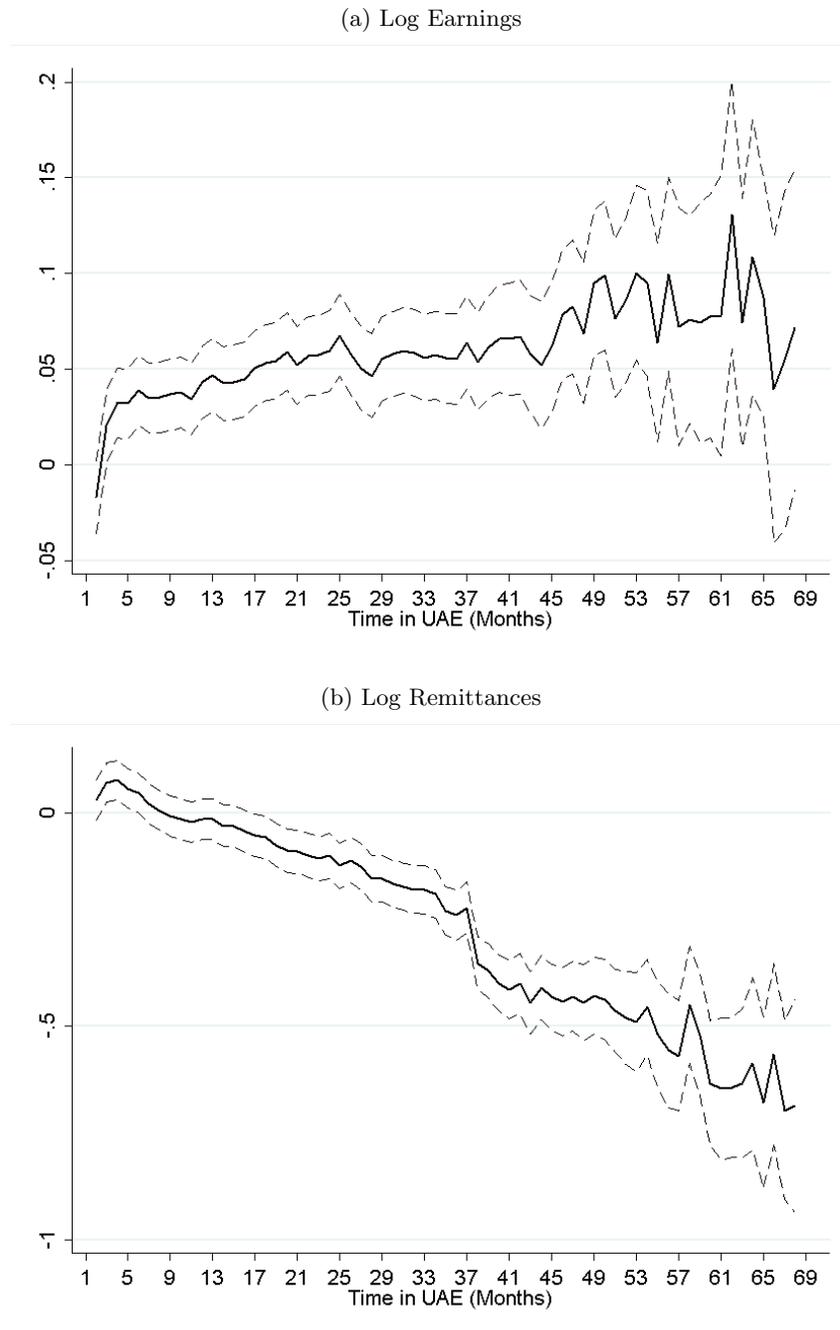


Notes: The estimated coefficients associated with each month of time in the UAE is given by the solid line. The regression includes individual fixed effects, year indicators and month indicators. The omitted category in the regressions is the first month of work. The 95% confidence interval is given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

Table 2: Summary Statistics

| | Remittance Only Sample | Earnings Only Sample | Merged Sample | Unobserved Earning as Zero | Unobserved Remittance as Zero |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| **Panel A: Financial Firm Variables** | | | | | |
| Remittances | 2668.2 | | 1327.2 | 1326.2 | 912.0 |
| | (3069.5) | | (1383.5) | (1386.0) | (1305.4) |
| India | 0.501 | 0.487 | 0.496 | 0.495 | 0.543 |
| | (0.500) | (0.500) | (0.500) | (0.500) | (0.498) |
| Monthly Earnings | | 1433.7 | 1559.8 | 1528.6 | 1474.1 |
| | | (1305.6) | (1214.9) | (1222.3) | (1150.8) |
| Age | | 35.52 | 36.31 | 36.30 | 36.05 |
| | | (8.722) | (8.734) | (8.729) | (8.617) |
| Male | | 0.991 | 0.992 | 0.992 | 0.993 |
| | | (0.0926) | (0.0895) | (0.0898) | (0.0845) |
| Observations | 34997684 | 6521954 | 553647 | 564968 | 927158 |
| **Panel B: Constructed Financial Firm Variable** | | | | | |
| Outdoor Occupation | | 0.446 | 0.516 | 0.518 | 0.547 |
| | | (0.497) | (0.500) | (0.500) | (0.498) |
| Observations | | 2944509 | 269761 | 277017 | 467419 |
| Time in UAE | | 2.477 | 2.109 | 2.109 | 2.134 |
| | | (1.858) | (1.618) | (1.618) | (1.620) |
| Observations | | 5267546 | 537836 | 548226 | 895480 |
| **Panel C: MOL Variables** | | | | | |
| Muslim | | 0.340 | 0.323 | 0.324 | 0.313 |
| | | (0.474) | (0.468) | (0.468) | (0.464) |
| High Education | | 0.388 | 0.404 | 0.404 | 0.382 |
| | | (0.487) | (0.491) | (0.491) | (0.486) |
| Observations | | 5351152 | 551052 | 562362 | 922782 |
| **Panel D: Within Contract Coefficient of Variation** | | | | | |
| CV Earnings | | 0.278 | 0.295 | 0.304 | 0.295 |
| | | (0.195) | (0.173) | (0.179) | (0.173) |
| CV Remittances | | | 0.700 | 0.700 | 1.124 |
| | | | (0.478) | (0.478) | (0.583) |
| Observations | | 547572 | 112357 | 112342 | 112668 |

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

Table 3: Fixed Effects Relationship between Log Earnings and Log Remittances

|  | (1) | (2) |
|---|---|---|
| **Panel A: Merged Sample** | | |
| Log(Earnings) | 0.325** | 0.326** |
|  | [0.005] | [0.005] |
| Worker Controls | No | Yes |
| Observations | 573132 | 543655 |
| Adjusted $R^2$ | 0.404 | 0.404 |
| **Panel B: Unobserved Earnings as Zero** | | |
| Log(Earnings) | 0.046** | 0.046** |
|  | [0.002] | [0.002] |
| Worker Controls | No | Yes |
| Observations | 584976 | 554688 |
| Adjusted $R^2$ | 0.391 | 0.391 |
| **Panel C: Unobserved Remittances as Zero** | | |
| Log(Earnings) | 1.027** | 1.028** |
|  | [0.012] | [0.012] |
| Worker Controls | No | Yes |
| Observations | 957764 | 904375 |
| Adjusted $R^2$ | 0.176 | 0.175 |

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

Table 4: Effects of Ramadan on Income and Remittances

|  | Log Earnings | | Log Remittances | |
|---|---|---|---|---|
|  | Full Sample | All Mons | Full Sample | All Mons |
|  | (1) | (2) | (3) | (4) |
| **Panel A: Ramadan Effects** | | | | |
| Days Ramadan/10 | -0.012** | -0.010** | -0.023** | -0.024** |
|  | [0.001] | [0.001] | [0.002] | [0.002] |
| Observations | 573132 | 359908 | 573132 | 359908 |
| Adjusted $R^2$ | 0.714 | 0.704 | 0.392 | 0.360 |
| **Panel B: Ramadan × Muslim Effects** | | | | |
| Days Ramadan/10 | -0.006** | -0.004* | -0.020** | -0.022** |
|  | [0.001] | [0.001] | [0.003] | [0.004] |
| Muslim × Ramadan | -0.018** | -0.018** | -0.014* | -0.014* |
|  | [0.002] | [0.003] | [0.006] | [0.006] |
| Observations | 321946 | 199120 | 321946 | 199120 |
| Adjusted $R^2$ | 0.735 | 0.722 | 0.409 | 0.371 |

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denotes 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 Country of Origin

|  | Log Earnings | | Log Remittances | |
|  | Full Sample | All Mons | Full Sample | All Mons |
|  | (1) | (2) | (3) | (4) |
| **Panel A: India** | | | | |
| Days Ramadan/10 | -0.004** | -0.002+ | -0.014** | -0.015** |
|  | [0.001] | [0.001] | [0.003] | [0.003] |
| Observations | 282033 | 174442 | 282033 | 174442 |
| Adjusted $R^2$ | 0.703 | 0.699 | 0.397 | 0.366 |
| **Panel B: Bangladesh** | | | | |
| Days Ramadan/10 | -0.022** | -0.020** | -0.046** | -0.049** |
|  | [0.002] | [0.002] | [0.005] | [0.005] |
| Observations | 134672 | 94567 | 134672 | 94567 |
| Adjusted $R^2$ | 0.527 | 0.510 | 0.295 | 0.273 |
| **Panel C: Pakistan** | | | | |
| Days Ramadan/10 | -0.030** | -0.028** | -0.032** | -0.031** |
|  | [0.003] | [0.003] | [0.005] | [0.006] |
| Observations | 62818 | 37729 | 62818 | 37729 |
| Adjusted $R^2$ | 0.710 | 0.717 | 0.397 | 0.374 |

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denotes 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

|  | Log Earnings | | Log Remittances | |
|  | (1) | (2) | (3) | (4) |
| **Panel A: Rainfall Shocks** | | | | |
| Precipitation | -0.356** | -0.305** | -0.266** | -0.364* |
|  | [0.034] | [0.067] | [0.078] | [0.155] |
| Precipitation × Outdoor |  | -0.170* |  | -0.005 |
|  |  | [0.078] |  | [0.183] |
| Observations | 563312 | 267432 | 563312 | 267432 |
| Adjusted $R^2$ | 0.715 | 0.698 | 0.392 | 0.371 |
| **Panel B: Heat Shocks** | | | | |
| Maximum Temperature | -0.003** | -0.003** | -0.010** | -0.017** |
|  | [0.001] | [0.001] | [0.001] | [0.002] |
| Temperature × Outdoor |  | -0.001** |  | -0.001** |
|  |  | [0.000] |  | [0.000] |
| Observations | 563312 | 267432 | 563312 | 267432 |
| Adjusted R$^2$ | 0.714 | 0.698 | 0.392 | 0.372 |
| Mean of Outcome | 7.172 | 7.160 | 6.992 | 6.958 |
| Standard Deviation | 0.598 | 0.588 | 0.956 | 0.962 |

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

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

|                                    | Log Earnings (1) | Log Remittances (2) |
|------------------------------------|:----------------:|:-------------------:|
| Post Reform X Post Expiration      | 0.040+           | 0.117*              |
|                                    | [0.024]          | [0.056]             |
| Post Reform X Contract Expiration  | 0.035**          | 0.065*              |
|                                    | [0.013]          | [0.033]             |
| Observations                       | 56057            | 56057               |
| Adjusted R$^2$                     | 0.010            | 0.010               |

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denotes 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

|                          | Log Earnings | | Log Remittances | |
|--------------------------|:--------:|:--------:|:---------:|:---------:|
|                          | (1)      | (2)      | (3)       | (4)       |
| **Panel A: Full Sample** |          |          |           |           |
| Time in UAE              | 0.017**  | 0.018**  | -0.096**  | -0.086**  |
|                          | [0.002]  | [0.003]  | [0.005]   | [0.007]   |
| Time in UAE$^2$          |          | -0.000   |           | -0.002*   |
|                          |          | [0.000]  |           | [0.001]   |
| Observations             | 543903   | 543903   | 543903    | 543903    |
| Adjusted R$^2$           | 0.719    | 0.719    | 0.400     | 0.400     |
| **Panel B: First Contract Sample** |  |     |           |           |
| Time in UAE              | 0.018**  | 0.050**  | -0.079**  | -0.055**  |
|                          | [0.003]  | [0.005]  | [0.006]   | [0.011]   |
| Time in UAE$^2$          |          | -0.008** |           | -0.006**  |
|                          |          | [0.001]  |           | [0.002]   |
| Observations             | 496266   | 496266   | 496266    | 496266    |
| Adjusted R$^2$           | 0.727    | 0.727    | 0.404     | 0.404     |

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denotes 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 Connections | | |
|---|---|---|---|---|---|---|
| | Negative | Positive | Diff | Less | More | Diff |
| **Panel A: Individual Characteristics (Time-Invariant)** | | | | | | |
| Initial Contract Salary | 1222.99 | 1264.60 | -41.61* | 1360.56 | 1422.25 | -61.69 |
| | (1286.01) | (1287.16) | | (1428.46) | (1334.13) | |
| Initial Contract Hours | 8.02 | 8.02 | -0.00* | 8.01 | 8.03 | -0.01* |
| | (0.18) | (0.19) | | (0.14) | (0.19) | |
| Initial Contract Length | 34.23 | 33.43 | 0.80* | 28.98 | 31.96 | -2.98* |
| | (6.33) | (7.84) | | (12.26) | (8.50) | |
| Initial Remittance | 1905.28 | 1832.79 | 72.49 | 1739.32 | 1564.73 | 174.60* |
| | (4099.55) | (3980.05) | | (1881.92) | (3170.57) | |
| Muslim | 0.25 | 0.23 | 0.03* | 0.09 | 0.10 | -0.01 |
| | (0.44) | (0.42) | | (0.29) | (0.30) | |
| India | 0.51 | 0.52 | -0.01 | 0.96 | 0.98 | -0.01* |
| | (0.50) | (0.50) | | (0.18) | (0.15) | |
| Age | 35.36 | 35.34 | 0.03 | 35.48 | 35.16 | 0.32 |
| | (8.75) | (8.76) | | (8.96) | (9.08) | |
| Male | 0.99 | 0.99 | 0.00 | 1.00 | 0.99 | 0.01* |
| | (0.10) | (0.10) | | (0.04) | (0.08) | |
| Dubai | 0.33 | 0.34 | -0.01 | 0.33 | 0.38 | -0.06* |
| | (0.47) | (0.47) | | (0.47) | (0.49) | |
| Observations | 18052 | 17519 | | 3705 | 4065 | |
| **Panel B: Time-Varying Variables** | | | | | | |
| Exit UAE | 0.016 | 0.014 | 0.002* | 0.016 | 0.014 | 0.002* |
| | (0.125) | (0.118) | | (0.127) | (0.118) | |
| Observations | 304721 | 250418 | | 63281 | 86476 | |

Notes: Standard deviations in parentheses. * denotes significance 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

|  | Log Earnings | | Log Remittances | |
| --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) |
| Time X Neg_Changes | -0.096** | -0.103** | -0.106** | -0.106** |
|  | [0.003] | [0.013] | [0.006] | [0.024] |
| Time X Pos_Changes | 0.114** | 0.108** | -0.016** | -0.014 |
|  | [0.002] | [0.013] | [0.006] | [0.024] |
| Worker Controls | No | Yes | No | Yes |
| Observations | 535254 | 507812 | 535254 | 507812 |
| Adjusted $R^2$ | 0.728 | 0.730 | 0.408 | 0.409 |

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denotes 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. Regressions include year indicators and month indicators, individual fixed effects and a constant term.

Table 11: Asymmetries in the Effects of Time in UAE and Home Connections

|  | Log Earnings | | Log Remittances | |
| --- | --- | --- | --- | --- |
| *Home Connections:* | Less | More | Less | More |
|  | (1) | (2) | (3) | (4) |
| **Panel A: Time in UAE** | | | | |
| Time in UAE | 0.034** | 0.030** | -0.051** | -0.010 |
|  | [0.005] | [0.006] | [0.013] | [0.018] |
| Observations | 79210 | 59148 | 79210 | 59148 |
| Adjusted $R^2$ | 0.645 | 0.727 | 0.373 | 0.409 |
| **Panel B: Time in UAE by Salary Change Type** | | | | |
| Time X Neg_Changes | -0.080** | -0.087** | -0.083** | -0.029 |
|  | [0.007] | [0.008] | [0.016] | [0.022] |
| Time X Pos_Changes | 0.108** | 0.125** | 0.009 | 0.050* |
|  | [0.006] | [0.007] | [0.015] | [0.021] |
| Observations | 79210 | 59148 | 79210 | 59148 |
| Adjusted $R^2$ | 0.658 | 0.738 | 0.395 | 0.420 |

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denotes 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. Regressions include year indicators, month indicators, individual fixed effects and a constant term.

Table 12: 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. +, *, ** denotes significance at the 10%, 5% and 1% levels, respectively. Regressions include year fixed effects, individual fixed effects and a constant term.

Table 13: Impact of Selection on the Estimates of Time in the UAE

|  | Log Earnings | | Log Remittances | |
| --- | --- | --- | --- | --- |
|  | High | Low | High | Low |
|  | (1) | (2) | (3) | (4) |
| **Panel A: Time in UAE** | | | | |
| Time in UAE | 0.014** | 0.005+ | -0.016** | -0.032** |
|  | [0.003] | [0.003] | [0.005] | [0.006] |
| Observations | 771635 | 771635 | 771635 | 771635 |
| Adjusted $R^2$ | 0.701 | 0.716 | 0.432 | 0.419 |
| **Panel B: Asymmetric Effect** | | | | |
| Time in UAE | -0.102** | -0.084** | -0.085** | -0.057** |
|  | [0.003] | [0.003] | [0.006] | [0.006] |
| Time X I(Postive Correlation) | 0.176** | 0.155** | 0.076** | 0.053** |
|  | [0.002] | [0.002] | [0.005] | [0.005] |
| Observations | 604017 | 604017 | 604017 | 604017 |
| Adjusted $R^2$ | 0.705 | 0.721 | 0.434 | 0.419 |

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denotes 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. Regressions include year indicators, month indicators, individual fixed effects and a constant term.

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. +, *, ** denotes 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. +, *, ** denotes 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: Estimates of the Impact of Weather (in Days) on Income and Remittances

|  | Log Earnings | Log Remittances |
|---|---|---|
|  | (1) | (2) |
| **Panel A: Rainfall Shocks** | | |
| Days Any Precipitation | -0.003*** | -0.005*** |
|  | [0.000] | [0.001] |
| Observations | 563312 | 563312 |
| Adjusted $R^2$ | 0.714 | 0.392 |
| **Panel B: Heat Shocks** | | |
| Days Max Temp 70-80 | -0.000 | -0.005** |
|  | [0.001] | [0.002] |
| Days Max Temp 80-90 | -0.001 | -0.007** |
|  | [0.001] | [0.002] |
| Days Max Temp 90-100 | -0.001 | -0.011** |
|  | [0.001] | [0.002] |
| Days Max Temp 100-110 | -0.001 | -0.011** |
|  | [0.001] | [0.002] |
| Days Max Temp Over 110 | -0.003** | -0.015** |
|  | [0.001] | [0.002] |
| Observations | 563312 | 563312 |
| Adjusted $R^2$ | 0.714 | 0.392 |

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


Appendix Table A.4: Effects of Ramadan on Income and Remittances

|  | Log Earnings | | Log Remittances | |
|---|---|---|---|---|
|  | Full Sample | All Mons | Full Sample | All Mons |
|  | (1) | (2) | (3) | (4) |
| **Panel A: Ramadan Effects** | | | | |
| Ramadan | -0.029** | -0.026** | -0.060** | -0.065** |
|  | [0.002] | [0.002] | [0.004] | [0.005] |
| Observations | 573132 | 359908 | 573132 | 359908 |
| Adjusted $R^2$ | 0.715 | 0.704 | 0.392 | 0.361 |
| **Panel B: Ramadan × Muslim Effects** | | | | |
| Ramadan | -0.016** | -0.013** | -0.057** | -0.062** |
|  | [0.003] | [0.003] | [0.007] | [0.008] |
| _ImusXram_1_1 | -0.040** | -0.039** | -0.022+ | -0.024+ |
|  | [0.005] | [0.005] | [0.012] | [0.013] |
| Observations | 321946 | 199120 | 321946 | 199120 |
| Adjusted $R^2$ | 0.735 | 0.722 | 0.409 | 0.371 |

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

Appendix Table A.5: Estimates of Time in the UAE and Firm Tenure on Income and Remittances

| | Log Earnings | | Log Remittances | |
| --- | --- | --- | --- | --- |
| | (1) | (2) | (3) | (4) |
| Time in UAE | 0.030* | 0.049* | -0.056** | -0.026 |
| | [0.012] | [0.024] | [0.017] | [0.036] |
| Time in UAE$^2$ | | -0.002 | | -0.004 |
| | | [0.003] | | [0.004] |
| Tenure | -0.014 | -0.032 | -0.041* | -0.060+ |
| | [0.012] | [0.024] | [0.017] | [0.035] |
| Tenure$^2$ | | 0.002 | | 0.002 |
| | | [0.003] | | [0.004] |
| F-Test: Time & Time$^2$ (p-value) | | 0.012 | | 0.001 |
| Observations | 543903 | 543903 | 543903 | 543903 |
| Adjusted R$^2$ | 0.719 | 0.719 | 0.400 | 0.400 |

Notes: Robust standard errors clustered by individual in parentheses. +, *, ** denotes significance at the 10%, 5% and 1% levels, respectively. Tenure refers to the number of months that they have been with the firm divided by 10. Regressions include year indicators, month indicators, individual fixed effects and a constant term.

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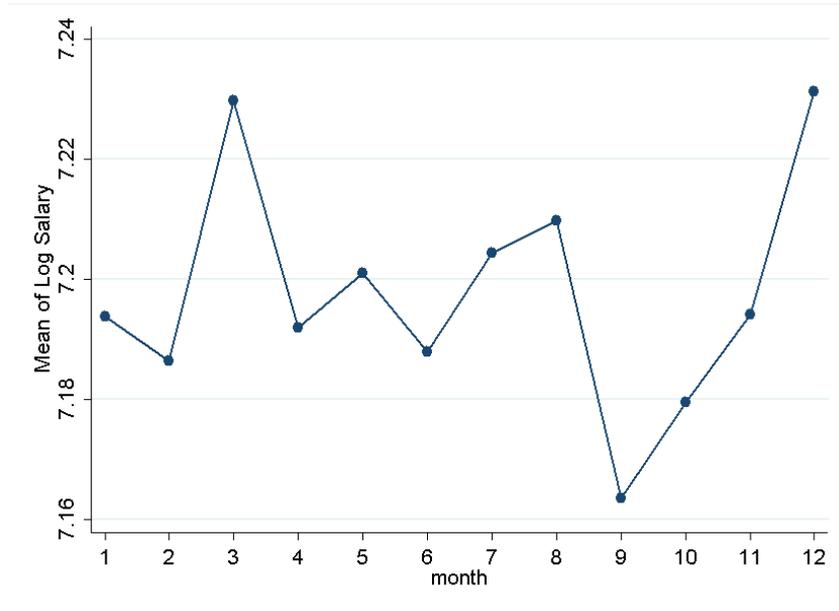
(a) Log Earnings
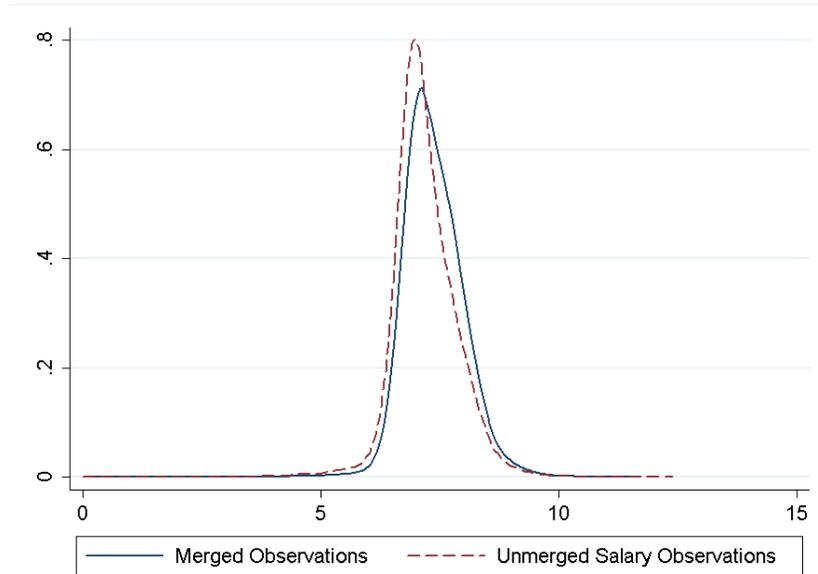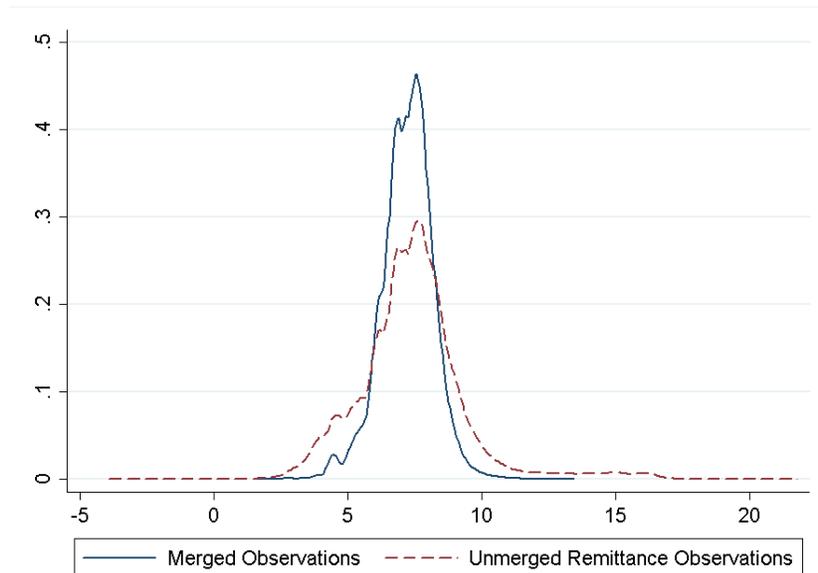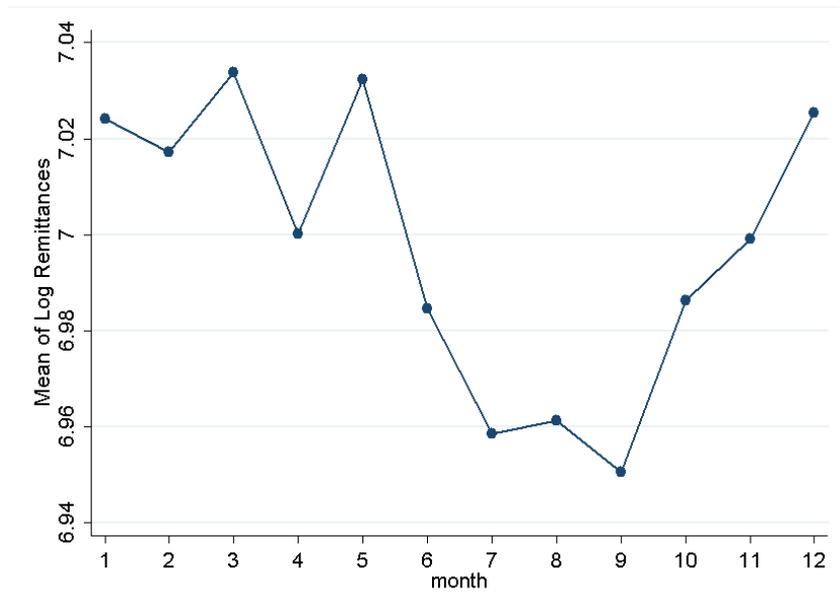


(b) Log Remittances

Appendix Figure A.2: Average Earnings and Remittances by Month

(a) Log Earnings



(b) Log Remittances

Appendix Figure A.3: Kernel Density of Firms' Share of Workers with Positive Changes over Time