Remittances and Household Expenditure Patterns in Tajikistan:
A Propensity Score Matching Analysis

MATTHIEU CLÉMENT

The object of this article is to assess the impact of remittances on household expenditure patterns in Tajikistan. More specifically, the paper applies propensity score matching methods to the 2003 Tajikistan Living Standards Measurement Survey. The results do not provide evidence of a productive use of remittances since neither internal nor external remittances have a positive effect on investment expenditures. Migration and remittances are therefore interpreted as short-term coping strategies that help dependent households achieve a basic level of consumption.

JEL classification: O12, O15

I. INTRODUCTION

What is the impact of remittances on household expenditure patterns? Several studies in the literature on migration and remittances find contemporary results. McKenzie and Sasin (2007) argue that researchers need to determine whether remittances are spent on consumption or investment and whether migrant families spend more on health and education. On a pessimistic view, receiving households tend to spend remittances on consumption rather than investment. Based on an examination of the relevant literature, Chaumi et al. (2003, 8–9) identified three stylized facts supporting this statement. The first is that "a significant proportion, and often the majority, of remitted funds are spent on consumption." The second is that "a significant, though generally smaller, part of remittances does go into uses that we can classify as saving or investment." Third, "the household saving and investment that are done using remittances are not necessarily productive in terms of the overall economy." However, majority of recent studies dealing with the microeconomic impact of remittances have generally taken a more optimistic view of this issue. At the microeconomic level, "remittances allow poor recipient households to increase their savings, spend more on consumer durables and human capital, and improve children's health and

educational outcomes. Remittances should thus be welcomed, encouraged, and facilitated" (Fajnzylber and Lopez 2008, 2).

Historically, Tajikistan was the poorest republic in the former Soviet Union and remains the poorest country in the Europe and Central Asia region. With a poverty line equal to $2.15 per day, the poverty headcount was 64% in 2003, as opposed to 54% in the Kyrgyz Republic (2001), 45% in Moldova (2002), 37% in Armenia (2001), 23% in Georgia (2002), and 22% in Azerbaijan (2001) (World Bank 2005a). A number of studies have underlined the major role of internal and external remittances in coping with the social consequences of the transition process (Olimova and Bosc 2003, World Bank 2005a, Kireyev 2006, Mughal 2006, Jones et al. 2007, ILO 2010). World Bank (2005a) explained that migration and remittances have significantly contributed to the high rate of poverty reduction observed between 1999 and 2003. As in most other countries of the former Soviet Union, domestic private transfers are widespread and operate as a means of mitigating vulnerability and poverty. As an illustration, Robinson and Guenther (2007) showed that households with migrant members in rural and mountainous areas are less likely to be poor since associated remittances contribute to income diversification. However, Tajikistan differs from other countries of the former Soviet Union because of the extent of international remittances. The civil war that lasted from 1992 to 1997 resulted in a first wave of migration that may be described as "defensive." Since the mid-1990s, labor migration has replaced defensive migration (Jones et al. 2007). The Tajik population is the youngest population of all countries of the former Soviet Union, and the severe economic crisis that followed the civil conflict prompted many young people to seek job opportunities abroad (Jones et al. 2007). From a macroeconomic perspective, workers' remittances and compensation of employees accounted for approximately 49.6% of gross domestic product (GDP) in 2008 (World Bank 2010), meaning that Tajikistan ranks top in the world.[1]

The object of this paper is to analyze how households spend remittances in Tajikistan. In other words, its purpose is to assess the impact of internal and external remittances on household expenditure patterns. To the best of the author's knowledge, no study has so far dealt with this issue in the specific case of Tajikistan, though many similar studies have been conducted on other countries. Unlike other studies, which tend to adopt an Engle curve framework, this paper uses an alternative methodology. More specifically, it applies a propensity score matching analysis designed to evaluate the impact of a treatment (i.e., receiving remittances) by constructing a counterfactual group describing the situation of households' receiving remittances before they receive them. The methodology is applied to data drawn from the 2003 Tajikistan Living Standards Measurement Survey (TLSS) conducted jointly by the State Statistical Agency,

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[1]By comparison, these proportions are 31.4% in Moldova, 27.0% in Lesotho, 24.5% in Lebanon, 21.5% in Honduras, 11.4% in Guatemala, and 11.2% in the Philippines.

the Center for Strategic Studies, the United Nations Programme (UNDP), and the World Bank.

The paper is structured as follows. Section I provides a survey of the empirical literature dealing with the effect of remittances on the structure of household expenditures. Section II presents the methodological framework. Section III describes the data, while the results produced by the propensity score analysis are discussed in Section IV.

II. REMITTANCES AND HOUSEHOLD EXPENDITURE PATTERNS: LITERATURE REVIEW

Adams (2007) argued that the impact of remittances on the structure of household expenditures is often viewed pessimistically. However, recent empirical studies have contradicted this statement, particularly those dealing with the impact of remittances on education and health.

Based on an analysis of a household survey in the Philippines, Tabuga (2007) provides mixed evidence of the impact of remittances. The study found that a significant proportion of transfers from abroad is spent on conspicuous consumption such as consumer goods or leisure, but also that these remittances increase education and housing expenditures. Furthermore, households receiving remittances spend less on tobacco and alcohol. Castaldo and Reilly (2007) underlined that Albanian households receiving international remittances tend to spend more on durable goods and utilities than other households and less on food consumption. In other words, a higher proportion of their expenditures are devoted to investment-type goods. However, the receipt of internal remittances has no significant impact on expenditure patterns. In the same way, Taylor and Mora (2006) found that in Mexico, external remittances tend to be spent productively. The share of a household budget devoted to investment is higher in households with migrants than in otherwise similar households without migrants, while the proportion of consumption expenditures is lower. This result is congruent with the findings presented in a study by Zarate-Hoyos (2004). Acosta et al. (2008) provided a comparative analysis of seven Latin-American countries (Mexico, El Salvador, Guatemala, Peru, Nicaragua, Jamaica, and the Dominican Republic). The results provide strong evidence of a productive use of international remittances. The study found that remittances decrease the budget share devoted to food consumption in all the countries studied with the exception of Jamaica, whereas they significantly increase the share of health expenditures in six countries (with the exception of Nicaragua). The results are more uncertain for educational expenditures. A significant and positive impact of remittances from abroad on household education expenditures is found for El Salvador, Guatemala, and Peru but not for the Dominican Republic, Jamaica, Mexico, and

Nicaragua. The absence of a significant impact of remittances on education expenditures was also highlighted by Cattaneo (2010) in the case of Albania. The low attainment rates characterizing the Albanian education system may be symptomatic of low returns for education, producing limited incentives for investments in education. The income supplement derived from remittances may therefore be channelled into more productive investments, such as land or other agricultural inputs. However, many studies applied to significantly different contexts provide evidence for the view that remittances and migration have a positive effect on education expenditures. For instance, Kifle (2007) showed that in Eritrea, households receiving international remittances tend to spend more on education than households that do not receive international remittances. Cardona Sosa and Medina (2006) found a similar result in Colombian households. According to Adams (2005), households spend remittances productively in Guatemala (housing, education, health), and a significant proportion of remittances is assigned to education. At the margin, households receiving internal or external remittances spend, respectively, 45% and 58% more on education than households that do not receive internal or external remittances. In the case of health expenditures, the literature appears to be more unanimous than in the case of education in assessing the beneficial impact of remittances. Many case studies of Mexico have shown that external remittances have a positive impact on household health expenditures (Amuedo-Dorantes et al. 2007, Amuedo-Dorantes and Pozo 2009, Valero-Gil 2009). Cardona Sosa and Medina (2006) also found a positive effect of remittances from abroad on health expenditures in Colombian households. Finally, gender issues are an important issue to consider in assessing remittances. Guzman et al. (2008) showed that households in Ghana that are headed by women show different expenditure patterns than male-headed families. Households headed by women tend to spend a greater proportion of remittances on education and health than households headed by men.

The empirical analysis presented in this paper is in line with the previous studies cited above and is applied to Tajikistan, the country with the highest level of international remittances and where domestic private transfers are also widespread.

III. METHODOLOGICAL FRAMEWORK

Empirical studies analysing the impact of remittances on expenditure patterns have generally adopted an Engel curve framework (Taylor and Mora 2006, Tabuga 2007, Castaldo and Reilly 2007, Valero-Gil 2009). The general idea is to estimate Engel curve equations in which the budget share of a certain commodity is a function of total expenditures and to include a dummy for

remittances receipt or the amount of remittances.[2] The main difficulty of this approach lies in the endogeneity of the remittance variable linked to the reverse causality between household expenditure patterns and the receipt of remittances. As noted by McKenzie and Sasin (2007) and Adams (2011), this model-based approach requires the use of an instrumental variables strategy with a robustness that is highly sensitive to the quality of available instruments.[3] A range of instruments have been used in the empirical literature on remittances and migration, including the distance between the country of origin and the country of migration, migration history (at a village or community level), and access to transport infrastructures and financial institutions (through which remittances are transferred). As argued by McKenzie and Sasin (2007) and Adams (2011), the main problem is that none of these variables appears to be a perfectly suitable instrument (i.e., a variable strongly correlated with the receipt of remittances and with no direct impact on household expenditure patterns).

Given these difficulties, this paper uses an alternative method. Following a study by Esquivel and Huerta-Pineda (2007) on the impact of remittances on poverty, a propensity score matching (PSM) analysis is carried out. Its chief purpose is to quantify the average effect related to the receipt of remittances by matching remittance-receiving households (the treatment group) with households with similar characteristics that do not receive remittances (the comparison group). The PSM approach is now widely used since it helps reduce the selection bias linked to the existence of observed differences in socioeconomic characteristics between recipient and nonrecipient households.[4] This method was initially introduced by Rosenbaum and Rubin (1983) and can be broken down into two stages. The first stage involves estimating a logit model explaining the receipt of remittances by observed socioeconomic characteristics. The propensity scores (defined as the probability of receiving remittances conditional to the characteristics included in the model) are deduced from this model. The second stage involves matching households receiving remittances with nonrecipient households that have close propensity scores (and which are therefore comparable to households receiving remittances on the basis of the observed characteristics). The average treatment effect is given by the difference in expenditure patterns

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[2]Most of these studies adopt the Working–Leser specification (Working 1943, Leser 1963), which states that the budget share of a given item is a function of the logarithm of total expenditures. One of the advantages of the Working–Leser specification is that it satisfies the adding-up restriction, which states that when the budget share of one commodity increases, another share must be reduced to maintain the budget constraint of the household.

[3]The implementation of an instrumental variables strategy also raises a number of econometric issues (not systematically addressed in the literature) since the endogenous variable is either a dummy variable (remittances receipt) or a censored variable (amount of remittances).

[4]If only the expenditure patterns of households receiving remittances and nonrecipient households are compared, the observed differences are not necessarily linked to the receipt of remittances since both groups may differ in terms of other characteristics. The PSM framework can be used to compare recipient and nonrecipient households with close similarities in terms of observable socioeconomic characteristics.

between the two groups. The methodological framework is presented in more detail in Appendix 1.[5]

IV. DATA DESCRIPTION

The data are drawn from the 2003 TLSS.[6] The TLSS survey is based on a stratified random probability sample, with the sample stratified according to *oblast* and urban/rural settlements, and with the share of each stratum in the overall sample in proportion to its share in the total number of households as recorded in the 2000 census. The sample includes 4,160 households and is designed to be representative of national and regional levels and of both urban and rural areas. The data collected provide detailed information on a wide range of topics such as migration, income, expenditure, education, health, agriculture, etc.

Generally speaking, remittances can be defined as the money sent from one place or person to another. This paper uses a broad definition of remittances by including all private monetary transfers received by households from persons who do not live in the household (relatives living elsewhere, friends, neighbors). Among these transfers, the TLSS survey draws a distinction between domestic transfers and transfers from abroad.[7] In TLSS data, household expenditures include seven broad categories of expenditure items defined as food, nonfood, education, health, rent and utilities, agriculture, and transfers to other households. Food and nonfood expenditures refer to consumption, while the five remaining categories are classified as investment expenditures.

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[5]The PSMATCH2 Stata module is used. See Leuven and Sianesi (2003).

[6]By analyzing the 2007 survey, a problem of data collection is found in the module "Transfers from another household." When the donor lives in Tajikistan, the amount of money transferred by the donor is not registered. In other words, the monetary component of transfers is only considered for transfers from abroad but not for domestic transfers. This is the reason why the 2003 survey is used.

[7]A distinction needs to be drawn between two components of domestic transfers. The first component includes all services and transfers operated through proximity social networks (neighbors and community). These consist mainly of nonmonetary transfers and were already institutionalized under the Soviet system. The second component involves remittances associated with internal migration. The extent of domestic migration has increased significantly with the economic crisis but remains relatively moderate in Tajikistan. The 2003 TLSS suggests that approximately 11% of Tajiks are domestic migrants in the sense that they were born outside their current place of residence (Jones et al. 2007). Surprisingly, internal migration is mainly toward rural areas where access to a private plot may help to lower social risks. Dushanbe is the only city with net migration inflows.

A.   Remittances

Table 1 provides some indications of the extent of remittances in Tajikistan. In the country as a whole, 19.1% of households receive remittances.[8] On average, these transfers reach 47.36 Somoni monthly for receiving households and account for 32.5% of their total income. These figures confirm the significant dependence of Tajik families on remittances. The proportion of households receiving domestic remittances is 9.4%, for an average monthly total of 32.08 Somoni (24.5% of recipients' income). Even if the extent of international remittances is significant in Tajikistan, domestic private transfers are thus also widespread. As noted by Clément (2008), the magnitude of internal remittances is observed in most former Soviet Union countries and was already widespread during the Soviet period, confirming the role of private transfers and social networks as a means of mitigating vulnerability, particularly in a context of economic transition.

Table 1. **Key Figures on Remittances**

	All Remittances		External Remittances		Internal Remittances	
	Proportion of Beneficiaries (%)	Average Amount[*]	Proportion of Beneficiaries (%)	Average Amount[*]	Proportion of Beneficiaries (%)	Average Amount[*]
All	19.09	47.36	10.12	59.53	9.40	32.08
Rural	17.84	47.61	10.11	60.55	7.92	29.92
Urban	21.25	47.01	10.13	57.76	11.97	34.56
Oblast						
GBAO	22.29	44.58	16.25	48.88	7.08	28.16
Sogdian	19.68	40.28	9.76	49.78	10.16	30.21
Khatlon	15.09	35.58	4.91	45.82	10.47	29.82
RRS	19.39	57.09	9.55	64.08	10.45	47.41
Dushanbe	21.57	65.22	15.00	82.95	7.00	23.23
Pretransfer Income Quintile						
1st	25.96	48.70	13.70	63.73	12.74	30.70
2nd	17.31	32.91	8.65	42.74	9.01	22.17
3rd	16.11	44.12	8.65	55.03	7.69	30.47
4th	18.51	50.37	9.98	61.13	9.13	35.30
5th	17.55	59.47	9.62	70.09	8.41	42.78

GBAO = Gorno-Badakhshan-Atunomous Oblast, RRS = Region of Republican Subordination.
Note: Monthly amount per household (Somoni).
Source: 2003 TLSS (State Statistical Agency, Center for Strategic Studies, UNDP, and World Bank).

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[8]When nonmonetary transfers are included, the proportion reaches more than 35%.

However, Tajikistan differs from other former Soviet Union countries because of its significant dependence on external remittances. Table 1 shows that in 2003, more than 10% of households received remittances from abroad and international transfers accounted for 38.5% of their total income (59.53 Somoni per month). Of course, the magnitude of international remittances is closely related to international migration. Though not designed to study migration, the TLSS indicates that nearly 20% of households had at least one member who lived abroad for 3 months or more over the period 1998–2003. According to World Bank (2005b) estimations, the principal destination of Tajik migrants is Russia (83%), followed by Kazakhstan (14%), and the Kyrgyz Republic (2%). The development of international migration and consequent remittances are closely linked to the economic and social crisis of the 1990s. The breakdown of economic activity that followed the collapse of the Soviet system, the increase of poverty, and the civil war have led many Tajik families to send at least one member abroad in search of an alternative source of income.

It is worth noting that only 0.4% of households simultaneously receive both internal and external remittances. The extremely low proportion of households receiving both internal and external remittances suggests that receiving internal remittances and receiving external remittances are two distinct phenomena with a potentially different impact on household expenditures.

Generally speaking, internal remittances are proportionally more designed to help urban households (12% as opposed to 8% in rural areas), and the average amount is also significantly higher in urban areas. One plausible interpretation is that social networks through which domestic transfers tend to be channelled are stronger and more institutionalized in cities. Curiously, the proportion of households benefiting from external remittances is not higher in urban areas compared to rural areas. It might have been predicted that migration and international transfers are facilitated by the proximity of transport infrastructures (airport, railway) and by financial institutions through which remittances from abroad are channelled. It appears that when making the decision to send one member abroad, rural households consider that the costs of accessing financial and transport infrastructures are more than compensated by the benefits derived from remittances. In examining the oblast of residence,[9] households in GBAO and Dushanbe were found to be more likely to receive external remittances, while households in Sogdian, Khatlon, and in the Region of Republican Subordination (RRS) receive a proportionally greater amount of domestic transfers. These geographic disparities suggest that households receiving remittances are significantly different from nonrecipient households and that comparisons cannot be made. Appendix Tables 1, 2, and 3 included in Appendix 2 confirm this view.

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[9]The territory of Tajikistan is divided into four administrative regions: the *oblasts* of Sogdian and Khatlon, the Gorno-Badakhshan-Atunomous Oblast, and the Region of Republican Subordination. In this last administrative division, the TLSS isolates the city of Dushanbe, distinguishing five regions in total.

The unmatched pairs t-tests show that there are significant differences in a wide range of observed characteristics between households receiving remittances and nonrecipient households, including sex, age, education, occupational status, proportion of children and the elderly, etc. The observed disparities create a selection bias, meaning that the observed differences in household expenditure patterns between recipient households and nonrecipient households can probably not be attributed exclusively to remittance receipts. The selection bias justifies the propensity score matching analysis.

Finally, the relation between income and the receipt of remittances needs to be considered. Quintiles were constructed on the basis of household income excluding remittances (i.e., pretransfer income). Table 1 shows that the role of income in explaining remittance receipt is not as significant as initially predicted. There are no significant differences in the proportion of recipient households from the second to the top quintile. The percentage of remittance-receiving households in these quintiles is between 16% and 18.5% for total remittances. However, households belonging to the lowest quintile receive proportionally more remittances than other households. For total remittances, the proportion of remittance-receiving households in the first quintile is approximately 26%. In other words, migration and remittances in Tajikistan are primarily designed to help the most vulnerable households cope with poverty.

B.   Household Expenditure Patterns

Table 2 presents the budget shares of seven expenditure categories for households receiving remittances, households that do not receive remittances, and all households. The main components of the mean budget are food and nonfood consumption, which account for 82% of the mean budget. Investment expenditures are limited (18%) and are mainly devoted to rent and utilities, health, and education. The share of health and education expenditures in household budgets is relatively low. All together, these account for approximately 10% of total household expenditures.

Households that receive remittances tend to spend more on consumption than households that do not receive remittances. However, the difference is not statistically significant. Investment categories indicate that households that receive remittances spend relatively less on productive expenditures such as rent, utilities, and agriculture. Health expenditures tend nevertheless to increase significantly with the receipt of private transfers. This result may suggest that migration and remittances act as a coping strategy to mitigate health risks. For education and other expenditures, there is no significant difference between the two categories of households. At length, these basic descriptive statistics provide mixed evidence and support neither the optimistic view that remittances are spent on investments rather than consumption nor a more pessimistic view.

Table 2. **Average Budget Shares for Households**

	Households With Remittances	Households Without Remittances	Difference	Two-sample T-test (prob.)
Consumption	**0.8243**	**0.8205**	**0.0038**	**0.472**
Food	0.6846	0.6805	0.0041	0.492
Nonfood	0.1397	0.1400	−0.0003	0.937
Investment	**0.1757**	**0.1795**	**−0.0038**	**0.472**
Rent and utilities	0.0565	0.0676	−0.0111	0.000***
Education	0.0444	0.0435	0.0009	0.765
Health	0.0570	0.0458	0.0112	0.003***
Agriculture	0.0146	0.0197	−0.0051	0.001***
Other	0.0032	0.0029	0.0003	0.617

* significant at 10%; ** significant at 5%; *** significant at 1%.

Source: 2003 TLSS (State Statistical Agency, Center for Strategic Studies, UNDP, and World Bank)..

V. RESULTS

A.   Propensity Scores Estimation

Propensity scores estimation is a key step in applying PSM analysis. Propensity scores are deduced from three distinct logit models estimated for total remittances, external remittances, and internal remittances, respectively. The dependent variables are dummy variables that take the value 1 when a household receives remittances (total, external, or internal) and 0 if not. The propensity scores are a one-dimensional summary of a set of socioeconomic characteristics. These characteristics have to be suitable instruments for remittance receipts. This implies two things. First, covariates have to be chosen to avoid reverse causality with remittance receipts in the logit models. Second, the explanatory variables must not influence household expenditure patterns other than through the remittances channel. The selected covariates relate to household characteristics (household size, proportion of children, and the elderly); characteristics of the head of household (age, sex, civil status, education, occupational status); and place of residence (urban/rural, *oblast*).[10] Also added is a migration variable. To avoid reverse causality (a source of endogeneity) between remittances receipt and this migration variable, current migration is not included. Past international migration with a dummy equal to 1 is taken if at least one member of the household lived abroad for a period lasting at least 3 months during the 5 years preceding the survey. It can also be reasonably argued that past international migration (contrary to current migration) has a limited direct effect on household expenditure patterns. Finally, following Esquivel and Huerta-Pineda (2007) and Gerber and Torosyan (2010), household income as a covariate is not included. As

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[10]Complementary explanatory variables dealing with access to infrastructures (community variables) and households assets (land, durables, etc.) were included. However, the kernel matching estimator performs less with these alternative specifications when the two criteria discussed below are considered.

shown previously, it is reasonable to assume that household income does not contribute as much as expected to the selection bias since the proportion of households receiving remittances is relatively constant from one quintile to another. Furthermore, household income has a strong direct impact on expenditure patterns and not merely an indirect effect through the remittances channel. Therefore, the introduction of income as a covariate may potentially create an endogeneity bias.

Table 3 presents the logit regressions used to estimate the propensity scores related to total remittances, external remittances, and internal remittances, respectively. After managing missing observations on covariates, a sample of 3,993 households was obtained. The explanatory power of the logit model for total remittances is satisfactory since the percentage of well-predicted cases is 82.5% and the McFadden and Nagelkerke pseudo R^2 are, respectively, above 10% and 15%. The percentage of well-predicted observations even exceeds 90% when distinctively external and internal remittances are considered separately. Nevertheless, the explanatory power is noticeably higher for external remittances with a McFadden pseudo R^2 reaching more than 21%, as opposed to 5.5% for internal remittances.

The influence of explanatory variables suggests a number of observations. As expected, the most significant determinant of remittances is the past international migration variable, which has a strong impact on external remittances, but also on internal remittances. The probability of receiving remittances depends positively on the proportion of elderly members within the household. This result indicates that sending remittances is a strategy for coping with significant dependence and for generating alternative sources of income. Nevertheless, the proportion of children has no significant influence on the receipt of remittances (both internal and external remittances). Male-headed households receive significantly less remittances than female-headed households, ceteris paribus. This result confirms the role of transfers as a means of mitigating dependence. But when considering external and internal remittances separately, a significant impact of the gender of the household head is not observed. Geographic location is also an important determinant of the receipt of remittances. As highlighted by previous descriptive statistics, urban households receive proportionally more remittances (and particularly more internal remittances) than rural households. Furthermore, households living in Sogdian and Khatlon *oblasts* tend to receive more domestic remittances than households living in Dushanbe, ceteris paribus. When remittances from abroad are considered, households living in GBAO appear to benefit more from external remittances than other households. The strong dependence of GBAO households on private transfers was already underlined by World Bank (2005a). These results show that living in the capital is not a decisive factor in triggering migration. A plausible interpretation could be that living in the capital offers a greater diversity

of income-generating activities (more opportunities on the formal labor market, informal activities, access to credit, etc.) and reduces the need for receiving private transfers.

Table 3. **Logit Regressions for Remittances Receipt**

	Total Remittances		External Remittances		Internal Remittances	
	Coeff.	t-test (prob.)	Coeff.	t-test (prob.)	Coeff.	t-test (prob.)
Constant	–0.6968	0.179	–4.2967	0.000***	0,1711	0,768
Household Characteristics						
Household size	–0.0214	0.249	0.0299	0.188	–0,0704	0,009***
Proportion of children	0.0355	0.885	0.0390	0.915	0,0696	0,816
Proportion of elderly	0.8736	0.001***	0.7327	0.074*	0,8020	0,012**
Past international migration	1.8605	0.000***	2.4998	0.000***	0,5862	0,000***
Urban area	0.3374	0.004***	0.2149	0.197	0,3561	0,012**
Oblast[1]						
GBAO	0.7742	0.000***	1.1116	0.000***	0,2338	0,345
Sogdian	0.3210	0.042**	0.1234	0.600	0,3768	0,042**
Khatlon	0.3662	0.035**	–0.2683	0.328	0,6879	0,001***
RRS	0.0579	0.757	–0.0253	0.923	0,0208	0,930
Household Head Characteristics						
Male	–0.4021	0.016**	–0.3501	0.136	–0,3268	0,102
Age	–0.0373	0.050**	0.0300	0.325	–0,0655	0,003***
Age squared	0.0002	0.131	–0.0002	0.434	0,0004	0,033**
Couple	–0.1410	0.401	–0.2209	0.351	–0,0633	0,755
Head's Education[2]						
Secondary education	0.2136	0.102	0.4652	0.012**	–0,0932	0,562
Postgraduate education	0.0943	0.562	0.0249	0.917	0,0403	0,836
Head's Occupational Status[3]						
Nonagricultural worker	–0.5749	0.000***	–0.4131	0.013**	–0,6325	0,000***
Agricultural worker	–0.4319	0.001***	–0.2215	0.215	–0,5852	0,001***
N	3993		3993		3993	
Pseudo R² McFadden	0.117		0.212		0.055	
Pseudo R² Nagelkerke	0.169		0.262		0.072	
Percent correct	82.5%		91.7%		90.6%	
LR test (prob.)	430.5 (0.000)***		487.8 (0.000)***		135.6 (0.000)***	

* significant at 10%; ** significant at 5%; *** significant at 1%.
GBAO = Gorno-Badakhshan-Atunomous Oblast, RRS = Region of Republican Subordination.
Note: (1) Base = Dushanbe; (2) Base = No education or primary education; (3) Base = unoccupied or unemployed.
Source: 2003 TLSS (State Statistical Agency, Center for Strategic Studies, UNDP, and World Bank).

A consideration of the characteristics of household heads indicates that the influence of age appears to be uncertain. The relation between the age of the head of the household and total remittances is linear and negative. For internal remittances, this relation takes the shape of a U-curve. In other words, young households and elderly households tend to receive relatively more domestic remittances. This corroborates the previous conclusion that migration and remittances operate as a coping strategy for reducing dependence. However, the

effect of the age of the head of household on external remittances is not significant. The educational level of the head of the household has a weak influence on remittances, whereas the occupational status of the head of the household is an important factor. Households with a head in agricultural or nonagricultural sectors receive fewer remittances compared to households headed by an unoccupied or unemployed head. In other words, remittances are a means of compensating for a low level or lack of earned income.

B.   Average Treatment Effects

The average treatment effects are estimated using Gaussian kernel matching (see Appendix 1) for total remittances, external remittances, and internal remittances, respectively. Appendix Tables 1–3 in Appendix 2 present two criteria for measuring the performance of the matching procedure: (i) t-tests for equality of means in the treated and control groups, both before and after matching; and (ii) the standardized bias before and after matching, and the achieved percentage reduction in bias. The balancing tests show that propensity score matching using the Gaussian kernel estimator removes most of the bias between the treatment and nontreatment groups. After matching, the two groups have nonsignificant different means for all the covariates included in the models. As can be seen, the proportion of bias reduction for each covariate is almost systematically greater than 50% for total remittances, external remittances, and internal remittances.[11] The Rosenbaum bounds analysis (Rosenbaum 2002) was also used to test the sensitivity of the matching estimates to the presence of unobserved characteristics. The methodology and the results of the analysis are presented in Appendix 3. The results show that the impact of remittances on household expenditure patterns is relatively sensitive to the presence of unobserved characteristics. However, this procedure only describes a worst-case scenario. While it assesses how the estimated average treatment effects could be modified by unobserved characteristics, it does not indicate if these unobserved characteristics actually exist.

1.   Total Remittances

The average treatment effects for total remittances are reported in Table 4a for the entire sample. The treatment effects by pretransfer income quintiles in Table 4b is also reported to assess the sensitivity of the results to household income. Total remittances tend to increase the share of the household budget devoted to consumption and decrease in the same proportion the proportion of

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[11]Matching only increases the bias for Sogdian (total remittances) and the proportion of elderly people (external remittances). The percentage of bias reduction is also less than 50% for age and age squared in the case of internal remittances.

investment expenditures. The difference for treated and control groups is above 0.3 percentage point but is not statistically significant. In other words, the results indicate indeterminacy in the way households spend remittances. For consumption, this indeterminacy is confirmed both for food consumption expenditures and nonfood consumption expenditures. In examining investment categories, the matching procedure shows conflicting results. Expenditures on rent and utilities decrease significantly with remittances, which may provide support to the idea that remittances are spent in an unproductive way. However, the share of health expenditures increases significantly (at the 5% level) by 0.9 percentage point with the receipt of remittances for the entire sample. Concerning income groups (Table 4b), the positive impact of remittances on health expenditures is only observed in the case of the second quintile. For other investment categories such as education or agriculture, there is no significant effect of remittances for the sample as a whole. However, there are significant disparities between different income quintiles. For example, remittances result in a significant decrease in the share of agriculture expenditures in the case of the three lowest quintiles but an increase in the case of the two highest quintiles. This suggests that, among the households engaged in agricultural activities, the wealthiest households spend remittances more productively than the poorest households. Although the analysis of total remittances suggests relatively ambiguous results, significant disparities are found when external and internal remittances are considered separately.

Table 4a. **Average Treatment Effects (total remittances),
Gaussian Kernel Matching Estimator**

	Budget Shares		Difference	Two-Sample
	Treated Group (N=695)	Control Group (N=3298)		T-test (prob.)
Consumption	**0.8226**	**0.8196**	**0.0030**	**0.570**
Food	0.6841	0.6794	0.0047	0.413
Nonfood	0.1385	0.1402	–0.0017	0.659
Investment	**0.1774**	**0.1804**	**–0.0030**	**0.570**
Rent and utilities	0.0546	0.0672	–0.0126	0.000***
Education	0.0431	0.0416	0.0015	0.603
Health	0.0609	0.0519	0.0090	0.032**
Agriculture	0.0157	0.0165	–0.0008	0.539
Other	0.0031	0.0032	–0.0001	0.872

* significant at 10%; ** significant at 5%; *** significant at 1%.
Source: 2003 TLSS (State Statistical Agency, Center for Strategic Studies, UNDP, and World Bank)..

Table 4b. **Average Treatment Effects (total remittances) by Pretransfer Income Quintiles, Gaussian Kernel Matching Estimator**

	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile
Consumption	0.0105	0.0020	0.0030	−0.0064	0.0057
Food	0.0170	0.0072	−0.0014	−0.0002	−0.0001
Nonfood	−0.0065	−0.0052	0.0044	−0.0062	0.0058
Investment	−0.0105	−0.0020	−0.0030	0.0064	−0.0057
Rent and utilities	−0.0123**	−0.0168***	−0.0039	−0.0142***	−0.0153***
Education	0.0087	0.0076	−0.0033	−0.0007	−0.0057
Health	0.0061	0.0188*	0.0093	0.0127	−0.0004
Agriculture	−0.0106***	−0.0099***	−0.0035*	0.0085**	0.0107***
Other	−0.0024***	−0.0017***	−0.0016**	0.0001	0.0050**

* significant at 10%; ** significant at 5%; *** significant at 1%.
Source: 2003 TLSS (State Statistical Agency, Center for Strategic Studies, UNDP, and World Bank).

2. External Remittances

The results for external remittances are presented in Tables 5a (entire sample) and 5b (income quintiles). External remittances are clearly devoted to consumption expenditures. The difference in budget shares for consumption between the treated and control groups is above 1.7 percentage points and is significant at 1% level. This result suggests a pessimistic view since external remittances are designed to increase nonproductive expenditures (consumption) rather than productive expenditures (investment). The decomposition of treatment effects by income quintiles confirms this finding at a more disaggregated level. For example, the receipt of external remittances is found to have a negative impact on the share of expenditures devoted to education for the third and fourth quintiles. Therefore, transfers from abroad need to be viewed as a short-term coping strategy in a context of significant vulnerability. This highlights the importance of international migration in helping dependent households to achieve a basic level of consumption.

Table 5a. **Average Treatment Effects (external remittances), Gaussian Kernel Matching Estimator**

	Budget Shares		Difference	Two-sample T-test (prob.)
	Treated Group (N=335)	**Control Group (N=3658)**		
Consumption	**0.8288**	**0.8117**	**0.0171**	**0.016****
Food	0.6790	0.6650	0.0140	0.071*
Nonfood	0.1498	0.1467	0.0031	0.604
Investment	**0.1712**	**0.1883**	**−0.0171**	**0.016****
Rent and utilities	0.0587	0.0640	−0.0053	0.134
Education	0.0414	0.0442	−0.0028	0.484
Health	0.0503	0.0573	−0.0070	0.167
Agriculture	0.0182	0.0193	−0.0011	0.574
Other	0.0026	0.0035	−0.0009	0.212

* significant at 10%; ** significant at 5%; *** significant at 1%.
Source: 2003 TLSS (State Statistical Agency, Center for Strategic Studies, UNDP, and World Bank)..

Table 5b. **Average Treatment Effects (external remittances)**
by Pretransfer Income Quintiles, Gaussian Kernel Matching Estimator

	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile
Consumption	0.0058	0.0170	0.0428***	0.0173	0.0056
Food	0.0145	0.0152	0.0160	0.0174	0.0073
Nonfood	–0.0087	0.0018	0.0268*	–0.0001	–0.0017
Investment	–0.0058	–0.0170	–0.0428***	–0.0173	–0.0056
Rent and utilities	0.0060	–0.0064	–0.0095	–0.0143**	–0.0015
Education	0.0079	0.0123	–0.0104**	–0.0113**	–0.0071
Health	0.0006	–0.0115	–0.0155*	–0.0020	–0.0091
Agriculture	–0.0166***	–0.0083***	–0.0062**	0.0097**	0.0106*
Other	–0.0037***	–0.0031***	–0.0012	0.0006	0.0015

* significant at 10%; ** significant at 5%; *** significant at 1%.

Source: 2003 TLSS (State Statistical Agency, Center for Strategic Studies, UNDP, and World Bank)..

3.   Internal Remittances

The results for internal remittances reported in Tables 6a and 6b highlight a significantly different logic. No significant difference in the proportion of consumption and investment expenditures is found between the treatment and control groups for the entire sample and the five income quintiles. In other words, there is a degree of uncertainty about the productive orientation of domestic transfers. At a more disaggregated level, internal remittances tend to decrease the proportion of expenditures devoted to investments in housing. Concerning agriculture expenditures, no significant impact is found for the entire sample. However, there are significant disparities between different income quintiles. While a negative impact is observed in the two lowest quintiles, a positive impact (significant at 10% level) is observed in the top quintile. External remittances have no significant effect on the share of education and other expenditures for the entire sample. These results could be construed as evidence of an unproductive use of internal remittances (in the same way as external remittances). However, a strong and positive effect on health expenditures is observed. The receipt of domestic transfers results in a 2.1 percentage point increase of the budget share of health expenditures. When considering the average treatment effect by quintiles, a positive and significant impact for the middle of the pretransfer income distribution (2nd, 3rd, and 4th quintiles) is found. The effect is particularly significant in the second and third quintiles, with an increase induced by internal remittances greater than 3 percentage points. The positive impact of internal remittances on health expenditures corroborates the findings of many previous studies carried out in other contexts (Amuedo-Dorantes et al. 2007, Acosta et al. 2008, Valero-Gil 2009).

Table 6a. **Average Treatment Effects (internal remittances),**
Gaussian Kernel Matching Estimator

	Budget Shares		Difference	Two-sample
	Treated Group (N=375)	**Control Group (N=3618)**		**T-test (prob.)**
Consumption	0.8182	0.8262	–0.0080	0.277
Food	0.6881	0.6892	–0.0011	0.889
Nonfood	0.1301	0.1370	–0.0069	0.184
Investment	0.1818	0.1738	–0.0080	1.08
Rent and utilities	0.0513	0.0669	–0.0156	0.000***
Education	0.0441	0.0401	0.0040	0.291
Health	0.0693	0.0484	0.0209	0.001***
Agriculture	0.0135	0.0157	–0.0022	0.153
Other	0.0036	0.0027	0.0009	0.314

* significant at 10%; ** significant at 5%; *** significant at 1%.
Source: 2003 TLSS (State Statistical Agency, Center for Strategic Studies, UNDP, and World Bank).

Table 6b. **Average Treatment Effects (internal remittances) by Pretransfer Income**
Quintiles, Gaussian Kernel Matching Estimator

	1st Quintile	**2nd Quintile**	**3rd Quintile**	**4th Quintile**	**5th Quintile**
Consumption	0.0098	–0.0047	–0.0385*	–0.0228	0.0081
Food	0.0113	0.0071	–0.0180	–0.0099	–0.0022
Nonfood	–0.0015	–0.0118	–0.0205*	–0.0129	0.0103
Investment	–0.0098	0.0047	0.0385*	0.0228	–0.0081
Rent and utilities	–0.0207***	–0.0207***	0.0039	–0.0115	–0.0260***
Education	0.0108	0.0028	0.0053	0.0072	–0.0091
Health	0.0080	0.0341*	0.0348**	0.0226*	0.0108
Agriculture	–0.0065***	–0.0108***	–0.0042	0.0046	0.0075*
Other	–0.0014**	–0.0007	–0.0013*	–0.0001	0.0087**

* significant at 10%; ** significant at 5%; *** significant at 1%.
Source: 2003 TLSS (State Statistical Agency, Center for Strategic Studies, UNDP, and World Bank).

The use of domestic private transfers for health expenditures suggests that improving health outcomes is a short-term priority for households that comes before more long-term investments such as education or agriculture. Compared to other former Soviet Union countries, Tajikistan has poor health outcomes. For example, the infant mortality rate (under 5 years old) was 74‰ in 2005, while life expectancy was just 64 years. Like many transition countries, Tajikistan suffered a deterioration of its public health system during the 1990s. For instance, the number of hospital beds per 1,000 people declined from less than 11 in 1990 to 5.9 in 2005. The low level of public health spending has led households to raise their private expenditures in order to cope with health problems. The ratio of private to public health expenditures has risen from 3.3 in 2000 to above 3.6 in 2004 (World Bank 2010). Internal remittances thus appear to be a crucial means of compensating for the disengagement of the public authorities in terms of health care provision. Domestic transfers appear ultimately to be less unproductive than external transfers but are still devoted to short-term priorities such as health expenditures.

Contrary to a number of studies (Adams 2005, Cardona and Sosa 2006, Kifle 2007), the empirical analysis carried out as part of this study found that remittances (both internal and external) have no positive impact on education expenditures, but rather an undetermined effect. A parallel can be drawn with the study carried out by Cattaneo (2010) on Albania referred to above. As in Albania, the poor quality of the Tajik education system may create disincentives to school attendance and school enrollment. As noted by World Bank (2008), the poor quality of education in Tajikistan is primarily explained by inadequate and damaged infrastructure (broken windows, lack of electricity and heating, lack of water connection, etc.), but also by a lack of qualified teachers. These issues are particularly salient in rural areas. The low level of public spending on education as a percentage of GDP explains these inefficiencies, and the existence of disincentive effects is confirmed by the decrease of school enrollment and school attendance (World Bank 2005a and 2008). For example, the basic secondary school gross enrollment rate was 102.1% in 1990, and fell to just 73.5% in 2000 (World Bank 2008). However, the situation has improved since the beginning of the 2000s, with the gross enrollment rate reaching 81.8% in 2005.

VII. CONCLUSION

The purpose of this paper was to analyze the impact of internal and external remittances on household expenditure patterns in Tajikistan. Unlike previous studies carried out in other contexts, an Engle curve framework was not used. Instead, propensity score matching techniques were applied to provide an unbiased estimation of a treatment-effect. This methodology is specifically designed to reduce the evaluation bias linked to the unobservability of the counterfactual, i.e., a situation in which households benefit from remittances before they receive them. Propensity score matching methods enable measurements of the average treatment effect by matching nontreated cases to treated cases that are similar based on observable socioeconomic characteristics. The matching analysis carried out in this study is satisfactory when considering balancing tests. However, the sensitivity analysis indicates that the estimated effects of remittances on household expenditure patterns are relatively sensitive to unobserved characteristics.

The empirical analysis sheds light on four key results. First, the results do not corroborate the idea of a productive use of remittances since neither internal nor external remittances have a positive effect on investment expenditures. Second, external remittances are shown to be significantly unproductive since they contribute to a significant increase in household consumption levels. It is estimated that receiving transfers from abroad increases the share devoted to consumption expenditures by 1.7 percentage points and decreases the share of

investment expenditures by the same proportion. Third, the results are more ambiguous in the case of internal remittances. Among the investment categories, domestic transfers tend to reduce housing and agriculture expenditures and significantly increase health expenditures. Fourth, remittances have no significant effect on household education expenditures. The interpretation given in this paper was that the poor quality of the education system in Tajikistan creates disincentives to school attendance and school enrollment.

As argued by Adams (2007), until recently researchers generally provided a pessimistic analysis of the way in which remittances were spent by households. This was the view defended by Chami et al. (2003), who argued that remittances are spent on consumption rather than investment expenditures and are not necessarily productive for the economy as a whole. However, the recent empirical studies discussed in this paper and applied to a wide range of contexts show that remittances may be productive by increasing investment expenditures (Zarate-Hoyos 2004, Adams 2005, Taylor and Mora 2006, Acosta et al. 2008). As the main conclusions of this paper suggest, this study is in line with the pessimistic view and provides evidence of an unproductive use of remittances (particularly external remittances). For example, the lack of impact of remittances on education expenditures contradicts the conclusions of several studies (Adams 2005, Cardona Sosa and Medina 2006, Kifle 2007). The positive effect of remittances on health expenditures is the only result that is clearly in line with previous studies (Adams 2005, Cardona Sosa and Medina 2006, Acosta et al. 2008).

The favorable evolution of public spending on education and health in Tajikistan since the beginning of the 2000s may encourage more optimism about the effect of remittances on household expenditure patterns. Public education spending per capita increased from $5.5 in 2003 to $17.7 in 2007, while public spending on health increased from $2.1 to $6.7 (World Bank 2008). These trends could potentially strengthen the productive use of remittances. On one hand, the increase of public health expenditures could reduce the share of household expenditures aimed at improving health outcomes. The idea is that public health expenditures could replace private health expenditures and shift the use of household remittances toward long-term investments such as education or agriculture. On the other hand, the increase of public education expenditures could improve the quality of the education system and thus decrease disincentives. Households should therefore be encouraged to invest in their children's education. The recent increase of enrollment rates noted above may provide support to this positive trend.

APPENDIX 1. PROPENSITY SCORE MATCHING

Denote by D_i a dummy variable equal to 1 if individual i is a treated individual (i.e., a household receiving remittances) and 0 if not. Y_{i1} and Y_{i0} are the outcome variables describing household expenditure patterns for unit i conditional on the presence and absence of treatment, respectively. The treatment effect for individual i measures the difference between the relevant outcome indicator with the treatment and the relevant outcome indicator without the treatment. It is given by:

$$\Delta Y_i = E(Y_{i1}/D_i = 1) - E(Y_{i0}/D_i = 1) \tag{A.1}$$

While the post-treatment outcome is observed, its value in the absence of treatment (i.e., the counterfactual) is not. In household surveys, it is impossible to simultaneously observe someone in two different states. Consequently, the components $E(Y_{i1}/D_i = 1)$ and $E(Y_{i0}/D_i = 0)$ are observable outcomes, whereas $E(Y_{i1}/D_i = 0)$ and $E(Y_{i0}/D_i = 1)$ are nonobservable outcomes. By filling in the missing data on the counterfactual, propensity score matching provides a potential solution to the evaluation problem.

More specifically, propensity score matching methods are based on the *conditional independence assumption*, which states that the outcome in the untreated state is independent of treatment participation conditional on a particular set of observable characteristics, denoted by *X* (Rosenbaum and Rubin 1983). This assumption is equivalent to the absence of selection bias based on unobservable heterogeneity (Heckman and Robb 1985) and can be expressed as:

$$(Y_{i0}, Y_{i1}) \perp D_i/X_i \tag{A.2}$$

This means that, given X_i, the outcomes of nontreated units can be used to approximate the counterfactual outcome of treated units in the absence of treatment.

$$E(Y_{i0}/D_i = 1, X_i) = E(Y_{i0}/D_i = 0, X_i) \tag{A.3}$$

Rosenbaum and Rubin (1983) show that it is possible to condition participation on the propensity score denoted *P(X)* rather than on observable characteristics *X*. The propensity score represents the probability of treatment conditional on a vector of observable characteristics and may be interpreted as the one-dimensional summary of the set of observable variables. It is expressed as:

$$P(X_i) = \Pr\{D_i = 1/X_i\} \tag{A.4}$$

The estimation of the counterfactual is:

$$E[Y_{i0}/D_i = 1, P(X_i)] = E[Y_{i0}/D_i = 0, P(X_i)] \tag{A.5}$$

Finally, the average treatment effect for individual i is measured by:

$$\Delta Y_i = E[Y_{i1}/D_i = 1, P(X_i)] - E[Y_{i0}/D_i = 0, P(X_i)] \tag{A.6}$$

The heart of the approach lies in the estimation of propensity scores. Common practice uses the predicted probabilities of being in the treatment group or in the nontreatment group derived from dichotomous logit or probit models including covariates X.

Once propensity scores are estimated, a matching estimator needs to be selected that describes how comparison units relate to treated units. According to Dehejia and Wahba (2002, 153), "matching on the propensity score is essentially a weighting scheme, which determines what weights are placed on comparison units when computing the estimated treatment effect." The average treatment effect may be expressed as follows:

$$\Delta \bar{Y} = \frac{1}{T} \sum_{i=1}^{T} \left[Y_{i1} - \sum_{j=1}^{C} W(i,j) Y_{ij0} \right] \tag{A.7}$$

where Y_{i1} is the post-treatment outcome of treated unit i, Y_{ij0} is the outcome of the jth nontreated unit matched to the ith treated unit, T is the total number of treated units, C is the total number of nontreated units, and $W(i,j)$ is a positive valued weight function. Different types of parametric and nonparametric weights are given in the propensity score matching literature. This paper adopts a *Kernel estimator* that matches each treated unit to a weighted sum of comparison units, with the greatest weight assigned to units with closer scores (Heckman et al. 1998):

$$W(i,j) = \frac{K\left(\dfrac{p_i - p_j}{h} \right)}{\displaystyle\sum_{j \in \{D=0\}} K\left(\dfrac{p_i - p_j}{h} \right)} \tag{A.8}$$

With p_i the propensity score of treated unit i, p_j the propensity score of comparison unit j and h a bandwidth parameter (fixed at 0.06). Kernel-based matching sometimes uses all comparison units (for example the Gaussian kernel), while others use comparison units with propensity scores p_j within a fixed bandwidth from p_i (for example Epanechnikov kernel). In this article, the Gaussian kernel estimator is used.

APPENDIX 2. BALANCING TESTS

Appendix Table 1. **Balancing Tests for Propensity Score Matching (total remittances), Gaussian Kernel Estimator**

	Sample	Percent Bias	Percent Reduction in Bias	T-test (prob.)
Household size	Unmatched	−3.0		0.459
	Matched	0.8	74.3	0.891
Proportion of children	Unmatched	−14.5		0.000***
	Matched	0.1	99.3	0.985
Proportion of elderly	Unmatched	16.5		0.000***
	Matched	0.3	97.9	0.954
International migration	Unmatched	69.7		0.000***
	Matched	2.3	96.7	0.719
Urban area	Unmatched	10.5		0.012**
	Matched	0.2	98.2	0.972
GBAO	Unmatched	10.0		0.013**
	Matched	0.4	95.8	0.941
Sogdian	Unmatched	2.3		0.587
	Matched	2.3	−3.7	0.662
Khatlon	Unmatched	−11.7		0.006***
	Matched	−1.6	86.3	0.759
RRS	Unmatched	3.7		0.376
	Matched	−1.4	62.1	0.801
Male	Unmatched	−25.5		0.000***
	Matched	−2.0	92.3	0.732
Age	Unmatched	10.1		0.013**
	Matched	0.6	93.7	0.910
Age squared	Unmatched	11.6		0.005***
	Matched	0.6	94.5	0.910
Couple	Unmatched	−22.9		0.000***
	Matched	−2.1	91.0	0.715
Head's Education				
Secondary education	Unmatched	3.4		0.419
	Matched	1.2	65.5	0.828
Postgraduate education	Unmatched	−10.1		0.018**
	Matched	−1.5	84.8	0.765
Head's Occupational Status				
Nonagricultural worker	Unmatched	−26.0		0.000***
	Matched	−3.0	88.5	0.564
Agricultural worker	Unmatched	−14.5		0.001***
	Matched	−0.7	95.1	0.889

* significant at 10%; ** significant at 5%; *** significant at 1%.
GBAO = Gorno-Badakhshan-Atunomous Oblast, RRS = Region of Republican Subordination.
Source: 2003 TLSS (State Statistical Agency, Center for Strategic Studies, UNDP, and World Bank).

Appendix Table 2. **Balancing Tests for Propensity Score Matching**
(external remittances), Gaussian Kernel Estimator

	Sample	Percent Bias	Percent Reduction in Bias	T-test (prob.)
Household size	Unmatched	29.6		0.000***
	Matched	0.4	98.6	0.959
Proportion of children	Unmatched	−18.0		0.002***
	Matched	−3.5	80.6	0.640
Proportion of elderly	Unmatched	4.7		0.413
	Matched	6.0	−29.5	0.420
International migration	Unmatched	118.0		0.000***
	Matched	0.4	99.6	0.962
Urban area	Unmatched	−2.6		0.643
	Matched	0.7	72.3	0.924
GBAO	Unmatched	29.1		0.000***
	Matched	9.0	69.0	0.286
Sogdian	Unmatched	−2.3		0.693
	Matched	−0.2	89.3	0.975
Khatlon	Unmatched	−34.1		0.000***
	Matched	−6.5	81.1	0.353
RRS	Unmatched	19.4		0.000***
	Matched	−1.6	91.6	0.845
Male	Unmatched	−17.4		0.001***
	Matched	−8.6	50.2	0.278
Age	Unmatched	23.7		0.000***
	Matched	6.6	72.1	0.384
Age squared	Unmatched	21.3		0.000***
	Matched	6.5	69.7	0.394
Couple	Unmatched	−15.1		0.006***
	Matched	−6.7	55.7	0.400
Head's Education				
Secondary education	Unmatched	12.6		0.029**
	Matched	1.8	86.0	0.818
Postgraduate education	Unmatched	−16.4		0.007***
	Matched	−3.5	78.8	0.633
Head's Occupational Status				
Nonagricultural worker	Unmatched	−30.5		0.000***
	Matched	−3.2	89.4	0.662
Agricultural worker	Unmatched	−7.2		0.215
	Matched	−1.9	74.2	0.807

* significant at 10%; ** significant at 5%; *** significant at 1%.
GBAO = Gorno-Badakhshan-Atunomous Oblast, RRS = Region of Republican Subordination.
Source: 2003 TLSS (State Statistical Agency, Center for Strategic Studies, UNDP, and World Bank).

Appendix Table 3. **Balancing Tests for Propensity Score Matching (internal remittances), Gaussian Kernel Estimator**

	Sample	Percent Bias	Percent Reduction in Bias	T-test (prob.)
Household size	Unmatched	–32.1		0.000***
	Matched	–5.6	82.6	0.433
Proportion of children	Unmatched	–11.4		0.026**
	Matched	–1.3	88.2	0.858
Proportion of elderly	Unmatched	22.5		0.000***
	Matched	2.7	88.0	0.746
International migration	Unmatched	12.9		0.013**
	Matched	1.5	88.1	0.841
Urban area	Unmatched	22.6		0.000***
	Matched	3.6	84.0	0.628
GBAO	Unmatched	–10.7		0.061*
	Matched	–1.9	82.7	0.787
Sogdian	Unmatched	4.8		0.370
	Matched	0.2	95.0	0.974
Khatlon	Unmatched	7.8		0.143
	Matched	1.0	86.8	0.890
RRS	Unmatched	–14.5		0.012**
	Matched	–2.3	84.0	0.735
Male	Unmatched	–28.9		0.000***
	Matched	–5.2	82.1	0.507
Age	Unmatched	–2.6		0.609
	Matched	–1.6	38.4	0.834
Age squared	Unmatched	1.5		0.765
	Matched	–0.9	44.5	0.911
Couple	Unmatched	–27.0		0.000***
	Matched	–5.4	80.1	0.485
Head's Education				
Secondary education	Unmatched	–6.5		0.229
	Matched	–1.7	74.2	0.819
Postgraduate education	Unmatched	–2.6		0.631
	Matched	0.4	86.6	0.961
Head's Occupational Status				
Nonagricultural worker	Unmatched	–18.1		0.001***
	Matched	–2.7	84.8	0.702
Agricultural worker	Unmatched	–18.9		0.001***
	Matched	–3.4	82.1	0.625

* significant at 10%; ** significant at 5%; *** significant at 1%.
GBAO = Gorno-Badakhshan-Atunomous Oblast, RRS = Region of Republican Subordination.
Source: 2003 TLSS (State Statistical Agency, Center for Strategic Studies, UNDP, and World Bank).

APPENDIX 3. SENSITIVITY ANALYSIS

Sensitivity of matching estimates to unobserved heterogeneity are tested following Duvendack and Palmer-Jones (2011). Matching procedures are based on the conditional independence assumption that states that selection in the treatment group is only based on observable characteristics. As underlined by Becker and Caliendo (2007, 1), "checking the sensitivity of the estimated results with respect to deviations from this identifying assumption has become an increasingly important topic in the applied evaluation literature." The sensitivity analysis is carried out using the Rosenbaum bounds method (Rosenbaum 2002). The purpose of this procedure is to determine if the average treatment effect may be modified by unobserved variables, thus creating a hidden bias. Let us assume that the treatment probability is:

$$P_i = P(X_i, u_i) = P(D_i = 1/X_i, u_i) = F(\beta X_i + \gamma u_i) \tag{A.9}$$

where X_i are the observed covariates, u_i is an unobserved covariate, γ is the effect of u_i on the treatment selection, and F is the logistic distribution. Let us now define the ratio of the odds that a treated case i has the unobserved characteristic to the odd that the control case j has it:

$$\frac{P_i/(1-P_i)}{P_j/(1-P_j)} = \frac{\exp(\beta X_i + \gamma u_i)}{\exp(\beta X_j + \gamma u_j)} \tag{A.10}$$

As implied by matching procedure, i and j have the same covariates, which implies:

$$\frac{P_i/(1-P_i)}{P_j/(1-P_j)} = \exp\left[\gamma\left(u_i - u_j\right)\right] \tag{A.11}$$

If the unobserved variable has no influence on the probability of treatment ($\gamma = 0$) or if the unobserved variable is the same for the treated and the nontreated cases ($u_i = u_j$), the odds ratio is equal to 1, indicating the absence of hidden bias linked to unobservable variables. Sensitivity analysis assesses how much the treatment effect is modified by changing the values of γ and $u_i - u_j$. Assuming that $\Gamma = e^\gamma$, Rosenbaum (2002) identifies the following bounds on the odds ratio:

$$\frac{1}{\Gamma} \le \frac{P_i/(1-P_i)}{P_j/(1-P_j)} \le \Gamma \tag{A.12}$$

$\Gamma = 1$ ($\gamma = 0$) means that no hidden bias exists whereas increasing values of Γ imply an increasing influence of unobserved characteristics in the treatment selection. Rosenbaum bound method uses matching estimates to calculate confidence intervals of the treatment effect, for different values of Γ. As explained by Duvendack and Palmer-Jones (2011) if the lowest Γ producing a confidence interval that includes 0 is small (i.e., less than 2), it is likely that such an unobserved characteristic exists and therefore that the estimated treatment effect is sensitive to unobservables.

Appendix Table 4 reports the results of Rosenbaum procedure for the different outcome variables when the treatment variable is total remittances receipt and the matching estimator is

Gaussian kernel.[12] These results show that robustness to hidden bias varies significantly across the different outcomes.

Appendix Table 4. **Rosenbaum Bounds Sensitivity Analysis**
(treatment = total remittances receipt; matching estimator = Gaussian kernel)

	Γ	Hodges-Lehmann Point Estimates		95% Confidence Intervals	
		Minimum	Maximum	Minimum	Maximum
Food	1	0.0139	0.0139	0.0025	0.0249
	1.2	0.0018	0.0255	**-0.0100**	**0.0363**
	1.4	**–0.0086**	**0.0351**	–0.0206	0.0460
	1.6	–0.0176	0.0433	–0.0299	0.0543
Nonfood	1	–0.0137	–0.0137	–0.0206	–0.0066
	1.2	–0.0210	–0.0061	**–0.0277**	**0.0012**
	1.4	**–0.0269**	**0.0003**	–0.0334	0.0082
	1.6	–0.0318	0.0062	–0.0384	0.0142
Rent and utilities	1	–0.0255	–0.0255	–0.0292	–0.0216
	2	–0.0386	–0.0077	–0.0414	–0.0017
	3	–0.0442	–0.0005	**–0.0466**	**0.0128**
	4	**–0.0475**	**0.0055**	–0.0499	0.0242
	5	0.0498	0.0109	–0.0521	0.0341
Education	1	–0.0122	–0.0122	–0.0153	–0.0090
	1.2	–0.0155	–0.0088	–0.0184	–0.0053
	1.4	–0.0181	–0.0058	–0.0210	–0.0018
	1.6	–0.0203	–0.0028	**–0.0232**	**0.0014**
	1.8	–0.0222	–0.0001	–0.0249	0.0042
	2	**–0.0238**	**0.0024**	–0.0263	0.0067
	3	–0.0290	0.0119	–0.0313	0.0177
Health	1	–0.0168	–0.0168	–0.0252	–0.0096
	1.2	–0.0256	–0.0092	–0.0329	–0.0023
	1.4	–0.0322	–0.0031	**–0.0376**	**0.0041**
	1.6	**–0.0363**	**0.0022**	–0.0410	0.0106
	1.8	–0.0394	0.0075	–0.0424	0.0171
Agriculture	1	–0.0097	–0.0097	–0.0107	–0.0083
	1.2	–0.0108	–0.0082	–0.0119	–0.0065
	1.4	–0.0118	–0.0067	–0.0127	–0.0046
	1.6	–0.0126	–0.0051	–0.0132	–0.0027
	1.8	–0.0130	–0.0037	–0.0136	–0.0008
	2	–0.0133	–0.0020	**–0.0140**	**0.0013**
	3	**–0.0149**	**0.0054**	–0.0157	0.0099
	4	–0.0159	0.0113	–0.0165	0.0155
Other	1	–0.0026	–0.0026	–0.0026	–0.0025
	2	–0.0028	–0.0019	–0.0031	–0.0018
	3	–0.0033	–0.0017	–0.0035	–0.0014
	4	–0.0035	–0.0012	–0.0040	–0.0003
	5	–0.0040	–0.0004	**–0.0046**	**0.0014**
	6	**–0.0044**	**0.0009**	–0.0050	0.0030

Notes: Rosenbaum bounds are calculated using the command rbounds in Stata (see Gangl 2004). The critical values corresponding to the lowest value of Γ that produces a confidence interval encompassing 0 are in bold.

Source: 2003 TLSS ((State Statistical Agency, Center for Strategic Studies, UNDP, and World Bank).

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[12]The sensitivity analysis was also implemented for the two other treatment variables (internal and external remittances receipt). The subsequent results are close to those obtained for total remittances.

For the share of food and non food consumption expenditures, the lowest value of Γ producing a 95% confidence interval encompassing zero is 1.2. This value means that the unobserved characteristic u_i would have to increase the odds ratio by less than 20% before it would bias the estimated impact. When considering Hodges-Lehmann point estimates the critical Γ reaches 1.4. These relatively low values imply that the treatment effects for consumption expenditures are thus sensitive to unobserved characteristics. The sensitivity analysis produces more mixed results when considering investment expenditures. For education, the critical values of Γ are 1.6 (95% confidence interval) and 2 (Hodges-Lehmann point estimates); and for health expenditures, 1.4 and 1.6. For the other categories of investment, critical values are higher. When considering Hodges-Lehmann point estimates, they reach 4 for rent and utilities, 3 for agriculture, and 6 for other expenditures. We conclude that the average treatment effect estimated for these categories are robust to the presence of unobserved characteristics.

With the exception of these last three categories, the impact of remittances on households' expenditures seems to be rather sensitive to hidden bias if we consider, as did Duvendack and Palmer-Jones (2011), that critical values less than 2 indicate a high sensitivity to unobservables. But this pessimistic conclusion has to be qualified at two levels. First, the degrees of sensitivity highlighted in this analysis are close to those identified in other studies in social sciences. Watson (2005) reports several studies that identify critical values of Γ that are close to this study's findings (between 1.1 and 2.2) and argues that such values cannot be compared to those obtained in medicine sciences (which often exceed 5). Aakvik (2001) explains that a critical Γ of 2 is a very large number. It states that the estimated impact would be biased only if an unobserved variable caused the odds ratio to differ between receiving and nonreceiving households by 100%. Second, such a sensitivity analysis describes a "worst-case scenario" insofar as it only shows how the treatment effect estimations could be altered by hidden biases, but it does not indicate if these biases exist (Aakvik 2001, Becker and Caliendo 2007).

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