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Remittance inflow and smallholder farming practices. The case of Moldova

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Abstract

In the Republic of Moldova, a large number of households that received land shares after the break-down of the collective farm structure currently focus on semi-subsistence agriculture. Often, one or more members of these households have migrated abroad. This paper aims at assessing the impact of remittances on their agricultural production practices and investments. The authors rely on the rotating panel dataset of the Household Budget Survey for the period 2007–2013, and on an original survey carried out on a sample of 126 households in 2015. To test if remittance recipients replace family labour and self-produced inputs with mechanisation services and purchased inputs, a shadow agricultural wage is estimated. Logistic regressions are used to assess whether the occurrence of investments (land, machinery, or dairy cattle) is more probable in the case of remittance inflow. The results show that recipient households reduce their drudgery by substituting family labour and self-produced seeds and feed with mechanisation services and purchased inputs, without necessarily increasing production efficiency. The relationship between remittances and agricultural investments is very weak or negative. However, qualitative insights demonstrate that many investments (greenhouses, rototillers, walnut orchards, etc.) were possible thanks to remittances. Although most recipients do not invest in agriculture, the minority that does invest has access to remittances.

Keywords: smallholders; remittances; investment decisions; farming practices; Republic of Moldova.

1.   Introduction

In a number of formerly centrally-planned economies, the decollectivisation of agriculture and privatisation of land resulted in agricultural structures dominated by small farms. Romania, Latvia, Lithuania and Moldova, in particular, experienced an increase in the share of agriculture in employment, combined with a growing number of individual farms (Macours and Swinnen, 2005; Swinnen et al., 2005). Many of these smallholders focus on semi-subsistence farming. Indeed, apart from the small size of their plots, which is not enough to provide decent revenue, the shortage of agricultural credit and the unreliability of output markets obstruct the development of viable commercial farms. Furthermore, the lack of non-farm jobs on the rural labour market represents a constraint in pursuing alternative livelihood choices locally. International migration has thus become a widespread strategy, illustrated by the high inflow of remittances. The Republic of Moldova is a prime example of this development pattern. Here, the break-down of collective agriculture generated around 900,000 small family farms within a population of 3.55 million inhabitants (NBS, 2011), while, due to high rates of emigration, in the last decade remittances have accounted for 20–30% of the GDP (World Bank, 2017). But whether households use this income for consumptive purposes or to invest in and develop their farming businesses remains an open question.

46   The literature on migration and agricultural change focuses either on developing countries
47   in Latin America (Aguilar-Støen et al., 2016; Davis and Lopez-Carr, 2014; Gray, 2009; Gray and
48   Bilsborrow, 2014; Jacoby, 1993; Taylor et al., 2016), Asia (Adams Jr., 1998; Sunam and McCar-
49   thy, 2016) and Africa (Adams Jr., 1991), or on emerging countries, primarily China (de Brauw
50   and Rozelle, 2008; Liu et al., 2016; Qin and Liao, 2016; Rozelle et al., 1999). As for Eastern
51   Europe, both the impact of remittances on the overall economy (León-Ledesma and Piracha,
52   2004), and the relationship between migration and agricultural labour (Macours and Swinnen,
53   2005), or land use (Baumann et al., 2011) have been investigated. Due to the huge proportions
54   assumed by international migration in Moldova, the impact of remittances on its economy has
55   been assessed in specific studies (Lücke et al., 2009; Pinger, 2010). The relationship between
56   remittances and land use has been looked at by Bolganschi (2011). Based on the results of a
57   qualitative survey and on secondary data, she argues that migration causes farming households to
58   switch towards less labour-demanding production activities, and fosters farm exit, although most
59   emigrants maintain the property of their land. She does not, however, provide an in-depth analysis
60   at to whether remittance inflow generates any change in the agricultural practices of the house-
61   holds who do not exit farming.

62   Economic theory offers several channels for explaining how migration could affect labour-
63   sending rural households. First, abstracting from hidden unemployment, migration of labour force
64   should lead to an increase in the opportunity cost of labour (Singh et al., 1986). Second, remit-
65   tances can enable households to overcome credit constraints (Stark, 1991). Conditional upon the
66   possibility to hire labour as a compensation for migrated household members, remittances will be
67   invested in productive or non-productive durable assets. The empirical evidence from a range of
68   developing and transition economies is rather mixed. On the one hand, Taylor and Lopez-Feld-
69   man (2010) find for Mexicans migrating to the US that the incomes of sending households and
70   their agricultural productivity increase due to remittances. Similarly, using Mexican data, Böhme
71   (2015) finds that accumulated agricultural assets are greater in households receiving international
72   remittances, but cannot find evidence of investment in riskier activities, like livestock husbandry.
73   Furthermore, he shows that investments are subject to a life-cycle, that households with older
74   heads invest less, and that migrant households even disinvest more at later stages of their life
75   cycle than non-migrant households. Differentiating between productive and non-productive as-
76   sets, and controlling for asset accumulation effect, Chiodi et al. (2012) find evidence that rural
77   Mexican households tend to use remittances to invest in productive assets. On the other hand,
78   using farm household data from Albania, Kilic et al. (2009) find that non-farm income is used to
79   move out of crop production and, for commercial farms, to invest in livestock production. Also,
80   the intensity of arable land use follows an inverted N-shaped curve as rural out-migration in-
81   creases, due to the concurrent impact of labour shortage and intensified use of fertiliser and pes-
82   ticide inputs (Liu et al., 2016). Qin and Liao (2016) analyse the relationship between migration,
83   agricultural change and general regional development by qualitatively reviewing twenty case
84   studies from rural China. They find that agricultural production declines in regions with high out-
85   migration and general low economic development, while in more economically developed regions
86   out-migration and agricultural production seem to be positively related. Thus, whether remit-
87   tances are used for achieving agricultural modernisation depends on the context and, probably,
88   on household-specific characteristics.

89   This paper aims at assessing the impact of remittances on the production practices of Mol-
90   dovan smallholders. More specifically, it analyses whether households receiving remittances
91   change their on-farm labour use, and whether they invest at least part of their remittances into
92   agriculture. Differently from previous studies on this country, econometric analyses drawing from
93   a rich database—the database of the Household Budget Survey (HBS) of the National Bureau of

Statistics of the Republic of Moldova (NBS) for the period 2007–2013—were carried out, applying (and building on) the methodology developed by Skoufias (1994). A further contribution of this paper relates to the combination of quantitative analyses and qualitative insights from an original survey carried out by one of the authors in spring 2015 (hereafter, "2015-smallholder-survey"). To avoid endogeneity issues due to common characteristics driving households' decisions related to migration, production, and consumption, here panel data allow for a more consistent modelling of the relationship between remittance inflow, and smallholders' investment decisions. To our knowledge, this is the first study analysing the effect of remittances on agricultural investments in a transition country context. The case of Moldova is particularly relevant due to the paramount role played by family farming in the national economy and society, and to the signing of an Association Agreement between this country and the European Union (EU) in 2014, which is expected to generate interesting opportunities for commercial farmers.

The rest of the paper is structured as follows. Section 2 provides a short background on smallholder agriculture and international migration in Moldova. Section 3 introduces the data and the methodology. Section 4 presents and discusses the results of the econometric analysis, putting them in perspective using the insights from the 2015-smallholder-survey. Section 5 concludes and provides some policy implications.

2.   Smallholder agriculture and international migration in Moldova

Moldova is a small landlocked country in which agriculture has long been an important economic activity[1]. While a member of the USSR, the country was a net exporter of agro-food products to the rest of the Union (primarily wine, spirits, and fresh products, like fruits and vegetables)[2] (Gorton and White, 2003). Its agro-industrial complex was dominated by huge collective and State farms: the only form of family agriculture was the small plots allocated to the members of rural households and to urban workers, which accounted for 7% of the agricultural land. Households were also engaged in animal breeding, producing a large share of the national output of meat, milk, eggs, and sheep wool. Smallholders emerged as a result of the insider privatisation of collective and State farms. Although foreseen in the Land code of 1991, the process of land distribution didn't begin until 1998, when the Parliament passed the National Land Program, and was carried out in the form of "shares"[3].

The portion of privately-owned land grew from around nil to 67% in 2003. In 2001, over 500,000 individuals had received land shares, and over 200,000 had registered their household as a peasant farm, with an average size of 1.8 hectares. However, the reform overlooked the role of collective and State farms as providers of social services and managers of rural infrastructure (including irrigation systems), which fell into disrepair. Furthermore, in many cases the privatisation process turned into a "grab what you can" at local level (Ibidem: 321). Reformers expected a structure of middle-sized commercial family farms to emerge gradually through market-based

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[1] All studies on the Republic of Moldova, including this one, focus on the western region of the country (Bessarabia), since eastern Moldova (Transnistria) is not controlled by the national government. The surface of Bessarabia is 30,355 square kilometres and, as of 2017, its population is 3.55 million inhabitants, of whom 57% live in rural areas (NBS, 2017c). The share of territory covered by arable land and permanent crops (64% in 2014) is one of the largest in the world (World Bank, 2017).

[2] Until 2005, agri-food products and drinks accounted for over 50% of Moldovan exports, and were still accounting for 33% in 2016 (NBS, 2017c).

[3] Home gardens and household plots were assigned to the households farming them as "small shares". The land farmed collectively (arable land, orchards and vineyards) was divided into "big shares", whose size and composition were set at the level of municipality based on the local land endowment. Furthermore, "shares of values" of the assets of collective and State farms were created. All workers of these State farms, including pensioners and former workers as of 1 January 1992, were entitled to a share. Furthermore, up to 50% of the local land was distributed to local residents belonging to certain categories, if none of their family members were eligible (Möllers et al., 2016).

131   land transactions and investments, thus triggering the economic development of rural areas. In-
132   stead, the land market evolved slowly: in ten years, only 2% of the land changed ownership, the
133   average transaction involving 0.1 hectares (Cimpoieș, 2010). As in other post-Soviet countries,
134   commercial agriculture continues to be dominated by the large corporate farms that succeeded
135   their socialist counterparts (Lerman and Sutton, 2008; Small, 2007).

136   In the same year that land began to be privatised (1998), Moldova was severely hit by the
137   Russian financial crisis, which lead to the beginning of mass migration. Estimates of the stock of
138   international migrants vary: in 2014, Moldovan diplomatic missions gave a figure of 984,000, up
139   from 505,000 in 2011, while State border authorities gave a figure of 762,000 (IOM, 2016). Since
140   the country is located at the border between the Community of Independent States and the EU,
141   Moldovans migrate in either direction. The common Soviet past reduces the transaction costs of
142   moving to Russia, which has constantly attracted an absolute majority of migrants (550,000 in
143   2014), followed by Italy (150,000) (Ibidem). Migration to Russia tends to be short-term, so that
144   numbers fluctuate more (Lücke et al., 2009). In 2014, limited to temporary migrants (342,000),
145   72% came from rural areas, 64% were male, and the largest age group (35%) was represented by
146   25 to 34-year-olds (IOM, 2016). These figures, which had not changed significantly since 2009,
147   give an idea of the impressive outflow of labour force, accounting for between 25 and 50% of the
148   active population (Pinger, 2010: 145). Simultaneously, migration resulted in a sizeable inflow of
149   remittances, which peaked at 35% of the GDP in 2006, and declined to 22% in 2016, when Mol-
150   dova was ranked the seventh country in the world by remittances as a share of GDP (World Bank,
151   2017). During the period studied here, this figure ranged from 34% in 2007, to 27% in 2013
152   (Ibidem). Of special relevance for the analysis at hand is that remittances have always accounted
153   for around twice the share of family income in rural areas than in cities (23% *vs.* 12% in 2016)
154   (NBS, 2017c).

155   Despite migration, 94% of the almost 900,000 family farms (not necessarily registered)
156   detected by the most recent Agricultural Census in 2011 were active (NBS, 2011). This corre-
157   sponds to one active family farm for every 4.2 inhabitants: the highest incidence among European
158   and Central Asian countries[4]. These family farms were found to have an average size of 1.1 hec-
159   tares, and make up 43% of the total agricultural land (NBS, 2011): a much larger share than in
160   Russia or Ukraine, where, in 2008, corporate farms accounted for around 80% of the total land
161   (Lerman and Sutton, 2008). In 2016, agriculture and related activities produced 12% of the GDP,
162   while agricultural employment stood at 34% (NBS, 2017c). Considering that most land recipients
163   did not register their households as farms, and many pensioners cultivate their land, the real num-
164   bers are probably much higher. The prevalence of informal agricultural labour can also explain
165   why the share of active population in rural areas was as low as 41% in 2016 (Ibidem).

166   Based on the Agricultural Census of 2011, a large majority of Moldovan family farms
167   (86%) focus on subsistence production. Less than 9% sell over half of their output. Farms are
168   small (71% have a surface area below one hectare, and 99.7% below ten hectares) and operate
169   with rather old machinery, if at all (e.g., one tractor for every 54 farms, of which 83% are older
170   than 10 years). Only 0.7% of the land farmed by family farms is irrigated. Furthermore, family
171   farms rely almost exclusively on family labour (81% of 1.6 million working persons), or on rela-
172   tives (17%). Finally, only 0.1% of them keep books[5]. Nevertheless, they are more efficient and
173   productive than corporate farms (Lerman and Sutton, 2008: 100): since 1999, their total yearly
174   production at national level has continued to surpass that of the latter (which farm more land) by
175   1.5 to 2.3 times (NBS, 2017c). Despite this efficiency, family farms face tight credit constraints,

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[4] Authors' elaboration on data from FAO (2014), and the Moldovan Agricultural Census (NBS, 2011).
[5] Authors' elaboration on data from the Moldovan Agricultural Census (NBS, 2011).

176 which prevent them from modernising and turning into viable businesses to support future gener-
177 ations. This situation is due to three main reasons: they lack collateral apart from their land, as
178 banks tend to formulate excessive requests (or undervalue their assets); the supply is limited al-
179 most exclusively to short-term loans; and there is a lack of instruments facilitating access to credit,
180 such as guarantee funds (Moroz et al., 2015). In 2011, only 0.1% of these farms received a bank
181 loan, 7% obtained State subsidies, and less than 1% had access to other types of financing[6].

182 The agricultural sector is a cornerstone of the government's *National Development Strategy*
183 *Moldova 2020*, approved in 2012. The general goal of the strategy is to ensure sustainable growth,
184 and improve living conditions in rural areas by increasing "competitiveness and productivity"
185 (FAO, 2012: 22). In the meanwhile, in 2014, the international framework within which Moldova
186 elaborates its rural development policy underwent relevant changes, as its government and the
187 EU signed an Association Agreement (which also includes a Deep and Comprehensive Free Trade
188 Agreement). Much like in other sectors, agricultural policies were also linked to the general goal
189 of EU integration. This is expected to translate into new opportunities and constraints for small-
190 holders, as the EU—like many other international and State-based development agencies active
191 in the country—foresees financial assistance for the producers interested in farm modernisation
192 (e.g., for conforming to food quality and safety standards) (EU, 2014). Understanding the rela-
193 tionship between remittances and agriculture among smallholders can thus contribute to the suc-
194 cess of the ongoing rural development measures.

195
196 ## 3. Data and methods

197 ### 3.1. Data

198 Two types of data were used: the results of the 2015-smallholder-survey and the database of the
199 Moldovan HBS for the period 2007–2013.

200 The database of the 2015-smallholder-survey provides an explanatory framework, and
201 makes it possible to identify smallholders' motivations, as well as relationships that are not de-
202 tectable by means of purely quantitative data. This survey was implemented by a two-person team
203 (a man and a woman) using a structured questionnaire, which was read to an adult member of the
204 households (or to a married couple) in face-to-face interviews. The population of reference con-
205 sisted of farming households, defined as households cultivating some land and obtaining a non-
206 zero farm income. Participation was voluntary: respondents were identified using snowball sam-
207 pling, while interviewers controlled for the distribution of two stratifying variables (farm size and
208 age of the household head), which were kept in line with the Agricultural Census (NBS, 2011).
209 The final sample size was 126[7]. The period of reference for the answers was either the 12 months
210 before the interview, or the previous agricultural year (November 2013 to October 2014). All
211 monetary values were registered in current (2015) Moldovan *Lei* (singular: *Leu*, MDL), and were
212 then converted to EUR, using the 2015 exchange rate, for the purpose of presenting them in this
213 paper[8].

214 Within the sample, farm sizes range from 0.04 to 38.50 hectares. Excluding three farms of
215 more than ten hectares, which would not be classified as "small" by the NBS (2017a) and repre-
216 sent clear outliers, the average size is 1.60 hectares, compared to 1.07 in the Agricultural Census.
217 The average age of the household head is 56.5 years, compared to 53.1 in the Agricultural Census.

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[6] See previous footnote.
[7] A simple random sample of 126 households from a population of 898,768 returns a confidence interval of ±8.7% at a confidence level of 95%, or of ±11.5% at a confidence level of 99%. Due to stratification, the actual error margin is likely to be narrower.
[8] In 2015, the average official exchange rate was 20.8980 MDL/EUR (0.0479 EUR/MDL).

218 An absolute majority of interviews was conducted in the districts of Orhei and Telenești, along
219 the Răut River Valley or in the surrounding hills. These districts occupy a midway position be-
220 tween the capital and the periphery of the country; therefore, their agricultural sector is affected
221 neither by excessive closeness to the former, nor by extreme isolation. To improve sample repre-
222 sentativeness, 20 interviews were taken in three districts which present specific conditions:
223 Briceni, the northernmost of the country; Găgăuzia, a remote southern region inhabited by a Turk-
224 ish-speaking minority; and Chișinău city-district, affected by the spill-overs of the large market
225 of the capital.

226 Furthermore, semi-structured qualitative interviews were carried out with a rural develop-
227 ment manager of the EU Delegation in Chișinău, with the accountant of a village-based associa-
228 tion granting short-term loans to smallholders, and with two village-based land registry officers.

229 The second database is the rotating panel database of the HBS. The HBS aims at determin-
230 ing people's life levels by registering household incomes, expenditures, consumption, living con-
231 ditions, and related variables (NBS, 2017b). The sampling unit is the household, and the popula-
232 tion of reference is all people residing in Moldova outside Transnistria. Sampling follows a two-
233 stage procedure: after dividing the country into primary sampling units representing big cities,
234 small towns, or villages, a group of households from each unit is selected. Weights are included
235 to weigh every household according to the size of its unit. Every month, the NBS selects 814
236 households which must register their incomes and expenditures along a given period (the month
237 of the interview and the last 12 months for remittances and farm income, the last two weeks for
238 expenditures and self-consumed farm products). Monthly data aim at obtaining representative
239 samples on a quarterly or yearly basis. In 2007–2013, yearly sample sizes ranged from a maxi-
240 mum of 6,133 units in 2008 to a minimum of 5,082 in 2013, for a total of 39,414 over the entire
241 period.

242 Around half of the households taking part in the HBS (from 3,012 in 2007, to 2,437 in
243 2013, for a total of 18,804 single observations) are included in a panel study based on a rotation
244 scheme. They are interviewed up to four times, once every 12 months. For most panel households,
245 less than four observations are available in the period 2007–2013, since they entered the study
246 either before 2007, or after 2010. This time span is not long enough to model phenomena like
247 farm exit, but allows for changes in other key variables to be observed.

248 The HBS does not focus exclusively on farming households. Therefore, only households
249 earning farm income (either in kind or in money) were selected. Choosing an appropriate defini-
250 tion of "farming household" was not trivial and this one was selected for its inclusiveness, allow-
251 ing for the detection of a larger spectrum of situations and diverse dynamics. Indeed, while the
252 households obtaining over half of their income from farming are few, agriculture represents an
253 important income source and life activity for many more. The sample size resulting from this
254 definition is 30,119. The number of households decreases gradually, from 4,627 in 2007, to 3,995
255 in 2013. Of these, 14,503 are panel observations but, for 2,158 households, only one observation
256 is available.

257 Remittance-recipient households were defined as households receiving money from
258 abroad, regardless of the amount or the sending person (a member of the family, a relative, or a
259 friend). Indeed, the latter information is not available in the database, and the variable indicating
260 whether a specific household member was missing is almost empty. No household in any year
261 reported receiving in-kind remittances, so the sum is made up of monetary transfers only. Internal
262 remittances from non-household members are included within a residual income aggregate, and
263 could not be extracted; furthermore, this aggregate is much smaller than international remittances

264 (88 EUR *vs.* 364 EUR on average for the entire population), and is rarely worth over 600 EUR
265 (10,000 MDL). Hence, it can barely have a relevant impact on agricultural practices and invest-
266 ments. Based on this definition, 7,871 farming households (26%) are recipients, while 22,248
267 (74%) are not. Among panel households for whom more than one observation is available, 3,251
268 are recipients, while 9,094 are not.

269   Within the HBS database, monetary values are expressed in current MDL. Before carrying
270 out the econometric analysis, they were deflated to obtain constant 2007 prices. For the purpose
271 of presenting them in this paper, they were converted into EUR using the 2007 exchange rate[9].The
272 2015-smallholder-survey and the HBS will be analysed in parallel. Indeed, the two samples are
273 easily comparable: first, the definition of the farming household is the same; second, as already
274 mentioned, the districts covered by the 2015-smallholder-survey represent the country well.

275
276 **3.2.   Methodology**

277 The econometric analysis presented here relies on HBS data for the years 2007 to 2013. All equa-
278 tions were estimated using pooled time-series and cross-section data (like in Skoufias, 1994),
279 ignoring sample weights to avoid mixing them (as suggested by Signoret, 2003).

280   Before assessing if remittances have an impact on production and investment behaviours,
281 the differences between recipient and non-recipient farming households in terms of demographics
282 and other variables were tested by means of a logit regression (where the dependent variable was
283 a dummy turning one if the family received remittances, zero otherwise), and through quantile
284 regressions estimated among recipients only (using the median, the third quartile, and the 90th
285 percentile, respectively). Based on these estimates, variables for matching recipient and non-re-
286 cipient households were identified.

287   To assess whether recipient households tend to replace family labour and self-produced
288 inputs with services and purchased inputs, the shadow value of family labour was calculated. The
289 first step consisted in estimating agricultural production functions.

290   Four Cobb-Douglas-shaped production functions were estimated: two with male, female
291 and child labour separately (like in Skoufias, 1994; Le, 2009), and two with total family labour.
292 For each setup, an equation was estimated using generalised two-stage least square random-ef-
293 fects[10], and another using the single-equation generalised method of moments (Jacoby, 1993; Le,
294 2009), both with instrumental variables (IV). All variables referring to agricultural family labour
295 and variable farm inputs were instrumented. Due to the difficulty in finding appropriate instru-
296 ments (the HBS database reports only the expenditure for inputs, without prices), dummy varia-
297 bles for macro-regions were included to account for price variations[11]. In contrast to developing

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[9] In 2007, the average official exchange rate was 16.5986 MDL/EUR (0.0602 EUR/MDL). In 2013, the two-stage sampling adopted in the HBS resulted in a standard error of ±1.35 EUR for individual income estimates, and ±1.28 EUR for consumption estimates, at a confidence level of 95% (NBS, 2017b).

[10] In line with Skoufias (1994), a fixed-effect model was also estimated, and the Hausman test of the random-effects versus fixed-effects specification calculated. The test favoured the latter if both covariance matrices were based on disturbance variance estimates from the efficient estimator, but the difference matrix was not positive definite, putting this result in doubt. The random-effect model was finally retained for several reasons. First, the average number of observations per household is limited (1.3), so that fixed-effects could barely be calculated; second, the R-squared index is significantly higher for the random-effects estimate (0.3899 vs. 0.0758); third, the results of the random-effects estimate were in line with those obtained with the generalised method of moments. The follow-up of the analysis was also performed with the shadow wage and incomes calculated from the fixed-effect model, and the results in terms of labour use did not change.

[11] The lists of the variables instrumented and of the instruments are provided in the Tables.

countries in Latin America or Southeast Asia, male and female labour is almost perfectly substitutable in Moldova, while child labour is secondary. Therefore, only the production functions with total family labour are retained in the Results Section. Production functions take the form:

$$ln(Y_{h,t}) = \beta_0 + \sum_i \beta_i ln(L_i)_{h,t} + \sum_j \gamma_j ln(C_j)_{h,t} + \sum_k \alpha_k N_{k_{h,t}} + \sum_l \delta_l ln(G_l)_{h,t} + \sum_m \theta_m A_{m_{h,t}} + \sum_n \varepsilon_n D_{n_{h,t}} + v_{h,t} \quad (1)$$

where $Y_{h,t}$ is the value of the total agricultural production of farming household h in year t, β_0 is a constant term, β_i's, γ_j's, α_k's, δ_l's, θ_m's and ε_n's are parameters, L_i are the hours of i types of labour (either female, male and child separately, or total family labour), C_j are the cost of j inputs (including mechanisation services and hired labour), N_k are the number of k types of animals, G_l are the surfaces (in ares[12]) of l types of land[13], A_m are m household characteristics, D_n are location and other variables, and v is an error term for the effect of omitted variables.

Using the coefficients from the production functions, agricultural shadow wages and shadow incomes were calculated. Unlike in previous analyses (Skoufias, 1994; Le, 2009), home labour and self-produced goods were not included in income due to the lack of data. The shadow cost of family labour was obtained by multiplying the shadow wages by the number of hours spent working on the family farm; then, its incidence on total farm costs (including shadow costs) was calculated. The share of internalised inputs was obtained by summing up the costs of self-produced feed and seeds (available in the database) with the shadow cost of family labour[14]. The formulas to calculate shadow wages $\widehat{w}^*_{i\,h,t}$ (2), shadow incomes $\widehat{V}^*_{h,t}$ (3), and labour costs C_l (4) are, respectively:

$$\widehat{w}^*_{i\,h,t} = \beta_i * (\widehat{Y}_{h,t}/L_{i_{h,t}}) \quad (2)$$

$$\widehat{V}^*_{h,t} = \widehat{Y}_{h,t} - \sum_i \widehat{w}^*_{i\,h,t} W_{i_{h,t}} - \sum_j C_{j_{h,t}} + \sum_p I_{p_{h,t}} \quad (3)$$

$$C_l = \sum_i \widehat{w}^*_{i\,h,t} L_{i_{h,t}} \quad (4)$$

where, for each household h in year t, $\widehat{Y}$ is the fitted value of farm output, W_i is the labour supplied (both on-farm and off-farm) by each type i of family members (males, females and children), and I_p are off-farm incomes, including eventual incomes from renting land, and from providing mechanisation services. The incidence of labour (5), and of internalised inputs (6) are, respectively:

$$\pi_{l_{h,t}} = C_{l_{h,t}} \Big/ \left(C_{l_{h,t}} + \sum_j C_{j_{h,t}} \right) \quad (5)$$

$$\pi_{i_{h,t}} = \left(C_{l_{h,t}} + C_{f_{h,t}} + C_{s_{h,t}} \right) \Big/ \left(C_{l_{h,t}} + \sum_{j \neq f,s} C_{j_{h,t}} \right) \quad (6)$$

where C indicates a cost, and s and f (here, as well as in the formulas below) refer to self-produced seeds (and seedlings) and feed, respectively.

Labour supply functions were estimated using two-stage least squares regressions with IV, considering all households with non-zero farm labour (as in Skoufias, 1994)[15]. Then, they were estimated for remittance-recipients and for non-recipient households separately, thus obtaining the elasticity of the labour supply with respect to shadow wages and incomes for both household

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[12] Due to the small farm sizes, hectares were converted into ares (1 are = 0.01 hectares) to avoid too small coefficients.
[13] Either "small shares", generally used for self-consumption crops, and "big shares", used for orchards or for the extensive cultivation of cereals.
[14] The shadow agricultural wage, the shadow income, and the shares of family labour and internalized inputs were calculated from each of the four production functions. The results with total family labour are retained in the Results Section, while those with male, female and child labour separately are presented within the Supplementary material.
[15] Labour supply functions were estimated also for males and females separately (as in Le, 2009); estimates are presented within the Supplementary material.

326 types. The labour supply functions for total family labour (7), male labour (8), and female labour
327 (9) take the following forms, respectively:

$$ln(W_{tot_{h,t}}) = \rho_0 + \rho_1 ln(\hat{w}^*_{tot_{h,t}}) + \rho_3 ln(\hat{V}^*_{h,t}) + \sum_m \theta_m B_{m_{h,t}} + \sum_n \varepsilon_n H_{n_{h,t}} + \eta_{h,t} \tag{7}$$

$$ln(W_{M_{h,t}}) = \rho_0^M + \rho_1^M ln(\hat{w}^*_{M_{h,t}}) + \rho_2^M ln(\hat{w}^*_{F_{h,t}}) + \rho_3^M ln(\hat{V}^*_{h,t}) + \sum_m \theta_m^M B_{m_{h,t}}^s + \sum_n \varepsilon_n^M H_{n_{h,t}}^s + \eta_{h,t} \tag{8}$$

$$ln(W_{F_{h,t}}) = \rho_0^F + \rho_1^F ln(\hat{w}^*_{F_{h,t}}) + \rho_2^F ln(\hat{w}^*_{M_{h,t}}) + \rho_3^F ln(\hat{V}^*_{h,t}) + \sum_m \theta_m^F B_{m_{h,t}}^s + \sum_n \varepsilon_n^F H_{n_{h,t}}^s + \eta_{h,t} \tag{9}$$

328 where, for each household h in year t, W_{tot} and $\hat{w}^*_{tot}$ indicate, respectively, the labour supply and
329 the shadow wage calculated for all family members, W_M and $\hat{w}^*_M$ indicate those for male members,
330 and W_F and $\hat{w}^*_F$ those for female members. B is a vector of household characteristics (different in
331 every equation), D is a vector of location and other variables, η is an error term for the effect of
332 omitted variables, and ρ_s's are the parameters to be estimated.

333   Before testing whether recipient and non-recipient households adopt significantly different
334 production strategies, the two groups were matched using propensity score matching. The pro-
335 pensity score was calculated with a logit regression where the dependent variable was a dummy
336 turning one for remittance recipients, zero otherwise. T-tests of difference of means between re-
337 mittance recipients and their matched non-recipient peers were implemented for the shares of
338 labour costs and of internalised inputs. A bootstrapped value of the differences was also calculated
339 to test whether it was significantly different from zero.

340   Nine more production indicators were calculated, and the difference between recipient and
341 non-recipient household tested after propensity score matching; for this analysis, input and output
342 variables were expressed in thousand MDL, family labour in hours, and land in ares:

343 1.   the intensity of purchased inputs on farmed land: $\left(\sum_{j \neq \{f,s\}} C_{j_{h,t}}\right) / \left(\sum_l G_{l_{h,t}}\right)$;

344 2.   the intensity of family labour on farmed land: $\left(\sum_i L_{i_{h,t}}\right) / \left(\sum_l G_{l_{h,t}}\right)$;

345 3.   the ratio of family labour to purchased inputs: $\left(\sum_i L_{i_{h,t}}\right) / \left(\sum_{j \neq \{f,s\}} C_{j_{h,t}}\right)$;

346 4.   the ratio of purchased inputs to farm output: $\left(\sum_{j \neq \{f,s\}} C_{j_{h,t}}\right) / Y_{h,t}$;

347 5.   the productivity of family labour (farm output unit per unit of family labour): $Y_{h,t} / \left(\sum_i L_{i_{h,t}}\right)$;

348 6.   the productivity of land (unit of farm output per unit of land farmed): $Y_{h,t} / \left(\sum_l G_{l_{h,t}}\right)$;

349 7.   the productivity of purchased inputs (unit of farm output per input unit): $Y_{h,t} / \left(\sum_{j \neq \{f,s\}} C_{j_{h,t}}\right)$;

350 8.   the share of animal production in total farm output: $Y_{h,t}^A / Y_{h,t}$;

351 9.   the incidence of farm sales (i.e., of monetary farm income) on total output (in kind and in
352   money): $Y_{h,t}^M / Y_{h,t}$.

353   To evaluate whether remittance recipients are more likely to invest in agriculture than non-
354 recipient households, both qualitative insights from the 2015-smallholder-survey, and economet-
355 ric analyses were used. First, examples of investments, not necessarily of remittances (e.g. roto-
356 tillers, greenhouses, walnut orchards, etc.), were identified through the 2015-smallholder-survey,
357 and are provided in the Results Section. In addition to providing information on actual invest-
358 ments, respondent households were asked how they would spend non-repayable sums of 50,000
359 EUR and 1,000 EUR, respectively. Three investment options that could be detected from the HBS
360 database were selected for further analysis: dairy cattle, agricultural machinery, and arable land
361 (either purchased or rented, since land rental represents a very common instrument for land con-
362 solidation, Möllers et al., 2016). Although the literature on remittance investment patterns reveals
363 that receiving households rarely opt for traditional agriculture as a livelihood strategy, these spe-
364 cific investments were chosen to test three findings of the 2015-smallholder-survey. First, small-

scale milk and cheese production emerged as a viable strategy for providing a constant side income to rural dwellers. Second, apart from traditional farming, agricultural machinery was used either to provide mechanisation services to other smallholders, thus ensuring a discreet income, or to reduce the drudgery of part-time farming (e.g., rototillers). Finally, respondents highlighted the importance of land ownership for achieving self-fulfilment, and some examples of land purchase for performing low-input agriculture were observed.

Only panel households were included in the study of farm investments. An investment (disinvestment) was registered if the variables indicating the asset showed a positive (negative) difference across years. For dairy cattle, the number of heads owned (2008–2013) was considered. For farm machinery, when one of the dummies indicating ownership of tractors, plugs, trailers, combines, or seeders turned from zero to one, an investment was registered, otherwise a disinvestment. For land, if the surface available to a household grew, an investment was registered, otherwise a disinvestment. Categorical variables (investment, no change, and disinvestment) were, thus, created.

The relationship between remittances and farm investments was assessed by means of multinomial logistic regressions of the abovementioned categorical variables on income variables, household characteristics (head age and sex, and family size), and location dummies (for urban areas, and regions). Three income typologies were considered: (1) remittances; (2) earned incomes (salaries and self-employment income); and (3) non-earned incomes (pensions and other welfare payments). For each of the three investments, four models were estimated. In the first model, income variables corresponded to the amount (in thousand MDL) in the current year. In the second one, variables for the amount in the previous year were also included. In the third model, incomes were represented, instead, by dummies for the availability of each type of income in the current year. In the fourth one, dummies for their availability in the previous year were also included[16]. Only the results of the estimate of the second model (with the current and lagged amount of the three income typologies as independent variables) are displayed in the Results Section[17].

Finally, t-tests were implemented to assess whether the shares of households making one of the three investments differed significantly between remittance recipients and non-recipients. First, the two groups were matched by means of propensity score matching. Bootstrapped values of the differences were also calculated to test whether they were significantly different from zero.

4.   Results

Throughout the entire period 2007–2013, 80% of the households included in the HBS database owned some land. The average property was 1.49 hectares but, due to leases (mostly to corporate farms, as reported by Möllers et al., 2016), only 0.74 hectares were available on average. The households farming some land were 78%, the average size being 0.30 hectares. Since rural households are overrepresented in the database, more reliable estimates can be obtained for 2013 using sample weights: 72% of the households owned land (1.32 hectares on average), the same percentage had access to some of it (although only to 0.64 hectares), and 69% were farming some (0.29

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[16] Since the HBS panel rotates, cumulated incomes along many years could not be calculated. The Variance Inflation Factor was used to check for multicollinearity between current and lagged values, but no multicollinearity was observed.

[17] The results of the estimates of the other models are provided within the Supplementary material.

405 hectares). Among farming households, the average yearly farm output (including in kind) at con-
406 stant 2007 prices was 416 EUR over the entire period, and 348 EUR in 2013 (using weights). By
407 comparison, family income accounted for 1,821 EUR and 1,862 EUR, respectively.

408   In 2013, farm income was the most widespread means of income (70% of the households),
409 followed by pensions and other welfare payments (60%), waged income (49%), remittances
410 (23%), and earnings from off-farm businesses (less than 1%). On average, remittances represented
411 the highest sum after waged incomes (460 EUR *vs.* 858 EUR), being slightly above welfare pay-
412 ments (409 EUR), more than twice farm revenues (187 EUR), and almost three times the earnings
413 from off-farm businesses (142 EUR). Property income was negligible (4 EUR). For most house-
414 holds, land ownership provided a simple supplement to wages or welfare: those earning over half
415 of their income from farming were only 6%; on average, farming accounted for 13% of the income
416 (18% among farming households).
417
418 Table 1. Differences between recipient and non-recipient households, and among recipients.

Explanatory variables	Logit for remittances (dummy)		Quantile regression (median)		Quantile regression (75th)		Quantile regression (90th)	
	Odd ratios	Std. err.	Coeff.	Std. err.	Coeff.	Std. err.	Coeff.	Std. err.
Household size	1.253	0.016	2.684	0.167	5.005	0.326	7.185	0.682
Household head age	1.008	0.007	-0.430	0.091	-0.571	0.178	-1.100	0.372
Household head age (squared)	1.000	0.000	0.003	0.001	0.003	0.002	0.006	0.004
Male household head (dummy)	0.540	0.017	-1.349	0.441	-1.547	0.862	-0.571	1.806
Urban location (dummy)	1.279	0.059	0.729	0.672	-0.969	1.312	-5.249	2.749
North (dummy)	0.855	0.029	3.088	0.509	2.875	0.994	1.786	2.084
South (dummy)	1.448	0.053	-1.472	0.511	-3.846	0.998	-8.579	2.092
Chișinău (dummy)	0.938	0.095	1.577	1.577	-0.194	3.079	-2.897	6.451
Earned income (1,000 MDL [1])	0.958	0.002	-0.084	0.016	-0.092	0.032	-0.140	0.067
Non-earned income (1,000 MDL [1])	0.954	0.003	-0.214	0.037	-0.323	0.073	-0.505	0.153
Farm income (1,000 MDL [1])	0.966	0.003	-0.010	0.036	-0.075	0.070	-0.361	0.146
Land farmed (ares)	1.008	0.001	0.003	0.011	-0.026	0.022	0.006	0.045
Low education (dummy)	0.636	0.022	-2.937	0.525	-4.855	1.025	-8.856	2.148
High education (dummy)	1.012	0.063	2.625	0.935	6.647	1.826	14.531	3.827
Constant term	1.191	0.202	25.469	2.256	41.444	4.405	79.830	9.230
Number of observations	30,119		7,871		7,871		7,871	

Notes: [1] 1,000 MDL correspond to 60 EUR.
Source: Authors' elaboration on data from the Moldovan HBS.

419
420   The 2015-smallholder-survey showed that, due to the important role of homemade food
421 and agricultural activities for self-reward and social appraisal, many smallholders choose to farm
422 even if it results in financial loss (Piras, 2016). Rather than selling their land, or leaving it fallow,
423 they use their waged income and remittances to cover farm costs. Thirty-five respondents (30%)
424 had received remittances in the last 12 months, although the frequency was not regular. Based on
425 HBS data for 2013, farming households receiving waged income or remittances were 41% and
426 25%, respectively. On average, these represented the largest types of earnings but, unlike for the
427 overall population, among farming households waged income was only slightly above remittances
428 (558 EUR *vs.* 449 EUR). Furthermore, due to a strongly right-skewed distribution, the average
429 amount of waged income for farming households with off-farm workers was lower than the av-
430 erage remittances for recipient farming households (1,358 EUR *vs.* 1,551 EUR).

431   Table 1 shows the results of the logit and quartile regressions identifying the differences
432 between remittance recipients (coded one) and other households (coded zero), and among the
433 former. Recipient households are larger, are more often female-led (probably due to the absence
434 of the husband), more often urban-based or from the south (more rarely from the north or from
435 Chișinău), earn lower "internal" incomes (including from farming, despite using a larger area of
436 land), and are less likely to be poorly educated. Furthermore, younger households, as well as those
437 from rural areas, from the north, and with a higher education tend to receive more remittances.
438 These findings suggest a need to implement propensity score matching.
439

11

4.1. Remittances and production practices

441 Table 2 presents two different estimates of the agricultural production functions for the house-
442 holds using non-zero family labour[18]. Regardless of the estimation method, the direction of the
443 coefficients does not change, meaning that the results are robust. Farm production is positively
444 correlated with family labour, expenditure on seeds, mechanisation services and other inputs, an-
445 imals (particularly cows) and male household heads. In contrast, hiring labour, larger land areas
446 (both "small shares" and "big shares"), and older ages of the family head have a negative impact.
447 Even the respondents to the 2015-smallholder-survey indicated the low productivity of hired ag-
448 ricultural workers (Piras, 2016).
449
450 Table 2. Estimates of the Cobb-Douglas production functions.

Farm output (1,000 MDL [1]) (log)	Random-effects IV regression (Model 1)		GMM IV regression (Model 2)	
	Coeff.	Std. err.	Coeff.	Std. err.
Household labour (hours) (log) [1]	0.2550	0.0195	0.2686	0.0264
Hired labour costs (1,000 MDL [2]) (log) [1]	-2.4967	0.3800	-3.9053	0.6018
Seed costs (1,000 MDL [2]) (log) [1]	1.2333	0.1182	1.2566	0.1455
Feed costs (1,000 MDL [2]) (log) [1]	-0.1683	0.1602	-0.2165	0.1856
Other costs (1,000 MDL [2]) (log) [1]	1.1224	0.1103	1.2104	0.1295
Mechanisation services costs (1,000 MDL [2]) (log) [1]	0.7051	0.1851	0.5300	0.2129
Number of cows	0.1579	0.0226	0.1579	0.0275
Number of sheep	0.0118	0.0020	0.0107	0.0028
Number of goats	0.0130	0.0060	0.0227	0.0179
Number of pigs	0.0099	0.0108	0.0713	0.0227
Number of poultry	0.0003	0.0005	0.0004	0.0007
Number of other animals	0.0092	0.0013	0.0106	0.0025
Size of the "small share" (ares) (log)	-0.0371	0.0205	-0.0353	0.0249
Size of the "big share" (ares) (log)	-0.2874	0.0716	-0.1603	0.0879
Land quality (%)	-0.0031	0.0009	-0.0026	0.0011
Household head age	-0.0040	0.0026	-0.0054	0.0028
Household head age squared	0.0000	0.0000	0.0000	0.0000
Male household head (dummy)	0.0880	0.0129	0.0992	0.0143
Education low (dummy)	0.0166	0.0133	0.0097	0.0146
Education high (dummy)	0.0195	0.0274	0.0491	0.0402
R-squared	0.3899		0.2926	
Number of observations	16,426		16,426	

Notes: [1] Endogenous variables. [2] 1,000 MDL correspond to 60 EUR.
Instruments: number of family members working on the farm, number of adult family members (aged 18 to 64), number of children (aged 4 to 17), number of elderly people (aged over 64), dummy for ownership of a tractor, dummy for urban locations, and regional dummies to account for price variations. Dummies for the year and the month of the interview and for inputs with zero value, and intercepts included in the regressions but not shown in the table. Constant of one added to all inputs before taking the logarithm.
Source: Authors' elaboration on data from the Moldovan HBS.

451
452 Table 3 gives the estimates of the labour supply functions. The elasticity of the labour sup-
453 ply with respect to the shadow agricultural wage is clearly positive[19], while its elasticity with
454 respect to the shadow income is negative, as expected. The coefficients maintain the same signs
455 when the functions are estimated separately for remittance recipients and non-recipients. How-
456 ever, the elasticities with respect to the shadow wages (either negative or positive) and incomes
457 (negative) are higher among recipients, meaning that the latter are more reactive to changes in
458 these variables. Furthermore, the amount of labour supplied by Moldovan families is positively
459 associated with the number of adult members, being married—as also detected by Skoufias (1994)
460 using Indian data—and with higher ages of the family head (although it decreases for very old
461 ages). In comparison, it is negatively associated with high education levels, probably due to the
462 higher productivity of labour in this case.
463

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[18] The test for endogeneity indicates that the variables instrumented are, indeed, endogenous.
[19] When the labour supply functions for male and female members are estimated separately, the elasticity with respect to their own shadow wage is negative, suggesting that the labour supply curve is S-shaped for wages close to the subsistence level (Dessing, 2002). Furthermore, the opposite signs of the coefficients associated with the wages of family members of different sex provides evidence of a substitution effect between male and female labour. Tables with the results of the estimates are provided in the Supplementary material.

464 Table 3. IV two-stage least squares estimates of the labour supply functions with shadow wages
465 and incomes calculated respectively from Model 1 and Model 2 of Table 2.

Shadow wage and income from Model 1	All households		Remittance recipients		Non-recipient families	
Household labour supply (hours) (log)	Coeff.	Std. err.	Coeff.	Std. err.	Coeff.	Std. err.
Household shadow wage (1,000 MDL ^{2}) (log) [1]	189.5492	14.2934	188.0882	26.5480	166.8521	15.1744
Shadow income (1,000 MDL ^{2}) (log) [1]	-0.2421	0.0260	-0.1579	0.0292	-0.1499	0.0485
Household head age	0.0126	0.0052	0.0110	0.0069	0.0121	0.0065
Household head age squared	-0.0001	0.0000	-0.0001	0.0001	-0.0001	0.0001
Married (dummy)	0.3199	0.0286	0.1164	0.0431	0.3666	0.0348
Education low (dummy)	0.0184	0.0250	0.0527	0.0364	0.0009	0.0285
Education high (dummy)	-0.1651	0.0542	-0.1561	0.0834	-0.1948	0.0614
Number of adults	0.3543	0.0127	0.3813	0.0169	0.3215	0.0162
Number of children	0.0750	0.0136	0.0575	0.0163	0.0771	0.0172
Number of infants	0.0319	0.0300	-0.0137	0.0370	0.0367	0.0379
Over-identification (p-value)	0.0294		0.0000		0.0000	
Number of observations	16,426		4,748		11,678	
Shadow wage and income from Model 2	All households		Remittance recipients		Non-recipient families	
Household labour supply (hours) (log)	Coeff.	Std. err.	Coeff.	Std. err.	Coeff.	Std. err.
Household shadow wage (1,000 MDL ^{2}) (log) [1]	146.6000	11.8192	179.5616	25.5652	122.8072	11.8895
Shadow income (1,000 MDL ^{2}) (log) [1]	-0.2292	0.0280	-0.1551	0.0318	-0.1396	0.0518
Household head age	0.0137	0.0055	0.0119	0.0075	0.0119	0.0068
Household head age squared	-0.0001	0.0001	-0.0001	0.0001	-0.0001	0.0001
Married (dummy)	0.3179	0.0306	0.1062	0.0474	0.3613	0.0366
Education low (dummy)	0.0225	0.0267	0.0667	0.0402	0.0041	0.0298
Education high (dummy)	-0.1738	0.0582	-0.1540	0.0911	-0.1983	0.0645
Number of adults	0.3442	0.0139	0.3726	0.0186	0.3153	0.0172
Number of children	0.0729	0.0146	0.0529	0.0180	0.0753	0.0181
Number of infants	0.0304	0.0321	-0.0121	0.0404	0.0277	0.0395
Over-identification (p-value)	0.0382		0.0000		0.0001	
Number of observations	16,426		4,748		11,678	

Notes: [1] Endogenous variables. [2] 1,000 MDL correspond to 60 EUR.
Instruments: exogenous income of the household (1,000 MDL – 60 EUR) (log), area of land farmed (ares) (log), number of family members working on the farm (aged 18 to 64), and dummy for urban locations. Dummies for the year and the month of the interview, for the region and for zero or negative shadow incomes, and intercepts included in the regressions but not shown in the table. Constant of one added to all inputs before taking the logarithms.
Source: Authors' elaboration on data from the Moldovan HBS.

466
467   The results of the tests of difference in the mean incidence of family labour and of inter-
468 nalised input costs between recipient and non-recipient households are shown in Table 4. The
469 difference in the shadow wages was also tested, but it was found to be non-significant. The inci-
470 dence of family labour and of internalised inputs on total farm costs differs significantly regard-
471 less of the estimation method. Family labour accounts for 50–52% of farm costs among recipients,
472 compared to 53–55% among non-recipients. Internalised inputs account for 58–59% and 62–63%,
473 respectively. These results suggest that recipients tend to substitute family labour and self-pro-
474 duced inputs with mechanisation services provided by contractors (as also observed during the
475 2015-smallholder-survey), and with purchased inputs.
476
477 Table 4. Incidence of family labour (calculated from Model 1 and Model 2 of Table 2) and of in-
478 ternalised inputs on total farm expenditures among recipient and non-recipient households.

Variable		Recipients	Others	Diff.	Std. err.	Bootstr. diff.	Std. err.
Share of labour costs (from Model 1)	Unmatched	0.5019	0.5272	-0.0253	0.0026	-0.0409	0.0026
	Matched	0.5011	0.5326	-0.0316	0.0044		
Share of internalised inputs (from Model 1)	Unmatched	0.5782	0.6188	-0.0406	0.0028	-0.0494	0.0027
	Matched	0.5779	0.6173	-0.0394	0.0047		
Share of labour costs (from Model 2)	Unmatched	0.5158	0.5435	-0.0277	0.0028	-0.0429	0.0029
	Matched	0.5151	0.5481	-0.0331	0.0046		
Share of internalised inputs (from Model 2)	Unmatched	0.5896	0.6317	-0.0421	0.0029	-0.0509	0.0030
	Matched	0.5893	0.6297	-0.0403	0.0049		

Notes: Households matched on the number of adult members, their average age (and its squared value), the gender of the household head, location dummies (urban settlement, north, centre and south; Chişinău omitted), earned income (1,000 MDL – 60 EUR), non-earned income (1,000 MDL – 60 EUR), farm income (1,000 MDL – 60 EUR), available land (ares), and year dummies. Values calculated on 16,324 households (2008–2013) producing a non-zero farm output and using a non-zero amount of family labour for which the propensity score could be estimated (11,677 untreated, 4,647 treated).
Source: Authors' elaboration on data from the Moldovan HBS.

479
480   All production indicators assume values that are significantly different between remittance
481 recipient and non-recipient households, as shown in Table 5. On average, recipient households

482   spend 523 EUR on purchased inputs, and employ 7,100 hours of family labour per hectare farmed,
483   compared to 489 EUR and 7,830 hours among non-recipients. Hence, remittance recipients show
484   higher labour productivity (0.36 *vs.* 0.33 EUR per hour), and lower land productivity (1,018 EUR
485   *vs.* 1,100 EUR per hectare). Due to the lower labour to inputs ratio (15.4 *vs.* 17.2 hours per EUR
486   spent), the incidence of monetary costs on farm production is higher among them (39% *vs.* 32%),
487   and the productivity of purchase input lower (4.12 *vs.* 4.36 units per unit spent). Finally, recipients
488   obtain a higher share of their farm output from animal breeding (39% *vs.* 37%), and sell a smaller
489   share of their production (11% *vs.* 15%)[20]. The latter figure seems to confirm the qualitative find-
490   ing of the 2015-smallholder-survey, reported by Piras (2016), that many smallholders who earn a
491   good income off-farm (including remittances from household members) continue to engage in
492   agriculture (eventually part-time) for non-financial reasons. Indeed, this survey showed that
493   working one's land and producing one's own food yields self-fulfilment and social appraisal,
494   especially in the villages. These smallholders are not interested in systematic commercialisation
495   of farm output.
496
497   Table 5. Difference in the values of production indexes among recipients and non-recipients.

Variable		Recipients	Others	Diff.	Std. err.	Bootstr. diff.	Std. err.
Intensity of purchased inputs on land (1,000 MDL/are [1])	Unmatched	0.0877	0.0753	0.0124	0.0026	0.0101	0.0030
	Matched	0.0868	0.0812	0.0056	0.0044		
Intensity of labour on land (hours/are)	Unmatched	71.3463	76.3946	-5.0483	1.7752	-5.1070	2.1189
	Matched	71.0343	78.2994	-7.2651	3.0176		
Labour to input ratio (hours/1,000 MDL [1])	Unmatched	920.6582	1045.7013	-125.0432	14.7387	-134.9787	17.1630
	Matched	926.1547	1038.0795	-111.9248	23.9181		
Purchased input cost on farm output	Unmatched	0.3932	0.2983	0.0949	0.0110	0.0495	0.0086
	Matched	0.3871	0.3187	0.0684	0.0148		
Labour productivity (1,000 MDL/hour [1])	Unmatched	0.0060	0.0059	0.0000	0.0001	0.0008	0.0001
	Matched	0.0060	0.0055	0.0005	0.0002		
Land productivity (1,000 MDL/are [1])	Unmatched	0.1689	0.1924	-0.0234	0.0051	-0.0124	0.0044
	Matched	0.1689	0.1826	-0.0137	0.0082		
Productivity of purchased inputs	Unmatched	4.0950	4.6440	-0.5489	0.0614	-0.1529	0.0778
	Matched	4.1181	4.3632	-0.2452	0.0967		
Animal production on total farm production	Unmatched	0.3940	0.3761	0.0180	0.0038	0.0252	0.0043
	Matched	0.3949	0.3722	0.0227	0.0063		
Farm sale on total farm production	Unmatched	0.1123	0.1454	-0.0331	0.0033	-0.0233	0.0045
	Matched	0.1133	0.1518	-0.0385	0.0055		

Notes: [1] 1,000 MDL correspond to 60 EUR. Households matched on the same variables as in Table 4. Values calculated on 18,831 households (2007–2013) producing a non-zero farm output and using non-zero family labour for which the propensity score could be estimated, and the index calculated (18,682 for input intensity, labour intensity and land productivity; 15,257 for labour to inputs ratio and input productivity; 18,723 for farm sales, animal output, input costs on farm production, and labour productivity). Source: Authors' elaboration on data from the Moldovan HBS.

498

499   **4.2.   Remittances and agricultural investments**

500   The 2015-smallholder-survey confirmed smallholders' difficulties in obtaining a bank loan, and
501   highlighted that interest rates are high (over 20% in 2015). The only options for those lacking
502   collateral, or a means of transport to cities (where banks are located) are formal loans from village-
503   based credit agencies, or informal private loans. These are usually small, short-term loans, and
504   are thus used for current expenditures. For example, the credit agency whose accountant was
505   interviewed was supplying one- or two-year loans of 500 EUR (2015) on average, at an interest
506   rate of 31% (the crisis of the Russian rouble had caused interest rates to raise). Furthermore, the
507   smallholders whose loan requests were approved had to give their land as collateral. Private loans
508   imply no administrative burdens, and low or even no interest, but generate an uncomfortable
509   moral obligation to maintain good relationships with the moneylender. Indeed, the latter is often

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[20] Any difference between the figures presented in the paragraph and those shown in Table 5 is due to the use of different units, and to the subsequent conversion of MDL into EUR. Indeed, to avoid obtaining too small coefficients, land variables in the database were converted into ares (1 are = 0.01 hectares), and monetary values into 1,000 MDL, which correspond to 60 EUR.

510 a large farmer renting the "big share" of the creditor. Smallholders usually ask for such loans at
511 the beginning of the agricultural year, and pay them back after harvesting.

512   Only 14 respondents (12%), with farms generally larger than the average (ten of them were
513 above two hectares, five above five hectares), had received a loan in the 12 months before the
514 2015-smallholder-survey. Seven had received a formal loan averaging 3,364 EUR (2015) and
515 seven an informal one averaging 507 EUR (2015). One respondent with a farm size of 7.2 hectares
516 had obtained 6,460 EUR (2015) within the framework of a development project funded by the
517 Japan International Cooperation Agency, but this was the only such case detected. Although in-
518 ternational grants for farm modernisation are becoming increasingly available thanks to the As-
519 sociation Agreement with the EU, no *ad hoc* program for assisting smallholders is currently in
520 place as the government presumes that, as a first step, smallholders should gather in producers'
521 groups in order to overcome the small size constraint and gain access to investment funds [21]. Un-
522 like loans or grants, remittances are available to many smallholders, and pose a much lower ad-
523 ministrative burden.

524   To assess the propensity of survey respondents to invest in agriculture, they were asked
525 how they would spend a non-repayable sum of 50,000 EUR[22]. A relative majority (31%) stated
526 that they would invest in housing, 27% in farming and related activities (including food pro-
527 cessing), 12% would give this sum to a younger relative (a child or a grandchild), 11% would
528 open a non-farm business, and 18% mentioned a different option. As for those interested in agri-
529 culture, given the low levels of mechanisation, many would purchase farm machinery (tractors or
530 combines); the second largest group would build storage facilities (including cold storage houses);
531 and others would invest in permanent crops, mostly walnuts or vineyards. Some mentioned ani-
532 mal farming (cattle, rabbits, beekeeping), or related activities (slaughterhouses). Only three would
533 purchase more land, while two spoke about rural tourism.

534   Respondents were also asked how they would spend a non-repayable sum of 1,000 EUR
535 usable only in agriculture, to see if they preferred to cover their current expenditures, or to make
536 a small investment[23]. Thirty-six percent opted for the former option: most of them mentioned
537 seeds, followed by mechanisation services; some named irrigation services, fertilisers, and young
538 animals. Sixty-four percent opted, however, to invest: in seedlings, usually walnut trees (21%),
539 small greenhouses (11%), farm equipment, large part rototillers (10%), arable land (9%), vine-
540 yards (6%), dairy cattle (6%), and drop irrigation facilities (4%). Such answers point to a certain
541 interest in the small-scale intensification of farm production.

542   Finally, respondents were asked whether they had used remittances to cover farm expend-
543 itures: out of 35 recipient households, 22 answered positively. The sum received was often enough
544 to make small investments. One respondent used remittances from Ireland to buy ten "big shares"
545 for planting walnut trees: this operation required much time due to the difficulty in convincing
546 other smallholders to sell their land, and in finding contiguous plots. Using money earned in Rus-
547 sia, a young family started a small pig farm, and purchased a large tractor that they were using to
548 provide mechanisation services to fellow farmers. After having received a rototiller from his child
549 working in Italy, an old agronomist began growing strawberries and gooseberries in his large
550 home garden, and was earning a decent income by selling them[24]. With remittances from Spain,

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[21] Partially based on the interview with the rural development officer of the EU Delegation.

[22] This was not a closed-ended question: respondents were allowed to express their ideas, and their answers were then classified according to pre-set categories. The total sums up to over 100% since respondents were allowed to mention more than one option.

[23] Also in this case, respondents were allowed to express their ideas, then their answers were assigned to a category.

[24] Berries emerged as a profitable production for smallholders, although the lack of irrigation represented a strong constraint.

551 a household renovated some greenhouses dating back to Soviet times to produce vegetables for
552 sale. After coming back from Russia, another dug a lake where people could fish for a fee, and
553 created a small ethnographic museum by gathering traditional objects. These remittances origi-
554 nated from many countries, primarily Russia and Italy. However, it is not always easy to detect
555 the impact of remittances, as they are often earned by a relative, and enter the budget of the fam-
556 ilies as donations, including in-kind.

557   Previous findings point to the relationship between migration and diversification, either on-
558 farm or off-farm. This issue has been extensively researched in the literature. Focusing on North-
559 ern China, Démurger et al. (2010) find that the decision to diversify on-farm is driven by the
560 availability of land, while the main determinants of off-farm diversification are a family's wealth
561 (especially for self-employment), higher levels of education, and access to social networks. The
562 answers from Moldovan smallholders confirm that to pursue non-farm self-employment, a sizea-
563 ble investment is required. Instead, diversification of farm activities could be achieved at a limited
564 cost and, unlike in Northern China, with limited land endowment. This is confirmed by what was
565 observed in Romania, a culturally-similar and geographically proximate country, where 37% of
566 the farming households (compared to 30% of corporate farms) engage in farm-related activities,
567 such as food processing (Albiou et al., 2011). Off-farm diversification in Romania consists mainly
568 in taking up waged jobs, to the extent that the largest share of family income is often earned off-
569 farm (Davidova and Thomson, 2013).
570
571 Table 6. Relationship between farm investments or disinvestments, and the values (current, and
572 first lag) of different types of income.

Output	Explanatory variables	Dairy cattle		Farm equipment		Farmland	
		R.R.R.	Std. err.	R.R.R.	Std. err.	R.R.R.	Std. err.
Disinvestment	Remittances (1,000 MDL [1]) (t)	1.002	0.004	0.995	0.005	0.996	0.003
	Non-earned income (1,000 MDL [1]) (t)	0.993	0.012	0.986	0.018	**0.979**	0.009
	Earned income (1,000 MDL [1]) (t)	0.991	0.006	0.983	0.011	**0.989**	0.005
	Remittances (1,000 MDL [1]) (t-1)	0.997	0.005	**1.006**	0.003	1.000	0.004
	Non-earned income (1,000 MDL) (t-1)	1.008	0.012	0.992	0.017	1.006	0.007
	Earned income (1,000 MDL [1]) (t-1)	1.001	0.005	0.994	0.010	0.999	0.005
	Mean adult age	**1.082**	0.030	**1.122**	0.050	0.998	0.017
	Mean adult age (squared)	**0.999**	0.000	**0.999**	0.000	1.000	0.000
	Male household head (dummy)	**1.389**	0.188	**1.720**	0.376	1.025	0.088
	Household size	**1.368**	0.064	**1.243**	0.099	1.060	0.038
No variation (base outcome)							
Investment	Remittances (1,000 MDL [1]) (t)	1.003	0.004	1.002	0.006	1.003	0.003
	Non-earned income (1,000 MDL) (t)	0.987	0.015	0.971	0.022	**1.025**	0.006
	Earned income (1,000 MDL [1]) (t)	**0.988**	0.006	1.002	0.007	**1.008**	0.003
	Remittances (1,000 MDL [1]) (t-1)	**0.981**	0.006	0.982	0.011	**0.995**	0.003
	Non-earned income (1,000 MDL [1]) (t-1)	0.995	0.014	0.984	0.026	**0.972**	0.009
	Earned income (1,000 MDL [1]) (t-1)	**0.987**	0.006	**0.982**	0.007	**0.992**	0.004
	Mean adult age	**1.102**	0.036	**1.172**	0.060	1.013	0.018
	Mean adult age (squared)	**0.999**	0.000	**0.998**	0.001	1.000	0.000
	Male household head (dummy)	**1.676**	0.270	**2.083**	0.492	0.966	0.080
	Household size	**1.427**	0.065	**1.416**	0.077	**1.113**	0.035
Number of observations		6,522		8,190		8,190	

Notes: [1] 1,000 MDL correspond to 60 EUR. Dummies for urban location, north, south and Chișinău, and intercepts included in the regressions but not shown in the table. R.R.R.: Relative-Risk Ratio, i.e. risk of the outcome, relative to the base outcome, for a one-unit change of the independent variable. Significant coefficients marked in bold.
Source: Authors' elaboration on data from the Moldovan HBS.

573
574   Table 6 contains the results of the multinomial logistic regressions for agricultural invest-
575 ments, or disinvestments. In most cases, the relative-risk ratios are not significant, meaning that
576 no correlation could be detected between the amount of remittances, earned incomes and/or non-
577 earned incomes received in the current or previous year, and a family's propensity to purchase or
578 sell farm assets. In most cases, when the ratios are significant, they are below 1, meaning that the
579 probability of either selling or purchasing farm assets is lower than the probability of staying in
580 the same situation if the smallholder has access to higher off-farm sums. This seems in line with
581 the finding of the 2015-smallholder-survey, that farming households whose members have a well-

16

582 paid non-agricultural job prefer to pursue off-farm-centred livelihoods, while keeping the farm
583 for lifestyle or reputational reasons. A partial exception is investments in land: the relative-risk
584 ratio of selling decreases by 2.1% for each additional 60 EUR (1,000 MDL) of non-earned in-
585 come, and by 1.1% for earned income, while the relative-risk ratio of purchasing increases by
586 2.5% and 0.8%, respectively. The opposite is true for dairy cattle (the relative-risk ratio of pur-
587 chasing always decreases for increasing incomes). During the 2015-smallholder-survey, dairy
588 cattle emerged as a successful investment for families wanting to earn a limited income by selling
589 cheese and sour cream. Finally, larger households, those headed by a male, and those with an
590 older head (although not too old) appear more dynamic in terms of both sales and purchases, as
591 the relative-risk ratios associated with these variables are above 1 for all outcomes.

592 Table 7 shows that the share of recipient households investing in farming is not signifi-
593 cantly different from that of non-recipient households. Around 4% of the families of either group
594 purchased dairy cattle, 9% increased their land endowment, and less than 2% of remittance recip-
595 ients purchased farm machinery, compared to almost 3% among non-recipient households.
596
597 Table 7. Incidence of investors among recipient and non-recipient households.

Variable		Recipients	Others	Difference	Std. err.	Bootstr. diff.	Std. err.
Purchasers of dairy cattle	Unmatched	0.0406	0.0409	-0.0003	0.0056	-0.0027	0.0081
	Matched	0.0422	0.0404	0.0018	0.0092		
Purchasers of farm equipment	Unmatched	0.0165	0.0183	-0.0017	0.0033	-0.0018	0.0040
	Matched	0.0166	0.0270	-0.0104	0.0058		
Purchasers of farmland	Unmatched	0.0942	0.0959	-0.0017	0.0074	-0.0029	0.0108
	Matched	0.0932	0.0890	0.0043	0.0116		

Notes: Households matched on the number of adult members, their average age (and its squared value), the gender of the household head, location dummies (urban settlement, north, centre and south; Chișinău omitted), earned income (1,000 MDL – 60 EUR), non-earned income (1,000 MDL – 60 EUR), farm income (1,000 MDL – 60 EUR), land owned the previous year (ares), and year dummies. Source: Authors' elaboration on data from the Moldovan HBS.

598

5. Conclusions

600 Using data from the Moldovan HBS for the period 2007–2013, and the findings of an original
601 mixed-methods survey of Moldovan smallholders carried out in 2015, this paper assessed the
602 impact of remittances on the production practices and investments of farming households in Mol-
603 dova.

604 The households whose members receive remittances are usually larger, younger, and better
605 educated, thus representing the most dynamic part of the society. The HBS estimates of the labour
606 supply functions showed that remittance recipients are also more likely to respond to economic
607 incentives, such as higher agricultural shadow wages. Furthermore, it emerged that they tend to
608 replace family labour and self-produced inputs (seeds, seedlings, and animal feed) with services
609 provided by contractors and purchased inputs, respectively. Both results (non-negative shadow
610 wages and the substitution of family labour with purchased inputs and services) indicate that hid-
611 den unemployment does not play an important role, and that the time constraints of migrant house-
612 holds are binding. Remittance-receiving households display higher labour productivity at the ex-
613 pense of lower land and input productivity; however, production or commercialisation levels do
614 not necessarily increase. These findings, together with what was observed during the 2015-small-
615 holder-survey, suggest that remittance recipients engage in agriculture mostly to achieve lifestyle
616 and social rewards, and are thus willing to reduce their drudgery.

617 As for investments, three options were considered: dairy cattle, machinery, and farmland.
618 The analysis of the HBS data showed that farming households that receive a larger amount of

619 remittances are not significantly more likely to either sell or purchase farm assets[25]. On the one
620 hand, this may confirm the previous observation that they engage in farming for non-financial
621 reasons, and as such do not need to increase the economic size of their farm. On the other hand,
622 this may suggest that they are caught in a "poverty trap", where the money earned abroad is not
623 enough to invest in farm growth, but they cannot quit farming because it provides a necessary
624 supplement to ensure family survival. This hypothesis needs to be further researched.

625   The results of the 2015-smallholder-survey show a partially different situation. Indeed,
626 most of the small improvements observed among respondents were possible thanks to the availa-
627 bility of remittances. A widespread interest for small investments aimed at intensifying farm pro-
628 duction to ensure a constant income supplement also emerged among respondent families. While
629 the econometric analysis confirmed the finding of Bolganschi (2011) that few migrant households
630 invest in agriculture, qualitative insights suggest that most farming households who invest in ag-
631 riculture are remittance recipients, as few alternative financing opportunities exist for them.

632   Agricultural Census data show that most Moldovan land recipients maintain the property
633 of their plots, and engage in agriculture at least as a side activity. While, on the one hand, this
634 may limit access to land for potential investors, obstructing a more efficient use of it, on the other
635 hand, this means that many households have a base from which to build a middle-sized commer-
636 cial farm. The results of this analysis suggest that, due to their widespread availability, remittances
637 could provide an effective starting point for policy makers. Co-funding of remittance-financed
638 projects could be one way to stimulate investments, and improve the efficiency of grants (Vargas-
639 Lundius et al., 2002). The 2015-smallholder-survey indicated a preference for small intensifica-
640 tion projects (greenhouses, recovery of orchards, purchase of rototillers, etc.), rather than farm
641 growth. Giving priority to such projects in funding programs would allow the land to flow into
642 middle-sized family businesses instead of large corporate farms, thus achieving a farm structure
643 more similar to market economies (Lerman and Sutton, 2008), and a fairer distribution of rural
644 incomes[26].

645   However, investments need a supportive business environment. Therefore, policy makers
646 should pay attention to removing any obstacles which prevent recipient farming households from
647 investing in agriculture. One of the main challenges is "systematic corruption", as also recognised
648 by the European Council (2016). Corruption not only obstructs the implementation of the Asso-
649 ciation Agreement with the EU, but also feeds parasitic rent-seekers while choking small inves-
650 tors, and thus needs to be addressed. Furthermore, "systemic risks like draught and frosts", which
651 hit smallholders particularly hard, endangering their investments, require the design of a viable
652 system of farm insurance, which is currently missing (World Bank, 2015: 5). Finally, the unreli-
653 ability of markets (Moroz et al., 2015) could be reduced, e.g., by negotiating preferential access
654 to the EU market for agro-food products made by smallholders.

655   One limit of this study consists in the fact that the HBS was conceived for a different pur-
656 pose and, as such, some relevant variables are missing. Furthermore, the role of informal channels
657 and of personal relationships in the circulation of remittances may prevent quantitative surveys
658 from effectively detecting their actual uses. As for the 2015-smallholder-survey, the small sample
659 size could cast doubts on its representativeness. Nevertheless, while rare phenomena were prob-

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[25] However, the same is true for all households who have access to larger off-farm incomes. These households are slightly more likely to purchase farmland, and slightly less likely to purchase dairy cattle.

[26] Lerman and Sutton (2008: 101) state that, instead, the Moldovan government "biases its policies in favour of large farms". The persistence of this bias may be proved by the lack of *ad hoc* programs for smallholders, highlighted during the interview with the rural development officer of the EU Delegation.

660 ably missed, the overall dynamics detected remain reliable, and the narration of individual expe-
661 riences holds an important added value. With a view to maximising the impact of the EU rural
662 development programs targeting Moldova, *ad hoc* qualitative surveys are thus needed to look at
663 the role of remittances in agricultural change and to identify the obstacles preventing the invest-
664 ment of these sums.

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