

# Determinants of Savings and Remittances – Empirical Evidence from Immigrants to Germany

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**Abstract.** This paper investigates the determinants of migrants' financial transfers to their home country using German data. A double-hurdle model is applied to examine the effect of relevant determinants on the propensity to send transfers abroad and the amount of transfers. The findings reveal that return intentions positively affect financial transfers of immigrants to their home country. Moreover, while the effect of the household size on migrants' transfers abroad turns out to be significantly negative, remittances are higher if close relatives live in the sending country. Finally, likelihood-ratio tests indicate that the double-hurdle model is the correct specification for the analysis of migrants' savings and remittances rather than the conventional Tobit model usually applied in the literature.

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**Keywords:** International migration, savings, remittances, double-hurdle model

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# 1 Introduction

Due to the increasing relevance of international migration, the economic performance of migrants represents an important factor for both the immigration and sending countries. In the receiving countries, the economic situation of the foreign-born population and the economic and societal integration of immigrant minorities into the host-countries' society have become a matter of intense debate among economists and policy makers. At the same time, the economic situation of migrants has become increasingly important for the sending countries because migrants' remittances have grown to the largest source of external funding in many emigration countries.

The economic literature on the performance of immigrants in their host country, which follows the contributions by Chiswick (1978) and Borjas (1985), concentrates predominantly on the analysis of migrants' earnings and employment status (Borjas, 1994; Zimmermann, 2005). Only a few studies have examined the wealth accumulation patterns of immigrants in their home countries (Bauer and Sinning, 2005; Amuedo-Dorantes and Pozo, 2006), although migrants' savings and investment abroad may represent a substantial or even the major part of their overall transfers (Brown, 1994). However, an investigation of such a long-run indicator of economic well-being may be relevant because the capacity of immigrants to accumulate wealth in their home countries does not only reflect their economic performance in the host country but also allows to draw inferences about their future economic situation.

According to the World Bank (2006a), remittance flows in 2005 have exceeded US\$ 233 billion worldwide. Moreover, recorded remittance flows to developing countries have doubled between 2000 and 2005, indicating a substantial increase in altruistic payments of migrants to their families abroad. The traditional development literature has largely focused on the size and potential impact of migrants' remittances (Adams, 1992; Durand et al., 1996). In addition, a sizeable theoretical and empirical literature has revealed that a variety of motives may induce migrants to send remittances to their countries of origin (Lucas and Stark, 1985; Bernheim et al., 1985; Cox, 1987; Cox and Rank, 1992; Cox et al., 1998; Ilahi and Jafarey, 1999; Amuedo-Dorantes and Pozo, 2006).

Despite the increasing importance of the long-run economic situation of migrants and the growing impact of their remittances, only a few studies have carried out a joint analysis of migrants' savings and remittances. Amuedo-Dorantes and Pozo (2006) analyze both savings and remittances of Mexican immigrants in the US. They demonstrate that immigrants remit a substantial part of their labor earnings for family-provided insurance as well as for self-insurance. Merkle and Zimmermann (1992) investigate migrants' savings in Germany and their transfers abroad. They find that return intentions significantly affect migrants' remittances but do not influence their savings behavior. Considering both migrants' savings in the home and host country, Bauer and Sinning (2005) demonstrate that immigrants who intend to stay in Germany only temporarily save significantly more than permanent migrants.

Germany, a major immigration country in the European Union, represents an excellent example for the analysis of the importance of migrants' savings and remittances. Even though the majority of the foreign-born population in Germany does not originate from developing countries, immigrants residing in Germany remit a substantial part of their income. In 2004, remittance flows from Germany amounted to US\$ 10.4 billion (World Bank, 2006b). A sizeable part of these transfers consists of savings-related remittances of temporary migrants (Merkle and Zimmermann, 1992; Bauer and Sinning, 2005). Since about 1.5 million immigrants in Germany will reach retirement age within the next 15 years, both savings and return intentions of immigrants may become important factors for the German pension system.

This paper aims at providing empirical evidence on the relative importance of the determinants of migrants' transfers to their home countries, paying particular attention to their return intentions and household composition in the home and host country. In the empirical analysis, which is based on data from the German Socio-Economic Panel (SOEP), different types of transfers will be distinguished, namely savings, payments to family members and other persons abroad as well as transfers that are sent to the home country for other reasons. In addition to the Tobit model, which accounts for the censored nature of the dependent variables, a double-hurdle model will be applied to assess the effects of relevant determinants on the individual decision to send transfers abroad and the amount of transfers.

The paper contributes to the existing literature in several respects. Firstly, empirical evidence on the determinants of migrants' remittances is generated by examining micro-level data from immigrants to Germany. While the major part of the existing literature on remittances mainly concentrates on migrants' transfers to developing countries, the analysis focuses on remittances of migrants' from traditional labor-exporting countries, such as Turkey, Italy and Greece as well as refugees originating from former Yugoslavian countries. Secondly, in addition to migrants' payments to family members in their countries of origin which are typically addressed by the literature on remittances, the analysis of German data allows an explicit consideration of migrants' savings in their home countries as a relevant part of their overall transfers. Finally, a double-hurdle model is applied to account for differences between the stochastic processes that determine the decision of immigrants to remit and the level of remittances. Existing studies have often adopted more restrictive models for binary or censored dependent variables to assess the determinants of migrants' remittances.

The empirical findings reveal that return intentions positively affect financial transfers of immigrants to their home country. Moreover, while the effect of the household size on migrants' transfers abroad turns out to be significantly negative, remittances are higher if close relatives live in the sending country. Women are less likely to send transfers abroad and – given that their payments are positive – also send smaller amounts to family members abroad than comparable men. While the current pre-government income increases migrants' savings and payments to persons abroad, the variation of past income streams increases the amount of other transfers to the sending countries, indicating that these transfers represent insurance payments to some extent. Finally, likelihood-ratio tests indicate that the double-hurdle model is the correct specification for the analysis of remittances rather than the conventional Tobit model usually applied in the literature.

The paper proceeds as follows. Section 2 gives a short survey of the existing literature on the determinants of migrants' remittances. Section 3 describes the empirical strategy and the data used for the analysis. The estimation results are presented in Section 4. Section 5 concludes.

## 2 Determinants of migrants' remittances

An extensive literature provides theoretical and empirical evidence on general motives behind migrants' remittances and outlines relevant determinants. Using data from the National Migration Study of Botswana, Lucas and Stark (1985) were the first to note that – in addition to altruism – a variety of motives could play a decisive role in determining remittances. They considered the strategy to secure inheritance and the desire to invest in assets at home as “pure self-interest” and designated the motives behind remittances that were based on contractual agreements between migrant and family as “tempered altruism or enlightened self-interest”. These motives could include, for example, repayments for a previous educational investment in the migrant or payments that insure migrants against income losses in the host country.

Several studies have provided evidence in support of these hypotheses. Bernheim et al. (1985) suggest that family members in the sending country may use their possibility of depriving migrants of their rights to inheritance to secure remittances. At the same time, expectations about future bequests may induce migrants to send remittances to their home country. Cox (1987) argues that altruism and exchange (such as repayments of educational costs or the purchase of services) are major motives behind migrants' remittances. Cox and Rank (1992) find empirical patterns for inter-vivos transfers (i.e. transfers between living persons) that are more consistent with exchange than altruism. Ilahi and Jafarey (1999) provide evidence on repayments of loans aimed at financing international migration. Finally, Amuedo-Dorantes and Pozo (2006) demonstrate that migrants do not only send remittances to their home country to insure family members against income losses (Coate and Ravallion, 1993) but also to insure themselves.

Although a sizeable literature has attempted to discriminate between various motivations to remit, empirical evidence on the determinants of migrants' savings in their countries of origin is rather scarce. However, a number of studies has highlighted the relevance of migrants' savings in their home countries. Using data from the 1979 Youth Cohort of the National Longitudinal Surveys, Amuedo-Dorantes and Pozo (2002) compare migrants' savings in the US to those of comparable natives.

They find that immigrants save significantly less than comparable natives and argue that the apparent lower precautionary savings of immigrants may be caused by the fact that immigrants engage in precautionary saving by remitting parts of their income to their countries of origin. Merkle and Zimmermann (1992) investigate migrants' savings in the host country as well as remittances using data from the German Socio-Economic Panel (SOEP). They find that migrants' return intentions significantly affect their remittances but do not influence their savings behavior. Based on these results, they conclude that temporary migrants hold savings mainly in their home countries. Using the same data source, Bauer and Sinning (2005) demonstrate that immigrants who intend to return to their home country save significantly more than permanent migrants if both savings in the home and in the host country are taken into account.

The theoretical and empirical literature on savings and remittances has highlighted a number of variables that may be relevant in explaining migrants' transfer behavior. Galor and Stark (1990) demonstrate that the positive probability of immigrants to return to their home countries positively affect their savings behavior. Return intentions have also been identified as a major determinant of migrants' payments to family members abroad by a number of studies on remittances (see Docquier and Rapoport, 2005 for a review).

Most empirical studies on migrants' remittances have focused on income effects to assess the degree of altruism that may be inferred from the migrants' behavior. The pure altruism hypothesis, which postulates unity of the transfer-income derivative, could be rejected by several studies on transfers in developed and undeveloped economies (Cox, 1987; Cox et al., 1998; Altonji et al., 1997). In addition to income, migrants' transfers are likely to be affected by income uncertainties. Following the literature on risk-diversification within families (Stark, 1991), Dustmann (1997) demonstrates that immigrants may accumulate more precautionary savings than comparable natives if they face high income uncertainties on the labor market of their host country. Amuedo-Dorantes and Pozo (2006) show that income risks may increase migrants' insurance payments to their countries of origin to smooth future consumption after remigration.

Following the contribution of Lucas and Stark (1985), the literature on the determinants of remittances has also focused on the migrants' family background in the home and host countries. Specifically, empirical studies have shown that the marital status and the household size and composition in the migrants' home and host country are important determinants of remittances (Hoddinott, 1994; de la Briere et al., 2002).

In addition to the determinants of migrants' savings and remittances presented above, a number of socio-economic and demographic characteristics may also affect transfers of immigrants to their home country. In particular, age, gender, education and the employment status have proved to be relevant in explaining both migrants' savings and remittances (see, e.g., Cox, 1987; Cox et al., 1998; de la Briere et al., 2002; Merkle and Zimmermann, 1992; Bauer and Sinning, 2005). Moreover, the transfer behavior of immigrants may also be influenced by their migration background. In particular, since the migration process leads immigrants to be a highly selected group of individuals (Borjas, 1987), both savings and remittances may vary substantially across countries of origin. Funkhouser (1995) demonstrates that self-selection of immigrants may have a decisive influence on migrants' remittances. The savings behavior may also be affected by the cultural background of immigrants (Carroll et al., 1994, 1999). Finally, in addition to source country variations, differences between immigration cohorts might exist. Specifically, migrants' remittances typically decline as the duration of residence in the host country increases (DeVoretz and Vadean, 2005), while wealth levels of more established immigrants in their host countries tend to be higher than those of more recent immigration cohorts (Bauer et al., 2007), suggesting that the length of stay in the host country might have positive effects on migrants' savings abroad.

The objective of the following analysis is to generate empirical evidence on the relative importance of the determinants of migrants' financial transfers, taking into account the factors mentioned above. Since these factors may have different effects on the propensity to send transfers abroad and the amount of transfers, a double-hurdle model is applied which allows a separate consideration of the underlying stochastic processes.

### 3 Empirical strategy and data

While investigating the determinants of migrants' savings and remittances, the censored nature of the outcome variable has to be taken into account. In particular, it seems likely that a substantial part of the foreign-born population does not send transfers abroad. One way to tackle this problem is to use a Tobit model (Tobin, 1958) which has been applied in previous studies on both savings and remittances (Merkle and Zimmermann, 1992; Rodriguez, 1996; Cox et al., 1998). An important shortcoming of the Tobit model is that zero values are considered as corner solution outcomes although the stochastic process that describes the individual decision to send transfers abroad may differ substantially from the one that governs the decision about the amount of transfers.

A model that may be applied if the participation decision and the level of the dependent variable are determined by different stochastic processes is the double-hurdle model. The double-hurdle model represents a parametric generalization of the Tobit model which characterizes the stochastic process of the participation decision by a binomial probability model and the conditional distribution of the level of the dependent variable by a truncated-at-zero regression model. Assuming that the error terms of the two stochastic processes are uncorrelated leads to the independent double-hurdle model, while the dependent double-hurdle model accounts for the possible correlation between the two error terms. To derive the double-hurdle model with dependent error terms (Jones, 1992), consider latent participation  $d^*$  and level  $y^*$  as linear functions of the first-hurdle regressor  $\mathbf{x}_1$  and the second-hurdle regressor  $\mathbf{x}_2$ , respectively. Then the double-hurdle model can be written as:

$$d^* = \mathbf{x}'_1 \beta_1 + \varepsilon_1,$$

$$y^* = \mathbf{x}'_2 \beta_2 + \varepsilon_2,$$

where  $\beta_1$  and  $\beta_2$  are the parameter vectors to be estimated and the random errors  $\varepsilon_1$  and  $\varepsilon_2$  are normally distributed with zero mean and variance-covariance matrix

$$\Sigma = \begin{bmatrix} 1 & \sigma_{12} \\ \sigma_{12} & \sigma^2 \end{bmatrix}.$$



In order to take heteroscedasticity of the the error term  $\varepsilon_2$  into account, the variance  $\sigma^2$  is allowed to vary across observations. Particularly, the standard deviation  $\sigma$  can be specified as  $\sigma = \exp(\mathbf{z}'\alpha)$ , where  $\mathbf{z}$  represents a vector of explanatory variables and  $\alpha$  is a vector of parameters. Since the double-hurdle model is based on the assumption that the error terms are normally distributed, the inverse hyperbolic sine (IHS) transformation (Burbidge et al., 1988) of the observed dependent variable is frequently applied (Yen and Jones, 1997). The IHS transformation is given by

$$\begin{aligned} T(y) &= \log(\gamma y + (\gamma^2 y^2 + 1)^{1/2})/\gamma \\ &= \sinh^{-1}(\gamma y)/\gamma, \end{aligned}$$

where  $\gamma$  represents an additional model parameter to be estimated. The IHS transformation approximates  $\log(y)$  for large values of  $y$ . In the empirical analysis, it is assumed that  $\gamma = 1$ . The IHS double-hurdle model may be written as

$$\begin{aligned} T(y) &= \mathbf{x}'_2\beta_2 + \varepsilon_2 \text{ if } \mathbf{x}'_1\beta_1 + \varepsilon_1 > 0 \text{ and } \mathbf{x}'_2\beta_2 + \varepsilon_2 > 0 \\ &= 0 \text{ otherwise.} \end{aligned}$$

The likelihood function of this model is

$$\begin{aligned} L &= \prod_{i \in \Omega_0} \{1 - \Phi(\frac{\mathbf{x}'_1\beta_1}{\sigma}, \mathbf{x}'_2\beta_2, \rho)\} \\ &\times \prod_{i \in \Omega_1} \{(1 + \gamma^2 y^2)^{-1/2} \frac{1}{\sigma} \phi[\frac{T(y) - \mathbf{x}'_1\beta_1}{\sigma}] \Phi[\frac{\mathbf{x}'_2\beta_2 + \frac{\rho}{\sigma}[T(y) - \mathbf{x}'_1\beta_1]}{[1 - \rho^2]^{1/2}}]\}, \end{aligned}$$

where  $\Omega_0 = \{i|y_i = 0\}$ ,  $\Omega_1 = \{i|y_i \neq 0\}$  and  $\Omega_0 \cup \Omega_1 = \{1, 2, \dots, N\}$ . When  $\gamma = 0$ , the likelihood function reduces to that of the dependent double-hurdle model (Blundell and Meghir, 1987; Jones, 1992). The function leads to the double-hurdle model with independence if  $\gamma = 0$  and  $\rho = 0$  (Cragg, 1971). In this case, the likelihood function is separable with respect to the parameter vectors  $\beta_1$  and  $\beta_2$ . The resulting log likelihood function can be written as the sum of the log likelihoods from two separate models: a binomial Probit model and a truncated-at-zero regression model. Finally, setting  $\Phi(\mathbf{x}'_2\beta_2) = 1$  in the independent double-hurdle model leads to the Tobit model (Tobin, 1958). Due to the nested structure of these models, likelihood-ratio tests can be applied to test the full model against the restricted models (Yen et al., 1995).

The elasticities of the IHS double-hurdle model are given by the derivation of the unconditional mean with respect to the explanatory variables. The unconditional mean of  $y$  consists of the probability of  $y$  being uncensored and the conditional mean of  $y$ :

$$\begin{aligned} E(y) &= P(y > 0)E(y|y > 0) \\ &= \Phi_2 \mathbf{x}'_1 \beta_1 + \sigma \phi(-v) \Phi[(w - \rho v)\delta] + \sigma \rho \phi(-w) \Phi[(v - \rho w)\delta], \end{aligned}$$

where

$$v = \frac{\mathbf{x}'_1 \beta_1}{\sigma}, \quad w = \mathbf{x}'_2 \beta_2, \quad \delta = \frac{1}{\sqrt{1 - \rho^2}}, \quad \text{and } \Phi_2 = \Phi(v, w, \rho).$$

The standard errors for the elasticities may be derived using mathematical approximation (Fuller, 1987).

In the following empirical analysis, data from the German Socio-Economic Panel (SOEP) is utilized.<sup>1</sup> The SOEP is a representative longitudinal study including German and immigrant households residing in the old and new German states which started in 1984. In 2005, more than 20,000 persons in about 12,000 households were sampled. The panel contains information about socioeconomic and demographic characteristics, household composition, occupational biographies, etc. The empirical analysis is restricted to full- or part-time employed immigrants between 18 and 64 years. Immigrants are defined as foreign-born persons who immigrated to Germany since 1948. Due to the small number of observations, the sample does not include ethnic migrants from Central and Eastern Europe who received German citizenship after immigration. Since less than two percent of the migrant population in the sample lives in East Germany, the analysis concentrates on immigrants residing in West Germany. Moreover, the year 1984 is not considered in the regression analysis because lag variables have to be generated for some of the explanatory variables of the model.

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<sup>1</sup>The data used in this paper were extracted from the GSOEP Database provided by the DIW Berlin (<http://www.diw.de/GSOEP>) using the Add-On package PanelWhiz v1.0 (Oct 2006) for Stata(R). PanelWhiz was written by Dr. John P. Haisken-DeNew ([john@panelwhiz.eu](mailto:john@panelwhiz.eu)). The PanelWhiz generated DO file to retrieve the GSOEP data used here and any Panelwhiz Plugins are available upon request. Any data or computational errors in this paper are my own. Haisken-DeNew and Hahn (2006) describe PanelWhiz in detail.

The SOEP contains detailed information about transfers of foreigners to their home country between 1984 and 1995. These transfers are subdivided into (i) savings for later, (ii) support for the family and (iii) transfers for other reasons. After 1995, only the amount of payments to persons abroad can be observed. Therefore, the analysis is limited to the examination of this rather general outcome measure between 1996 and 2005.<sup>2</sup>

In the empirical analysis, a number of socio-economic and demographic characteristics are considered as explanatory variables of migrants' transfers to the home country. These variables include a squared function of age, the household pre-government income, the number of years of education and indicator variables for the migrants' gender and the attendance of school in Germany. Moreover, the variance of the average income of the last five years is used as a proxy variable for income risk. In general, it may be expected that migrants facing greater income risk are more likely to send transfers abroad and transfer more than migrants facing less income risk.

In addition to these characteristics, the set of explanatory variables includes information about the household composition, such as the household size, the marital status and the presence of children in the household. Unfortunately, the SOEP does not contain information about the household size of immigrants in their home country. Instead, dummy variables indicating whether the spouse or children of the respondent live abroad are included into the regression equation. In order to avoid causality problems, lag variables are used for some of the explanatory variables of the regression model.

Since all kinds of transfers may be observed for both temporary and permanent migrants, differences between the two groups will be investigated in the empirical analysis. In particular, the SOEP provides information on the intentions of immigrants to stay in Germany. This information is used to generate a dummy variable for return intentions. Finally, differences between immigration cohorts and immigrants originating from different source countries are taken into account by including

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<sup>2</sup>A detailed description of the definition of variables used in the analysis is given in the Appendix.

the number of years since migration and a set of source country indicators into the model. The sample is restricted to immigrants from OECD member countries and former Yugoslavian countries. Source country indicators were generated for immigrants from major traditional labor-exporting countries, namely Turkey, Italy and Greece. After excluding all observations with missing values on one of the variables used in the analysis, the panel data set contains 9,331 person-year-observations of 1,760 individuals for the period 1985-1995 and 5,512 person-year-observations of 1,280 persons for the period 1996-2005.

The descriptive statistics presented in Table 1 reveal that the proportion of immigrants who save abroad in the period from 1985 to 1995 is 5.7%, while 9.3% of the foreign-born population sends transfers to their home country for other reasons. Moreover, the share of immigrants who send payments to family members in their countries of origin amounts to 30.2%, indicating that these payments are relatively more important if compared to savings and other transfers abroad. While immigrants save on average about 20 Euros per month in their home country, the average amount of savings of persons reporting positive values is about 360 Euros, suggesting that migrants' savings abroad seem to be highly relevant for a relatively small part of the foreign-born population. On average, immigrants remit about 23 Euros per month to their home country for other reasons. Given that these transfers are positive, more than 250 Euros are sent abroad for other reasons. The conditional average amount of payments to family members abroad is about 240 Euros. Finally, 17.4% of the foreign-born individuals report to send remittances abroad between 1996 and 2005. While the average amount of remittances is about 33 Euros, migrants send more than 190 Euros to their home country given that their remittance level is positive.

The mean values presented in the bottom part of Table 1 expose that some of the explanatory variables have changed considerably between the sample periods 1985-1995 and 1996-2005. In particular, the share of immigrants originating from countries other than Turkey, Italy and Greece has increased to 47.1% in the sample period after 1995. In addition to the changing nationality mix within the foreign-born population in Germany (see Bauer et al., 2005 for details), a substantial part

of these differences may be attributed to a change in the sample design. In 1994 and 1995, two additional sub-samples of immigrant households were appended to the SOEP (Frick and Haisken-DeNew, 2005). As a consequence of these changes, return intentions have declined over time. Particularly, while the majority of the guest-worker generation observed before 1996 (64.4%) wishes to remain in Germany temporarily, only 34.5% of the foreign-born population surveyed between 1996 and 2005 plans to return to the country of origin.

## 4 Results

This section presents the Tobit and IHS double-hurdle estimates of migrants' savings and remittances. The estimates of savings and other transfers of the sample period 1985-1995 are presented in Section 4.1. Section 4.2 includes the corresponding results for payments to family members and other persons residing abroad, using the available information of the periods 1985-1995 and 1996-2005. Wald tests were performed to test whether the error terms of participation and level equations of the double-hurdle model are insignificant. While the test results of the stochastic processes describing other transfers (1985-1995) and payments to persons abroad (1996-2005) were in favor of the dependent double-hurdle model, the error terms of the estimates of savings and payments to family members (1985-2005) turned out to be insignificant. The respective estimates of the correlation coefficients of the dependent double-hurdle models confirm these findings. Since the independent double-hurdle model represents a special case of the double-hurdle model with dependent error terms, the following tables contain the dependent double-hurdle estimates which account for possible correlation of error terms. Finally, in order to accommodate heteroscedasticity of the error terms of the level equation, possible income effects on the variation of the error variance were taken into account. These effects turned out to be insignificant, indicating homoscedasticity of the error terms. The test results and the estimates of independent IHS double-hurdle models and heteroscedasticity equations are available from the author upon request.

## 4.1 Savings and other transfers

Tables 2 and 3 include the estimates of Tobit and double-hurdle models, using information about migrants' savings and other transfers abroad as dependent variables. The marginal effects of these models denote the size and direction of the impact of the explanatory variables on the savings level. In particular, the (semi-)elasticities of the double-hurdle model indicate the effect of a change in one of the explanatory variables on the unconditional mean of the dependent variable.<sup>3</sup> Moreover, the coefficients of the participation and level equations of the double-hurdle model denote the influence of the explanatory variables on the probability to send transfers abroad and the monthly amount of transfers, respectively.

The estimates in Tables 2 and 3 provide evidence for an inverted U-shaped transfer-age profile which is consistent with the implications of the inter-temporal consumption model (see, e.g., Amuedo-Dorantes and Pozo, 2006). Specifically, the profile reflects that migrants increase savings over their work life and smooth consumption after retirement. The findings also reveal that immigrant women are on average less likely to send savings or other transfers abroad. However, given that their transfers are positive, they do not send significantly less to their home country than average men. This result is in line with the literature on the labor market activity of immigrants which finds that foreign-born women are economically less active than comparable foreign-born men (Basilio et al., 2007).

The household pre-government income positively affects migrants' savings and other transfers abroad. In addition, the double-hurdle estimates show that income volatility increases the amount of migrants' other transfers abroad, indicating that these transfers represent insurance payments to some extent (see Amuedo-Dorantes and Pozo, 2006). The income elasticity of the double-hurdle model reveals that an income increase of 1% raises savings by 0.23%. This effect is considerably smaller than the effect of 0.39% predicted by the Tobit model.

The years of education lower the saving propensity and the amount of other

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<sup>3</sup>The elasticities are not strictly defined for binary explanatory variables. The reported values are actually changes in the dependent variable in response to the change in the binary variable from zero to one.

transfers sent to the country of origin, while immigrants exhibit higher savings abroad if they attended school in Germany. While the marginal effect of the level of education on migrants' other transfers abroad is significantly negative in the Tobit model, the marginal effect of the double-hurdle model is insignificant. The household size in Germany negatively determines savings abroad in both the Tobit and the double-hurdle model. The estimates of the double-hurdle model indicate that the migrants' household size in the host country lowers the propensity to save in the country of origin. In contrast to the Tobit model, the household size effect on other transfers abroad is insignificant in the double-hurdle model.

The marginal effects of the double-hurdle model also reveal that average married immigrants accumulate about 13% more wealth in their home country and send about 15% more transfers abroad than average single immigrants. Moreover, while the presence of children below 5 years positively affect savings in the Tobit model, children have no influence on savings and other transfers abroad in the double-hurdle model. Furthermore, according to the double-hurdle model, immigrants whose spouse or children have remained in the country of origin do not save or send significantly more transfers abroad for other reasons than comparable immigrants whose closest relatives reside in Germany. This result implies that migrants' transfers which are sent abroad for other reasons do not seem to be intended for consumption of family members in the home country.

While the Tobit estimates indicate that return intentions do not significantly affect migrants' savings or other transfers abroad, the marginal effects of the double-hurdle models reveal that temporary migrants save on average 24.3% more and send 21.0% more other transfers to their home country than permanent migrants. This effect is attributable to the fact that migrants, who intent to return to their home country, are more likely to save or send other transfers abroad than migrants who intent to stay in Germany permanently. Given that migrants' transfers to their home country are positive, the effect of return intentions on the amount of savings and other transfers is not significant. The estimate of the level equation of the double-hurdle model even suggests that return intentions reduce the amount of other transfers, highlighting the importance of a separate consideration of the stochastic

processes that describe transfer probabilities and levels.

The effects of the years since migration suggest that the duration of residence in Germany appears to be a weak predictor of migrants' savings and other transfers. Finally, the marginal effects of the source country indicators in the double-hurdle model reveal that saving disparities across countries are insignificant, while substantial source country differences with respect to other transfers seem to exist. Specifically, the propensity of Italian and Greek immigrants to send transfers to their home country for other reasons is significantly lower than that of immigrants originating from other source countries.

## 4.2 Transfers to persons abroad

Tables 4 and 5 contain the estimates of dependent IHS double-hurdle models, using information about payments to family members surveyed between 1985 and 1995 as well as payments to persons abroad surveyed between 1996 and 2005 as dependent variables. Similar to the estimates presented in Section 4.1, an inverted U-shaped transfer-age profile may also be observed for migrants' payments to persons in the home country. In addition, immigrant women send significantly less transfers to persons abroad than comparable men. The income elasticities of the double-hurdle model, which range between 0.22% and 0.36%, indicate that the pure altruism hypothesis of migrants' payments to persons abroad may be rejected (Altonji et al., 1997). Moreover, the variation of past income streams lowers the propensity of immigrants to send remittances to family members in their home country.

While the length of education appears to play a minor role in explaining remittances, migrants' payments to family members are significantly lower if they attended school in Germany. Household size effects on migrants' payments to persons abroad are significantly negative, suggesting that migrants residing in relatively large households do not have the financial capacity to remit sizeable amounts to their home country. In contrast, married immigrants have a higher propensity to send remittances to persons abroad than singles. The presence of children in the household has no additional effect on migrants' payments abroad. Instead, remittances are substantially higher if close relatives live in the country of origin. According to



the double-hurdle model, remittances observed between 1985 and 1995 increase by about 160% if the migrants' spouse or the children reside in the sending country. Between 1996 and 2005, a similar effect may be observed for migrants whose spouse lives abroad, while the corresponding effect of children residing in the home country is insignificant.

The coefficients and marginal effects of return intentions suggest that temporary migrants are more likely to remit and remit a higher amount to persons abroad than permanent migrants. The marginal effects of return intentions on migrants' payments to persons abroad are somewhat larger than the corresponding effects on savings and other transfers. While temporary migrants surveyed between 1985 and 1995 remit on average 37.7% more than permanent migrants, remittances of temporary migrants are 31.5% higher than those of average permanent migrants in the period 1996-2005. Moreover, the number of years since migration do not have a significant influence on migrants' transfers to persons abroad. Finally, the marginal effects of the source country indicators exhibit that immigrants originating from Italy or Greece remit less to their countries of origin than immigrants from other source regions.

### 4.3 Tobit vs. double-hurdle model

Likelihood-ratio ( $LR$ ) tests were performed to investigate whether the double-hurdle model is more appropriate in modeling migrants' remittances than the Tobit model. In particular, since the independent double-hurdle model originally proposed by Cragg (1971) is equivalent to a combination of a binomial Probit model and a truncated-at-zero regression model, the value of the log-likelihood of the Tobit model could be compared to the sum of the log-likelihood values of the truncated model and the Probit model. Specifically, the  $LR$ -statistic may be computed as follows:

$$\lambda = -2[\ln L_T - (\ln L_P + \ln L_{TR})] \sim \chi_k^2,$$

where  $L_T$  represents the value of the likelihood of the Tobit model and  $L_P$  and  $L_{TR}$  are values of the likelihood functions of the Probit model and the truncated regression model, respectively.  $k$  denotes the number of independent variables in the

regression equations. The test hypothesis, which postulates that the parameters of the Probit model and the truncated regression model may be restricted to those of the Tobit model, will be rejected on a pre-specified significance level if  $\lambda > \chi_k^2$ . In all cases, the results of the *LR*-tests indicate that the double-hurdle model represents a more suitable way of modeling migrants' remittances than the Tobit model. The test results and the underlying estimates are available from the author upon request.

## 5 Conclusions

This paper provides empirical evidence on the relative importance of the determinants of migrants' transfers to their country of origin, paying particular attention to return intentions and migrants' household composition in the home and host country. In the empirical analysis, which is based on data from the German Socio-Economic Panel (SOEP), the determinants of different types of transfers (savings, payments to persons abroad and other transfers) are being investigated. In addition to the Tobit model, which accounts for the censored nature of the dependent variables, a dependent double-hurdle model is applied to assess the effects of different determinants on both the migrants' propensity to send transfers abroad and the amount of transfers.

The empirical analysis reveals that savings in the home country are highly relevant for a relatively small group of immigrants, while a relatively large part of the immigrant population sends payments to persons in the sending countries. Moreover, migrants' return intentions have a significant influence on all types of payments abroad. The household size turns out to have a significantly negative impact on migrants' transfers, indicating that migrants residing in relatively large households do not seem to have the financial capacity to send high amounts to their home country. The estimates also suggest that both the propensity to remit and the level of remittances are significantly higher if close relatives live in the country of origin. Furthermore, the relatively small income elasticities of migrants' transfers suggest that the pure altruism hypothesis, which postulates unity of the transfer-income derivative, can be rejected. While the current pre-government income increases mi-

grants' savings and payments to persons abroad, past income streams only affect other transfers to the sending countries, indicating that these transfers represent insurance payments to some extent. Finally, likelihood-ratio tests suggest that the double-hurdle model represents the correct specification for the analysis of migrants' savings and remittances rather than the conventional Tobit model usually applied in the literature. This result implies that a separate consideration of the stochastic processes describing the propensity to send transfers abroad and the amount of transfers is necessary for the investigation of the determinants of migrants' savings and remittances.

# Appendix

**Table:** Definition of variables

<b>Variable</b>	<b>Description</b>
Savings abroad	Average monthly amount of savings abroad (in real 2000 Euro, 1985-1995).
Other transfers abroad	Average monthly amount of transfers abroad for other reasons (in real 2000 Euro, 1985-1995).
Payments to family members abroad	Average monthly amount of payments to family members abroad (in real 2000 Euro, 1985-1995).
Payments to persons abroad	Average monthly amount of payments to persons abroad (in real 2000 Euro, 1996-2005).
Age	Age of respondent in years.
Female	1 if respondent is female; 0 otherwise.
Income	Household pre-government income (in real 2000 Euro).
Variance of past income	Variance of household pre-government income over the last 5 years.
Years of education	Education of respondent in years.
Attended school in Germany	1 if respondent attended school in Germany; 0 otherwise.
Household size	Number of persons in household.
Married	1 if respondent is married; 0 otherwise.
Children below 5 years in household	1 if children below 5 years in household; 0 otherwise.
Children 5-15 years in household	1 if children between 5 and 15 years in household; 0 otherwise.
Spouse lives abroad	1 if spouse of respondent lives abroad; 0 otherwise.
Children live abroad	1 if children of respondent live abroad; 0 otherwise.
Intended return migration	1 if immigrant wishes to return to the country of origin; 0 otherwise.
Years since migration	Duration of German residence in years.
Country of origin: Turkey	1 if respondent originates from Turkey; 0 otherwise.
Country of origin: Italy	1 if respondent originates from Italy; 0 otherwise.
Country of origin: Greece	1 if respondent originates from Greece; 0 otherwise.
Country of origin: Other	1 if respondent originates from other OECD member country or former Yugoslavia (reference category); 0 otherwise.

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# Tables

**Table 1:** Descriptive statistics

Variable	1985-1995		1996-2004	
	Mean	Standard Deviation	Mean	Standard Deviation
<b>Savings and remittances</b>				
Proportion of migrants saving abroad	0.057	0.005		
Savings abroad	20.53	2.276		
Savings abroad if > 0	357.35	30.009		
Proportion of migrants sending other transfers abroad	0.093	0.006		
Other transfers abroad	23.45	1.841		
Other transfers abroad if > 0	252.10	11.972		
Proportion of migrants sending remittances to family members	0.302	0.014		
Payments to family members	73.24	6.216		
Payments to family members if > 0	242.17	14.173		
Proportion of migrants sending remittances to persons abroad			0.174	0.018
Payments to persons abroad if > 0			33.15	5.078
			190.65	20.139
<b>Explanatory variables</b>				
<b>Socio-economic and demographic characteristics</b>				
Age	40.763	0.356	43.458	0.516
Female	0.317	0.013	0.352	0.019
Income	3367.78	65.932	3629.76	91.500
ln(Variance of past income)	12.179	0.059	12.535	0.081
Years of education	9.458	0.085	10.583	0.128
Attended school in Germany	0.200	0.014	0.271	0.023
<b>Household composition</b>				
Household size	3.587	0.074	3.392	0.079
Married	0.759	0.016	0.797	0.018
Children <5 years in household	0.194	0.014	0.124	0.013
Children 5-15 in household	0.309	0.016	0.290	0.022
Spouse lives abroad	0.069	0.011	0.020	0.007
Children live abroad	0.096	0.010	0.041	0.009
<b>Migration background</b>				
Intended return migration	0.644	0.016	0.345	0.021
Years since migration	19.343	0.235	24.032	0.478
Country of origin: Turkey	0.432	0.025	0.342	0.028
Country of origin: Italy	0.188	0.018	0.130	0.018
Country of origin: Greece	0.101	0.012	0.058	0.010
Country of origin: Other	0.279	0.020	0.471	0.028
N	9,331		5,512	



**Table 2:** Estimation of Tobit and dependent IHS double-hurdle model: Savings abroad – 1985–1991, 1993 and 1995

	Tobit				Double-Hurdle					
	Marginal		Participation		Level		Elasticity			
	Coefficient	t-value	Effect	t-value	Coefficient	t-value	effect	t-value		
Age	0.147	2.63	0.147	2.63	0.058	2.41	0.044	0.82	0.042	2.48
Age <sup>2</sup> × 10 <sup>3</sup>	-1.621	-2.49	-1.621	-2.49	-0.532	-1.83	-0.378	-0.66	-	-
Female	-0.269	-1.93	-0.269	-1.93	-0.389	-6.76	-0.147	-0.58	-0.246	-5.13
ln(Income)	0.394	2.46	0.394	2.46	0.315	4.25	0.395	3.15	0.235	4.10
ln(Variance of past income)	0.020	0.59	0.020	0.59	-0.012	-0.80	0.009	0.30	-0.007	-0.74
Years of education	0.010	0.31	0.010	0.31	-0.033	-2.00	0.016	0.51	-0.021	-1.83
Attended school in Germany	0.414	2.03	0.414	2.03	0.231	2.25	0.300	1.43	0.194	2.20
Household size	-0.214	-3.82	-0.214	-3.82	-0.075	-2.67	-0.094	-1.47	-0.056	-3.02
Married	0.080	0.36	0.080	0.36	0.242	2.07	-0.245	-1.12	0.137	2.19
Children < 5 years in household	0.544	2.87	0.544	2.87	0.130	1.47	0.271	1.47	0.111	1.58
Children 5–15 years in household	0.279	1.60	0.279	1.60	0.070	0.88	0.125	0.92	0.055	1.00
Spouse lives abroad( $t - 1$ )	-0.033	-0.12	-0.033	-0.12	-0.103	-0.57	0.072	0.31	-0.062	-0.58
Children live abroad( $t - 1$ )	-0.051	-0.29	-0.051	-0.29	0.119	1.29	-0.070	-0.44	0.083	1.15
Intended return migration( $t - 1$ )	0.088	0.55	0.088	0.55	0.400	6.56	-0.086	-0.32	0.243	5.02
Years since migration	-0.084	-1.49	-0.084	-1.49	0.010	0.41	-0.052	-1.01	0.004	0.25
Years since migration <sup>2</sup> × 10 <sup>3</sup>	2.488	1.74	2.488	1.74	-0.386	-0.57	1.292	0.97	-	-
Country of origin: Turkey	0.243	1.61	0.243	1.61	0.025	0.30	0.252	1.68	0.030	0.52
Country of origin: Italy	-0.006	-0.03	-0.006	-0.03	-0.166	-1.45	0.044	0.23	-0.102	-1.50
Country of origin: Greece	-0.134	-0.65	-0.134	-0.65	-0.130	-1.36	0.086	0.44	-0.078	-1.35
Constant	0.089	0.06	-	-	-5.464	-7.03	2.418	1.01	-	-
$\rho$	-	-	-	-	-0.267	-0.38	-	-	-	-

Notes: Number of observations: 9,331. Weighted Tobit and weighted double-hurdle using weights provided by the SOEP. Standard errors are adjusted in order to take repeated observations of households into account. The regression further includes year dummies.

**Table 3:** Estimation of Tobit and dependent IHS double-hurdle model: Other transfers abroad – 1985-1991, 1993 and 1995

	Tobit				Participation				Double-Hurdle					
	Coefficient		t-value		Marginal Effect		t-value		Coefficient		Level		Elasticity	
Age	0.022	0.56	0.022	0.56	0.052	2.40	-0.013	-0.30	0.042	2.00				
Age <sup>2</sup> × 10 <sup>3</sup>	-0.244	-0.55	-0.244	-0.55	-0.547	-2.13	0.167	0.32	-	-				
Female	-0.361	-3.65	-0.361	-3.65	-0.258	-5.43	0.059	0.53	-0.196	-2.81				
ln(Income)	0.307	2.47	0.307	2.47	0.284	4.59	-0.346	-1.36	0.211	2.46				
ln(Variance of past income)	0.003	0.13	0.003	0.13	-0.005	-0.42	0.060	1.99	-0.0003	-0.03				
Years of education	-0.085	-3.65	-0.085	-3.65	0.023	1.67	-0.111	-3.54	0.011	1.01				
Attended school in Germany	0.151	0.93	0.151	0.93	0.115	1.34	-0.111	-0.62	0.092	1.22				
Household size	-0.109	-3.46	-0.109	-3.46	-0.009	-0.36	-0.033	-0.80	-0.009	-0.54				
Married	0.308	2.48	0.308	2.48	0.213	2.76	-0.129	-0.82	0.152	2.36				
Children < 5 years in household	0.032	0.23	0.032	0.23	0.053	0.58	0.028	0.15	0.047	0.66				
Children 5-15 years in household	0.106	0.91	0.106	0.91	-0.002	-0.02	0.083	0.59	0.004	0.07				
Spouse lives abroad( $t - 1$ )	-0.634	-2.36	-0.634	-2.36	-0.111	-0.84	-0.033	-0.10	-0.086	-0.98				
Children live abroad( $t - 1$ )	-0.020	-0.13	-0.020	-0.13	-0.021	-0.25	0.173	0.94	-0.005	-0.09				
Intended return migration( $t - 1$ )	0.006	0.06	0.006	0.06	0.301	5.80	-0.335	-2.83	0.210	2.84				
Years since migration	0.012	0.28	0.012	0.28	-0.011	-0.53	0.059	1.18	-0.005	-0.32				
Years since migration <sup>2</sup> × 10 <sup>3</sup>	-0.367	-0.32	-0.367	-0.32	0.114	0.21	-1.337	-1.08	-	-				
Country of origin: Turkey	0.003	0.03	0.003	0.03	-0.033	-0.47	0.025	0.18	-0.025	-0.48				
Country of origin: Italy	-0.325	-2.13	-0.325	-2.13	-0.194	-2.38	-0.223	-1.33	-0.158	-2.31				
Country of origin: Greece	-0.010	-0.08	-0.010	-0.08	-0.276	-3.22	0.197	1.18	-0.184	-2.38				
Constant	3.360	2.39	-	-	-5.056	-7.78	11.491	4.68	-	-				
$\rho$	-	-	-	-	-0.914	-11.61	-	-	-	-				

Notes: See notes to Table 2.

**Table 4:** Estimation of Tobit and dependent IHS double-hurdle model: Payments to family members – 1985-1991, 1993 and 1995

	Tobit				Double-Hurdle					
	Marginal		Participation		Level		Elasticity			
	Coefficient	t-value	Effect	t-value	Coefficient	t-value	effect	t-value		
Age	0.015	0.34	0.015	0.34	0.159	7.23	0.033	1.24	0.270	7.06
Age <sup>2</sup> × 10 <sup>3</sup>	-0.154	-0.28	-0.154	-0.28	-1.692	-6.71	-0.249	-0.81	-	-
Female	-0.462	-6.01	-0.462	-6.01	-0.495	-9.88	-0.350	-6.20	-0.830	-11.38
ln(Income)	0.444	5.61	0.444	5.61	0.174	3.15	0.323	4.89	0.362	3.82
ln(Variance of past income)	-0.006	-0.34	-0.006	-0.34	-0.027	-2.12	-0.015	-1.18	-0.049	-2.23
Years of education	0.056	3.06	0.056	3.06	0.001	0.06	0.016	0.99	0.005	0.21
Attended school in Germany	-0.398	-2.67	-0.398	-2.67	-0.213	-2.14	-0.163	-1.37	-0.369	-2.43
Household size	-0.112	-2.82	-0.112	-2.82	-0.082	-3.56	-0.090	-3.66	-0.156	-3.89
Married	0.028	0.27	0.028	0.27	-0.098	-1.23	-0.122	-1.68	-0.195	-1.38
Children < 5 years in household	-0.143	-1.11	-0.143	-1.11	0.084	1.04	-0.053	-0.58	0.128	0.92
Children 5-15 years in household	-0.122	-1.28	-0.122	-1.28	-0.091	-1.35	-0.065	-0.91	-0.164	-1.46
Spouse lives abroad( $t - 1$ )	0.450	3.95	0.450	3.95	0.729	6.20	0.347	4.00	1.600	5.82
Children live abroad( $t - 1$ )	0.389	5.70	0.389	5.70	0.750	10.07	0.364	6.42	1.622	9.53
Intended return migration( $t - 1$ )	0.248	3.51	0.248	3.51	0.212	4.47	0.170	3.07	0.377	4.92
Years since migration	0.036	1.14	0.036	1.14	0.024	1.04	0.032	1.22	0.046	1.22
Years since migration <sup>2</sup> × 10 <sup>3</sup>	-1.144	-1.38	-1.144	-1.38	-1.179	-2.00	-0.930	-1.36	-	-
Country of origin: Turkey	-0.068	-0.68	-0.068	-0.68	0.159	2.19	-0.104	-1.44	0.243	1.91
Country of origin: Italy	0.237	1.51	0.237	1.51	-0.627	-6.81	0.194	1.87	-0.856	-7.66
Country of origin: Greece	0.073	0.61	0.073	0.61	0.118	1.36	0.130	1.39	0.234	1.49
Constant	1.479	1.31	-	-	-4.664	-7.86	2.285	3.01	-	-
$\rho$	-	-	-	-	0.008	0.17	-	-	-	-

Notes: See notes to Table 2.

**Table 5:** Estimation of Tobit and dependent IHS double-hurdle model: Payments to persons abroad – 1996-2004

	Tobit				Double-Hurdle			
	Marginal		Participation		Level		Elasticity	
	Coefficient	t-value	Effect	t-value	Coefficient	t-value	effect	t-value
Age	0.141	1.85	0.141	1.85	0.090	2.84	0.125	2.90
Age <sup>2</sup> × 10 <sup>3</sup>	-1.390	-1.64	-1.390	-1.64	-0.943	-2.62	-	-
Female	-0.123	-0.88	-0.123	-0.88	-0.227	-3.53	-0.289	-3.59
ln(Income)	0.303	1.77	0.303	1.77	0.143	2.33	0.223	2.75
ln(Variance of past income)	-0.017	-0.55	-0.017	-0.55	-0.017	-1.05	-0.020	-0.98
Years of education	-0.022	-0.72	-0.022	-0.72	-0.011	-0.74	-0.013	-0.70
Attended school in Germany	-0.015	-0.06	-0.015	-0.06	-0.092	-0.83	-0.112	-0.83
Household size	0.002	0.02	0.002	0.02	-0.118	-3.39	-0.157	-3.44
Married	-0.304	-1.38	-0.304	-1.38	0.302	2.64	0.356	3.17
Children < 5 years in household	-0.270	-0.94	-0.270	-0.94	-0.052	-0.41	-0.072	-0.48
Children 5-15 years in household	-0.086	-0.34	-0.086	-0.34	-0.119	-1.22	-0.167	-1.48
Spouse lives abroad( $t - 1$ )	0.558	0.89	0.558	0.89	0.784	2.80	1.588	2.52
Children live abroad( $t - 1$ )	0.302	1.21	0.302	1.21	0.221	1.49	0.294	1.32
Intended return migration( $t - 1$ )	0.106	0.64	0.106	0.64	0.231	3.44	0.315	3.35
Years since migration	-0.037	-1.03	-0.037	-1.03	0.010	0.51	0.008	0.35
Years since migration <sup>2</sup> × 10 <sup>3</sup>	0.360	0.42	0.360	0.42	-0.491	-1.24	-	-
Country of origin: Turkey	0.253	1.35	0.253	1.35	-0.098	-1.07	-0.091	-0.81
Country of origin: Italy	0.090	0.28	0.090	0.28	-1.196	-8.37	-0.962	-7.48
Country of origin: Greece	0.026	0.11	0.026	0.11	-0.311	-2.00	-0.323	-2.16
Constant	0.598	0.29	-	-	-3.434	-4.33	-	-
$\rho$	-	-	-	-	-0.866	-5.13	-	-

Notes: See notes to Table 2. Number of observations: 5,512.