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The volatility effect of diaspora's location: A migration portfolio approach

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Volatilité macroéconomique et localisation de la diaspora: Une approche par le portefeuille de migration

Résumé

Les envois de fonds peuvent transmettre la volatilité des pays hôtes vers le pays d'origine de la diaspora. Dans un modèle de portefeuille de migration, le risque global de volatilité associé à la distribution des localisations d'une diaspora est décomposé en risques de contagion et de concentration. Une diaspora située dans des destinations plus volatiles induit un risque de contagion supérieur, alors qu'une diaspora située dans quelques pays de destination augmente le risque de concentration. Une série d'estimations sur un panel de 93 pays 1995-2015 fournissent des preuves de ces deux risques et de leurs effets cumulatifs. L'estimation d'un modèle structurel confirme que la géographie de la diaspora a un impact indirect sur l'instabilité globale du pays d'origine par le biais des envois de fonds.

Mots-clés: Migration, transferts de fond, volatilité macroéconomique, modèle de portefeuille, diaspora

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Abstract

Remittances can transmit volatility from migrants' host countries to migrant's home country for some common patterns of a country diaspora's geographical distribution. In a migration portfolio model, the overall risk of volatility of any set of diaspora location is decomposed into a contagion and a concentration risks: a diaspora located in more volatile destinations induces a higher contagion risk, while a diaspora located in few destination countries increases the concentration risk. A series of estimations on a panel of 93 countries over 1995-2015 provide evidence for these two risks and their cumulative effects. Estimation of a structural model confirms that the geography of diaspora has an indirect impact on the origin country's aggregate instability through remittances.

Keywords: Migration, remittances, macroeconomic volatility, portfolio choice model, diaspora

JEL: F24, F3, F4, F62, F63, J61, O11, O15, O47

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1 Introduction

Over the last three decades, developing economies have been increasingly connected to the global economy, with the consequence that have been more exposed to external shocks and macroeconomic volatility (Aghion et al., 2004; Prasad et al., 2007; Kose et al., 2009). Macroeconomic volatility is a great concern for developing countries as it drags economic growth prospects (Ramey and Ramey, 1995; Rodrik, 1999; Loayza et al., 2007) and worsens poor households' vulnerability (Aizenman and Pinto, 2005; Guillaumont-Jeanneney and Kpodar, 2011). Recent episodes of crisis in emerging economies have demonstrated how brutally capital can fly out in the event of economic difficulties, obstructing any countercyclical fiscal policy aimed at limiting the macroeconomic cost of the shock (Edwards, 2004; Arze del Granado et al., 2013)¹. In the context of a higher vulnerability to external shocks, migrants' remittances are a potential channel through which income and consumption volatility can be smoothed in developing countries. Since Stark and Bloom (1985), we know that migration is an efficient tool of microeconomic risk diversification in developing countries, transfers from migrants smoothing migrants family's income fluctuations and improving its resilience against shocks (Hakura et al., 2009; Mohapatra et al., 2012)². At aggregate level, remittances also prove less volatile than other foreign currency flows during episodes of financial crises or sudden stops (De et al., 2015) and tend to be countercyclical in migrant's home country (Kapur, 2004; Frankel, 2011)³. Larger flows of remittances therefore contribute to risk sharing in the origin country of migrants by reducing consumption, investment or tax income volatility (Hakura et al., 2009; Bugamelli and Paterno, 2011; Balli and Rana, 2015).

Still, all geographical distributions of a country's diaspora will not equally mitigate in-

¹Recent studies have also found that instability is imported through trade flows. di Giovanni et al. (2016) estimate for example that two thirds of the French economy's cycle co-movement is due to direct trade and multinational inter-firm linkages. Internal factors like policy shifts also matter to explain output instability in emerging market economies, as evidenced by Aguiar and Gopinath (2007).

²Additionally, transfers promote financial development in the recipient country (Aggarwal et al., 2011), thereby improving household resilience through a wider access to credit (Combes et al., 2014; Bettin et al., 2017).

³Various studies find that the impact of remittances on macroeconomic stabilization is not linear. Hakura et al. (2009) find that remittances would be less effective in stabilizing GDP growth in recipient countries when they exceed 2% of GDP and Combes and Ebeke (2011) find a threshold value of 6% of GDP beyond which remittances have a lower capacity to stabilise consumption. One explanation proposed by Hakura et al. (2009) is that countries receiving large amounts of transfers are less likely to implement efficient economic policies.

come and consumption volatility. As the present paper argues, the risk sharing impact of remittances in the origin country⁴ is strongly conditional on the distribution pattern of migrants across destination countries in two main respects. First and quite intuitively, when the diaspora is located in more volatile host countries, aggregate output volatility in the migrant’s destination country may be transferred to its origin country through the channel of remittances. If destination countries are highly volatile or deeply integrated (with business cycles strongly co-moving), households in home country are exposed to high risks of sudden changes in the amounts transferred. The 2008 crisis was a paroxysmal, albeit exceptional, example of such a perfect symmetric shock⁵. This is what we call the *contagion* risk. Second and less intuitively, excessive geographic concentration of the diaspora in one or a few host countries might also increase the risk of aggregate volatility in the migrant’s origin country. In the extreme case where the diaspora is concentrated in a single destination country, any economic downturn in this country will lead to a drop of migrants’ transfers that cannot be compensated by remittances sourced from more stable destinations. Conversely, when the diaspora is spread across several countries, the overall level of remittances received by the home country will not be strongly affected if one of the host countries experiences temporary economic difficulties, provided that the other host countries are not affected by similar economic reversals. When the number of host countries increases and the diaspora is more evenly distributed among these countries, the adverse impact of an economic downturn in one host country is averaged out across all the locations of the diaspora. This is what we call the *concentration* risk. The geographical locations of migrants’ destinations is therefore a decisive factor in the stability of remittances: the more diversified and stable the destinations, the less likely a sharp fall in remittances in case of economic slowdown in some of the destination countries.

In order to strengthen our argument and help to interpret the empirical findings, the paper’s general argument is framed in the unified framework of a model of migration portfolio. The migration portfolio is defined as the combination of expected return (expected amount of remittances) and expected risks (expected standard deviation of remittances), both weighted by the share of the country’s diaspora in the overall migrant population,

⁴In the rest of the paper, we will use the terms “home” and “origin” to designate the country of origin of migrants and the terms “host” or “destination” to designate the country of destination of migrants.

⁵Our paper provides suggestive evidence of this exceptionality.

that results from the aggregation of individual migrants choices. The standard portfolio theory establishing that asset diversification reduce volatility in asset returns was transposed to the issue of productive diversification and macroeconomic volatility by Lucas (1977). In more diversified economies, shocks to individual productive sectors have no effect on aggregate volatility: as the number of independent and identically distributed shocks increases in an economy, each independent sectoral shock become inconsequential according to the law of large numbers⁶. Transposed to remittances, the standard portfolio diversification argument states that when the geographical location of a country's diaspora is diversified, shocks in individual host countries are unimportant because each independent shock would become inconsequential as the number of independent and identically distributed shocks increases in the country's migration portfolio. Moreover, the theoretical migration portfolio framework allows decomposing the overall risk generated by migration as the sum of a *contagion* risk, related to host countries' business cycles as well as their co-moving, and a *concentration* risk related to the degree of migrants' geographical diversification.

The empirical analysis is directly drawn from this theoretical decomposition of risks. Our estimations confirm, for a panel of 93 countries over 1995-2015, the existence of the *concentration* and *contagion* risks by showing that remittances volatility increase when a diaspora is located in a less diversified set of destination countries, and in destination countries that are more volatile. Then, by estimating a structural model, we provide empirical evidence that the diaspora distribution across host countries has an indirect impact on the migrant origin country's aggregate volatility through the channel of remittances. Our findings therefore confirm that remittances are a crucial channel of macroeconomic volatility transmission from host to home country, with the intensity of the transmission being conditioned by the geographic pattern of diaspora's distribution. Our results notably point to particularly high levels of risks for countries that are, in the same time, highly dependent to remittances and have their diaspora located in excessively concentrated or risky geographical destination countries. Indeed, we find that the *contagion* and *concentration* risks can be cumulative as the adverse effect of the main destination country's output business cycle on the volatility of remittances is magnified

⁶Only aggregate shocks - affecting many economic sectors in the same way - are important to explain economic volatility in diversified productive systems.

for more geographically concentrated diasporas. For countries cumulating the two risks, the adverse effect of remittances on macroeconomic stability would be mitigated by a more diversified structure of labour migration by destination countries and by promoting more stable destinations.

As argued by Carling (2008), the literature on remittances has paid excessive attention to the microeconomic foundations (altruism versus self-interest) and has consequently under-investigated the determinants of their actual variation which are crucial in a policy perspective. Although the present paper is the first to address theoretically and empirically the impact of the pattern of distribution of migrants on remittance volatility in the set-up of a migration portfolio model, it relates to several other papers in the literature.

By estimating a dynamic panel data model using the system-GMM estimator over the period 1970–2007, Cooray and Mallick (2013) document that the level of remittance inflows increases with the volatility in host countries, especially for middle-income countries. Their result is consistent with the assumption that insurance motive of migrant workers prevails when host countries are particularly risky because of large and sudden downswings of activity (Galor and Stark, 1990), and with the evidence provided by Amuedo-Dorantes and Pozo (2006) for remittances from USA to Mexico. The measurement of the volatility in host countries used by Cooray and Mallick (2013) is similar to ours since they compute the weighted average of real GDP growth volatility of all host countries from where a home country receives remittances, with the weight attached to a host country being its share in total remittance inflows to the home country and alternatively its share in the stock of migrants. Still, Cooray and Mallick (2013) provide no estimation for the impact of host countries' macroeconomic conditions on home countries' economic volatility, nor do they document the impact of diaspora's concentration. In a recent paper, Balli and Rana (2015) have measured that the contribution of migrants' transfers to risk sharing in the origin country is significant but larger when migrants' destinations are well diversified or more distant from the origin country. Although their result partially connects to ours, their framework is different as they focus more on remittance levels than on remittance volatility. Moreover, attention is mainly put on the decomposition of consumption volatility in origin countries and not on the geography of

diasporas as we do in this paper. Although we confirm that diaspora concentration matters to explain growth volatility in origin countries, our portfolio set-up allows providing empirical evidence as to how this *concentration* risk articulates with the *contagion* risk⁷.

The vulnerability of capital-importing developing countries to external volatility has been investigated for other flows of external finance. For instance, Nicet-Chenaf and Rougier (2014, 2016) have shown that FDI to developing countries are highly dependent on macroeconomic conditions in source countries. Moreover, various recent studies have focused on the impact of a concentrated structure of trade on growth volatility. While the panel data estimations by Malik and Temple (2009) and Joya (2015) show that diversifying exports helps reducing growth volatility in resource-rich countries, Balavac and Pugh (2016) show for a sample of transition countries that diversifying export helps reduce output volatility at lower initial levels of diversification. Likewise, Kim et al. (2016) has found that greater commercial activity (exports and imports) generates long-term growth instability through the channel of a strong concentration of the country's trade following comparative advantage. Thus, a highly specialised country might be naturally more vulnerable to external shocks than a more diversified one.

The concentration of diaspora is not always detrimental to developing countries' economic development, lastly. Vaaler (2013) provides theory and evidence linking the geographic concentration of migrant diasporas abroad to the magnified venture investment impact of their remittances back home. By studying remittances to 50 developing countries from 2002-2007, it shows that diaspora concentration abroad facilitates more effective discovery of venture opportunities back home since the venture investment impact of remittances may be completely nullified when coming from geographically-dispersed immigrant diasporas. To our knowledge, this is the single study, with Balli and Rana (2015), to have addressed issues linked to diaspora concentration. Lastly, although the paper deals with diaspora, it is not strictly interested by the diaspora effect describing the impact of network spillovers and agglomeration effects on the choice of migrant destinations (Beine et al., 2011). We focus on the effect of the distribution of diasporas across different

⁷While Frankel (2011) finds that remittances are procyclical with respect to income in the host country, other studies based on time series find that remittances from Germany to Turkey are either acyclical (Sayan, 2004) or procyclical (Akkoyunlu and Kholodilin, 2008) with respect to the host country's business cycle.

destination countries and how it exposes the home country to a stronger risk of volatility.

The paper is structured as follows. Next section 2 motivates the paper's focus on *contagion* and *concentration* risks. Section 3 presents the migration portfolio set-up underlying our empirical analysis. Section 4 exposes the methodological aspects, original risks indicators and empirical strategy, before section 5 presents the estimation results and a series of robustness checks. Section 6 exposes some policy issues.

2 Remittance volatility, the *contagion* risk and the *concentration* risk: What's the point?

As for all types of financial flows⁸, the level and stability of remittances transferred to migrants' home countries are partially related to economic conditions in the economies from which remittances are sourced. Indeed, a severe economic downturn in the country where migrants work can drastically reduce the amount of their transfers, therefore exerting procyclical and hence negative effects in origin countries if cycles are synchronised⁹. Insofar as developing countries' economic cycles have become more synchronised with those of the advanced regions since two decades (Frankel and Rose, 1998; Clark and van Wincoop, 2001; Imbs, 2004; Baxter and Kouparitsas, 2005; Calderon et al., 2007; di Giovanni and Levchenko, 2010), the risk of volatility contagion through remittances proves more relevant than ever, putting the countercyclical impact of remittances into question.

To better illustrate this issue, it is interesting to consider the example of Tajikistan, Kyrgyzstan and Moldova. All these economies are strongly dependent on migrants' transfers, with remittances accounting for more than 25% of their GDP and have a very concentrated diaspora, with a large part of their migrants being located in Russia¹⁰. Figure

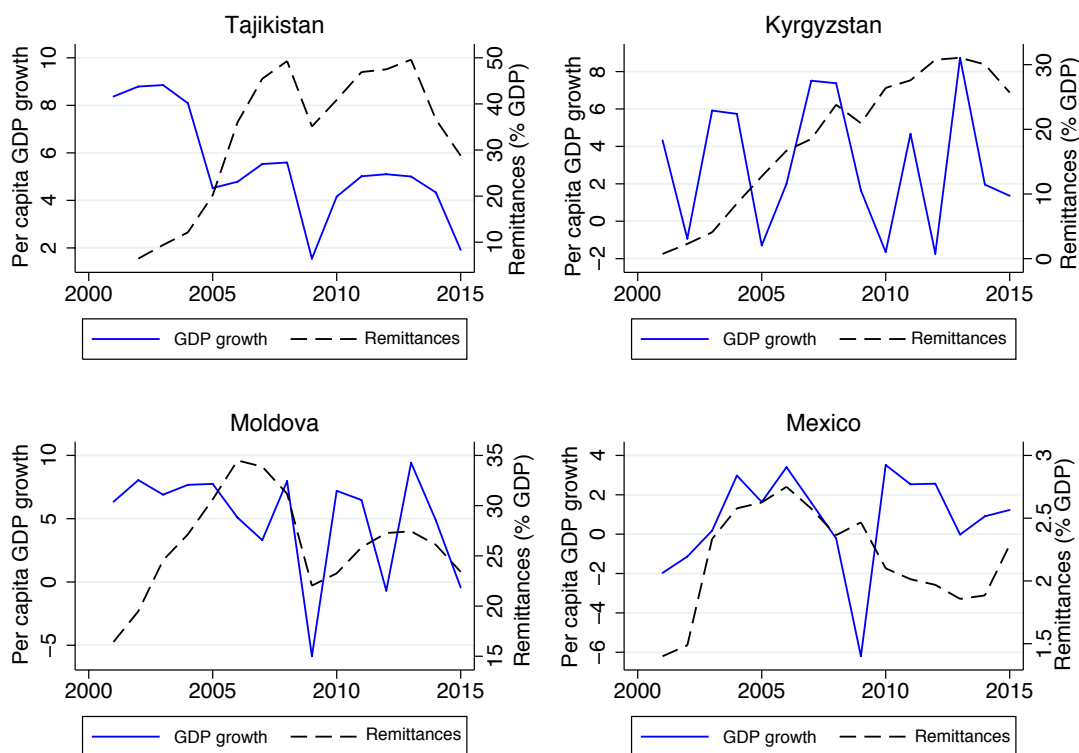
⁸Recent empirical evidence shows that swings of capital flows to developing countries are highly sensitive to push factors, that is those related to the countries or regions from which external finance is sourced (Nicet-Chenaf and Rougier, 2014, 2016; Pagliari and Hannan, 2017).

⁹In addition to their adverse impact on migrants' labour income, economic reversals in host countries are frequently followed by restrictive immigration policies, as in the US after the 2008 crisis. See Ratha (2005) for an historical illustration.

¹⁰Specifically, Kyrgyzstan and Tajikistan had more than 78% of their diaspora located in Russia in 2010, as compared to 35 per cent for Moldova (United Nations data).

1 illustrates that remittance volatility has increased over the last decade in these three countries. Although the impact of financial crises was generally local and confined to specific geographical areas until 2007 (Koser, 2009), the 2008 global crisis did, for the first time, cause a global reduction in remittances¹¹. Comparison of figures 1 and 2 shows that remittance inflows are more significantly correlated with host country’s macroeconomic conditions (Russia for Tajikistan, Kyrgyzstan, Moldova and USA for Mexico) than with those of the receiving country.

Figure 1: Remittances and home country GDP growth

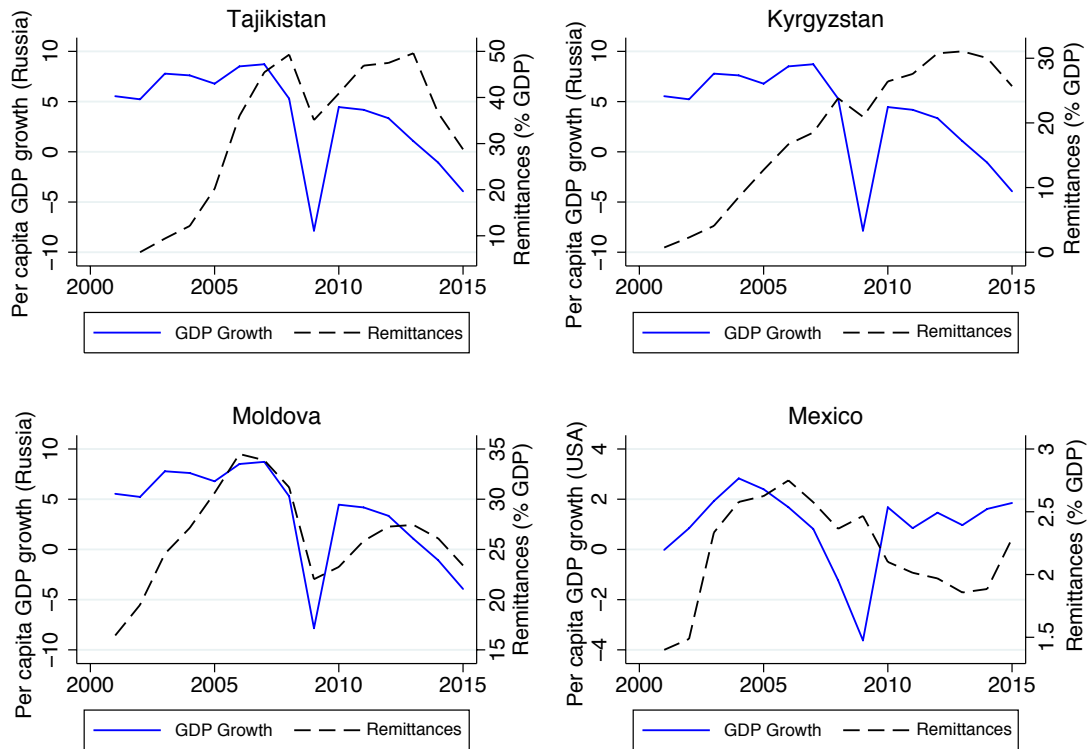


Sources: World Bank and IMF.

Figure 2 shows the impact of the 2008 economic crisis, both on Russian growth and on the amounts transferred by migrants. Although the drop in transfers over the period should not be attributed solely to it, the Russian recession is obviously an important explanatory factor. Figure 3 shows that the correlation appears to be much stronger with the home country’s household consumption level, particularly in Tajikistan and Moldova.

¹¹Cooray and Mallick (2013) report that remittance flows to low and lower-medium-income countries declined to US \$ 230,483.60 in 2009 when the developed economies were hit by recession, after having increased approximately 12-fold from US \$ 19,929.98 million to US \$ 235,685.7 million over the 1990–2008 period.

Figure 2: Remittances and main host country GDP growth

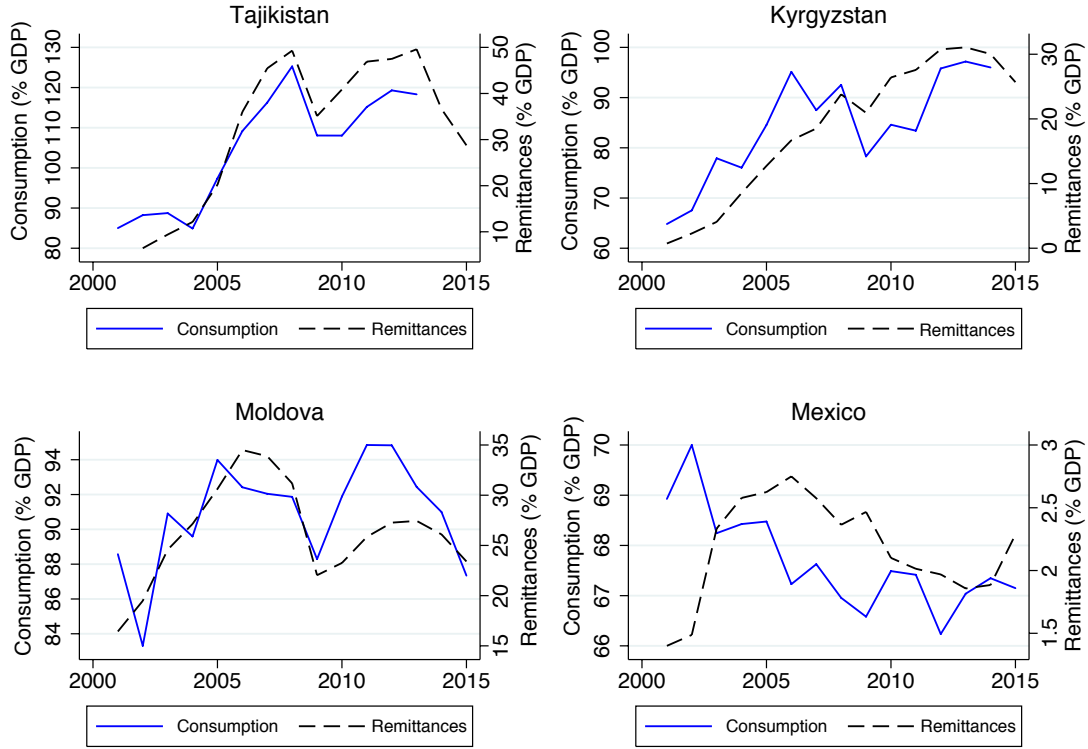


Sources: World Bank and IMF.

Here again, the simultaneous variation in consumption and transfers is probably conditioned by other variables. Still, when a labour-exporting economy is highly dependent on remittance flows sourced from a limited number of destination countries, and when the latter face output volatility, the migrant family's income and consumption levels in home country become less stable. It is interesting to note that the Mexican aggregate consumption level is less correlated to remittances, since the latter represent a smaller share of GDP compared with the three other countries.

Even in the absence of co-movement between source and destination countries, volatility can be transferred by remittances if the diaspora is concentrated in a limited number of locations abroad. The risk of volatility is stronger when remittances are insufficiently diversified over different source countries. When the diaspora is geographically concentrated, migrants' families become excessively vulnerable to bad economic conditions in the destination countries.

Figure 3: Remittances and households' consumption in home country



Sources: World Bank and IMF.

One appealing way to describe the diversification mechanism would be to consider the risk that all migrants from a given origin will be exposed to a shock in the destination country and show that this risk decreases with the number of destinations. Let the probability or risk θ_j of a shock in the host country j be equal to $\frac{1}{\alpha}$, with this probability being similar for all countries j for the sake of simplicity. The risk that the entire diaspora, that is all groups of migrants, will be hit by a shock in host countries is given by:

$$\cap_{i=j}^n \theta_j = \frac{1}{\alpha^n} \quad (1)$$

with n standing for the number of host countries. Equation (1) shows that the probability that all migrants will be exposed to a shock in their host country goes down when the number of destination countries n increases, that is when the diaspora is less concentrated. Mexican migrants and their families stayed home are particularly illustrative of this phenomenon as they were quickly and strongly affected by a drop of remittances received during the 2008 economic shock originating in the US, the main destination country of the Mexican diaspora. The result was a severe recession for Mexico in 2009

(-4.7%), coupled with a sustained decline in international transfers.

One important observation here is that, although not to such extreme extent as it is for the Mexican and former-USSR small economies, developing countries' diasporas tend to be fairly concentrated in a few host countries. Although migrants are generally dispersed over a large number of countries and the law of large number should apply, the distribution of the stocks of migrants is frequently fat-tailed, with diasporas tending to be concentrated in a few host countries. Table 1 confirms this trend by showing that the four countries with the largest stocks of migrants account for a substantial part, at least 80%, of the diaspora of the countries in the sample of developing countries used in the present paper¹².

Table 1: Share of migrants taken into account (% stock) considering the main host country (left) and the four main host countries (right)

	Main destination country			Four main destination countries		
	Minimum	Maximum	Average	Minimum	Maximum	Average
1995	10.00	99.85	52.53	33.51	100	80.06
2000	11.46	99.91	51.50	35.33	100	82.48
2005	10.39	99.90	50.19	33.31	100	81.20
2010	10.69	99.93	49.21	32.71	100	80.71
2015	9.40	99.90	48.65	32.22	100	80.37

Source: United Nations data, authors' calculations.

Recent literature on diaspora effects has explained that it is individually rational to migrate in a country hosting a large diaspora of fellow countrymen, even though we argue and show in this paper that it may be collectively dangerous for the migrant's origin country. Various mechanisms have been put forward to explain the pattern of diaspora concentration illustrated by Table 1. It was first emphasised that migrants don't choose their destination randomly¹³, the direction of migratory flows being partially determined

¹²Accordingly, we will essentially consider the four main destination countries in our empirical work.

¹³We will not expose extensively the literature dealing with the determinants of migration, but rather the articles dealing with the choice of migrants as to their country of destination. On the determinants of migration, see Sjaastad (1962), Mincer (1978), Borjas (1987), Stark (1991), Borjas et al. (1992), Rotte and Vogler (1998), Chiswick (2000). For a general review, see Hagen-Zanker (2008).

by the size of the national diaspora in the different destinations¹⁴. Migrant national communities already installed in host countries favour the arrival of new national migrants by reducing the cost of migration and facilitating their integration into the labour market (Munshi, 2003; Colussi, 2015; Chort, 2017). In addition, network effects in the destination country help migrants to diversify their portfolio of insurance mechanisms by associating informal diaspora-based insurance and formal mechanisms of social protection (Sabates-Wheeler and Waite, 2003). The constitution of a diaspora of fellow migrants in a foreign country is therefore a dynamic and self-sustaining phenomenon, network effects generating chain migration to this country at the expense of the others, featuring more limited diasporas (Beine, 2013)¹⁵.

3 The migration portfolio theoretical set-up

3.1 Micro-foundations

In the first place, we develop a simple model of labour migration that shows that although families choose rationally destinations in host countries with large diaspora or featuring volatility risks, the aggregation of these individually rational choices can create adverse macroeconomic risks for the country (that may eventually be harmful for migrant's family stayed home). This model partially adapted from Beine et al. (2015) provides micro-foundations to the migration portfolio model developed in the second part of the section.

Families in home country i decide whether to keep all of their members in their home country i or to send their migrants to destinations j ($j = 1, \dots, J$), each destination being

¹⁴According to Beine et al. (2011), the size of diasporas exerts one of the most important quantitative impact on the size and the composition of migration flows, once other factors like distance, colonial links, selective policies (Ortega and Peri, 2009) or wage differential (Rosenzweig et al., 2006; Grogger and Hanson, 2011) are accounted for. Relying on the cross-country gravity estimations of the determinants of bilateral migration flows of Beine and Parsons (2015) and Bertoli and Moraga (2012), Beine (2013) reports estimations of the elasticity of migration flows to the size of the diaspora of about 0.4 for all mixed-up flows (0.7 for the flows to OECD countries).

¹⁵Recent empirical evidence shows that network effects are reinforced by various factors like common history (Geis et al., 2013; Westmore, 2015), common language (Pedersen et al., 2008), linguistic and ethnic proximity (Fafchamps and Shilpi, 2013), cultural diversity in host countries (Wang et al., 2016), and geographical distance (Mayda, 2010).

characterised by a specific return/risk ratio¹⁶. Households assess these return/risk ratios by considering (i) the host country's average wage level w_j , (ii) the probability π_j to find a job in the host economy, which depends on the pace of GDP growth and/or the adequacy of the skill demand structure and (iii) the probability β_j that the migrant worker, through his/her wages, and for his/her family through remittances, will overcome income instability, with this probability being determined by growth volatility in host country.

As in recent migration models (Grogger and Hanson, 2011; Beine et al., 2015), the individual utility is linear in income and includes migration costs as well as positive and adverse characteristics of the country of residence. The utility obtained when a s -type individual migrates to location j is given by:

$$u_{ij} = w_j + A_j - C_{ij} + \zeta_{ij} \quad (2)$$

where w_j denotes the expected labour income in host country j , A_j denotes various host country j 's characteristics like amenities, migration policy, public spending, noted α_j , and the ratio of the probability π_j to find a job in the host economy and the probability β_j to overcome income instability. ζ_{ij} is a random variable representing influences on non-migration decisions that are not included in the model. In a standard fashion, it is assumed to be independent and identically distributed across locations and across periods and independent of the state variables explaining migration in the model.

The deterministic component of utility A_k can be generally written as:

$$A_k = A\left(\alpha_k \frac{\pi_k}{\beta_k}\right) \text{ with } A'_\alpha > 0 \text{ and } A'_{\frac{\pi}{\beta}} > 0 \quad (3)$$

According to equation (3), any country k 's potential (including the host country j) of attractiveness to migrant workers will increase with all the amenities, including the pace of GDP growth determining the probability π_j to find a job in the host economy, and will decrease with GDP growth volatility, conditioning the probability β_j to overcome income

¹⁶Obviously, all individuals (or families) have not the same type (skill, preferences, social capital ...) and the probability to migrate, as well as the destination of migration, will depend on these deterministic parameters that could be summed up by a state vector. However, for the sake of simplifying notations, we have not reported the subscript specifying the type of individuals or families in equations. For a model in which individuals feature homogeneous skill types, see Beine et al. (2015).

instability for the migrant and, by extension, for his/her family, through private transfers.

Symmetrically to equation (2), the utility of the same s -type individual born in country i and staying in country i (not migrating) is given by :

$$u_{ii} = w_i + A_i + \zeta_{ii} \quad (4)$$

where ζ_{ii} is a random factor of influences on the decision not to migrate from country i that are not included in the model.

As in the recent literature emphasizing the role of social ties in migration (Munshi, 2003; Beine et al., 2011; Bertoli and Fernández-Huertas Moraga, 2013), migration costs are assumed to decrease with the size of the home country i 's diaspora network in host country j (D_{ij}) measured by the total number of people born in country i living in country j . The cost of migrating¹⁷ from i to j (c_{ij}) thus depends on the distance between countries i and j (d_{ij}) and on the size of the country i 's diaspora in country j (D_{ij}):

$$c_{ij} = c(d_{ij}, D_{ij}) \text{ with } c'_d > 0 \text{ and } c'_M < 0 \quad (5)$$

As in standard migration models (Fafchamps and Shilpi, 2013), households in country i will therefore decide whether they send migrant, and where they send him/her, by optimizing the distance between the different destinations, including home country (that is not migrating), with respect to the different parameters of their utility function and in function of their preference with respect to risks¹⁸. Aggregation of individual utility-maximizing choices leads to various proportions of the home country's total population within the age of migration having migrated in different locations abroad or having not migrated.

We define N_i as the size of the native population of country i who is migration aged, and

¹⁷Contrary to Beine et al. (2015), we consider that there are no administrative costs related to visa obtaining. The reason is our focus is put on the influence of diaspora's size and host country's volatility characteristics and not on the determinants of migration as in Beine et al. (2015).

¹⁸Their budget constraint is determined by the fact that migration costs should be at least covered by incomes generated by it.

N_{ij} the size of the population that effectively migrates to destination country j ¹⁹. As in recent models of migration destination choice (Kennan and Walker, 2013; Beine et al., 2015), we suppose that the random variable ζ_{ij} is drawn from (type I) extreme value distribution and use results by McFadden (1973) and Rust (1987) to conveniently write the probability that an individual born in country i will move to location j as:

$$Pr(u_{ij} = \max_k u_{ik}) = \frac{N_{ij}}{N_i} = \frac{e^{(w_j + A_j - c_{ij})}}{\sum_k e^{(w_k + A_k - c_{ik})}} \quad (6)$$

3.2 Aggregation

As in Beine et al. (2015), the ratio of country i 's migrants to country j to country i 's non migrants (residents of i) is drawn from (6) and can be expressed as:

$$\frac{N_{ij}}{N_{ii}} = \Omega_{ij} = \frac{e^{(w_j + A_j - c_{ij})}}{e^{(w_i + A_i)}} = \frac{e^{[w_j + A(\alpha_j \cdot \frac{\pi_j}{\beta_j}) - c(d_{ij} \cdot D_{ij})]}}{e^{(w_i + A_i)}} \quad (7)$$

Replacing by equations (3) and (5) in equation (7) gives the expression of the ratio of country i 's migrants to country j to country i 's non migrants in terms of the country i 's diaspora size in host country j (D_{ij}), the probability of finding a job (π_j) and the probability of being exposed to income volatility (β_j) in host country j , and the other amenities provided by host country j (α_j):

$$\frac{N_{ij}}{N_{ii}} = \Omega_{ij} = \frac{e^{[w_j + A(\alpha_j \cdot \frac{\pi_j}{\beta_j}) - c(d_{ij} \cdot D_{ij})]}}{e^{(w_i + A_i)}} \quad (8)$$

With $\Omega'_{D_{ij}} > 0$, $\Omega'_{\alpha_j} > 0$, $\Omega'_{\pi_j} > 0$ and $\Omega'_{\beta_j} < 0$.

From (7) we can easily draw the expression of the share of the country i 's diaspora located in country j :

$$\frac{N_{ij}}{N_{ii}} = \Omega_{ij} \times \frac{N_{ij}}{\sum_k N_{ik}} \quad (9)$$

Which has similar functional characteristics as the ratio of country i 's migrants in country j to non migrants (equation (8)). As the result of this optimization process, each country can be associated, at equilibrium, to a K -set of destination-vectors (with K being poten-

¹⁹Another optimization constraint is that the total number of individuals of migration age in country i equals the sum of the migrants located in all destination countries abroad and of the individuals of migration age who stay home. More formally : $N_i = \sum_k N_{ik}$

tially different between countries) including (among other things) the relative size of the country i 's diaspora in each country j (hereafter noted w_{ij}) and the level and volatility of GDP growth in the host countries j (hereafter noted σ_j). The K equilibrium destination vectors (w_{ij}, σ_j) will be the constitutive elements of the origin country's migration portfolio model developed in the next sub-section 3.3.

3.3 The migration portfolio and the *contagion* and *concentration* risks

The theoretical intuitions supporting our empirical analysis can be conveniently formulated in the unique set-up of a portfolio model applied to the set of a country's diaspora locations. For the sake of clarity, before generalizing the migration portfolio framework, the *contagion* and *concentration* risks are first illustrated in the simplified set-up of a two destination countries portfolio.

Let consider n individuals migrating from a given origin country to two destination countries A and B in the respective proportions of w and $1 - w$. Then, the expected overall return and risk of the migration portfolio P is the weighed sum of the average individual remittance level from countries A and B :

$$\pi_P = w\pi_A + (1 - w)\pi_B \quad (10)$$

and the risk of the migration portfolio P is the weighed sum of the standard deviation of individual remittances from countries A and B :

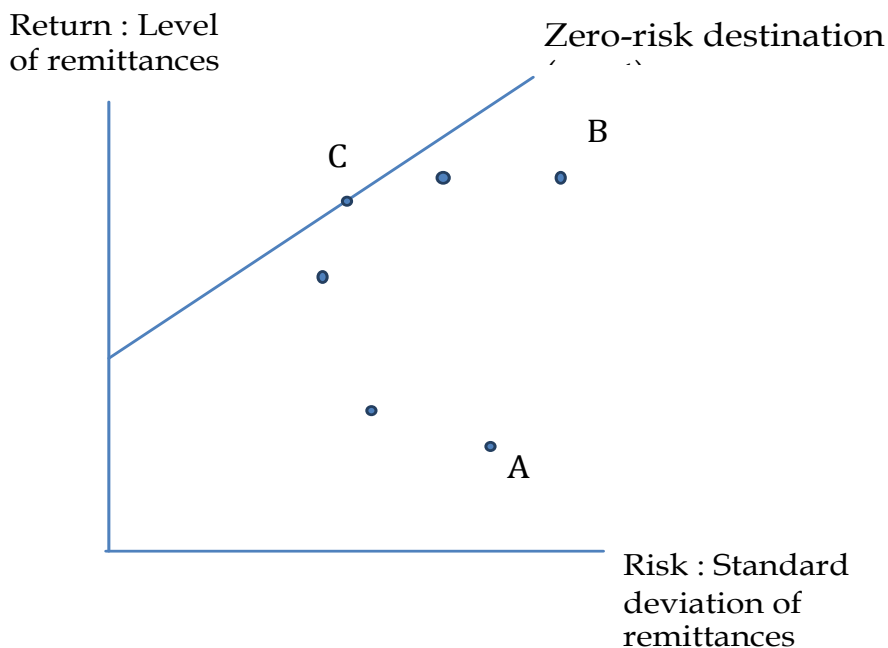
$$\sigma_P = [w^2\sigma_A + (1 - w)^2\sigma_B + (w)(1 - w)\rho_{AB}]^{\frac{1}{2}} \quad (11)$$

Let first assume that the entire set of n migrants had the same and unique destination country, the diaspora being located in country A ($w = 1$). The coefficient of correlation ρ_{jk} ²⁰ is null and the portfolio risk is equal to σ_A . The same would hold for a diaspora located exclusively in B ($w = 0$) where the portfolio risk is equal to σ_B . These two points are illustrated by A and B in the mean-standard deviation diagram in Figure 4. Any

²⁰ ρ_{jk} represents the correlation between host countries' business cycles. This variable is defined in the next section (see equation (15)).

combination of non null diaporas in A and B ($0 < w < 1$) would lead to a diversified migration portfolio and to a reduction of its expected risk. They are represented by the diversification curve that would link A , C and B in Figure 4.

Figure 4: Risk diversification in a two destinations portfolio



This two-country case illustrates that any diversified migration portfolio (dots other than A and B) provides a lower risk in terms of remittance instability than A and B , the two non-diversified cases. A simple numeric example based on equation (11) illustrates this point. Starting from an even distribution of migrants over the two destinations A and B , any move towards diaspora concentration in one of the two destinations would increase the overall risk. Let the shares of a country's diaspora be $w = 1 - w = 0.5$ initially, and the idiosyncratic country risks be $\sigma_A = \sigma_B = \sigma$. Then, it is straightforward to check that the portfolio risk will be higher if the diaspora gets more concentrated in one country e.g. $w = 0.9$, as $(0.5^2 + 0.5^2) \cdot \sigma < (0.9^2 + 0.1^2) \cdot \sigma$

This case can be generalised to more than two destination countries. Let the migration portfolio P_i of the labour-exporting country i be characterised by a n -set of return-risk pairs (π_{ij}, σ_{ij}) . π_{ij} stands for the return of migration to the destination country j for the migrants from country i characterised by the expected overall amount of remittances

transferred by the migrants from country i (based in country j), which is determined by the level of GDP growth in the destination country²¹. σ_{ij} stands for the risk attached to the destination country j defined by the expected volatility of remittances sent from the destination country j , which depends on the volatility of GDP growth in this country. For each home country i , the expected return of the migration portfolio P_i is given by equation (12) where π_i is the amount of remittances and w_j is the weighing of the component asset, that is the share of the diaspora in country j in the country i 's overall diaspora:

$$E(\pi_i) = \sum_j w_j E(\pi_j) \quad (12)$$

The aggregate risk of country i 's migration portfolio σ_p is given by equation (13), where σ_j is the standard deviation of the return from migration from the country i to the country j (remittances flowing from country j to country i) and ρ_{jk} is the correlation coefficient between the returns from migration (remittances) for country i 's migrants located in countries j and k . σ_{jk} is the covariance between expected returns from migrants in countries j and k .

$$\sigma_p = \left(\sum_{j=1}^n \sum_{k=1}^n w_j w_k \sigma_j \sigma_k \rho_{jk} \right)^{\frac{1}{2}} = \left(\sum_{j=1}^n \sum_{k=1}^n w_j \sigma_{jk} w_k \right)^{\frac{1}{2}} \quad (13)$$

If ρ_{jk} is null, that is remittances are perfectly uncorrelated across the different pairs of migrants, then the migration portfolio's return standard deviation is the sum over all destination countries j of the fraction held by this country in the total stock of migrants of the home country times the country j 's standard deviation of remittances. In that case, the risk attached to the migration portfolio can be reduced if destination countries exhibit lower GDP growth volatility or if less unstable remittances are sourced from them. If ρ_{jk} is positive, then the risk of the migration portfolio is increased by the co-movement of business cycles and remittances across the different destination countries. If some weights w_j become larger, because national diaspora gets more concentrated in

²¹Usual assumptions of portfolio theory hold: countries are risk averse, meaning that given two migration portfolios that offer the same expected return, countries will prefer the less risky one, the one with the lower expected risk of remittance volatility. Thus, a country can take on increased risk with migration destinations if this risk is compensated by higher expected returns in terms of GDP growth and remittance levels. Different countries can evaluate the risk-return trade-off differently based on national risk aversion characteristics.

a small set of destination countries, then the overall risk associated with the portfolio will be increased because of the squared weights imposed by the portfolio arithmetic of equation (13). The overall risk will be larger if those destination countries concentrating the diaspora show patterns of high and correlated volatility, that is if ρ_{jk} is positive. If ρ_{jk} is negative, then the migration portfolio risk is decreased by any combination of the two migration destinations, that is for any w different from 1.

The modern portfolio theory (Markowitz, 1952; Merton, 1972) makes the demonstration that, given the parameters π_{ij} , σ_{ij} and for $-1 < \rho_{jk} < 1$, any combination of risky assets (w_i is different from 1) generates risks lower than that of a single asset, and there is a unique set of w_i that minimises the overall risk of the portfolio. Transcribed to diasporas, this result implies that any diversified combination of destination countries is less risky than the concentration of the diaspora in a single one. Another implication is that there exists an optimal distribution of a country's diaspora for any given set of expected idiosyncratic returns and risks and of covariance between these idiosyncratic risks. From this result, we can infer that the risk associated to a given migration portfolio increases with the idiosyncratic volatility of destination countries, with the co-movement of these locations' business cycles (i.e. the *contagion* risk) and with the geographical concentration of the diaspora's location (an inflation of the weight of a limited number of destination countries in the distribution of the diaspora, i.e. the *concentration* risk)²². The next section presents the different indicators used to assess these *contagion* and *concentration* risks.

²²Various bilateral mechanisms could also differentiate the set (π_{ij}, σ_{ij}) of risk and return associated to migrating from i to j , like the nature of political relationships and migration controls, past common history and current common language, job opportunities for migrants, taxes or incentives on remittances or exchange rate instability and controls. Still, to make the presentation more tractable, we have supposed above that all (π_{ij}, σ_{ij}) are equal for each given destination country j , whatever the origin country i , the probability θ_j of a shock in the migrant's destination country being similar for all countries i . Relaxing this assumption would not change the result of modern portfolio theory for which each individual has its own structure of expectations conditioned by its degree of risk aversion for each type of asset.

4 Measurement and identification issues

4.1 Measuring *contagion* and *concentration* risks

As demonstrated in the previous section, the *contagion* risk drawn from the migration portfolio set-up includes two components: the idiosyncratic volatility in host countries and the co-movement of their business cycles. The weighed average volatility of the four main migrants' destinations (i.e. the idiosyncratic volatility in host countries) will be considered as our first indicator of host countries' volatility. Indeed, Table 1 showed that including the four main countries allows to capture 80% of the stock of diasporas. Host countries' volatility can therefore be computed as:

$$\sigma_{j,k,l,m}^{\Delta GDP^c} = \sum_{j,k,l,m} w^2 \cdot \sigma^{\Delta GDP^c} \quad (14)$$

where w is the relative stock of migrants from the country i located in countries j , k , l or m , i.e. the four countries with the largest stocks of migrants from country i . σ is the standard deviation of the GDP per capita growth rate in destination countries. The properties of the indicator $\sigma_{j,k,l,m}^{\Delta GDP^c}$ are very interesting for our purpose since it takes into account the per capita GDP growth rate of the four countries j , k , l or m hosting the largest shares of migrants from country i , while weighting this rate in relation to the relative weight of the country i 's diaspora in these four destination countries.

As suggested by the migration portfolio model, we consider the co-movement of host countries (equation (15)), that is the correlation between their respective GDP per capita growth rate. More precisely, equation (15) represents the sum of all pairwise correlations of host countries' GDP per capita growth rates, weighted by the share of the home country's diaspora working in each of these host countries. This variable is computed as:

$$\rho_{j,k,l,m}^{\Delta GDP^c} = \sum_{j,k,l,m} w^2 \cdot \rho_{j,k}^{\Delta GDP^c} \quad (15)$$

ρ is the correlation coefficient between the GDP per capita growth rates of the four main host countries.

The total migration portfolio risk (*Totalrisk*) is also inspired by the portfolio theory framework developed in section 3. It measures the periodic risk of remittance volatility to which home country i is exposed as the sum of the contagion risks related to weighed average idiosyncratic volatility and co-movement. The term σ_j stands for the average idiosyncratic risk in host country j measured by the five-year standard deviation of GDP growth, while the term ρ_{jk} represents the co-movement risk and is measured by the five-year covariance of GDP growth for the host countries j and k . For each country i , the indicator is computed over the four main location countries of the diaspora and for five-year periods from 1995 to 2015. It is described by equation (16).

$$Totalrisk = \left(\sum_{j=1}^4 \sum_{k=1}^4 w_j w_k \sigma_j \sigma_k \rho_{jk} \right)^{\frac{1}{2}} \quad (16)$$

The first component of equation (16) gives the total idiosyncratic risk of the migration portfolio. It is proxied by the weighed average of the five-year standard deviation of GDP growth in the four main destinations of the country i 's diaspora computed for each period (see equation (14)). Following the portfolio risk theory, the weights used are the squared shares of country j in the country i 's overall diaspora. This means that the weighing of the indicator gives higher risk value to more concentrated diasporas, as demonstrated in section 3. The second component accounts for the risk of business cycle co-movement (see equation (15)). If all ρ_{jk} are null, that is if remittances are perfectly uncorrelated between the four main host countries, then the migration portfolio's total risk is the weighed sum over all destination countries of the five-year standard deviation of GDP growth. In that case, the risk attached to the country i 's portfolio can be reduced if destination countries exhibit lower GDP growth volatility or if the diaspora is more evenly distributed across destination countries. If ρ_{jk} is positive, then the risk of the migration portfolio is increased by the co-movement of business cycles and remittances across the different destination countries.

According to the migration portfolio diversification theory, the total risk of migration (*Totalrisk*) should be weaker when the average volatility of the four main diaspora locations is lower and when the number of destination countries of the diaspora is increased, for example when the diaspora is located in different regions of the world or in economies

at different development levels. The latter condition should reduce the value of the overall risk of remittance volatility for the origin country through (1) the traditional diversification channel, and (2) through the lower risk of business cycle co-movement ρ_{jk} which is based on the four main destination countries. By construction, the *concentration* risk is incorporated in the total portfolio risk, through the diaspora’s location weights.

In order to get a more explicit estimation of the specific impact of diaspora’s concentration on remittance volatility though, we will also consider a separate concentration indicator. We follow the sparse literature on this issue (Vaaler, 2013) and use the Herfindahl-Hirschman index with the United Nations International migrants stock database²³. By definition, an individual is considered to be a migrant when she/he resides in a country other than her/his native country²⁴. The Herfindahl index of diaspora concentration applied to the UN population stock estimates is given by:

$$CONC_i = \sum_{j=1}^n S_{ij}^2 \quad (17)$$

Where S_{ij} is the share of the stock of origin country i ’s diaspora which is located in the destination country j .

4.2 Econometric specification and estimation issues

We first estimate equation (18) to test the assumption that the more diaspora is concentrated in a limited number of host countries, or the more these countries are volatile, the more unstable their remittances to their country of origin:

$$\sigma_{it}^{REM} = \alpha_1 + \alpha_2 \sigma_{it-1}^{REM} + \alpha_3 CONC_{it} + \alpha_4 Totalrisk_{it} + \alpha_5 X_{it} + \eta_i + \mu_t + \epsilon_{it} \quad (18)$$

²³UN estimates cover the years 1990, 1995, 2000, 2005, 2010, 2015 and are carried out in the middle of the year (in June). Other sources of migrant stocks exist (Docquier et al., 2009) but they have limited time variability as they only cover two non-consecutive years (1990 and 2000).

²⁴One drawback of this definition is that it considers persons born of foreign parents to migrants in countries using the basis of *jus sanguinis*. In these countries, persons born to foreign parents do not acquire the nationality of the country of residence, which then counts them as migrants. However, the UN database is the most complete source about global migration and provides updated estimates every five years.

In Equation (18), σ^{REM} represents the instability of remittances, $CONC$ stands for the concentration of migration and $Totalrisk$ is the indicator of weighed idiosyncratic and covariant risks. Finally, the vector X contains additional controls. In line with the empirical literature on economic volatility (see below), the dependent variable σ^{REM} representing remittance volatility is measured by the standard deviation of the data in five-year intervals, without overlap (1995-2000, 2000-2005, 2005-2010, 2010-2015). A coefficient α_3 taking a positive value would imply that a stronger concentration of migrants in destination countries increases the volatility of remittances received by the origin country. As discussed above, $Totalrisk$ is the main variable of risk including both volatility in host countries and the co-movement between them. A positive coefficient α_4 would mean that remittance instability increases with host countries' volatility or co-movement. Equation (18) is also estimated using the two component variables of the total portfolio risk separately (i.e. volatility in host countries and co-movement), in order to determine their respective impact on remittances flows.

A dynamic model with fixed-effects will be used in order to estimate equation (18). Insofar as our sample counts 93 countries and four time periods, it seems essential to take into account the unobserved time-invariant country factors and time-varying factors common to all countries that can explain the volatility of migrants' remittances. Moreover, it is very likely that the estimated equation is dynamic, in the sense that the current volatility can be explained by previous volatility. This is why we use the generalised method of moments, which allows the introduction of a lagged dependent variable while taking into account the individual fixed effects. More precisely, we will use the system-GMM estimator developed by Blundell and Bond (1998). Following Roodman (2009), we limit the number of instruments and we apply the Windmeijer (2005) correction for standard errors in order to avoid overestimating the significance of the coefficients.

It should be noted that the estimate of Equation (18) might be immune from endogeneity issues, particularly with respect to our two regressors of interest i.e. diaspora concentration and growth volatility in the host economies. Obviously, there is no reason why volatility of remittances received in the origin country should increase output volatility in the host country. Moreover, more unstable remittances has no reason to induce a

more concentrated diaspora. Bad economic conditions in one origin country may push more individuals to migrate abroad, this migration being likely larger in the destination countries already hosting a large diaspora from this origin country. Conversely, higher volatility of remittances in origin countries may not influence the structure of migration, unless migrants disproportionately go to one of the four main countries of destination, which would be a strong assumption. A possible bias could come from exchange rate volatility because empirical literature has shown that if exchange rate affects the flows of remittances, the opposite relationship is also observed (Higgins et al., 2004; Rahman et al., 2013). Since the system-GMM estimator enables to correct this kind of bias, exchange rate volatility is treated as endogenous in the dynamic model.

The literature conveys only a small number of papers on the stability of remittances at the macroeconomic level. Still, we use them to select the control variables covering all the usual determinants of remittance levels and fluctuations. For example, Lartey (2016) includes controls for the exchange rate, GDP per capita in the country of origin, GDP per capita in host countries²⁵ and institutional quality. In our study, it seems appropriate to use exchange rate volatility because the exchange rate will determine the monetary value of the transfer from the host country of the migrant. A highly volatile currency will create uncertainty that can increase the variability of remittances. Similarly, institutional uncertainty can create disincentives for migrants to remit, especially if they want their transfers to be invested in the country of origin. Volatile government spending in the origin country - particularly transfers to households - is another explanatory factor in the volatility of remittances. In addition, a volatile credit supply limits the ability of households to stabilise their consumption and can therefore create more uncertain needs for remittances. The volatility of inflation in the migrant's country of origin may also create strong pressure on the capacity of the migrant's family to satisfy its needs, which can result in large fluctuations in private transfers. Jackman (2013) shows that a highly dependent population (aged or young) is a negative determinant of the volatility of remittances. The author interprets this result as an altruistic behaviour, according to which migrants would send money more regularly to inactive households. The last control concerns the occurrence of natural disasters, since damages are often followed by

²⁵For sake of consistency, we weighted GDP/capita in host countries in relation to the relative weight of the country i 's diaspora working in the four destination countries j , k , l and m .

the sending of foreign funds (Bettin and Zazzaro, 2016). However, the impact on volatility is ambiguous because natural disasters - which are essentially random - can create sudden variations in the amounts of remittances, but a regular occurrence can also stabilise flows in order to prevent damages (Mohapatra et al., 2012). The control variables included in the X vector, measurement and sources are listed in appendix 1. The list of countries included in our sample is presented in appendix 2.

5 Results

5.1 Baseline estimation: The impact of diaspora’s concentration and host countries’ volatility on remittances

In this section, we present and comment the results of the linear estimation of equation (18). They are reported in Table 2 for various measurements of the *contagion* and *concentration* risk. All specifications are conducted with system-GMM. The first series of results is related to the *contagion* risk. We can see in column (2) that a greater risk of macroeconomic instability in host countries, as defined by the *Totalrisk* variable, increases the instability of remittances. This means that the volatility of host countries, as well as their co-movement, significantly affects migrants’ remittances by making them more unstable. This is a first confirmation of the *contagion* risk by which instability in host countries of the diaspora is transmitted to the origin country through the remittances channel. The *contagion* risk will nonetheless be more fully tested in the structural model in the next section.

In order to identify which dimension of the portfolio risk matters the most to explain the volatility of remittances, the two components of the *Totalrisk* variable, (i.e. the average host countries’ idiosyncratic volatility and average co-movement) are separately tested in equation (18). Results reported in columns (3) and (4) show that the effect of the total risk is mostly driven by the average host countries’ idiosyncratic volatility component ($\sigma_{j,k,l,m}^{\Delta GDP^c}$), the average co-movement between host countries ($\rho_{j,k,l,m}^{\Delta GDP^c}$) being not significant in our sample. In other words, volatility in host countries increases remittances’ instability, while the co-movement between the different locations of the diaspora does

Table 2: System-GMM estimation of remittances volatility, five-year periods (1995-2015)

Exogenous variables	(1)	(2)	(3)	(4)	(5)
	Dependent variable: volatility of remittances				
Lag dependent variable	0.116 (0.209)	0.200 (0.198)	0.128 (0.213)	0.198 (0.196)	0.0957 (0.197)
Concentration of diaspora (<i>CONC</i> , log)	0.339** (0.147)	0.249* (0.128)	0.285** (0.145)	0.308** (0.137)	0.432*** (0.157)
<i>Totalrisk</i>		0.0241** (0.0114)			
Volatility host countries ($\sigma_{j,k,l,m}^{\Delta GDP^c}$)			0.0229** (0.0100)		
Co-movements host countries ($\rho_{j,k,l,m}^{\Delta GDP^c}$)				0.214 (0.695)	
Volatility main host country ($\sigma_j^{\Delta GDP^c}$)					0.0609* (0.0349)
Investment freedom	-0.0101** (0.00497)	-0.0110** (0.00466)	-0.0113** (0.00503)	-0.00942** (0.00446)	-0.00962* (0.00532)
Dependency	-0.00656 (0.00667)	-0.00816 (0.00659)	-0.00617 (0.00678)	-0.00854 (0.00678)	-0.00730 (0.00714)
σ Credit	0.0478*** (0.0178)	0.0395** (0.0188)	0.0409** (0.0173)	0.0486** (0.0203)	0.0443*** (0.0168)
Natural disaster	-0.0419*** (0.0162)	-0.0356*** (0.0126)	-0.0398** (0.0155)	-0.0372*** (0.0129)	-0.0323** (0.0145)
σ Exchange rate	-0.000201 (0.000613)	0.000140 (0.000773)	-0.000266 (0.000579)	0.000251 (0.000727)	3.74e-05 (0.000650)
σ Inflation	0.00317** (0.00151)	-0.00218 (0.00692)	0.00312** (0.00150)	-0.00316 (0.00742)	0.00231 (0.00171)
GDP/Capita home (log)	-0.687*** (0.215)	-0.607*** (0.193)	-0.667*** (0.215)	-0.625*** (0.198)	-0.585*** (0.187)
GDP/Capita host countries (log)	0.406*** (0.138)	0.391*** (0.114)	0.451*** (0.136)	0.336*** (0.109)	
GDP/Capita main host country					0.156** (0.0660)
σ Government expenditure	0.178** (0.0738)	0.182** (0.0754)	0.183** (0.0743)	0.177** (0.0777)	0.188** (0.0790)
Constant	0.132 (1.313)	0.317 (1.222)	-0.0437 (1.305)	0.492 (1.217)	0.860 (1.495)
Observations	294	291	294	291	296
Countries	93	93	93	93	93
Arellano-Bond, AR(2) (p-value)	0.892	0.713	0.887	0.744	0.892
Hansen (p-value)	0.212	0.163	0.203	0.205	0.194
Number of instruments	24	24	24	24	24

Two-step system-GMM estimations. Standard errors with Windmeijer's (2005) correction in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

not contribute to the *contagion* risk in our sample.

As for the *contagion* risk, Table 2 shows that the concentration of the diaspora exhibits a positive and significant coefficient in all specifications (columns (1) to (5)), suggesting that a more concentrated diaspora increases the volatility of remittances in our sample. This result confirms recent reduced form estimations by Balli and Rana (2015), finding that remittances fail to smooth consumption volatility in the country of origin when migrants are concentrated in a small number of countries. In order to check the sensitivity of our GMM estimations to changes in specification, various combinations of lags for the

lagged dependent and for the GMM instruments have been tested without modifying substantially the results in what concerns the *contagion* and *concentration* risks (results not reported).

These results have important implications for countries receiving large flows of remittances. While some studies found that remittances prompt economic growth in developing countries (Catrinescu et al., 2009; Giuliano and Ruiz-Arranz, 2009), our estimations show that external conditions (i.e. business cycles in host countries) are important conditioning factors of the stability of remittances. Countries receiving large amounts of remittances might therefore be more vulnerable to external shocks since economic instability in host countries can be literally “imported” in the home country through the channel of aggregate remittances, at least for some patterns of diaspora distribution and location.

5.2 Further testing for sensitivity and cumulative effects

We now test for the sensitivity of our results by using the volatility of the main host country instead of the average volatility of the four main host countries. Indeed, the total risk indicator and the average idiosyncratic volatility of the four main host countries might overestimate the volatility risk, especially when host countries’ cycles are synchronised. We therefore check if the volatility risk persists if limited to the single idiosyncratic volatility of the main host country. Estimation results reported in column (5) of Table 2 show that the volatility of the main host country has a positive and significant coefficient. This finding suggests that the risk of importing volatility through remittances sourced in one single country is real and that the volatility of migrants’ transfers is not driven by similar and undiversified trends of instability in destination countries. Since the first destination of migrants weighs on average one half of the diaspora, as illustrated in Table 1, this finding underlines once again the risks of a concentrated diaspora for remittance stability.

Previous section’s results show, on the one hand, that a more concentrated diaspora and stronger instability in host countries increase the volatility of remittances, while, on the other hand, the co-movement between migrants’ destinations has no impact. We now in-

Table 3: System-GMM estimation of remittances volatility with interaction terms, five-year periods (1995-2015)

Exogenous variables	(1)	(2)	(3)	(4)
	Dependent variable: volatility of remittances			
Lag dependent variable	0.200 (0.201)	0.137 (0.221)	0.177 (0.200)	0.134 (0.202)
Concentration of diaspora (<i>CONC</i> , log)	0.133 (0.138)	0.158 (0.131)	0.351** (0.152)	0.0590 (0.175)
<i>Totalrisk</i>	-0.356 (0.533)			
<i>Totalrisk</i> × <i>CONC</i>	0.0449 (0.0653)			
Volatility host countries ($\sigma_{j,k,l,m}^{\Delta GDP^c}$)		-0.351 (0.495)		
Volatility host countries × <i>CONC</i>		0.0443 (0.0604)		
Co-movements host countries ($\rho_{j,k,l,m}^{\Delta GDP^c}$)			4.631 (8.227)	
Co-movements host countries × <i>CONC</i>			-0.558 (1.072)	
Volatility main host country ($\sigma_j^{\Delta GDP^c}$)				-1.223** (0.611)
Volatility main host country × <i>CONC</i>				0.162** (0.0811)
Investment freedom	-0.0118** (0.00485)	-0.0117** (0.00514)	-0.00932** (0.00442)	-0.0104* (0.00552)
Dependency	-0.00691 (0.00655)	-0.00470 (0.00690)	-0.00888 (0.00670)	-0.00613 (0.00740)
σ Credit	0.0373* (0.0218)	0.0374* (0.0195)	0.0493** (0.0191)	0.0370** (0.0173)
Natural disaster	-0.0368*** (0.0131)	-0.0403** (0.0162)	-0.0391*** (0.0126)	-0.0289** (0.0144)
σ Exchange rate	0.000169 (0.000950)	-0.000292 (0.000714)	0.000224 (0.000677)	-4.40e-05 (0.000706)
σ Inflation	-0.00514 (0.00786)	0.00324* (0.00169)	-0.00316 (0.00711)	0.00217 (0.00197)
GDP/Capita home (log)	-0.558*** (0.187)	-0.610*** (0.213)	-0.652*** (0.193)	-0.512*** (0.190)
GDP/Capita host countries (log)	0.366*** (0.112)	0.422*** (0.136)	0.354*** (0.111)	
σ Government expenditure	0.182** (0.0795)	0.180** (0.0768)	0.185** (0.0794)	0.178** (0.0814)
GDP/Capita main host country (log)				0.139** (0.0679)
Constant	1.111 (1.454)	0.751 (1.364)	0.223 (1.392)	3.371* (1.951)
Observations	291	294	291	296
Countries	93	93	93	93
Arellano-Bond, AR(2) (p-value)	0.644	0.806	0.768	0.460
Hansen (p-value)	0.091	0.102	0.219	0.117
Number of instruments	25	25	25	25

Two-step system-GMM estimations. Standard errors with Windmeijer's (2005) correction in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

investigate for cumulative effects between the diaspora *concentration* risk and the different sources of the *contagion* risk.

Indeed, it is likely that the impact of host countries' volatility on remittances will be amplified for countries featuring a more concentrated diaspora since the former risk come

from a more limited set of countries and is consequently not diversified. Table 3 reports the results of equation (18) with interaction terms between the *concentration* and *contagion* risks. Columns (1) to (4) show that all estimated interaction terms are insignificant, except the one between the concentration of diaspora and the volatility of the main host country. In other words, a more concentrated diaspora magnifies the destabilizing effect of output volatility of the main host country. When a diaspora is concentrated in one specific destination country, remittances flows tend to be more strongly dependent on economic conditions in this country. Taking the four main destination countries does not provide the same effect since remittances come from many destinations (column (2)), allowing a better risk diversification over the four destinations.

5.3 Are remittances a transmission channel of external instability? A structural estimation of the *contagion* and *concentration* risks

In the previous section, we showed that both concentrated diaspora and higher volatility in migrants' destination countries lead to a largest risk of remittances instability. In this section, we proceed a step further by testing whether these geographical patterns of diaspora localization can induce a larger risk of macroeconomic volatility in the home country, especially when its economy is strongly dependent on remittances. Indeed, unstable remittances may create fluctuations of households' income and consumption but also affect exchange rate stability, leading to policy troubles in fixed regimes²⁶. Government financial stability might also be impacted, as remittances are a source of tax revenues through consumption. Lastly, because of unstable private and public revenues, investment can be destabilised, with adverse effects on economic growth.

In order to test whether the *concentration* and *contagion* risks related to remittances do effectively impact aggregate volatility in the home country of migrants, we estimate the structural model described by the system of simultaneous equations (19a-19b).

²⁶Singer (2010) shows that countries receiving remittances are more likely to adopt a fixed exchange rate regime.

$$\begin{cases} \sigma_{it}^{REM} = \beta_1 + \beta_2 CONC_{it} + \beta_3 \sigma_{j,k,l,m,t}^{\Delta GDP^c} + \beta_4 \xi_{it} + \eta_i + \mu_t + \phi_{it} & (19a) \\ \sigma_{it}^{\Delta GDP^c} = \theta_1 + \theta_2 \sigma_{it}^{REM} + \theta_3 \sigma_{it}^{TOT} + \theta_4 GDP/capita_{it} + \eta_i + \mu_t + \omega_{it} & (19b) \end{cases}$$

where $\sigma^{\Delta GDP^c}$ is the volatility of per capita GDP growth in migrants' origin country and ξ additional controls²⁷. Although the specification of model (19a-19b) is parsimonious, we follow the literature on growth volatility (Easterly et al., 1993) and include the volatility in terms of trade (σ^{TOT}) as a control in equation (19b). Indeed, greater terms of trade volatility is known to be an important determinant of GDP growth instability, especially in developing countries (Easterly et al., 2000).

When estimating a structural model, endogeneity is a central issue because of the presence of an endogenous variable among the regressors of the main equation. In the case of equation (19b), remittance volatility is naturally included as an explaining factor of the home country volatility since we are interested in this effect. More extensively, we estimate a two-equations model where instability in host countries determines the volatility of remittances, while the latter simultaneously explains the volatility of the origin country. The system (19a-19b) is identified by using a full information method, the three-stage least squares (3SLS) that allows for the cross-correlation of errors and for the use of external instrument of the endogenous regressor. In our case, equation (19a) can be understood as a pseudo-first stage at which the endogenous regressor (remittance volatility) is regressed on a set of exogenous determinants including the diaspora concentration and the average idiosyncratic risk of the four main locations of the diaspora. As shown by Zellner and Theil (1962) and Wooldridge (2010), 3SLS are a generalization of the 2SLS providing consistent estimates of simultaneous equations models with endogenous regressors. In order to estimate the validity of the results, we also report the Hansen/Sargan statistic in all specifications. Rank and order identification conditions have also been systematically and successfully tested.

Model (19a-19b)'s 3SLS estimation results are presented in Table 4. Column (1) shows that, as found in the two previous sections, a greater instability in host countries increases

²⁷All additional controls are reported in Tables 4 and 5.

Table 4: Indirect impact of diaspora concentration and host countries volatility on migrants' home economies: 3SLS estimates of the structural model

Equation (19a)	(1)	(2)	(3)	(4)
	Dependent variable: volatility of remittances			
Concentration of diaspora (<i>CONC</i> , log)	0.591** (0.279)	0.385* (0.216)	0.364 (0.227)	0.386* (0.217)
Volatility host countries ($\sigma_{j,k,l,m}^{\Delta GDP^c}$)	0.0212*** (0.00673)			
Volatility main host country 1 ($\sigma_j^{\Delta GDP^c}$)		0.0746*** (0.0284)	0.0745*** (0.0263)	0.0715*** (0.0257)
Volatility main host country 2 ($\sigma_k^{\Delta GDP^c}$)			0.0471*** (0.0143)	0.0456*** (0.0142)
Volatility main host country 3 ($\sigma_l^{\Delta GDP^c}$)			0.00200 (0.0249)	
Volatility main host country 4 ($\sigma_m^{\Delta GDP^c}$)			-0.0112 (0.0151)	
GDP/capita home country (log)	-0.872** (0.358)	-0.515 (0.349)	-0.803** (0.351)	-0.653* (0.347)
GDP/capita host countries (log)	1.144*** (0.269)			
GDP/capita main host country 1 (log)		0.0951 (0.0664)	0.389*** (0.0927)	0.217*** (0.0755)
GDP/capita main host country 2 (log)			0.300*** (0.0630)	0.169*** (0.0494)
GDP/capita main host country 3 (log)			0.182*** (0.0548)	
GDP/capita main host country 4 (log)			0.105*** (0.0391)	
Constant	-8.997** (3.938)	-0.794 (3.013)	-6.409* (3.296)	-2.254 (3.063)
Observations	379	391	379	386
Country-fixed effects	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
Equation (19b)	Dependent variable: volatility of GDP/capita			
Volatility of remittances	1.137* (0.594)	2.974** (1.313)	2.309*** (0.593)	2.567*** (0.746)
Volatility terms of trade	12.47*** (2.211)	11.97*** (2.192)	11.98*** (2.208)	11.75*** (2.185)
GDP/capita home country (log)	-1.532 (1.039)	-0.542 (1.451)	-0.927 (1.215)	-0.650 (1.272)
Constant	14.18** (6.535)	7.060 (9.336)		8.022 (8.009)
Observations	379	391	379	386
Country-fixed effects	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
Hansen/Sargan (p-value)	0.5666	0.9309	0.9256	0.8800

3SLS estimations. Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

the volatility of remittances, as well as a more concentrated diaspora. More interesting, the coefficient of the volatility of remittances is positive and significant in the second equation. These results confirm the fact that, as they are sensitive to instability in home economies, remittances transmit external volatility to the migrants' origin countries. The coefficients do not vary a lot when we use different sets of host countries (columns (2) -

(4)), meaning that our estimates are robust to various specifications²⁸. Moreover, column (4) shows that the volatility of remittances is driven by the first two main destinations and confirms the findings of the previous section. This is consistent since the first two main host countries determine an important part of aggregate remittances sent to the origin country, as illustrated in Table 4. GDP growth instability in these countries has strong effects on remittance volatility which, in turn, impacts aggregate output stability in the home country of the migrant.

In a last series of estimations, we test whether the volatility impact of the diaspora is homogeneous with respect to the degree of home economy's dependence on remittances. More specifically, we check if the remittance channel of volatility transmission, whether it is driven by the *contagion* or the *concentration* risk, is different for countries relatively dependent on migrants' transfers. We run the model (19a-19b) again, but we only include countries where the level of remittances is above the sample average (5.3% of GDP). Table 5 shows that the determinants of remittances' instability remain quite similar compared with the results of the whole sample (see Table 4). As previously, Table 5's column (1) shows that output volatility in host countries represents the main source of remittance instability. This finding holds for various measurements of output volatility in host countries (columns (2)-(4)), while diaspora concentration exhibits less significant coefficients. However, it should be noticed that the estimated coefficients of host countries instability are higher than in the previous estimates. This finding was expected to the extent that host countries' economic instability is likely to have stronger effects when the amounts of remittances are larger. In contrast, comparison of Tables 4 and 5 does not put forward significant differences regarding the impact of remittances on the home country's GDP growth volatility. In both cases, more unstable remittances increase the volatility of GDP growth in the home economy, but restricting the sample to the most important recipient countries does not affect the value of the coefficients. Therefore, remittances represent an important channel of transmission of external shocks, whatever their levels in the home economy. Countries receiving modest amounts of remittances are also affected by their fluctuations, especially when the diaspora is located in one or two specific destinations. This is for instance the case of Mexican remittances. They

²⁸The coefficient of the variable *CONC* is not significant in column (3), but the p-value (0.108) is very close to the 10% threshold.

Table 5: Indirect impact of diaspora concentration and host countries volatility on migrants' home economies: Results with remittances $\geq 5.3\%$ of GDP

Equation (19a)	(1)	(2)	(3)	(4)
	Dependent variable: volatility of remittances			
Concentration of diaspora (<i>CONC</i> , log)	1.200* (0.693)	1.121* (0.677)	0.533 (0.735)	0.489 (0.641)
Volatility host countries ($\sigma_{j,k,l,m}^{\Delta GDP^c}$)	0.124*** (0.0223)			
Volatility host country 1 ($\sigma_j^{\Delta GDP^c}$)		0.277*** (0.0745)	0.240*** (0.0798)	0.202*** (0.0751)
Volatility host country 2 ($\sigma_k^{\Delta GDP^c}$)			0.113** (0.0539)	0.151*** (0.0473)
Volatility host country 3 ($\sigma_l^{\Delta GDP^c}$)			-0.0244 (0.0551)	
Volatility host country 4 ($\sigma_m^{\Delta GDP^c}$)			-0.00885 (0.0523)	
GDP/capita home country (log)	-1.418* (0.792)	-1.228 (0.847)	-1.482* (0.846)	-1.443* (0.846)
GDP/capita host countries (log)	2.519*** (0.644)			
GDP/capita host country 1 (log)		0.253 (0.244)	0.488* (0.281)	0.351 (0.242)
GDP/capita host country 2 (log)			0.363** (0.155)	0.207* (0.118)
GDP/capita host country 3 (log)			0.243* (0.143)	
GDP/capita host country 4 (log)			0.186 (0.114)	
Constant	-23.39** (10.11)	-4.536 (8.570)	-7.268 (9.021)	-0.475 (8.450)
Observations	164	170	164	167
Country-fixed effects	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
Equation (19b)	Dependent variable: volatility of GDP/capita			
Volatility of remittances	0.736* (0.421)	1.799** (0.739)	1.425*** (0.546)	2.275*** (0.759)
Volatility terms of trade	15.99** (6.247)	16.17*** (6.081)	15.67** (6.278)	12.56** (6.179)
GDP/capita home country (log)	-6.274*** (2.335)	-4.485 (2.757)	-5.051** (2.543)	-3.516 (2.992)
Constant	44.72*** (14.73)		37.38** (16.01)	
Observations	164	170	164	167
Country-fixed effects	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
Hansen/Sargan (p-value)	0.9529	0.6223	0.0379	0.1142

3SLS estimations. Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

only reach 2.5% of the Mexican GDP but they may fluctuate suddenly because Mexican migrants live in the US essentially (95% of the total Mexican diaspora). Even if the determinants of the volatility of remittances are slightly different across the two samples, consequences remain the same for the recipient countries, according to our results.

6 Discussion of some policy issues

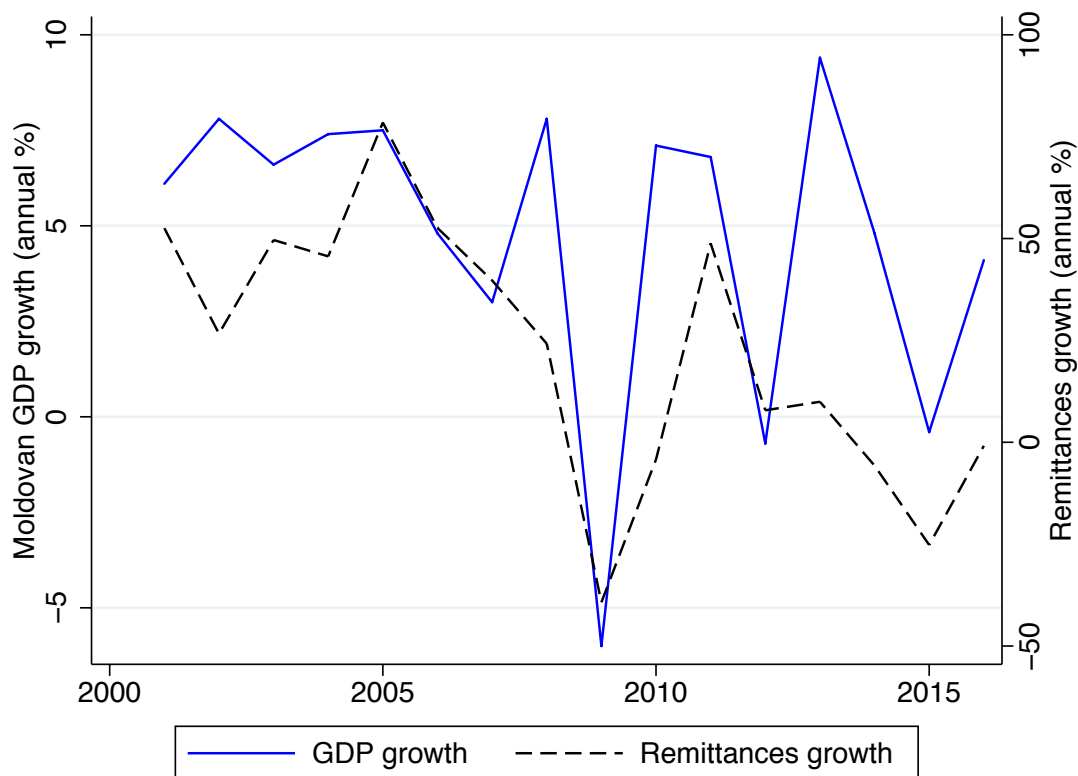
The estimation results presented in the previous section confirm that adopting a macroeconomic approach leads to a fairly nuanced assessment of the impact of remittances. Since the well-known article of Stark and Bloom (1985), many studies have found that remittances allow households stayed in home countries to diversify their source of income. Our findings suggest that this conclusion does not necessarily hold when a macroeconomic perspective is adopted insofar as aggregate flows of migrants' transfers are subjected to business cycles in host countries, with potentially negative consequences for the home country's own macroeconomic stability. These fluctuations are even stronger when migrants are concentrated in a limited number of destinations because remittance levels and variations will depend on the economic conditions of one or a few countries. Beyond the stabilizing potential of migrants' transfers evidenced by the microeconomic literature, aggregate flows of remittances may therefore induce macroeconomic volatility for some patterns of diaspora distribution in host countries that could annihilate the positive impacts on migrants' family. Indeed, we show that remittances may increase instability in migrants' origin countries by "importing" external volatility. It means that if remittances undoubtedly represent a source of economic growth for developing countries, they can also cause output instability in home countries, with adverse effects on livelihoods at the microeconomic level.

These results have important implications for economic policy. Indeed, remittances should be considered by developing countries' policymakers as a temporary additional income rather than an essential resource because economic uncertainty in host countries can induce sudden fluctuations²⁹. This is all the more true as remittances are not only subjected to business cycles in host countries but also to political shocks. In particular, immigration policies may change quickly and create important drop in remittances. For instance, Ratha (2005) pointed out that MENA oil producers' countries have strongly tightened their immigration policies during the 1980s, inducing a significant decrease in remittances sent to developing countries. Policies in host economies represent an additional source (and cumulative one) of aggregate remittance volatility, particularly if

²⁹For instance, the Russian currency crisis (2014-2015) has generated important fluctuations of remittances sent to Moldova and to other countries whose migrants work in Russia.

migrants are concentrated in one or two specific countries.

Figure 5: Remittances and output volatility in Moldova



Data: National Bank of Moldova and IMF.

Equally, governments should not rely too extensively on remittances to promote economic growth and must provide countercyclical policies to smooth cycles when migrants' transfers drop. More generally, policymakers should care about the reliance of the economy to remittances and increase diversification in order to avoid sudden drop of GDP during bad times in migrants' destination countries. Let's take the example of Moldova again, which features a sizeable and concentrated diaspora in Russia and Europe. The recent episodes of economic instability in Russia (2015 currency crisis) and in Europe (2011 foreign debts crisis), made remittances to Moldova more volatile, with significant effects on the GDP growth rate. We can see on figure 5 that until 2007, remittances sent to Moldova were relatively stable, as well as economic growth. After the global crisis of 2008, remittances have durably become much more volatile, inducing large fluctuations of GDP growth. Moldova's national surveys show that remittance fluctuations have impacted both households' income and government revenues, since VAT represents an important part of taxes

in this country. External volatility therefore had a procyclical effect because, on the one hand, households' income dropped, while, on the other hand, government was not able to finance its expenditure due to the decrease in tax revenues. This sequence is fairly close to the "when it rains, it pours" effect (Kaminsky et al., 2005) since capital flows follow the same trend that business cycles, inducing more dramatic GDP growth instability.

Conclusion

The results of this paper can be summarised as follows. Overall, the geographical distribution of a country's diaspora may generate two risks of volatility transmission to the home country of migrants: the *concentration* and the *contagion* risks.

First, the concentration of the diaspora in one (or some) particular countries or regions has destabilizing effects in the country of origin through various patterns. The most important pattern would be the excessive dependence of an economy on migrants' remittances that are geographically concentrated, therefore exposing it to the economic conditions prevailing in host countries. As the amounts transferred by migrants will be very sensitive to the economic cycle of a limited number of countries, any fluctuation in the host economy will translate into aggregate remittances volatility. Remittances fluctuations will therefore destabilise the whole economy, especially in countries enjoying large amounts of these foreign transfers. This is what we call the *concentration* risk. Second, another risk corresponds to the pattern where diaspora is not concentrated *per se*, but localised in destination countries that are particularly volatile and/or whose business cycles are correlated. Here, a common shock in host countries would translate into volatility in the origin country through the channel of remittances inflows, although the diaspora is not concentrated in a single or few countries. This is what we call the *contagion* risk. In addition, we show that these two risks may have cumulative effects.

Our results suggest that while remittances may increase GDP growth (Catrinescu et al., 2009), education outcomes (Medina and Cardona, 2010) and consumption (Combes and Ebeke, 2011), their unstable nature could well disrupt these beneficial effects by destabilizing the receiving economy. More generally, we show that beyond migrants' motivations,

remittances flows are driven by business cycles in host countries. To be able to remit to the origin country, migrants must first of all make stable earnings, whatever altruistic or selfish are their motivations. In this regard, the results of our study contribute to explain the procyclical/acyclical trends of remittances observed in the previous literature (Lueth and Ruiz-Arranz, 2006; Sayan, 2006; Lueth and Ruiz-Arranz, 2007; Sayan and Tekin-Koru, 2012). Despite of migrants' altruistic motivations, remittances are not systematically countercyclical and may even turn procyclical if business cycles in host and home countries are synchronised. In that case, economic growth in origin and destination countries co-move so that remittances flowing to the home country increase during good times and decrease during bad times. These procyclical effects shall be amplified when bilateral trade and capital exchanges are important between home and host countries, since the most recent literature has established that migration tends to strengthen trade and financial ties (Kugler et al., 2017). As countries get increasingly connected through FDI and value chains, these sources of cumulative effects should be investigated in the future.

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Appendices

Appendix 1: Additional controls

Variable	Measurement	Source
Exchange rate volatility	5-years standard deviation	World Bank & IMF
Inflation volatility	5-years standard deviation	World Bank & IMF
Credit volatility	5-years standard deviation	World Bank & IMF
Natural disaster	5-years average	CRED (Catholic University of Louvain)
GDP/Capita (home country)	5-years average	World Bank & IMF
GDP/Capita (host countries)	5-years average	World Bank & IMF
Public expenditure volatility	5-years standard deviation	World Bank & IMF
Dependency	5-years average	World Bank & United Nations
Investment freedom	5-years average	Heritage Foundation

Appendix 2: Sample of countries

Afghanistan	Moldova
Albania	Mongolia
Algeria	Morocco
Angola	Mozambique
Argentina	Namibia
Armenia	Nepal
Azerbaijan	Nicaragua
Bangladesh	Niger
Belarus	Nigeria
Belize	Pakistan
Benin	Panama
Bhutan	Papua New Guinea
Bolivia	Paraguay
Botswana	Peru
Brazil	Philippines
Bulgaria	Romania
Burkina Faso	Russian Federation
Burundi	Rwanda
Cambodia	Senegal
Cameroon	Sierra Leone
Cabo Verde	Solomon Islands
China	South Africa
Colombia	Sri Lanka
Congo (Dem. Rep.)	Swaziland
Congo (Rep.)	Tajikistan
Costa Rica	Tanzania
Djibouti	Thailand
Dominican Republic	Timor-Leste
Ecuador	Togo
El Salvador	Tonga
Fiji	Tunisia
Gabon	Turkey
Gambia, The	Uganda
Georgia	Ukraine
Ghana	Venezuela, RB
Guatemala	Vietnam
Guinea	Yemen, Rep.
Guinea-Bissau	
Guyana	
Haiti	
Honduras	
India	
Indonesia	
Jordan	
Kazakhstan	
Kenya	
Kyrgyz Republic	
Lao PDR	
Lesotho	
Liberia	
Macedonia, FYR	
Malawi	
Malaysia	
Mali	
Mauritius	
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