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The macroeconomic effects of migrants' remittances in Moldova: a stock–flow consistent model*

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Migrants' remittances are an essential source of income in many developing countries. In this article, we build a post-Keynesian stock–flow consistent model adapted to Moldova, one of the top recipients of remittances. In addition to increasing household consumption, migrants' transfers have strong effects on economic growth in Moldova. However, remittances are very sensitive to the economic conditions in migrants' destination countries, especially since the 2008 global financial crisis. After including remittances in consumption behavior and lenders' risk, we run simulations to show how shocks in migrants' destination countries (that is, Europe and Russia) impact the Moldovan economy through fluctuations in remittances. First, the increasing instability of remittances explains a significant portion of the economic volatility experienced by Moldova. Second, the high level of imports implies a weak multiplier effect of remittances, leading to an unsustainable pattern of growth.

Keywords: *remittances, Moldova, stock-flow consistent models, business cycles, migration, volatility*

JEL codes: *E12, E32, F22, F24, F43*

1 INTRODUCTION

Since the mid 1990s, migrants' monetary transfers have become an essential source of income in many developing countries. These so-called 'remittances' represent the second-biggest inward private financial flow to developing countries according to the World Bank, reaching $429 billion in 2016. Unlike foreign investments and foreign aid, migrants' remittances have been remarkably stable since the 1990s and seem relatively insensitive to economic fluctuations, leading to a better smoothing of business cycles in receiving countries. In addition to diversifying households' income (Stark/Bloom 1985) and promoting education expenditure (Adams/Cuecuecha 2010; Salas 2014), remittances are also an efficient macroeconomic stabilization tool (Hakura et al. 2009), especially in a context of counter-cyclical flows. The growing importance of remittances and their efficiency in reducing poverty in developing countries have been extensively stressed by the World Bank and

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other international institutions[1] as a way to overcome the weaknesses of official development assistance (ODA). In contrast with ODA, personal remittances are sent and received by households directly, with immediate effects on poverty, and avoid the diversion of funds by predatory governments (Kapur 2004). Migrants' transfers may be seen as a 'private aid' contributing to the fueling of growth in receiving countries by supporting household consumption, investment, and economic stability.

Despite the positive effects of migrants' transfers at both microeconomic and macroeconomic levels, the last decade has raised several questions regarding the ability of remittances to support economic development. The 2008 global financial crisis has caused, for the first time, a decline in remittances sent to developing countries, while developed economies are increasingly tightening their immigration policies. In this regard, Moldova has been one of the countries most affected by the economic crisis of 2008, and by the ensuing economic uncertainty. This Eastern European country is highly dependent on remittances (31 percent of its GDP in 2008, see Figure 1, p. 36), sent by a diaspora essentially located in Russia and Europe.[2] Between 2008 and 2009, remittances received by Moldova dropped by 28 percent, leading to a decrease in household income and to a severe contraction of GDP (–6 percent). Although remittances undoubtedly supported Moldova's economic growth during the 2000s, their apparent stability was mainly due to the prosperity of the world economy. In particular, European countries and Russia experienced a decade of robust economic growth, generating growing flows of remittances addressed to Moldova. The sudden economic crisis of 2008, followed by economic fluctuations in Europe and Russia, have made remittances more unstable than ever, leading to dramatic swings in Moldova's GDP growth. As well as other foreign capital flows, migrants' transfers tend to 'import' external volatility to recipient countries: inflows are highly dependent on the ongoing economic conditions in migrants' host countries. In the case of Moldova, an economic downturn in Russia or Europe shrinks the income of migrants, leading to a decrease in their monetary transfers and finally to a fall in Moldovan GDP growth. This is the main argument of this article.

As most studies have estimated the macroeconomic impacts of remittances using panel data, they are not able to take the specifics of migrants' destination countries into account. To cite just a few, Catrinescu et al. (2009) and Giuliano/Ruiz-Arranz (2009) report that remittances are positively related to economic growth, but do not include the economic cycle of migrants' destination countries in their econometric models. Similarly, Hakura et al. (2009) and Combes/Ebeke (2011) empirically found that remittances reduce output volatility and household consumption instability in developing countries, without dealing with economic conditions in migrants' host countries. Yet the business cycle in host countries matters, since migrants work, earn wages, and send remittances from these countries. Any recession leads to an increase in unemployment – especially for foreign workers who are often hired in precarious jobs – and to a decrease in remittances, harming the recipient economies.[3] By omitting migrants' host countries, previous studies are not able to show

1. For instance, the United Nations 2030 agenda for sustainable development includes a target to reduce transaction costs on migrants' remittances (see goal 10).
2. However, we will see in Section 3 that a sizeable proportion of remittances is sent from Israel and the US.
3. In a press release dating from April 2017, the World Bank notes that '[r]emittances are an important source of income for millions of families in developing countries. As such, a weakening of remittance flows can have a serious impact on the ability of families to get health care, education or proper nutrition.' The full press release is available at URL: http://www.worldbank.org/en/news/press-release/2017/04/21/remittances-to-developing-countries-decline-for-second-consecutive-year.

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how remittances can transmit external volatility to recipient countries during periods of economic turmoil. In addition, other factors such as migration restriction policies can affect migrants and therefore remittances sent to developing countries. This is all the truer in the case of Moldova because this country has ambiguous political relationships with Russia and Europe, the main destinations of Moldovan migrants. Moreover, both Russia and Europe have been economically unstable since 2008, inducing more fluctuations in remittance flows.

In contrast with panel data analysis requiring large samples of countries, macroeconomic modeling can be used to study a specific country, providing more contextualized results. Among macroeconomic models, stock–flow consistent (SFC) models are particularly well suited to the study of remittances given their demand-led structure. As shown by numerous studies,[4] remittances are mostly used to support households' consumption and investment, leading to a great impact on aggregate demand in receiving countries. Since the most recent SFC models are designed for open economies (Lavoie/Zhao 2010; Le Heron 2011), they take migrants' destination countries into account and serve to estimate the effect of their business cycle on remittance flows.

In this paper, we build an SFC model of the economy of Moldova, with the rest of the world being split into three currency areas (euro, ruble, and dollar). Using simulations, our model analyses the macroeconomic effects of remittance fluctuations in Moldova, as well as different scenarios depending on the evolution of the economic context in countries hosting the Moldovan diaspora, namely Europe and Russia. We show that Moldova is very exposed to external shocks due to the reliance of the economy on remittances. In particular, since 2008 Moldova has experienced huge swings in GDP growth which are, for the most part, due to external fluctuations (that is, in Russia and in Europe). First, we conclude that while remittances represent a source of economic growth for Moldova, their exogenous determinants expose the country to foreign volatility but also to political changes, such as immigration policies in migrants' host countries. Second, the fact that remittances finance the consumption of imported goods implies a very weak multiplier effect, leading to an unsustainable pattern of growth. Section 2 describes the Moldovan context, Section 3 presents the SFC model and Section 4 outlines the results of simulations. Section 5 concludes.

2 THE MOLDOVAN CONTEXT

2.1 Historical background and out-migration in Moldova

Despite having a small territory and population (3.5 million inhabitants in 2016), Moldova is a history-rich country which has been influenced by several cultures through the ages. Until the early nineteenth century, the Principality of Moldavia was a Romanian-speaking independent country, albeit a vassal of the Ottoman Empire or other countries depending on the political situation in Europe. During World War II, the country was annexed by the USSR in 1940[5] and became the Moldavian Soviet Socialist Republic, which it remained until 1991. After the collapse of the Soviet Union, Moldova experienced many troubles leading to the migration of the population. First, the eastern region of the country – namely Transnistria – was opposed to the independence of Moldova and to any rapprochement with Romania. Unlike the rest of Moldova, Transnistria had been a

4. See Giuliano/Ruiz-Arranz (2009) and Démurger/Wang (2016), among others.
5. The territory of Moldova was under the control of Axis powers between 1941 and 1944.

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part of the USSR since 1924 and was a Russian-speaking region with close ties with Russia. These controversies led to war in 1992 (the Transnistria war), after Transnistria proclaimed its independence from Moldova. Since then, Transnistria has been an unrecognized state[6] protected by the Russian army and having its own government, currency, army, etc. The loss of Transnistria was a big concern for the Moldovan government because this region was the most industrialized area of Moldova in 1990, generating 90 percent of energy production and a third of industrial output (Waters 2003). The rest of the country was mainly agricultural, exporting wine, wheat, apples and other primary products to Russia and CIS[7] countries.

In Moldova, the official spoken language is Romanian but a large part of the population also speaks Russian[8] and other regional languages such as Ukrainian or Gagauz.[9] Moldovan citizens' language skills as well as their historical background therefore explain the various locations of the current diaspora (Russia, Europe, Ukraine). Although a large number of Moldovan citizens were already living abroad before independence, out-migration has dramatically increased since the early 1990s, currently reaching more than 25 percent of the whole population. Like many CIS countries, the transition of the Moldovan economy to a 'market economy' has induced an increase in poverty, inflation, and unemployment. Although independent, Moldova remained reliant on Russia's imports during the 1990s because of its agricultural-based economy, exposing the country to external shocks such as the 1998 Russian crisis. Facing high unemployment levels, the population tried to escape poverty by working in neighbor countries (Ukraine, Romania), but mostly in Russia which is still the main destination of Moldovan migrants.[10]

However, the number of Moldovan migrants living in Italy, Portugal, and to a lesser extent Germany has greatly increased since the mid 2000s.[11] Although they were mainly undocumented before 2005, Moldovan migrants now benefit from more flexible working conditions in Europe, thanks to several agreements with European countries. This significant diaspora allows Moldova to receive huge amounts of remittances which contribute to supporting its economic growth.

2.2 External trade and international relationships

As discussed above, the economy of Moldova – especially exports – remained highly dependent on Russia after independence (1991).[12] The Russian crisis (1998) forced Moldova to increase the diversification of its trade partners, particularly European

6. According to the United Nations, Transnistria is recognized as a *de jure* part of Moldova. However, this region is excluded from the national statistics of Moldova.
7. Commonwealth of Independent States.
8. Russian was the official language in Moldova during the Soviet era.
9. Gagauzia is a Moldovan region located in the south of the country. Although an autonomous region, Gagauzia is fully integrated into Moldova (unlike Transnistria).
10. In addition to escaping unemployment, working abroad is also a way for a migrant to help the family left behind by sending remittances, especially to inactive relatives such as children or elderly parents.
11. It should be noted that there is a significant Moldovan diaspora in Ukraine. For the most part, this Moldovan population was living in Ukraine before 1991 and may be considered as a 'permanent' diaspora rather than temporary immigrant workers (IOM 2012). Therefore, remittance flows between Ukraine and Moldova are relatively modest.
12. For instance, 54 percent of Moldova's total exports were to Russia in 1996.

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countries. The diversification of the economy accelerated in the mid 2000s, following several political disputes with Russia. In 2006, Russia imposed import bans on Moldovan products (essentially agricultural), leading to a sharp decrease in Moldova's economic growth. Since then, the Moldovan government has tried to form closer ties with the European Union (EU), which represents an important potential market for the exports of Moldova and a source of diversification. United Nations trade data show that the share of exports to Russia dropped to 10–15 percent of the total, while trade with European countries more than doubled between 2005 and 2015. The agreements signed in 2005[13] and 2014[14] aim to accelerate economic cooperation, as well as convergence of legislation and regulation between the EU and Moldova. In particular, the Moldova–European Union Association Agreement led to a decrease in tariffs, allowing Moldovan products to be sold on the European market more easily. At the same time, Russia has continued to impose bans on Moldovan products in response to EU–Moldova trade agreements. Indeed, relationships between Moldova, Russia, and Europe may be seen as a zero-sum game: the closer Moldova gets to Europe, the more Russia imposes sanctions on the country.

Moldova's quest for new markets has had a direct impact on migration flows. It is well-established that bilateral trade exchanges and agreements increase migration flows between trade partners (Pedersen et al. 2008; Orefice 2015), in particular when differences in levels of development and wages are significant. Therefore, the increasing integration of Moldova into the European market may act as a reinforcing factor of immigration from Moldova to Europe. The effects are also noticeable on migrants' monetary transfers, despite the fact that Russia still represents the main source of remittances for Moldova (45 percent of the total in 2015). The National Bank of Moldova (NBM) reports increasing amounts of remittances sent from European countries, in particular from Italy. However, closer cooperation between Moldova and the European Union is far from being an irreversible policy. Indeed, Moldovan citizens elected a new president in 2016, Igor Dodon, who wishes to abandon the Moldova–EU Association Agreement in order to join the Eurasian Economic Union. Even though the Moldovan government and parliament are still held by pro-European political parties, the next legislative election (scheduled in 2019) could lead to important changes in the country's political direction.

2.3 The growing importance of remittances for households and the economy

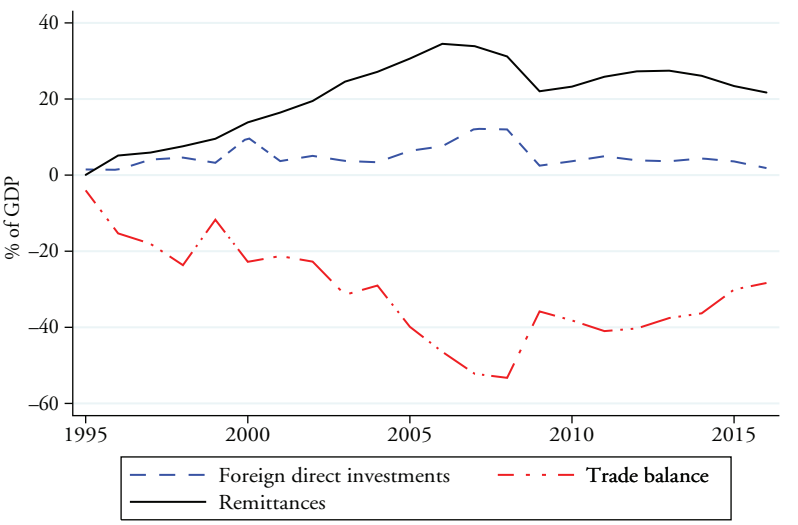
Over the years, remittances have become an essential resource for a large part of the Moldovan population. This is especially true in rural areas, where remittances represent on average one-quarter of total household income. In contrast, migrants' transfers are less essential for urban households, accounting for about 12 percent of total income nonetheless.[15] Two factors may explain the greater reliance of rural households on remittances. First, wages are particularly low in the agricultural sector, inducing higher levels of poverty compared with urban areas. Second, Russian bans have mainly targeted agricultural products, contributing to increased vulnerability among agricultural workers. Therefore, remittances support a significant share of household consumption in Moldova, including food, clothing, and health expenditure.

13. European Union (EU)-Moldova Action Plan.
14. Moldova-European Union Association Agreement.
15. Statistics are available on the National Bureau of Statistics of Moldova website. See URL: http://www.statistica.md/.

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While remittances help households to improve their standard of living, they also limit public transfers and government expenditure more generally. Indeed, migrants' transfers increase household income and reduce poverty, allowing the government to limit social expenditure. In this context, remittances may be considered as an informal social protection, leading to better resilience of the households left behind and greater income diversification (Stark/Bloom 1985; Clément 2017). Yet remittances received by the Moldovan population depend strongly on foreign business cycles, that is, the economic conditions in countries hosting immigrant workers. For instance, the 2008 global financial crisis and the 2015 Russian currency crisis strongly impacted the flows of remittances received by Moldova. The decrease in remittances has been particularly damaging in rural areas because they account for more than 20 percent of household income, as stressed above. The effects of migrants' transfers are therefore more ambiguous than they seem, because while they represent a powerful source of resilience for receiving households, unstable flows contribute to greater vulnerability.

Given that remittances account for more than 20 percent of Moldovan GDP, impacts are not limited to the household level. National accounts statistics show that the Moldovan economy is mainly driven by internal demand, especially consumption (see also Figure 2, p. 40). Moreover, consumer goods are essentially imported, inducing a huge trade balance deficit (Figure 1) that requires a substantial source of foreign exchange. Therefore, remittance inflows ensure the sustainability of the balance of payments by providing foreign exchange to the central bank. Inflows of foreign exchange – including remittances – are also essential to conduct monetary policy, in particular the exchange-rate policy. The Moldovan leu fluctuates according to a 'managed floating policy,' requiring interventions from the central bank and therefore stable currency reserves. The stability of the leu is a crucial concern for the Moldovan authorities insofar as consumption is, for the most part, imported. Any drop in the national currency translates into an upsurge of inflation inducing dramatic effects on household real income.



Source: National Bank of Moldova and World Bank.

Figure 1 Foreign direct investments, remittances, and trade balance

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In addition to supporting monetary stability, remittances can also contribute to an increase in private investment, as has been argued by some empirical studies (Woodruff/Zenteno 2007; Giuliano/Ruiz-Arranz 2009). For instance, Giuliano/Ruiz-Arranz (2009) suggest that remittances have a stronger impact on investment when financial development is weak in the migrant's home country. In that case, income received from abroad is used as a substitute for credit, inducing significant effects on long-run economic growth. Economic policy matters too, in that policymakers may create incentives to channel remittances towards productive investments. In this regard, the case of Moldova is particularly interesting. The country's financial sector is weakly developed and provides modest amounts of credit.[16] Therefore, remittances may represent an opportunity for recipients to make small investments, for instance in micro-enterprises. This is especially true because the Moldovan government has encouraged remittances to be used in investment projects since 2010 with the 'PARE 1+1' program.[17] The program consists of doubling each remittance spent on any investment project,[18] the aim being to promote private investment against a backdrop of significant financial constraints. However, the PARE 1+1 program has not been as successful as expected (IOM 2015),[19] because households are limited to 200 000 lei (about €9700). Only 504 projects benefited from public support between 2010 and 2014, for a total of 184 million lei (€9 million) (IOM 2015: 12).

Despite the mixed success of the PARE 1+1 program, remittances might have indirect effects on private investment. In particular, national surveys report that most firms are micro-enterprises, with low levels of capital and external finance. These small productive units facing huge financial constraints are more likely to employ remittances to buy any kind of equipment such as vehicles, tools, or inventories (Woodruff/Zenteno 2007). Moreover, household surveys report that the more basic needs are met, the more remittances are likely to be invested in business activities (IMF 2005: 45). In addition, remittances can be considered as collateral, contributing to lowering the lender's perceived risk and facilitating access to credit. As Ambrosius/Cuecuecha (2016) argue, remittances increase the creditworthiness of borrowers by diversifying the source of income, with significant effects on credit access.

3 THE MODEL

To save space, we will present the main equations only. The full model is available in Appendix 1.[20] We first establish the balance-sheet matrix (Appendix 2) and the transactions matrix (Appendix 3). We follow Godley/Lavoie (2007), Lavoie/Zhao (2010), Le Heron (2011) and Le Heron/Marouane (2018). Six sectors are considered: firms (F), households (H), government (G), private banks (B), central bank (CB), and the rest of the world (ROW).

3.1 Remittances

As discussed in the previous section, Moldova's diaspora is mainly located in Russia and in European countries. However, the NBM reports that a significant portion of remittances

16. In 2016, domestic credit provided by banks to the private sector reached 26 percent of GDP.
17. Project for Attracting Remittances into the Economy.
18. Mexico has developed similar incentives with the well-known '3X1' program.
19. IOM: International Organization for Migration.
20. The EViews program file is available upon request.

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(about 10–20 percent of the total) is also sent from Israel and the US (in dollars). Therefore, the rest of the world is split into three areas: a 'euro area,'[21] a 'ruble area,'[22] and a 'dollar area.'[23] In order to take into account the distribution of the Moldovan diaspora among the countries in each area, we weight the GDP growth of each host country in relation to the relative stock of diaspora. In the dollar area, 75 percent of Moldovan migrants are located in the US and 25 percent in Israel. Therefore, GDP growth in the US accounts for 75 percent of total GDP growth in the dollar area (y^{US}). The same weighting was computed for the euro area.

Moldovan households receive remittances (*REM*) from Russia, Europe, and the dollar area. The amount of remittances depends on the business cycles of migrants' host countries: the more foreign GDPs increase, the more remittances are sent to Moldova. More precisely, remittances depend on the level of GDP in the three areas, that is, y^{EU}, y^{RU}, y^{US}, and exchange rates E_1, E_2, E_3.[24,25]

$$REM_{EU} = \frac{\beta_1 + \beta_2 . y^{EU}}{E_2} \tag{1}$$

$$REM_{RU} = \frac{\beta_3 + \beta_4 . y^{RU}}{E_1} \tag{2}$$

$$REM_{US} = \frac{\beta_5 + \beta_6 . y^{US}}{E_3} \tag{3}$$

$$REM = REM_{EU} + REM_{RU} + REM_{US} \tag{4}$$

Remittances are considered as exogenous to Moldovan GDP, an assumption which is a discordant with the current literature. Indeed, several authors consider remittances as counter-cyclical with the home country's GDP, because of migrants' altruistic behavior. According to this theory, migrants increase their transfers when economic conditions worsen in the home country, in order to smooth their family's consumption (Kapur 2004; Frankel 2011). However, there is a gap between migrants' motivations (for example, altruism) and migrants' ability to remit. Emigrants workers must first make earnings in the host country before sharing a part of their income with relatives living in the home country. In other words, the business cycle in the host country is the first determinant of migrants' transfers, since higher economic growth induces higher employment levels, higher wages and therefore more remittances.

A closer look to the balance of payments[26] strengthens the assumption that remittances are exogenously determined and pro-cyclical in Moldova. Remittances sent by Moldovan migrants are strongly correlated with Russian business cycles, and to a lesser extent with the European economy. Insofar as Moldova's GDP growth is also correlated with Russian

21. The euro area includes the main destinations of Moldovan migrants in Europe, that is, Germany, Italy, Romania, Spain, and Portugal. See the United Nations Global Migration Database.
22. The ruble area includes Russia.
23. The dollar area includes Israel and the US.
24. All GDPs are expressed as a logarithm. '*EU*' refers to the euro area, '*RU*' refers to the ruble area and '*US*' represents the dollar area.
25. E_1 refers to the leu/ruble exchange rate (number of rubles per leu), E_2 is the leu/euro exchange rate (number of euros per leu) and E_3 represents the leu/dollar exchange rate (number of dollars per leu).
26. All statistics are available on the National Bank of Moldova website. See URL: https://www.bnm.md/en.

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and European economic growth rates, remittances appear to be clearly pro-cyclical, in contrast with the common view of the literature. Counter-cyclical migrants' transfers are not an unthinkable scenario, but would require remittances to be sent from countries that have uncorrelated business cycles with Moldova. In accordance with the empirical data, our model takes remittances as pro-cyclical with migrants' host countries (that is, the three foreign areas) and a-cyclical with the origin country (that is, Moldova).

In order to calibrate equations (1), (2), and (3), we used information provided by the balance of payments of Moldova. Data show that remittances are, for the most part, sent from Russia and Europe, while the rest comes from the dollar area. We take these proportions into account, through the calibration of parameters β_1, β_3, and β_5.

3.2 International trade

As Section 2 showed, Moldova's trade partners are actually the main host countries of Moldovan emigrant workers, that is, Russia and Europe. Since trade exchanges between Moldova, the US, and Israel represent about 1 percent of Moldova's total exports and imports, we do not include the dollar area in international trade flows.

We follow Godley/Lavoie (2007) and Lavoie/Zhao (2010) in modeling trade flows, although with some differences. Similarly to remittances, Moldova's exports depend on Russian and European business cycles (y^{EU} and y^{RU}). On the other hand, we consider that exports are not affected by the exchange rate because Moldova's exported products are essentially agricultural. As worldwide demand for agricultural products is very inelastic and because Moldovan wages are particularly low, price competitiveness is not an essential determinant of exported volumes. A greater concern for Moldova is quality: the high standards of quality requested by European institutions represent the main barrier for Moldovan exports, requiring huge investments to increase quality competitiveness (Cenusa et al. 2014). Imports do not depend on the exchange rate either, because a huge share of consumption is imported (see Figure 2, overleaf). A depreciation of the national currency translates into an upsurge of inflation, without decreasing imports significantly since Moldova does not produce national substitutes. For instance, almost all medicines are imported from abroad: any drop in the leu leads to huge inflation rates in this specific sector, although the government tries to smooth currency fluctuations (IDIS 2012).[27]

Moldova's imports come from Europe and Russia. In order to avoid any 'black hole,' imports from one zone represent the sum of exports of the other two zones.

$$IM = (\mu_1^{RU} + \mu_2.y^{MO}) + (\mu_3^{EU} + \mu_4.y^{MO}) \tag{5}$$

In the model, Russia and the euro area import Moldovan products:

$$IM_{RU/MO} = \mu_5^{RU} + \mu_6.y^{RU} \tag{6}$$

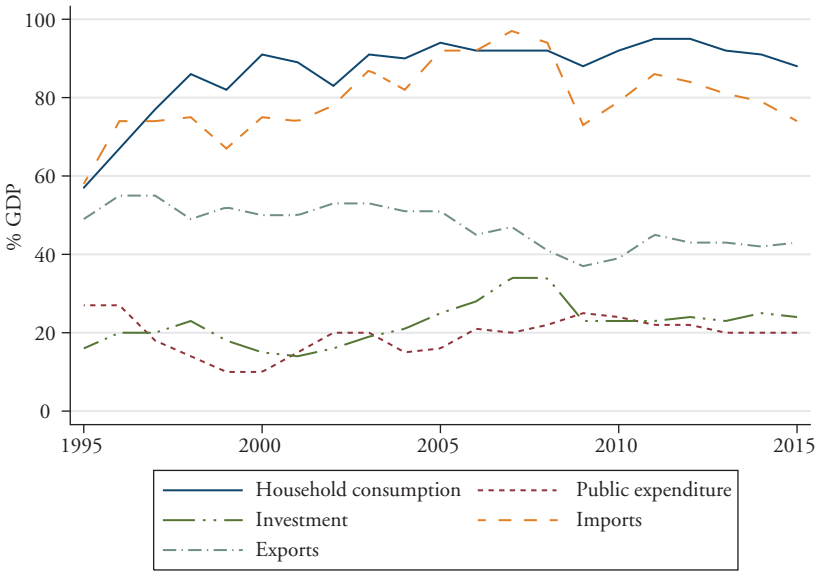
$$IM_{EU/MO} = \mu_7^{EU} + \mu_8.y^{EU}. \tag{7}$$

Moldova's exports are the sum of Russian and European imports:

$$X = \frac{IM_{RU/MO}}{E_1} + \frac{IM_{EU/MO}}{E_2}. \tag{8}$$

27. For instance, when the leu/euro exchange rate dropped in 2009, the inflation rate in pharmaceutical products rose to 20 percent.

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Source: National Bureau of Statistics of Moldova.

Figure 2 Moldova's GDP components

We have shown that Moldova's external trade was mainly carried out with Russia until the mid 2000s. The first series of Russian bans (2006) greatly impacted Moldova's exports, especially the agricultural sector. While the Russian market represented almost 40 percent of Moldova's total exports before 2006, this share was suddenly halved. We take bans into account by decreasing the parameter μ_5^{RU} after 2005, while the parameter μ_7^{EU} increases gradually as Moldova's European integration accelerated.

3.3 Households

The consumption function includes labor income (Y_w), financial income (Y_v), and the stock of savings ($D_{-1} + HPM_{H-1}$). Of course, remittances (REM) are also included in the consumption function. However, we assume that households have no access to credit, since financial development is very weak in Moldova. In particular, Rios Avila/Schlarb (2008) show that the use of formal financial services (bank accounts, formal savings) is still underdeveloped. As a result, most savings are kept 'under the mattress' and do not contribute to increasing the size of the financial sector. Therefore, households own high-powered money (HPM_H), which can be used like deposits for consumption purposes.

Following Kalecki's (1971) theory, we assume that incomes are not equally consumed. Labor income is the main source of consumption, such that $\alpha_1 > \alpha_2 > \alpha_3$. Regarding remittances, we calibrate the parameter α_4 using the results of household surveys. According to Cuc et al. (2006), remittances are mainly consumed in Moldova and weakly saved (less than 10 percent). Therefore, we assume that $\alpha_4 = 0.95$.

$$C = \alpha_1 Y_w^a + \alpha_2 Y_v^a + \alpha_3 (D_{-1} + HPM_{H-1}) + \alpha_4 REM \tag{9}$$

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Labor income (Y_w) consists of wages (W), social benefits, and government transfers (G_H). The government taxes wages and capital (T_H).

$$Y_w = W + G_H - T_H \tag{10}$$

$$W = \frac{\omega}{\sigma_2}.Q, \tag{11}$$

where ω represents the wage rate, σ_2 is productivity, and Q stands for domestic sales. Financial income (Y_v) consists of interests earned on bank deposits ($i_{D-1}.D_{-1}$) and profit shares paid by banks (P_B^d) and firms (P_F^d).

$$Y_v = i_{D-1}.D_{-1} + P_B^d + P_F^d \tag{12}$$

Following Le Heron (2009), the consumption function includes error-correction behavior, as a way to introduce adaptive expectations.

$$Y_w^a = Y_{w-1} + \theta_H.(Y_{w-1} - Y_{w-1}^a) \tag{13}$$

$$Y_v^a = Y_{v-1} + \theta_H.(Y_{v-1} - Y_{v-1}^a) \tag{14}$$

3.4 Firms

One of Moldova's main problems is the weakness of investment, while consumption is, for the most part, imported. The economy of Moldova is based on agriculture and manufacturing, but industrial production has barely increased since independence. According to the national statistics, Moldova's GDP growth is driven by agriculture, manufacturing industry (in particular clothing, footwear, and automotive industries), and retail and wholesale trade. Moldova attempts to attract foreign investments in order to develop the local industry, but high levels of perceived corruption, as well as political uncertainty, have detrimental effects on the country's attractiveness.

As discussed in the Section 1, remittances are acknowledged to support private investment in some receiving countries. Remittances can promote investment by (i) reducing the lender's risk (Ambrosius/Cuecuecha 2016) or (ii) by substituting for credit when access to financial services is strongly constrained (Giuliano/Ruiz-Arranz 2009). Empirically, some articles find that remittances are used to finance small-scale productive activities, particularly in micro-enterprises (Woodruff/Zenteno 2007). Although there exists no causal estimation of the impact of remittances on private investment in Moldova, we consider that migrants' transfers may have a slight effect. Indeed, we emphasized in Section 2 that the Moldovan government is attempting to increase the growth potential of remittances with a program called 'PARE 1+1.' The aim is to foster the creation of micro-enterprises by doubling each leu invested, but a study by the IOM (2015) pointed out the mixed success of the program. Therefore, we argue that remittances can promote investment by reducing the lender's risk (Ambrosius/Cuecuecha 2016), rather than by increasing investment directly. In this case, remittances work as a collateral because lenders are more likely to grant a loan to a borrower who enjoys an additional income that is exogenous to the local economy. This assumption is particularly relevant in the Moldovan context because the private sector faces huge financial constraints. Moreover, the high number of micro-enterprises in Moldova confirms that remittances may contribute to financing small investment projects by increasing credit access.

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The investment function is similar to that of Le Heron (2011), and remittances have a slight effect through the lender's risk (see the next section). In order to take the country's weak financial development into account, we consider that firms can increase their investment by self-financing or borrowing. There is one kind of loan and no financial assets such as commercial papers, bonds, or equities.

$$I \equiv \rho + IF \tag{15}$$

$$IF = P_F^u - \theta L_{F-1}, \tag{16}$$

where P_F^u is retained earnings and L_F firms' loans. As in Le Heron (2011), we consider that firms prefer self-financing, then borrow external funds if necessary. As investment is partially financed with external funds, the demand for investment (I^d) is not always satisfied. A financing constraint may arise and depends on banking behavior.[28]

$$I^d = gr_{Kd}.K_{-1} \tag{17}$$

$$\rho^d = I^d - IF \tag{18}$$

$$gr_{Kd} = \gamma_1 + \gamma_2 r_{cf-1} + \gamma_3 U_{-1} - \gamma_4 lev_{-1}, \tag{19}$$

where ρ^d is the desired amount of external funds. Desired growth of capital (gr_{Kd}) depends on an exogenous state of confidence parameter (γ_1), the rate of cash flow (r_{cf}), the capacity utilization rate (U), and leverage (lev).

$$lev = \frac{L_F}{K_{-1}} \tag{20}$$

$$r_{cf} = \frac{P_F}{K_{-1}} \tag{21}$$

$$U = \frac{Y}{Y^\star} \tag{22}$$

$$Y^\star = K_{-1}.\sigma, \tag{23}$$

where $Y^\star$ is the full capacity output. Firms' profits are given by equation (24).

$$P_F \equiv C + I + G_F + X - IM - W - T_F - i_{L-1}.L_{F-1}, \tag{24}$$

where T_F are taxes, W wages, and G_F public subsidies.

3.5 Private banks

Private banks provide loans to firms and set an interest rate based on the central bank's key rate (i_{CB}), plus a mark-up (χ_1). The interest rate on deposits is lower and the profit (P_B) is partially paid to households.

$$P_B = i_{CB-1}.B_{-1} + i_{L-1}.L_{F-1} - i_{CB-1}.REF_{-1} - i_{D-1}.D_{-1}, \tag{25}$$

28. See Le Heron/Mouakil (2008) for a complete explanation of this financing constraint.

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where B are treasury bills, *REF* are central-bank refunds, and i_{CB} the central bank's key rate. Remittances are taken as a collateral since they increase the creditworthiness of the borrower. Migrants' transfers are therefore an additional guarantee for the lender: if the loan goes bad, the borrower can still use remittances to repay his debt. *LR* represents the lender's risk and depends on an exogenous state of the confidence parameter (ϕ_1), the leverage ratio (*lev*), and the central bank's key interest rate (i_{CB}). Given that the contribution of remittances to investment seems to be low in Moldova, we assume that the effect on the lender's risk is weak and related to the growth rate of these remittances ($\frac{\Delta REM}{REM_{-1}}$).

$$\rho = \rho^d.(1 - LR) \tag{26}$$

$$LR = -\phi_1 + \phi_2 lev - \phi_3 \frac{\Delta REM}{REM_{-1}} + \phi_4 i_{CB} \tag{27}$$

$$i_L = i_{CB} + \chi_1 \tag{28}$$

$$i_D = i_{CB} - \chi_2 \tag{29}$$

3.6 The government

The government taxes wages ($\lambda_1.W_{-1}$) and financial income ($\lambda_2.Y_v$). Firms' profits are also taxed ($\lambda_3.P_F$), as well as domestic sales ($\lambda_4.Q_D$).

$$T_H = \lambda_1.W_{-1} + \lambda_2.Y_v \tag{30}$$

$$T_F = \lambda_3.P_F + \lambda_4.Q_D \tag{31}$$

$$Q_D = C + I + G_F \tag{32}$$

The government's deficit is financed with treasury bills (ΔB). As in Le Heron/Marouane (2018), public expenditure grows at the same pace as the economy in the previous period (grY_{-1}^{MO}), involving a slight counter-cyclical effect.

$$G = G_{-1}.(1 + grY_{-1}^{MO}) \tag{33}$$

$$\Delta B = DG \tag{34}$$

$$DG \equiv G + (i_{CB-1}.B_{-1}) - T - P_{CB}^d \tag{35}$$

3.7 The central bank

The first concern of the Moldovan central bank (NBM) is to target inflation at a rate of 5 percent (± 1.5 percent). There is no official exchange-rate target but currency fluctuations are a matter of concern for the monetary authorities. Since a large share of consumer goods is imported into Moldova, inflation is highly correlated to exchange-rate fluctuations. Therefore, the central bank intervenes regularly in the exchange-rate market to maintain the leu within an 'acceptable band,' in order to ensure price stability.

Instead of including inflation in the model through an additional equation, we use the exchange rate as a determinant of price fluctuations. Any drop in the leu decreases the

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monetary value of remittances (received in foreign currencies) and increases the value of imports. For the purpose of realism, we use time series for the different exchange rates (E_1, E_2, E_3) during simulations. Since inflation in Moldova is mostly 'imported' through the exchange-rate channel, this strategy is more relevant than determining price fluctuations with a Phillips curve. Even if the official strategy of the NBM is inflation targeting, it is clear from actual data that the central bank is targeting exchange-rate stability. Furthermore, the purpose of this article is to show the links between the economic situation abroad and economic growth in Moldova.

Remittances can affect monetary policy in two ways. First, it is known that 'unearned incomes' fuel inflation because of increasing demand in domestic markets (Narayan et al. 2011). Remittances may also appreciate the local currency and reduce exports in the receiving country, a phenomenon known as the 'Dutch disease' (Acosta et al. 2009; Bayangos/Jansen 2011). However, the NBM's data show that migrants' transfers are not correlated to inflation, while exports have been stable since the 2000s. For these reasons, we consider that remittances do not affect the value of the Moldovan leu. However, they represent an essential source of foreign exchange for the central bank, serving to stabilize the exchange rate.

As remittances represent the main source of foreign exchange in Moldova, they are used to cover the country's huge trade deficit (see Figure 1). As such, migrants' monetary transfers contribute to increasing imports but the effect on the current account is limited since remittances are also an inflow of foreign currency for the Moldovan central bank. Therefore, foreign loans (L) increase with the trade deficit and decrease with remittances.

$$\Delta L^{EU} \equiv E_2.IM_{MO/EU} - E_2.X_{MO/EU} + i^{EU}_{L-1}.L^{EU}_{-1} - E_2.REM_{EU} \tag{36}$$

$$\Delta L^{RU} \equiv E_1.IM_{MO/RU} - E_1.X_{MO/RU} + i^{RU}_{L-1}.L^{RU}_{-1} - E_1.REM_{RU} \tag{37}$$

$$\Delta L^{US} \equiv i^{US}_{L-1}.L^{US}_{-1} - E_3.REM_{US} \tag{38}$$

$$L = L^{EU} + L^{RU} + L^{US} \tag{39}$$

The profit of the central bank (P_{CB}) depends on the interest paid by private banks, minus interest paid on ruble, euro, and dollar loans. The interest rate i_{CB} is exogenous in the model, as is monetary policy.

$$P_{CB} = i_{CB-1}.REF_{-1} - i^{EU}_{L-1}.\frac{L^{EUR}_{-1}}{E_2} - i^{RU}_{L-1}.\frac{L^{RU}_{-1}}{E_1} - i^{US}_{L-1}.\frac{L^{US}_{-1}}{E_3} \tag{40}$$

4 SOME EXPERIMENTS

4.1 The global financial crisis (2008–2009) and the Russian currency crisis (2014–2015)

To ensure that our model is well calibrated, we present the results of the steady state in Appendix 5.[29] The model is very stable and achieves convergence after about 50

29. For reasons of space, we will only discuss the variables of interest, that is, remittances, GDP growth, household consumption, and investment.

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replications.[30] A comparison of simulated and empirical values before the global financial crisis of 2008 (see Figure 2) confirms the relevance of the calibration. In particular, the level of remittances (33 percent of GDP), consumption (94 percent of GDP), investment (24 percent of GDP), and GDP growth (7.5 percent) fit the empirical values very well.

Our first series of simulations aims to reproduce the effect of the 2008 crisis on remittances and on the economy of Moldova. This episode of economic turmoil caused a sharp drop in remittances received by Moldova, after a decade of growing inflows (see Figure 1). Given their crucial importance for the Moldovan economy, we can expect fluctuations in remittances to explain a large part of Moldova's business cycle. In other words, Moldova is likely to be subjected to fluctuations in migrants' host economies through the remittances channel. In order to test our assumption, we reproduce the fluctuations in the Moldovan economy from 2005. To achieve these first simulations, we use time series on foreign GDP growth (that is, in Europe, Russia, and the US), as well as time series on exchange rates.[31] This step is useful to estimate the extent to which Moldova is exposed to foreign fluctuations because so far, the model is driven by foreign GDP and exchange-rate fluctuations (all other parameters remain constant). Therefore, a strong correlation between simulated and empirical values would suggest a high exposure of the country to external shocks.

Note that including foreign currency fluctuations allows us to take the impact of the ruble crisis (2014–2015) into account. As Section 2 argues, Russia is the primary destination of Moldovan immigrants and therefore the main source of remittances. The increasing swings of the Russian economy, as well as ruble fluctuations, contribute to destabilizing workers' remittances sent to Moldova. In particular, the sudden drop in the ruble that occurred in December 2014 depreciated the value of monetary transfers received by Moldovan households.[32]

The results of simulations are presented in Figure 3 (overleaf). As expected, the simulated values are very close to the empirical ones, confirming the reliance of Moldova's economy on external fluctuations. In particular, the model fits the huge swings of GDP and consumption, except in 2013.[33] Similarly, the predicted values of remittances follow the same trend as the empirical data, but the drop observed in 2014–2015 is not fully taken into account by the model. This is because political instability in neighboring countries, especially Ukraine,[34] accentuated the drop in remittances experienced by Moldova in 2015 (–28 percent). A more surprising result is seen in investment: while all parameters of the investment function (equation (19)) are kept constant, we can see that simulated values are close to the empirical observations. This finding suggests that investment is also sensitive to external factors, which may be explained by the weight of exports in GDP (45–50 percent). Yet we assumed that remittances may impact investment through the lender's risk: higher fluctuations in flows are therefore detrimental because migrants' transfers are considered as a collateral, facilitating access to credit.

These experiments confirm the fact that Moldova's economy is highly exposed to external shocks and more precisely to sudden fluctuations in migrants' monetary transfers. An

30. Additional robustness checks have been carried out by the authors. Changing some of the key parameters (for instance, in the investment function) does not affect the results significantly.
31. As explained in Section 3, each GDP is weighted in relation to the share of the Moldovan diaspora living in the corresponding country.
32. It should be noted that after the Russian currency crisis, an increasing share of monetary transfers was carried out in dollars. However, the effects of the depreciation are still significant, unless migrants' wages are paid in dollars.
33. These differences may result from the discretionary fiscal policy of the Moldovan government.
34. Ukraine's GDP growth dropped to –9.8 percent in 2015.

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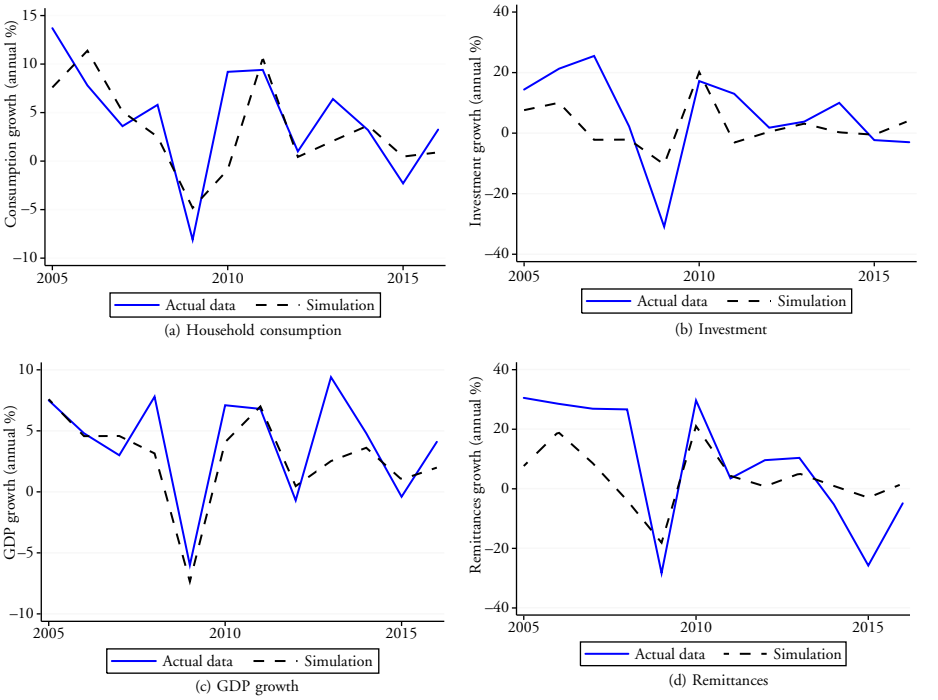


Figure 3 Main trends of Moldova's economy, 2005–2016

economic downturn in migrants' host countries reduces remittances and transmits external volatility to the domestic economy. Given that Moldova mainly exports to the host economies of migrants (that is, Russia and the EU), any shock in these countries induces a simultaneous decrease in remittances and exports, worsening the effect on the economy.

4.2 Simulating economic and currency crises in Russia

We now focus on Russia more specifically because this country hosts the largest share of Moldovan migrants (about 32 percent of the total Moldovan diaspora in 2015, according to the United Nations). We build three scenarios by introducing different kinds of shocks from the steady state of the model (that is, from Appendix 5). In order to estimate the extent to which Moldova is subjected to Russian fluctuations, we simulate an economic recession in a first scenario, assuming that Russia experiences a negative growth rate of –7.8 percent during a given period,[35] then recovers the next year. In a second scenario, we estimate the effect of a ruble depreciation, using a depreciation rate of 30 percent, while Russian GDP growth remains constant.[36] In a third scenario, we simulate an exogenous drop in remittances[37] (that is, not resulting from economic difficulties in Russia).

35. We use the same growth rate as in 2009.
36. As migrants' monetary transfers carried out from Russia are received in rubles by Moldovan households, any drop in the Russian currency implies a decrease in the value of remittances (unless the leu simultaneously depreciates, which is unlikely and not a part of this scenario).
37. In our simulations, remittances sent from Russia drop by 20 percent, as observed in 2009.

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Table 1 Simulations of economic and currency crises in Russia

	Steady state	Economic crisis	Currency crisis	Exogenous drop of remittances
Consumption	7.5	3.1	1.7	−2.4
Investment	7.5	−1.0	−3.6	−7.7
GDP growth	7.5	2.0	0.3	0.4
Remittances	7.5	−5.0	−8.9	−20.0

Note: Data are expressed in annual growth rate (%).

This last scenario is useful to estimate the 'pure' effect of a fluctuation in remittances, which could result from a tightened migration policy for instance. Unlike in scenarios 1 and 2, we keep Russia's GDP and exchange rate constant in scenario 3, in order not to affect Moldova's exports. This ensures that simulations report the effects related to remittances only and not the effects of external trade fluctuations, which depend on foreign GDPs and exchange rates.

Table 1 shows that remittances are modestly affected by the economic shock, decreasing by 5 percent. This trend is much lower than the estimates in the previous section and means that remittances are affected by other factors. The Moldovan GDP growth rate is also reduced but remains positive, as does household consumption growth. In contrast, a ruble depreciation has significant effects on all variables, especially the GDP growth rate. Remittances fall by 8.9 percent, while GDP growth is now close to zero, suggesting that monetary fluctuations in migrants' host countries have stronger impacts on remittances than an economic recession. Finally, the last column of Table 1 confirms that remittances are the main determinant of Moldova's macroeconomic fluctuations. In this scenario, remittances drop by 20 percent, while all other parameters (including Russia's GDP and exchange rate) remain constant. The decrease in remittances has significant effects on the economy, leaving no doubt about the reliance of Moldova on migrants' transfers.

These experiments provide evidence that remittances represent one of the main sources of volatility for the economy of Moldova. This is especially true as, for the most part, remittances are sent from Russia whose economy has been highly volatile since 2008. As a result, migrants' transfers are much more unstable than before the 2008 crisis and transmit the volatility of the Russian economy to Moldova.

5 CONCLUDING REMARKS

We have studied the macroeconomic effects of migrants' remittances in Moldova. Using a stock–flow consistent model, we provide evidence that remittances affect the Moldovan economy in many ways. On the one hand, migrants' monetary transfers increase household consumption and help support economic growth, while on the other hand the reliance of Moldova on remittances (reaching 25 percent of GDP) is a major source of volatility. In particular, our results suggest that the huge economic swings experienced by Moldova since 2008 essentially result from the greater volatility of remittances. In contrast with previous studies based on panel data (Hakura et al. 2009; Combes/Ebeke 2011), we argue that remittances do not represent an efficient tool of macroeconomic stabilization in Moldova. The excessive reliance of internal demand on remittances, as well as economic uncertainty in migrants' host countries, have detrimental effects on economic growth and cast doubt on the efficiency of the pattern of development.

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As suggested previously, Moldova is currently divided between European and Russian interests. While European integration represents an opportunity for Moldova to increase exports and remittance inflows, the country remains exposed to Russian punitive sanctions. Indeed, the Russian government has always applied import bans following Moldova–EU agreements, such as in 2006 and more recently in 2014. Even though European integration may increase inflows of remittances through greater mobility of Moldovan migrants in Europe, it should be noted that effects will not be immediate. As a large part of the Moldovan diaspora is Russian-speaking, European integration does not mean that all migrants will move massively from Russia to Europe. Exports to European markets will also only increase gradually, because Moldovan products must be adapted to European quality standards, requiring massive investments (Cenusa et al. 2014).

The complex relationships between Moldova, Europe, and Russia contribute to curbing the development of the economy. Political and economic uncertainties work as pull factors for foreign investments and explain the low level of foreign direct investment received by Moldova (1.3 percent of GDP in 2016). In particular, political instability is a current issue because the Moldovan President wishes to abandon the Moldova–EU Association Agreement in order to join the Eurasian Economic Union. Therefore, the 2019 legislative elections will have a crucial impact on the country's economic policy. Whatever the results of the elections, Moldova should take advantage of remittances to develop local markets, in order to limit import leakages. As the present paper shows, remittances could represent strong support for demand for local goods, with potential multiplier effects. The development of the domestic economy would also reduce the massive out-migration of the active population and brain drain. A higher active/inactive ratio would increase tax revenues, allowing the government to finance expenditure on health and education, as well as counter-cyclical fiscal policy. Currently, public revenues are mainly supported by VAT, that is, by remittances.

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APPENDIX 1 THE FULL MODEL

$Y = C + I + G_F + X - IM$	National income
$gr_Y^{MO} = \frac{\Delta Y}{Y_{-1}}$	National income growth rate
$T \equiv T_H + T_F$	Taxes
$T_H = \lambda_1 W_{-1} + \lambda_2 Y_v$	Taxes (households)
$T_F = \lambda_3 P_F + \lambda_4 Q_D$	Taxes (firms)
$Q = C + I + G_F + X$	Sales
$Q_D = C + I + G_F$	Domestic sales
$\Delta B = DG$	ΔTreasury bills
$DG \equiv G + (i_{CB-1}.B_{-1}) - T - P_{CB}^d$	Public deficit
$G = G_{-1}.(1 + grY_{-1}^{MO})$	Public expenditure
$G_F \equiv G - G_H$	Public investments
$G_H = z.G_{-1}$	Public transfers (households)
$I^d = gr_{Kd}.K_{-1}$	Demand of investment
$K = K_{-1} + I$	Capital
$IF = P_F^u - \theta L_{F-1}$	Self financing
$I \equiv IF + \rho$	Investment
$\rho^d = I^d - IF$	Desired external funds
$gr_{Kd} = \gamma_1 + \gamma_2 r_{cf-1} + \gamma_3 U_{-1} - \gamma_4 lev$	Desired growth in capital
$r_{cf} = \frac{P_F}{K_{-1}}$	Cash-flow ratio
$U = \frac{Y}{Y^\star}$	Capacity utilization rate
$Y^\star = K_{-1}.\sigma$	Output of full capacity
$W = \frac{w}{\sigma_2}.Q$	Wages
$P_F \equiv C + I + G_F + X - IM - W - T_F - i_{L-1}.L_{F-1}$	Firms' profits
$P_F^d = \kappa_1.P_F$	Distributed profits
$P_F^u = P_F - P_F^d$	Non-distributed profits
$Y_w^a = Y_{w-1} + \theta_H.(Y_{w-1} - Y_{w-1}^a)$	Expected disposable wage income
$Y_v^a = Y_{v-1} + \theta_H.(Y_{v-1} - Y_{v-1}^a)$	Expected disposable financial income
$Y_w = W - T_H + G_H$	Disposable wage income
$Y_v = i_{D-1}.D_{-1} + P_B^d + P_F^d$	Disposable financial income
$Y_H = Y_w + Y_v + REM$	Disposable income of households
$C = \alpha_1 Y_w^a + \alpha_2 Y_v^a + \alpha_3 (D_{-1} + HPM_{H-1}) + \alpha_4 REM$	Households consumption
$REM = \frac{\beta_1 + \beta_2.y^{EU}}{E_2} + \frac{\beta_3 + \beta_4.y^{RU}}{E_1} + \frac{\beta_5 + \beta_6.y^{US}}{E_3}$	Remittances

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$HPM_H = HPM_{H-1} + \nu(Y_H - C)$	High-powered money (households)
$\Delta D \equiv Y_H - C - \Delta HPM_H$	ΔDeposits
$\Delta L_F \equiv I - P_F^u$	ΔLoans
$\rho = \rho^d.(1 - LR)$	External funds
$LR = -\phi_1 + \phi_2 lev - \phi_3 \frac{\Delta REM}{REM_{-1}} + \phi_4 i_{CB}$	Lenders' risk
$lev = \frac{L_F}{K_{-1}}$	Leverage ratio
$X_{MO/RU} = \frac{IM_{RU/MO}}{E_1}$	Moldova's exports to Russia
$X_{MO/EU} = \frac{IM_{EU/MO}}{E_2}$	Moldova's exports to euro area
$IM_{MO/RU} = \mu_1^{RU} + \mu_2.y^{MO}$	Moldova's imports from Russia
$IM_{MO/EU} = \mu_3^{EU} + \mu_4.y^{MO}$	Moldova's imports from euro area
$IM_{RU/MO} = \mu_5^{RU} + \mu_6.y^{RU}$	Russia's imports from Moldova
$IM_{EU/MO} = \mu_7^{EU} + \mu_8.y^{EU}$	EU's imports from Moldova
$\Delta L^{EU} \equiv E_2.IM_{MO/EU} - E_2.X_{MO/EU} + i_{L-1}^{EU}.L_{-1}^{EU} - E_2.REM_{EU}$	ΔForeign loans (euros)
$\Delta L^{RU} \equiv E_1.IM_{MO/RU} - E_1.X_{MO/RU} + i_{L-1}^{RU}.L_{-1}^{RU} - E_1.REM_{RU}$	ΔForeign loans (rubles)
$\Delta L^{US} \equiv i_{L-1}^{US}.L_{-1}^{US} - E_3.REM_{US}$	ΔForeign loans (dollars)
$i_L = i_{CB} + \chi_1$	Interest rate on loans
$i_D = i_{CB} - \chi_2$	Interest rate on deposits
$P_B \equiv i_{CB-1}.B_{-1} + i_{L-1}.L_{F-1} - i_{CB-1}.REF_{-1} - i_{D-1}.D_{-1}$	Profits of banks
$P_B^d = \kappa_2.P_B$	Distributed profits of banks
$P_B^u = P_B - P_B^d$	Non-distributed profits of banks
$HPM_B = \eta D$	High-powered money (banks)
$HPM = HPM_H + HPM_B$	High-powered money (total at the central bank)
$P_{CB} \equiv i_{CB-1}.REF_{-1} - i_{L-1}^{EU}.\frac{L_{-1}^{EUR}}{E_2} - i_{L-1}^{RU}.\frac{L_{-1}^{RU}}{E_1} - i_{L-1}^{US}.\frac{L_{-1}^{US}}{E_3}$	Profits of the central bank
$P_{CB}^d = P_{CB}.\zeta$	Distributed profits of the central bank
$P_{CB}^u \equiv P_{CB} - P_{CB}^d$	Non-distributed profits of the central bank
$\Delta REF \equiv \Delta H_B + \Delta B + \Delta L_F - P_B^u - \Delta D$	CB refunds
$\Delta HPM_{th} \equiv \Delta REF - \frac{\Delta L^{EU}}{E_2} - \frac{\Delta L^{RU}}{E_1} - \frac{\Delta L^{US}}{E_3} - P_{CB}^u$	Missing equation

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APPENDIX 2 BALANCE-SHEET MATRIX

	Government	Households	Firms	Private banks	Central bank	Rest of the world			Σ
	–	–	–	–	–	Ruble area	Euro area	Dollar area	–
Capital	–	–	$+K$	–	–	–	–	–	$+K$
High-powered money	–	$+HPM_H$	–	$+HPM_B$	$-HPM$	–	–	–	0
Treasury bills	$-B$	–	–	$+B$	–	–	–	–	0
Loans	–	–	$-L_F$	$+L_F$	–	–	–	–	0
Foreign loans	–	–	–	–	$-L^{RU}$	$+L^{RU}$	$+L^{EU}$	$+L^{US}$	0
					$-L^{EU}$				0
					$-L^{US}$				0
Deposits	–	$+D$	–	$-D$	–	–	–	–	0
CB advances	–	–	–	$-REF$	$+REF$	–	–	–	0
Net wealth	$-B$	$+V_H$	$+V_F$	$+V_B$	$+RES$	$+L^{RU}$	$+L^{EU}$	$+L^{US}$	$+K$

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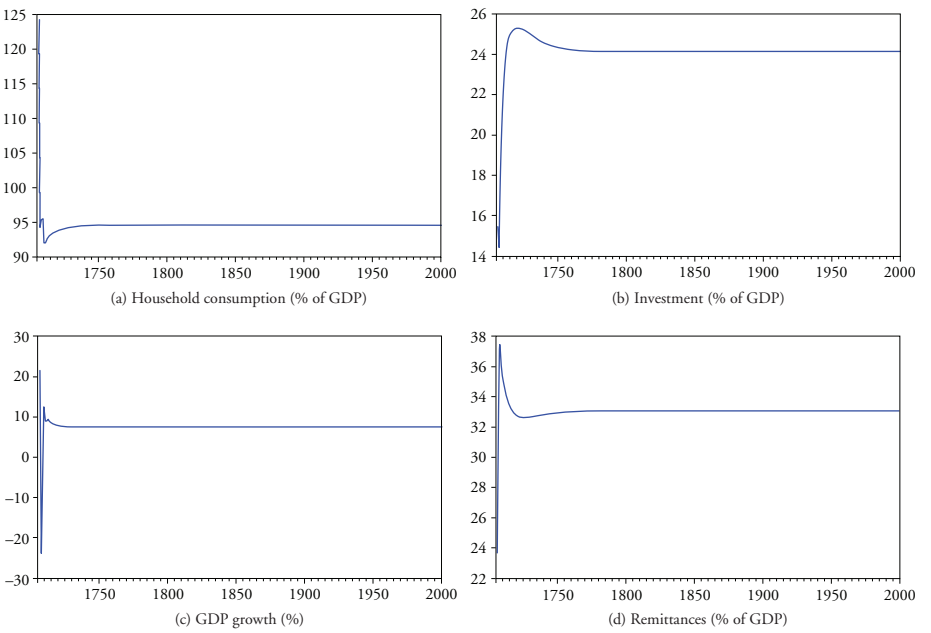
APPENDIX 3 TRANSACTIONS MATRIX

	Government	Households	Firms		Private banks		Central bank		Σ	Rest of the world						Σ Σ
	–	–	Current	Capital	Current	Capital	Current	Capital	–	Ruble area	–	Euro area	–	Dollar area	–	–
Consumption	–	$-C$	$+C$	–	–	–	–	–	0	–	–	–	–	–	–	0
Public expenditure	$-G$	$+G_H$	$+G_F$	–	–	–	–	–	0	–	–	–	–	–	–	0
Investment	–	–	$+I$	$-I$	–	–	–	–	0	–	–	–	–	–	–	0
Wages	–	$+W$	$-W$	–	–	–	–	–	0	–	–	–	–	–	–	0
Remittances	–	$+REM_{EU}$ $+REM_{RU}$ $+REM_{US}$	–	–	–	–	–	–	0 0	$-REM_{RU}$	E_1	$-REM_{EU}$	E_2	$-REM_{US}$	E_3	0 0
Taxes	$+T$	$-T_H$	$-T_F$	–	–	–	–	–	0	–	–	–	–	–	–	0
Interests on Treasury bills	$-i_{CB-1}.B_{-1}$	–	–	–	$+i_{CB-1}.B_{-1}$	–	–	–	0	–	–	–	–	–	–	0
Interests on loans	–	–	$-i_{L-1}.L_{F-1}$	–	$+i_{L-1}.L_{F-1}$	–	–	–	0	–	–	–	–	–	–	0
Interests on deposits	–	$+i_{D-1}.D_{-1}$	–	–	$-i_{D-1}.D_{-1}$	–	–	–	0	–	–	–	–	–	–	0
Interests on CB adv.	–	–	–	–	$-i_{CB-1}.REF_{-1}$	–	$+i_{CB-1}.REF_{-1}$	–	0	–	–	–	–	–	–	0
Interests on foreign loans	–	–	–	–	–	–	$-\frac{i^{RU}_{L-1}.L^{RU}_{-1}}{E_1}$ $-\frac{i^{EU}_{L-1}.L^{EU}_{-1}}{E_2}$ $-\frac{i^{US}_{L-1}.L^{US}_{-1}}{E_3}$	–	0	$+i^{RU}_{L-1}.L^{RU}_{-1}$	E_1	$+i^{EU}_{L-1}.L^{EU}_{-1}$	E_2	$+i^{US}_{L-1}.L^{US}_{-1}$	E_3	0
Profits of firms	–	$+P^d_F$	$-P_F$	$+P^u_F$	–	–	–	–	0	–	–	–	–	–	–	0
Profits of banks	–	$+P^d_B$	–	–	$-P_B$	$+P^u_B$	–	–	0	–	–	–	–	–	–	0
Profit of CB	$+P^d_{CB}$	–	–	–	–	–	$-P_{CB}$	$+P^u_{CB}$	0	–	–	–	–	–	–	0
Δ HPM	–	$-\Delta HPM_H$	–	–	–	$-\Delta HPM_B$	–	$+\Delta HPM$	0	–	–	–	–	–	–	0
Δ Treasury bills	$+\Delta B$	–	–	–	–	$-\Delta B$	–	–	0	–	–	–	–	–	–	0
Δ Loans	–	–	–	$+\Delta L_F$	–	$-\Delta L_F$	–	–	0	–	–	–	–	–	–	0
Δ Deposits	–	$-\Delta D$	–	–	–	$+\Delta D$	–	–	0	–	–	–	–	–	–	0
Δ CB adv.	–	–	–	–	–	$+\Delta REF$	–	$-\Delta REF$	0	–	–	–	–	–	–	0
Δ Foreign loans	–	–	–	–	–	–	–	$+\frac{\Delta L^{RU}}{E_1}$ $+\frac{\Delta L^{EU}}{E_2}$ $+\frac{\Delta L^{US}}{E_3}$	0	$-\Delta L^{RU}$	E_1	$-\Delta L^{EU}$	E_2	$-\Delta L^{US}$	E_3	0
Exports	–	–	$+X$	–	–	–	–	–	0	$-IM_{RU/MO}$	E_1	$-IM_{EU/MO}$	E_2	–	–	0
Imports	–	–	$-IM$	–	–	–	–	–	0	$+X_{RU/MO}$	E_1	$+X_{EU/MO}$	E_2	–	–	0
Σ	0	0	0	0	0	0	0	0	0	0	–	0	–	0	–	0

APPENDIX 4 PARAMETER VALUES FOR SIMULATIONS

$\lambda_1 = 0.15$	$\lambda_2 = 0.04$	$\lambda_3 = 0.06$	$\lambda_4 = 0.12$
$z = 0.4$	$\theta = 0.05$	$\sigma = 0.9$	$\omega = 0.45$
$\gamma_1 = 0.07$	$\gamma_2 = 1$	$\gamma_3 = 0.02$	$\gamma_4 = 0.02$
$\kappa_1 = 0.3$	$\theta_H = 0.5$	$\beta_1 = -2.2$	$\beta_2 = 1.5$
$\beta_3 = -1.3$	$\beta_4 = 1.5$	$\beta_5 = -3.6$	$\beta_6 = 1.5$
$\alpha_1 = 0.9$	$\alpha_2 = 0.1$	$\alpha_3 = 0.6$	$\alpha_4 = 0.95$
$\phi_1 = 0.05$	$\phi_2 = 1$	$\phi_3 = 5$	$\phi_4 = 0.3$
$\mu_1^{RU} = -1$	$\mu_2 = 1$	$\mu_3^{EU} = -0.6$	$\mu_4 = 1$
$\mu_5^{RU} = -0.9$	$\mu_6 = 1.5$	$\mu_7^{EU} = -1.3$	$\mu_8 = 1.5$
$\chi_1 = 0.01$	$\chi_2 = 0.01$	$\kappa_2 = 0.7$	$\eta = 0.3$
$\zeta = 1$	$\nu = 0.5$		

APPENDIX 5 THE STEADY STATE



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