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Impact of remittances on household consumption and public-private investment in Ecuador: Application of a Vector Autoregressive Model and impulse-response function

Impacto de las remesas sobre el consumo de los hogares y la inversión público-privada en Ecuador: Aplicación de un Modelo Vectorial Autorregresivo y función impulso-respuesta

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Abstract

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The objective of this research was to measure the impact of the components of aggregate demand, consumption, and investment, generated by changes in the remittance flows that entered Ecuador in the period 2000-2020, using an Autoregressive Vector model, through the impulse-response function. The results showed that remittances decreased household consumption and public-private investment in the short term. However, the impulse of the flow of remittances that entered the country in the period analyzed increased both variables, in the medium and long term. Thus, it concludes that households receiving remittances, once they receive this income from their relatives, take time to decide about the destination they will give it, so their consumption does not adapt or change in the first quarters, but with time when it becomes used for the final expenditure of households.

Keywords: VAR, remittances, aggregate demand, household consumption, investment.

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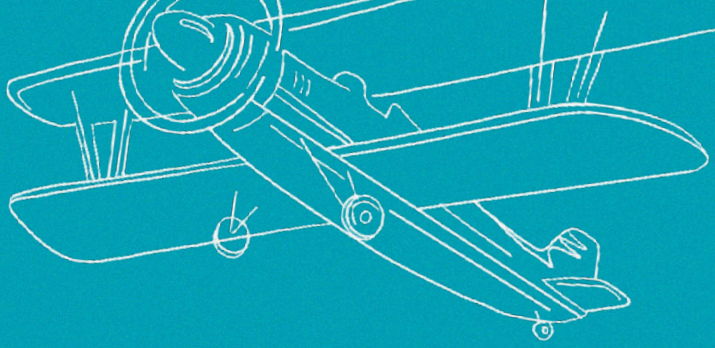
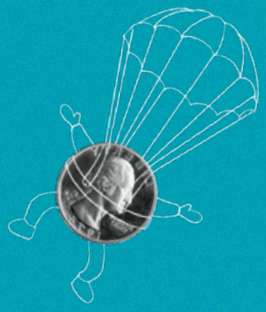
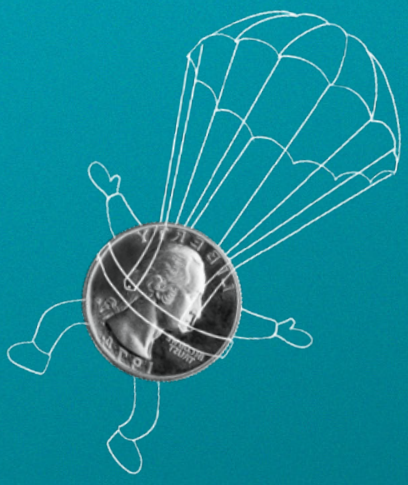


Resumen

El objetivo de la presente investigación fue medir el impacto de los componentes de la demanda agregada, consumo e inversión, generado por cambios en los flujos de remesas que ingresaron al Ecuador en el periodo 2000-2020 empleando un modelo de Vectores Autorregresivos, a través de la función impulso-respuesta. Los resultados demostraron que las remesas disminuyeron el consumo de los hogares y la inversión público-privada en el corto plazo. No obstante, el impulso del flujo de remesas que ingresaron al país en el periodo analizado, incrementó ambas variables, tanto en el mediano como en el largo plazo. Concluyendo así que, los hogares receptores de remesas, una vez que reciben este ingreso de sus familiares, tardan en tomar una decisión sobre el destino que le darán, por lo que su consumo no se adapta ni se modifica en los primeros trimestres, sino con el paso del tiempo, cuando pasa a ser utilizado para el gasto final de los hogares.

Palabras clave: VAR, remesas, demanda agregada, consumo de los hogares, inversión.





Introduction

It is relevant to analyze the effect of remittances on production and investment in Ecuador, due to the economic and social repercussions that currency flow has on agents of the national economy. One of the main reasons to research the effect of remittances on consumption and investment is because through the years and nowadays, are a vital source of financing, having such an important impact on the Ecuadorian economy; which gives it revitalization and liquidity for production activities.

Remittances are an important factor for the economy in present and previous years, above all the 2000s, because there was an abrupt increase in migratory waves. In the second trimester of 2022, remittances exceeded any value recorded ever in the country's history, reaching $4,743 million; which is 8,73% higher than recorded in 2021 of $4,362.63 million (BCE, 2022).

According to the Central Bank of Ecuador (2004), since dollarization in 2000, the flow of remittances received has grown annually. During 2004-2007, remittances were between 5-7% of GDP (Ruso et al. 2020), proving to be a significant flow for the Ecuadorian economy.

However, in 2009 the world suffered the consequences of the real-estate crisis in the U.S., and Ecuador, wasn´t the exception. Being a country where GDP depended mainly on raw exports, the demand contracted due to the consequences caused by the crisis in developed countries, especially the United States and Spain, where most Ecuadorian migrants are settled (Sotomayor et al. 2019).

For almost ten years, remittances represented the second most important item from abroad, only below raw oil (BCE, 2017). The destination of remittances can be used as a tool for the definition of public policies and gives information about households´ behavior since it can influence their consumption decisions.

Another important event to mention is the Covid-19 pandemic, which had a negative impact on the world economy. Despite this fact,

the level of remittances received to the Ecuadorian economy in 2020 was USD 3,337.8 million, around 100 million additional dollars, compared to 2019 (BCE, 2020). This could be mainly due to two reasons; the first is that the pandemic caused an impressive increase in the migratory waves of Ecuadorians, who sought better opportunities to survive the economic crisis, in countries such as Mexico, Spain, and the United States. The other reason is due to the gradual recovery of the last quarter of 2020, in the developed economies, which was clearly reflected in an increase in the sending of remittances, as well as the stimuli sent by the United States in the context of the pandemic (Andrade, 2021).

Likewise, identify the degree of reaction or sensitivity of these flows, concerning public-private investment, bringing with it sources of employment, productivity, and improvement of living conditions.

Some studies like Romero et al. (2020), Castañeda (2021), and Salazar (2021), relate Ecuadorian remittances to GDP, consumption, or investment, through weightings of percentages in which this volume of foreign currency is allocated; however, the degree of reaction generated by remittances concerning each of these variables is not determined. It is taken for granted that consumption is more affected by a change in the flow of remittances, but this fact is not corroborated by empirical evidence.

In this research, the Vector Autoregressive Model (VAR) was used, through the impulse-response function, to identify the reaction of consumption and investment, when the flow of remittances generates an impact on these variables; in the short, medium and long term, when there are changes in the volume of workers' remittances that enter the Ecuadorian economy.

Literature review

Over the years, the impact of remittances on different macroeconomic variables in various countries around the world has been investigated. The importance of studying their behavior is reflected in their economic and social incidence, not only in those nations that depend on this flow of currency but also internationally, due to their notable migratory component. Therefore, to analyze the effect that remittances have on consumption and investment, it is necessary to carry out an approach to the different investigations that have been executed, so that it is possible to identify results.

Impact of remittances on consumption and investment

According to González et al. (2009), remittances had a positive impact on the quality of life of thousands of Ecuadorian households, at the same time that they boosted various sectors of the economy, such as agriculture, commerce, construction, telecommunications, transportation, among others; which contributed to the creation of new jobs. Therefore, if the evolution of remittances is analyzed from an investment perspective, these become a key factor for the economic growth of a country to be sustainable over time. Remittances represent an injection of money for the popular economy so that to a certain extent they reduce the pressure on the State, concerning the application of social programs to appease poverty and lack of job opportunities within the country.

Regarding research in emerging economies, Démurger and Wang (2016) identified the extent to which remittances had an effect on consumption patterns in China. These authors included total household spending in their analysis, which was not found to be related to housing issues, in the years 2001 and 2004. In order to meet the objective of the study, they used household spending as the dependent variable, and as independent variables: remittances, income from local employment, and

other net income. The remittances were used in three different equations to measure the impact of each of them.

Regarding developing African countries, Randazzo and Piracha (2018), conducted research in Senegal, in which they sought to find out if remittances had an impact on economic development, and on how they were spent or used by recipient households, during 2009-2010. The authors used household marginal spending as the dependent variable and remittances, household size, and a dummy variable to indicate the presence of children and the elderly as independent variables. It was found that those households that received remittances spent more of this money on education and on more productive activities, such as investment in human capital, rather than on consumption. This is because, for these families, remittances were considered temporary income.

Within the same context, Kakhkharov et al. (2020) identified the effect of remittances from international migrant workers on household expenses in Uzbekistan, in the years 2013 - 2014. The consumption of food and non-food items, education, and health were taken into account as independent variables. In the same way, it was observed that the households that received remittances allocated a greater part of their total expenses to non-food consumption.

Samaratunge et al. (2020) studied the impact of international private remittances on household consumption in Sri Lanka, using a Logistic Regression Model for the year 2016. The results of this research were similar to those of Khan et al. (2019), who based their study on India, Sri Lanka, Pakistan, Nepal and Bangladesh. In parallel, Dash (2020) included in his research, in addition to the five countries previously mentioned, the Maldives. In these three studies, it was observed that remittances significantly increased household per capita spending; in addition to promoting certain positive changes, concerning household spending allocations, to cover their basic needs.

Pratikto et al. (2020) determined whether remittances contribute to an increase in household investment in Indonesia, using the Ordinary Least Squares and Probit Methods, during the period 2017-2019. The dependent variables of each proposed model were consumption and investment spending, while for the independent one, income from remit-

tances. They showed that if the flow of remittances increases, this will increase the consumption and/or investment of families. Likewise, the use of remittances for investment had a multiplying effect on consumption.

Analyzing underdeveloped economies, which are similar to the Ecuadorian, Barahona and Veres (2020) carried out a study of the remittances of Peruvian migrants residing in Chile, during the period 2005-2014. The investigation showed that the migration of Peruvians has a social and economic component, as well as that the spending of Peruvian households increases significantly when the Gross Domestic Product of Chile does as well.

In the Latin America context, Zarate-Hoyos (2022) studied the impact of remittances on macroeconomic variables in Peru for the period 1992-2017, using a VEC model. It is interesting to mention that only remittances received from Peruvian migrants living in the United States were used. The results of the investigation showed that the behavior of Peruvian households has a high correlation with the flow of remittances sent from their migrant relatives.

Schutt (2020) prepared an article on money transfers between economies, using remittances from Colombia as a proxy variable, to study the effects of an increase in a household income economy. The most interesting finding of the research was the strong relationship between remittances and the hours worked by members of households where a family member decides to migrate: the higher the volume of remittances received, the fewer hours worked, this does not mean that they stop working.

Application of VAR to the study of remittances

There are several ways to examine the connection between remittances, consumption, and investment. However, the Autoregressive Vector Model is particularly fascinating to study. In their research, Islas and Moreno (2011) sought to investigate the factors that influence remittances, the routes through which they are transferred, and the effects they have had on Mexico from 1980 to 2008, based on quarterly time-series data. This research used family remittances as the dependent variable

and U.S. and Mexico GDP as the independent variables. The findings indicated that the link between remittances and migration was negative due to the extended duration of migration to the United States.

Anarfo et al. conducted a thorough study in 2020 on the correlation between financial inclusion and migrant remittances in sub-Saharan Africa from 1990 to 2014. The research utilized the Panel Autoregressive Vector Model (VAR) to evaluate the impact of various independent variables on remittances, such as the GDP per capita growth rate, the progress of the financial sector, and an amalgamated index proxy variable for financial inclusion. The authors opted for the Panel VAR methodology to analyze the causal relationship between financial inclusion, remittances, economic growth, and financial sector development. Additionally, the approach accounted for country-specific fixed effects and resolved endogeneity issues.

In the Ecuadorian panorama, Romero et al. (2020) carried out a study on the behavior of remittances and their impact on investment, applying a VAR model. In this study, the flow of remittances was considered as an independent variable and Gross Fixed Capital Formation as a dependent one, also assuming that the latter is endogenous to the model. As Castañeda (2021), who calculated an impulse-response function, the results suggested that, in the short term, remittances had a negative impact on investment in Ecuador, since this money was initially destined to meet the needs of families through their consumption. However, in the long term, remittances had a positive impact on investment, since, after meeting the consumption needs of households, they became capital generators.

Likewise, this investigation showed that remittances explained the behavior of the final consumption expenditure of households by 30.92% and the Gross Fixed Capital Formation by approximately 25.32%, demonstrating that remittances had a notorious effect on private consumption, compared to investment, in the Ecuadorian economy.

Similarly, to complement the elasticity analysis presented in the results section, we considered studies that used autoregressive models.

This is the case of Franco and Lama (2019), who measured the impact of international remittances on private consumption in Peru during the period 1990-2017. The methodologies implemented in this research were Vector Autoregressive Models (VAR) and Vector Error Correction (VECM). Additionally, the Johansen Cointegration Test was used to measure the sensitivity of the variables studied. The results showed that 53% of the changes caused in Peruvian private consumption were explained by the behavior of the remittance flow.

Hernández and Toledo (2020) analyzed the impact of remittances on imports of capital and consumer goods in eight Latin American countries. These authors applied the Cointegration Test and a VEC Panel Model, during 1992 - 2004. They placed remittances as the dependent variable and capital imports, merchandise imports, consumer goods imports, and intermediate goods imports as independent variables. At the end of the investigation, it was possible to show that, in the long term, remittances were important for the dynamics of capital and consumer goods imports.

However, the elasticity measured concerning this type of income was much lower in the case of goods purchased for daily consumption, as the percentage increase in remittances resulted in an increase in consumer goods of only 0.29%. This reflects a much lower sensitivity than that registered for capital goods, which increased by 3.57%, before slight percentage increases, due to the flow of remittances in this economy.

Methods

The present study was descriptive in that it aimed to observe and analyze the behavior of consumption and investment in light of the changes in the flow of remittances. In addition, the focus of the study was quantitative, since an analysis of numerical data was carried out to build an econometric model.

It is important to note that workers' remittances were not available in constant values, so the dependent variables were expressed in nominal values and thousands of dollars. However, to reiterate the rigor and care with which the data for this research has been processed, it is necessary to mention a transformation in the Household Consumption Expenditure and Gross Fixed Capital Formation database, transforming the data from thousands to millions of dollars. This modification has been carried out, was done to ensure that all the information is in the same unit of measurement, and can be used properly. After the construction of the corresponding database, 84 observations were obtained, which were used within the proposed models.

In addition, taking as a reference the publication of the Central Bank of Ecuador (2014), in collaboration with the Latin American Faculty of Social Sciences (FLASCO), as well as the study by Padilla (2015), it was decided to express the variables under study as proportions of GDP, in order to enrich the analysis, provide more information to the model, and minimize econometric problems that could arise later in the research. The data on Gross Domestic Product was obtained by entering the Real Sector of the ECB (2021a), in the Quarterly National Accounts, within the GDP account. It should be noted that this variable was only included to compare the weight of the other three on the national production of the country, but it was not included in the model as it could cause multicollinearity problems, so no in-depth interpretation of it was carried out. It is included in the research results section.

The research used data from the Statistical Information Microsite on the website of the Central Bank of Ecuador. Time series data were considered. These were representative at the country level, for the period 2000 to 2020, expressed at a quarterly frequency. The study included these two decades in its analysis, as from 2000 Ecuador was dollarized, so the data presented until 1999 were still subject to exchange rate conversions, and their interpretation was therefore modified. Similarly, the year 2021 was not taken into account, because no availability of these data was found.

For the variable of workers' remittances, the information was obtained from the ECB's External Sector, in Results of the Balance of Pay-

ments, within the Current Transfers account (ECB, 2021b). Remittances are expressed in millions of dollars and nominal values.

In the case of the household consumption variable, the data were obtained in the Real Sector section of the Quarterly National Accounts, specifically in the BCE Household Final Consumption Expenditure account (2021a). Regarding investment, Gross Fixed Capital Formation (FBKF) was considered as a proxy variable, following Sánchez et al. (2019) and Salazar (2021). According to the ECB (2021d), the GFCF refers to a country›s investment, which is represented by the variation in public and private non-financial fixed assets, in a given period of time. The information was obtained in the Real Sector from the ECB, in Quarterly National Accounts, within the Gross Fixed Capital Formation account.

VAR Autoregressive Vector Econometric Model

In the present research, an econometric model of autoregressive vectors (VAR), proposed by Sims (1980), was constructed. According to Gujarati (2015), the VAR model is a system of dynamic equations through which the relationship between certain economic variables is studied, along with a valid representation of the past and present relationships of these variables. This model allows us to visualize how the change in one variable affects the behavior of the others. In turn, it assumes that all the variables are endogenously determined, i.e. they are interrelated, integrating the simultaneity criterion between variables.

The reduced form of a VAR model is expressed through the following equation:

$$YT=A0+pi=l\ AiYt\text{-}i+\ t\ (1)$$

Where Yt is the vector of K endogenous variables; Ai is the KxK matrix of lag coefficients i of the endogenous variables and εt is the vector of residuals that have a white noise process, with mean zero and variance Σ (εt ~ N (0, Σ)). According to Garcia et al. (2017), in a VAR model, all the variables are treated symmetrically and are explained by their past. Furthermore, the model has as many equations as there are variables. The autoregressive term refers to the presence of the lagged value of the dependent variable, on the right side of the model. On the other hand,

these are models with a vector of two or more variables.

The VAR model is defined by the following equations:

LOG Consumption= B0+ LOG Remittances + LOG Remittances (t-1) + ut (2)

LOG FBKF= B0+ LOG Remittances + LOG Remittances (t-1) + ut (3)

In the equations previously presented, it has been demonstrated that the independent variable is remittances, and the dependent variables are consumption and investment, respectively. The implementation of the VAR methodology is supported by studies such as those by Islas and Moreno (2011), Jordán (2014), Romero et al. (2020), Anarfo et al. (2020), and Castañeda (2021), who studied the relationship between remittances, consumption and investment, through the impulse-response function, which provides an interpretation of the results of the autoregressive vector through an analysis of the response provided by the response variable, in the short, medium and long term, based on the impact behavior of the explanatory variable (Novales, 2017).

In this way, it is possible to justify the use of this model, as well as the variables mentioned throughout this investigation, since the impact of the independent variable on each of the dependent variables can be identified in isolation, basing the analysis on each of the equations previously presented.

Before estimating an econometric model that incorporates time series, it is imperative to perform specific assessments. Among these assessments is the examination of the variables' stationarity, which refers to their ability to remain consistent over time with a consistent mean and variance. To verify this, the Dickey Fuller unit root test was conducted.

Results

This section describes the results of this research. To begin with the analysis of the empirical results, the estimation of both models is presented, together with the graphs of the impulse-response function, emphasizing the interpretation of the behavior of the variables.

Lag Analysis

The autoregressive vector model uses lags to determine the influence of the independent variable throughout the evolution of the dependent variables. For this reason, it is necessary to calculate the optimal number of lags so that the model estimate is as accurate as possible and degrees of freedom are not lost.

Table 1

Optimum lag of VAR Consumption and Remittances

lag	AIC	HQIC	SBIC
0	-14,331	-14,305*	-14,267*
1	-14,238	-14,162	-14,047
2	-14,260	-14,134	-13,942
3	-14,324	-14,147	-13,878
4	-14,499	-14,271	-13,925
5	-14,506*	-14,227	-13.8049

To find the optimal number of lags, the information criteria specified in the methodological apparatus were considered. Table 1 shows

that the optimal number of lags for the VAR model between the remittances and consumption variables is between 0 and 5. This means that it is feasible to lag up to 5 quarters, representing one year and three months, within the period analyzed in this research.

Table 2

Optimum lag of VAR FBKF and Remittances

lag	AIC	HQIC	SBIC
0	-15,964	-15,939*	-15,901*
1	-15,963	-15,887	-15,772
2	-15,943	-15,816	-15,624
3	-15,985	-15,808	-15,539
4	-16,010*	-15,782	-15,437

To estimate the VAR model for Remittances-FBKF, we follow the same process. To determine the optimal number of lags, we considered the information criteria mentioned in the methodological apparatus. Therefore, it was possible to establish that the optimal number of lags is between 0 and 4. This means that for Gross Fixed Capital Formation it is possible to lag up to four quarters, equivalent to one year, within the period studied in this article.

Estimation of the VAR and Impulse-Response Function models

Since it is a multivariate time series model, two different estimates were obtained; the first reflects the impact of remittances on consumption behavior, and the second, the same impact produced by the income

of remittances to the Ecuadorian economy, on public and private investment, represented by the FBKF (see Annexes 1 and 2).

Figure 1

Impulse-response function Consumption and Remittances

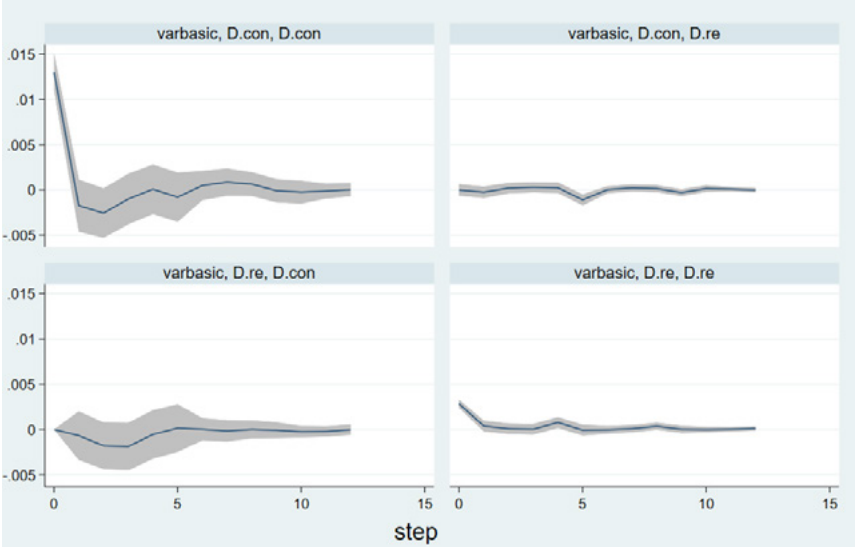


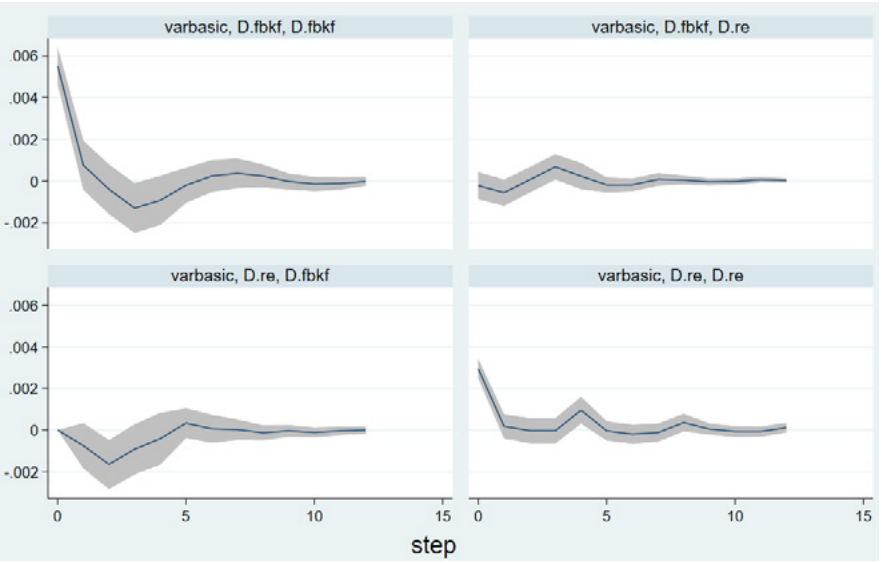
Figure 1 shows the impulse response function of the VAR model between Consumption and Remittances. In the lower left quadrant, it was possible to observe that, in the short term, (which includes until approximately the second quarter of the year 2000), there was a greater dispersion of the data.

A greater volatility was evidenced in the response of the consumption with the arrival of remittances from migrant workers. In addition, this graph shows how, in the face of a boost in the flow of remittances, consumption fell slightly. The economic implication of this result is due to the fact that the households receiving remittances did not immediately adapt to the new income represented by remittances, but instead considered different options to allocate the money received; therefore, they may have saved this family income.

Once the households got used to the new family disposable income, consumption stabilized in the medium term, (same as from the second to the fourth period), so it could be said that consumption became constant. The most pronounced effect in the face of a remittance shock (from the third to the fifth period) could be observed in the long term, when consumption increased, in response to the increase in the flow of remittances, due to the fact that the recipient households they adapted to this new income that they received, sent from abroad, and began to allocate it to consumption.

Figure 2

Impulse-response function FBKF and Remittances



In the lower left quadrant, it can be seen that, in the face of a shock to remittance flows, the FBKF was negatively affected in the short term, as investment fell slightly. However, in both the medium and long term, the impact of the remittance flow caused a slight increase in Ecuadorian public and private investment, up to a point where the FBKF managed to stabilize and its impulse response became constant.

The negative response of Ecuadorian investment is interesting, given the impetus provided by workers' remittances. The explanation derives from what happened to consumption. Households that receive remittances will first save the new income they receive until they get used to it, and then allocate it to consumption. For this reason, in Ecuador, it is not typical for households that receive remittances to allocate that money towards productive ventures for the nation. On the contrary, in most cases, this income is used to cover their basic needs and improve their living conditions.

However, without proper financial education and facing challenges in starting a business, households may rely solely on remittances from their migrant relatives.

Discussion

The impact of remittances on different macroeconomic variables has shown a variety of results, depending on the type of economy studied and the variables included in the models.

The results of the investigation showed that an increase in the flow of remittances in the short term caused a negative response in household consumption and investment in the Ecuadorian economy from 2000-2020, that is, the consumption and investment decreased until the second period analyzed.

These results coincide with what was stated by Romero et al. (2020) and Castañeda (2021), who carried out a VAR model to measure the impact of the same variables in Ecuador, in the period 2000-2019, in the case of Romero et al. (2020), took only consumption as an independent variable in their research. Both in the research presented and in that of the authors, it can be seen how in the long term (from the third to the fifth period) consumption increases exponentially. In the case of the be-

havior of the investment variable, given its impulse-response function, it agrees with what was stated by Castañeda (2021), both in the short term as already explained above, as well as in the medium and long term. In this context, it was observed that the FBKF variable had a pronounced growth.

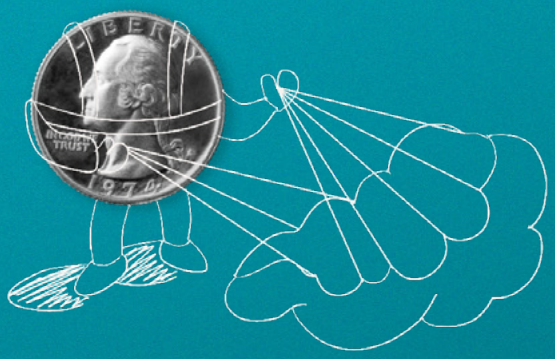
The exogeneity of the variable in the model proposed in this research is contrary to what was presented by Islas and Moreno (2011), Franco and Lama (2019), and Anarfo (2020), since they considered remittances as an endogenous variable, determined in the proposed econometric model, and consequently caused by household final consumption expenditure and financial inclusion.

The authors found an inverse relationship between migration and household consumption in the long run. This may be a valid reason for the differences between the results obtained by these authors and those presented in this article. However, it is clear that in the economies that are developing or that have a strong dependence on the flow of remittances received from workers, this variable is exogenous to the models proposed; since, although it influences the behavior of consumption and investment, it does not represent one of the determining factors for the existence of said variables.

Randazzo and Piracha (2018) applied a different methodology, with a Lesser Model. On the other hand, Hernández and Toledo (2020) used an Autoregressive Vector Model for Latin American countries but obtained different results from those obtained in this study. This is because the authors used capital goods and household consumption as dependent variables, while our dependent variables are gross fixed capital formation and household consumption. These differences can be explained by the changing behavior of remittances, which, in most cases depends on the type of economy being analyzed.

Conclusions

International remittances from workers represent one of the most important sources of foreign currency that enters the Ecuadorian economy since they directly contribute to the increase in the income of family members who remain in the country. Similarly, in most cases, they alleviate the budgetary constraints of the most economically vulnerable households, thus improving their average living conditions. The objective of this study was to measure the elasticity between the components of aggregate demand, consumption, and investment, in the face of changes in the flow of remittances in Ecuador from 2000-2020. To fulfill this purpose, an Autoregressive Vector Model and a Log-Log Model were applied to determine the degree of reaction and the sensitivity of consumption and investment.



By analyzing the impulse response function between the variables, the results show that remittances reduced consumption and investment in the short run. However, they increased both variables in the medium and long term.

This may be because remittance-receiving households, once they receive this income from their relatives, take time to decide on the destination to which they will give it so that their consumption does not adjust or change in the first quarters, but with time when it starts to be used for the final household expenditures. The investment case is different; since households with migrant family members are usually poor and in need, which are precisely the reasons that led them to leave their country of origin, it is logical that they use the volume of remittances received to cover their daily consumption, and the simple idea of investing this money in family businesses, communities, in the financial or business system remains in the background; Therefore, investment has increased only a little.

Previous studies conducted by Démurger and Wang (2016) and Kakkkharov et al. (2020) present findings that contradict the results of this study. According to their research, a rise in remittances received by an economy corresponds with an increase in both the consumption of recipient households and investment levels. It is worth noting that this disparity may be because in other emerging economies, unlike Ecuador, remittances have a favorable effect on the investment behavior and savings levels of its residents.

On the other hand, Kakkkharov et al. (2020) used household consumption as an independent variable and the flow of remittances as a dependent variable. For these reasons, the results between the present article and those previously mentioned differ.

Another contradiction with the findings of this study is according to the authors, Pratikto (2016), Xie et al. (2019), Githaiga (2020), and Mendoza (2021), who found that remittances contributed to a significant increase in both household consumption and public and private investment in a country, throughout the entire year.

On the other hand, in the results obtained within this investigation, in the first two periods, (referring to the short term), an inverse relationship is observed in both consumption and investment, in relation to the flow of remittances. However, among the discoveries of the authors, as well as those obtained within this research in the long term, they demonstrated that an incentive in the flow of remittances increased the investment of the households that received them.

Based on the previous analysis, it is important to reiterate the significant contribution that remittances make to the Ecuadorian economy, promoting economic growth by increasing the Gross Domestic Product. This serves as a determining factor for private household consumption, as well as a generator of investment in physical and human capital goods and productive and industrial activities in the country, although the latter is to a lesser extent than its contribution to consumption. It is important to note that remittances are currencies without an economic counterpart, and are one of the most significant items in current transfers for the Balance of Payments. For this reason, it is crucial to determine the impact of remittance flow when it enters the Ecuadorian economy.

To accurately determine the impact of workers' remittances on aggregate demand, further research should explore how other components such as public spending, exports, and imports react to percentage variations. The inclusion of variables like real exchange rate and Gross Domestic Product will also help measure the short, medium, and long-term effects of remittances on economic growth. Moreover, analyzing public policy proposals can provide valuable insights.

Remittances represent a financing source for thousands of Ecuadorian households. Due to the different economic crises that the country has gone through, family members chose to seek job opportunities abroad. That is why, it is recommended that the Ecuadorian government take such behavior into account in the development and execution of social assistance programs and projects. This will enable them to support and provide necessary guidance to households that receive aid, allowing them to benefit from financial education and make better use of the remittances sent by their relatives. By doing so, it can lead to an improvement in the quality of life.

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Annexes

Annexe 1

Estimation of VAR Model Consumption and remittances

Vector autoregression

Sample: 2001q3 - 2020q4		Number of obs	=	78
Log likelihood =	575.0101	AIC	=	-14.17975
FPE =	2.39e-09	HQIC	=	-13.91365
Det(Sigma_ml) =	1.35e-09	SBIC	=	-13.51503

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_con	11	.014028	0.1176	10.39395	0.4066
D_re	11	.003055	0.2638	27.9482	0.0018

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_con						
con						
LD.	-.1342056	.1122138	-1.20	0.232	-.3541406	.0857294
L2D.	-.2217448	.1019122	-2.18	0.030	-.4214891	-.0220005
L3D.	-.1454315	.1056054	-1.38	0.168	-.3524143	.0615512
L4D.	-.0697383	.1036957	-0.67	0.501	-.2729781	.1335014
L5D.	-.0962031	.1030297	-0.93	0.350	-.2981376	.1057313
re						
LD.	-.2410113	.4825877	-0.50	0.617	-1.186866	.7048432
L2D.	-.6357817	.4624036	-1.37	0.169	-1.542076	.2705127
L3D.	-.7148475	.4619346	-1.55	0.122	-1.620223	.1905275
L4D.	-.3452548	.4710065	-0.73	0.464	-1.268411	.5779011
L5D.	-.0952901	.4908889	-0.19	0.846	-1.057415	.8668345
_cons	-.0031339	.0016084	-1.95	0.051	-.0062862	.0000185
D_re						
con						
LD.	-.0203704	.0244362	-0.83	0.404	-.0682646	.0275237
L2D.	.014265	.0221929	0.64	0.520	-.0292323	.0577623
L3D.	.0178783	.0229972	0.78	0.437	-.0271953	.0629519
L4D.	.0182262	.0225813	0.81	0.420	-.0260322	.0624847
L5D.	-.0751444	.0224362	-3.35	0.001	-.1191186	-.0311702
re						
LD.	.1340549	.1050907	1.28	0.202	-.071919	.3400289
L2D.	.0044588	.1006953	0.04	0.965	-.1929003	.2018179
L3D.	-.0073515	.1005931	-0.07	0.942	-.2045105	.1898074
L4D.	.2716738	.1025687	2.65	0.008	.0706428	.4727048
L5D.	-.0772894	.1068984	-0.72	0.470	-.2868064	.1322276
_cons	-.000206	.0003502	-0.59	0.556	-.0008925	.0004804

Annexe 2

Estimation of VAR FBKF and Remittances Model

Vector autoregression

Sample: 2001q2 - 2020q4		Number of obs	= 79
Log likelihood = 646.9483		AIC	= -15.92274
FPE = 4.18e-10		HQIC	= -15.70645
Det(Sigma_ml) = 2.64e-10		SBIC	= -15.38287

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_fbkf	9	.005869	0.2361	24.41199	0.0020
D_re	9	.003135	0.1921	18.77966	0.0161

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_fbkf						
fbkf						
LD.	.1272641	.106918	1.19	0.234	-.0822913	.3368194
L2D.	-.1364042	.1062932	-1.28	0.199	-.3447351	.0719266
L3D.	-.2673856	.1051237	-2.54	0.011	-.4734243	-.061347
L4D.	-.1089432	.1066188	-1.02	0.307	-.3179122	.1000259
re						
LD.	-.2552655	.1866179	-1.37	0.171	-.6210299	.1104989
L2D.	-.5122733	.1945249	-2.63	0.008	-.8935351	-.1310114
L3D.	-.2472204	.2003243	-1.23	0.217	-.6398489	.145408
L4D.	-.2392113	.1974903	-1.21	0.226	-.6262852	.1478626
L4D.	-.2392113	.1974903	-1.21	0.226	-.6262852	.1478626
_cons	.0002984	.0006538	0.46	0.648	-.0009829	.0015797
D_re						
fbkf						
LD.	-.0991554	.0571028	-1.74	0.082	-.2110748	.012764
L2D.	.0289255	.0567691	0.51	0.610	-.0823399	.1401909
L3D.	.1051119	.0561445	1.87	0.061	-.0049293	.2151531
L4D.	.0075775	.056943	0.13	0.894	-.1040288	.1191837
re						
LD.	.0614205	.0996689	0.62	0.538	-.1339271	.256768
L2D.	-.0399596	.1038919	-0.38	0.701	-.243584	.1636648
L3D.	-.0566592	.1069893	-0.53	0.596	-.2663543	.1530359
L4D.	.3411035	.1054757	3.23	0.001	.134375	.547832
_cons	-.0001503	.0003492	-0.43	0.667	-.0008347	.000534

Annexe 3

Descriptive Statistics

Variable	Obs	mean	Std, Dev.	Min	Max	q.25	q.50	q.75
remittances	84	0.417	0.015	0.021	0.075	0.027	0.038	0.054
Consumption	84	0.638	0.047	0.583	0.743	0.600	0.617	0.671
FBKF	84	0.232	0.029	0.178	0.281	0.204	0.238	0.255

As can be seen in Annexe 3, the measures of central tendency showed that, on average, remittances represented 41.72% of Ecuador's GDP during the period analyzed. This result is important to highlight, since it reiterates the relevance of this variable, both for the measures of the country's economic growth, as well as for generating an increase and/or dynamism in its national production. Similarly, consumption stood at more than 60% in relation to GDP; This finding does not show anything new, because, thanks to previous statistical analyses, it is known that it is the component of aggregate demand with a greater weight or weight over the national product, precisely because it reflects the daily spending of Ecuadorian families.

Gross Fixed Capital Formation stood at 23.24% of Ecuadorian GDP on average, thus indicating that it is the variable that contributes the least to economic growth, compared to consumption. Another finding of the descriptive analysis was that remittances showed the lowest level of standard deviation; this means that, by expressing the variable as a proportion of GDP, it stabilizes and reduces its volatility, as well as its level of dispersion.

Annexe 4

Dickey Fuller test of variables in levels

Variable	p value
remittances	0.173
Consumption	0.627
FBKF	0.521

Annex 4 shows the results, for the p value, when applying the Dickey Fuller test to remittances, consumption, and FBKF. In all cases, the P value turned out to be greater than 5%, so the null hypothesis was accepted; indicating in this way, that the three variables are not stationary, and, consequently, that they have unit roots. For this reason, the first differences were applied to the three times series, for model estimation.

Annex 5

Dickey Fuller test of variables in first differences

Variable	p value
remittances	0,000
Consumption	0,000
FBKF	0,000

Once the first differences were applied, the analysis was similar to that previously exposed. Annex 5 shows that both remittances and consumption and the GFCF are stationary variables because the null hypo-

thesis is rejected, thus indicating that the time series does not have a unit root. In this way, it was possible to verify that the proposed model is stationary and stable, which means that it is statistically significant. Next, it was necessary to calculate the optimal number of lags for each equation, so that the best possible estimate could be obtained.