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FERTILITY AND MIGRATION

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JEL Codes: O11, J11, F22, F24

Keywords: Fertility, migration, remittances

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Fertility and Migration*

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May 16, 2022

Abstract

Over the past three decades, the drop in fertility rates has been accompanied by high rates of migration in several developing countries. We argue that migration affects fertility negatively in the countries of origin. To analyze the effect of migration we build a fertility choice model, based on De La Croix (2014), with endogenous migration decisions. In this framework, when a member of the household migrates abroad, income increases due to remittances but at the same time, individuals left at home face a much higher opportunity cost time. This means that household members have less time to devote to taking care of the children and the consequence is a decrease in fertility. We calibrate the model to match the migration rates and to quantify the effect of migration on the fertility rate in those countries. To this end, we first show that the model can replicate the high rate of migrations in several developing countries. Then we perform two counterfactual exercises to address the effect of our mechanism. In the first exercise, we keep the migration constant as in the benchmark model while we give a higher value to the time cost of migration. The result is an increase in fertility. In the second exercise, we quantify how the differences in the time cost of migration affect the differences in fertility. We found that the time cost of migration accounts for 53% of the fall in the fertility of the developing countries in our sample between 1990 and 2017.
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1. Introduction

In this paper, we document the existence of a negative correlation between migration and fertility by analyzing a large sample of developing countries. We argue that this correlation is the result of the opportunity cost associated with migration: when a family member emigrates abroad, individuals remaining at home face a higher opportunity cost with a consequent reallocation of household time. This reorganization of time leads to a decrease in fertility.

To show this argument, we build a model based on Delacroix (2014). In De la Croix model (2014) households care about their consumption, the number of children, and their education, and adult members of the household divide their time between working and taking care of the children. In our model, we further assume that individual adult members decide to migrate abroad. In this framework, migration generates two opposite effects on fertility. On the one hand, migration increases the fertility rate. When the salary abroad is more attractive than the local salary, the agents have an incentive to migrate, and the family left in the home country receives remittances. This increase in income, due to remittances, induces the household to increase the number the children, given they are normal goods. On the other hand, migration decreases the fertility rate through two mechanisms. The first mechanism is the substitution between children and education. Migration relaxes the household budget constraint via remittances. This causes the adults to increase the amount of education expenditure reducing directly the quantity of children. The second mechanism is a general equilibrium effect due to migration. When the migration takes place, the local labor supply decrease and, consequently, the local salary increases. Individuals who stay in the home country now face a higher local salary, but a lower salary level to migrate, which implies a higher opportunity cost to take care of children. This induces a change in the household time allocation choices that induces a reduction in fertility. Thus, the new critical elements in our paper are that the reorganization of the activities and the general equilibrium effect jointly induce the decrease in fertility.

From the theoretical point of view, our paper is in line with the literature. In Becker's publications on fertility (1960), he states that a couple gets utility from their consumption, the number of their children, and their quality producing a positive income effect on fertility, i.e. that family size increases household income. Children are viewed as durable goods also because they are seen as labor service providers. Furthermore, in another work, Becker extended his theory assuming that as income rise with growth and development, the demand for quality gets more elastic. This leads to an increase in the demand for quality, raising the cost of children and reducing their quantity (Becker and Lewis 1973). In another work, Mincer (1963) develops the theory that the variation in the number of children is due to the opportunity cost of the women's time as measured by the women's wage rate, which is negatively related to fertility. This has already progressed by Becker (1960) who associates the greater effect of technological progress on the productivity of women's time concerning domestic production, with the rising opportunity cost of time women spent in child-rearing. In another approach (Barro, Becker 1988) parents care about the future of their children but also their retirement. In this sense parents with lower incomes choose to invest less in their children while parents with higher incomes will invest in the optimal amount of human capital. Willis (1994) extends the work of Becker adding institutional context to the fertility transition. In more recent work, De la Croix and Doepke (2003) show that inequality and growth explain the differential in the fertility rate.

In the first part of the paper, we show empirical evidence of the negative impact of migration on fertility by controlling for different cofactors. In the second part, we build a general equilibrium model able to explain the empirical findings. In the third section, we calibrate the parameters of the model and we show that it can replicate the fertility pattern across countries. Based on this framework, we perform two quantitative exercises to analyze the role of migration on fertility.

In the first counterfactual exercise, we show what is the effect of the time cost to migrate on the fertility rate in the model. For this purpose, we raise the time migration cost. We found that a higher migration time cost is associated with a lower higher fertility rate. The intuition is the following: when people can't migrate due to a higher time cost, the working hours in the home country increase, while the intern salaries decrease. The consequence is that the birth rate increases since the opportunity cost of having children, in terms of wage, decreases.

In the second counterfactual exercise, we analyze what would have happened to the cross-country fertility differences if the time cost dedicated to migration had not changed. More precisely we observe a change in the differences in fertility across countries between the years 1991 and 2017. At the same time, the level of migration in the year 1991 compared with the year 2017 has increased. We argue that this increase in migration, measured as dispersion, is associated with the observed differences in fertility. To quantify how the differences in migration affect the differences in fertility among countries we first calibrate the model to replicate the distribution of fertility across countries in the years 1991 and the year 2017. Then, we simulate again the model using the economic information from 2017 but setting the value of the time cost of migration at the observed level in 1991 level for all the countries. The result of this counterfactual exercise indicates that the time cost of migrating in 1991, the fertility would have been 53% higher than the value of fertility with the time cost of migrating in 2017.

This result is due to the interaction between two effects: the first effect is associated with an income effect of remittances on fertility. Migrating now is more time costly, but the family left behind is still receiving the amount remitted in 2017, which is higher than the amount remitted in 1991. This led to an increase in household income. The second effect is associated with a substitution effect of migration on the opportunity cost of having children. Given that the time cost of migrating remains stable, the labor supply increases (more people working in the home country), and the intern wages decrease. In this case, the opportunity cost of having children, induced by migration is lower. This generates a substitution mechanism: given that the children are considered a normal good the households prefer to substitute quantity for quality of children, which means raising the fertility rate. Thus, in this counterfactual exercise, the sum of the income effect and the mechanism associated with the opportunity cost is larger than the effect associated with the education on fertility.

2. Empirical motivation

In this section, we show empirical evidence about the facts that motivate the paper. First, we want to show the negative relationship between fertility and migration. To do this we use data from World Bank, United Nation Population Division, WHO, and ILO for a large panel of countries. We pool the data of all countries from 1991 to 2017, and we filter out cross-country differences in level by regressing the fertility against the quadratic term of GDP per capita in dollars and country fixed effect.

Figure 2.1, panel a, shows the scatter plot of the share of migrants and remittances in a sample of 50 developing countries, over the period from 1991 to 2017. A more detailed description of the data and the countries are reported in the Appendix. The graph indicates a positive correlation between migration and remittances. The first motivations for migration from developing countries are generally linked to economic opportunities overseas and sharing part of this newly acquired economic opportunity with family members remained behind (Skeldon, 1997; Faist, 2000; Oda, 2004; Piper 2007; de Haas, 2010; Ullah, 2010; Adams et al., 2012; Rajan, 2012; Sirkeci et al.,2012). In these terms, remittance represents the most direct beneficial private transactions

Figure 2.1. Correlation between the stock of migrants, fertility and remittances

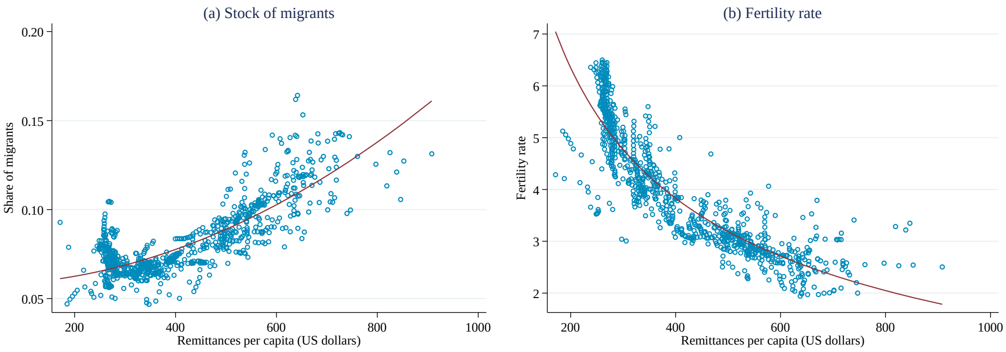
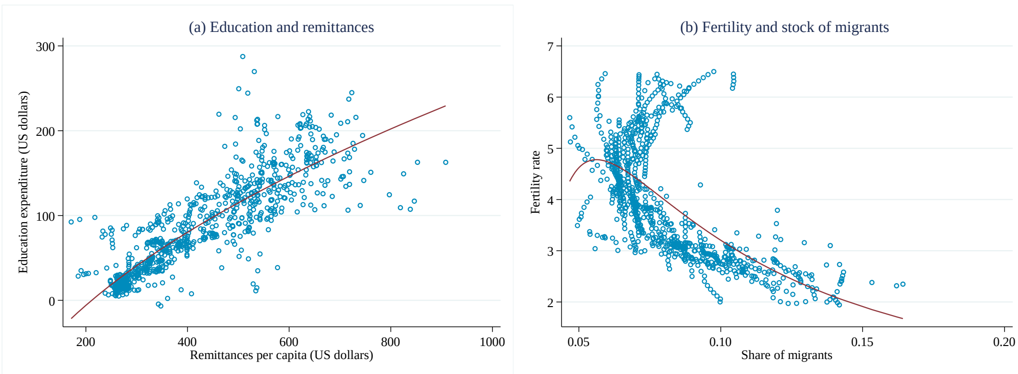


Figure 2.2. The negative correlation between fertility and number of migrants



in the global economy. At the same time, this transmission of money and the diaspora, have been accompanied by a decrease in fertility.

The Figure 2.1, panel b, is a scatter plot showing a negative relation of fertility and remittances. This decreasing relationship between the two variables suggests that money sent at home by these migrants is an important source for the left-behind households, but also has an impact on the households' reproductive behavior. This impact extends beyond the households that migrants left behind in their home countries As a consequence, Figure (2.2), panel a, show the positive correlation between education spending and remttances and Figure (2.2) panels b shows the negative correlation between migration and fertility rate. The issue of international migration linked with the fertility behavior of the migrants has been studied by Fargues (2007) as said in the introduction. He demonstrated that fertility rates, in three source countries, have been affected by the rates prevailing in their migrants' host countries. He concludes by assuming that the impact of host countries' fertility rates on those in migrants' home countries is the result of the transfer of behavioral norms from host to source country.

2.1. Data

In this section, we build a panel dataset (unbalanced) that contains data from WORLD BANK, ILO, UNDP, and WHO for 50 developing countries from 1991 to 2017. More precisely we use aggregate data on migration, remittances, expenditure in education, GDP per capita, and labor force participation of women.

We set as dependent variable birth per woman (FERTRATE), defined as the number of children that would be born to a woman if she were to live to the end of her childbearing years.

As explanatory variables, we use the share of emigrants (MIGRRATE), calculated as the ratio between the total migration and total population. Since several studies demonstrated that remittances have a negative impact on fertility, we added the log of remittances per capita (REMPERCAP) which represents the current transfers in cash or in-kind made or received resident households to or from nonresident households. The intuition is that remittances affect the budget constraint and expenditure behavior of the households left behind, decreasing fertility rates. Following Anwar and Mughal (2014), we control also contraceptives (CONTRACC), the mortality rate of children (INFMORTR), primary enrollment rate school (PRIMATOT), and health expenditure per capita (HEEXPFEM). The first variable reports the values of contraceptive prevalence (for any modern method and specific modern methods) as a percentage of married or in-union women of reproductive age; the second indicates the number of infants dying before reaching one year of age, per 1,000 live births in a given year. The third is the ratio of total enrollment, to the population of the age group that officially corresponds to the level of primary education. The fourth shows the current expenditures on health, goods, and services, per capita in current US dollars. All these four variables, contribute to lowering the fertility rate. Furthermore, as in Naufal and Vargas (2009), we control for the female labor force participation (FEMLABPART), calculated as% of the female population that is economically active. Finally, we control for GDP per capita (LOGGDPPP) and education expenditure (EDEXPEND), which refers to the current operating expenditures in education, including wages and salaries. Table 2 in the appendix displays the descriptive statistics of the variables used in the empirical analysis.

2.2. Estimation

To estimate this relation, we use cross-country analysis over time (panel analysis) to examine empirically the effects of migration on fertility. More specifically, we need a fixed-effects assumption to avoid systematic biases connected to unobserved characteristics that remain constant over years and might affect fertility. We think that the standard two–way fixed effects seem the more appropriate since the variables vary over time and across countries. For the estimation, we use the following specification.

$$Y_{it} = b + \beta X_{it} + \alpha_{it} + \gamma_t + \varepsilon$$

where Y_{it} is fertility of country i at time t, b is the constant term, β is a coefficient vector, and α_{it} and γ_t represent country and time fixed effects, respectively. The last variable ε_i, epsilon is the error term. The vector X includes all the regressors used in the estimations. The estimations were performed using four specifications to ensure the robustness of the results. In table 1 we display the estimation results of the relation between fertility and migration, controlling for other covariates. We can observe that migration has a negative effect on the fertility rate in all four specifications. This is consistent with previous studies of the relationship between migration and fertility. Jensen and al. (2004) find that, in the Philippines, fertility declines accompanying migration may be large enough to be explained by the effect of normative adaptation. Lindstrom and Giorguli-Saucedo

(2002) found that Mexico-US temporary migration of women reduces long-term household fertility. In the same way, Beine et al. (2008), argue that migration raises households' incentive in investing in the education of their children and so reducing fertility. In particular, in the first column, we estimate the effect of migration on the fertility rate controlling for remittances, GDP, female labor participation, infant mortality rate, and rural population.

Observe that the sign of remittances is negative, which means that they have a negative impact on the fertility rate of the home country. This suggests that a part of remittances could be spent on health services, and education, which contributes to decreasing fertility. The GDP is negatively correlated with the fertility rate as expected since poor countries tend to have higher levels of fertility than rich countries. More specifically, the sign of the quadratic term of the GDP implies that the curve is concave. Also, female labor participation has a negative impact on fertility because the more females participate in the labor force more high is the opportunity cost they have to face, and this lowers the fertility rates (Naufal, Vargas 2009). A negative relationship between the infant mortality rate and fertility is expected. In the second column, we added the level of current health expenditure.

For developing countries, the effects of expenditure on health care goods and services have a positive effect on fertility and, consequently, a negative on the infant mortality rate. In the third column, controlling also for contraceptives, we found an expected negative impact on the fertility rate. In the fourth column, the last term we check for is the ratio of total enrollment in primary school, which is negative, since a higher level of literacy tends to decrease fertility. In this sense, educated women become more skilled and the opportunity cost of bearing children become relatively high. This result was already obtained by Castro Martìn (2015) analyzing the relationship between women's education and fertility, confirming that school allows women to change reproductive choices. In the fifth column, we added the expenditure education, where the sign is negative. The effect of the educational investment of the government on fertility has been analyzed by DeCicca and Krashinsky (2016) who demonstrated that expenditure in education compress the fertility distribution and woman are less likely to have multiple children.

We argue that these results exist because the left of a member of the household implies a cost for the family. The intuition is the following: when a member of the family migrates abroad the available total time of the family is reduced, implying a reorganization of the activities inside of the household. In the next section, we built a theoretical model incorporating the time constraint of the household.

Table 2.1. Estimated effect of migration on fertility

VARIABLES	(1) FE (a)	(2) FE (b)	(3) FE (c)	(4) FE (d)
MIGRSHAR	-1.652**	-2.469**	-3.662***	-3.943***
	(0.827)	(1.042)	(1.179)	(1.150)
REMPERCAP	-0.0232**	-0.0316***	-0.0326***	-0.0313***
	(0.0106)	(0.0110)	(0.0117)	(0.0114)
LOGGDPPP	-5.463***	-6.409***	-5.993***	-5.689***
	(0.649)	(0.687)	(0.766)	(0.749)
LOGGDPPP^2	0.348***	0.410***	0.379***	0.359***
	(0.0393)	(0.0415)	(0.0464)	(0.0454)
FEMLABPT	-0.0116***	-0.00393	-0.00414	-0.00293
	(0.00274)	(0.00287)	(0.00312)	(0.00306)
INFMORTR	0.000312	-0.00851***	-0.0109***	-0.0109***
	(0.00159)	(0.00190)	(0.00214)	(0.00210)
HEEXPFEM	0.000199**	0.000296***	0.000415***	0.000213**
	(7.73e-05)	(7.43e-05)	(8.16e-05)	(9.38e-05)
CONTRACC		-0.0140***	-0.0143***	-0.0146***
		(0.00157)	(0.00164)	(0.00160)
PRIMATOT			-0.00274**	-0.00561***
			(0.00112)	(0.00131)
EDEXPEND				-0.00659***
				(0.00208)
Constant	26.37***	30.67***	29.83***	28.87***
	(2.762)	(2.936)	(3.270)	(3.194)
Observations	617	514	457	457
R-squared	0.843	0.868	0.865	0.873
Number of id	45	42	41	41
Country effects	YES	YES	YES	YES
Time effects	YES	YES	YES	YES
Interaction		YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3. The model

3.1. Households

The model based on De la Croix (2014), considers an economy populated by a continuum of agents with a mass of one. The agents live for childhood and adulthood and their decisions are taken when they are adults. Agents care about their consumption, the number of children, and their children's education. The utility function that represents the agents' preferences is:

$$U_t = \ln c_t + \gamma(\ln n_t + \eta \ln e_t), \tag{1}$$

where $\gamma > 0$ means the weight attached to children in the function, and $\eta\gamma$ represents the weight attached to their education, with $0 < \eta < 1$. Parents care about both child quantity and quality. The budget constraint for a single agent is about in terms of resources and time and it is represented by the following equations:

$$c_t = h_t w_t + \Pi + (R_t - \psi)m_t - e_t n_t, \tag{2}$$

and

$$1-\phi_n n_t = \phi_h h_t + \phi_m m_t, \tag{3}$$

where h_t is the share of household members that work at home country; w_{it} represents the salary in the home country. Π is the profit deriving from being the owner of a firm; R_t is the salary abroad while m_t and ψ represent respectively the share of household members that decide to migrate and the cost of sending remittances. The expenditure in education is indicated like e_t, while n_t the number of children. In the equation (3), the time endowment of the household is normalized to 1; The parameters ϕ_n, ϕ_h,and ϕ_m are the time cost of child care, work in the home country, and work abroad which are considered to be constant. As a result, the interaction between the parameters and the variables represents the share of total hours spent in child care, working in the home country, and migrating. Consequently, the household chooses the number of the children, the number of household members who work in the home country and abroad such that the agents maximize their utility subject to the equation (2) and (3). In Appendix A, we show that the solution of the household's problem is characterized by the following equations:

$$e_t = \frac{\eta}{1-\eta}\frac{\phi_n}{\phi_h} w_t, \tag{4}$$

$$c_t = \frac{1}{1+\gamma}\left(\Pi + \frac{w_t}{\phi_h}\right), \tag{5}$$

$$n_t = \frac{\phi_h}{\phi_n}\frac{1-\eta}{w_t}\frac{\gamma}{1+\gamma}\left(\Pi + \frac{w_t}{\phi_h}\right), \tag{6}$$

$$m_t = \frac{1}{\phi_m} - \frac{\phi_h}{\phi_m} h_t - \frac{\phi_n}{\phi_m} n_t. \tag{7}$$

We can see that the education of children depends on w_t, c_t and n_t are a function of the earning profit, while m_t depends from the profit wage, and the labor supply of the households. In equilibrium the labor supply in the home country will be determined by the following condition:

$$\frac{w_t}{\phi_h} = (R_t - \psi)\frac{1}{\phi_m} \tag{8}$$

The decision to migrate in this economy is given by w_t. The worker is indifferent to the decision to migrate if the labor income in the home country, applying the effort which corresponds to the worked hours abroad, is the same as the labor income abroad. If the labor income is higher in the home country with respect to the income abroad, the agent chooses to stay

3.2. Firm

Production of the consumption good is carried out by a single representative firm which operates the technology:

$$y = Ah^{\alpha}, \tag{9}$$

where h is the labor input, $A > 0$ represents the TFP, and the elasticity of the output respect to labor is $\alpha \in (0, 1)$. The firm solves the maximization problem:

$$\max_h \Pi = Ah^{\alpha} - wh, \tag{10}$$

choosing the amount of labor. From the first order condition we obtain the demand function of labor equal to:

$$h^d = \left(\frac{\alpha A}{w}\right)^{\frac{1}{1-\alpha}},$$

which implies that the profit is:

$$\Pi^{*} = (1-\alpha)\, A \left(\frac{\alpha A}{w} \right)^{\frac{\alpha}{1-\alpha}}.$$

4. Equilibrium

We define a competitive equilibrium as an allocation,{c,e,m,n,h}, and prices,{w}, such that I)consumers choose the quantity of the consumption, level of education, migration, numbers of children, and hours to work in the home country to maximize the (1), II) firms choose the quantity of labor demand to maximize 10, III) the goods and domestic labor markets are cleared. In this equilibrium the optimal demand of labor is:

$$h^{*} = \left(\frac{\alpha A}{w} \right)^{\frac{1}{1-\alpha}}, \tag{1}$$

Given this constant demand of labor, the household decision to migrate is:

$$m_t^{*} = \Delta_1 - \Delta_2 w_t^{-\left(\frac{1}{1-\alpha}\right)}, \tag{2}$$

and the amount of children is:

$$n_t^{*} = \Delta_3 + \Delta_4 w_t^{-\left(\frac{1}{1-\alpha}\right)}, \tag{3}$$

where $\Delta_1, \Delta_2, \Delta_3$ and Δ_4 are function of parameters which are showed in the appendix. The optimal choice of consumption and education are defined in the equation (5) and (4).

4.1. Comparative statics

Based on the previous equations, we find that migration causes two effects on fertility: income and substitution effect. The substitution effect prevails on the first, which entails a decrease in fertility. To examine the implications and the reduction in fertility we examine the partial derivatives of the equilibrium solution, in particular the solution of m and n. From (2) we have:

$$\frac{\partial m_{it}^{*}}{\partial R_{it}} = \frac{\Delta_2}{1-\alpha} \frac{\left[(R_t - \psi) \frac{\phi_h}{\phi_m} \right]^{-\frac{1}{1-\alpha}}}{R_t - \psi} > 0$$

where we substituted the wage using (8). This result shows that when the wage abroad increases and is higher that local wage migration increases, which is consistent with the empirical evidence in the previous section. From (3) we obtain that the effect of remittances on the fertility rate is:

$$\frac{\partial n_{it}}{\partial R_{it}} = -\frac{\Delta_4}{1-\alpha} \frac{\left[(R_t - \psi) \frac{\phi_h}{\phi_m} \right]^{-\left(\frac{1}{1-\alpha}\right)}}{R_t - \psi} < 0$$

The negative effect of remittance on fertility is explained by two mechanisms. The first mechanism is associated with the general equilibrium effect on the local labor market induced by migration. When migration takes place the local labor supply declines and as a consequence the intern salary increases. This is due to the internal equilibrium market to satisfy the firm demand for labor. As a result, the individual who stays in the home country faces up a higher salary but also a higher opportunity cost for raising children. The second mechanism is associated with an income effect deriving from the remittances due to migration: when the family receives the money, this relaxes the budget constraints and allows to expends more for the education of the children (and for the consumption). This implies that parents substitute the number of children with the quality, which means having fewer children but more educated. The migration process, in our model, boosts the quality-quantity pointed out by De la Croix (2014) through remittances. This increase in the opportunity cost of having children induces a reduction in fertility.

5. Quantitative analysis

5.1. Calibration

In this section, we present the strategy to calibrate the model's parameters to analyze the effect of migration on fertility. For this purpose, in this first exercise, we show that our model can replicate the observed fertility rate in the countries in our sample.[1] Our strategy consists of identifying first the parameters which are common to all the economies, and then those parameters which are specific to each country.

The first set of parameters is represented by $\{\gamma, \eta, \alpha\}$. We set the value of elasticity of the output with respect to labor, α equals to 0.53 which is the average value of the labor income share in the Penn World Table. Then we give a value of 0.08 to the weight attached to children in the household's utility, γ, and 0.64 to the elasticity of income to schooling, η. These two parameters are taken inside of an interval estimated by Delacroix (2014) which correspond to the upper limit of the estimated coefficient to match the median value of fertility rate for the poorest countries and the median value of the labor income share from the total sample, respectively.[2]

The second set of the country-specific parameters is represented by $\{A, \phi_h, \phi_m, \phi_n\}$. We set jointly the value for $\{A, \phi_h, \phi_m, \phi_n\}$ to match, the following targets: the GDP per capita, the share of migrants and the persons engaged in the home country as a fraction of total population, and the education spending as percentage of GDP. We take the average value of them for each country. To set the value of the remaining parameter, ψ, we assume that the cost of sending remittances is a fraction of the wage abroad and we approximate the value of the wage abroad using the average of remittances per migrant . In particular we take the value of cost sending remittances from World Bank, for every country of our database.

Note that $A, \phi_h, \phi_m,$ ϕ_n are calibrated given the exogenous wage abroad, R and the cost of sending remittances ψ. [3] The results are shown in the Figure 5.1, while the values of the calibrate parameters are reported in the table C.4 of the appendix. In Figure 5.1, panel (a), reports the existing correlation between the simulation of the model and the data. Note that the model replies in a very good way to the data since that most part of the simulated information are on the line of 45 degrees. [4]. The second result we obtain is in panel (b). We observe the relation between the stock of migration and the fertility rate of the model and of the data. The model replicates in a good way the correlation between these two variables. From these analyses, we conclude that the

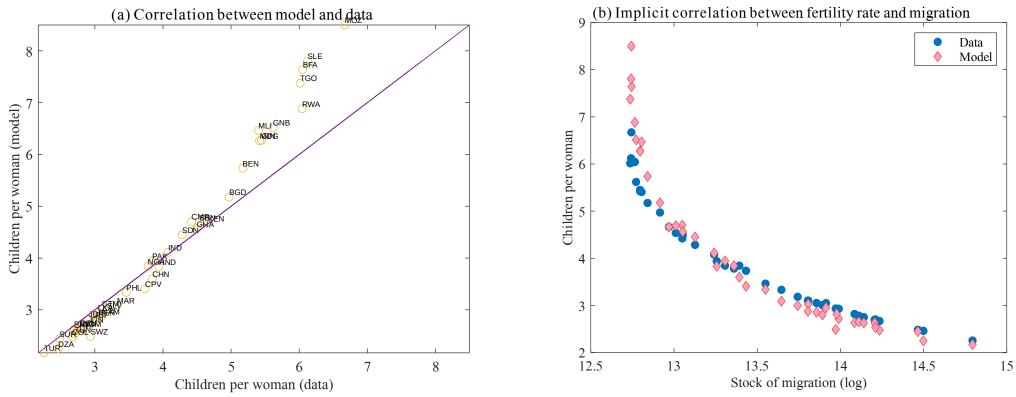
[1] Our sample consists of 42 countries described in the appendix. We focus on this group of countries given the available data on labor income share, cost of sending remittances, number of children per woman, migration stock, GDP per capita, GDP per worker, total remittances, and education spending per child.

[2] We compute the quartiles of income (GDP per capita, PPP) to calculate the median value of the fertility rate for the poorest country group.

[3] Moreover, in the appendix, we report how the model matches the targets based on this strategy. The four plots replicate the GDP, the migration rate, the labor in the home country and education of the model with the data

[4] The existing correlation between the data and the model is 0.98, although the model overestimates the value of some countries.

Figure 5.1. Non target moment: fertility rate



model can replicate the fertility pattern of the countries. As a consequence these results allow us to explore the impact of migration on fertility. For this purpose in the next subsection, we perform two exercises: in the first, we want to know what is the effect of the time constraint introduced by the migration process on fertility rate in the model. In the second exercise, we want quantify how much of the differences in fertility between countries is explained to the migration.

5.2. First quantitative exercise: effect of change in the time cost of migration on fertility

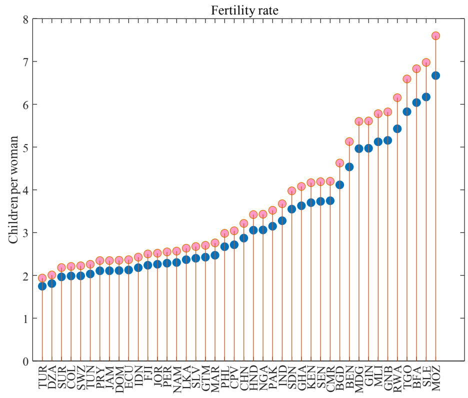
In this section, we compute the first counterfactual experiment. The purpose of the exercise is to answer the following question: what would happen to the fertility rate if the time cost of migration increased? To this end, we keep the migration constant as in the benchmark model while we give to ϕ_m a higher value. In particular, we assume that the cost to migrate abroad in terms of time ϕ_m, for the 42 countries, is a 20% more than the ϕ_m calibrated. The results of this exercise are reported in the Figure 5.2 and in the Figure C.2 in the appendix. In the Figure 5.2, we observe that the fertility rate increases in all the countries. In particular, the growth is higher in the countries with a higher number of children. In the C.2, we show that the labor supply increases at home (panel b), while the salary decreases (panel c). Simultaneously, the household stops receiving remittances which reduce the expenditure on education (panel d).

The intuition of these results is the following. Since family members can no longer go abroad because the time cost to migrate is higher, this implies that more people stay in the home country. Due to a lower opportunity cost, more people stay at home, so that the individuals have more time to take care of the children. At the same time, the number of people working in the home country increase implying a reduction in local wages. The second consequence is due to the trade-off between quantity and quality of children. Since the family is not receiving remittances, the total income decreases, so they cannot finance the education of children anymore. The sum of the two effects is that the fertility rate increase.

5.3. Second quantitative exercise: effect of migration to explain cross-country differences in fertility

Since the beginning of the 1990s, developing countries have been undergoing a process of demographic transition which has led to major changes in fertility levels (Lee, 2015; World Fertility Report United Nations, 2015). This difference in the number of children is reflected in

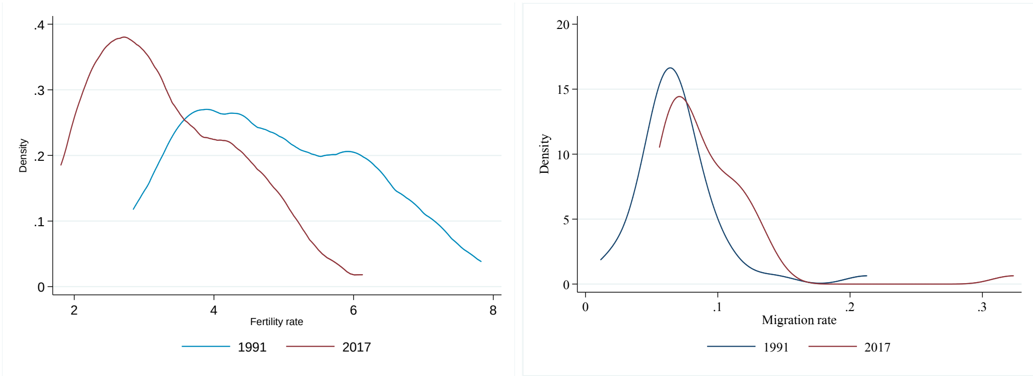
Figure 5.2. Changes in fertility rates due to changes in the time cost of migration



the distribution of our sample of countries that we analyzed before. Taking data about fertility in two different periods (1991 and 2017) for these countries, we observe that there is an important variation in the differences in fertility. In particular, the Figure 5.3 shows the distribution of fertility across countries in two different years. In 1991, the distribution of fertility (blue line) is characterized by a variance value around 1.6758, and the mean value of children was around 3.8. In contrast, in 2017, the variance and the mean value of the distribution function of fertility (red line) were around 1.06 and 2.5, respectively. Thus, the dispersion of fertility (measured by the variance) was higher in 1991 at around 60% than in 2017, while the mean value was around 50% higher in 1991 than in 2017. Simultaneously to this fact, the number of people migrating from their country of origin to another one has been grown dramatically in recent decades (Démurger, 2015). For the same periods and for the same countries we observe in the Figure 5.3 the level of migration of 1991 compared with 2017. The blue line of the year 1991 indicates that the dispersion is very low and around 0.5. On the contrary in 2017 there is a shift to the right of the red line making the dispersion higher. This suggests that migration has increased. We argue that this increase in migration, measured as dispersion, is associated with the observed differences in fertility. To assert and quantify how the differences in migration affect the differences in fertility among countries we do the following counterfactual exercise.

First, we calibrate the the parameters such that the model replicates the distribution of fertility across countries in the year 1991. We repeat the calibration and the simulation using economic information for the year 2017. We then simulate again the model using data from 2017 but setting the time cost to migrate, ϕ_m, at the observed level in 1991 for all the countries. The purpose of the exercise is to answer the following question: what would have happened to the cross-country fertility differences if the time cost to migrate would have not changed? The result of this counterfactual exercises is reported in the Figure 5.4 and in Table 5.1 while the parameters calibrated for the year 1991 and the year 2017 are reported in the appendix. Figure 5.4 plots the distribution of fertility in the year 1991 (blue line) and 2017 (red line) as in the Figure 5.3 and the counterfactual distribution (green line), generate by the model. The graphic analysis indicates that maintaining constant the time dedicated to migrate, the average number of children, and the dispersion would have been higher than the values of the year 2017 given that the distribution shifts towards right. Table 5.1. reports the differences in the average number of children according to the 90-10, the median, and the coefficient of variation between the years 1991, 2017, and

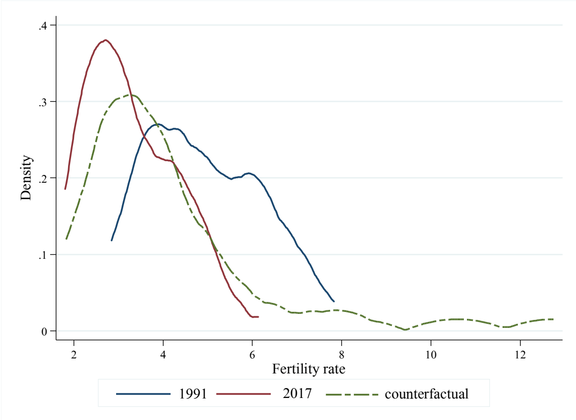
Figure 5.3. Cross-country differences in fertility: 1991 vs 2017



the counterfactual (2017).More precisely, we report, for every type of descriptive statistics, the simulated and actual data of the distribution of fertility.

In the first column, we see that the model replicates exactly the data of the year 1991. In the second and third columns are reported respectively the actual data of the year 1991 and the year 2017. Setting the value of migration of the year 2017 equals to the value of migration of 1991 we obtain the values reported in the fourth column. In the fifth and sixth columns, we report respectively the ratio between the actual data of 2017 and between the data of 2017 generated by the counterfactual exercise, to compare how the statistics changes. In the last column, we report the differences between the two ratios. With respect to the statistic 90-10, we notice that the value of the ratio between the values of the year 2017 with the actual migration data of 2017 is equal to 1.1639. The value of the ratio with the counterfactual data is 1.69. The difference between the two values is 0.53. This result indicates the difference between the countries that have the most children and the least children, with the share of migrants of 1991 the fertility would have been 53% higher than the value of fertility with the share of migrants of 2017. Regarding the median, we obtained a similar result. The values of the ratio between the values of the year 2017 are 0.66, while the value of the ratio with the counterfactual data is 0.77. The difference between the two values is 0.11, meaning that with the share of migrants of 1991 the fertility would have been 11% higher than the value of fertility with the share of migrants of 2017. For the coefficient of variation, the difference between the two ratios is 82%. These results suggest that the demographic transition of fertility would have been slower without the migration process through which these countries went through between 1991-2017.

Figure 5.4. Cross-country differences: actual vs contrafactual distribution



In our model, this result is due to the interaction between two effects. The first effect is associated with an income effect of remittances on fertility. In our counterfactual exercise, we set the share of migrants of each country to their reported values in 1991 instead of the share of migrants of 2017. Although fewer people migrate, the family left behind is still receiving the number of remittances of 2017, which are higher than the number of remittances of 1991.[5]. This implies an increase in the household income and consequently, this arise the fertility rate as the children are a normal good. The second effect is associated with a substitution effect of migration on the opportunity cost of having children. Given that the time cost dedicated to migrate does not change and more people stay in the home country, the labor supply increases (more people working in the home country), and the intern wages decrease. In this case, the opportunity cost of having children, induced by migration is lower. This generates a substitution mechanism: the households prefer to substitute quantity for quality of children, which means raising the fertility rate. Thus, in this counterfactual exercise, the sum of the income effect and the mechanism associated with the opportunity cost is larger than the effect associated with education on fertility. Our results suggest that migration is an important element to explain the cross-country differences in fertility.

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Table 5.1. Cross-country difference in fertility

					Ratios		
Statistics	Model	1991 (actual)	2017 (actual)	2017 (counterfactual)	2017-1991 (actual)	2017-1991 (countefactual)	Ratio differences (actual less) contrafactual)
90 - 10	2.10	2.10	2.45	3.58	1.16	1.69	0.53
Median	4.50	4.50	2.97	3.5	0.66	1.77	0.11
Coeffcient of variation	0.26	0.26	0.31	0.53	1.18	2.01	0.82

[5] In 1991 the average amount of remittances relative to GDP received was 8%, while in 2017 was 11%.

6. Conclusions

The objective of this paper is to examine the negative relationship between fertility and migration. To do that, we developed a model that allows us to quantify the role of migration on the reduction of fertility experimented by some developing countries in the last 26 years. We build a model based on the De la Croix framework of fertility choice (2014), including the time dedicated to migrating, working in the home country, and taking care of children. These elements have been left out of the analysis in standard macroeconomic models of fertility. In particular, we found that migration, through a general equilibrium mechanism, raises the cost opportunity to have children which induce a reduction in fertility. This mechanism explains the inverse relationship between fertility and migration that we observe in the data.

We perform two quantitative exercises to analyze and quantify the role of migration on fertility. In the first counterfactual exercise, we raise the time migration cost to show what is its effect on the fertility rate in the model. We found that a higher migration time cost is associated with a higher fertility rate. The intuition of this result is explained by the following mechanism: when more people can not migrate due to a higher migration cost, the working hours in the home country increase, while the intern salaries decline. Given that the household cannot finance the education of children anymore because is not receiving remittances anymore, the family decides to have more children. This implies implying a rise in the fertility rate due to a lower opportunity cost of having children.

In the second counterfactual, we analyze how important is the mechanism of general equilibrium induced by migration to explain the cross-country differences in fertility. We discipline the model to replicate the distribution of fertility across countries in the year 1991 and for the year 2017. Then, we simulate again the model for the year 2017, but setting the time cost of migration at the observed level of 1991 level for all the countries. Thus, in this exercise, we show what would have happened to the cross-country fertility differences if share of migrants had not changed. The results suggest that the difference between the countries that have the most children and the least children would have been 53% higher than the observed differences in fertility in 2017. Our results lead to these conclusions: migration is an important element to explain the evolution of fertility in a developing country and why some countries experienced more decrease in fertility with respect to other countries. In this sense, this paper contributes to the literature by providing a complementary mechanism to explain the demographic transition of developing countries.

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Appendix

A. Solution of the consumer problem

The consumers maximize the utility function subject to the budget constraint 2. The Hamiltonian present value associated to this maximization problem is:

$$\mathcal{L} = \ln c_t + \gamma \ln [n_t \pi_t (e_t)] + \lambda_1 [hw_t + \Pi + R_t m_t - \psi m_t - e_t n_t - c_t] + \lambda_2 [1 - \phi_h h - \phi_n n_t - \phi_m m_t] \quad (1)$$

The first order conditions with respect to c_t, n_t, e_t, m_t, and h_t, are,respectively,

$$\mathcal{L}_{c_t} \quad : \quad \frac{1}{c_t} = \lambda_1, \quad (2)$$

$$\mathcal{L}_{n_t} \quad : \quad \frac{\gamma}{n_{it}} = \lambda_1 e_t + \lambda_2 \phi_n, \quad (3)$$

$$\mathcal{L}_{e_t} \quad : \quad \frac{\eta\gamma}{e_t} = \lambda_1 n_t, \quad (4)$$

$$\mathcal{L}_{m_t} \quad : \quad \lambda_1 (R_t - \psi) = \phi_m \lambda_2, \quad (5)$$

$$\mathcal{L}_{h_t} \quad : \quad \lambda_1 w_t = \phi_h \lambda_2, \quad (6)$$

$$\mathcal{L}_{\lambda_1} \quad : \quad hw_t + \Pi + R_t m_t = \psi m_t + e_t n_t + c_t, \quad (7)$$

$$\mathcal{L}_{\lambda_2} \quad : \quad 1 = \phi_h h_t + \phi_n n_t + \phi_m m_t. \quad (8)$$

From (2) and (7), we obtain

$$\lambda_2 = \frac{1}{c_t} \frac{w_t}{\phi_h}. \quad (9)$$

We can substitute (2) and (9) in (3) to obtain fertility rate as a function of education and consumption

$$n_t = \frac{\gamma c_t}{e_t + \frac{\phi_n}{\phi_h} w_t}. \quad (10)$$

Then, we substitute (10) together with (2) in (4) to obtain education expenditure

$$e_t = \frac{\eta}{1 - \eta} w_t \frac{\phi_n}{\phi_h}. \quad (11)$$

We obtain the fertility rate as a function of consumption expenditure by substituting (11) in (10),

$$n_t = \frac{\phi_h}{\phi_n} (1 - \eta) \gamma \frac{c_t}{w_t}. \quad (12)$$

From (5) and using (2) and (9), we can obtain the following knife condition

$$R_t - \psi = \frac{\phi_m}{\phi_h} w_t \quad (13)$$

which means that the individual in this condition it is indifferent if to migrate or stay in the country. We use (7), (13) and (8) to obtain share of migrants

$$m_t = \frac{1}{\phi_m} - \frac{\phi_h}{\phi_m} h_t - \frac{\phi_n}{\phi_m} n_t. \quad (14)$$

We then substitute (14), (11) in (10) and, after arranging terms, we obtain the consumption expenditure as function of wage and profit,

$$c_t = \frac{1}{1+\gamma}\left(\Pi + \frac{w_t}{\phi_h}\right) \tag{15}$$

Substituting (15) in (12) to obtain the optimal fertility choice is

$$n_t = \gamma\frac{\phi_h}{\phi_n}\frac{1-\eta}{1+\gamma}\frac{1}{w_t}\left(\Pi + \frac{w_t}{\phi_h}\right). \tag{16}$$

A.1. Firm's problem with profits

The representative firm maximize profits choosing the amount of labor given the exogenous wage

$$\max_h \Pi = Ah^{\alpha} - wh$$

which implies

$$w = \alpha A h^{\alpha-1} \tag{17}$$

We obtain the demand function of labor by clearing h from (17),

$$h^d = \left(\frac{\alpha A}{w}\right)^{\frac{1}{1-\alpha}}. \tag{18}$$

Given the labor demand, the optimal production is

$$y^* = A\left(\frac{\alpha A}{w}\right)^{\frac{\alpha}{1-\alpha}}, \tag{19}$$

and the profits Π are

$$\Pi^* = (1-\alpha)\, y^*. \tag{20}$$

A.2. The optimal migration and fertility rates

To obtain the optimal share of migrants, we use the market clearing condition in the home-country labor,

$$h = h^d.$$

Consequently, we substitute (20), (18) and (16) in (14) to obtain that the optimal share of migrants is

$$m_t^* = \Delta_1 - \Delta_2 w^{-\left(\frac{1}{1-\alpha}\right)} \tag{21}$$

where

$$\Delta_1 = \frac{1+\gamma\eta}{1+\gamma}\frac{1}{\phi_m},$$

and

$$\Delta_2 = \left[\frac{1}{1+\gamma} + \frac{\gamma}{\alpha}\frac{1-(1-\alpha)\,\eta}{1+\gamma}\right]\frac{\phi_h}{\phi_m}(\alpha A)^{\frac{1}{1-\alpha}}.$$

Substituting (20) in (16), we obtain the fertility rate is

$$n_t^* = \Delta_3 + \Delta_4 w^{-\left(\frac{1}{1-\alpha}\right)},$$

where

$$\Delta_3 = \frac{1-\eta}{\phi_n}\frac{\gamma}{1+\gamma},$$

and

$$\Delta_4 = \left[(1-\eta)\frac{\phi_h}{\phi_n}\frac{\gamma}{1+\gamma}\frac{1-\alpha}{\alpha}\right](\alpha A)^{\left(\frac{1}{1-\alpha}\right)}. \tag{22}$$

A.3. Remittances effect on migration and fertility

From (13), we obtain that the home-country wage should satisfy the following condition for an interior solution

$$w_t = (R_t - \psi)\frac{\phi_h}{\phi_m}. \tag{23}$$

Substituting this condition in (21), we obtain that migration depends on the wage abroad, R_t, as follows

$$m_t = \Delta_1 - \Delta_2\left[(R_t-\psi)\frac{\phi_h}{\phi_m}\right]^{-\left(\frac{1}{1-\alpha}\right)},$$

which partial derivative respect to the wage abroad is

$$\frac{\partial m_t}{\partial R_t} = \frac{\Delta_2}{1-\alpha}\frac{\left[(R_t-\psi)\frac{\phi_h}{\phi_m}\right]^{-\frac{1}{1-\alpha}}}{R_t-\psi}$$

and under the assumption that $R_t - \psi > 0$, the partial derivative is positive. Substituting (23) in (22),and taking the partial derivative respect to fertility, we obtain that

$$\frac{\partial n_t}{\partial R_t} = -\frac{\Delta_4}{1-\alpha}\frac{\left[(R_t-\psi)\frac{\phi_h}{\phi_m}\right]^{-\left(\frac{1}{1-\alpha}\right)}}{R_t-\psi}.$$

which is negative given the assumption $R_t - \psi > 0$.

B. Appendix B

B.1. The data

The data used in the regression are available for the following countries: Algeria, Bangladesh, Belize, Benin, Burkina Faso, Cabo Verde, Cameroon, China, Colombia, Dominican Republic, Ecuador, El Salvador, Eswatini, Ethiopia, Fiji, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Honduras, India, Indonesia, Jamaica, Jordan, Kenya, Madagascar, Maldives, Mali, Morocco, Mozambique, Namibia, Niger, Nigeria, Pakistan, Paraguay, Peru, Philippines, Rwanda, Samoa, Senegal, Sierra Leone, Sri Lanka, Sudan, Suriname, Thailand, Togo, Tunisia, Turkey, Vanuatu.

The data used for the calibration and numerical simulation are available for the following countries: Benin, Burkina Faso, Bangladesh, China, Cameroon, Colombia, Cabo Verde, Dominican Republic, Algeria, Ecuador, Fiji, Ghana, Guinea, Guinea-Bissau, Guatemala, Honduras, Indonesia, India, Jamaica, Jordan, Kenya, Sri Lanka, Morocco, Madagascar, Mali, Mozambique, Namibia, Nigeria, Pakistan, Peru, Philippines, Paraguay, Rwanda, Sudan, Senegal, Sierra Leone, El Salvador, Suriname, Eswatini, Togo, Tunisia, Turkey.

B.2. Filtering the panel data

The figure 1, 2 and 3 have been built as follows, according Garcia-Santana, "Investment Demand and Structural Change", 2020: first we regress the wanted variable, z_{it} on a low polynomial of log y_{it} and country fixed effects α_{zi} :

$$z_{it} = \alpha_{zi} + \alpha_{z1} \log(y_{it}) + \alpha_{z2} \log(y_{it})^2 + \varepsilon_{it}$$

The second step is to use the prediction equation,

$$\hat{z}_{it} = \alpha_{zi} + \hat{\alpha}_{z1} \log(y_{it}) + \hat{\alpha}_{z2} \log(y_{it})^2$$

with α as intercept equal to the unweighted average of country fixed effect α_{zi} . The lines in the graphs represent all the countries in the dataset. We use this method, filtering the data for remittances, fertility and migration.

C. Appendix C

C.1. Tables and Figures

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Table C.1. Definition of variables

VARIABLE	ABBREVIATION	EXPLANATION
Fertility rate	FERTRATE	The number of children that would be born to a woman if she were to live to the end of her childbearing years
Flow of migration	MIGRRATE	Logarithm of flow of migration calculated as the difference between the stock of total migrationin year 1and year 0
Remittances per capita	REMPRCAP	Logarithm of remittances per capita
Contracceptive	CONTRACC	Contracceptive prevalence, any method is the percentage ofmarried women ages 15-49
GDP	LOGGDPPP	Logarithm of GDP, PPP (constant 2017 international $) divided by total population
Labor force partecipation	FEMLABPT	The proportion of the population age 15 and older that is economically active
Infant mortality rate	INFMORTR	Number of infants dying before reaching one year of age, per 1,000 live births in a given year
Health expenditure per woman	HEEXPFEM	Level of current health expenditure per women between ages 15-49
School enrollment, primary	PRIMATOT	Ratio of children of official school age who are enrolled in school to the population of the corresponding official school age
Education expenditure	EDEXPEND	The current operating expenditures in education expressed as a percentage of GDP

.

Table C.2. Descriptive Statistics

		Mean	Std. Dev.	Min	Max	N/n/T-bar
FERTRATE	overall	3.189684	1.659875	1.085	7.761	4428
	between		1.59748	1.284444	7.545407	164
	within		.467153	1.179018	6.213684	27
INFMORTR	overall	35.28955	32.98132	1.5	176	4239
	between		30.70282	2.866667	126.0259	157
	within		3.521787	29.17316	65.07116	26.96341
REMPRCAP	overall	3.670435	2.019436	-6.497116	8.149185	3565
	between		1.927915	-2.981202	7.785658	154
	within		1.10741	-5.326743	7.257447	23.14935
CONTRACC	overall	47.48518	23.0761	1.7	88.12857	2931
	between		22.45721	4.722222	85.88182	141
	within		6.379206	23.30185	92.41375	20.78723
MIGRRATE	overall	8.867091	1.886273	1.788762	14.42375	3485
	between		1.748474	3.465803	12.81034	158
	within		.8456015	4.103577	13.56653	22.05696
LOGGDPPP	overall	9.01838	1.237964	6.083686	11.72824	4077
	between		1.219826	6.63405	11.65109	155
	within		.2608361	6.455745	10.17853	26.30323
HEEXPFEM	overall	2150.298	2716.543	32.09975	16636.78	2713
	between		2568.737	65.43828	11031.44	154
	within		864.4327	-2589.486	9091.541	17.61688
EDEXPEND	overall	78.06555	58.61227	-6.609402	287.5457	956
	between		56.83881	11.60631	210.4127	50
	within		25.54107	-42.77722	233.463	19.12

Table C.3. Calibration

Parameters	Value	Targets
γ	0.064	(Delacroix)
η	0.649	(Delacroix)
α	0.531	Penn World Table

Table C.4. Calibrated country specific parameters

	A	ϕ_m	ϕ_h	ϕ_n
Algeria	2488.15	5.975	1.369	0.027
Bangladesh	14690.35	6.488	1.015	0.073
Benin	6098.59	9.281	1.328	0.045
Burkina Faso	7149.26	8.580	1.211	0.055
Cabo Verde	12711.16	7.091	1.049	0.068
Cameroon	3256.27	7.695	1.383	0.033
China	14440.14	6.975	1.049	0.070
Colombia	21918.49	5.418	0.929	0.080
Dominican Republic	5882.11	9.735	1.271	0.046
Ecuador	4789.56	9.720	1.331	0.043
El Salvador	6562.56	9.745	1.226	0.052
Eswatini	1656.51	4.483	1.429	0.025
Fiji	2968.33	6.223	1.390	0.028
Ghana	8046.19	9.886	1.240	0.051
Guatemala	7051.02	9.228	1.232	0.055
Guinea	8197.76	8.554	1.215	0.057
Guinea-Bissau	14686.08	6.549	1.021	0.073
Honduras	5934.44	9.387	1.364	0.042
India	12084.93	6.877	1.038	0.070
Indonesia	11098.99	7.415	1.082	0.068
Jamaica	10955.41	6.678	1.103	0.074
Jordan	2425.02	5.818	1.411	0.029
Kenya	11379.53	7.734	1.078	0.065
Madagascar	5302.93	10.016	1.296	0.044
Mali	14244.09	5.328	0.921	0.081
Morocco	2812	7.800	1.387	0.033
Mozambique	4928.03	8.159	1.424	0.037
Namibia	3306.20	7.772	1.385	0.034
Nigeria	15844.70	6.393	1.007	0.074
Pakistan	6092.26	9.240	1.252	0.050
Paraguay	11879.51	8.023	1.091	0.064
Peru	11083.78	7.663	1.096	0.066
Philippines	9332.52	8.228	1.138	0.062
Rwanda	2639.41	6.113	1.376	0.028
Senegal	16315.53	7.103	1.109	0.071
Sierra Leone	4423.81	8.743	1.326	0.038
Sri Lanka	9236.65	8.696	1.157	0.059
Sudan	3249.90	7.259	1.385	0.032
Suriname	13730.12	6.139	0.987	0.075
Togo	15380.06	6.082	0.984	0.076
Tunisia	15024.59	6.175	0.990	0.075
Turkey	21834.60	4.663	0.857	0.087

Table C.5. Calibrated country specific parameters (year 1991)

	A	ϕ_m	ϕ_h	ϕ_n
Algeria	9335.965	6.814	1.051	0.051
Bangladesh	15067.95	9.040	1.374	0.057
Benin	14158.75	7.150	1.020	0.054
Burkina Faso	8171.813	7.578	1.113	0.054
Cabo Verde	13841.51	6.000	0.912	0.048
Cameroon	3066.959	8.786	1.224	0.042
China	3630.387	5.780	1.626	0.035
Colombia	3053.424	18.264	0.895	0.033
Dominican Republic	10665.76	9.524	1.347	0.059
Ecuador	3880.836	9.487	1.132	0.034
El Salvador	3785.552	9.418	1.420	0.041
Eswatini	9602.349	8.487	1.260	0.050
Fiji	2597.706	6.609	1.228	0.034
Ghana	8407.192	9.916	0.817	0.042
Guatemala	1587.823	4.220	1.326	0.028
Guinea	9774.892	3.373	2.124	0.052
Guinea-Bissau	14752.97	22.610	1.819	0.070
Honduras	10061.69	9.860	1.041	0.048
India	13332.31	25.642	1.162	0.058
Indonesia	2531.094	7.685	1.324	0.032
Jamaica	1716.111	5.423	0.984	0.032
Jordan	24481.61	17.995	1.050	0.067
Kenya	2551.21	7.285	1.056	0.049
Madagascar	7061.313	9.820	1.145	0.044
Mali	2734.547	6.625	1.339	0.038
Morocco	13030.71	3.796	1.703	0.057
Mozambique	7227.76	7.763	1.364	0.059
Namibia	5350.365	8.965	1.268	0.041
Nigeria	5984.759	8.689	1.494	0.036
Pakistan	7139.643	1.943	3.093	0.051
Paraguay	2863.605	6.126	1.720	0.035
Peru	14475.02	8.591	1.086	0.052
Philippines	757.5777	2.283	1.117	0.029
Rwanda	5188.111	9.983	1.158	0.040
Senegal	4164.628	8.911	1.324	0.039
Sierra Leone	3027.567	4.958	1.710	0.035
Sri Lanka	4268.233	6.727	1.519	0.042
Sudan	9375.983	7.605	1.509	0.051
Suriname	5558.632	8.011	1.417	0.052
Togo	3092.157	7.299	1.460	0.034
Tunisia	7195.908	7.372	1.643	0.051
Turkey	18165.1	4.290	0.703	0.066

Table C.6. Calibrated country specific parameters (year 2017)

	A	ϕ_m	ϕ_h	ϕ_n
Algeria	2192.08	4.637	1.246	0.033
Bangladesh	7622.28	6.892	1.401	0.058
Benin	12815.54	7.749	1.115	0.066
Burkina Faso	5323.24	6.558	1.411	0.049
Cabo Verde	17242.08	7.125	0.901	0.070
Cameroon	3817.52	8.366	1.370	0.042
China	6159.55	9.486	1.111	0.054
Colombia	2877.88	7.943	1.289	0.044
Dominican Republic	24090.85	4.757	0.715	0.081
Ecuador	3570.51	6.684	1.116	0.038
El Salvador	8460.73	10.042	0.880	0.060
Eswatini	9125.54	8.647	0.694	0.061
Fiji	18861.12	4.942	0.787	0.097
Ghana	15934.69	4.351	1.030	0.077
Guatemala	13129.00	5.594	0.714	0.068
Guinea	26591.38	1.808	0.756	0.096
Guinea-Bissau	7709.49	10.216	0.934	0.068
Honduras	10864.49	5.347	1.123	0.071
India	3298.61	8.898	0.958	0.041
Indonesia	13630.47	8.550	0.977	0.072
Jamaica	16189.68	4.567	1.455	0.120
Jordan	18569.94	6.051	0.785	0.082
Kenya	3840.79	8.836	1.062	0.045
Madagascar	6725.20	9.267	1.063	0.054
Mali	4225.55	7.832	1.254	0.045
Morocco	2626.89	7.910	1.045	0.046
Mozambique	22182.78	4.320	0.943	0.071
Namibia	8315.05	10.044	0.863	0.050
Nigeria	6771.89	7.942	1.066	0.047
Pakistan	11117.20	8.717	1.235	0.061
Paraguay	17563.80	5.201	0.816	0.079
Peru	15030.07	5.103	0.733	0.078
Philippines	17170.11	5.562	0.810	0.085
Rwanda	12498.06	7.706	0.737	0.090
Senegal	21178.52	5.456	0.783	0.091
Sierra Leone	3473.68	8.931	1.234	0.039
Sri Lanka	23973.86	7.017	1.053	0.067
Sudan	19648.50	6.501	0.841	0.067
Suriname	5370.20	11.381	0.864	0.048
Togo	13353.49	4.681	0.998	0.078
Tunisia	16994.28	6.042	0.907	0.074
Turkey	40088.18	4.281	0.752	0.107

Figure C.1. Model performance: target moments

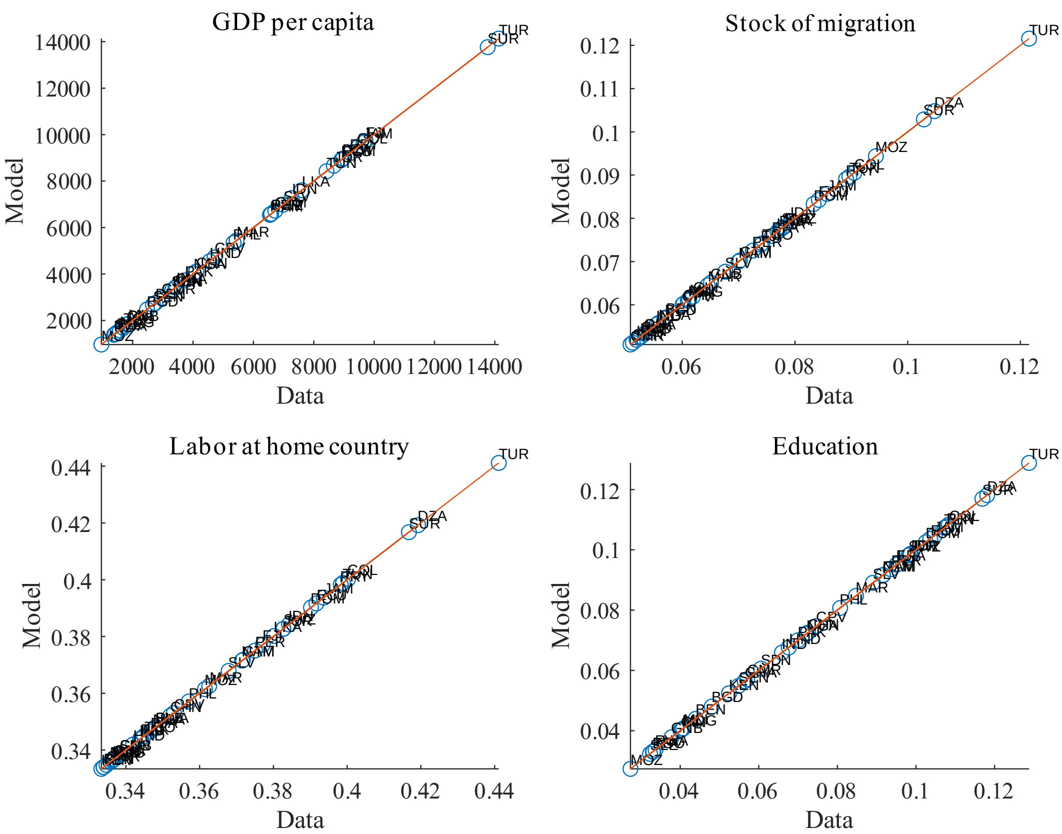

Figure C.2. Implicit changes due to reduction in the time cost to migrate