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International Remittances, Migration, and Primary  
Commodities in FSGM

by Stephen Snudden

I N T E R N A T I O N A L M O N E T A R Y F U N D

**IMF Working Paper**

Research Department

**International Remittances, Migration, and Primary Commodities in FSGM****Prepared by Stephen Snudden**

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**Abstract**

This paper adds international migration and remittances into the IMF's Flexible System of Global Models (FSGM). FSGM is a global general equilibrium model with endogenous primary commodity markets. A method to estimate the structural dynamics of major remitter regions is proposed. The dynamics of remittances and migration in FSGM are calibrated to be consistent with the main stylized facts of the empirical estimates. Structural disturbances pertinent to current global remittance flows are examined. These disturbances include disruptions to oil supply, output variation in Europe and the United States, labor nationalization policies in Saudi Arabia, and a global reduction in the cost to remit. The multilateral framework illustrates how remittance inflows need not originate from the region with the underlying economic disturbance but can arise from third party remitter regions affected by global commodity markets. The results also illustrate that the correlation of remittance inflows and the real GDP of labor-exporting economies can be either positively or negatively correlated. The evidence suggests that the behavioral incentive to migrate and remit cannot be deduced from correlations of real GDP and remittance inflows.

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## I. Introduction

The unrequited, nonmarket personal transfers of earned income by expatriate workers to their country of origin constitute a large share of international capital flows and an important source of financial inflows to developing countries. For many labor-exporting countries, remittances trump international aid and foreign direct investment. The World Bank (2015) estimates the stock of international migrants in 2013 to be 247 million and expects remittances to reach US\$582 billion in 2015. Migration can play an important role in labor market dynamics, particularly in economies where foreign labor constitutes a large share of the labor market. Moreover, many large oil-exporters are also labor-importers, such as in the Gulf Cooperation Council (GCC) economies and Russia. Despite this, there are no current studies on the response of remittances to structural shocks to the global market for crude oil.

This paper provides original contributions to the study of migration and remittances. A structural vector auto regressions method is proposed to estimate the structural dynamics of major remitter regions. The empirical method also identifies structural shocks to the global market for crude oil. The estimation reveals varied responsiveness of remittances across regions to domestic and foreign structural disturbances. The structure of the empirical estimates is motivated by a proposed general equilibrium model of the global economy with endogenous commodity markets. The proposed model of migration and remittances is added to the International Monetary Fund's Flexible System of Global Models (FSGM). FSGM is a global general equilibrium model with endogenous primary commodity markets. The structural dynamics of remittances and migration in FSGM are calibrated to broadly match the stylized facts of the empirical estimates.

Issues currently pertinent to global remittance flows are examined using FSGM and include an increase in oil supply in the GCC, a permanent stagnation of output in Europe, higher private domestic demand in the United States, recent nationalization policies in Saudi Arabia, and permanent declines in the cost to remit. The multilateral framework illustrates how remittance inflows need not originate from the region with the underlying economic disturbance but can arise from third party remitter regions affected by global commodity markets. The results also illustrate that the correlation of remittance inflows and the real GDP of labor-exporting oil-importing economies can either positively or negatively correlated. The evidence suggests that the behavioral incentive to migrate and remit cannot be deduced from the real GDP and remittance inflows correlations.

The paper is structured as follows. Section II provides a literature review. Section III introduces the structural general equilibrium model of migration and international remittance flows. Section IV proposes a method to estimate remitter dynamics using structural vector auto regressions and the calibration strategy of the structural model. Section V conducts scenario analysis using the general equilibrium structural model. Section VI discusses the implications of the analysis of the structural model for the identification of the motive to remit and migrate. Section VII concludes.

## II. Literature Review

The empirical literature on remittance dynamics has primarily focused on the relationship between remittance flows and the output fluctuations of home and host economies. Remittance flows are consistently found to be positively correlated with the host economies GDP. In contrast, the evidence suggests that remittance flows differ in how they respond to home countries GDP, although countercyclical correlations are predominant (Chami and others 2005, 2008; Frankel, 2011; Sayan, 2004). This suggests that remittance dynamics may depend on the migration-remittance corridor as the motivation to migrate and remit may differ across regions and countries.

Most studies, including those mentioned above, employ panel estimates and gravity-type models. These conditional correlation studies are subject to issues with endogeneity and lack structural interpretation. This has encouraged the use of structural empirical analysis to examine remittance dynamics to economic shocks. For example, Lueth and Ruiz-Arranz (2007) employ a vector-error-correction model to determine the response of remittance recipients to shocks in macroeconomic variables for Sri Lanka. Mughal and Ahmed (2014) propose a structural vector auto-regression to decompose the remittance flow into host and home economy shocks for a number of South Asian countries. Both of these studies provide insight into the remittance dynamics to economic shocks while attempting to account for issues with endogeneity. However, the latter study does not take into account the role of oil prices and the former study looks only at Sri Lanka and does not consider the source of global oil price movements.

There is a potentially important link between oil prices, remittances, and migrant flows. It has been well documented that large labor-importers are also oil-exporters. Moreover, economies that are dependent on remittance inflows and labor-exports tend to also be oil-importers (see, for example, Choucri (1986) and Ahmed (2013)). Hence, oil price shocks may have important consequences for both remitter and remitee economies, apart from the role of remittances. The relationship between oil prices and remittances has been casually examined in Choucri (1986) and Ahmed (2013) and formally estimated in panel models for the Gulf Cooperation Council countries by Ratha and others (2015) and Naufal and Termos (2009). There have been no studies to attempt to identify remittance dynamics from oil price shocks in remitter economies using structural methods.

To this end, this paper proposes an empirical method to identify structural shocks in remitter economies and to the global market for crude oil. It is the first study to examine whether the source of the global oil price movements matters for remittance flows. Distinguishing between the source of the underlying price movement may be important since it has been shown to have different consequences on macro-aggregates (see for example Kilian (2009) among others).

In addition to empirical evidence, there have been few studies to examine remittances and migration in general equilibrium. Durdu and Sayan (2008), for example, develop a small open economy two-sector model and apply it to Turkey and Mexico. Similarly, Acosta and others (2009) develop a small open economy two-sector model and examine issues of Dutch disease for El Salvador. However, none of these studies have formally modeled the interaction between migration and remittances flows in general equilibrium. Moreover, no

paper has considered the interaction of migration and remittances with oil price shocks in general equilibrium. To this end, this paper proposes a global, dynamic, stochastic, general equilibrium (DSGE) model with endogenous remittances, migration, and primary commodity markets to examine the interaction of these channels. This allows for a formal decomposition of the contribution of remittances from the oil channels in oil-importing, and labor-exporting economies.

The proposed global general equilibrium model of migration and remittances flows has a multilateral framework. In particular, the global model has several regions and includes both oil-exporting and oil-importing economies. The main migration-remittances corridors are explicitly modeled. The multilateral framework can illustrate how remittance flows can transmit across regions given movements in the global price of crude oil. It is the first model of migration and remittances in a multilateral structural model, and does so while explicitly taking into account the role of primary commodities as an international transmission mechanism.

The structural model also provides a theoretical contribution to the determination of remittance outflows in remitter economies. The model identifies that remittance dynamics can be decomposed into the contribution from changes in migration, employment and wages of migrants, and changes in migrants marginal propensity to remit. This insight contributes to the ongoing debate on the identification of the behavior to remit and migrate.

### **III. A Multilateral Model of Remittances**

This section provides an overview of the model structure and documents the modifications made to include the novel labor migration and remittance channels. Section III.A provides a non-technical overview of the pre-existing model. Section III.B provides a non-technical overview of the remittances and labor migration channels that are introduced into the model. Section III.C provides a technical overview of the proposed remittance and labor migration channels.

#### **A. Non-Technical Overview of the Model**

The remittance and labor migration channels are built into the International Monetary Funds (IMF) Flexible System of Global Models (FSGM). This framework is explicitly designed for the examination of international spillovers in a globally consistent, stock-flow system for analysis at the IMF. FSGM is an annual, multi-region, general equilibrium model of the global economy. There are nine modules, each with a unique multi-region composition sharing a common forward-looking theoretical framework. The theoretical foundations and dynamic properties of the model are extensively described in Andrieu and others (2015). The structure of the model, apart from the labor and remittance mechanism, is identical to that described in Andrieu and others (2015).

To allow for more individual country/region coverage, FSGM employs a simplified semi-structural formation for select sectors. FSGMs key behavioral elements, including

private consumption and investment, are micro-founded, whereas trade, labor supply, and inflation have reduced-form representations. The sectors that are reduced-form are designed to be consistent with the properties of the IMF's micro-founded structural models such as GIMF, the Global Integrated Monetary and Fiscal model (Kumhof and others, 2010; Anderson and others, 2013), and GEM, the Global Economy Model (Pesenti, 2008). In addition, the semi-structural framework has allowed for more empirical determination of the dynamic properties and heterogeneity of the behavior of individual countries. The gains of country/region coverage are not inconsequential, with each module including roughly two dozen countries/regions. With nine modules, almost all large economies and all regions are modelled.<sup>1</sup>

Households consist of both overlapping generation (OLG) households that consume out of a stock of wealth that is discounted beyond that of their standard rate of time preference and a set of liquidity constrained households (LIQ) that consume their present income. The presence of the LIQ agents is an important additional non-Ricardian feature. The presence of the OLG households implies that changes in household wealth from changes in government debt have significant economic implications. This results from a share of associated tax liabilities falling outside of OLG households' planning horizon. It also implies that aggregate saving, net foreign assets, and the global equilibrium real interest rate are endogenous, with the real interest rate adjusting to equilibrate the global supply and demand for saving.

There is a fully specified fiscal sector with several policy instruments. There is full stock-flow accounting of fiscal policy with a fiscal balance that accumulates to a stock of debt and tracking of the interest burden of debt. Fiscal policy stabilizes debt as a percent of GDP and responds to temporary domestic conditions by varying fiscal instruments in response to changes in the output gap. Monetary policy follows an inflation-forecast-based interest rate reaction function, but can also be modeled as a hard peg or managed floating exchange rate depending on the monetary policy framework in the country. All currency unions are modeled as such.

Exports and imports are modeled with reduced-form equations. Exports increase with foreign activity and with the depreciation in the real competitiveness index. Imports increase with domestic activity and with the appreciation of the real effective exchange rate (REER). The model replicates the Balassa-Samuelson effect from a relative increase in the productivity of the tradable sector. Time-varying trade shares are designed to mimic the properties of multiple-good structural models and are a function of the relative

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<sup>1</sup>There are 63 unique countries and 27 unique regions modeled among the nine modules. Using International Organization for Standardization (ISO) country codes, the unique countries are AGO, ARG, AUS, AUT, BEL, BGD, BGR, BOL, BRA, CAN, CHE, CHL, CHN, COL, CRI, CZE, DEU, DOM, ECU, ESP, FIN, FRA, GBR, GHA, GRC, GTM, HKG, HRV, HUN, IDN, IND, IRL, ITA, JPN, KHM, KOR, LKA, MEX, MNG, MYS, NGA, NLD, NZL, PAN, PER, PHL, POL, PRY, ROM, RUS, SAU, SGP, SRB, SWE, THA, TTO, TUR, UKR, URY, USA, VNM, ZAF, and ZMB. The unique regions are ASEAN, Caucasus and Central Asia Oil Exporters, Caucasus and Central Asia Oil Importers, Central America, Central Asia and Caucasus Oil Exporters, Central Asia and Caucasus Oil Importers, Central Europe 3, Core Euro Area, Eastern Africa, Eastern and Southeastern Europe, Emerging Asia, Emerging Euro Area, Euro Area, Euro Area Periphery, European Union, Fragile Africa, Gulf Cooperation Council (GCC) Oil Exporters excluding Saudi Arabia, Latin America, Low Income Africa, Middle East and North Africa Oil Importers, Middle Income Africa, Newly Industrialized Asia excluding China and India, OPEC, Pacific Island Countries, Sub-Saharan Africa Oil Exporters, Sub-Saharan Africa Oil Importers, and the other West African Economic and Monetary Union (WAEMU).

level of tradable and nontradable productivity within each country.

The stock of private capital is chosen by firms to maximize their present discounted profits. Investment follows a Tobins Q specification with quadratic real adjustment costs. A corporate risk premium based on Bernanke and others (1999) follows a reduced form relationship and responds to the domestic output gap. Potential output is based on Cobb-Douglas production technology with trend total factor productivity, trend labor, and the actual capital stock. The unemployment rate follows an Okuns Law relationship.

The consumer price index excluding food and energy, CPIX, is the core price in all regions and is determined by an inflation Phillips curve. Prices are sticky and there are channels for oil prices to leak into core inflation through the pass-through of higher oil prices in the marginal costs of production. Corresponding deflators exist for headline (including food and energy), the government, investment, imports and exports. A Phillips curve for wages exhibits price stickiness and responds to the evolution of overall economic activity.

The model includes three primary commodity markets crude oil, agricultural goods, and metals. These three sectors provide richness in international spillovers with appropriate responses for production and demand of commodities in both exporters and importers. The demand for commodities is driven by world demand, and it is relatively price inelastic based on estimated short run elasticities of the respective sectors. The supply of commodities is also price inelastic in the short run. Oil is consumed by households, used in manufacturing, imported and exported. The behavior of oil in consumption, imports and exports are governed by reduced form equations. Agricultural goods and metals follow a similar structure except that metals are not consumed directly by households.

Primary commodities affect the economy through several channels. Food and oil feed into the consumption basket and pass through into headline inflation which deflates real disposable income and wealth. Metals and oil affect the cost of production. Consequently, commodity prices have an impact on the demand for capital and labor through production. As mentioned above, oil prices can pass through into core inflation which can elicit a response of the monetary policy authority.

Overall, the structure of FSGM serves as an ideal platform for the incorporation of remittances and migrant labor. The detailed structure of consumption, production, and fiscal and monetary policy can capture key differences in the structure of domestic economies. Moreover, the accounting of trade and the international spillovers from primary commodities provides a plausible benchmark on which to incorporate spillovers from international remittance flows.

## **B. Non-Technical Overview of Remittances in FSGM**

Households of working age in their home country provide migrant labor to foreign economies. When a worker travels abroad, they reduce the population of their country and increase that of the foreign economy. The model allows for labor emigration to be drawn from either the labor force or non-participating population. This can be calibrated for each region/country. These labor market dynamics are fully reflected in domestic participation rates, and it is assumed that if workers return to the labor force they do so

such that the unemployment rate is unaffected.

Foreign workers are assumed to have full employment in the host economy and influence accordingly the participation and unemployment rates. Expatriate workers can have a different level of productivity relative to native workers resulting in distinct wages for both native and expatriate workers. The share of foreign labor in aggregate employed labor is motivated by a Leontief-type labor production function in total labor supply. The source of foreign labor is explicitly modeled via fixed bilateral shares from labor-exporting economies.

Foreign workers remit a share of their after-tax earning to their home country. The remittance economies accept fixed bilateral shares of each remitters outflow. The fixed bilateral weights for both the bilateral flows of labor and remittances simplify the framework and allow for more extensive decomposition of economic regions. The cost of sending remittances through a financial intermediary is explicitly modeled and remittance flows are net of costs. Financial intermediaries of remittances operate at no cost and pay out profits in the form of dividends to OLG households.

Remittances are received by only LIQ households of the home economy. The assumption that all remittances are spent is consistent with empirical estimates and case studies suggesting that remittances are primarily used for immediate consumption (World Bank, 2006; Multilateral Investment Fund, 2004). As noted by Chami and others (2008), even the share of remittances often attributed to savings is primarily used for the consumption of education and durables. In the data and in FSGM, these are considered consumption goods and hence are assumed to not increase private savings.

There are several unique features in the design of the remittance channels to reduce the number of equations in FSGM. The remittance channels are modular, allowing for an economy to be remitter (importer) and/or remittee (exporter) of remittances (labor), or neither.

### C. Technical Overview of Remittances in FSGM

The following notation is consistent with Andrlé and others (2015). The world consists of  $\tilde{N}$  countries. The domestic economy is indexed by  $j = 1$  and foreign economies by  $j = 2, \dots, \tilde{N}$ . Domestic labor variables are denoted by  $H$ , representing home, to distinguish from foreign  $F$  labor. In the exposition, country indices are ignored except when interactions between multiple countries are concerned. There is positive trend labor augmenting technology  $T_t$  with a growth rate  $g_t$  and a positive population growth rate  $n$ . Quantities of labor are rescaled by  $n$  and real variables are scaled by both technology and population. The hat notation  $\hat{x}_t$  denotes the real variable of  $x_t$ , trend variables are denoted by  $\check{x}_t^{FE}$ , and the steady state is denoted by  $\bar{x}$ .

#### 1. Consumption

The domestic labor force consists of a share,  $(1 - \lambda^{c,h})$ , of OLG households and a share,  $\lambda^{c,h}$ , of domestic LIQ households. Both types of domestic households earn the wage of

domestic workers  $\check{w}_t^H$  and together supply aggregate employed domestic labor  $\check{l}_t^H$ .

Foreign workers are assumed to consume out of their present after-tax income and hence comprise a share of total LIQ households. Whilst abroad, foreign workers spend,  $SP\check{E}NT_t$ , and remit a fixed share,  $MPR$ , of their after tax labor income. Total spending of foreign workers is given by:

$$SP\check{E}NT_t = (1 - MPR)(1 - \tau_t^l)\check{w}_t^F\check{l}_t^F, \quad (1)$$

where  $\check{w}_t^F$  is the wage of foreign workers, and  $\check{l}_t^F$  is the stock of employed foreign workers. The share of earnings not spent abroad is remitted by foreign workers to their home economy,  $P\check{A}Y_t$ , subject to a cost:

$$P\check{A}Y_t = MPR(1 - \tau_t^l)(1 - RCOST_t)\check{w}_t^F\check{l}_t^F, \quad (2)$$

where  $RCOST_t$  is the cost of sending remittances through a financial intermediary. The revenue earned by financial intermediaries,  $R\check{R}EV_t$  is given by:

$$R\check{R}EV_t = RCOST_tMPR(1 - \tau_t^l)\check{w}_t^F\check{l}_t^F, \quad (3)$$

where  $R\check{R}EV_t$  is contemporaneously paid out as a lump sum dividend to OLG households.

The expatriate's home country receives flows of remittances from workers abroad,  $\check{R}_t$ :

$$\check{R}_t = \sum_{j=2}^{\check{N}} BRSHR(1, j)P\check{A}Y_t(j)\frac{Z_t(j)}{Z_t}, \quad (4)$$

where  $BRSHR(1, j)$  is a fixed bilateral share of country  $j$ 's remittances received by the expatriates home economy. Foreign currency is converted to domestic units by  $Z_t$ . Hence, changes in the bilateral exchange rates will affect the value of remittances received in domestic units. Remittance flows are accounted for in real gross national product and the current account.

LIQ households consume their present share of domestic after tax labor earnings, LIQ transfers,  $\Upsilon_t^{LIQ}$ , their share of general transfers,  $\Upsilon_t$ , and lump sum taxes,  $tax_t^{ls}$ . LIQ households also consume received remittance flows from abroad  $\check{R}_t$ . As migrant workers are assumed to be liquidity constrained, the aggregate consumption of LIQ households is defined as:

$$(1 + \tau_t^C)p_t^C\check{c}_t^{LIQ} = \lambda^{c,h}(\Upsilon_t - tax_t^{ls}) + \Upsilon_t^{LIQ} + \lambda^{c,h}(1 - \tau_t^l)\check{w}_t^H\check{l}_t^H + \check{R}_t + SP\check{E}NT_t, \quad (5)$$

where the tax rate on consumption is given by  $\tau_t^C$ , and  $p_t^C$  is the price of consumption goods.

## 2. Labor Demand and Supply

Emigrated labor,  $\check{l}_t^E$ , is tracked and given by:

$$\check{l}_t^E = \sum_2^{\check{N}} LABSHARE(j, 1)\check{l}_t^F(j), \quad (6)$$

where  $LABSHARE(j, 1)$  is the share of country  $j$ 's imported labor,  $\check{l}_t^F(j)$ , supplied by the home economy.

The share of foreign labor in aggregate employed labor is motivated by a Leontief-type labor production function. Specifically, trend foreign labor,  $\check{l}_t^{F,FE}$ , is given by:

$$\check{l}_t^{F,FE} = \Lambda_0^F + \frac{\alpha^F \Lambda_1^F}{z_t^F} \check{l}_t^{FE} + \epsilon_t^{F,FE}, \quad (7)$$

where  $\alpha^F$  is a parameter equal to the steady state share of foreign labor in aggregate labor, and  $\epsilon_t^{F,FE}$  is a permanent shock to the foreign labor stock. A constant,  $\Lambda_0^F$ , allows the absorption of permanent changes in aggregate labor by foreign workers to differ from the steady state share of foreign workers in aggregate labor. Generally,  $\Lambda_0^F = 0$  and  $\Lambda_1^F = 1$ , so changes in employed labor are absorbed by foreign laborers based on the share of foreign workers in the steady state share labor force.

The trend stock of foreign labor is distinguished from the actual stock,  $\check{l}_t^F$ , so that only the trend level of foreign workers will be used to calculate potential output. The actual stock of foreign labor is given by:

$$\check{l}_t^F = \check{l}_t^{F,FE} + \frac{\alpha^F \Lambda_1^F}{z_t^F} (\check{l}_t - \check{l}_t^{FE}) + \epsilon_t^F, \quad (8)$$

where  $\epsilon_t^F$  is a temporary shock to the stock of foreign labor. Similar to the steady state equation, this allows for the absorption of temporary changes in labor by foreign workers to differ from the steady state share of foreign labor in total labor. This specification also implies that labor flows are driven entirely by pull factors, i.e. labor demand in the host country.

The economies population,  $\check{N}_t$ , is given by:

$$\check{N}_t = \check{N}_t^H + \check{l}_t^F, \quad (9)$$

where  $\check{N}_t^H$  is the domestic born working age population. The population of domestically-born residents is given by:

$$\check{N}_t^H = \check{N}_t^B - \check{l}_t^E, \quad (10)$$

where  $\check{l}_t^E$  is the stock of emigrated labor and  $\check{N}_t^B$  is all persons born in an economy. Hence emigration reduces the population of the country. The employed domestic labor,  $\check{l}_t^H$ , is given by:

$$\check{l}_t^H = (1 - U_t^H) PART_t^H \check{N}_t^H, \quad (11)$$

where  $PART_t^H$  is the participation rate of home's domestic workers, and  $U_t^H$  is their unemployment rate. This specification results from a 100 percent employment rate of foreign labor, implying that the aggregate participation and unemployment rates differ from that of domestic workers.

Aggregate unemployment rates operate via an Okun's law. The unemployment rate of total labor force,  $U_t$ , and that of the domestic labor force are related by:

$$U_t = \frac{U_t^H PART_t^H \check{N}_t^H}{PART_t^H \check{N}_t^H + \check{l}_t^F}. \quad (12)$$

Similarly, the participation rate of total working age population,  $PART_t$  is given by:

$$PART_t = \frac{PART_t^H \check{N}_t^H + \check{l}_t^F}{\check{N}_t}. \quad (13)$$

The total employed labor force,  $\check{l}_t$ , becomes the sum of domestic and foreign workers:

$$\check{l}_t = \check{l}_t^H + \check{l}_t^F, \quad (14)$$

The labor augmenting productivity of foreign and domestic workers are denoted by  $z_t^F$  and  $z_t^H$ , respectively. The productivity of home workers,  $z_t^H$ , is unity in steady state and is included only as a shock, so  $z_t^F$  defines the steady-state relative productivity of foreign versus home workers. The effective wage,  $\check{w}_t^\varphi$ , per unit of labor is derived from the marginal product of labor and defines the labor factor share  $(1 - \alpha_t)$ , where earnings are given by:

$$\check{w}_t^\varphi \check{l}_t^\varphi = \check{w}_t^H \check{l}_t^H + \check{w}_t^F \check{l}_t^F = (1 - \alpha_t) \check{y}_t p_t^y, \quad (15)$$

where  $p_t^y$  is the price of output, and  $\check{l}_t^\varphi$  is the effective labor force defined by  $\check{l}_t^\varphi = z_t^H \check{l}_t^H + z_t^F \check{l}_t^F$ . Wages of foreign and domestic-born workers are defined by  $\check{w}_t^F = z_t^F \check{w}_t^\varphi$  and  $\check{w}_t^H = z_t^H \check{w}_t^\varphi$ , respectively. The economy-wide wage,  $\check{w}_t$ , is the weighed average of the wages of domestic-born and foreign-born workers:

$$\check{w}_t = \frac{\check{w}_t^F \check{l}_t^F + \check{w}_t^H \check{l}_t^H}{\check{l}_t}. \quad (16)$$

### 3. Balance of Payments and Potential Output

Remittance flows are accounted for in current account flows (measured in relative prices, superscript  $N$ ),  $CA_t^N$ :

$$CA_t^N = TB_t^N - PAY_t^N + R_t^N + INT_{t-1}^{NFA} \frac{NFA_{t-1}^D}{\epsilon_t Z_{t-1} \pi_t g_t n}, \quad (17)$$

where  $TB_t^N$  is the trade balance,  $INT_{t-1}^{NFA}$  is the nominal interest rate for net foreign assets,  $\epsilon_t$  is exchange rate depreciation, and  $\pi_t$  is inflation. Remittance flows also enter real gross national product,  $G\check{N}P_t$ :

$$G\check{N}P_t = G\check{D}P_t + INT_{t-1}^{NFA} \frac{NFA_{t-1}^D}{\epsilon_t Z_{t-1} \pi_t g_t n} \frac{1}{p_t^y} + (\check{R}_t - P\check{A}Y_t) \frac{1}{p_t^y}. \quad (18)$$

Potential output,  $\check{y}_t^{FE}$ , is given by:

$$\check{y}_t^{FE} = A_t^{FE} COM_t^{FE} \left( \frac{\check{k}_{t-1}}{g_t n} \right)^{\alpha^{FE}} \left[ \left( 1 - \frac{U_t^{H,FE}}{100} \right) z_t^H PART_t^{H,FE} \check{N}_t^H + z_t^F \check{l}_t^{F,FE} \right]^{(1-\alpha^{FE})}, \quad (19)$$

where  $\check{k}_t$  is the capital stock,  $\bar{U}_t^H$  is the NAIRU, and  $PART_t^{H,FE}$  is trend participation rate of home workers. Trend total factor productivity is denoted by  $A_t^{FE}$ , and the effect on productivity from permanent metal and oil price movements is due to  $COM_t^{FE}$ .

## IV. Calibration of Remittances and Migration in FSGM

This section discusses the method used to calibration remittances in FSGM. It begins by proposing a method to estimate remitter dynamics using structural vector auto regressions (SVAR) in part A. The SVAR also identifies shocks to the global market for crude oil, and is estimated for Russia and Saudi Arabia. The dynamics of the SVAR are used to gain insight into how the response of remittances varies across countries to structural shocks to the global oil market and domestic real GDP.

The steady state and dynamic calibration of migration and remittances in FSGM is then discussed in part B. The steady state of remittances and migration are exactly set to available bilateral data. A description of the regional foreign labor stocks and remittance flows summarized using the regional compositions of FSGM's modules can be found in Appendix I. The strategy to calibrate the dynamics of migration and remittances is also outlined in part B. The structural responses of remittances in the SVAR are used broadly to inform the dynamics of remittances in FSGM.

### A. Structural Estimation of Remittance Dynamics

The SVAR takes the following form:

$$\mathbf{A}(\mathbf{I}_K - \sum_{i=1}^p \mathbf{A}_i L^i) \mathbf{y}_t = \mathbf{B} \mathbf{e}_t$$

where  $\mathbf{e}_t$  is a  $K \times 1$  vector of orthogonal disturbances,  $\mathbf{A}$  is a  $K \times K$  lower triangular matrix with ones on the diagonal,  $\mathbf{B}$  is a  $K \times K$  diagonal matrix,  $\mathbf{A}_i$  are  $K \times K$  matrices of auto regressive parameters, and  $\mathbf{y}_t$  is a  $K \times 1$  vector of endogenous variables.

The benchmark model employs a recursive structure with the following ordering: foreign (world excluding home) oil supply, home oil supply, foreign (world excluding home) real GDP, the U.S. refiners real import price of crude oil, home real GDP, and real remittances. Thus, the model attempts to identify shocks to both domestic and home oil supply, foreign and home demand, other oil specific demand, and remittances. The structure is modified appropriately for the United States and the euro area as discussed and reported in Appendix 2.

A variant of Kilian's (2009) methodology is used to estimate shocks to the global market for crude oil. In particular, the methodology assumes that oil supply and real GDP do not respond contemporaneously to oil prices, but oil prices respond contemporaneously to shocks to oil production and demand. The structure is motivated by both empirical evidence and institutional information on the real rigidity in demand and supply and is suitable with models estimated at monthly and quarterly frequency (Kilian, 2009).

The main difference of the method in this paper and that of Kilian (2009) is that the oil supply of the small open economy (SOE), responds contemporaneously to shocks to foreign oil supply. This modification takes into account the relative slack in Saudi Arabia and Russia oil supply, and makes sense especially at a quarterly frequency. The response

of oil supply of the SOE (OPEC economies) is found in some cases to be significant given shocks to foreign oil supply shocks. This is an interesting avenue of further research.

The model presented in section IV provides the additional motivation of the remittance and SOE elements of the SVAR. In particular, remittances of the SOE do not drive global business cycles or the real price of crude oil. In addition to the zero restrictions on contemporaneous innovations, which is reflected in the recursive structure, these assumptions motivate additional zero restrictions on the parameters on lagged variables in the  $\mathbf{A}_i$  matrices. In particular, the coefficients for lags of remittances are set to zero in all foreign equations and the SOE oil supply equation, and the coefficients for lags of SOE real GDP are constrained to zero in the foreign equations.

The remittance measure is the sum of personal transfers and employee compensation from the IMF's Balance of Payments databases. This measure is based on residency rather than migrant status. Oil prices are the quarterly average imported crude oil price from the Energy Information Administration (EIA). Both remittances and oil prices are in real US\$ and deflated by the U.S. consumer price index from the Federal Reserve Economic Data (FRED). The oil supply series is production of crude oil including lease condensate measured in 1000 barrels per day from the EIA. Real GDP is in US\$, from the World Bank's Global Economic Monitor. Foreign variables are always measured as world excluding that of the home economy. Variables are seasonally adjusted prior to estimation. No evidence of co-integration was found so the model is estimated with all variables in percent change.

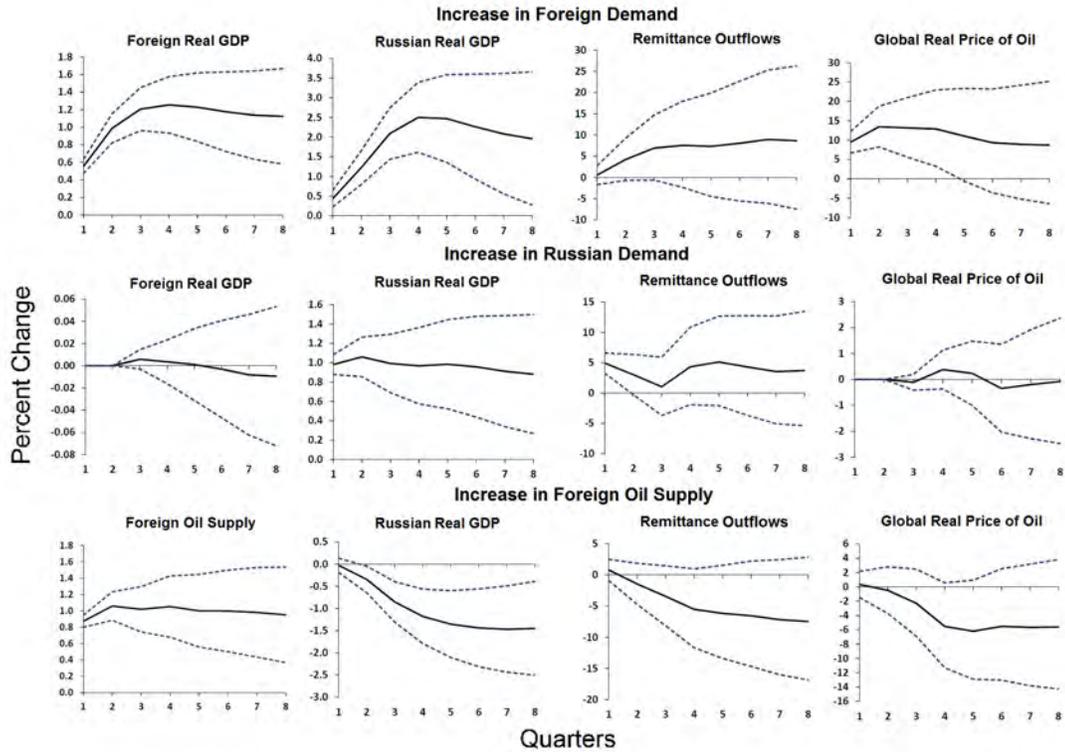
The SVAR models are estimated for Russia and Saudi Arabia. Estimates for the United States and the euro area as well as annualized elasticities for all shocks are presented in Appendix II. The impulse response dynamics for the foreign and home real GDP, and foreign oil supply shocks are presented in the following sections. The impulse responses are normalized so that shocks are one percent on average in the first year, consistent with the tables. The impulse responses are presented with 68 percent confidence intervals (1 standard deviation) which are parametrically bootstrapped with 1000 simulations.

## 1. Russia

Figure 1 illustrates the impulse response functions (IRFs) of the structural shocks in the SVAR estimated for Russia. Quarterly data of personal transfers is only available from 2001q1, so is extrapolated back using employee compensation from 1995q1 to 1999q4. The impulse responses of remittance are similar for the models estimated from 1995q1 or 2001q1, so the full data sample is used. The IRFs are normalized so that the shock is one percent on average in the first year. The model is estimated using quarterly data from 1995q1 to 2015q2.

A demand shock that increases foreign real GDP by one percent on average in the first year puts significant upward pressure on the price of oil by approximately 12.3 percent on average in the first year. Russian oil supply does not significantly respond but Russian real GDP increases significantly by close to 1.6 percent on average in the first year. Remittances increase by close to 4.8 percent on average in the first year.

Figure 1. SVAR: Remittance Outflows in Russia



In response to a demand shock that increases Russian real GDP by one percent in the first year, remittances increase significantly by 3.3 percent. Oil supply in Russia does not significantly respond. Foreign real GDP, foreign oil supply and the real price of crude oil do not significantly respond consistent with the identification restrictions. The correlation of remittances and Russian real GDP is only slightly less for foreign real GDP shocks relative to domestic real GDP shocks.

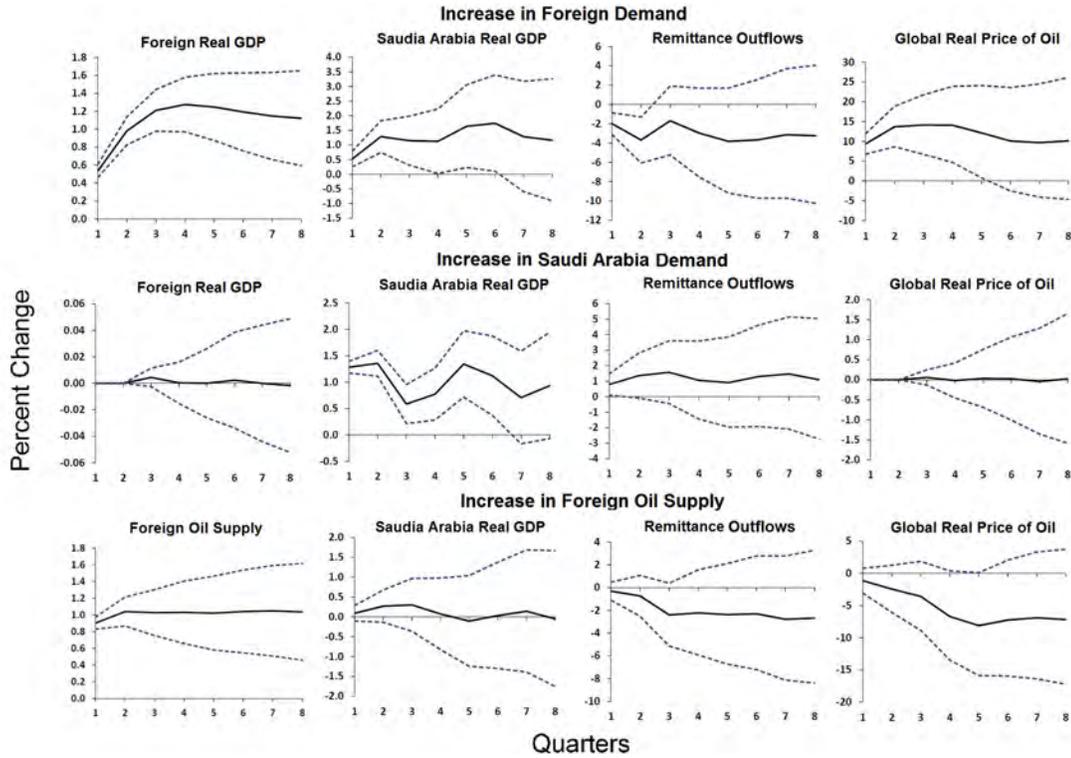
The shock which increases foreign oil supply by one percent on average in the first year generates a 2 and 5.9 percent fall in the real oil price on average in the first and second year, respectively. Russian real GDP falls by 0.6 percent in the first year and remittances outflows decline significantly by just over 2.4 percent on average in the first year. Overall, the estimates for Russia suggest a larger response of remittance outflows relative to real GDP to shocks to foreign oil supply relative to shocks from foreign or domestic real GDP.

## 2. Saudi Arabia

Figure 2 illustrates the IRFs of structural shocks in the SVAR estimated for Saudi Arabia. The level of real GDP from the Global Economic Monitor is only available from 2010q1 so the series is extended back using the IMF's International Financial Statistics seasonally adjusted volume index of GDP using year-over-year growth rates prior to 2010q1. The

growth rates of the IMF's volume index closely matches the growth rates of the Global Economic Monitor for the overlapping sample. Moreover, quarterly remittances data for Saudi Arabia is only available from 2006q1 on, so is extrapolated back using annual data and real GDP from 1995q1 to 2005q4. The impulse responses of remittance and real GDP to structural shocks are similar for the models estimated from 1995q1 or 2006q1, so the full 1995q1 to 2015q2 data sample is used.

Figure 2. SVAR: Remittance Outflows in Saudi Arabia



A demand shock that increases foreign real GDP by one percent on average in the first year significantly increases the price of oil by 12.8 percent in the first year. This is consistent with the SVARs estimated for Russia or using global data (see Appendix 2). Saudi real GDP increases by 1 percent on average in the first year accompanied with a 1.3 percent increase in Saudi oil supply. Interestingly, out-flowing remittances fall by 2.6 percent. This fall in remittances is robust across specifications of the SVAR estimated using data prior to 2010q1. Due to data limitations it is not possible to decompose this response into declines in labor inflow, reductions in the marginal propensity to remit, or expatriates wages. This is further complicated by the fact that foreign real GDP may not be correlated with expatriates home economies real GDP. Due to this, the fall in remittances to a rise in foreign real GDP is a puzzle left to be explored in future research.

In response to a demand shock that increases Saudi real GDP by one percent on average in the first year, remittances increase significantly by 1.2 percent. There is no significant response of the price of oil or foreign GDP consistent with the identifying restrictions. The different response of remittances to Saudi real GDP for alternative structural shocks is stark. The results suggest a positive correlation of remittances and Saudi real GDP for

shocks to domestic demand, and negative correlations for the shock to foreign demand.

A shock that increases foreign oil supply by one percent on average in the first year generates a 3.5 percent fall in the price of crude oil in the first year on average. This is slightly more than the estimates from the other SVARs. This possibly arises from the significant 1.3 percent rise in Saudi oil supply in response to a one percent shock to foreign oil supply, resulting in a larger overall oil-supply shock. There is no significant movement in Saudi real GDP in response to an increase in foreign oil supply. Saudi oil supply responses are interesting as they dampen oil price movements from foreign demand shocks but amplify oil price movements from foreign oil supply shocks, possibly consistent with their role as a central Organization of the Petroleum Exporting Countries (OPEC) producer. In response to the increase in foreign oil supply, remittances fall insignificantly by 1.4 percent on average in the first year. Together, the above evidence suggest that remittance outflows are more stable under foreign oil supply shocks in Saudi Arabia relative to Russia.

### 3. Summary of Structural Estimation Results

The estimates of the responsiveness of remittance outflows is found to differ across regions and across structural shocks. The empirical results illustrate the usefulness of the structure to capture the key stylized facts of remittances. Ultimately, the objective is to decompose the response of remittances into the response of the stock of foreign labor, foreign worker wages and employment, and the marginal propensity to remit out of foreign worker income. Unfortunately, the lack of data is a severe restriction on both the study of remitter dynamics, and the understanding of behavioral motives to remit and migrate.

Despite the usefulness of the SVAR as a method to provide insight into structural dynamics, caveats should be mentioned. The dynamics of the SVAR are somewhat sensitive to the sample period, particularly for the responses of remittances and home real GDP. Due to this, the SVAR is only used to roughly calibrate the dynamics of remittances in FSGM, and the calibration of the oil market dynamics was already found to be consistent. The next section details the dynamic calibration strategy for FSGM in detail.

#### B. Steady State and Dynamic Calibration of Remittances and Migration in FSGM

In the general equilibrium model, remittance dynamics are jointly determined by the dynamics of foreign labor,  $l_t^F$ , the marginal propensity to remit,  $MPR_t$ , and the wage of the foreign workers  $w_t^F$ . As discussed in the empirical section, the lack of data on foreign labor precludes a formal decomposition of these three channels using the SVAR. Thus, FSGM is calibrated to broadly match the stylized facts of structural shocks from the VARs using similar structural shocks in FSGM. To accomplish this, foreign wage dynamics are assumed to follow those of home workers and the marginal propensity to remit is calibrated jointly with foreign labor dynamics to loosely match the remittance dynamics from structural shocks in the SVAR.

The stock of foreign labor,  $l_t^F$ , in steady state is set to estimates for 2010 and 2013 from Ratha and Shaw (2007). Foreign labor stocks for other years are extrapolated assuming a fixed share of foreign labor in total labor. The dynamics of foreign labor are determined by  $\Lambda_1^F$ . Note that trend foreign labor, equation 7, includes a constant,  $\Lambda_0^F$ , implying that changes to  $\Lambda_1^F$  do not determine the steady-state stock of workers but instead determine the marginal absorption of changes in aggregate labor by foreign workers. For example, if  $\Lambda_1^F = 0$  foreign labor supply is exogenous so all changes in employed labor from the steady state balanced growth path are filled by domestic workers. Similarly, if  $\Lambda_1^F \alpha^F = 1$ , all changes in labor from the steady state balanced growth path are absorbed by foreign labor supply. The starting point for the calibration in all countries is to allow for changes in labor to be absorbed by foreign workers based on the share of foreign labor in total labor in steady state.

In steady state, total remittances sent abroad,  $PAY_t$ , are set for 2010–2015 to bilateral remittance payments from Ratha and Shaw (2007). Foreign labor supply and outgoing remittance are set equal to the data. Thus, the relative productivity of foreign workers,  $z_t^F$  (and by extension foreign wages,  $w_t^F$ ), jointly determines the marginal propensity to remit,  $MPR$ , and the share of LIQ agents in total consumption. Foreigners' relative productivity,  $z_t^F$ , is set to get  $MPR$  to generate desired remittance dynamics, while also assuring a sensible share of LIQ agents in total consumption (based on Andrle and others, 2015). If this alone is insufficient for broad consistency of the remittance dynamics with the SVAR,  $\Lambda_1^F$  is calibrated to generate the additional remittance dynamics by varying the degree of absorption of changes in aggregate labor by foreign workers.

Due to the lack of data on worker status before and after emigration, the default calibration for all regions is to assume that changes in labor emigration are fully drawn from (return to) the non-labor force participating population. The baseline calibration implies that potential output does not change (for example, from brain drain) from emigration. In section 5.A, sensitivity analysis is performed to allow for emigration to influence the labor force to illustrate the role of this assumption.

Two shocks in particular summarize the global oil market dynamics. The first is a simultaneous increase in private domestic demand in all regions (similar to the U.S. private domestic demand shock in section V.D). In this case, a one percent increase in global real GDP increases the real price of oil by 8.3 percent in the first year. This is consistent with the 12-13 percent estimate found in the SVARs, given that the calibration of the FSGM version used here has crude oil calibrated at 90 USD\$ a barrel whereas it is 55 USD\$ a barrel on average in the data sample. The second is a permanent increase in oil supply in the MENA oil-exporting region. A one percent permanent increase in oil supply reduces the global real price of crude oil permanently by 4 percent in FSGM, which is consistent with the SVAR estimates.

Similarly, two structural shocks in FSGM are primarily used to calibrate remittance dynamics. These are permanent increases in total factor productivity and temporary increases in private domestic demand in remitter regions. As per the calibration strategy described above, the marginal propensity to remit and the degree of absorption of foreign labor are set to broadly match the remittance dynamics of the home real GDP shocks in the SVAR using these two shocks. Other aspects of FSGM's calibration are identical to Andrle and others (2015).

Currently, remittances in FSGM are modeled to all countries where remittances represent over 1 percent of GDP. Hence, most economies in Central America, Pacific islands, Central and East Asia, and Southeastern Europe are remittees. The United States, the euro area, Russia and the GCC countries are assumed to be remitters and hosts of foreign labor. Although other countries remit large amounts in U.S. dollars, they often represent a small share in GDP in the destination economies, and hence are not modeled in this exercise for parsimony. A detailed summary of foreign labor, and inflows and outflows of remittances in FSGM is provided in Appendix 1.

## V. Scenario Analysis

This section illustrates the properties of the proposed model of foreign labor and remittances by examining scenarios pertinent to international remittance flows. The following scenarios are examined:

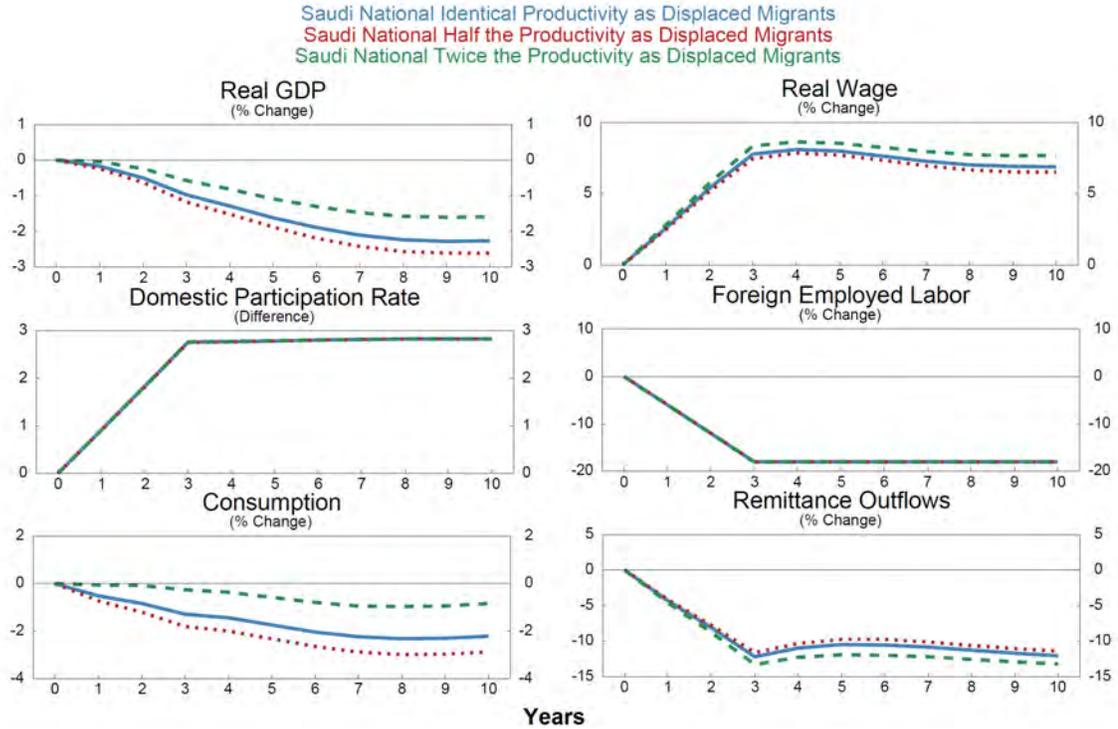
1. labor nationalization policies in Saudi Arabia that permanently substitute domestic for foreign labor;
2. a permanent increase in oil production in the GCC;
3. a permanent stagnation in output in the euro area;
4. a temporary increase in private domestic demand in the United States; and
5. a permanent reduction in the cost to remit from all countries.

### A. Nationalization Policies in Saudi Arabia

To increase Saudi nationals' employment in the private sector, a revised nationalization policy was launched in 2011 known as the *Nitiqat* program. While previous Saudization programs have been perceived to not be effective (Hertog, 2012), the current mandate has both strong incentives and sanctions. Private enterprises face Saudi employment quotas, and if they are not met, expatriate employee visas are restricted or revoked. The government was to further increase Saudi employment quotas for major commercial firms in April 2015 from 29 percent to 66 percent, but the legislation was postponed because of backlash. Moreover, in 2013 and 2014, authorities clamped down on illegal expatriate workers, resulting in a large outflow of these workers.

The implications of these labor nationalization policies are examined using FSGM. The stock of foreign labor is permanently reduced by 1.8 million based on estimates of displaced workers between 2011 and 2015 (EIU, 2015). Moreover, using official data, the private sector participation of Saudi nationals has increased from 0.84 million in 2011 to 1.6 m in 2015. It is assumed that the rise in Saudi employment, 760 thousand, is attributed to labor nationalization policies. The labor response is assumed to be gradually realized over three years. The outcome depends on the productivity of the marginal Saudi nationals. The results when the marginal Saudi national has equal, double, and half the productivity of the displaced foreign workers are presented in Figure 3.

Figure 3. Saudi Arabia: Labor Nationalization Policies in Saudi Arabia

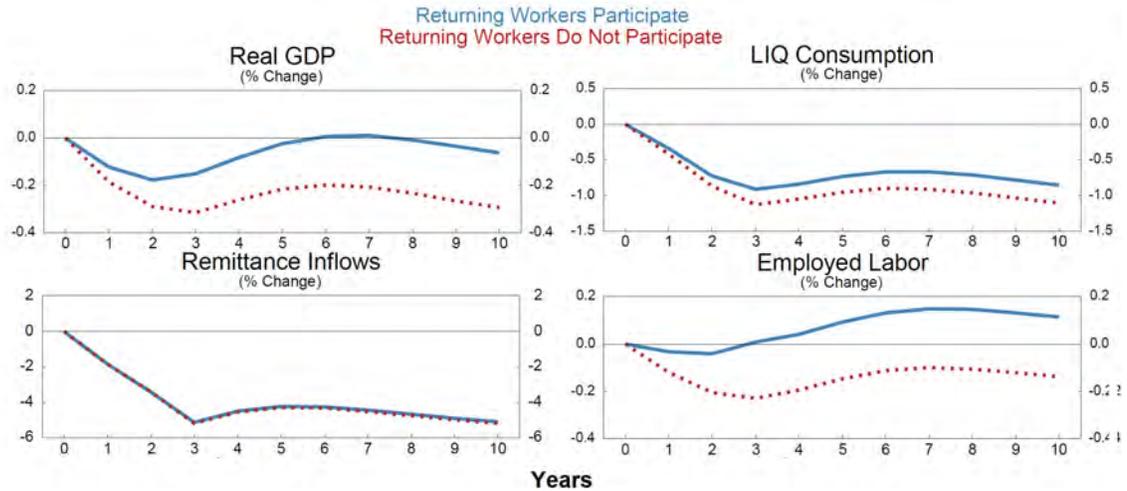


First, consider the case when the productivity of the additional Saudi nationals in the private sector is equal to that of the displaced workers. The cessation of remittance flows from the departure of 1.8 million foreign workers permanently lowers remittances around 12 percent after three years. Since the number of foreigners exiting the labor force is greater than the number of Saudis gaining private employment, total labor supply and overall labor force participation falls, even though the domestic participation rate rises. Lower labor supply drives up the marginal productivity of labor and hence the real wage. The fall in consumption from migrant labor is only partly offset by rise in the real wage resulting in a decline in overall consumption. After the first few years, as the higher cost of labor reduces the marginal return on investment, capital falls. Combined with a smaller overall labor force, this results in a decline in potential output.

The long run effect on output depends on the marginal productivity of the domestic worker relative to the marginal productivity of the displaced worker. For example, if domestic workers exhibit half of the productivity of displaced foreign workers, output would be expected to fall by over two and a half percent in the long run. To offset the losses to output, the productivity of the additional domestic laborer would have to be approximately six times that of the displaced foreign worker.

Regardless of the relative marginal productivity of the foreign workers, remittance flows decline to the economies supplying expatriate labor to the GCC. In Egypt, Figure 4, remittance inflows decline by about five percent. The decline in remittances lowers liquidity constrained households income and their consumption disproportionately declines relative to overlapping generation households. Figure 4 shows two cases. In the first case,

Figure 4. Egypt: Labor Nationalization Policies in Saudi Arabia



Egyptian workers who leave Saudi Arabia return to Egypt and join the labor force based on current participation rates, “Returning Workers Participate.” In the second case, “Returning Workers Do Not Participate, the returning workers do not participate in the labor force, increasing the population and the non-labor force participating population by the same amount.

When returning workers do not reenter the labor force of Egypt potential real GDP falls by an additional 0.2 percent. When workers do reenter the labor force it helps offset some of the effect from the decline in remittances, and hence LIQ consumption falls by less. The effect on real GDP is also mitigated by the depreciation of the real effective exchange rate and the corresponding improvement in the trade balance. These results illustrate that labor driven movements in remittances can have varying implications on the expatriate economy depending on how well the returning workers are absorbed back into the labor force as productive workers.

## B. Permanent Increase in Oil Production in the GCC

Many large remitters are also oil producers, including the GCC countries and Russia, potentially making remittance flows particularly susceptible to movements in oil prices. Figure 5 illustrates the effect on the MENA oil-exporting region from a permanent increase in the supply of oil in the GCC countries. The permanent rise in oil supply by close to eight percent results in a 15 percent decline in the real global price of oil in the first year and 10 percent decline thereafter. The fall in oil prices induce a loss in wealth and income of households as royalties from oil production fall, even though there is a rise in real GDP from an increase in real exports and oil production. Overall, the demand for labor and real wages fall, resulting in a four percent permanent decline in remittances from the MENA oil-exporting region.

The MENA oil-importing region (Figure 7) experiences close to a three percent decline in

Figure 5. MENA Oil Exporters: Permanent Increase in Oil Production in the GCC

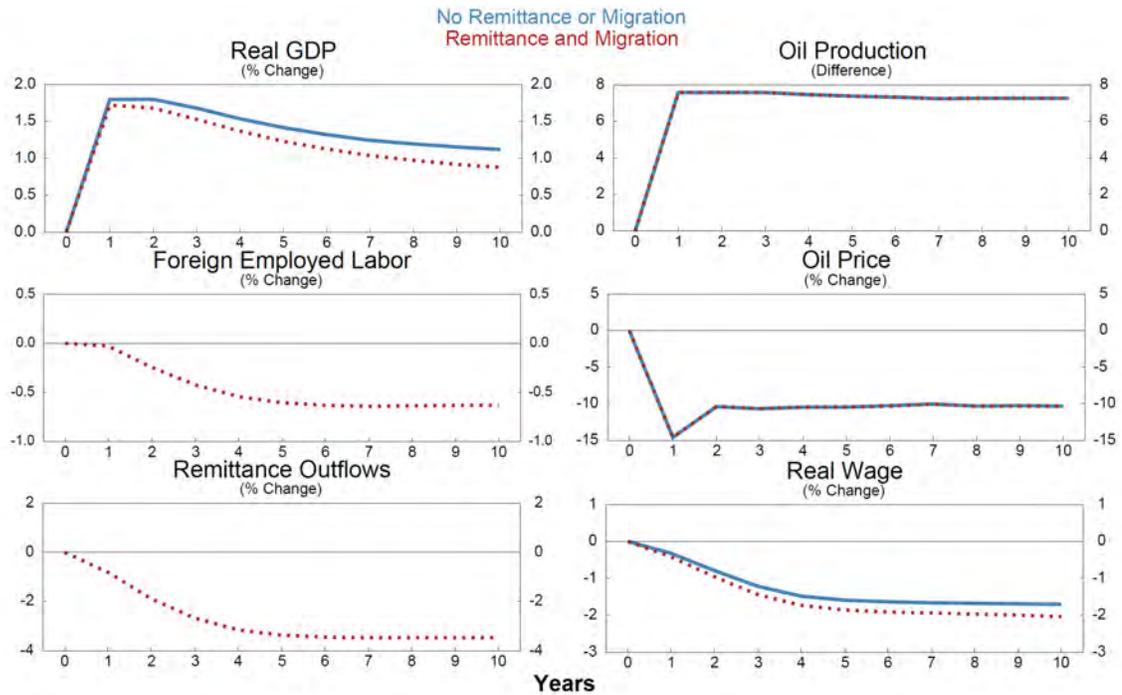
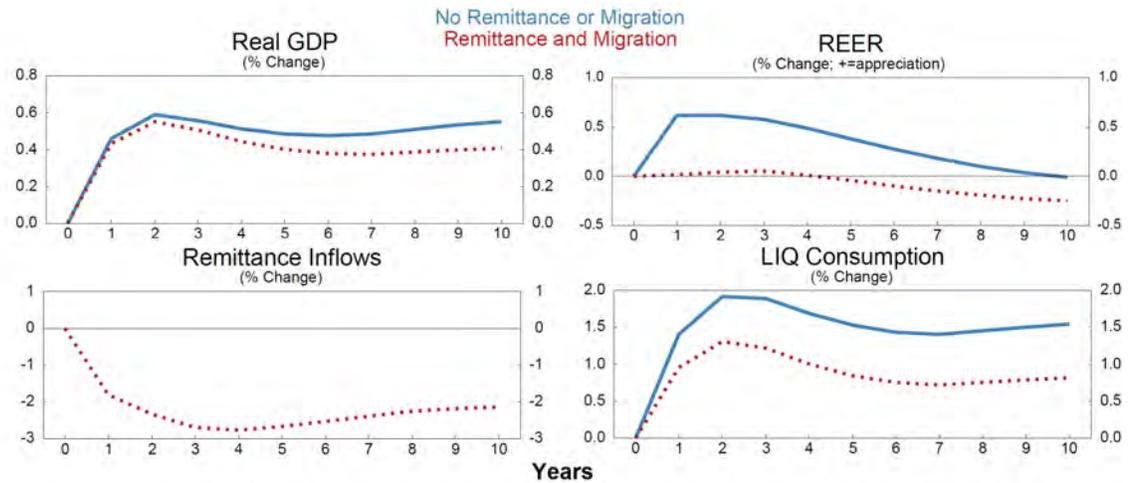


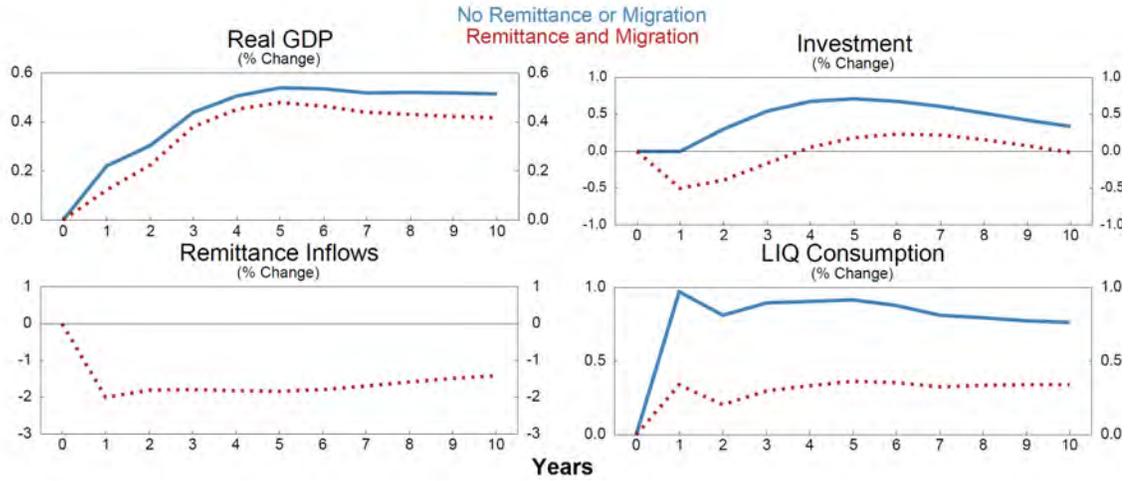
Figure 6. MENA Oil Importers: Permanent Increase in Oil Production in the GCC



remittances at peak. The decline in remittances from the MENA oil-exporting region are slightly offset by increasing remittances from the euro area and the United States who benefit from the lower oil prices. The decline in remittances lowers LIQ consumption. Overall, the decline in remittances is more than offset by the benefits from the decline in the price of oil reducing the cost of oil in consumption, and production. As shown by the above examples, the macroeconomic effects from movements in oil prices can dominate the macroeconomic effects from remittance channels from oil supply driven oil price

movements.

Figure 7. CCA Oil Importers: Permanent Increase in Oil Production in the GCC



All else equal, the decline in remittance flows has adverse effects on the Central Asia and Caucasus oil-importing region, which consists of Armenia, Georgia, the Kyrgyz Republic, and Tajikistan (Figure 6). These countries receive almost no remittances from MENA oil exporters, but are highly dependent on remittance flows from Russia with remittance inflows constituting 25 percent of GDP in 2015. The decline in the price of crude oil represents a negative terms of trade and wealth shock to Russia. As oil prices fall, the demand for labor and real wages fall, which induces a three percent decline in remittance outflows from Russia. Remittance inflows to the Central Asia and Caucasus oil-importing region decline by almost two percent. However, as this region is a large oil importer, overall real GDP increases from the improvement in the terms of trade from the falling oil prices. This example illustrates the role of third countries on the transmission of remittance flows from oil price shocks. It also illustrates the the role of the remittee's net oil export position, as foreign oil price movements result in lower remittances inflow but also higher real GDP from the improved terms of trade.

### C. Permanent Stagnation in Output in the Euro Area

Figure 8 presents the a permanent stagnation in output driven by a decline in total factor productivity in the euro area that lowers the level of real GDP by one percent in the long run. The decline in the return on capital leads to lower investment which accumulates into a lower capital stock. Reduced marginal product of labor lowers labor demand, and wages decline permanently by one percent. Foreign workers are adversely affected by the declining wages, which lowers migrants' labor income, and results in a one percent fall in remittance outflows from the euro area.

The MENA oil-importing region is presented in Figure 9. In the model without remittances or migration, the decline in external demand reduces domestic demand and

Figure 8. Euro Area: Economy Wide Productivity Decline in the Euro Area

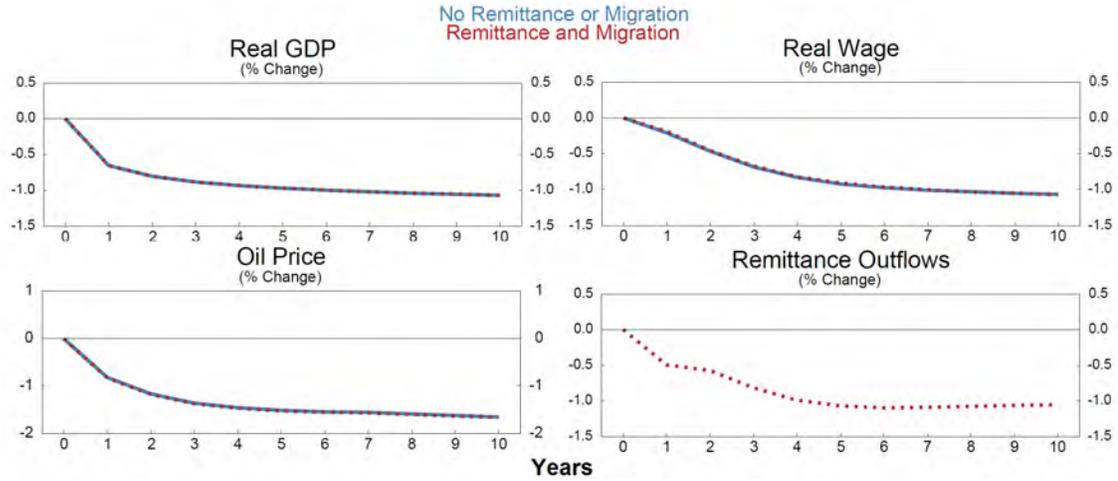
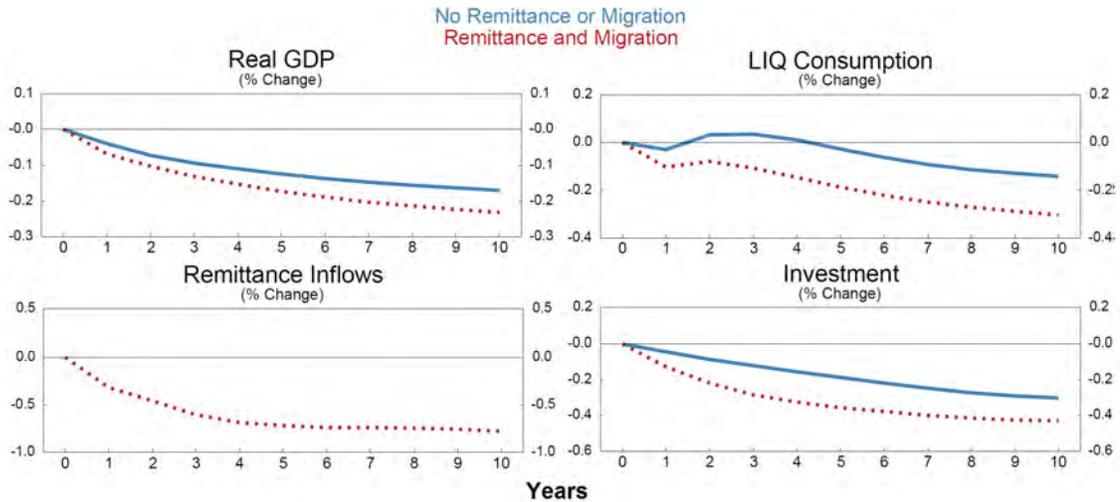


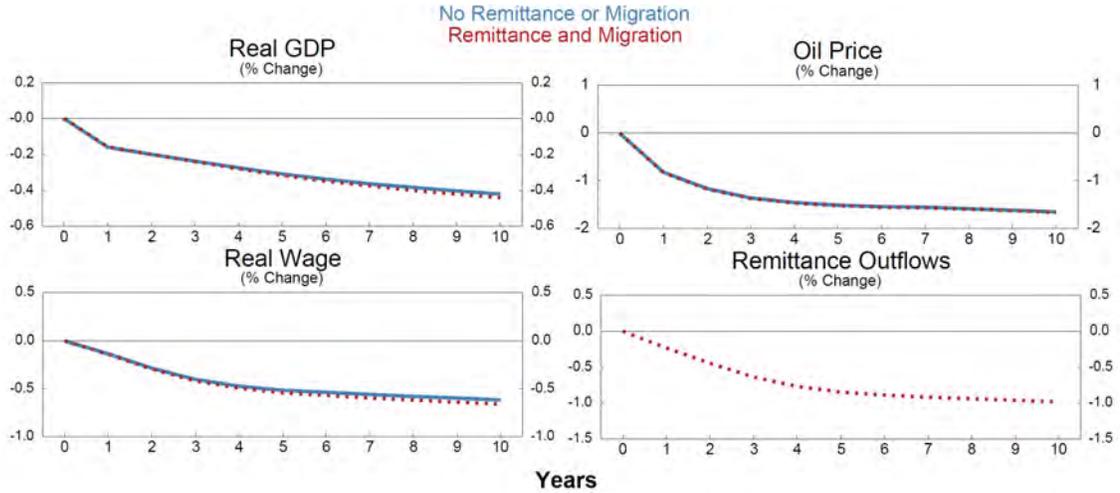
Figure 9. MENA Oil Importers: Economy Wide Productivity Decline in the Euro Area



real GDP in the region. In the model with remittances and migration, the region experiences an overall decline in remittances of close to 0.8 percent in the long run. This leads to an additional 0.2 percent fall in consumption of LIQ households, further reducing domestic demand relative to the model without remittances.

Interestingly, approximately 75 percent of the decline in remittance inflows to the MENA oil-importing region originates not from the euro area but from the MENA oil-exporting region. As shown in Figure 10, the MENA oil-exporting region is adversely affected by the two percent decline in oil prices and declining external demand from the euro area. Remittance outflows from the MENA oil-exporting region decline by approximately one percent in the long run. As the above example illustrates, remittance inflows from third-party remitter countries may dominate changes in remittance inflows from the

Figure 10. MENA Oil Exporters: Economy Wide Productivity Decline in the Euro Area



country of which the shock originated.

#### D. Increase in Private Domestic Demand in the United States

Figure 11 illustrates a persistent increase in private domestic demand in the United States that is calibrated to increase real GDP by one percent in the first year relative to baseline. The increase in private investment is roughly five times larger than that of private consumption in percent terms. The increase in private investment accumulates into a higher stock of private capital which contributes to a persistent increase in potential output. The increase in output raises aggregate labor demand putting upward pressure on real wages. In the model with remittances and migration, there is an inflow of foreign workers which further increases employed labor and results in less wage pressures. Due to higher real wages and an influx of migrants, remittances increase by close to 2 percent in the first and second years.

The spillover on Guatemala is summarized in Figure 12. In the model without migration or remittances, the economy experiences an increase in external demand and real GNP increases primarily from the increase in exports. As the increase in external demand puts upward pressure on inflation, the monetary authority increases interest rates to return inflation to target. As a result private investment and consumption decline.

In the model with remittances and migration, remittance inflows increase by close to 2 percent. This inflow of remittance increases LIQ households' income and hence their consumption. The inclusion of remittances is able to replicate the positive contemporaneous consumption co-movement observed in the data but difficult to find in the international spillovers from structural models.

The outflow of workers from the non-labor participating population reduces the total population by a small amount. The inflow of remittances puts pressure on the exchange rate to appreciate, resulting in less external demand all else equal. Even though only

Figure 11. United States: Temporary Increase in Private Domestic Demand in the United States

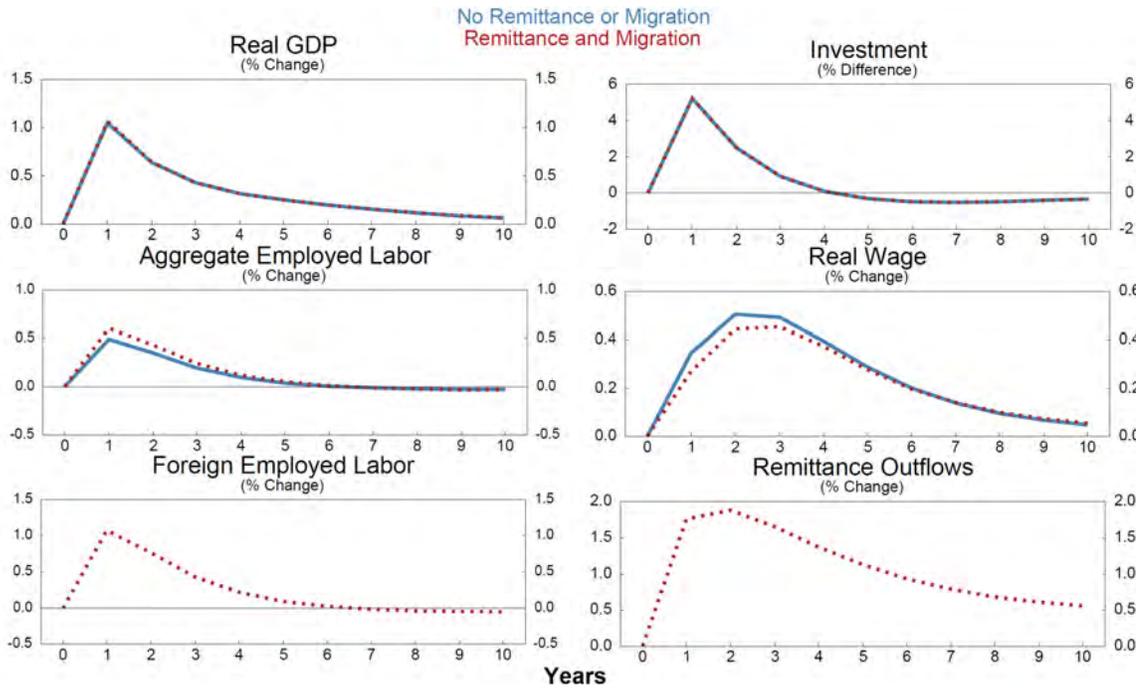
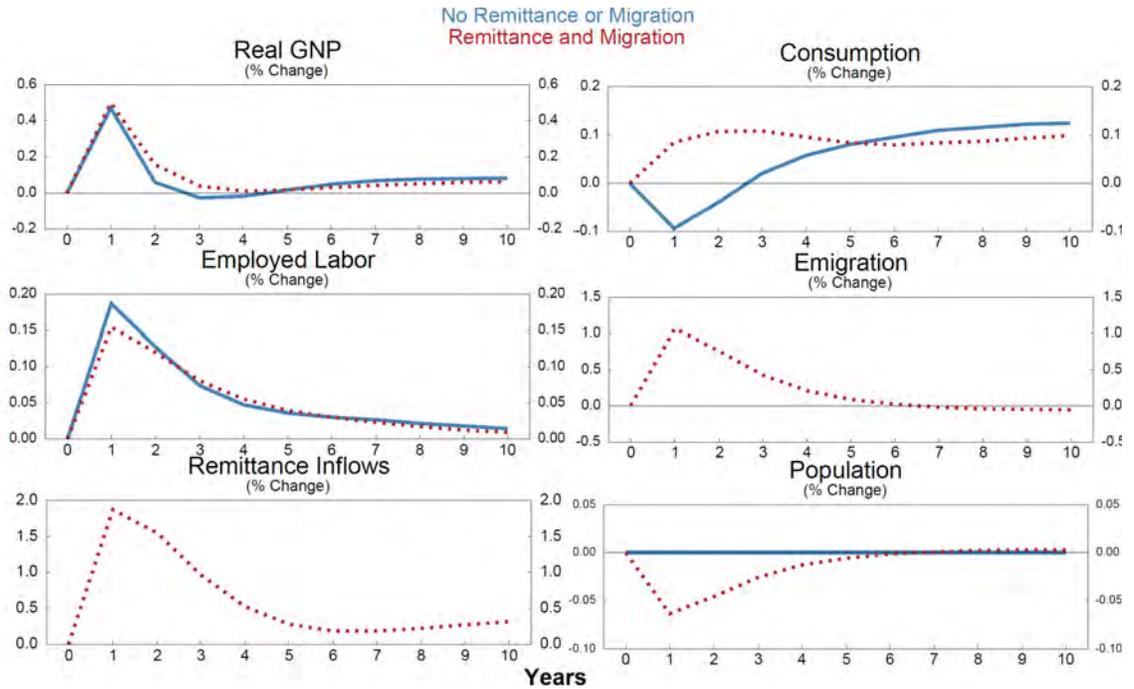


Figure 12. Guatemala: Temporary Increase in Private Domestic Demand in the United States

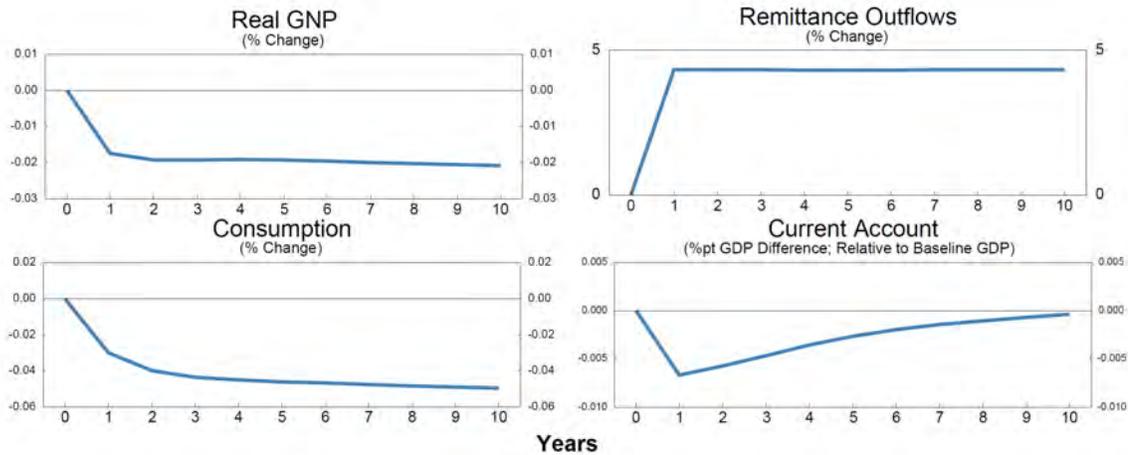


non-labor force participating persons emigrate, the general equilibrium implications of the decline in external demand put downward pressure on labor demand which slightly dampens the rise in employed labor.

### E. Permanent Reduction in the Cost to Remit from All Regions

The World Bank estimates that the average global cost of remitting funds was 8 percent in 2014, and as high as 12 percent in Sub-Saharan Africa (World Bank, 2015). The disproportional cost to remit to Africa has been criticized. Figure 13 and 14 illustrates the implications of a permanent global reduction in the cost to remit by four percentage points. This could come from policy intervention or financial innovation, such as improvements in financial technology (fin-tech) services.

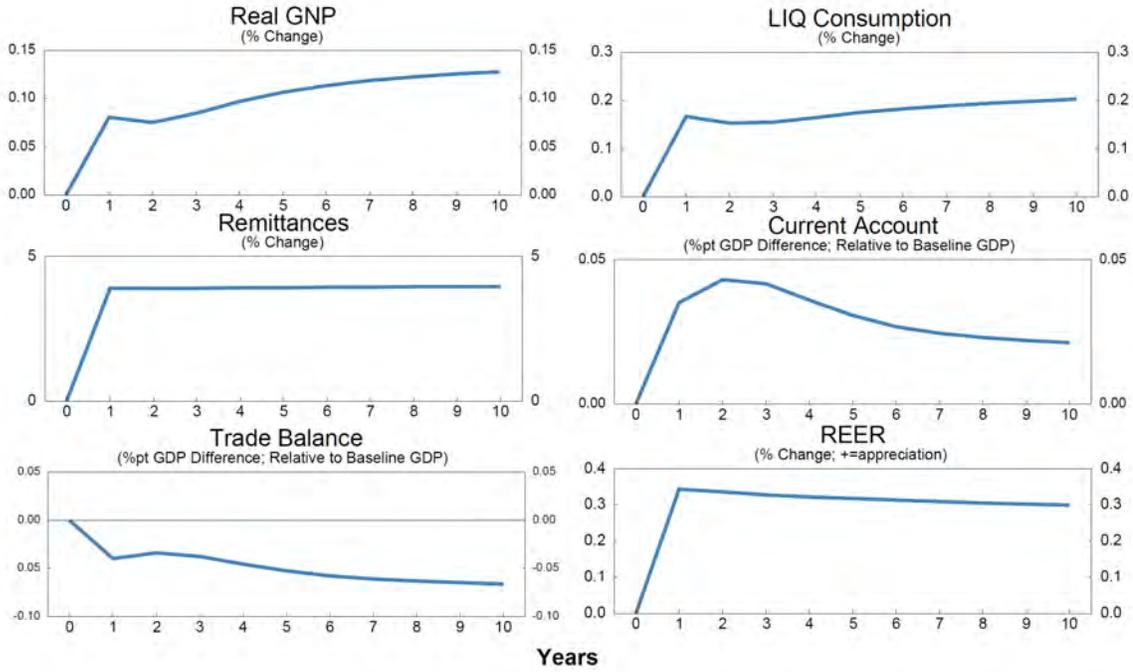
Figure 13. Euro Area: Permanent 4 ppt Global Reduction in the Cost to Remit



Financial intermediaries of remittances collect lower revenue and report lower profit and, therefore, pay lower dividends to OLG households in remitter regions. These dividends represent a very small proportion of overall income in remitter countries. The effects from the decline in the cost to remit on the euro area are negligible (Figure 13). Expatriate workers remit all cost savings. As a result, remittance outflows increase by just over four percent.

Figure 14 shows the implications of the higher remittances on Nigeria. Remittance inflows increase by 4 percent, resulting in higher consumption of LIQ households by 0.2 percent. Remittances in Nigeria are 4 percent of GDP, so the rise in remittances is only 0.16 percent of GDP. The benefits are slightly offset by the appreciating real exchange rate, resulting in a deterioration in the terms of trade. Overall, real GNP increases by 0.1 percent in the long run. With exogenous labor export shares, the model does not take into account any additional migration due to the increase in the return on exporting labor abroad. Hence, the results may be under estimating the benefits, especially if the labor came from those currently not participating in the Nigerian labor force.

Figure 14. Nigeria: Permanent 4 ppt Global Reduction in the Cost to Remit



## VI. Discussion on Identification of the Motives to Remit and Migrate

The structural model identifies four factors that drive remittance outflows from remitters. These are the stock of foreign labor, foreign worker wages and employment, and the marginal propensity to remit (MPR) out of foreign worker income. The analysis of the structural general equilibrium model made a number of assumptions, including that foreign and domestic workers share wage dynamics, and that the marginal propensity to remit is constant. Despite this, the scenario analysis illustrates that remittance inflows and the real GDP of labor-exporting economies can be either negatively or positively correlated depending on the source of the structural disturbance. In the presence of several linkages across economies, including from primary commodity markets and from non-primary commodity trade, the correlations will depend on the source of the underlying shock.

Consider, for example, the relationship of remittance flows and commodity markets. The correlation of remittance inflows and the real GDP of labor exporting economies are related by the fact that many labor-importing economies are also oil exporters, and that many labor-exporting economies are also oil importers. This is because remittance dynamics from major oil exporters may be driven by commodity price changes that also induce persistent terms of trade effects which may have first order effects on the remittes economy. This suggests that, going forward, the link between oil-markets and remittances needs to be made explicit.

The above-mentioned issues also suggest that one should be cautious about using estimates of conditional correlations of remittances to home economy's GDP to draw conclusions of the motives of remittance determination. Suppose that we allow the MPR to respond to conditions in the home economy. Then, there would be a wide range of responses of the MPR to conditions in the home economy (both positive and negative) where the dynamics of the MPR would not be able to be identified by the behavior of the aggregate remittances. This is because aggregate remittances will also be driven by the number of expatriate workers, their employment, and wage dynamics.

In order to better understand remittances and migration behavior, we need to better understand the motives to remit and migrate (as they may be different) by decomposing the response of aggregate remittances into the stock of foreign labor, foreign worker wages and employment, and the MPR. Future studies on remittances should also take primary commodity and multilateral channels into account given the evidence on the potential importance of these channels. Such a structural interpretation is also crucial for the evaluation of alternative theories of remittance behavior.

## VII. Conclusion

This paper provides model-based analysis of international labor migration and remittances. It utilizes a global general equilibrium model with labor migration and remittances in a multilateral setting with endogenous primary commodity markets. The multilateral framework shows how changes in remittance inflows need not originate from the region with the underlying economic disturbance but can come primarily through third country effects, such as through international spillovers from primary commodity markets on labor-importing, oil-exporting economies. Moreover, the inclusion of remittances can help generate the positive co-movement in consumption across economies, which is often found lacking in multi-country general equilibrium models.

The structural model is calibrated based on a proposed method to estimate the structural dynamics of remittance outflows of the major remitter regions. The identification restrictions are motivated by the general equilibrium model of the global economy with endogenous commodity markets. The estimates of the responsiveness of remittance outflows is found to differ across regions and across structural shocks. Generally, remittance outflows from Saudi Arabia are found to be more stable than those from Russia, particularly for shocks to home demand and foreign oil supply. Moreover, remittances outflows from home demand shocks have a larger elasticity with respect to home real GDP than foreign demand shocks in Russia but are smaller in Saudi Arabia.

Structural disturbances are examined in the general equilibrium model. Results illustrate that remittance inflows and the real GDP of labor-exporting oil-importing economies can be either negatively or positively correlated given shocks to the global market for crude oil. This raises questions as to the validity of evaluating alternative theories of remittance behavior based on the responsiveness of remittances to the remitter's GDP. This is because remittance dynamics from major oil exporters may be driven by commodity price changes that can have first order effects on the domestic economies since many labor-exporting economies are also oil-importers.

Future studies on remittances should take primary commodity and multilateral channels into account given the evidence on the potential importance of these channels. Also, further research and additional data measures are needed to decompose remitter dynamics into changes into migration, the marginal propensity to remit, and wages and employment of foreign workers. Such a structural interpretation is also crucial for the evaluation of alternative theories of remittance behavior.

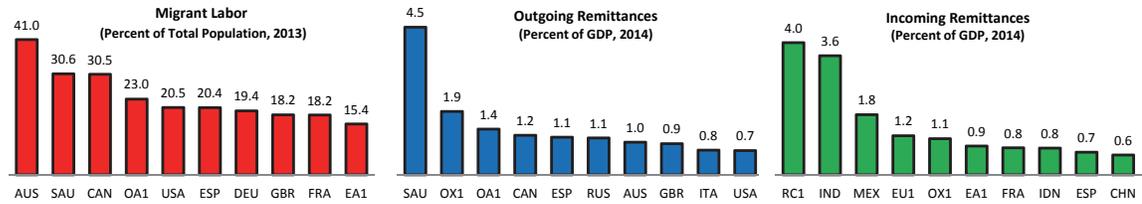
## Appendices

### Appendix 1: Regional Remittance Trends

This section provides a description of the regional migrant labor stocks and the remittance flows summarized using the regional compositions of FSGM’s modules. The intent is to provide an introduction to the regions and FSGM modules in which remittance channels may play a major role in dynamics. Figures, 15-22 summarize the top regions in the FSGM modules that have the highest stock of migrant labor as a percent of the total population, outgoing remittances to GDP, and income remittances to GDP.

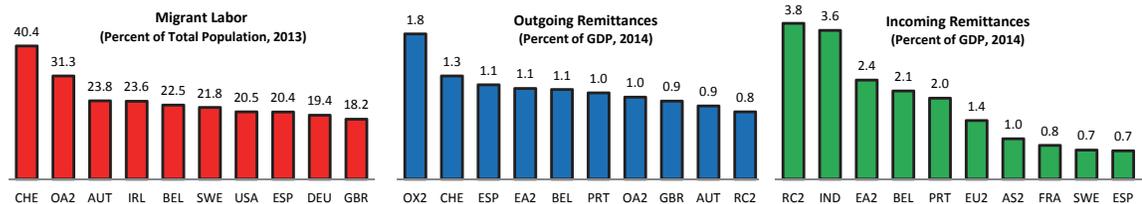
Gulf Cooperation Council (GCC) members remit some of the highest shares of GDP in 2013: 4.5 percent in Saudi Arabia and 6.1 percent in other GCC economies (GCX region), see Figure 17. Approximately half of GCC remittances are sent to South Asia: India, Bangladesh, Nepal and Pakistan. For example, Pakistan, with remittances at 6 percent of GDP, receives some 60 percent of its remittances from GCC countries. The other half is sent to other countries in the Middle East and North Africa (MENA) region, mostly Egypt and Libya. Outflows of remittances from the GCC have doubled in recent years, although the persistent decline in oil prices could eventually erode these increases. Moreover, nationalization policies in Saudi Arabia have slowed remittance flows in recent years, reducing the number of migrant workers to Saudi Arabia.

Figure 15. Remittance and Migrant Labor in G20MOD



Region codes are as follows: EA1, Other Euro Area; EU1, Other European Union; OA1, Other Advanced Economies; OX1, Other Oil Exporters (mostly OPEC); RC1, Remaining Countries

Figure 16. Remittances and Migrant Labor in EUROMOD

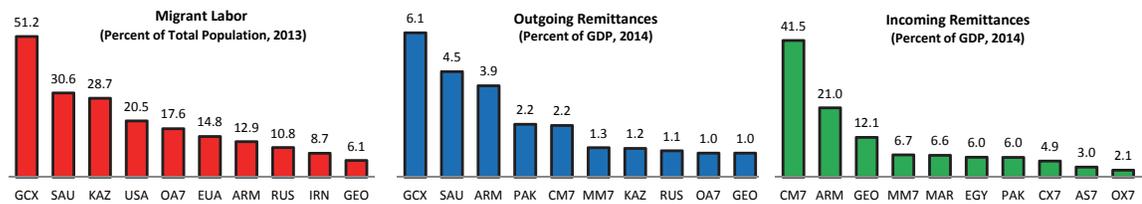


Region codes are as follows: AS2, Newly Industrialized Asia excluding China and India; EA2, Other Euro Area; EU2, Other European Union; OA2, Other Advanced Economies; OX2, Oil Exporters (mostly OPEC, Russia); RC2, Remaining Countries

In G20MOD and EUROMOD, receipts of remittances are largest in the remaining regions followed by India, close to 4 percent of GDP in both modules (Figures 15 and 16). The majority of these remittances originate from the GCC countries. Even though many advanced economies have foreign labor share as a percent of the population above fifteen percent, outgoing remittance flows are very small. Thus, the GCC to South Asia flows are expected to have the largest international spillovers from remittances in both G20MOD and EUROMOD.

Remittance dynamics are expected to constitute a large proportion of international spillover channels in MCDMOD which models many of the Middle East and Central Asia economies. As shown in Figure 17, seven regions in MCDMOD have remittance shares greater than or equal to 6 percent of GDP. However, the GCC is not necessarily the largest source of remittances for many economies.

Figure 17. Remittances and Migrant Labor in MCDMOD

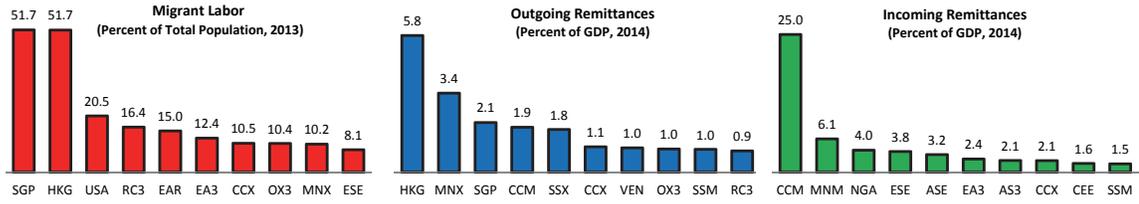


Region codes are as follows: AS7, Emerging Asia; CM7, Central Asia and Caucasus Oil Importers; CX7, Central Asia and Caucasus Oil Exporters; EUA, Euro Area; EU7, Other European Union; GCCX, Other GCC Oil Exporters; LAT, Latin America; MN7, Other Middle East and North Africa Oil Importers; OA7, Other Advanced Economies; OX7, Other Oil Exporters; RC7, Remaining Countries

Eastern and Southern Europe as well as Central Asia rely heavily on remittances from Russia and Western Europe. In MCDMOD, the largest recipients of remittances are those dependent on flows from Russia. For example, the Caucasus and Central Asia Oil Importers (CM7) region has remittance inflows of 41.5 percent of GDP, followed by Armenia (21 percent), and Georgia (12.1 percent). In EMERGMOD (Figure 18), remittances flows to the Central Asia and Caucasus Oil Importers (CCM) are very high at 25 percent of GDP, mostly coming from Russia. Moreover, in EEUMOD (Figure 19), Ukraine is highly dependent on remittances from Russia, with remittances constituting 5.4 percent of GDP.

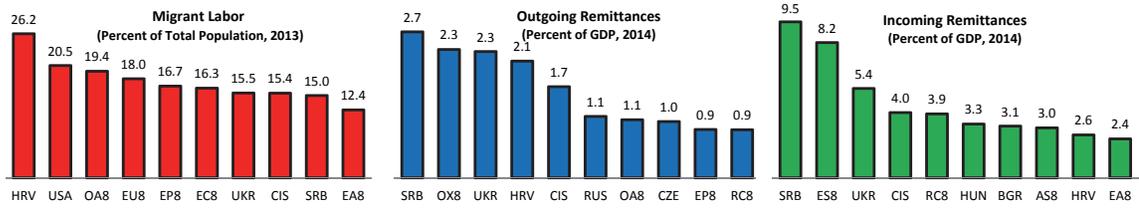
Remittance flows from Europe are particularly large for Northern Africa, and Eastern and Southern Europe. North Africa receives over half of its remittances from Europe, whereas a third is from the GCC. In MCDMOD, European flows are high in comparison to the other Middle East and North Africa Oil Importers (MM7) and Morocco, at 6.7 and 6.6 percent of GDP, respectively. In EEUMOD, Southeastern Europe and Serbia have high shares of remittances at 8.2 and 9.5 percent of GDP, respectively. This is reflected in EMERGMOD which includes many of the countries in EEUMOD and MCDMOD. In EMERGMOD, remittances to GDP are 3.8 percent of GDP in Eastern and Southeastern Europe (ESE) and 6.1 percent of GDP in the Middle East and North Africa Oil Importers region (MNM), making these regions susceptible to remittance outflows from Europe.

Figure 18. Remittances and Migrant Labor in EMERGMOD



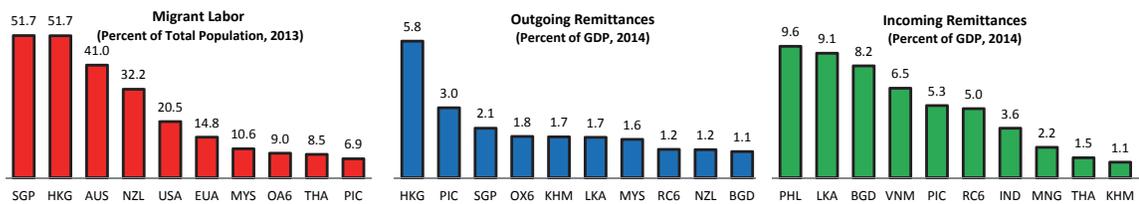
Region codes are as follows: ASE, ASEAN-3 (MYS,PHL,THA); AS3, Rest of Emerging and Newly Industrialized Asia (including IND, IDN, KOR); CCM, Caucasus and Central Asia Oil Importers; CCX, Caucasus and Central Asia Oil Exporters; CEE, Central Europe 3; EA3, Emerging Euro Area; ESE, Eastern and Southeastern Europe; MNM, Middle East and North Africa Oil Importers; MNX, Middle East and North Africa Oil Exporters; OX3, Other Oil Exporters (mainly NOR, RUS); SSM, Sub-Saharan Africa Oil Importers; SSX, Sub-Saharan Africa Oil Exporters; RC3, Remaining Countries

Figure 19. Remittances and Migrant Labor in EEUMOD



Region codes are as follows: AS8, Emerging Asia; CIS, CIS excluding Russia; EA8, Emerging Euro Area; EC8, Core Euro Area; EP8, Euro Area Periphery; ES8, Eastern and Southeastern Europe; EU8, Other European Union; LAT, Latin America; OAS, Other Advanced Economies; OX8, Oil Exporters; RC8, Remaining Countries

Figure 20. Remittances and Migrant Labor in APDMOD

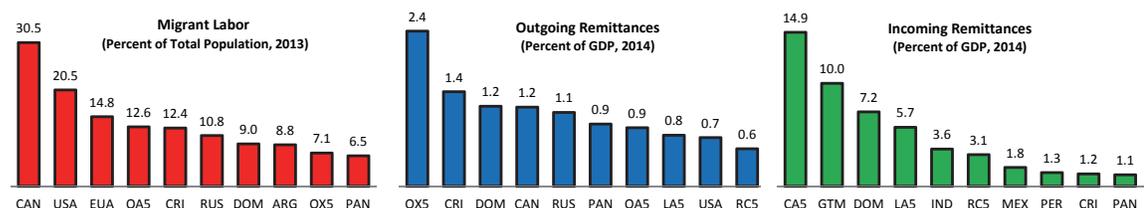


Region codes are as follows: EUA, Euro Area; LAT, Latin America; OAS, Other Advanced Economies; OX6, Oil Exporters; PIC, Pacific Island Countries; RC6, Remaining Countries

The importance of remittances to East Asia and the Pacific regions is notable in APDMOD, as remittances are larger than or equal to 5 percent of GDP in six of its regions. At 9.6 percent of GDP, the Philippines is the regions largest recipient of remittances as a percent of GDP, coming primarily from the U.S., Euro Area, Canada,

and Singapore. This is followed by Sri Lanka (9.1 percent), Bangladesh (8.2 percent), Vietnam (6.5 percent), and the smaller Pacific Islands (PIC) at 5.3 percent. The source of remittances across these economies is quite diversified, such as for the above-mentioned example of the Philippines.

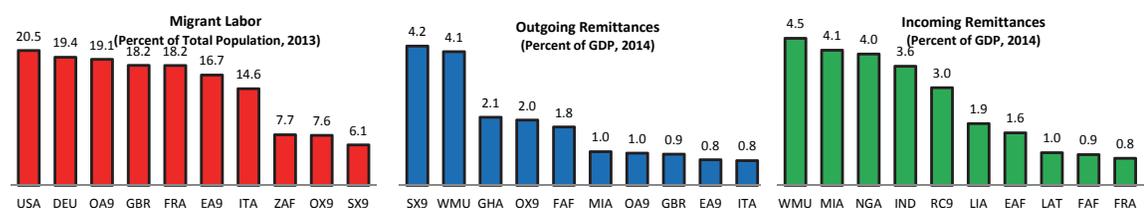
Figure 21. Remittances and Migrant Labor in WHDMOD



Region codes are as follows: CA5, Other Central America (SLV,HND,NIC); EUA, Euro Area; LA5, Other Latin America; OX5, Oil Exporters; RC5, Remaining Countries

Many of the Latin American and Caribbean economies are reliant on regional remittance flows. The United States accounts for over half of the flows, which are concentrated in the Caribbean and Central America. In WHDMOD (Figure 21), the United States largest recipients are Mexico (1.8 percent of GDP), Other Central America (CA5) (14.9 percent of GDP), the Dominican Republic (7.2 percent of GDP), Guatemala (10 percent of GDP), and Other Latin America (LA5) (5.7 percent of GDP). Spain hosts over one-tenth of all migrants from Latin America, although as a percent of GDP, remittances from Spain are only important in the Other Latin America region (LA5) which has total incoming remittances at 5.7 percent of GDP.

Figure 22. Remittances and Migrant Labor in AFRMOD



Region codes are as follows: EA9, Other Euro Area; EAF, Eastern Africa; FAF, Fragile Africa; LAT, Latin America; LIA, Low Income Africa; MIA, Middle Income Africa; OA9, Other Advanced Economies; OX9 , Other Oil Exporters; SX9, Sub-Saharan Africa Oil Exporters; WMU, West African Economic and Monetary Union, WAEMU; RC9, Remaining Countries

In Sub-Saharan Africa, the importance of remittances varies greatly depending on the country. In AFRMOD (Figure 22), the largest recipients of remittances are the West African Economic and Monetary Union (WMU), Middle Income Africa (MIA), and Nigeria, all close to 4 percent of GDP. Nigeria accounts for around two-thirds of total remittance inflows to the region. Of these flows, most originate in Western Europe, notably France, with a third coming from the United States.

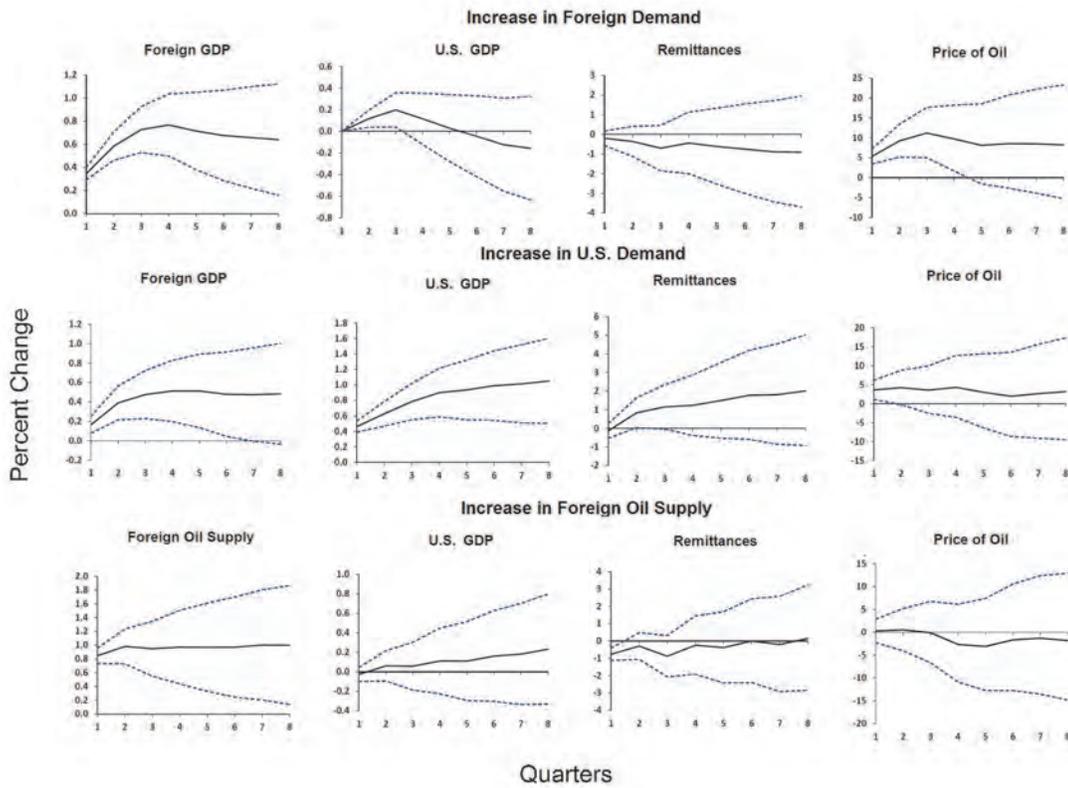
Overall, MCDMOD is the FSGM module where remittances channels drive the dynamics in the most regions. The GCC, Europe, and Russia are the primary sources for these regions. Many of these regions are represented in EMERGMOD, and EEUMOD, suggesting that remittances are also important to these modules. A handful of regions in WHDMOD have high dependence on remittances, mainly from the United States. Again, several regions in APDMOD have high share of remittances, although the source of these remittances tends to be diversified. Overall, G20MOD and EUROMOD will have little of their dynamics influenced by remittances. The main link in these models is from oil exporters to the remaining country and Asian regions.

## Appendix 2: Additional SVAR Results

### The United States

Figure 23 illustrates the IRFs of structural shocks in the SVAR estimated for the United States. The IRFs are normalized so that the shock is one percent on average in the first year. The model is estimated using quarterly data from 1994q1 to 2015q2. The assumption of a SOE is unlikely for the United States so the structure is modified to allow for shocks to U.S. real GDP to have a contemporaneous effect on foreign real GDP but not vice versa. Further the lags of U.S. GDP are not restricted to zero in any equations. Although the ordering affects the contemporaneous response of U.S. and foreign real GDP to each other's demand shocks, the response of remittances is robust across specifications. A demand shock that increases foreign real GDP by one percent on average in the first

Figure 23. SVAR: Remittance Outflows in the United States



year results in a significant fifteen percent increase in the real price of oil on average in the first. Oil supply does not significantly rise, but home real GDP increases significantly by 0.2 percent on average in the first year. There is a slight insignificant fall in U.S. remittance outflows.

A demand shock that increases U.S. real GDP by one percent on average in the first year results in an increase in U.S. remittance outflows of one percent on average in the first year and two percent on average in the second year. There is significant upward pressure

in the first year on the price of oil by five and half percent on average and foreign real GDP increases significantly by half a percent.

The shock which increases foreign oil supply by one percent in the first year results in a decline in the real price of oil by half a percent on average in the first year and two percent on average in the second year. U.S. and foreign real GDP increase slightly but insignificantly.

### The Euro Area

Figure 24. SVAR: Remittance Outflows in the Euro Area

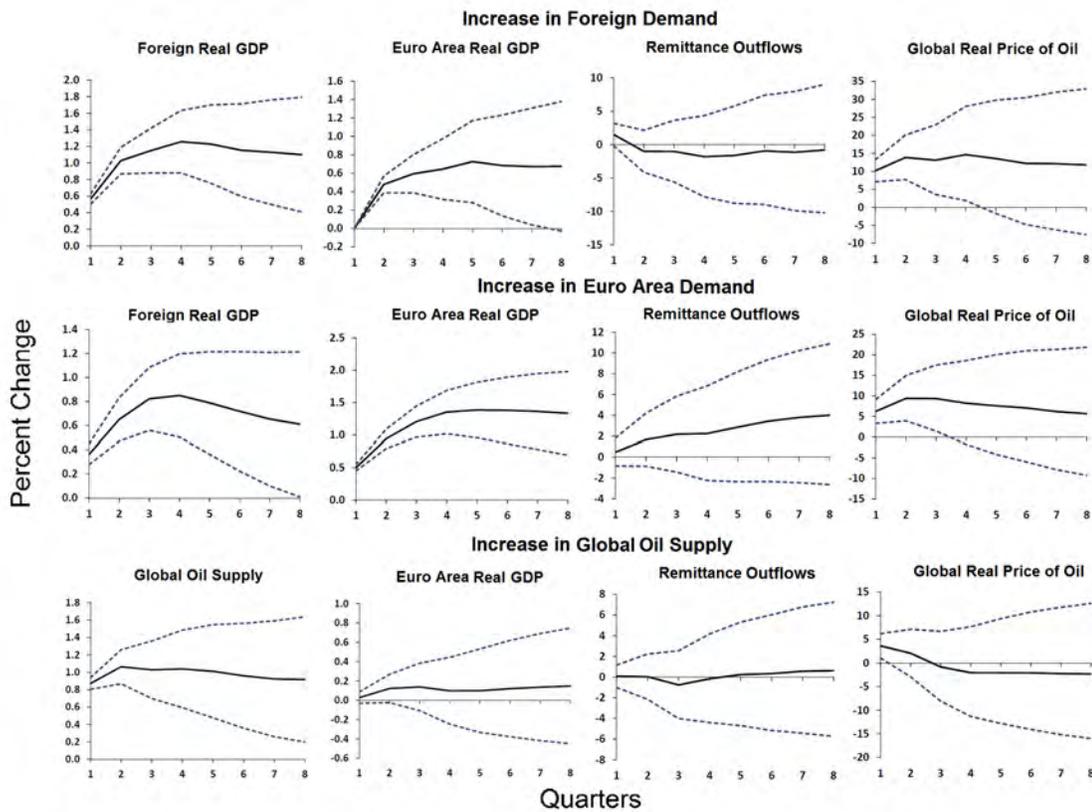


Figure 24 illustrates the IRFs of the SVAR estimated for the euro area. The IRFs are normalized so that the shock is one percent on average in the first year. The model is estimated using quarterly data from 2000q1 to 2015q2. As with the U.S., the assumption of a SOE is unlikely for the euro area so the structure is modified to allow for shocks to euro area real GDP to have a contemporaneous effect on foreign real GDP but not vice versa. Further, the lags of euro area real GDP are not restricted to zero in any equations. Similar to the estimates of the United States, the ordering of home and foreign GDP affects the contemporaneous real GDP responses but not the response of remittances. Since the euro area produces only a small amount of crude oil, the SVAR is estimated using global oil supply. Hence, the only oil supply shock is that of global oil supply.

A demand shock which increases foreign real GDP by one percent on average in the first year significantly increases the real price of oil by approximately 13 percent on average in the first year. Euro area real GDP increases significantly by 0.4 percent on average in the first year. Remittances fall by close to 0.6 percent on average in the first year.

A demand shock which increases euro area real GDP by one percent on average in the first year results in a significant 8.3 percent increase in the real price of oil and a 1.6 and 2.6 percent increase in remittances on average in the first and second year, respectively. Foreign real GDP significantly increases by close to 0.7 percent on average in the first year.

A shock that increases global oil supply by one percent on average in the first year is unable to identify a significant fall in oil prices in the first year, but results in a decline in the real oil price by 2.3 percent on average in the second year. Euro area real GDP increases on average slightly in both years. Remittances increase by 0.6 percent on average in the second year. Overall, the estimates suggest a slightly less responsive remittances outflow in the euro area relative to the United States.

### Annualized SVAR Elasticities

The following tables summarize the SVAR impulse responses by averaging the responses in the first and second years as elasticities. These are the same IRFs presented in the graphs in the previous sections. The results for a SVAR estimated using global data is also presented in Table 1. In the global SVAR, the structural shocks to the global market of crude oil are consistent with the impulse response of the SVARs estimated for each economy and with the findings of Kilian (2009).

Table 1. Annualized Global SVAR Elasticities

First Year			
Impu./Resp.	SUPOIL	GDP	POIL
SUPOIL	1.00*	0.05	-2.22
GDP	0.45*	1.00*	12.94*
POIL	0.01	-0.003	1.00*
Second Year			
Impu./Resp.	SUPOIL	GDP	POIL
SUPOIL	1.00*	0.06	-6.00
GDP	0.56*	1.00*	9.00
POIL	0.01	-0.02	1.00*

Annual averages. Sample period: 1994q1 - 2015q2. \* represents significance at the 32 percent significance level. SUPOIL is global oil supply, GDP is global real GDP, and POIL is the real price of crude oil. Rows are shocks, columns are responses.

Table 2. Annualized SVAR Elasticities for Russia

First Year						
Impu./Resp.	SUPOILF	SUPOILH	GDPF	POIL	GDPH	PAY
SUPOILF	1.00*	-0.15	0.03	-2.00	-0.60*	-2.41
SUPOILH	0.00	1.00*	0.04	0.94	0.49*	1.89
GDPF	0.54*	0.01	1.00*	12.25*	1.56*	4.81
POIL	0.01	0.00	0.00	1.00*	0.04*	0.16
GDPH	0.00	0.02	0.00	0.07	1.00*	3.34
PAY	0.00	0.000	0.000	0.000	0.00	1.00*
Second Year						
Impu./Resp.	SUPOILF	SUPOILH	GDPF	POIL	GDPH	PAY
SUPOILF	1.00*	-0.30	0.01	-5.86	-1.46*	-6.97
SUPOILH	0.06	1.00*	0.07	1.54	0.74*	4.64*
GDPF	0.66*	-0.34	1.00*	8.16	1.88*	7.08
POIL	0.000	0.02	-0.02	1.00*	0.03	0.02
GDPH	0.01	-0.11	-0.01	-0.10	1.00*	4.47
PAY	0.00	-0.001	0.00	0.000	0.00	1.00*

Annual averages. Sample period: 1995q1 - 2015q2. \* represents significance at the 32 percent significance level. SUPOILH is domestic oil supply, SUPOILF is foreign oil supply, GDPH is domestic real GDP, GDPF is foreign real GDP, POIL is real price of crude oil, PAY are real remittance outflows. Rows are shocks, columns are responses.

Table 3. Annualized SVAR Elasticities for Saudi Arabia

First Year						
Impu./Resp.	SUPOILF	SUPOILH	GDPF	POIL	GDPH	PAY
SUPOILF	1.00*	1.37*	0.05	-3.47	0.18	-1.42
SUPOILH	0.00	1.00*	0.00	0.80	0.20*	0.06
GDPF	0.37*	1.33*	1.00*	12.81*	1.00*	-2.55
POIL	0.00	0.06*	-0.003	1.00*	0.04	0.09
GDPH	0.00	0.02	0.00	0.01	1.00*	1.19
PAY	0.00	0.00	0.00	0.00	0.07*	1.00*
Second Year						
Impu./Resp.	SUPOILF	SUPOILH	GDPF	POIL	GDPH	PAY
SUPOILF	1.00*	1.33	0.09	-7.10	0.00	-2.45
SUPOILH	0.02	1.00*	-0.05	0.07	0.19	0.12
GDPF	0.35	2.18*	1.00*	8.92	1.24	-2.90
POIL	0.00	0.11	-0.02	1.00*	0.05	0.15
GDPH	0.00	-0.02	0.00	0.01	1.00*	1.16
PAY	0.00	0.00	0.00	0.00	0.09	1.00

Annual averages. Sample period: 1995q1 - 2015q2. \* represents significance at the 32 percent significance level. SUPOILH is domestic oil supply, SUPOILF is foreign oil supply, GDPH is domestic real GDP, GDPF is foreign real GDP, POIL is real price of crude oil, PAY are real remittance outflows. Rows are shocks, columns are responses.

Table 4. Annualized SVAR Elasticities for the Euro Area

First Year					
Impu./Resp.	SUPOIL	GDPH	GDPF	POIL	PAY
SUPOIL	1.00*	0.10	0.08	0.69	-0.20
GDPH	-0.02	1.00*	0.67*	8.28*	1.64
GDPF	0.77*	0.43*	1.00*	12.96*	-0.59
POIL	-0.01	-0.02*	-0.02*	1.00*	0.16
PAY	0.00	0.00	0.00	0.002	1.00*
Second Year					
Impu./Resp.	SUPOIL	GDPH	GDPF	POIL	PAY
SUPOIL	1.00*	0.13	-0.01	-2.30	0.46
GDPH	-0.19	1.00*	0.51*	4.84	2.57
GDPF	0.97*	0.60*	1.00*	10.79	-0.98
POIL	-0.01	-0.08*	-0.05*	1.00*	0.01
PAY	-0.01	0.01	0.00	0.00	1.00*

Annual averages. Sample period: 2000q1 - 2015q2. \* represents significance at the 32 percent significance level. SUPOIL is global oil supply, GDPH is domestic real GDP, GDPF is foreign real GDP, POIL is real price of crude oil, PAY are real remittance outflows. Rows are shocks, columns are responses.

Table 5. Annualized SVAR Elasticities for the United States

First Year						
Impu./Resp.	SUPOILH	SUPOILF	GDPH	GDPF	POIL	PAY
SUPOILH	1.00*	0.02	0.005	-0.01	-0.58	-0.16
SUPOILF	-0.41*	1.00*	0.05	0.02	-0.28	-0.69
GDPH	-0.49*	0.47*	1.00*	0.52*	5.22*	1.17
GDPF	-0.41	0.26*	0.17*	1.00*	14.67*	-0.77
POIL	-0.02	0.01	-0.01	-0.003	1.00*	-0.04
PAY	0.02	-0.04*	-0.12*	-0.02*	0.30	1.00*
Second Year						
Impu./Resp.	SUPOILH	SUPOILF	GDPH	GDPF	POIL	PAY
SUPOILH	1.00*	0.01	0.003	-0.02	-1.93	-0.09
SUPOILF	-0.82	1.00*	0.19	-0.03	-1.89	-0.17
GDPH	-1.28*	0.60*	1.00*	0.47*	2.22	1.79
GDPF	-0.10	0.17	-0.10	1.00*	12.46*	-0.97
POIL	-0.02	0.02	-0.02	-0.01	1.00*	-0.07
PAY	0.34	-0.15	-0.30*	-0.05	0.73	1.00

Annual averages. Sample period: 1994q1 - 2015q2. \* represents significance at the 32 percent significance level. SUPOILH is domestic oil supply, SUPOILF is foreign oil supply, GDPH is domestic real GDP, GDPF is foreign real GDP, POIL is real price of crude oil, PAY are real remittance outflows. Rows are shocks, columns are responses.

## References

- Acosta, P. A., E. K. Lartey, and F. S. Mandelman, 2009, "Remittances and the Dutch disease." *Journal of international economics*, Vol. 79, No. 1, pp. 102–116.
- Ahmed, F. Z., 2013, "Remittances Deteriorate Governance," *Review of Economics and Statistics*, Vol. 95, No. 4, pp. 1166–1182.
- Anderson, D., B. Hunt, M. Kortelainen, M. Kumhof, D. Laxton, D. Muir, S. Mursula and S. Snudden, 2013, "Getting to Know GIMF: The Simulation Properties of the Global Integrated Monetary and Fiscal Model," IMF Working Paper No. 13/55. (Washington: International Monetary Fund).
- Andrle, M., P. Blagrove, P. Espallat, K. Honjo, B. Hunt, M. Kortelainen, R. Lalonde, D. Laxton, E. Mavroeidi, D. Muir, S. Mursula, and S. Snudden, 2015, "The Flexible System of Global Models FSGM," IMF Working Paper No. 15/64 (Washington: International Monetary Fund).
- Bernanke, B., M. Gertler and S. Gilchrist, 1999, "The Financial Accelerator in a Quantitative Business Cycle Framework," in J. Taylor and M. Woodford, eds., *Handbook of Macroeconomics*, Vol. 1c. Amsterdam: Elsevier.
- Chami, R., A. Barajas, T. Cosimano, C. Fullenkamp, M. Gapen, and P. Montiel, 2008, "Macroeconomic consequences of remittances," Occasional Paper No. 259. (Washington: International Monetary Fund)
- Chami, R., C. Fullenkamp, and S. Jahjah, 2005, "Are Immigrant Remittance Flows a Source of Capital for Development?" *IMF Staff Papers*, Vol. 52, No. 1, pp. 55–81.
- Choucri, N., 1986, "The Hidden Economy: A New View of Remittances in the Arab World," *World Development*, Vol. 14, pp. 697–712.
- Durdu, B., and S. Sayan, 2008, "Emerging market business cycles with remittance fluctuations," *IMF Staff Papers*, Vol. 57, pp. 303–325.
- Economist Intelligent Unit (EIU) 2015. Country report: Saudi Arabia. The Economist Magazine (<http://country.eiu.com/saudi-arabia>)
- Frankel, J., 2011, "Are bilateral remittances countercyclical?" *Open Economies Review*, Vol. 22, No. 1, pp. 1–16.
- Hertog, S., 2012, "A comparative assessment of labor market nationalization policies in the GCC," in *National Employment, Migration and Education in the GCC. The Gulf Region: Economic Development and Diversification* ed. by Hertog, S., Vol. 4., Gerlach Press, Berlin, Germany.
- Kilian L., 2009, "Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market," *American Economic Review*, Vol. 99, No. 3, pp. 1053–69.

- Kumhof, M., D. Laxton, D. Muir, and S. Mursula, 2010, "The Global Integrated Monetary and Fiscal Model (GIMF) - Theoretical Structure." IMF Working Paper No. 10/73. (Washington: International Monetary Fund).
- Lueth, E. and M. Ruiz-Arranz, 2007, "Are Workers' Remittances a Hedge Against Macroeconomic Shocks? The Case of Sri Lanka," *Asia-Pacific Development Journal*, Vol. 14, No. 1.
- Mughal, M. Y., and J. Ahmed, 2014, "Remittances and business cycles: Comparison of south Asian countries." *International Economic Journal*, Vol. 28, No. 4, pp. 513–541.
- Multilateral Investment Fund, 2004, *Sending Money Home: Remittance to Latin America and the Caribbean*, Inter-American Development Bank.
- Naufal, G., and A. Termos, 2009, "The Responsiveness of Remittances to Price of Oil: the Case of the GCC," *OPEC Energy Review*, Vol. 33, No. 3-4, pp. 184–197.
- Pesenti, P., 2008, "The Global Economy Model: Theoretical Framework." *IMF Staff Papers*, Vol. 55, pp. 243–284.
- Ratha, D., and W. Shaw, 2007, "South-South Migration and Remittances," Development Prospects Group, World Bank Publications ([www.worldbank.org/prospects/migrationandremittances](http://www.worldbank.org/prospects/migrationandremittances))
- Ratha, D., K. Schuettler, and S. Yousefiand, 2015, "Falling Oil Prices and Remittances From GCC Countries," Annex 1 in *Plunging Oil Prices. MENA Quarterly Economic Brief*, 4, ed. by L. Mottaghi and S. Devarajan (Washington, D.C.: World Bank Publications).
- Sayan, S., 2004, "Guest Workers' Remittances and Output Fluctuations in Host and Home Countries: The Case of Remittances from Turkish Workers," *Emerging Markets Finance and Trade*, Vol. 40(6), pp. 70–84.
- World Bank, 2006, *The Development Impact of Workers Remittances in Latin America, Vol. 2: Detailed Findings*, Report No. 37026 (Washington, D.C.: World Bank Publications).
- World Bank, 2015, *Migration and Remittances: Recent Developments and Outlook*, Special Topic: Financing for Development, Migration and Development Brief 24, April 13, 2015 (Washington, D.C.: World Bank Publications).