Labor and Behavior Determinants of Remittances in Saudi Arabia

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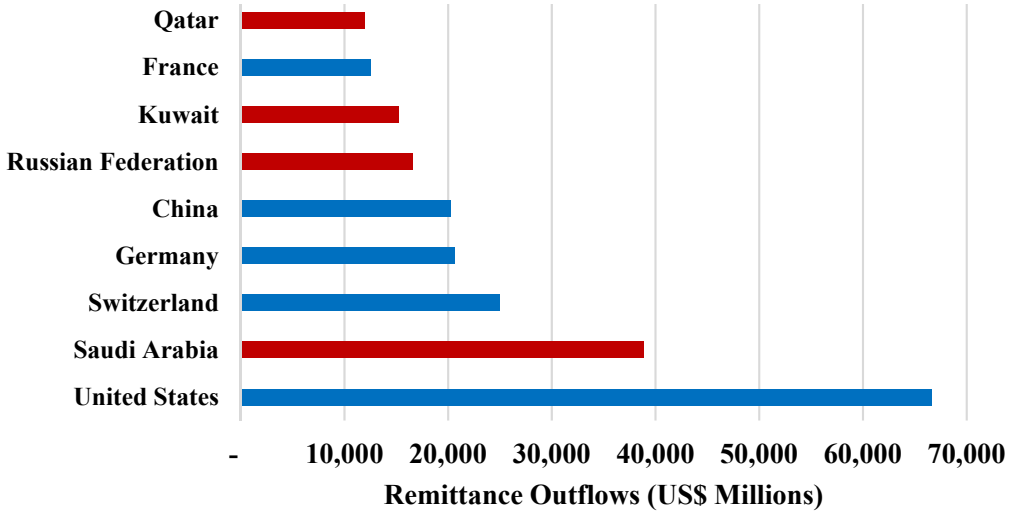
Saudi Arabia is the second largest sender of international remittances. These remittances constitute large foreign capital inflows to labor-exporting remittee economies. This study is the first to structurally deconstruct remittance dynamics into behavioral and labor market outcomes of migrants. Remittance outflows are decomposed into migrant labor supply, unemployment and participation rates, wage earnings, and the marginal propensity to remit out of migrant earnings. The estimates suggest that migrant labor supply is highly elastic. The important driver of remittance dynamics is the marginal propensity to remit, migrant wages and the labor supply of migrants. The marginal propensity to remit is found to respond counter cyclically to foreign GDP.

JEL classification: F22; F24; F41; Q4
Keywords: International Migration; Remittances; Macroeconomic Interdependence; Oil Price; Saudi Arabia.

1 Introduction

In Saudi Arabia, outflows of unrequited personal transfers of earned income by expatriate workers was 38.9 billion USD in 2016. This makes Saudi Arabia the second largest remitter country after the United States, see Figure 1. Migrants represent 38 percent of the population in Saudi Arabia and 58 percent of the labor force in 2016. The sheer magnitude of migration and remittance levels in Saudi Arabia imply substantial potential for international economic and welfare spillovers to remittee countries. The importance of this economic lifeline to developing countries make understanding the drivers of migration and remittance channels critical for tens of millions of migrants and their families.

Figure 1. Top 10 Remitter Countries in 2016

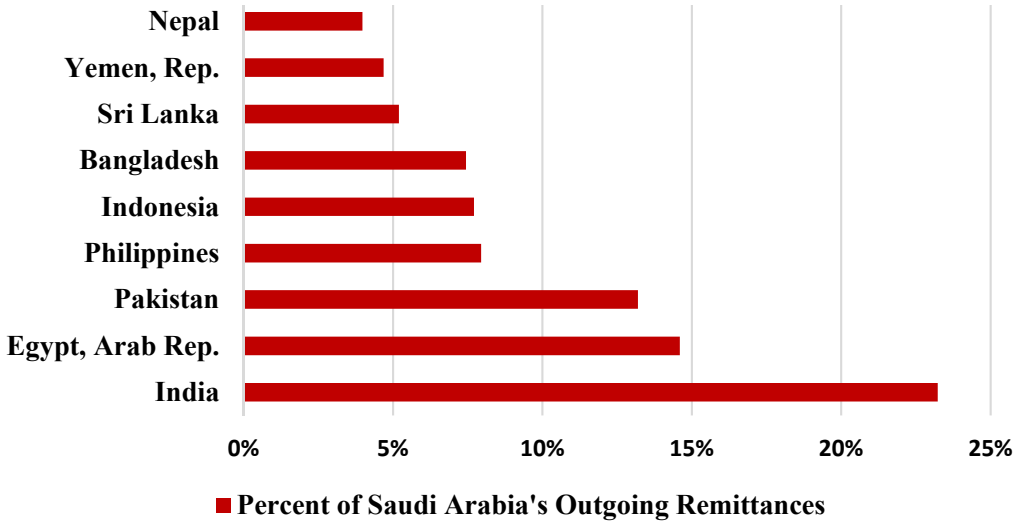


Receipts of Saudi remittances are largest in South Asia and Middle East and North Africa oil importers, see Figure 2. India receives over 23 percent of Saudi remittances followed by Egypt and Pakistan with 14.5 and 13.5 percent, respectively. Bangladesh, Indonesia and the Philippines all receive almost 3 billion USD of remittances or about 7.5 percent of Saudi remittances. Jordan, Nepal, Sri Lanka, and Yemen receive 4-5 percent of Saudi remittance outflows. Such large values of remittances can have sizeable utilitarian consequences for welfare within the recipients' countries.

In addition to welfare consequences, Saudi remittances are expected to produce sizeable economic consequences in countries where remittance inflows constitute a large proportion of real output. As shown in Figure 3, Saudi remittances constitute a large share of GDP in several countries. Saudi remittances are 8.3 percent and 7.6 percent of GDP in Nepal and Yemen, respectively. Overall, Saudi remittances are over 2 percent of GDP in eight countries. These flows have direct consequences on the current account and the consumption demand of remittee families.

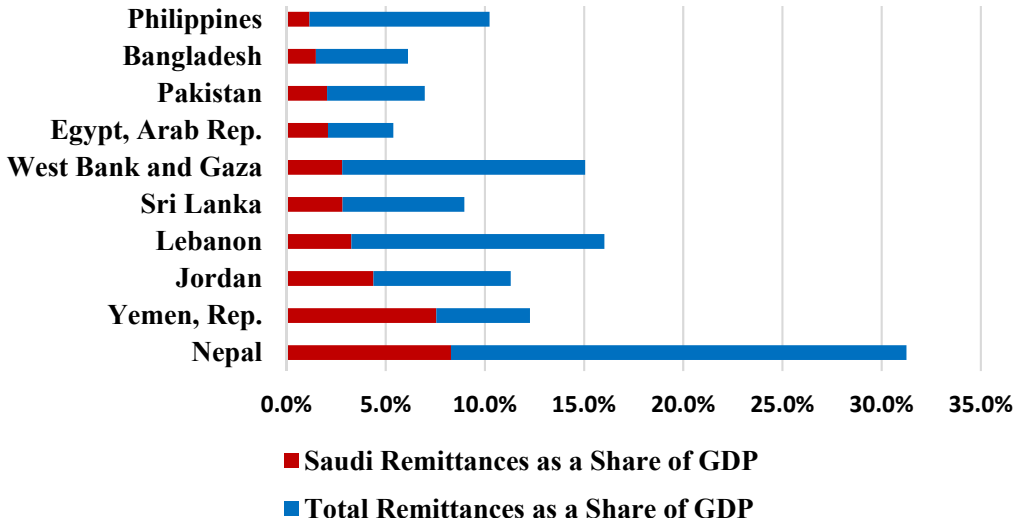
In addition to being labor exporters, most of the major Saudi recipient economies are oil-importers (Choucri, 1986; Ahmed, 2013). Disruptions to the global market for crude oil will have consequences not just for Saudi Arabia but for remittee economies. Snudden (2018) shows that a global oil market shocks induce large changes in remittance flows from Saudi Arabia. However, the terms-of-trade channels dominate the output response in labor-exporting oil-importing countries (Snudden, 2018). The implication is that the dynamics of remittances must be examined

Figure 2. Destination of Saudi Remittances in 2016



concurrently with the structural drivers of global oil prices.

Figure 3. Share of Remittance Inflows as Percent of GDP in 2016



Studies which include oil prices in understanding remittance dynamics have been estimated in panel models for the Gulf Cooperation Council countries by Ratha *et al.* (2015) and Naufal and Termos (2009). These studies lack the structural interpretation of Lueth and Ruiz-Arranz (2007) and Mughal and Ahmed (2014) who study the remittance inflow dynamics in remittee regions. These studies have treated oil prices as exogenous and not considered structural demand or supply shocks to the global oil markets concurrently with migration and remittances apart from Snudden (2018).

While Snudden (2018) estimates remitter dynamics in the presence of the shocks to the global market for crude oil, the study precludes a structural decomposition of the drivers of remittances. These earnings and behavioural estimates are critical as previous studies attempting to identify the marginal propensity to remit (MPR) use the correlation of remittance inflows to remittee real

GDP, omit or assume exogenous oil prices, lack structural interpretation, and are thus subject to issues with endogeneity (Chami *et al.* 2005, 2008; Frankel, 2011; Sayan, 2004). The structural decomposition in the presence of the global market for crude oil is critical, as shown by Snudden (2018), who finds that trade and primary commodity channels dominate remittee channels for the real GDP response in oil-importing remittee economies. Thus, the behavioral incentive to migrate and remit cannot be deduced from correlations of real GDP and remittance inflows.

This paper builds upon Snudden (2018) and is the first structural study to decompose remittance dynamics into behavioral and earning dynamics of migrants. Outflows of remittances from Saudi Arabia are decomposed into the migrant labor supply, participation and unemployment rates, wages, and the MPR. A novel data set and empirical identification allows for this structural decomposition. Importantly, the empirical method identifies structural shocks to domestic and foreign supply and demand in the global market for crude oil.

The empirical decomposition of remittance outflows suggest that migrant labor supply, wages, and their MPR are the most important drivers of remittance outflows from Saudi Arabia. In contrast, the unemployment rate of migrants is less responsive. Remittances are found to be negatively correlated with foreign GDP, driven mainly from a significant negative correlation of the MPR to foreign GDP. The response of the MPR is consistent with pure and impure altruism (Andreoni, 1989) or enlightened selfishness (Lucas and Stark, 1985) and a variety of other motives to migrate and remit, Rapoport and Docquier (2006).

For all structural shocks, migrant labor supply is found to be very elastic. This suggests a highly elastic supply of international migrant labor. Migrant labor market outcomes are found to follow Saudi nationals outcomes, albeit more responsive for most shocks. Migrant labor supply is found to be positively correlated with Saudi real GDP. The unemployment rate of migrant workers is small over the full sample and found to have an economically insignificant contribution to remittance determination. Instead, the empirical findings suggest that the number of migrants, wages, and the propensity to remit out of earnings determinate remittance outflows.

The paper is structured as follows. Section 2 introduces the extension to the empirical method of Snudden (2018) and the data set. Section 4 summarizes the main results by reporting structural impulse response functions. Section 5 evaluates the robustness of the results. Section 6 concludes.

2 Structural Model

A modified version of the structural vector auto regression (SVAR) identification of Snudden (2018) is proposed to estimate remittance dynamics and its determinants in Saudi Arabia. The model identifies structural demand and supply shocks to the global market for crude oil for both Saudi Arabia and the rest of the world. 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 SVAR model employs a recursive identification with the following ordering: foreign (world

excluding Saudi) oil supply, foreign (world excluding Saudi) real GDP, Saudi oil supply, the real price of crude oil, Saudi real GDP, and a remittance related variable. The model identifies shocks to both Saudi and foreign demand, Saudi and foreign crude oil supply, and other oil specific demand. This is achieved using a combination of recursive restrictions and block recursivity which uses zero restriction in the lags of $\mathbf{A}_i$.

The identification of the structural shocks to the global market for crude oil rely on the recursive identification strategy of Kilian (2009). The strategy replies on the assumption that non-Saudi oil supply does not respond contemporaneously to oil prices, but oil prices can respond contemporaneously to shocks to oil production. The identification strategy also relies on evidence that foreign real GDP does not respond contemporaneously to innovations in the real price of crude oil but that the real price of crude oil is contemporaneously responding to innovations in the demand for crude oil. This identification of the foreign shocks is motivated by both empirical and institutional evidence presented in Kilian (2009).

The identification of Kilian (2009) is modified by allowing Saudi crude oil supply to respond contemporaneously to shocks to foreign oil supply and demand. This is also a modification of the Snudden (2018) method which only allowed Saudi crude oil supply to respond to foreign oil crude oil supply innovations but not foreign oil demand shocks. This is motivated by the excess capacity in Saudi Arabia's crude oil production and its leadership among the OPEC countries. Interestingly, Saudi crude oil production is found to have a small contemporaneous response to foreign oil supply and demand shocks. The main qualitative results are robust to the assumptions regarding the contemporaneous response of the Saudi oil production.

The DSGE models of Andrle *et al.* (2015) and Snudden (2018) provide the additional motivation for the recursive and lag restrictions for the identification of the Saudi demand and oil production shocks. Neither the remittances related variable nor the real GDP from Saudi Arabia is allowed to contemporaneously or with lags drive foreign variables or Saudi oil supply. This is achieved using both the recursive structure to achieve the null contemporaneous innovations and zero restrictions on all auto-regressive parameters on Saudi GDP and the remittance variable for Saudi oil supply and foreign variables in the $\mathbf{A}_i$ matrices. Importantly, Saudi crude oil supply drives real oil prices and Saudi variables contemporaneously, and foreign crude supply and demand with lags.

3 Data

Oil prices are from the Energy Information Administration (EIA) and are the quarterly average of U.S. refiners' imported crude oil price. The remittance measure is personal remittances, the sum of personal transfers and compensation of employees, from the International Monetary Fund's (IMF) Balance of Payments database. Personal remittances do not require migrant status but is based on residency. 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 production of crude oil is from the EIA and includes lease condensate and is measured in 1000 barrels per day.

The World Bank's Global Economic Monitor is the source of the world and Saudi real GDP measure in billions of USD. The level of Saudi real GDP from the Global Economic Monitor is available starting 2010Q1 so the series is extended back using quarter-over-quarter growth rates of seasonally adjusted volume index of GDP from the IMF's International Financial Statistics (IFS)

prior to 2010Q1. Foreign real GDP and oil supply are measured as the world value less that of the Saudi value.

All variables are seasonally adjusted prior to estimation. The SVAR is estimated with all variables in percent change as no evidence of co-integration was found. Estimation of all variables in percent change allows for the potential permanent effects on the levels of variables. The levels of the variables are presented in the impulse response functions.

Table 1. Summary Statistics and Data Availability

	2016	Availability	Imputed	Imp. >06	Source
Saudi GDP/ World GDP	0.9%	1994Q2-2017Q4	0%	0%	Global Economic Monitor, IMF IFS
Saudi Oil Supply/ World Oil Supply	13.0%	1994Q2-2017Q4	0%	0%	U.S. Energy Information Administrati
Remittances as a Share of GDP	6.8%	1994Q2-2017Q4	20%	0%	GEM, World Bank; IFS, IMF
Wage of Saudi / Migrant Workers	36.0%	1994Q2-2017Q4	65%	60%	LFS, General Authority for Statistics
MPR out of Migrant Earnings	45.7%	1994Q2-2017Q4	65%	52%	LFS, General Authority for Statistics
Unemployment Rate of Migrants	0.7%	1999Q2-2017Q4	65%	52%	LFS, General Authority for Statistics
Unemployment Rate of Saudis	11.9%	1999Q2-2017Q4	65%	52%	LFS, General Authority for Statistics
Participation Rate of Migrants 16+	76.2%	1999Q2-2017Q4	65%	52%	LFS, General Authority for Statistics
Participation Rate of Saudis 16+	41.1%	1999Q2-2017Q4	65%	52%	LFS, General Authority for Statistics
Migrants Share of Labor Force	58.3%	1999Q2-2017Q4	65%	52%	LFS, General Authority for Statistics
Migrants Share of Population	36.8%	1994Q2-2017Q4	75%	75%	Balance of Payment, IFS, IMF

Note: LFS refers to the Labour Force Survey, GEM refers to the Global Economic Monitor, IMF refers to the International Monetary Fund, IFS refers to the International Financial Statistics, MPR refers marginal propensity to remit. Imputed refers to the share of quarterly observations imputed from annual and bi-annual estimates in the total quarterly sample between 1999Q2-2017Q4. "Imp. >06" are the imputed share of observations from 2006Q1-2017Q4.

The remittance related variables of interest is personal remittance outflows, decomposed using the number of migrants employed in the labor force, average quarterly real wages, migrant participation and unemployment rates, and the MPR out of migrant labor earnings. The labor force variables and wages are from the Labor Force Survey (LFS) through the Saudi General Authority for Statistics. Finally, the MPR is calculated for migrants as the value of personal remittance outflows divided by the earnings of migrant workers. The quarterly earnings of migrant workers is measured as the quarterly average wage earnings times the number of employed migrants.

The remittance related variables are used to decompose the overall change in remittances and are summarized in Table 1. The table presents key summary statistics for for the annual average of quarterly observations for 2016. It also reports the quarters the data are available as well as the share of quarterly observations that are imputed as a percent of total quarterly observations. The share of imputed quarterly observations are shown for the full sample, 1999Q2–2017Q4, as well as for the second half of the sample, 2006Q2-2017Q4, considered in the robustness of section 5. For both samples, for both foreign and domestic regions, none of the real GDP and crude oil production variables are imputed.

The decomposition of remittances into its components relies on LFS surveys conducted quarterly from 2016Q2–2017Q4 and bi-annually from 2007Q2–2016Q1, albeit also annually in 2009–2011. The exception is the monthly average wage earnings measure which is only available annually prior to 2014Q2. Observations with annual or bi-annual data, are assigned to the quarters the survey was conducted. Missing values are interpolated by exact fitting of a cubic curve to two data points

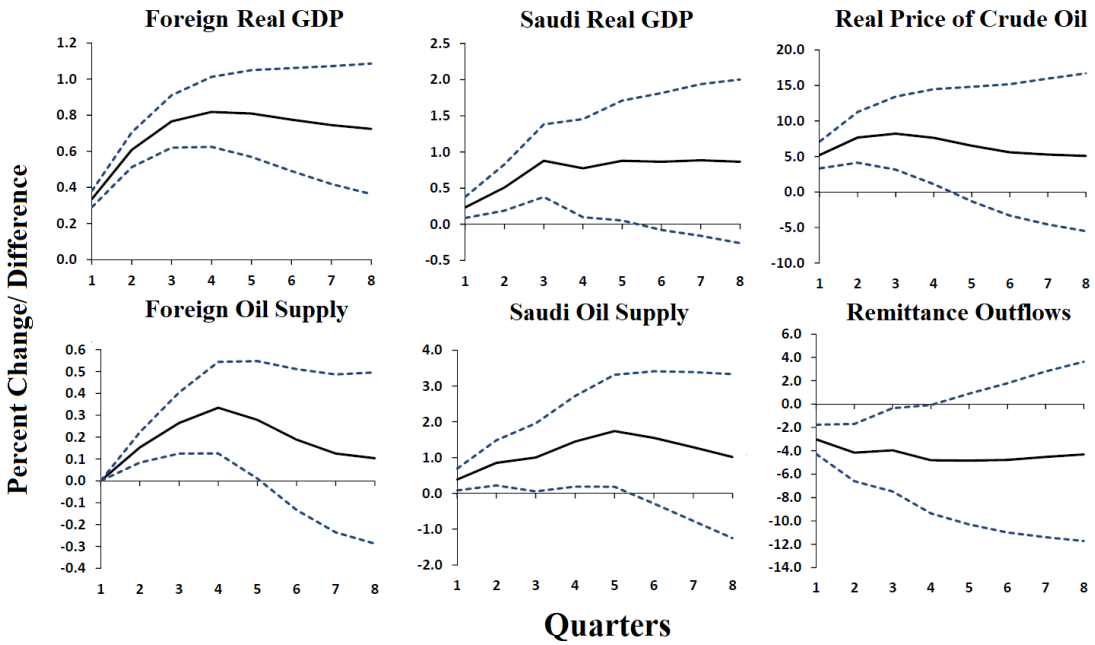
before and after each observation for which observation is missing. The number employed and unemployed in the labor force for both Saudi and non-Saudis is only available annually until 1999 so the sample begins in 1999Q2, the quarter the survey was conducted.

Despite the need to account for missing observations, the estimates for the SVAR estimated from 2006 or 1999 are qualitatively similar and discusses in the robustness of section 5. For the later samples, the signs are similar but a strengthening in the magnitudes of some of the variables. Hence, the full 1999Q2 to 2017Q4 sample is presented in the baseline estimates. As the remittance related variable does not contemporaneously or with lags drive any other variable, the identification of all other shocks is not affected by the choice of the remittance related variable. Hence, a model is estimated for each of the remittance related variables. This insures that the structural shocks for all demand and supply shocks to the global market for crude oil are exactly identical for all models estimated. The impulse responses are presented with 68 percent confidence intervals (1 standard deviation) which are parametrically bootstrapped with 1000 simulations.

4 Estimates

Figure 4 illustrates the structural IRFs from a one standard deviation shock to foreign real GDP on the global market for crude oil. A foreign demand shock increases foreign real GDP by 0.7 percent by the first year, and significantly increases the real price of crude oil by just over 8 percent. The foreign demand shock is permanent, with level of foreign real GDP higher by 0.7 percent, and the level of the global real price of crude oil is higher by 5 percent. This is consistent with the SVAR estimates from shocks to global demand estimated in Snudden (2018).

Figure 4. Increase in Foreign Real GDP, Oil Market



Saudi real GDP increases significantly and permanently by 0.8 percent. Interestingly, both

foreign and Saudi crude oil supply increase significantly and Saudi crude oil production is five times more responsive than foreign supply. These estimates suggest that Saudi Arabia oil has used its production to dampen the oil price movements from foreign demand shocks, reflecting the country's role as a key OPEC oil producer and their explicit policy objective of dampening oil price volatility.

Figure 5. Increase in Foreign Real GDP, Labor Market

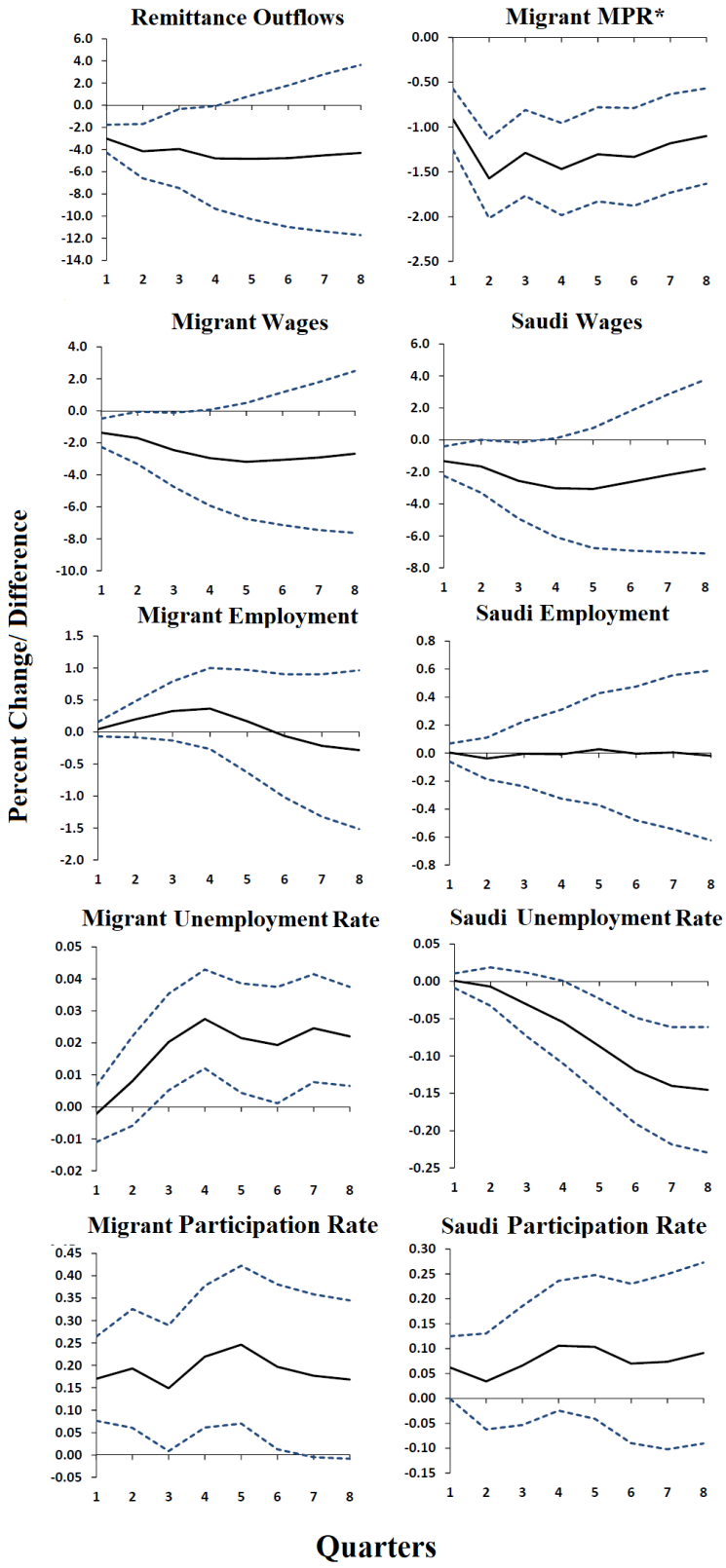


Figure 5 illustrates the structural IRFs from the same one standard deviation shock to foreign real GDP on the Saudi remittance outflows and labor market outcomes. Interestingly, and consistent with Snudden (2018), remittance outflows fall permanently by close to 3 percent. However, unlike in Snudden (2018), the fall in remittances can now be deconstructed into the response of migrant labor earnings and the MPR. Interestingly, the fall in remittances is driven by a significant decline in the MPR. This is slightly offset by a small, temporary increase in migrant employment and participation rates by the end of the first year.

The response of Saudi labor market outcomes is remarkably similar. There is a decline in migrant and Saudi real wages by two percent. This decline arises partially from from higher U.S. CPI as well as a decline in nominal wages. The only variable with a different sign for migrants and Saudi's is unemployment rates which decline slightly for Saudi's but increases in an economically insignificant amount for migrants. Overall, these estimates suggest that a important driver of remittance dynamics to foreign real GDP shocks is the MPR which responds counter-cyclically to foreign real GDP. The results also suggest similar labor market outcomes of migrants and Saudi nationals for foreign driven oil price movements.

Figure 6. Increase in Foreign Oil Supply, Oil Market

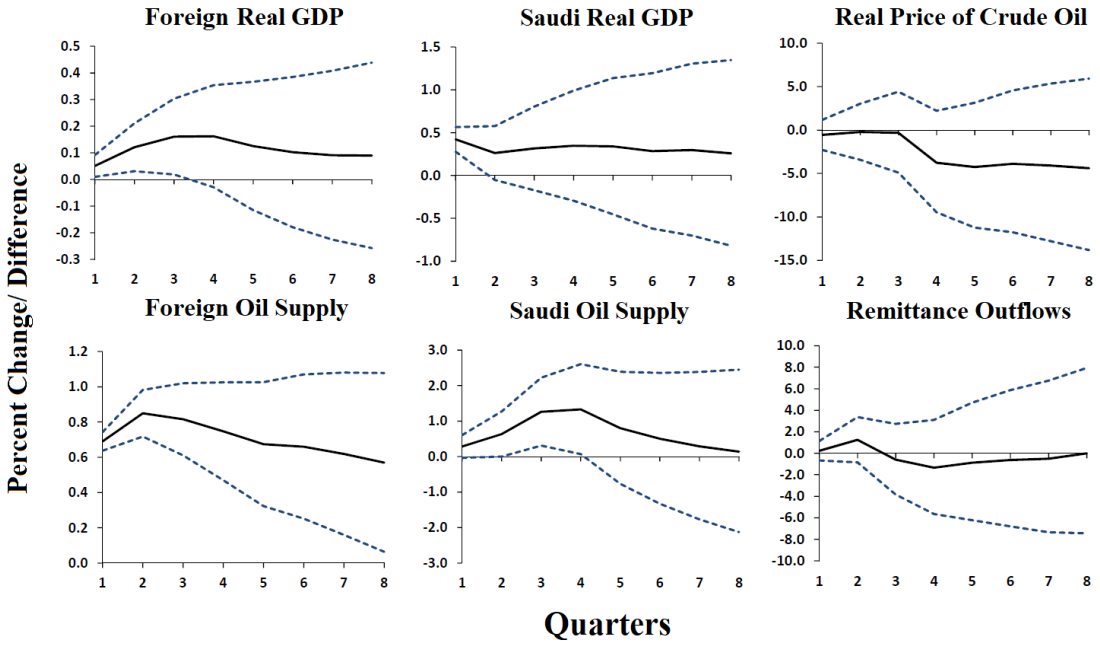
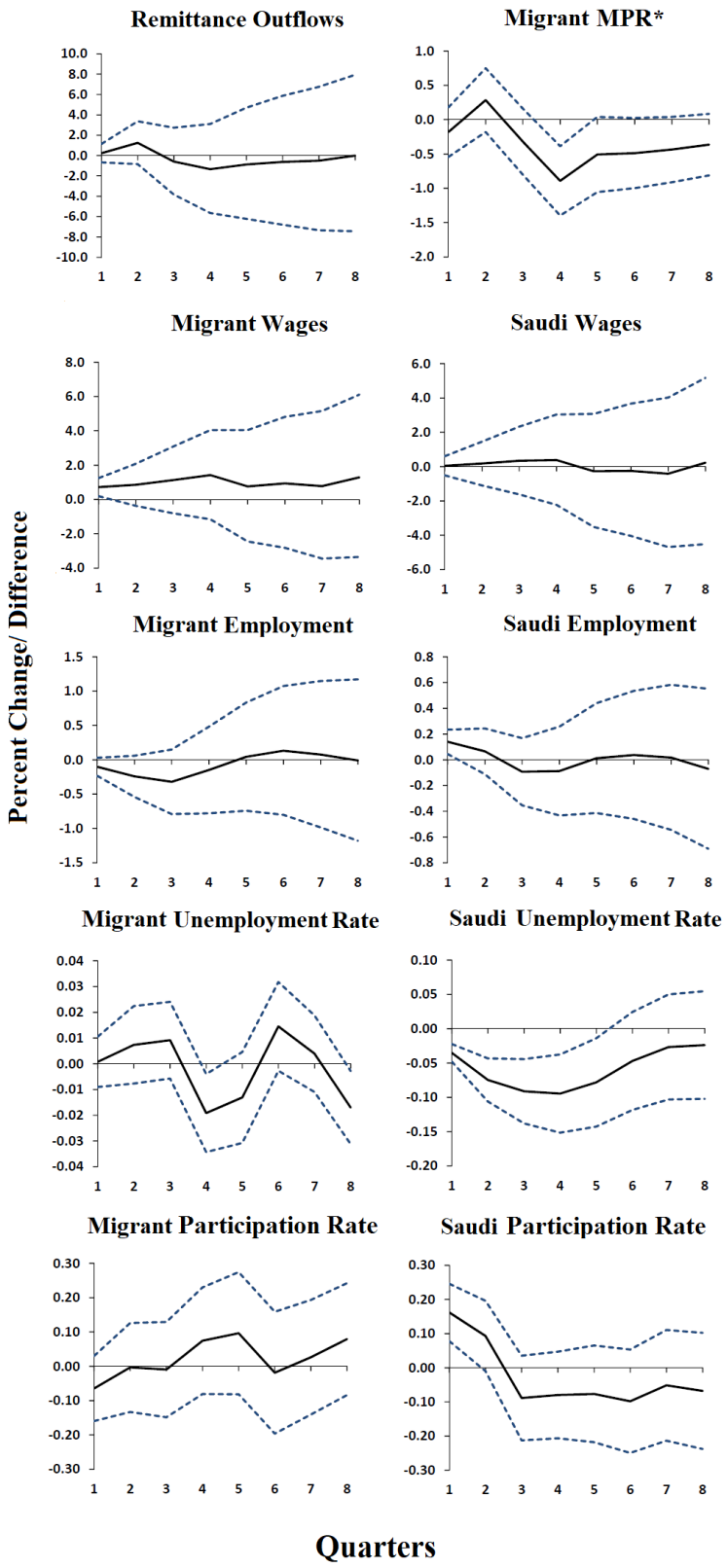


Figure 6 illustrates the structural IRFs from a one standard deviation shock to foreign oil production on the global market for crude oil. A one standard deviation shock increases the level of foreign oil production persistently by 0.6 percent. Interestingly, Saudi oil production also increases temporarily by a similar amount. Saudi Arabia's crude oil production is 13 percent of global oil production in 2016 and 12.5 percent over the whole sample period. Hence, the increase in Saudi oil supply compliments the rise in the foreign crude oil production and contributes to the persistent 4 percent decline in the real price of crude oil after four quarters. The decline in the price of oil is significant in the samples beginning in 1994Q2 and 2006Q1, with similar responses

in the other variables. Thus, the results with the model estimated in 1999Q2 is an anomaly in the statistical significance of the oil price to foreign crude oil price shocks but still robust in the labor and behavior estimates.

Saudi oil production returns to baseline after two years. This suggests that Saudi crude oil production moves in step with foreign oil supply, at least temporarily. The foreign oil supply shock is likely a combination of OPEC supply shocks and non-OPEC market innovations over the sample.

Figure 7. Increase in Foreign Oil Supply, Labor Market



In response to the increase in foreign oil supply, Saudi real GDP increases significantly by 0.4 percent in the first quarter. Foreign real GDP increases temporarily and significantly for the first three quarters. The estimates suggest that Saudi oil supply amplifies the oil price movement from foreign oil supply shocks but dampens the oil price movement from foreign demand shocks. It may also suggest that Saudi Arabia's recent reaction to the increase in U.S. shale oil production by temporarily increasing their oil supply and allowing the price to fall is consistent with earlier episodes.

Figure 7 illustrates the structural IRFs from a one standard deviation shock to foreign oil production on the Saudi remittance and labor markets. In response to the increase in foreign and Saudi oil supply that reduces the real price of crude oil, the level of personal remittance outflows insignificantly responds. This insignificant response is driven by a significant decline in migrants MPR which offsets the slight rise in migrant wages. Again, the MPR is found to be countercyclical to foreign real GDP. This occurs despite a slight rise in migrant wages, which contrasts with no movement in Saudi real wages. Migrant's employment and participation rates insignificantly respond. In contrast, Saudi employment increases mainly from a rise in participation rates. Saudi and migrant unemployment rates decline, albiet in an economically significantly way for migrants.

Figure 8. Increase in Saudi Real GDP

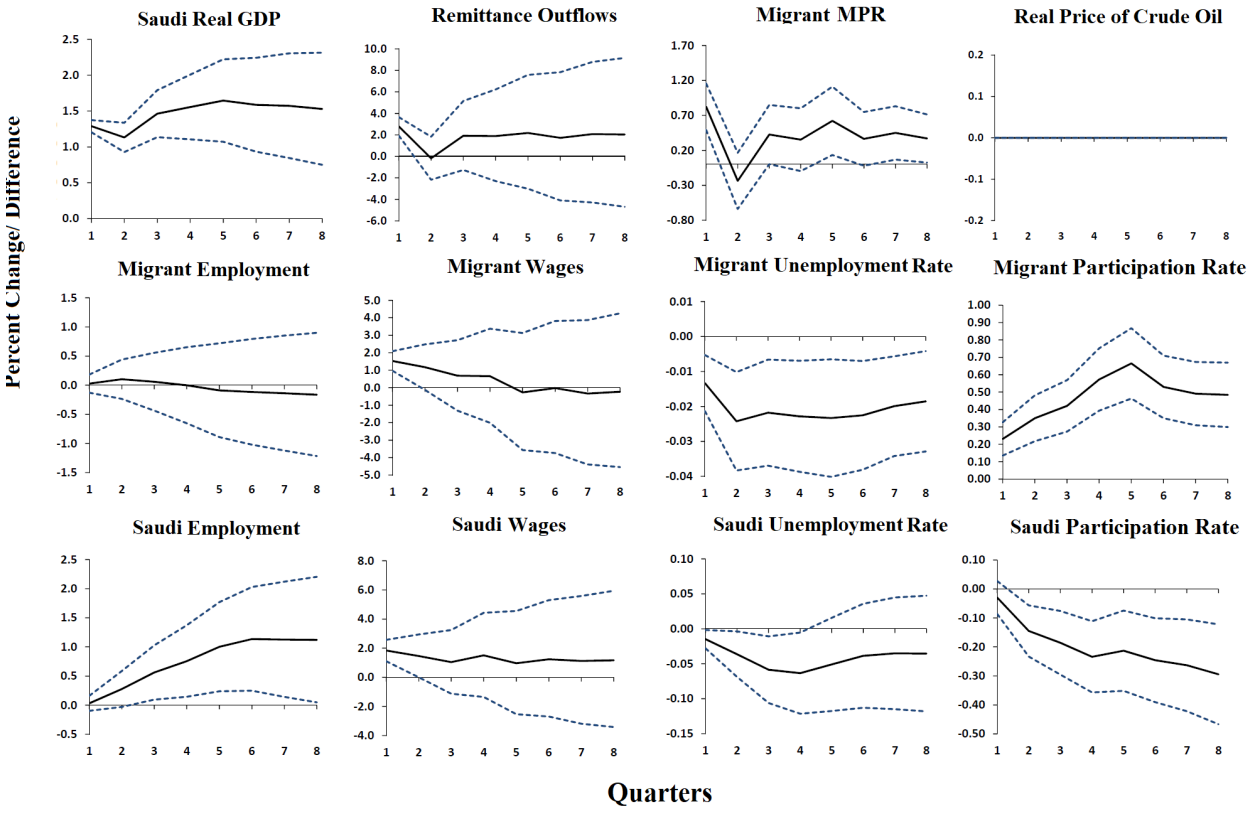


Figure 8 illustrates the IRFs from a one standard deviation increase to Saudi real GDP. In response to a Saudi demand shock that increases Saudi real GDP permanently by 1.5 percent, remittances increase by 2 percent. There is no response of the price of oil, foreign GDP, or oil supply

consistent with the identifying restrictions. The rise in the remittance outflows is driven by a temporary increase in the MPR and a rise in migrant wages. Again, migrant unemployment rates have a economically insignificant response despite a decline in both Saudi and migrant unemployment. The participation rate increases for migrants and declines for Saudi nationals. Despite the rise in migrant participation rates, there is a statistically insignificant response of migrant employment.

Figure 9. Increase in Saudi Oil Supply, Oil Market

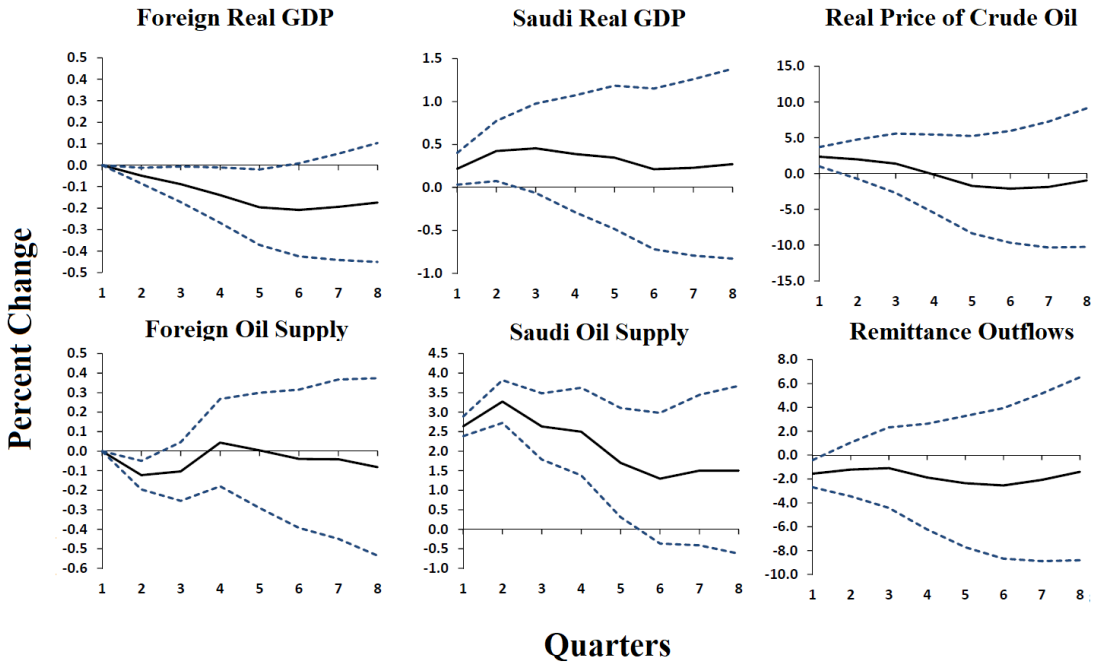
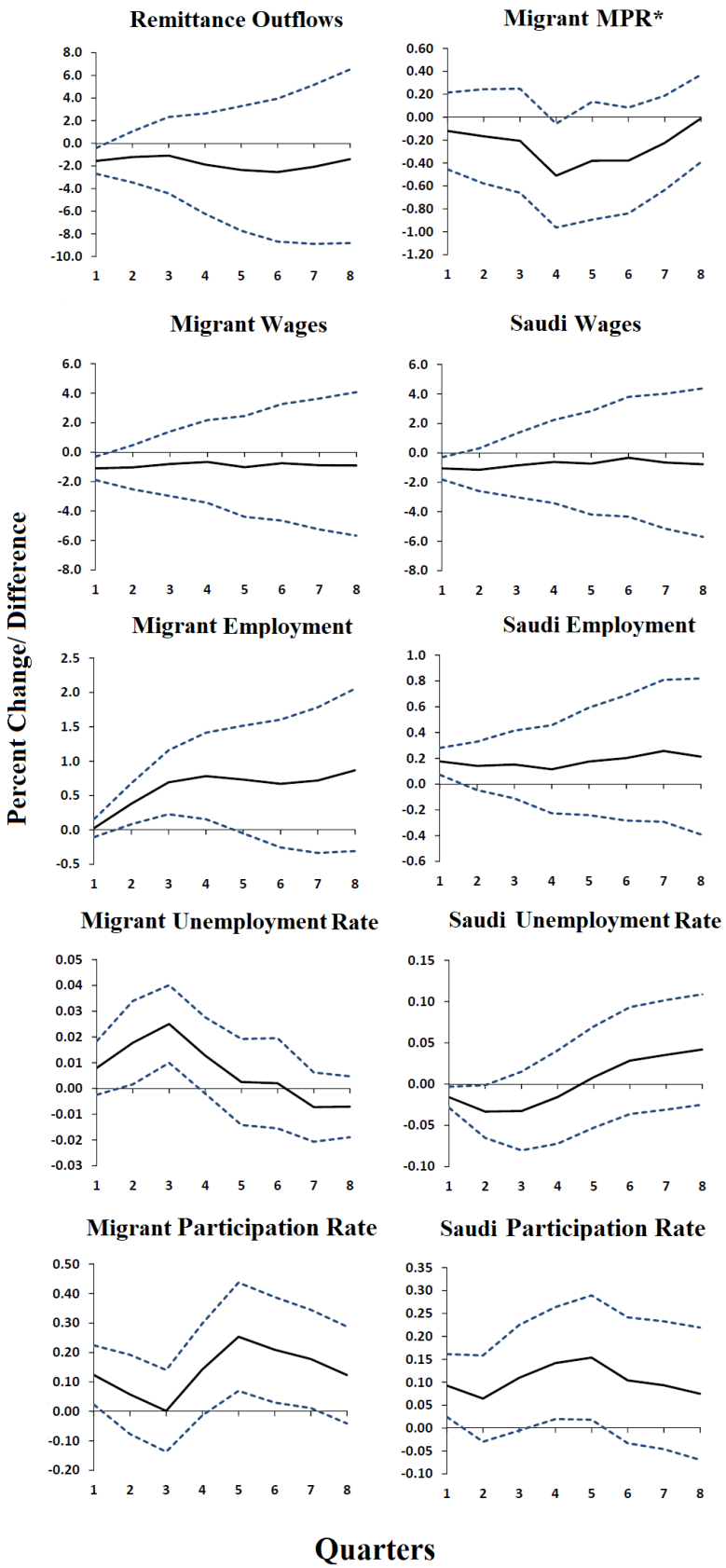


Figure 9 illustrates the structural IRFs from a one standard deviation shock to Saudi crude oil production on the global market for crude oil. A one standard deviation shock increases Saudi crude oil production significantly by 3 percent. In contrast, foreign oil supply falls slightly. Overall, the real price of crude oil falls by the second year albeit it is statistically insignificant. The insignificant decline is true for both the the samples starting in 1999Q2 and 2006q1. The contrasting reaction of foreign and Saudi crude oil production from the foreign supply shocks is interesting as it reflects a potential lack of presence of Saudi crude oil supply shocks that are independent of OPEC. The Saudi crude oil supply shock and responses are avenues of future research.

Figure 10. Increase in Saudi Oil Supply, Labor Market



In response to the increase in Saudi oil supply, the level of personal remittance outflows fall slightly, Figure 10. This is driven by a persistent decline in the MPR and a temporary decline in real wages. Migrant unemployment is again economically insignificant and Saudi unemployment also declines by an economically small amount.

The fall in remittances occurs despite an sizeable and persistent increase in migrant employment. This rise in employment occurs concurrently with small rise in migrant participation, and hence is mainly driven by increased immigration. The response of the participation rate may be driven by a difference in the number of family members accompanying the marginal migrant worker compared to the current stock of migrants. This, along with the skill set of the marginal migrant workers are interesting topics for further study.

For all of the structural shocks to the market for crude oil, migrant employment moved with the direction of crude oil prices. The elasticity of the migrant labor was largest for the Saudi oil production. This suggests a strong link between migrant employment, Saudi oil production, and crude oil wealth effects. The results highlight the importance of identifying structural drivers of remittance outflows. There is a negative correlation of remittances and the MPR to foreign GDP. Remittances and the MPR have a positive correlation with Saudi real GDP for shocks to domestic demand but has a negative correlation for all other structural shocks.

To summarize, the empirical decomposition suggests that the MPR, migrant wages, and migrant labor supply are the most important drivers of remittance outflows in Saudi Arabia. There is a negative correlation of the MPR to foreign GDP. There is also a significant positive correlation of migrant labor supply to home GDP. Across structural shocks, real wages of migrant workers move quite closely with Saudi wages and are influenced by the CPI deflator movements. This suggests an highly elastic medium-term migrant labor supply and a quick to respond MPR. The response of the unemployment rate of migrant workers has a economically insignificant contribution to remittance determination.

5 Robustness

While the above analysis has compared the estimates to other sample periods when they differed this section reports the robustness of the elasticities to other sample periods. Observations of migrant labor outcome occur with more regularity in the later sample so the main comparison is the SVAR when estimated starting in 2006Q1. This sample also does not have any imputed values of remittance outflows. Moreover, as shown in Table 1, the share of imputed values as a percent of total observations drops from just below two thirds to just over half.

Table 2 reports the average in the first year of the level of the response for each variable when the SVAR is estimated for the 1994Q1–2017Q4 and 2006Q1–2017Q4 sample periods. All of the responses are normalized by the average value of the level of the shock in the first year, so that the responses can be interpreted as a elasticity and are directly comparable across samples.

The medium-term elasticity of the price of crude oil to foreign demand is very similar. The lower average price of crude oil in the first year in response to an increase in foreign oil supply is due to faster convergence of the crude oil price its new level. Although as mentioned, the model estimated starting in 1999Q2 has more difficulty identifying a significant price fall. The Saudi oil supply shock also suggest more of crude oil price decline in the later sample. In response to a

Table 2. Elasticity Consistent Albiet Larger for Second Half of Sample

1999Q2-2017Q4											
Impu./Resp.	Oil S. F.	Oil S. KSA	GDP F.	Price Oil	GDP KSA	Remit.	MPR	M. Wage	M. Emp.	M. Unem.	M. Part.
Oil Sup. F.	1.00*	1.13*	0.16*	-1.56	0.43	-0.14	-0.36	1.33	-0.26	0.00	0.00
Oil Sup. KSA	-0.02	1.00*	-0.03*	0.51	0.13	-0.52	-0.09	-0.33	0.17*	0.01*	0.03
GDP Foreign	0.32*	1.46*	1.00*	11.37*	0.95*	-6.31*	-2.08*	-3.36*	0.37	0.02*	0.29*
GDP KSA	0.00	0.00	0.00	0.00	1.00*	1.21	0.26	0.76	0.03	-0.02*	0.29*
2006Q1-2017Q4											
Impu./Resp.	Oil S. F.	Oil S. KSA	GDP F.	Price Oil	GDP KSA	Remit.	MPR	M. Wage	M. Emp.	M. Unem.	M. Part.
Oil Sup. F.	1.00*	0.62	0.24*	-9.86*	0.15	-2.08	0.18	0.57	-0.75	-0.04*	0.16
Oil Sup. KSA	-0.06	1.00*	-0.09*	-0.71	0.15	0.23	-0.02	0.15	0.52*	0.00	0.10
GDP Foreign	0.01	3.17*	1.00*	11.87*	0.78	-14.52*	-2.81*	-8.47*	1.11	0.00	0.39*
GDP KSA	0.00	0.00	0.00	0.00	1.00*	0.23	0.60*	-0.06	-0.27	-0.02*	0.24*

Annual averages. Rows are shocks, columns are responses. Normalized so that the average value of the shocks in the first years are unity. KSA refers to the Kingdom of Saudi Arabia, F. refers to the rest of the world, M. refers to Migrant. * represents significance at the 32 percent level.

foreign demand shock, Saudi crude oil production responds by twice as much for the second half of the sample. This is likely due to the exceptional response in its role of dampening oil price volatility during the great recession.

Interestingly, in response to a foreign demand shock that increases increases foreign real GDP by 1 percent on average in the first year, remittances decline by 6.3 percent for early sample but by 14.5 percent over the later sample. This is mainly due to the great recession which seemly induced larger fluctuations in real wages. The response of wages is insignificant for both samples to all other shocks. The same is true for remittances where the response to all other shocks are not consistently smaller in magnitude. This suggests that the remittance and wage response to the foreign demand shock in the later half of the sample is particular to the demand shock associated with the great recession and not due to reduced variance from the imputations of quarterly observations prior to 2006Q1.

The magnitudes for most of the labor market variables are not consistently larger for the second half of the sample period. This suggests a lack of dampening of the volatility for employment, unemployment, and participation rates due to the higher imputation rates over the full sample. However, regardless of the sample period, the MPR and labor market determinants of remittance outflows are qualitatively similar in sign and statistical significance.

The qualitative results are robust for alternative forms of interpolation including linear and piece-wise cubic Hermite interpolation. The results also hold if missing observations are backcasted using models that minimized the difference between observed and omitted data for periods around missing observations. While the standard errors are slightly effected for the imputation of the labor variables, the signs and magnitudes of the IRFs are consistent across imputation methods.

6 Conclusion

This paper documents that Saudi Arabia exhibits a sizeable contribution to international remittance flows as a source of, and in response to, shocks to the global market from crude oil. Saudi labor market demand induces large flows in international migration. This makes global remittance and

labor flows susceptible to global oil price movements.

The paper is the first to structurally deconstruct drivers of migrants' remittance outflows into the behavioral and labor market outcomes of migrants. The migrant labor supply, wage earnings, and the marginal propensity to remit out of labor earnings are important drivers of remittance outflows from Saudi Arabia. In contrast, migrant unemployment does not contribute to remittance outflows.

The paper provides an answer to the puzzle found in Snudden (2018) of why remittances declined in response to foreign demand shocks in Saudi Arabia but increased in Russia. Remittances in Saudi Arabia are found to be negatively correlated with foreign GDP due to a significant negative correlation of the marginal propensity to remit. The analysis suggests the importance of the marginal propensity to remit in determining international remittance flows. It also suggests the need to replicate the exercise for other oil-exporting remitters to isolate the stylized facts of the main migration-remittance corridors.

The results suggest a highly elastic supply for foreign labor and that remittance outflows are driven by migrant labor outcomes in remitters economies. The insights from the structural estimates can discipline the dynamics and theoretical structure of models of international migration and remittances. The results suggest the need to structurally identify the propensity to remit and labor market outcomes to attempt to identify the behavioral incentive to remit.

In addition to replicating this method in other remitter countries, the identification method could also be applied to questions of skilled and unskilled migration. Particularly, are either skill group more responsive to structural shocks at the margin? For example, the aggregate migrant participation rate dynamics could be influenced from workers from either skill group being more likely to migrate with their families. It could also drive some of the aggregate dynamics, such as real wages if the marginal share of skilled and unskilled workers differs from the average over business cycles. These questions are left for future research as data becomes available.

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