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ABSTRACT: This paper studies the macroeconomic and sectoral impacts of labor migration. We employ LMGE, a multi-sector, multi-labor Computable General Equilibrium model. We have distinguished between "skilled-labor" and "unskilled-labor" which may be employed in the domestic labor market or abroad. Labor supply is determined endogenously by leisure decision. The Household's optimization behavior determines the demand functions for commodities and leisure. Finally, time allocation between leisure and work determines the labor supply. The model is calibrated based on the 2001 Labor Micro Consistent Matrix (L-MCM) of the Iranian Economy. The L-MCM is a modified Social Accounting Matrix (SAM) which includes 147 commodities and 99 production activities. We find that labor inflow increases GDP as well as the consumption of households. But, employment may not rise in some sectors. Skilled labor migration increases the employment of unskilled labors in Agriculture, Oil and Gas, and Energy, while it decreases unskilled employment in other sectors. We also find that the labor category with the highest population has a stronger effect on GDP and consumption. Our sensitivity analysis proves the robustness of the results.

KEYWORDS: Migration, Employment, General Equilibrium, Micro Consistent Matrix

JEL: C68, J22, J61, E16

1. Introduction

Labor mobility has become the main feature of globalization and the global economy. It is a common phenomenon facing most developing and developed countries. International labor migration is defined as the movement of people from one country to another to find a job. As highlighted by the International Organization of Migration (IOM), an estimated 105 million workers are working in a country other than their country of birth (IOM, 2011).

Labor migration affects host and origin country. It increases the labor supply in the destination country and decreases the cost of production in favor of labor-intensive sectors. The country of origin gains from labor migration because it eases unemployment pressures and accelerates development through business creation and remittances. According to the International Monetary Fund (IMF), these remittances have the capacity to act as a cushion for economic shocks and provide direct benefits to households (IMF, 2006).

The International Labor Organization (ILO) indicates that Iran is becoming a labor exporter. Indeed, Iran now faces an annual outflow of 285 thousands of workers and has a total of 3 million Iranians working abroad (ILO, 2006). Moreover, the Organization for Economic Co-operation and Development (OECD) estimates about 2 million immigrants are living in Iran (OECD, 2012). Iran also sees a sizeable drain of highly educated individuals (Carrington and Detragiache, 1998).

Due to the importance of labor migration, many researchers are interested in investigating the impacts of migration. Most empirical studies use econometric models to examine the impacts of migration on the economy. Contributions to these researches include those by Docquier et al. (2011), Docquier et al. (2010), Ethan (2005), Edwards and Uretta (2003), and Parrado and Cerrutti (2003). There are also other empirical studies which employ partial equilibrium models and standard neoclassical growth models to investigate economic impacts of migration including Palivos (2009), Palivos and Yip (2007), and Moy and Yip (2006). But, Borjas (1999) states that we need a more detailed model with inter-linkages of various sectors to investigate the impacts of migration. A comprehensive model could show how the economy would change when the labor market might be flooded by millions of new workers. A multi-sector framework is required to examine the ripple effects of migration on other sectors of the economy. Without such a framework, it is impossible to evaluate the actual consequences of migration.

Although the Computable General Equilibrium (CGE) models have such a framework, they have not gained the deserved attentionfor being used in the analysis of labor migration. Dixon et al. (2008) use an economy-wide model to analyze the effects of three broad programs to reduce illegal immigrants in U.S. employment namely tighter border security, taxes on employers, and vigorous prosecution of employers. Their analysis is in favor of taxes on employers. Liu (2011) employs a dynamic general equilibrium model with labor market frictions to explore the economic consequences of illegal immigration. Simulations show that an increase in skilled immigration will raise the wages, employment, and consumption of unskilled workers, and lowers skilled workers' wages, employment, and consumption. Using a dynamic computable general equilibrium model, Bohlma (2010) examines the macroeconomic impact of skilled emigration from South Africa. Results indicate that skilled emigration (in the absence of any programs to counter this flow of workers) has a generally negative effect on the economy. Industries with the greatest exposure to the investment and export sectors as well as those with the highest concentration of skilled workers are shown to be most affected. Borgy and Chojnicki (2009) assess the demographic and economic consequences of migration in Europe and the neighborhood countries. Using a general equilibrium overlapping-generations model, they show that the financing of the "Pay-As-You-Go" pension system is substantially improved in the regions receiving the migrants.

Despite migration is a substantial phenomenon in Iran, few studies have investigated the impacts of migration on the Iranian economy. In fact, we found two relative studies done in Iran. In the first study, Asgari and Taghavi (2010) have investigated the cause and effects of brain-drain from 135 developing countries including Iran to 16 developed OECD countries from 1990 to 2004. The main result of this research is that brain-drain has a positive and significant effect on the accumulation of human capital, and regional convergence among developing countries with different income. In the other study, Shaterian and Ganji Pour (2010) have examined the impact of Afghans migration to Iran. The results show that Afghans inflow will decrease employment opportunities and increases unemployment.

In this paper, we take one step forward. This paper measures the impacts of different counterfactual scenarios of migration on sectoral production, macro variables, and welfare in Iran. To achieve this, this paper employs LMGE, a multi-sector, multi-labor computable General Equilibrium model, to study the impacts of labor migration. We have distinguished between "skilled-labor" and "unskilled-labor" which may be employed in the domestic labor market or abroad. Labor supply is determined endogenously by leisure decision. The model is calibrated based on the 2001 Labor Micro Consistent Matrix (L-MCM) which is a modified Social Accounting Matrix (SAM).

The reminder of this paper is arranged as follows. The CGE model is presented in section two. Then, section three introduces the data used in the model. The estimated results are reported and discussed in section four. Finally, section five concludes.

2. Structure of the LMGE model

LMGE provides interactions between different activities, households, and agents through numerous markets of goods, services, and factors of production. Each household has an initial endowment of labor and capital. Household's utility optimization determines the demand for each commodity. On the other hand, producers buy labor and capital from households and produce goods and services in a cost minimization or profit maximization goal. These demand and supply functions interact in different markets. In this framework, at any price, the total value of consumer expenditure equals consumer income. A set of prices and levels of production in each sector characterize the equilibrium in the model, such that market demand equals supply for all commodities.

In our model, the economy is characterized by seven different sectors including the oil and gas sector, food production, agriculture, energy sector, metals sector, other manufacturing, and services. Production factors consist of skilled labor, unskilled labor, and capital. Production nests of inputs include Capital (K), Labor (L), and Intermediate inputs (M). Activities mix the production inputs in nested Constant Elasticity of Substitution functions (NCES) and produce the commodities. The representative household has an endowment of labor and capital.

According to theories of labor economics, we assume a trade-off between consumption and leisure. That means if households need to increase consumption, they had to decrease leisure to raise labor supply. In LMGE, the supply of skilled labor is a function of the opportunity cost of leisure, the price index for composite goods, potential income, share parameters, and elasticity of substitution between leisure and consumption. Similarly, the demand for consumption composite (consumption) depends mainly on potential income, relative prices, and elasticity of substitution between leisure and consumption.

Households may supply labor to different sectors. We assume that labor is not perfectly mobile across sectors. That means the economic resources would not be reallocated completely according to new equilibrium prices and wages. It also implies that factors are not sector-specific. There is an optimization behavior to find the optimal level of labor supply to each sector. Labor owner tries to maximize the revenue from labor supply considering an elasticity of transformation across sectors as well as different sectoral wages.

LMGE model includes various equations. We assume zero profit condition for production sectors, income balance condition for households, and market clearance condition for all markets in the economy. The following section introduces the main equations of the model.

2.1. Production structure

We apply a nested structure format for domestic products in the LMGE model. The model assumes a weak separability for inputs and output in this format. According to weak separability, if a function is separable, then its components can be divided into certain subgroups (Bor and Haung, 2010).

As depicted in figure 1, the upper nest of the nested structure comprises the value added nest and intermediate inputs nest. Firms supply the products thorough the constant elasticity of transformation (CET) function. In addition, the intermediate nest is an aggregate of various goods that are themselves a nested combination of transport margin, trade margin, and domestic and imported goods. The value added nest aggregates capital and labor. The labor nest combines skilled and unskilled labor. Finally, the Armington nest aggregates imported and domestic goods.

We assume that inputs needed for joint production in each sector are divided into two groups: intermediate inputs and primitive inputs, i.e. labor and capital. Therefore, the functional form of the upper nest of production can be shown as a zero profit condition in each sector:

$$\pi_s = \underbrace{\left[\sum_g \left(\delta_{s,g}\left[(1+str_{g,s})PP_{g,s}\right]^{1-\theta_s}\right)\right]^{\frac{1}{1-\theta_s}}}_{(1-1)} - \underbrace{\left[\alpha_{s,va}PVA_s^{1-\beta_{klm,s}} + \alpha_{s,ma}PMA_s^{1-\beta_{klm,s}}\right]^{\frac{1}{1-\beta_{klm,s}}}}_{(1-2)} = 0 \qquad (1)$$

where π is the profit. The first phrase (1-1) shows unit revenue and the second (1-2) presents unit cost. *PP, PVA, PMA* are the product cost, value added composite cost index, and intermediate inputs composite cost index respectively. Furthermore, *str* is tax on products, α is the share of each nest in production cost, δ is share of each product in total production, θ is elasticity of transformation, β elasticity of substitution in the first nest, *s* is sector index, *klm* refers to the first nest, *va* refers to the value added nest, *ma* refers to the intermediate inputs nest, and *g* refers to goods.

As the cost of intermediate inputs consists of input price, transport cost, and trade margin, we can express the intermediate inputs nest as follows:

$$PMA_s = \left[\sum_g \left[\alpha_{s,g,tp}PTP_g + \alpha_{s,g,wh}PWH_g + \alpha_{s,g}PIN_{g,s}\right]^{1-\beta_{ma,s}}\right]^{\frac{1}{1-\beta_{ma,s}}} \qquad (2)$$

where *PIN, PWH, PTP* are the transport margin, the trade margin, and intermediate inputs cost index, respectively. Furthermore, α shows the share of each component in this nest and β is the elasticity of substitution. Other indices are as before.

Capital and labor combine together in the value added nest which can be shown as follows:

$$PVA_s = \left[\alpha_{s,l}PL_{l,s}^{1-\beta_{va,s}} + \alpha_{s,k}r_{k,s}^{1-\beta_{va,s}}\right]^{\frac{1}{1-\beta_{va,s}}} \qquad (3)$$

where *PL* is the index for labor nest, *l* and *k* refer to labor and capital, respectively, α is the share of each component in this nest and β is the elasticity of substitution between labor and capital.

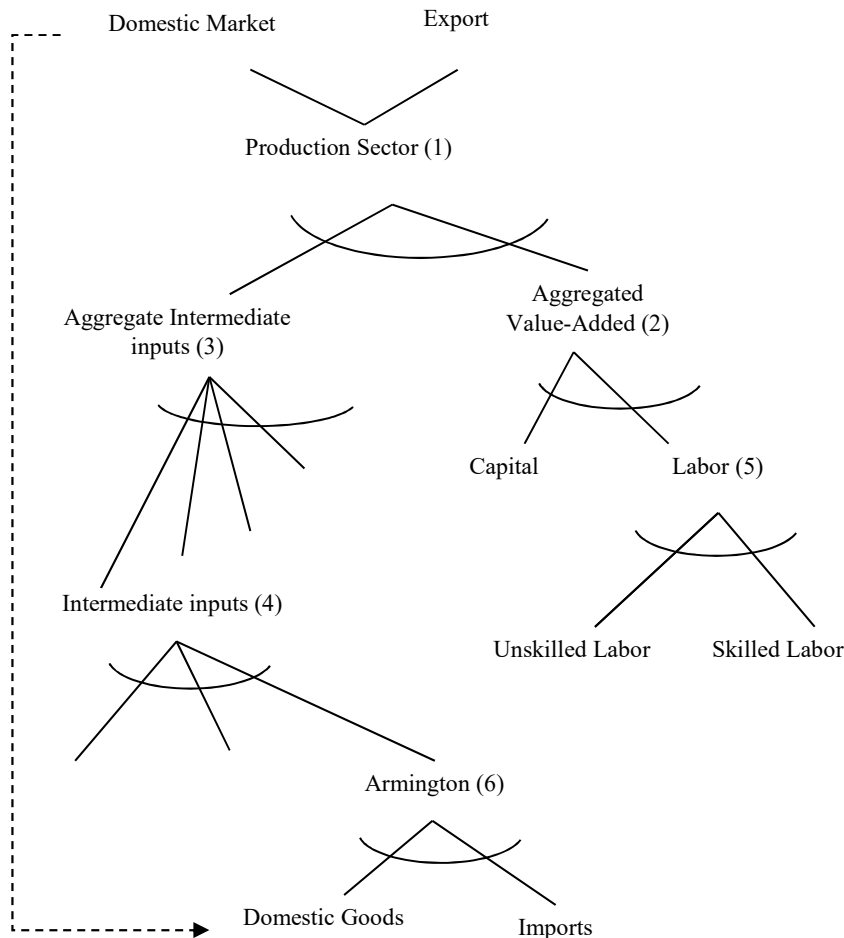On the other hand, we can express the labor nest as below:

$$PL_s = \left[\alpha_{s,skl}w_{skl,s}^{1-\beta_{l,s}} + \alpha_{s,usl}w_{usk,s}^{1-\beta_{l,s}}\right]^{\frac{1}{1-\beta_{l,s}}} \qquad (4)$$

where *w* is wage index, *skl* refers to skilled labor and *usl* refers to unskilled labor, α is the share of each labor type in this nest and β is the elasticity of substitution between skilled and unskilled labor.

Finally, we can show the Armington nest which aggregates domestic and imported goods as follows:

$$PIN_g = \left[\alpha_{ar,g,m}PM_g^{1-\beta_{ar,g}} + \alpha_{ar,g,dp}PD_g^{1-\beta_{ar,g}}\right]^{\frac{1}{1-\beta_{ar,g}}} \qquad (5)$$

where *PD* and *PM* are domestic and imported goods price index, *m* and *dp* depict imported and domestic products.

Domestic Market   Export

Production Sector (1)

Aggregate Intermediate inputs (3)

Aggregated Value-Added (2)

Capital   Labor (5)

Intermediate inputs (4)

Unskilled Labor   Skilled Labor

Armington (6)

Domestic Goods   Imports

2.2. Labor market structure

Some assumptions are required in the model to completely represent the Iranian labor market. We assume the minimum wage policy for unskilled labor that is being applied by the Iranian government on wage rates. It would result in involuntary unemployment for unskilled labor.

Some CGE models assume complete mobility of labor and capital between sectors. In these models, the economic resources would be reallocated completely based on new equilibrium prices and wages. Nevertheless, complete mobility is sometimes inappropriate for the analysis. Some other models assume immobility of factors, which means that factors are sector-specific. This assumption is not also appropriate for Iran. Hence, we assume incomplete labor mobility between sectors. In other words, labor is neither completely mobile nor immobile.

2.3. The demand function for labor

The demand for labor is obtained by solving the firm's optimization problem. Demand function of labor is as follows in this model:

$$D_{l,s} = \alpha_{s,va}\alpha_{s,L}\alpha_{s,l}AL_s\bar{Q}_s \left(\frac{\left(\omega_{kl,s}PVA_s^{1-\beta_{klm,s}} + \omega_{m,s}PMA_s^{1-\beta_{klm,s}} \right)^{\frac{1}{1-\beta_{klm,s}}}}{PVA_s} \right)^{\beta_{klm,s}} \left(\frac{PVA_s}{PL_s} \right)^{\beta_{va,s}} \left(\frac{PL_s}{w_l} \right)^{\beta_{l,s}} \tag{6}$$

where *Q, AL*, and *D* are production level in the initial state, activity level, and demand for labor, respectively. Other indices are chosen as before. According to this equation, demand for labor is directly affected by activity level and indirectly affected by "proportion of wage relative to other prices". It also indicates that the share of labor in the total cost of production has a significant role in the demand for labor.

One should notice that if there is no substitution between the value added nest and the intermediate inputs nest, demand for labor will be as equation (7); in this case, changes in prices of intermediate inputs have no effect on labor demand.

$$D_{l,s} = \alpha_{s,va}\alpha_{s,L}\alpha_{s,l}AL_s\bar{Q}_s \left(\frac{PVA_s}{PL_s} \right)^{\beta_{va,s}} \left(\frac{PL_s}{w_l} \right)^{\beta_{l,s}} \tag{7}$$

Likewise, if the elasticity of substitution between labor and capital be equal to zero, the demand function for labor will be as below:

$$D_{l,s} = \alpha_{s,va}\alpha_{s,L}\alpha_{s,l}AL_s\bar{Q}_s \left(\frac{PL_s}{w_l} \right)^{\beta_{l,s}} \tag{8}$$

In other words, neither changes in prices of intermediate goods nor changes in capital rent affects labor demand.

Finally, if the elasticity of substitution between skilled and unskilled labor be equal to zero, the demand function for *l* labor type will be:

$$D_{l,s} = \alpha_{s,va}\alpha_{s,L}\alpha_{s,l}AL_s\bar{Q}_s \tag{9}$$

This demand function expresses that if we assume zero substitution in the production structure (Leontief function), demand for labor will be depended only to activity level and technical coefficients.

2.4. Labor supply function

The unskilled labor supply in the LMGE model is exogenous. However, the supply of skilled labor is determined based upon a choice between consumption and leisure. Any time spent in leisure means losing potential earnings so that the opportunity cost of leisure is lower consumption. It means that the more hours the labors work the more earnings they earn to consume. Therefore, we can define the utility function of consumer based on leisure and consumption and the implicit expenditure function correspond to this utility function can be obtained as follows:

$$PE_h = \left(\omega_{c,h}CPI_h^{1-\sigma_{cz,h}} + \omega_{z,h}PZ_z^{1-\sigma_{cz,h}} \right)^{\frac{1}{1-\sigma_{cz,h}}} \tag{10}$$

where *PE, CPI, PZ, ω, σ* are implicit index for household's expenditure, consumer price index, *the* opportunity cost of leisure, share parameter, and elasticity of substitution between work and leisure,

respectively. The h index refers to households, c refers to consumption and z refers to leisure. We can also express the leisure demand function as follows:

$$D_{z,h} = \omega_{z,h} WL_s \overline{E}_h \left(\frac{\left(\omega_{c,h} CPI_h^{1-\sigma_{cz,h}} + \omega_{z,h} PZ_z^{1-\sigma_{cz,h}} \right)^{\frac{1}{1-\sigma_{cz,h}}}}{PZ_z} \right)^{\sigma_{cz,h}} \tag{11}$$

where WL and E are the household's utility level, and benchmark expenditure.

Since the cost opportunity of leisure indicator is equal to the skilled labor wage index, we can show the leisure demand function as follows:

$$D_{z,h} = \omega_{z,h} WL_s \overline{E}_h \left(\frac{\left(\omega_{c,h} CPI_h^{1-\sigma_{cz,h}} + \omega_{z,h} w_{skl}^{1-\sigma_{cz,h}} \right)^{\frac{1}{1-\sigma_{cz,h}}}}{w_{skl}} \right)^{\sigma_{cz,h}} \tag{12}$$

The estimated leisure demand function then determines the supply of skilled labor given by S as follows:

$$S_{skl} = \overline{TE}_{skl} - D_z \tag{13}$$

where TE is the index for time endowment available to households.

2.5. Foreign trade structure

Supply of exports in the LMGE is a function of production level, exchange rate, foreign price, and elasticity of substitution between domestic supply and exports. Demand for imports is also a function of households' income, production level, and demand for foreign exchange. The exchange rate is determined in the interaction of demand for foreign exchange and supply of it. Moreover, the supply of products to the foreign world is obtained by solving the firm's optimization problem as:

$$X_{g,s} = \delta_{s,g} \varphi_{x,g} AL_s \overline{Q}_s \left(PP_{s,g} \middle/ \left[\sum_s \delta_{s,g} \left[(1+str_{g,s}) PP_{g,s} \right]^{1-\theta_s} \right]^{\frac{1}{1-\theta_s}} \right)^{\theta_s} \left(\frac{PX_g}{PP_{s,g}} \right)^{\lambda_g} \tag{14}$$

where X is export and PX is export goods price index.

Similarly, demand function for imports is obtained by solving the firm's optimization problem as:

$$M_{g,s} = \omega_{m,s} \alpha_{s,g} \alpha_{ar,g,mp} AL_s \overline{Q}_s \left(\frac{PKLM_s}{PMA_s} \right)^{\beta_{klm,s}} \left(\frac{PMA_s}{PIN_{g,s}} \right)^{\beta_{ma,s}} \left(\frac{PIN_{g,s}}{PM_g} \right)^{\beta_{ar,s}} \tag{15}$$

where $PKLM$ is price index for the KLM nest.

3. Data

The model is calibrated based on the 2001 Labor Micro Consistent Matrix (L-MCM). The L-MCM is a modified Social Accounting Matrix (SAM). The basic data in the construction of the L-MCM are compiled from 2001 SAM and 2001 input-output (IO) tables (147 commodities and 99 industries) published by Statistical Center of Iran (SCI). We use both sources to construct the L-MCM. The 2001 IO table includes tables of use, supply, import, trade, and transport margin, and capital formation.

The abstract form of L-MCM consists of seven commodities and seven production sectors. Indeed, we aggregate similar commodities based on Central Product Classification (CPC) codes and activities based on the International Standard Industrial Classification of all economic activities (ISIC) codes into seven major categories in the L-MCM. Regarding this fact that the labor market is the main focus of our study, we distinguish skilled and unskilled labor types.

The L-MCM is a balanced matrix in which row and columns sums are zero. Columns of the L-MCM correspond to production sectors or consumers, and rows correspond to commodities. In the L-MCM, each row portrays a market balance, and each column shows either zero profit condition or income balance condition. The L-MCM shows the financial flows between all economic agents through markets or transfer payments. In the L-MCM, a positive number shows the value of earnings, while a negative number is the value of expenditures.

Table 1: Labor Micro Consistent Matrix, production sectors (Millions of Rials)

	Agriculture	Oil and Gas Sector	Food Production	Energy Sector	Production of metals	Industry	Services
Agriculture	1,050		-533			-7	-19
Oil and Gas		941		-89	-78	-39	-6
Food	-61		871		-9	-41	-105
Energy	-13	-3	-13	309	-40	-8	-123
Metals			-8		322	-472	-46
Industry	-101	-12	-46	-4	1,497		-275
Services	-46	-7	-5		-7	-74	4,367
Saving							
Skilled Labor	-26	-29	-69	-29	-44	-206	-948
Unskilled Labor	-2	-3	-16	-7	-10	-47	-52
Mix Income	-588	-1	-62		-6	-34	-1,088
Surplus	-211	-886	-120	-185	-122	-570	-1,706

Table 2: Labor Micro Consistent Matrix, Final Demand, Margins and Institutions (Millions of Rials)

	Capital formation	Households	Import	Margin	Export	Public sector
Agriculture	-114	-736	78	379	-98	
Oil and Gas	-23		12	84	-801	
Food	-33	-1,151	232	395	-99	
Energy		-106	16	55	-74	
Metals	-18	-27	97	191	-38	
Industry	-1,668	-511	752	464	-96	
Services	-74	-1,602	104	-1,568	-86	-1,001
Saving	1,931	-1,494				-437
Skilled Labor		1,351				
Unskilled Labor		137				
Mix Income		1,779				
Surplus		2,362				1,437

4. Policy simulation analysis

This study employs LMGE model as a structure for economic impact analysis of labor migration in Iran. We measure the effects on sectoral skilled and unskilled labor employment, activity level, consumption, and GDP.

4.1. Simulation scenarios

To measure the impacts of migration, we apply five counterfactual scenarios on the migration of both skilled and unskilled labor. These scenarios are presented in table 2. We should mention that positive entries in this table refer to labor immigration and negative entries refer to labor emigration. For instance, scenario 1 means that the supply of labor increases by two percent due to the immigration of foreign workers into Iran. Likewise, scenario 6 expresses that five percent of labors emigrate from Iran to other countries.

Table 3: Scenarios on the migration of skilled and unskilled labor

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
Change in labor supply	+2%	+5%	+10%	+20%	-2%	-5%	-10%

4.2. Impacts of labor migration on GDP and consumption

Our calculations demonstrate that unskilled labor immigration has a positive impact on GDP. As shown in figure 1, GDP increases in scenario 1, 2, 3, 4. A 2% unskilled labor increase due to migration in scenario 1 will increase GDP by 1.34%. Similarly, 5% unskilled labor inflow in scenario 2 will raises GDP by 3.32%. And a 20% increase in unskilled labor force affects GDP by 12.71%.

We found that skilled labor inflow will raises GDP too but in lower amounts. A 2% skilled labor increase due to migration in scenario 1 will increase GDP by 0.64%. Similarly, 5% of skilled labor inflow in scenario 2 will raises GDP by 1.57%. And a 20% increase in skilled labor force affects GDP by 5.91%.
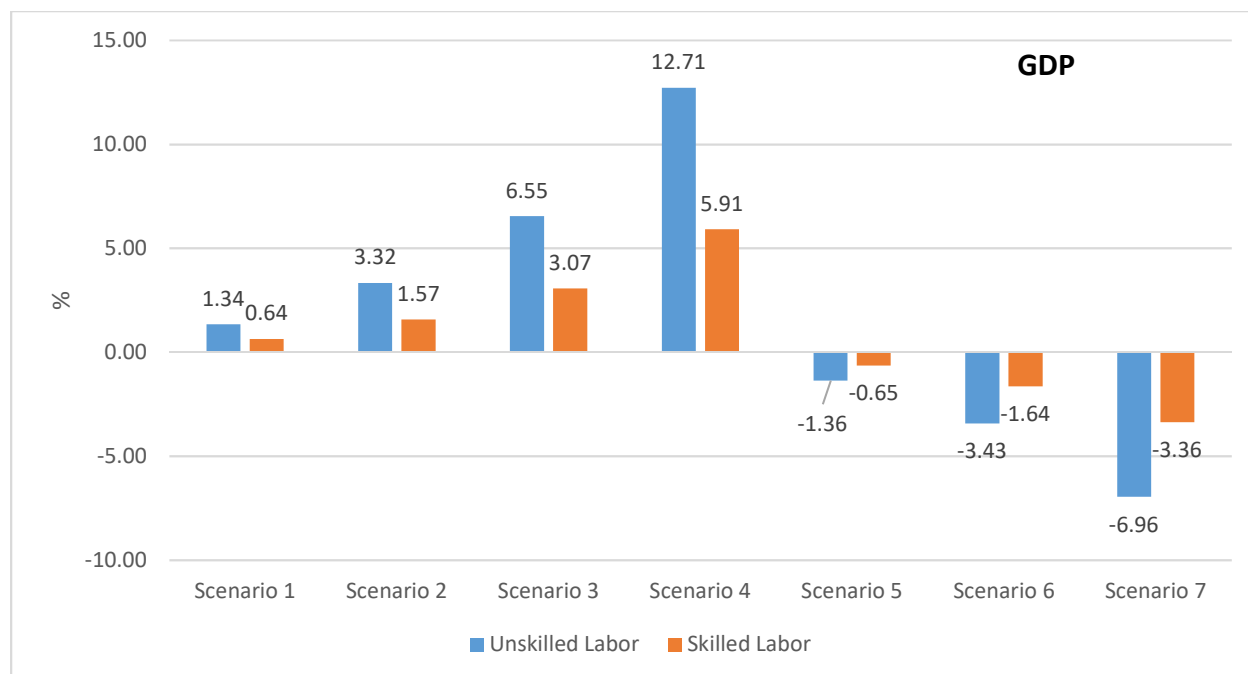
Figure 1: Impacts of labor migration on GDP under different scenarios of skilled and unskilled labor migration

We found that GDP decreases by 1.36% because of 2% reduction in unskilled labor supply (scenario 5), while it decreases by 6.96% after 10% reduction in unskilled labor supply (scenario 7). GDP also falls due to skilled labor outflow.

Results indicate that migration has a similar effect on consumption. Immigration of skilled and unskilled labor will increase consumption, while emigration will reduce it. As figure 2 depicts, the more the migration magnitude, the more its effects on consumption.

In addition, we see that unskilled labor migration have a stronger effect on GDP and consumption compared to skilled labor migration. Why does skilled labor inflow affect GDP less than unskilled labor inflow? It seems that skilled labor inflow reduces the skilled labor wage and therefore the opportunity cost of leisure will decline. As the opportunity cost of leisure determines the labor supply, the skilled labor will choose to work less and rest more. This leads to lower domestic skilled labor supply. Therefore, the rise in GDP will be less than expected.
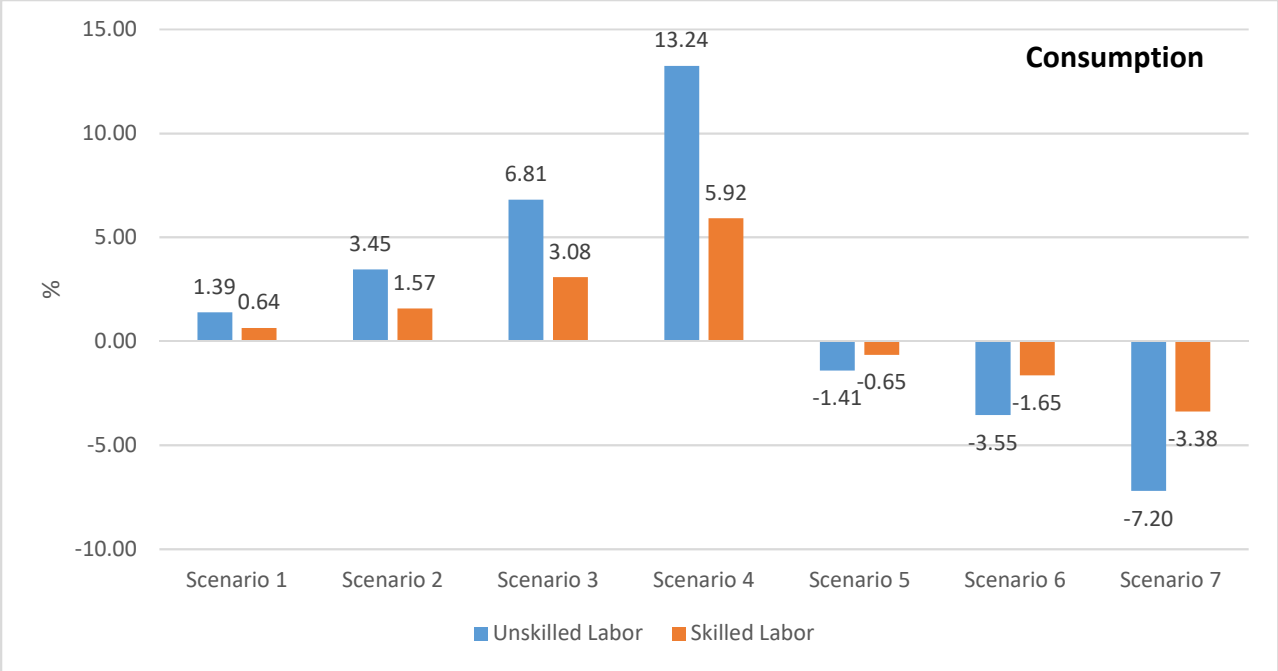
Figure 2: Impacts of labor migration on consumption under different scenarios of skilled and unskilled labor migration

4.3. Impact of labor migration on skilled and unskilled labor employment

Skilled labor inflow will increase skilled labor employment in all sectors. Our simulations suggest that employment of skilled workers increase in all sectors when skilled labors flow into the country and it decrease when skilled labors emigrate from the country (see figure 3). Highest employment change happens in Agriculture, Oil and Gas sector, and Energy sector. Appendix of this paper includes detailed tables with more information about impacts on each sector.

However, the impact of skilled labor inflow on unskilled labor employment is not straightforward. Skilled labor migration increases the employment of unskilled labors in Agriculture, Oil and Gas, and Energy, while it decreases in other sectors. On the other hand, skilled labor outflow decreases the employment of unskilled labors in Agriculture, Oil and Gas, and Energy sectors, while it expands in other sectors (see figure 4). Indeed, there is a substitution between skilled and unskilled workers in economic sectors.

We found that under unskilled labor migration the employment of skilled labor and unskilled labor move in opposite direction. Unskilled labor immigration into the country decreases skilled employment in all sectors (scenario 1, 2, 3, 4). And unskilled labor outflow increases skilled employment (see figure 5, scenario 5, 6, 7). On the other hand, unskilled labor inflow (under scenarios 1, 2, 3, and 4) increases the employment of unskilled labor in all sectors; while unskilled labor outflow reduces the employment of unskilled labors reduces (see figure 6).
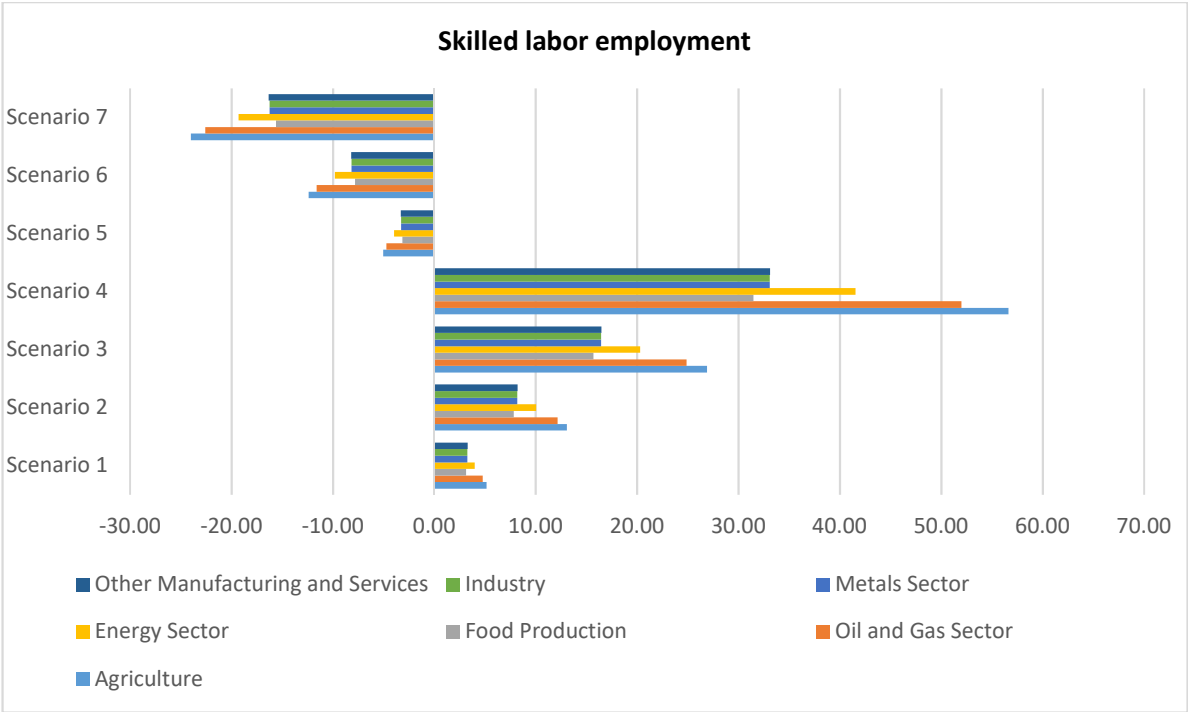
Figure 3: Percentage change in sectoral employment of skilled labor under different scenarios on skilled labor migration
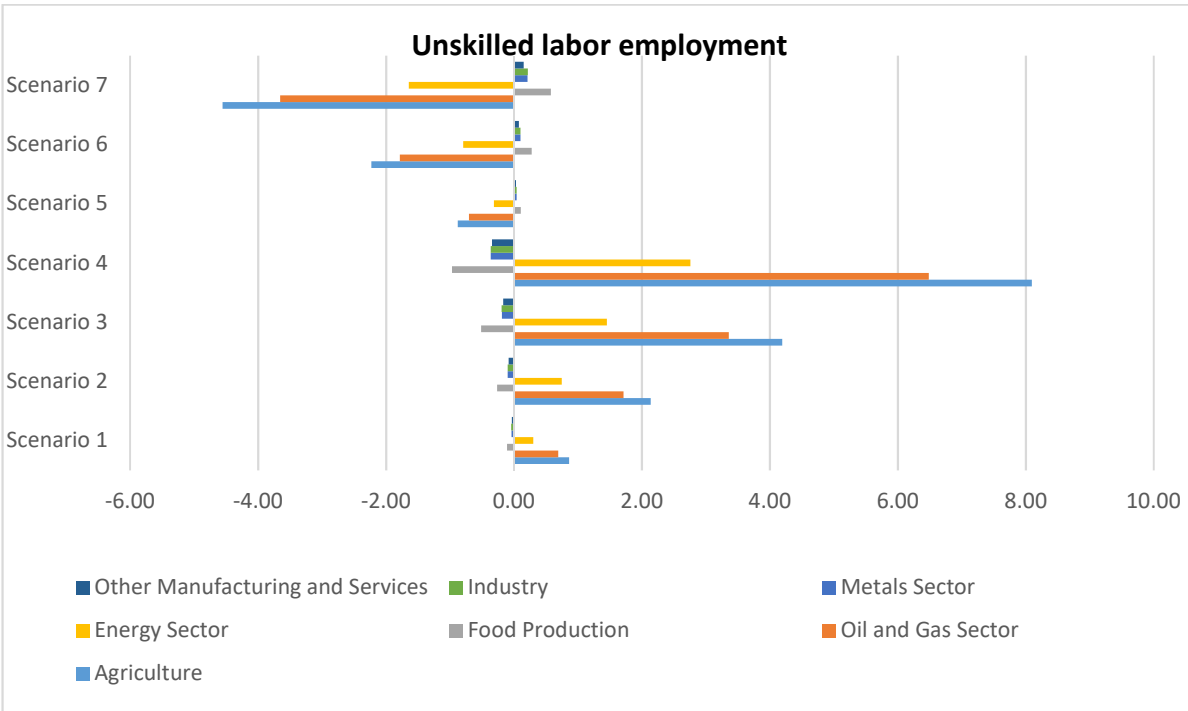

Figure 4: Percentage change in sectoral employment of unskilled labor under different scenarios on skilled labor migration
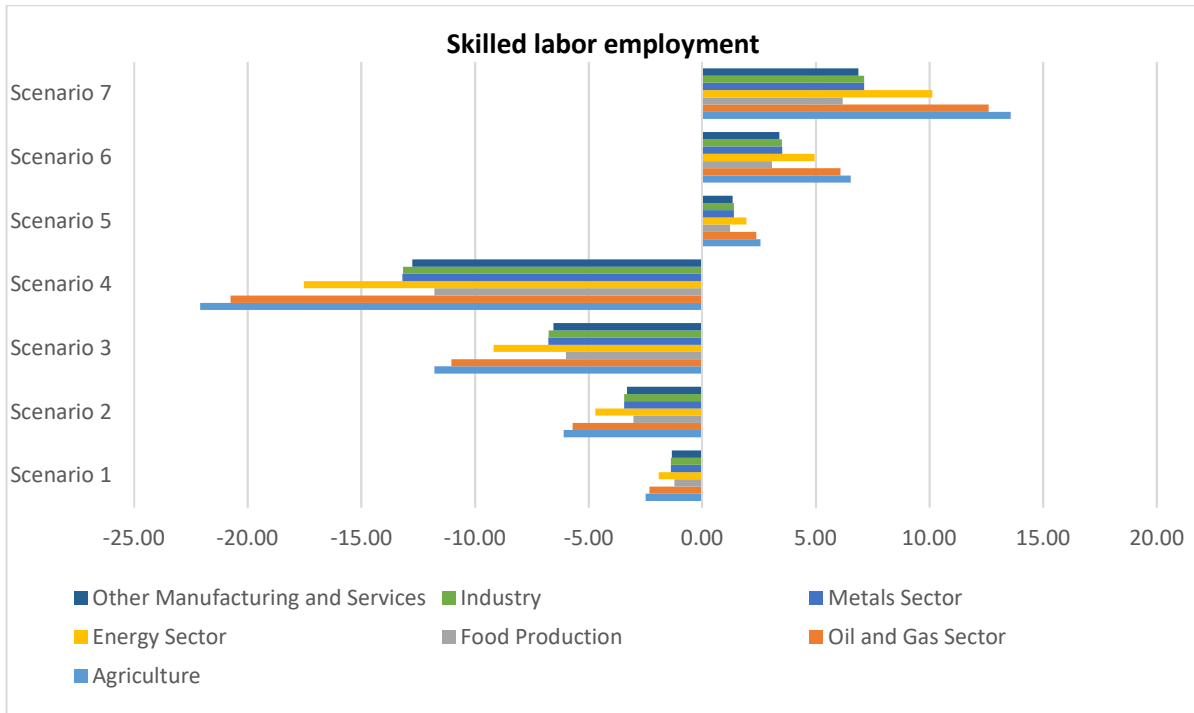
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Figure 5: Percentage change in sectoral employment of skilled labor under different scenarios on unskilled labor migration
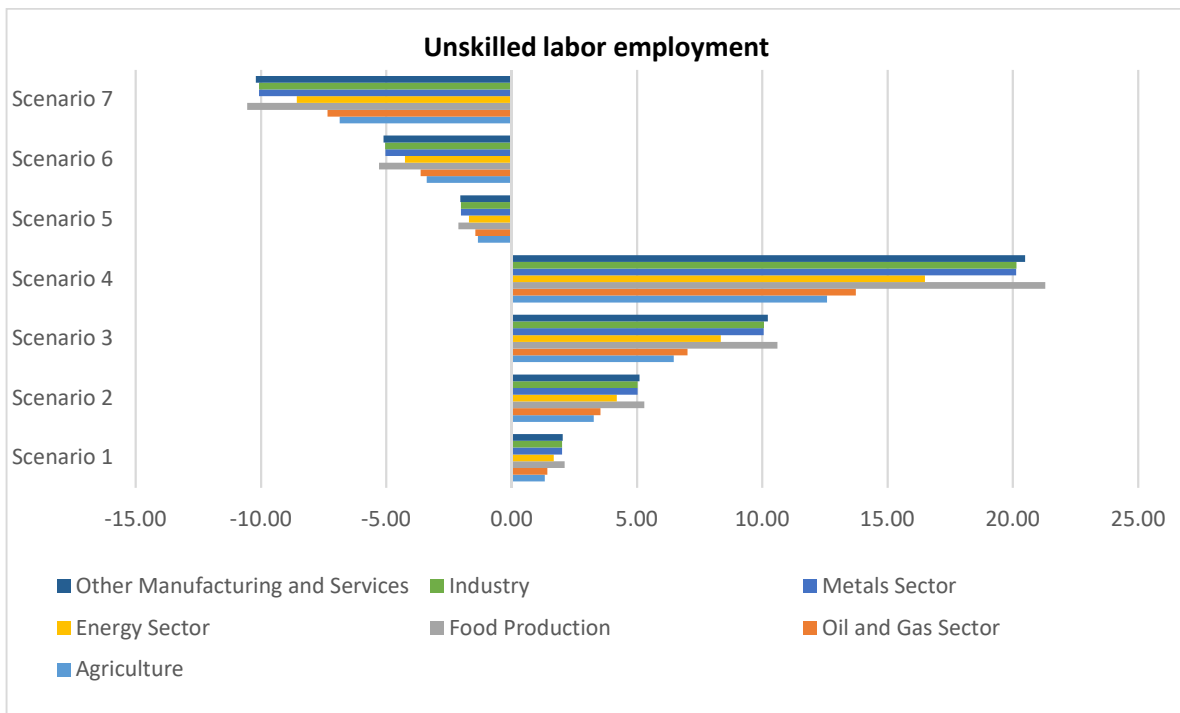

Figure 6: Percentage change in sectoral employment of unskilled labor under different scenarios on unskilled labor migration

4.4. Impact of labor migration on the activity level of sectors

We found that labor inflow will foster activity level for all sectors, while labor outflow will tighten production in all sectors. As figure (7) reveals, that skilled labor inflow to the country expands the activity level of all sectors (scenario 1, 2, 3, 4). It shows that outflow of skilled labor (scenarios 5, 6, 7) diminishes all sector's activity level. Unskilled labor migration has a similar effect on the activity level of sectors; inflow of unskilled labor increases the activity levels and outflow of unskilled labors decreases activity levels (see figure 8). Look at table 4, 5, 6, and 7 in the appendix for more details.
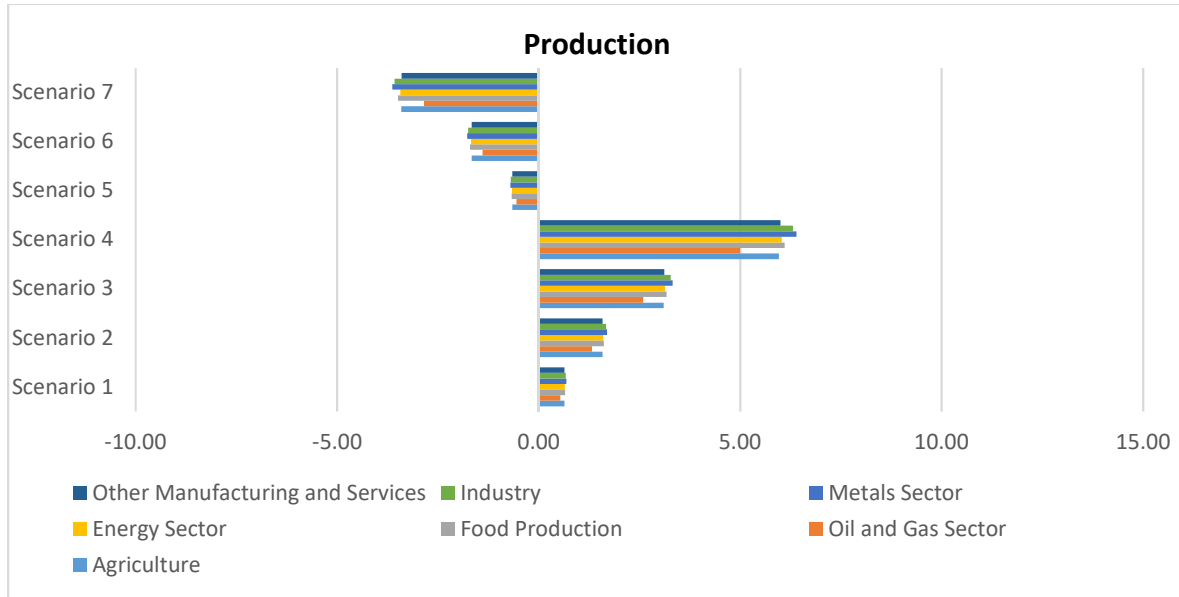

Figure 7: Percentage change in the activity level of sectors under different scenarios on skilled labor migration
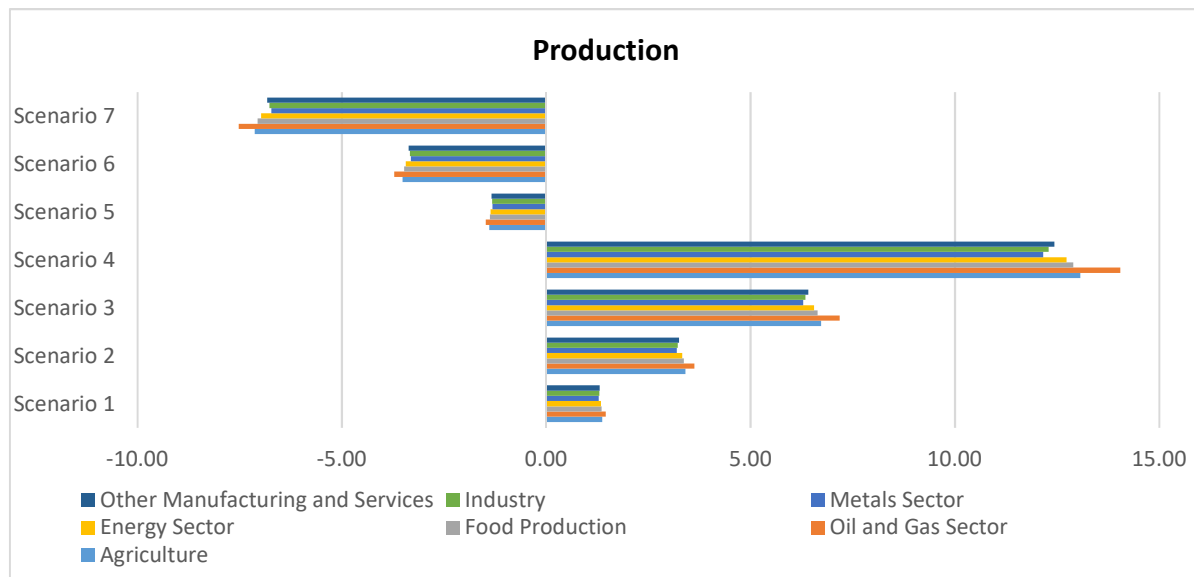

Figure 8: Percentage change in the activity level of sectors under different scenarios on unskilled labor migration

5. Discussion and other applications

The core part of the model is developed in a team of economists and is well-documented and well-known. This framework is applied in the assessment of the following policies: Cash Subsidy Transfer (Shahmoradi et al., 2011; Manzoor & Haqiqi, 2013); Access to Public Services (Mortazavi et al., 2013; Haqiqi & Mortazavi, 2012); Resources Boom (Manzoor et al. 2012a; Haqiqi & Bahador, 2015; Haqiqi & Bahalou, 2013); Generational Justice (Haqiqi, 2012; Haqiqi et al, 2013); Trade Barriers (Haqiqi & Bahalou, 2013) ; Labor Market Policies (Haqiqi & Bahalou, 2015; Manzoor and Bahaloo, 2015); Environmental Emissions (Manzoor and Haqiqi, 2012a); Energy Price Reform (Manzoor et al. 2010; Manzoor et al. 2012b; Manzoor & Haqiqi, 2012b; Sharifi et al., 2014) ; Energy Efficiency (Manzoor et al., 2011; Haqiqi et al., 2013) ; Energy Demand (Manzoor et al., 2012c; Manzoor & Haqiqi, 2013); Direct Investment (Manzoor et al. 2013). A full listing of equations for this study is available at Haqiqi and Bahalou Horeh (2014).

It will be important to continue to study the impacts of migration on national production, domestic labor income, redistribution, and exchange rate. In future works, it will also be important to expand the analysis to include different job categories. Much more can be done to understand and quantify the economic impacts of labor migration.

6. Conclusion

Previous studies have estimated the impacts of brain-drain on human capital, but this paper goes one step further and calculates the general equilibrium impacts of labor migration in Iran. While undoubtedly labor inflow increases GDP and consumption of private households, our analysis makes it clear that employment may not increase in some sectors. Skilled labor migration increases the employment of unskilled labors in Agriculture, Oil and Gas, and Energy, while it decreases unskilled employment in other sectors.

Unskilled labor migration has a stronger effect on GDP and consumption compared to skilled labor migration. Under the reasonable assumption, skilled labor inflow reduces the skilled labor wage and therefore the opportunity cost of leisure will decline. Therefore, skilled labor will choose to work less and rest more. The result is lower domestic skilled labor supply and less than expected GDP rise. We conducted a sensitivity analysis[1] and found that the results are robust.

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[1] The huge information produced in sensitivity analysis are available upon request through email.

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Appendix: A General Equilibrium Model with Labor-Leisure and Domestic-Abroad Choice for Assessment of Labor Migration in a Small Open Economy

Table 4: Impacts of skilled labor migration on employment and activity

Skilled labor flow	(%)						
	+2%	+5%	+10%	+20%	-2%	-5%	-10%
Skilled labor employment							
Agriculture	5.15	13.10	26.91	56.64	-5.04	-12.37	-24.01
Oil and Gas Sector	4.79	12.16	24.89	52.01	-4.70	-11.58	-22.56
Food Production	3.14	7.85	15.71	31.47	-3.13	-7.82	-15.61
Energy Sector	3.99	10.04	20.33	41.56	-3.95	-9.79	-19.30
Metals Sector	3.28	8.20	16.46	33.09	-3.27	-8.15	-16.23
Industry	3.27	8.20	16.45	33.09	-3.26	-8.14	-16.22
Other Manufacturing and Services	3.29	8.24	16.51	33.14	-3.28	-8.19	-16.33
Unskilled labor employment							
Agriculture	0.87	2.14	4.19	8.10	-0.88	-2.23	-4.55
Oil and Gas Sector	0.69	1.71	3.36	6.48	-0.70	-1.79	-3.65
Food Production	-0.11	-0.26	-0.51	-0.97	0.11	0.28	0.58
Energy Sector	0.30	0.75	1.46	2.76	-0.31	-0.79	-1.64
Metals Sector	-0.04	-0.10	-0.19	-0.36	0.04	0.10	0.21
Industry	-0.04	-0.10	-0.19	-0.36	0.04	0.10	0.22
Other Manufacturing and Services	-0.03	-0.08	-0.17	-0.34	0.03	0.08	0.15
Activity level							
Agriculture	0.64	1.59	3.10	5.96	-0.65	-1.66	-3.41
Oil and Gas Sector	0.54	1.33	2.60	5.00	-0.55	-1.39	-2.84
Food Production	0.66	1.62	3.18	6.10	-0.67	-1.70	-3.48
Energy Sector	0.65	1.60	3.14	6.03	-0.66	-1.67	-3.43
Metals Sector	0.69	1.70	3.32	6.40	-0.70	-1.77	-3.63
Industry	0.68	1.67	3.28	6.31	-0.69	-1.75	-3.58
Other Manufacturing and Services	0.64	1.59	3.12	6.00	-0.66	-1.66	-3.40

Table 5: Impacts of unskilled labor migration on employment and activity

	(%)						
unskilled labor flow	+2%	+5%	+10%	+20%	-2%	-5%	-10%
Skilled labor employment							
Agriculture	-2.49	-6.10	-11.79	-22.09	2.56	6.54	13.58
Oil and Gas Sector	-2.32	-5.70	-11.03	-20.75	2.39	6.09	12.61
Food Production	-1.22	-3.02	-5.99	-11.78	1.22	3.07	6.19
Energy Sector	-1.91	-4.70	-9.18	-17.53	1.95	4.94	10.13
Metals Sector	-1.38	-3.43	-6.77	-13.19	1.40	3.52	7.13
Industry	-1.38	-3.43	-6.76	-13.17	1.40	3.52	7.12
Other Manufacturing and Services	-1.33	-3.31	-6.54	-12.76	1.35	3.39	6.87
Unskilled labor employment							
Agriculture	1.33	3.28	6.47	12.58	-1.34	-3.38	-6.86
Oil and Gas Sector	1.43	3.55	7.02	13.74	-1.44	-3.63	-7.34
Food Production	2.12	5.30	10.62	21.30	-2.11	-5.28	-10.55
Energy Sector	1.69	4.20	8.35	16.49	-1.70	-4.26	-8.57
Metals Sector	2.01	5.03	10.07	20.13	-2.01	-5.04	-10.07
Industry	2.01	5.04	10.07	20.15	-2.01	-5.04	-10.07
Other Manufacturing and Services	2.04	5.11	10.23	20.49	-2.04	-5.10	-10.20
Activity level	1.38	3.41	6.73	13.07	-1.39	-3.51	-7.13
Agriculture	1.46	3.63	7.18	14.05	-1.48	-3.72	-7.52
Oil and Gas Sector	1.36	3.37	6.65	12.90	-1.38	-3.48	-7.06
Food Production	1.34	3.33	6.56	12.73	-1.36	-3.43	-6.97
Energy Sector	1.29	3.20	6.29	12.17	-1.31	-3.30	-6.72
Metals Sector	1.30	3.22	6.35	12.29	-1.32	-3.33	-6.77
Industry	1.31	3.26	6.41	12.43	-1.33	-3.36	-6.83
Other Manufacturing and Services	1.38	3.41	6.73	13.07	-1.39	-3.51	-7.13

Table 6: Impacts of skilled labor migration on export and import

Skilled labor flow	(%)						
	+2%	+5%	+10%	+20%	-2%	-5%	-10%
Export							
Agriculture	0.61	1.50	2.91	5.47	-0.63	-1.61	-3.34
Oil and Gas Sector	0.46	1.13	2.20	4.15	-0.48	-1.21	-2.51
Food Production	0.69	1.70	3.30	6.24	-0.71	-1.82	-3.77
Energy Sector	0.65	1.59	3.08	5.82	-0.67	-1.70	-3.52
Metals Sector	0.77	1.90	3.69	6.99	-0.79	-2.02	-4.18
Industry	0.75	1.84	3.57	6.77	-0.77	-1.95	-4.04
Other Manufacturing and Services	0.84	2.07	4.03	7.68	-0.86	-2.19	-4.52
Import							
Agriculture	0.66	1.61	3.12	5.91	-0.67	-1.71	-3.55
Oil and Gas Sector	0.58	1.42	2.75	5.22	-0.59	-1.51	-3.11
Food Production	0.54	1.34	2.59	4.89	-0.56	-1.43	-2.95
Energy Sector	0.66	1.63	3.16	5.99	-0.68	-1.73	-3.59
Metals Sector	0.64	1.56	3.04	5.77	-0.65	-1.66	-3.43
Industry	0.55	1.34	2.61	4.93	-0.56	-1.43	-2.97
Other Manufacturing and Services	0.50	1.22	2.37	4.46	-0.51	-1.31	-2.71

Table 7: Impacts of unskilled labor migration on import and export

(%) unskilled labor flow	+2%	+5%	+10%	+20%	-2%	-5%	-10%
Skilled labor employment							
Agriculture	1.37	3.39	6.68	12.95	-1.39	-3.50	-7.11
Oil and Gas Sector	1.53	3.79	7.50	14.71	-1.54	-3.87	-7.82
Food Production	1.29	3.18	6.26	12.08	-1.31	-3.30	-6.72
Energy Sector	1.33	3.30	6.50	12.60	-1.35	-3.41	-6.94
Metals Sector	1.21	2.98	5.85	11.25	-1.23	-3.10	-6.33
Industry	1.23	3.05	5.99	11.54	-1.25	-3.17	-6.45
Other Manufacturing and Services	1.14	2.81	5.51	10.57	-1.16	-2.93	-5.99
Unskilled labor employment							
Agriculture	1.33	3.29	6.47	12.55	-1.34	-3.39	-6.90
Oil and Gas Sector	1.41	3.50	6.91	13.47	-1.42	-3.59	-7.26
Food Production	1.44	3.58	7.06	13.78	-1.46	-3.67	-7.43
Energy Sector	1.32	3.27	6.44	12.47	-1.34	-3.37	-6.86
Metals Sector	1.35	3.34	6.59	12.81	-1.36	-3.44	-6.98
Industry	1.44	3.57	7.05	13.75	-1.45	-3.66	-7.41
Other Manufacturing and Services	1.49	3.70	7.31	14.29	-1.50	-3.78	-7.65